CITY OF TAMPA

LAND REGULATORY RESPONSE TO SEA-LEVEL RISE FINAL REPORT

TASK 6, REPORT #7: IMPLEMENTATION PLAN

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Cook, B., Cheng, A. & Fernandez, S. (2021). Land Regulatory Response to Sea-level Rise: Final Report (Report #7). For the City of Tampa.

INTRODUCTION

In his article about rising seas and property ownership, James Titus opens by saying that, "In the next century, the majority of America's publicly owned tidal shorelines could be replaced by a wall, not because anyone decided that this should happen but because no one decided that it should not." (Titus, 1998) This poses an interesting challenge to municipalities and planners. Will incremental, unplanned and individualized adaptation strategies be the norm, ultimately requiring large scale infrastructural change in the future? Or, as Titus suggests, will communities, through governance, take a forward-looking approach and develop a coordinated response while adapting to coastal change?

The City of Tampa has initiated work to understand its options. This "Land Use Regulatory Response to Sea-Level Rise" project, funded by the Florida Department of Environmental Protection (Agreement #R2129), provides a foundation on which to base policy decisions and to begin a dialogue with the community. The study includes an inventory of existing City of Tampa codes that pertain to water and coastal development (Task 1 Report), as well as a preliminary assessment of impacts from four sea-level rise scenarios (also Task 1 Report). A comprehensive literature review was accomplished to identify policy options to mitigate future impacts from sea-level rise, either suggested by academic research or implemented in other municipalities (Task 3 Report). The assessment of impacts allowed the team to identify geographic and spatial characteristics of potential impacts, which helped to determine policies most suitable for Tampa, and a time period for effectiveness (Task 4 and 5 Reports). Finally, policy recommendations and suggestions for implementation are provided through this report (Task 6, Report #7). An appendix to this report includes an 'Illustrated Guide to Sea-level Rise Policies' and 'A Homeowner's Best Practices Manual' (Reports #8 and #4, respectively).

Final results of this study are considered recommendations, not as enacted policy. Approval of any regulatory change will be determined by the Tampa City Council and will need additional public outreach and communication. The scope of this project is limited to cataloguing the existing codes in Tampa that relate to sea-level rise, and exploring best practices from around the country. As a study, it presents opportunities, not definitive results, while suggesting next steps for action based on the unique attributes of the City.

Major policy change will need to occur through processes associated with changing the Comprehensive Plan. After goals and objectives are established through that document, more definitive policies will be created, in the Land Use Code for example. During the Comprehensive Planning process, further evaluation of codes, costs and other ramifications will be studied and additional community engagement will occur.

SEA-LEVEL RISE 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 variability within these scenarios is quite large. This will make monitoring important, but also planning for flexibility.

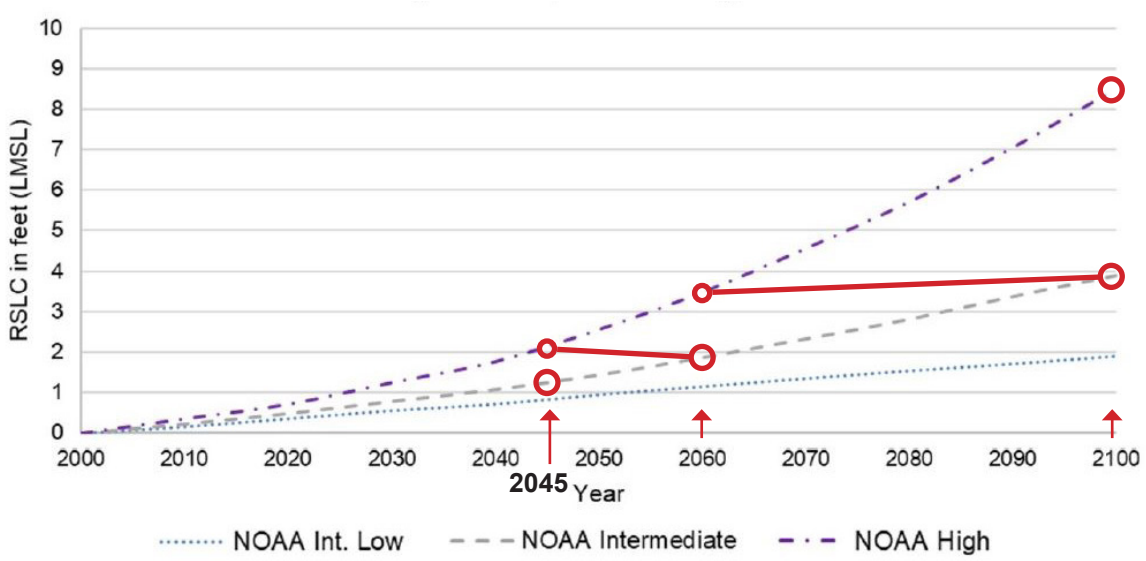
According to the *Recommended Projections of Sea Level Rise in the Tampa Bay Region* report (CSAP, 2019), the heights and likelihood of each scenario are as follows:

- "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)

For the purposes of this project, four scenarios were selected. These sea-level elevations are used in association with topographic data to spatially evaluate potential impact to land and built environment features. The 'High' and the 'Intermediate' scenarios are used, as was determined by the project Technical Group (see appendix).

The diagram below shows how projection points between different scenarios are generally similar, and so provide a comparative view of potential impacts, thus expanding the study to include six total scenarios. The projections used are as follows: (All elevations are compared to year 2000 heights. *Asterisks denote projections used):

- *2045 Intermediate: 1.26'
- 2045 High / *2060 Intermediate: 1.87'
- 2060 High / 2100 Intermediate: 3.90'
- *2100 High: 8.50'



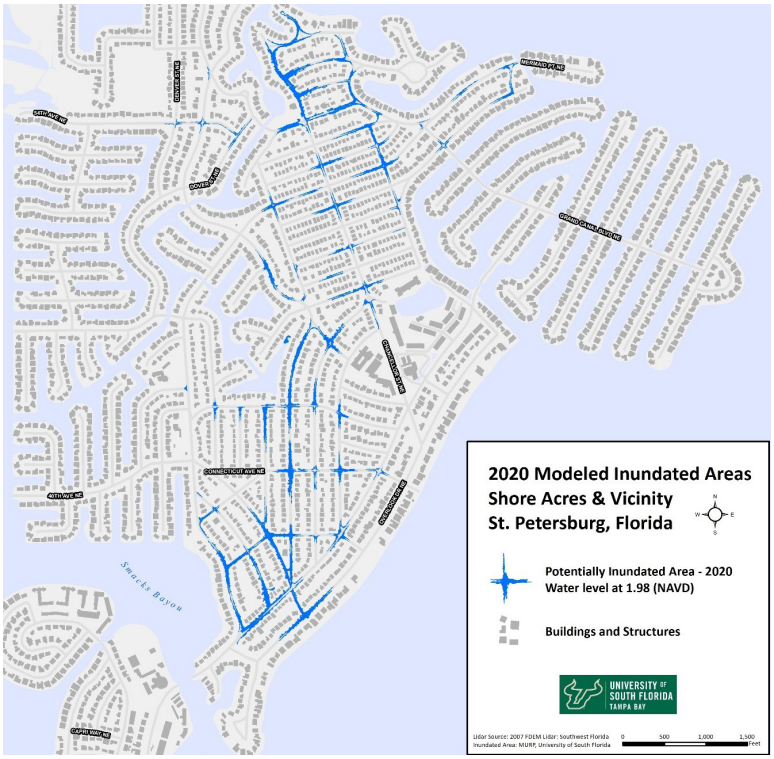
Sea-level rise projections, taken from CSAP Sea-Level Rise Projection Chart (2019). Scenarios used for this study are circled. Those that are connected are considered as a singular scenario, with the larger circle showing the projection used.

TIMELINE AND IMPACTS

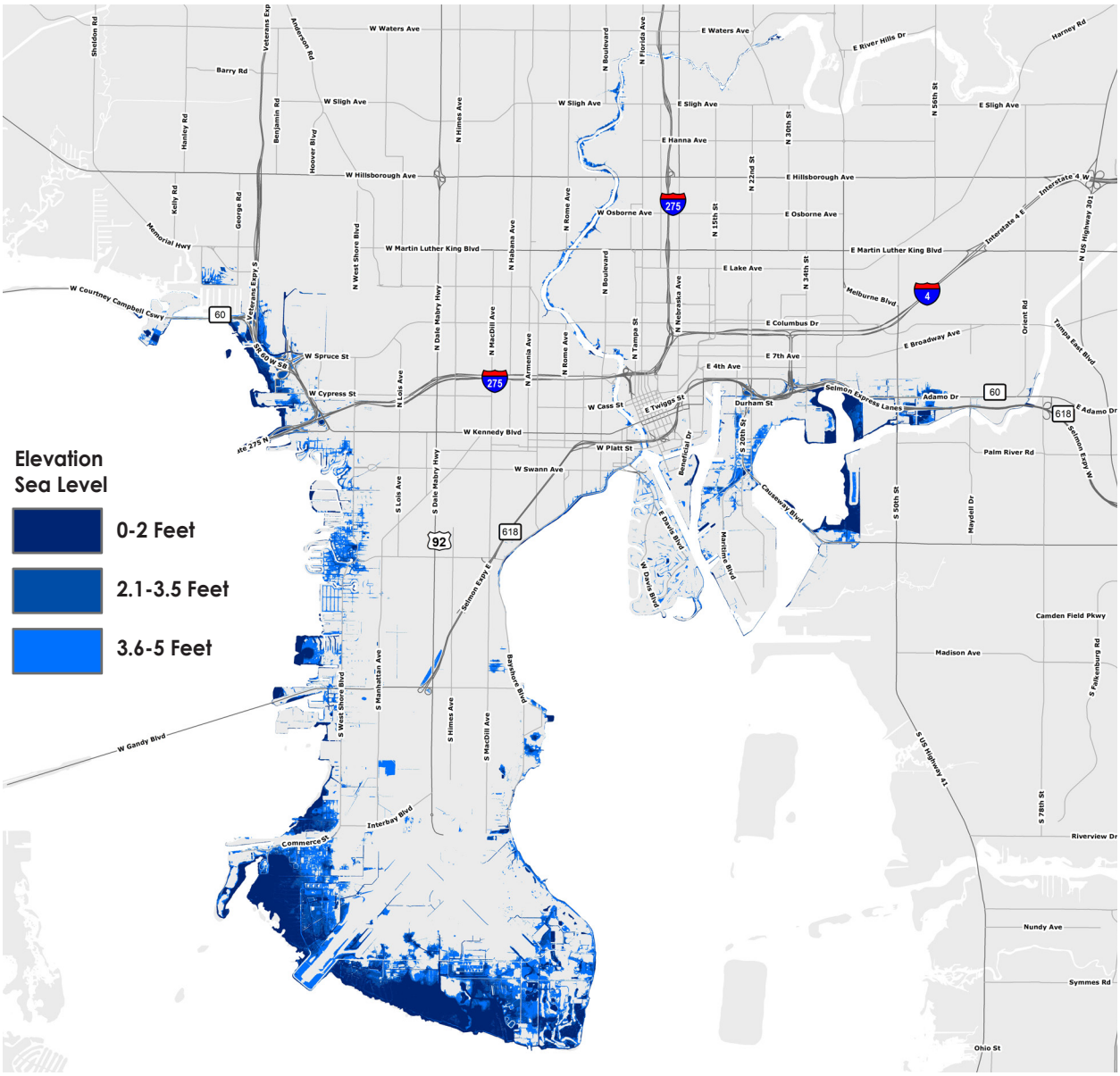
Seasonal High Tide Flooding

Some communities are already experiencing physical impacts from rising waters. For example, the Shore Acres neighborhood in St. Petersburg flooded last September without rain or storm surge (Fernandez, 2020). Groundwater levels elevated during high tide events and surged out of drainage infrastructure and into streets. Steven Fernandez, a University of South Florida professor, conducted an analysis and found that on average lands two feet NAVD (above sea-level) and below were flooded (Fernandez, 2020). The Shore Acres data provides insight for identifying areas in Tampa that may be experiencing similar conditions.

Future expectations can be established for seasonal, high tide flooding by adding future sea-level rise scenarios. The map on the following page identifies sites that are at 2 feet (NAVD) and below in Tampa, and also at 2.1 - 3.5 feet elevation and 3.6 - 5 feet. Whereas elevations 2 and below may already be experiencing similar conditions as Shore Acres, sites at elevation 2.1 to 3.5, using the Intermediate scenario, may experience tidal (non-rain or storm surge induced) flooding in the next 35 years, and elevations up to 5 feet in the next 65 years. When using the High scenario, lands up to elevation 3.5 (NAVD) can be expected to have seasonal flooding in the next 15 years, with areas located at 5 feet and below encountering event-based tidal flooding in the next 35 years.



Images from 'Modeling Sea-level Rise with Tidal Floods in Shore Acres Neighborhood of St. Petersburg,' showing seasonal flooding from high tides in September, 2020 (Fernandez, 2020).



(Main) Areas that may possibly be experiencing high tide flooding (in darkest blue), or where this type of flooding can be expected in the near future.

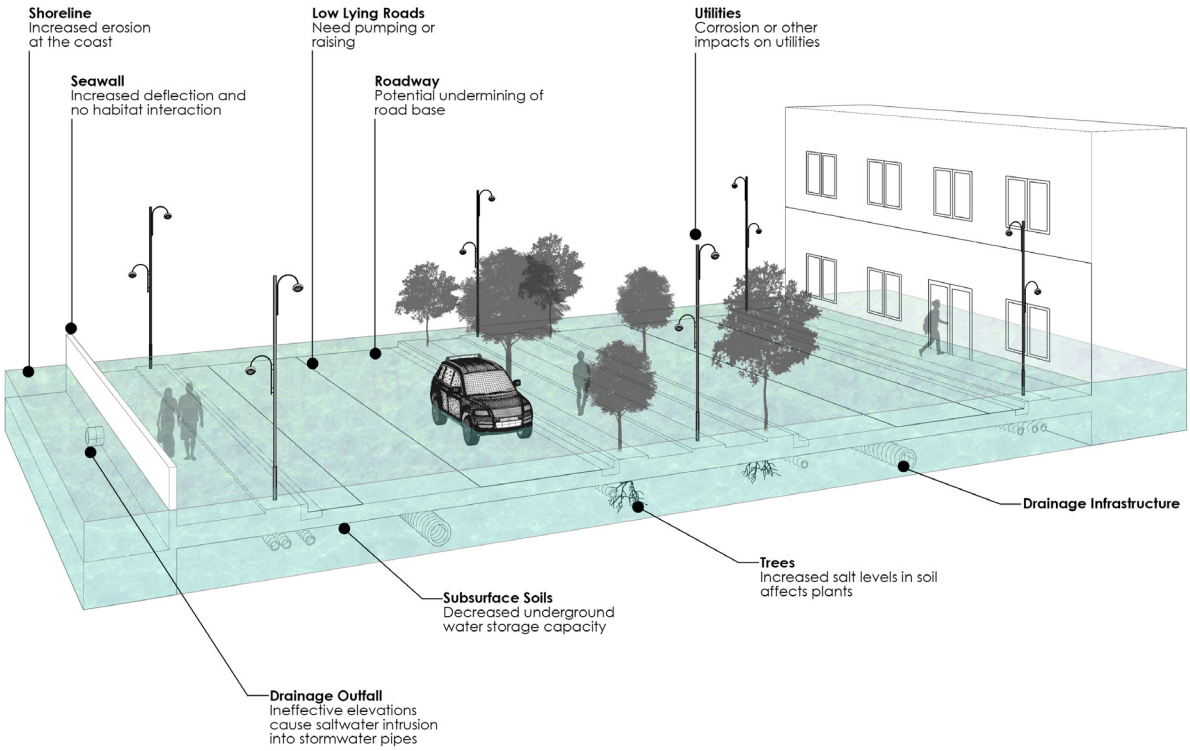
(Right bottom) The projected flood scenarios from the Climate Science Advisory Panel (CSAP, 2019), highlighting elevations that may be associated with seasonal floods.

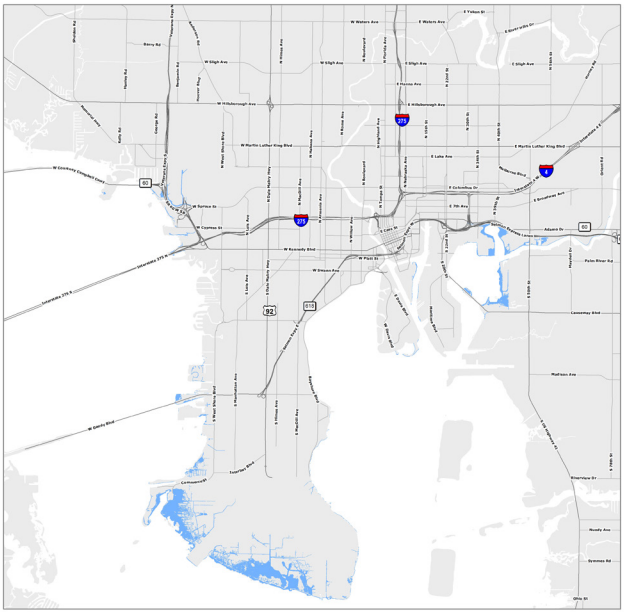
	Year	NOAA Int-Low (feet)	NOAA Intermediate (feet)	NOAA High (feet)
2020	2000[3]	0	0	0
	2030	0.56	0.79	1.25
	2040	0.72	1.08	1.77
30 Years	2050	0.95	1.44	2.56
	2060	1.15	1.87	3.48
	2070	1.35	2.33	4.56
60 Years	2080	1.54	2.82	5.71
	2090	1.71	3.38	7.05
	2100	1.90	3.90	8.50

Initial 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; 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.

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.

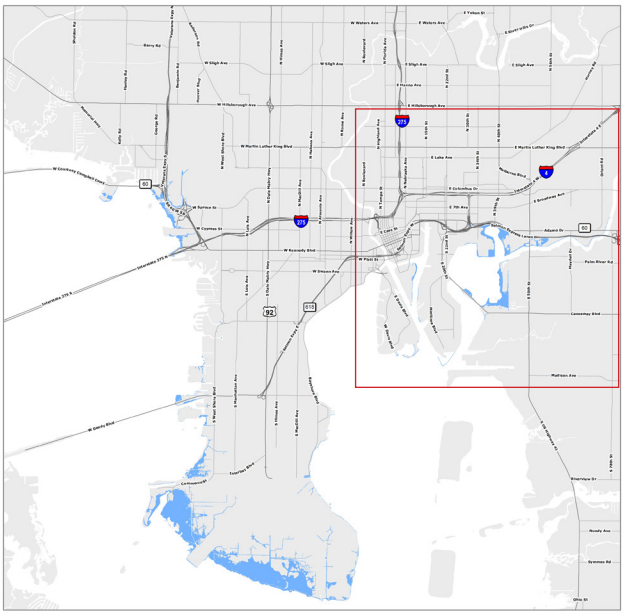




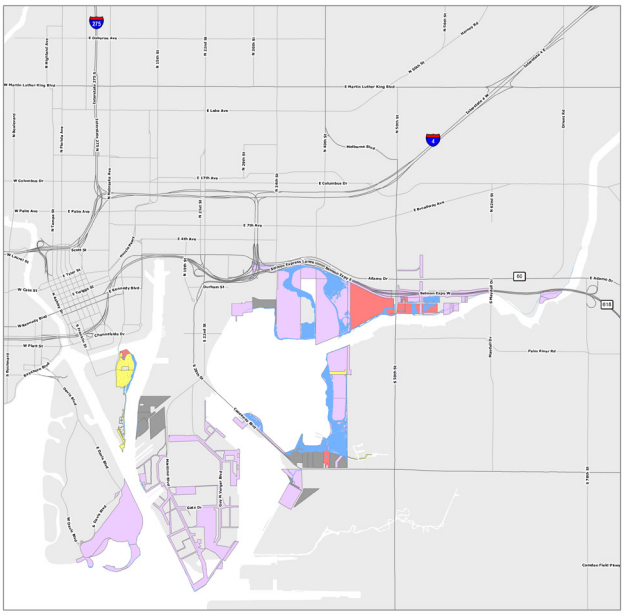
2045 Intermediate sea-level rise projection scenario

Permanent Flooding

In the first two scenarios associated with this study, in the 2045 Low and in the 2045 High/2060 Intermediate scenarios, no roads or structures are shown to be permanently inundated. The majority of affected property is government owned and is designated as open space or vacant lands. In 2060, however, in the High scenario (also the 2100 Intermediate) clustered areas in low-lying parts of the City are affected, such as in Old Port Tampa, the Sunset Beach neighborhood, Beach Park, Palmetto Beach and along the north end of Bayshore Boulevard. When compared against historic maps and aerials, it is apparent that many of these neighborhoods were either carved



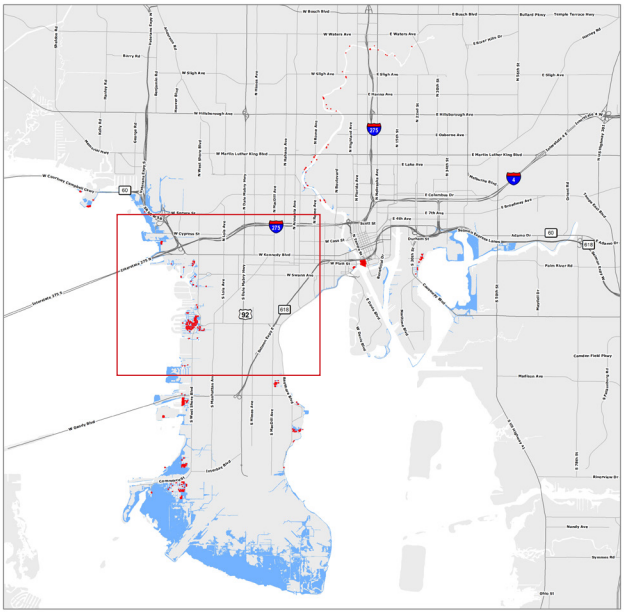
2045 High / 2060 Intermediate SLR Scenario



In the 2045 High / 2060 Intermediate scenarios, impacted lands are predominantly government owned, by area.

out of existing coastal wetlands or built over historic hydrologic zones (notice the name "Beach" associated with some of them). Some were man-made islands built close to the water, unknowing of what the future had in store. Intermittent properties along the Hillsborough River are also affected by this scenario. Most are structures built close to the shoreline and where there is less grade change along the banks.

Significant inundation is suggested by the 2100 High scenario map, which uses the CSAP projection of 8.5 feet of sea-level rise (from the year 2000). Affected properties are no longer isolated to the coastline. In some situations, especially where the grade-change

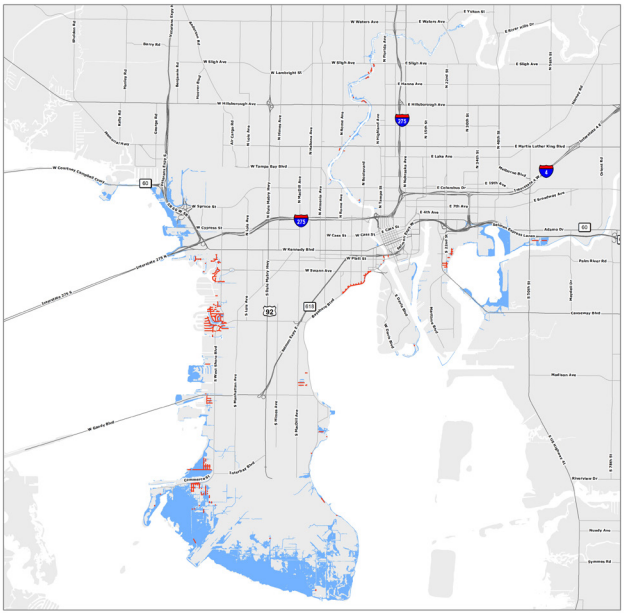


Buildings permanently affected in the 2060 High / 2100 Intermediate scenario.

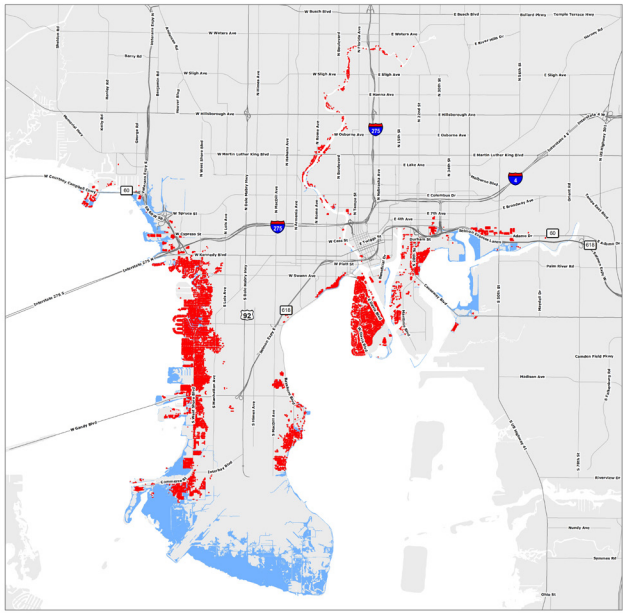
1938 Aerial view of highlighted area from image at the left. Image from Hillsborough County online collection (2021).

gradient is shallow (often where historic wetlands or tidal flats existed), a broad width of properties may be impacted. Data analysis shows this may include approximately 9,000 residents valued at more than $4 billion. Far fewer commercial and industrial buildings are vulnerable using that projection. Total numbers are suggested to be 276 and 230, respectively.

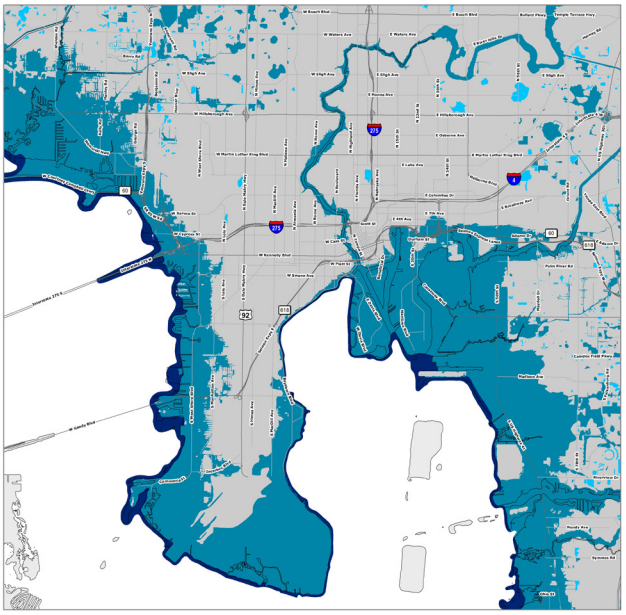
The extents of the 2100 high scenario generally equates to the 1% FEMA Flood Zone and the Coastal High Hazard Area. Whereas those two designations were created to mitigate storm-based flooding, a much different situation arises when that flooding becomes permanent. This transition from temporary to permanent flooding and the timeline that is associated should be incorporated into future planning and mitigation.



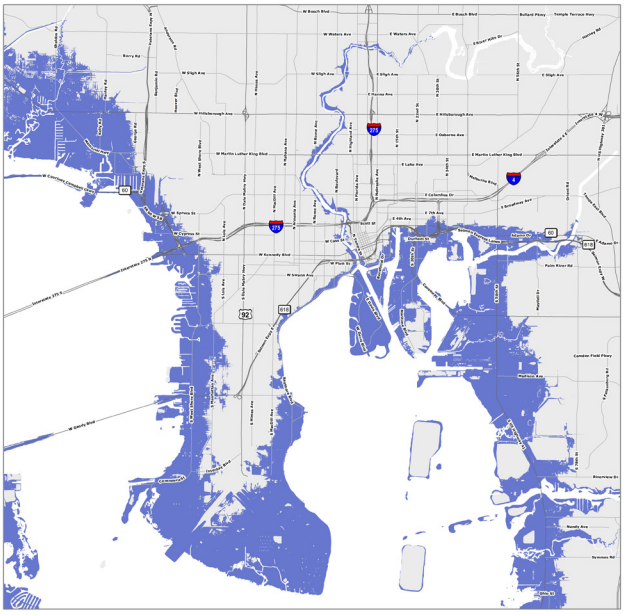
Roads permanently affected in the 2060 High / 2100 Intermediate scenario



Buildings potentially affected in the 2100 High sea-level rise projection



Current FEMA flood map showing overlay of Zone A (1% flood event) areas and Zone V (darker blue) at the coast.

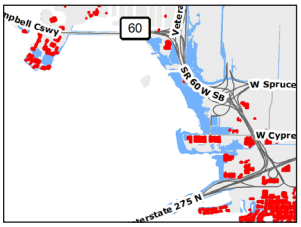


The Coastal High Hazard Area, per State statute

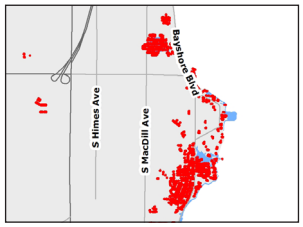
SPATIAL CHARACTERIZATION OF VULNERABLE PROPERTIES

Mappings reveal that there are generally four spatial characterizations for properties at risk, including:

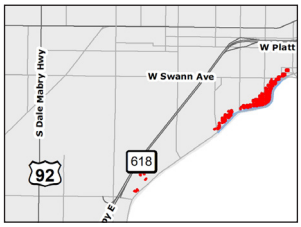
1.) Dispersed properties,
2.) Clustered properties,
3.) Linear areas, along a coastal edge, and
4.) Saturated areas, where large swaths of urban land is affected.



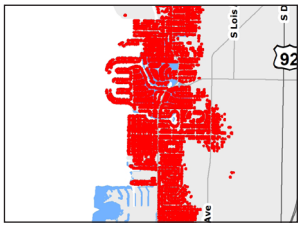
'Dispersed' properties, near Fish Creek. All scenarios shown are the 2100 High at the same scale.



'Clustered' properties, near Ballast Point.



'Linear' properties, near Spanishtown Creek, northern Bayshore Boulevard.

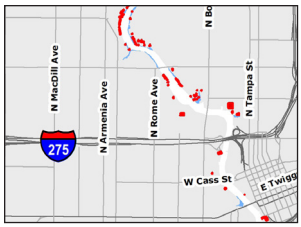


'Saturated' properties, near John Branch and South West Shore Boulevard.

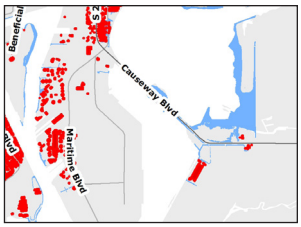
Recognizing this, it would appear beneficial to match regulatory response to individual communities, or areas with similar spatial charactarization of vulnerability. Community specific overlays would help to match policy to community determinants, and would allow them to develop consensus while formalizing adaptation goals. The following provides a more detailed description of the issues and opportunities within each spatial characterization zone.

Dispersed Areas

Generally found in less dense parts of the city, these areas show more isolated instances of structures affected by flood. Open space between buildings may allow the area to mitigate sea-level rise by concentrating water into specific areas while increasing building and infrastructure height in others. Access may still be maintainable, especially if there is an ability to make physical changes to mitigate risk. Infrastructure may still be able to function, however this would be site dependent. Infrastructure may also be modified to use more flexible, nature-based approaches, because of the space available.



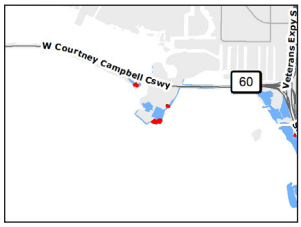
'Dispersed' properties along the Hillsborough River, using the 2100 High scenario



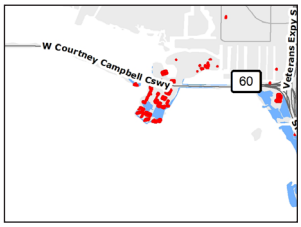
'Dispersed' properties near the Port, using the 2100 High scenario,

Clustered Areas

Some areas have a small concentration of structures that are affected by sea-level rise, usually found in topographic depressions. Flooding is not wide-spread, however this spatial characteristic refers to areas with a 'deep middle,' where properties will become inaccessible. The interior spaces may incur increased issues with infrastructure, or more difficulty mitigating their flooded condition.



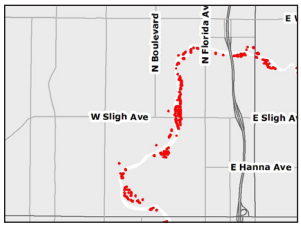
'Dispersed' properties on Rocky Point, using the 2060 High / 2100 Intermediate scenario.



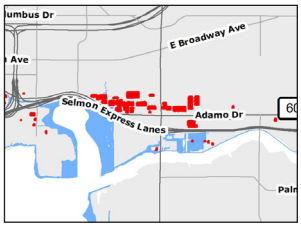
'Clustered' properties on Rocky Point, using the 2100 High scenario.

Linear Areas

A linear pattern of sea-level rise exposure is most often found along shorelines or embankments. These are fairly dense and developed areas, however only the edge of the community is situated at risk, in a low-lying elevation. It may still be possible to maintain accessibility, however this may have to occur from an alternative route (from the inland side). Infrastructure, such as roads, sea walls, drainage, power and pumps, would have to be evaluated. Linearly affected areas are usually in a unique situation, they often protect their inland context (similar to a beach dune). This should be considered in developing a response to sea-level rise, but also for storm surge.



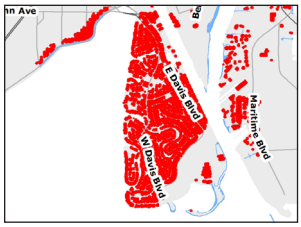
'Linear' sea-level rise inundation along the Hillsborough River, with the 2100 High scenario.



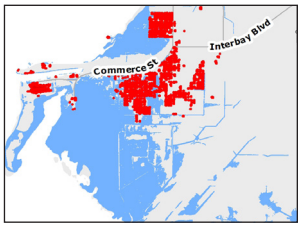
'Linear' sea-level rise inundation near MacKay Bay and East Ybor City, with the 2100 High scenario.

Saturated Areas

Some areas are forecasted to have wide-spread inundation, using the most extreme scenario. These are typically shallow gradient sites that are close to the coastline, or islands that were constructed at low elevations. Eventual deep



'Saturated' sea-level rise inundation at Davis Islands, with the 2100 High scenario.

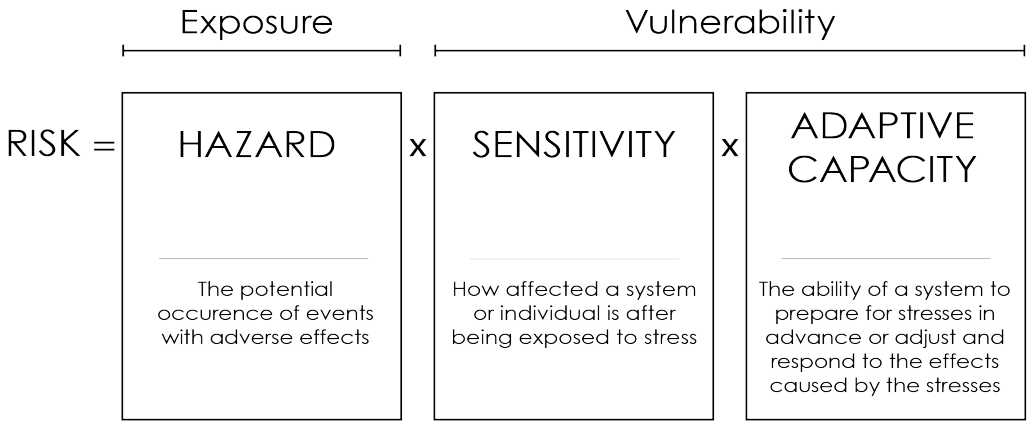


'Saturated' sea-level rise inundation near Port Tampa City, with the 2100 High scenario.

penetration into already developed, dense urban districts could potentially nullify the existing road network and subsurface infrastructure. If an area is 'saturated' in this way, it would be overtaken by the sea.

A RISK APPROACH

There are many different types of communities that will be affected by sea-level rise. Places have varying levels of density in their urban infrastructure, different economic capacities and/or population groups, or different topographic and environment features. Physical, economic and social characteristics will have an impact on a community's adaptive capacity - their ability to change in response to sea-level rise. It would be appropriate, then, to create policy that matches a community's capacities. This can be considered at multiple scales. A neighborhood may have large or small homes, be shallow or steep, or can be extremely affected by sea-level rise, or not. At the city-scale, the same characteristics can be considered. Each city has varying degrees of effective governance, of economy, of culture and community, or of willingness to act in a cooperative way. In the Hillsborough Community Vulnerability Study (FCCDR, 2020), the following diagram was used to describe the different factors that lead to risk, which can also be used to consider capacities for reducing risk. Evaluation of a community through this lens can help to determine the most suitable approach for a regulatory response.



From the Hillsborough County Community Vulnerability Study (FCCDR, 2020), adapted from diagrams in Engle (2011) and Tostevin (2014).

For the purposes of this study, sea-level rise is the defined hazard. A community's sensitivity depends on the extent that sea-level rise will affect the area. Generally, this depends on topographic elevation. For example, we can compare the sensitivity between properties on Davis Islands and along Bayshore Boulevard. Lastly, and possibly most influential when deciding on risk mitigation policy, adaptive capacity describes a community's ability to meet the challenge. A dense, urban economic center may have minimal physical adaptive capacity to address issues associated with sea-level rise, however there may be high economic capacity. This means that a regulatory approach may want to support actions that leverage the financial capabilities of an area to fund protective measures, and to prolong the economic value of the place.

An engineered response to sea-level rise will be costly, but communities may decide that there is value in providing the necessary funds, especially if they are not able to easily change their physical composition. Conversely, a low density urban environment may be able to concentrate sea-level rise into open areas and, if reasonable, could raise roads and houses. This type of physical adaptive capacity affords flexibility, which minimizes the cost of mitigation. Less economic capacity is required.

Acknowledging the many different categorizations of places within the city will be affected, or within the region, it is recommended that a place-based regulatory strategy be established so that areas can be effective in adapting to sea-level rise (the hazard).

TYPES OF POLICY

City-wide Policy

Some policies will help to reduce risk at a city-scale. Actions taken towards these ends will be effective in creating systematic change and/or resilience, acknowledging that issues at the coast are intertwined with other aspects of the city. For example, the Climate Science Advisory Panel (CSAP) report (2019) specifically connects future sea levels to greenhouse gas emission-reducing efforts. This can be accomplished through city-wide policy that targets land use, transportation, building practices and energy use. Other strategies at a city-wide scale include protecting water storage infiltration capacities, protecting and enhancing landscape systems, especially at the coast, locating development density outside of hazard areas, developing city-wide economic and governance adaptive capacities, creating awareness about sea-level rise as a Prioritized policies for Tampa are described in this report, with an extended list of options in the Appendix.

FEMA Flood Zones

FEMA designated flood zones have limited use in strategizing a regulatory approach toward sea-level rise. These zones were developed to address temporary flooding and include policies such as building height and flood-proofing, and are connected to flood insurance rates. Some policies that address temporary flooding issues may apply to leading edge communities that are affected by rising waters. For permanent flooding, however, FEMA flood policies and associated zones may not be applicable. Because the timeline associated with permanent flooding is so extended, a place-based approach is recommended (for addressing sea-level rise specifically), that can incrementally and geographically address community goals, rather than utilizing existing FEMA delineations.

Overlay Zones

Sea-level rise will incrementally affect parts of the city, occuring over decades if not centuries. A recommended approach is to work at multiple scales, coordinating strategies at the city-scale while also developing community-specific regulations. Not only are sea-level rise impacts unique to different terrains, but so are the densities of assets, value, buildings, population and infrastructure.

The City already has overlay zones to accomplish place-based objectives. This includes Planning Districts, of which Tampa has five; Zoning Districts, such as single family, commercial and also The Ybor City Historic District, The Central Business District and The Channel District; and Special Districts, such as Seminole Heights and the University-Community districts. These designations allow areas to set policy toward a community vision with associated goals, and to create insulated funding to work towards those goals. It is recommended that similar tactics be applied toward sea-level rise.

At the state level, there are grant opportunities to financially support planning and projects in specially designated areas, especially for sea-level rise. One such tool was created by state statute in 2011, named Adaptation Action Areas. It specifically allocates funds toward defined communities that "experience coastal flooding and are vulnerable to the related impacts of rising sea levels, for the purpose of prioritizing funding for infrastructure needs and adaptation planning." (FDEO & SFRPC, 2014) This is one of many sources that, once prioritized sites are identified, will support the design and implementation of mitigation strategies.

KEY RECOMMENDATIONS

Although sea-level rise is associated with a long and incremental process of change, deferring critical action will make future decision-making and adaption more difficult. New development and infrastructure projects have recently been constructed in some of the lowest parts of the city, and more are planned for the near future. Some of these areas have been identified in this study as first candidates for experiencing seasonal flooding. Although sea-level rise may not encroach upon upland soil for some time, it would be beneficial to establish protocols and decide the trajectory of development. This does not mean that development should not occur. It may be decided that there is value in protecting some areas with engineered solutions. However, without making that decision the city as a whole is in jeopardy of installing infrastructures that may not be desirable, or that may prove extremely costly in the future.

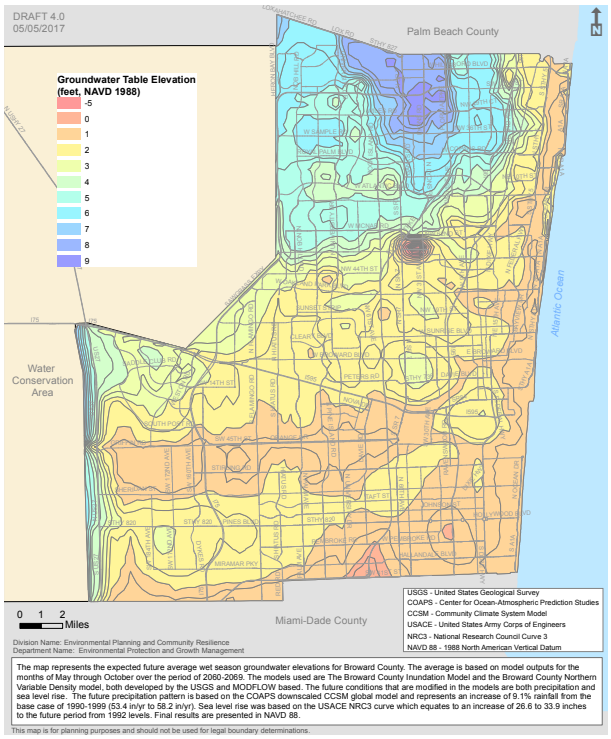
The following provides a concentrated list of recommendations for first steps. A longer and more detailed list of regulatory recommendations is provided in the Appendix, catalogued by policy document.

1. Building Toward the Future

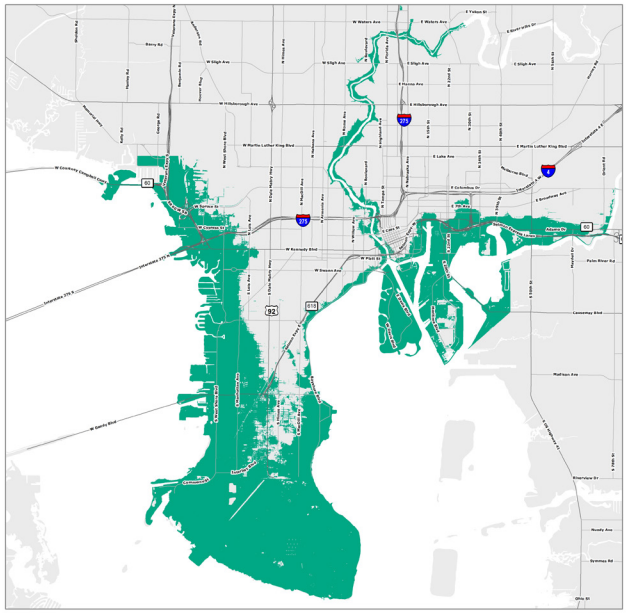
The most fundamental regulatory change involves acknowledging that sea-level rise is occurring and using an agreed-upon future forecasted scenario, or set of scenarios, for planning and capital improvements. The most common outlook uses a 50 year horizon for actionable policy with an eye on potential 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. This also coincides with a recent study for the City of Tampa that assumed a 30-40 year project use life for typical stormwater improvements (Applied Sciences, 2020). In this study a height of 1.44 feet was added to the current 1-year stillwater elevation to create a recommended new tailwater elevation of 3.44 feet (NAVD), aimed toward the year 2050. Planning horizons can be updated on a 10 year cycle and should be coordinated with monitoring of sea-level rise change.

This strategy also applies to groundwater conditions. Elevated water levels below ground can impact water storage volumes, can help determine locations for wet and dry retention, and also impact utility lines and building foundations (Broward County, 2017 & 2021b; Davtalab et al., 2020). Broward County now uses a Future Conditions Groundwater Map to evaluate projects during the permitting phase. Substantial volume in detention ponds, exfiltration storage and site elevations are calculated using forward-looking targets.

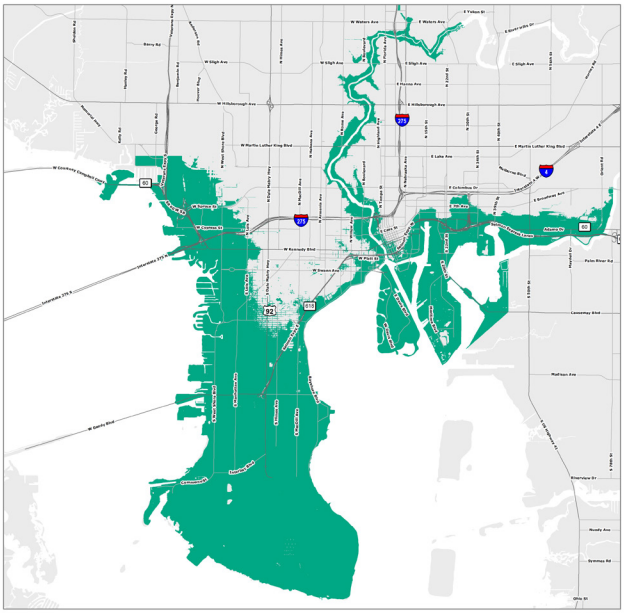
A 'Building Toward the Future' strategy could also include a forward looking flood zone, similar to what has been developed in New York City (New York City Planning, 2019) or San Francisco (San Francisco Planning, 2021), in lieu of the current FEMA Flood and Coastal High Hazard Zone designations. This would help to inform property owners of their risk and to mitigate future conditions, including storm based flooding and storm surge scenarios. This policy would include disclosures during property transfer, similar to what is accomplished through the process of purchasing insurance.



Broward County 'Future Conditions Average Wet Season Groundwater Elevation Map' (2017)



Extent of the 1% flood zone with the 2060 High / 2100 Intermediate scenario added



Extent of the 1% flood zone with the 2100 High scenario added

Recommended Next Steps

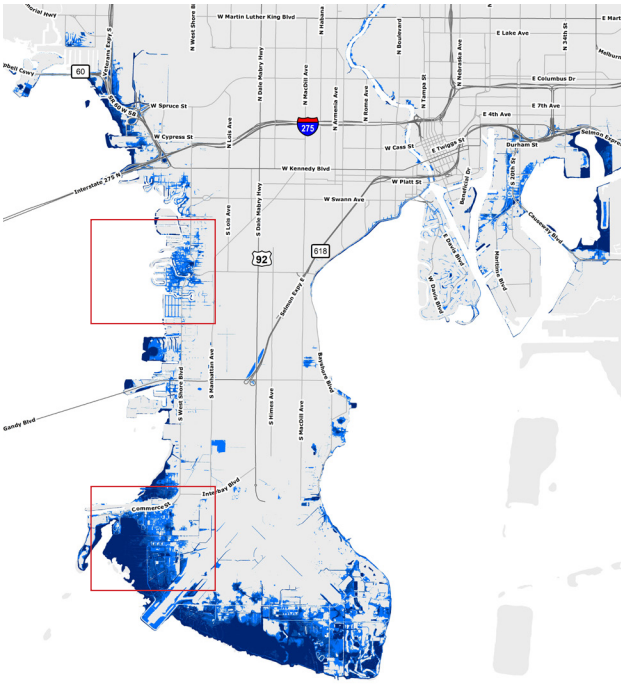
- *Through the comprehensive planning process, which includes public involvement, decide an agreed upon sea-level rise scenario to guide planning and permitting. Decide the extent of policy that this target scenario will affect, which could include modified FEMA flood zone delineations.*
- *Commission a future groundwater conditions map.*
- *Work with FDOT to stipulate target elevations for bridge and road construction.*

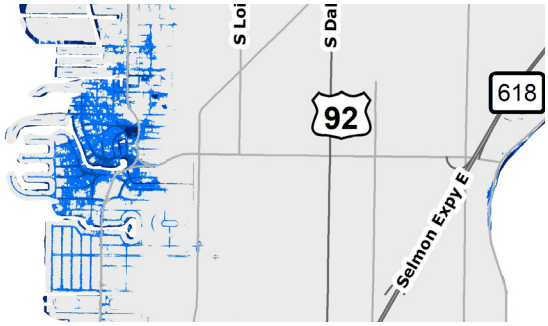
2. Establishing Adaptation Action Areas

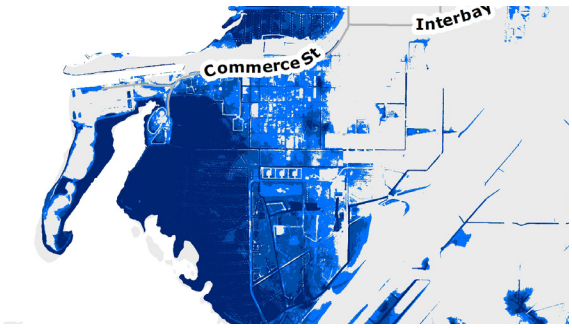
This study revealed that some areas within the City of Tampa may be at risk of experiencing seasonal flooding due to sea-level rise. It is recommended that efforts are put forth in the near term to address these locations with more detailed assessments and community engagement. There are many funding sources that are available for coastal and community resilience, including the designation of Adaptation Action Areas in the Comprehensive Plan, grants provided by the Florida Department of Environmental Protection, or through programs associated with FEMA or HUD. This process would help to field-verify existing conditions and would lead to needs and goals-based policy with potential accompanying capital improvements. Seasonal flooding occurs in the fall, in August through October. This would be an ideal time to accomplish next levels of investigation. Decision-making, of mitigation strategies, should be accompanied by designating an Overlay Zone type, as described in the following pages.

Recommended Next Steps

- *Commission studies to field verify data results for most vulnerable communities.*
- *Adopt criteria into the Tampa Comprehensive Plan to establish Adaptation Action Areas.*
- *Commit or apply for funding to work directly with identified communities.*





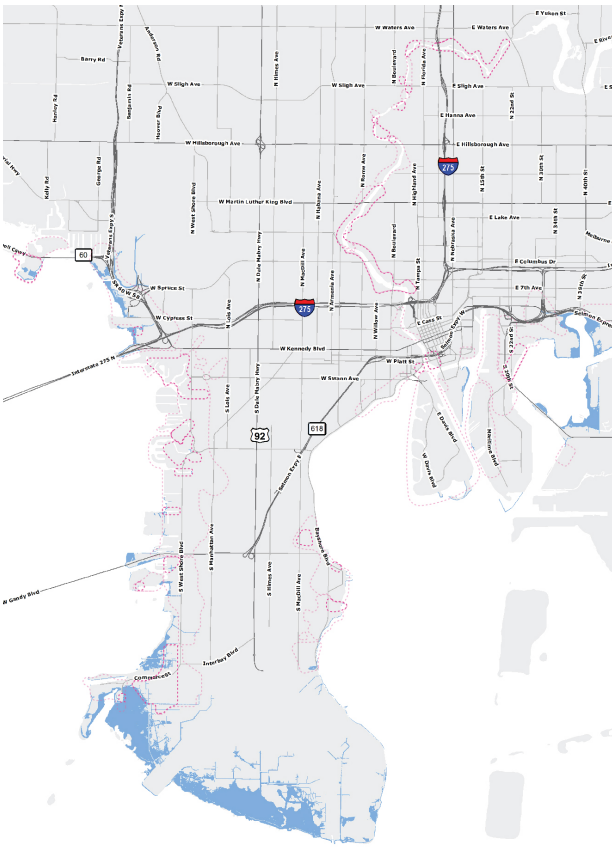


3. Establishing Overlay Zones

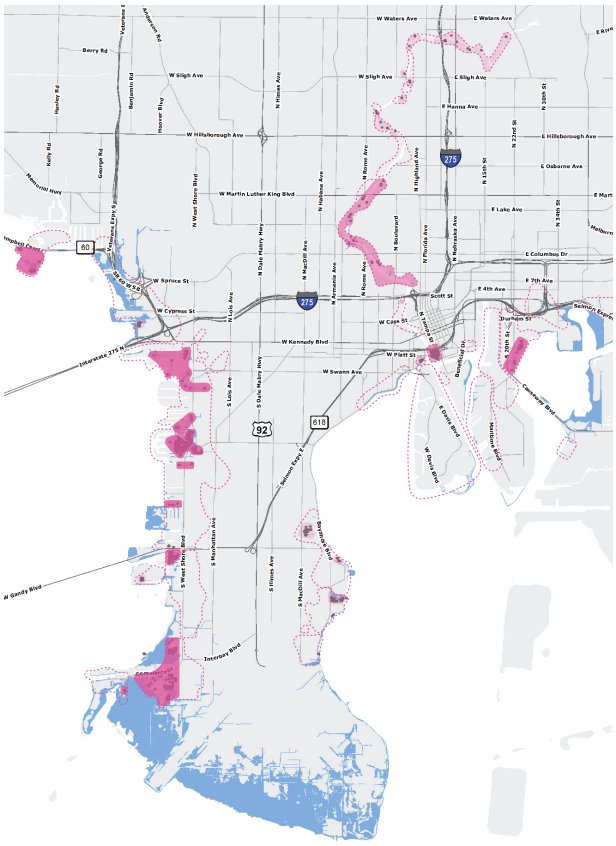
Distinct geographic areas, or zones, impacted by sea-level rise are recognizable within the maps. Similarities in topography and spatial distribution create clusters of property that will be similarly impacted, and have common community characteristics.

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")



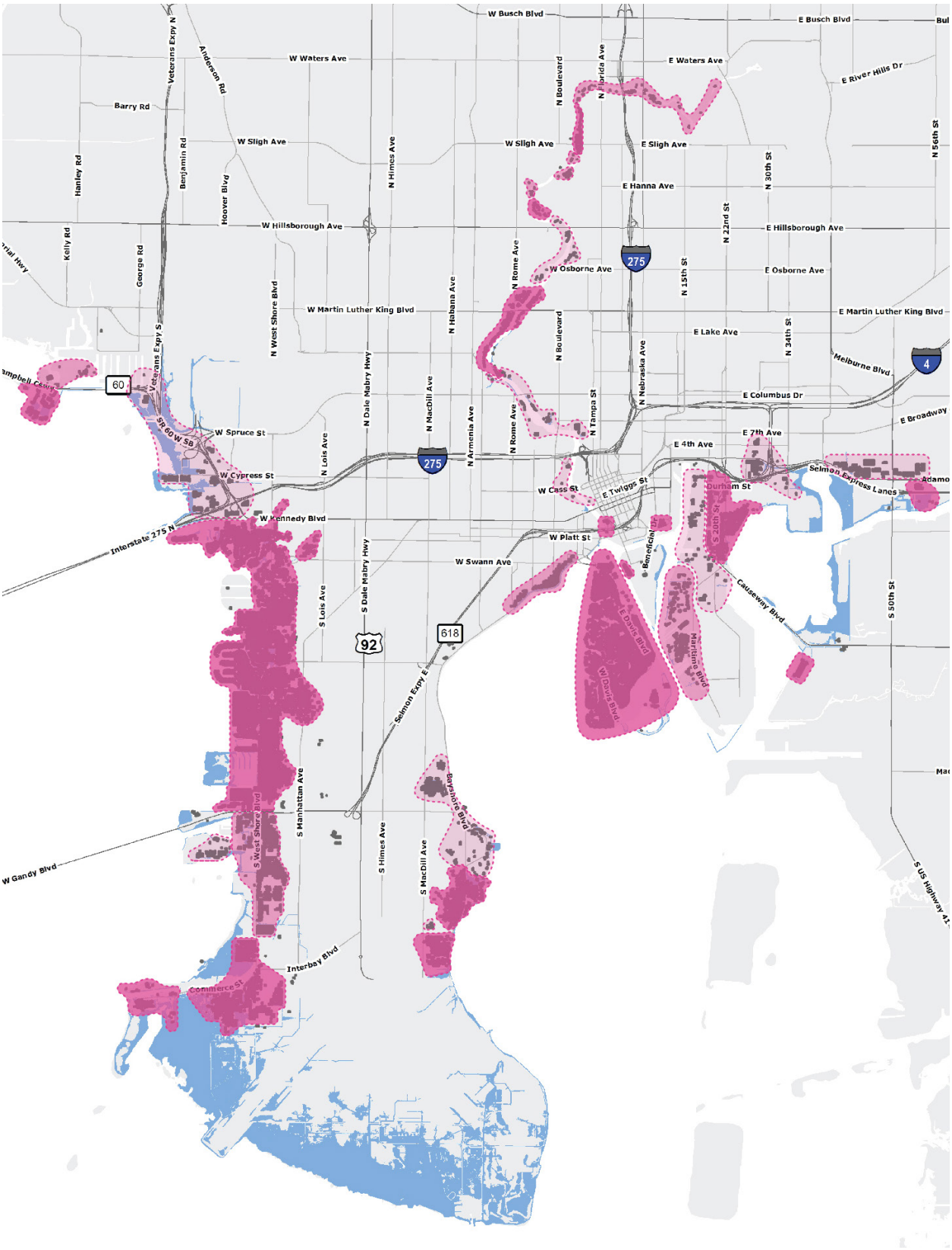
2045 High / 2060 Intermediate Scenario



2060 High / 2100 Intermediate Scenario

The maps above and on the following page show community clusters with similar spatial attributes and levels of being affected by sea-level rise. These similarities provide opportunity to create place-based regulatory strategies.

Each map shows potential future vulnerability to sea-level rise with dashed lines. Solid colors represent areas that are affected by the scenario shown. Darker tones highlight locations with higher densities of structures at risk. This correlates to higher possible severity of impacts. Lighter tones are associated with areas with 'dispersed' densities of vulnerability.



2100 High Scenario, with clusters of similar classifications of spatial density and vulnerability.

Regulatory strategies that may accompany each overlay zone are described later in this report. No specific policy will be adopted at this time, however 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.

Density Decrease and Habitat Restoration

- 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.

Recommended Next Steps

- *Evaluate cost-benefit and socio-economic benefit of overlay zones.*
- *Initiate planning areas for future study and funding opportunities. Use the maps provided by this study as genesis for area boundaries.*

4. Identify Critical Infrastructure and Utilities Vulnerable to Sea-level Rise

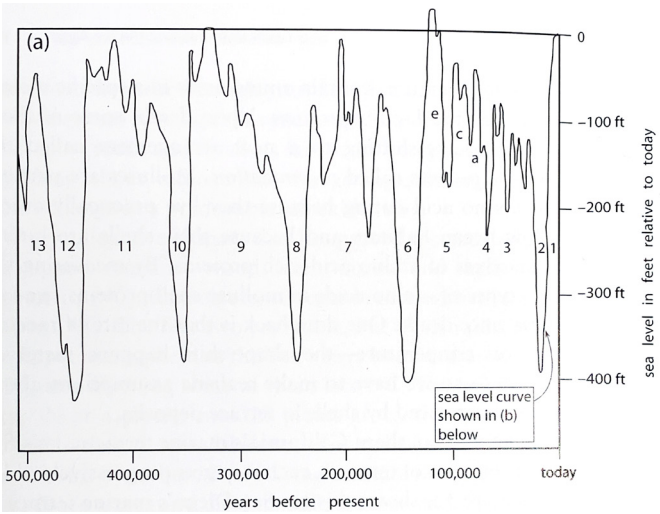
Utilities such as power, storm drainage, water distribution and pumping, and facilities such as hazardous sites or waste facilities can be impacted by rising waters, both at the coast and below ground. These places or systems are difficult to modify and may take time and dedicated funds to change. Prioritizing attention to critical infrastructure and facilities will help to secure their functionality in the future. Historic or cultural assets can be included in this list. Special attention may be needed for places with cultural value, in addition to hard infrastructure.

Recommended Next Steps

- *Conduct an inventory of utilities and facilities that are within areas vulnerable to sea-level rise.*
- *Evaluate options and a perform cost-benefit analyses. Consider alternative strategies.*
- *The LMS working group shall to continue to work with critical facilities infrastructure owners in assessing needs and developing mitigation measures for sea-level rise.*

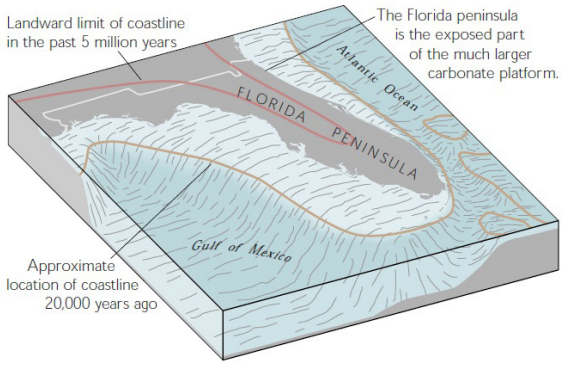
5. Promoting Flexibility through Landscape Systems

Many coastal communities were designed without considering the possibility of environmental change. There was no expectation for the seas to rise. Because of this, some properties lack buffering zones, were sited at low elevations, and/or are reliant on fixed, not flexible infrastructure. Now that conditions are changing these types of spatial arrangements can teach a lesson: Landscape systems are not static and need space, too. They pulse with the ebb and flow of tides, with rain and drought, with seasons and now it is understood that its oceans rise and fall over millennia.



Sea-level curve for the past five hundred thousand years. Image from 'Surf, Sand and Stone,' by K.H. Meldhahl, 2015.

Designing for the longest time span may not be feasible, but it is possible to allocate space for seasonal changes and now sea-level rise, so that there is room for landscape systems to adapt. These systems are responsible for maintaining water quality, atmosphere, nutrient cycling, carbon sequestration, habitats and fisheries, supplying oxygen and food for both people and animals (Plantier Santos, 2017). If constricted, there is conflict in use, and either the environmental or human ecosystems are forced to change.

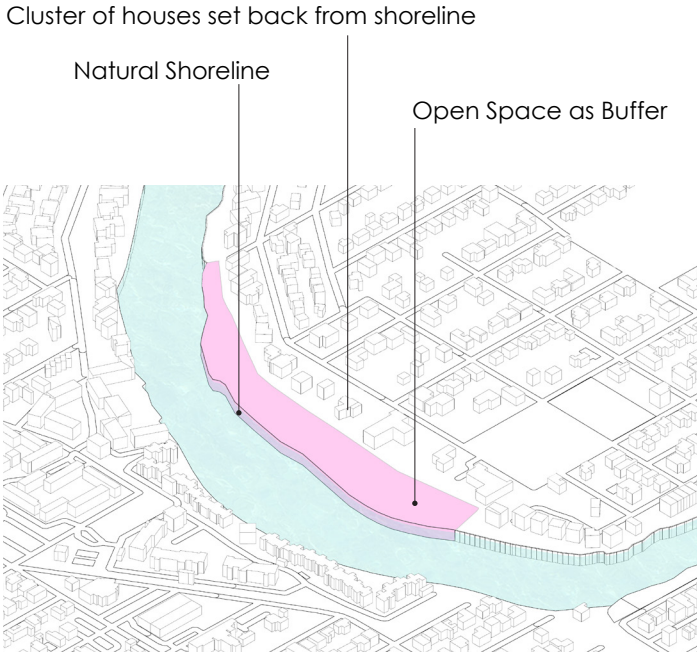


Geographic shelves formed in Florida from previous sea levels. Image from 'Sinkholes, West-central Florida,' by A.B. Tihansky.

With regard to policy, the uncertainty associated with future sea-level rise scenarios creates a difficult planning situation. There is a big difference between 2 and 8.5 feet of change. This points toward the need for flexibility, especially at the coastal edges. This can be accomplished by establishing policy for parks use and land purchasing. For private property, increasing buffers and

setbacks (options are described in the Appendix) and promoting natural vegetation with low maintenance zones will help to expand the flexibility of shoreline spaces. Prioritizing locations for the removal of sea walls would be a good first step. The Tampa Bay Estuary Program has created a mapping website to highlight areas where removal of sea walls, or creating living shorelines, would be appropriate (Tampa Bay Estuary Program, 2021).

Other strategies, promoted through policy, can be effective for inducing flexibility at the coastal edge. Some of these policies are described in the appendix. One example is to address clusters of properties where buildings are continuously set back more than 50-100 feet from the shoreline. If coordinated, effort to initiate shoreline projects with these property owners may result in a positive value situation for the city and homeowner by transforming the sea wall into a living shoreline, and through the potential purchase of conservation easemenets. This would allow habitat to migrate as sea-level rise continues, and to maintain habitat functionality.



Drawing showing opportunity area for converting sea walls to living shorelines, where a cluster of houses are set back a wide distance. This strategy would have to be coordinated through property owner engagement, but could be incentivized through conservation tax credits, grant allocation or purchase of easement.

Recommended Next Steps

- *Commission a study to identify and prioritize sites for removal of sea walls, on both public and private properties.*
- *Identify potential property segments that can be incorporated into a continuous coastal open space.*
- *Assess existing coastal public-owned open space and prioritize projects for layering of uses while restoring habitats and landscape functionality.*
- *Create a program that provides guidance and assistance for property owners that want to create living shorelines.*
- *Establish future setback regulations for new construction in locations vulnerable to sea-level rise.*

6. Evaluate the Feasibility of a Coordinated Transfer of Development Rights Program

Some areas are vulnerable to intense pressure from sea-level rise. In these situations, it leaves property owners with few options. They will either have to subscribe to costly and recurring mitigation efforts, either individually or through community programs, or they will have to vacate the property. This can leave citizens in a difficult financial situation, considering property value as a primary asset. However, if coordinated, 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

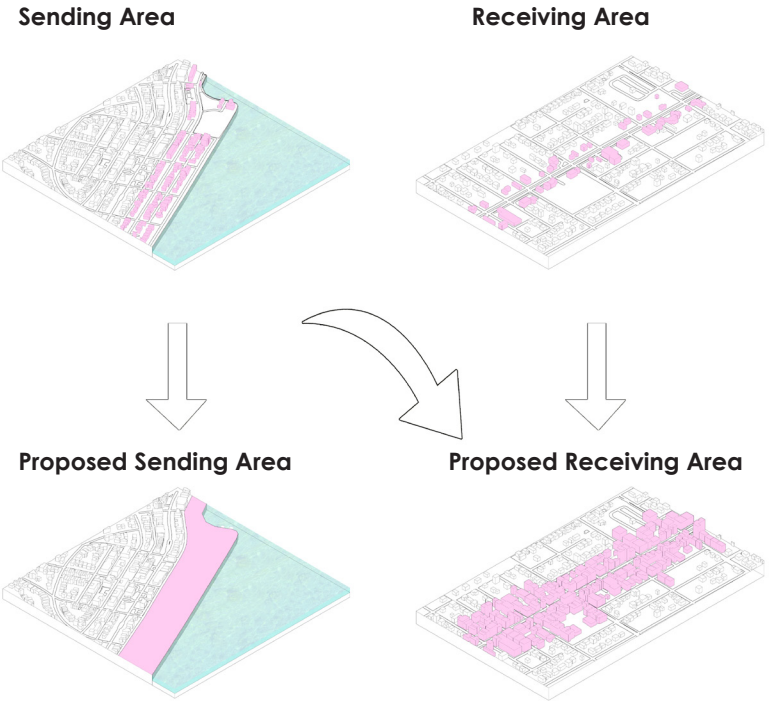
right program establishes "sending areas," where the goal is to reduce density. In other locations, near transportation hubs or commercial districts for instance, "receiving areas" are created. These are target zones for increased density and development. Density bonuses and other incentives can be associated with properties in the 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.

This can be especially useful in areas where a community affected by sea-level rise is generational. In historic working waterfront communities, where property may have been passed down, the current occupant may not have the economic capacity to modify their property. If designated as a 'sending zone,' additional value can be associated with the lot through bonus densities and tax credits. This provide them opportunity, if desired, to move to a more suitable location for their lifestyle; especially useful if they no longer rely on waterfront proximity. This transfer, however, needs to be coordinated. An equitable transfer of development rights program only works if affordable housing is available, which is usually associated with density (or which can be prescribed through the land use code). This type of policy would be best applied to areas for Accommodation or Density Decrease.

This report identifies a Transfer of Development Rights (TDR) Program as the most suitable method for the City of Tampa to direct growth, either toward or away from specific areas, under the current conditions of planning and governance. TDRs establish a free market method of coordinating density and can be used to support communities that find themselves in the precarious situation of unexpected environmental change.

Recommended Next Steps

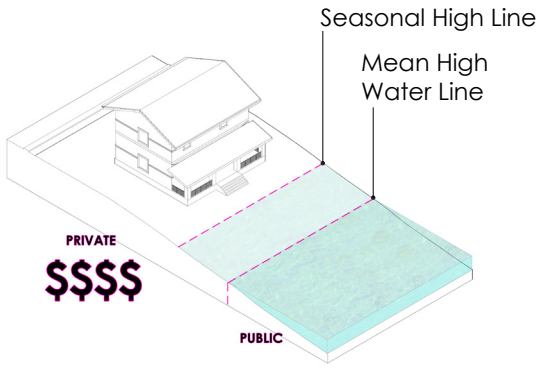
- *Refine the TDR concept and establish a detailed implementation guide.*
- *Complete a cost-benefit analysis of the program.*



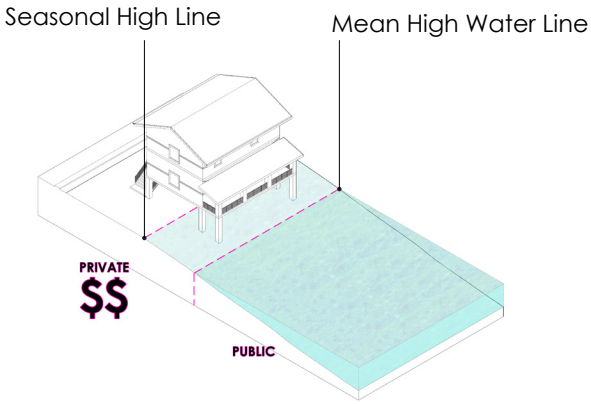
7. Find Opportunities to Create Rolling Easements

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.

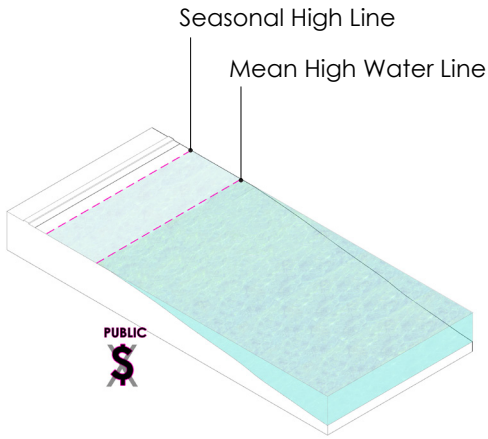
If the municipality purchases the land, in order to mitigate their own financial hardship they may charge an annual rent at or below fair market value. This rent would generate funds to clean up the site and restore habitats once structures are abandoned (remember the long timeline associated with this 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 the diagram at right).



This strategy is useful where there is a desire to decrease density, especially in areas of less development and value (Titus, 2011). It is recommended that the municipality only begin implementing this strategy once they

have determined where decrease of density is desired, as opposed to those that will be protected.

Recommended Next Steps

- *Refine the rolling easement concept, establishing a detailed implementation guide.*
- *Complete a cost-benefit analysis of the program.*

8. Education and Information

The current regulatory approach to most hazards, including sea-level rise, relies on individual decision making. Risk management is personal, with each property owner assuming risk through the purchase of insurance, or not. In the absence of definitive policy that creates assurances for property owners, it is critical that decisions are based upon the best and most current information. This is a similar policy as the FEMA Flood Zones and the National Flood Insurance Program. To support property owner education, a few regulatory approaches would include:

- Identifying future sea-level rise projections on plat and permit maps.
- Encouraging private owners to conduct a climate change vulnerability assessment. The City could support this through a website dedicated to communicating hazard information.
- Creating a standard disclosure document and policy for all transfer of property. This would include demarkation of sea-level rise and storm surge information, as well as FEMA flood delineations. If overlay zones are established, this information would be included also. In Broward County, the following has been adopted into policy:

    - In any contract for the sale of real estate located in tidally influenced areas of Broward County executed after December 31, 2020, the seller shall include in the contract or a rider to the contract the following disclosure in not less than fourteen-point, capitalized, bold-faced type:

      "This real estate is located in a tidally influenced area. The owner may be required by county or municipal ordinance to meet minimum tidal flood barrier elevation standards during construction or substantial repair or substantial rehabilitation of seawalls, banks, berms, and similar infrastructure or when required to abate nuisance flooding." (Broward county, 2021)

Community education about sea-level rise as a hazard should already be part of the process in creating the Local Mitigation Strategy (the LMS. See Hillsborough County, 2021). Efforts to increase community exposure to this information may help to create a more educated constituency. Similarly, the comprehensive planning process can be used to inform and develop goals in partnership with communities in the City.

Recommended Next Steps

- *Create an ongoing sea-level rise education program.*
- *Evaluate community acceptance of disclosure policies through the Comprehensive Planning process.*
- *Create a digital database of flood elevation certificates that is publicly accessible.*

9. Reducing Greenhouse Gas Emissions

The Climate Science Advisory Panel (CSAP) specifically correlates efforts toward reducing greenhouse gas emissions with sea-level rise at the coast. Policies can be amended to the comprehensive plan to set goals and targets, or they can be embedded within sustainability action plans, but other more specific codes can incentivize private sustainability practices and to demand it for public projects. The availability of transportation options plays a major role in greenhouse gas emissions. Especially when connected to land use, a focus on multi-passenger or human-powered transportation can reduce vehicle miles travelled and greenhouse gas emissions.

Preserving and promoting tree canopy can help to absorb carbon and to mitigate energy use and reflective heat. Sea grass meadows, mangrove forests, salt marshes and salt barrens, all to be found abundantly in Tampa Bay, are areas of intense carbon sequestration (Sherwood et al., 2019). A recent report identified that these habitats can be "conservatively estimated to generate $24 million year in carbon sequestration services in addition to traditional economic value estimates placed upon Tampa Bay" (Russell and Greening, 2015, from Sherwood et al., 2019).

Efforts to decrease greenhouse gas emissions are part of a global effort to affect climate. Although the City cannot directly change its immediate conditions through this strategy, it is suggested that participation carries weight in establishing a movement toward lessening the overall effects of climate change, including associated sea-level increase due to multiple climate factors (see CSAP, 2019).

Recommended Next Steps

- *Complete the planned Climate Adaptation Strategy study.*

10. Planning the City of the Future

Many of the policies that can support property owners during this time of change rely on coordinating policy and opportunities. This should occur at multiple scales and will help to create layers of community engagement and planning. For example, in order to define receiving areas for transferring of development rights, the City needs to establish target areas for higher density. These locations should provide development opportunities for higher density rates and that are integrated with overall goals, such as reducing greenhouse gas and transportation system design. Understanding where these locations will be is the first step in creating policy that will help at the coast.

While much of this study has concentrated on the areas vulnerable to sea-level rise, much of the City of Tampa will not be affected for more than 100 years. Long range planning should consider the form and vision of a City where new development

is guided to, in areas outside the 100 year sea-level rise projections. This will inform strategies such as transfer of development rights and will benefit efforts toward reducing greenhouse gas emissions.

Recommended Next Steps

- *Complete a Sea-level Rise Resiliency Visioning Exercise that envisions a city predominantly outside of projected sea-level rise and flood vulnerability zones.*
- *Assess economic, social and political implications.*
- *Complete a cost-benefit analysis.*
- *Update the Post Disaster Redevelopment Plan for the City to support a new form and vision in the event of a major catastrophic event.*

APPENDIX

POLICY RESOURCE: EXISTING AND POTENTIAL POLICIES (BY DOCUMENT)

An in-depth analysis of current policies in Tampa revealed that while there are not specific policies that confront sea-level rise directly (the Peril of Flood amendments to the Comprehensive Plan in 2017 were fairly general), regulations such as overlay zones and transfer of development rights have already been established and can provide a framework for future work. Existing reguatory documents and their associated policies are explained in the following pages. Where applicable, best practices options are inserted, to be considered for incorporation. Policy options are provided for review and future deliberation. They are not means-tested or evaluated in terms of cost-benefits.

This information is outside the scope of this planning effort. The list is provided to inform future policy discussions, studies and community dialogue for a regulatory approach to sea-level rise.

Terminology

A few terms that are useful to understand and may relate to sea-level rise include:

> Substantially Damaged: According to Tampa ordinance, this is defined as, "damage of any origin sustained by a building or structure whereby the cost of restoring the building or structure to its before-damaged condition would equal or exceed 50 percent of the market value of the building or structure before the damage occurred. The term also includes flood-related damage sustained by a structure on two separate occasions during a 10-year period for which the cost of repairs at the time of each such flood event, on average, equals or exceeds 25 percent of the market value of the structure before the damage occurred. [Also defined in FBC, section 202.]" (City of Tampa, 2021)
>
> Substantially Inundated (A suggested term, see policy in the state of Maine; Grannis, 2011): Structures that come to be located on an intertidal zone (seaward of the mean high tide line) for a period of six consecutive months.

Comprehensive Plan: Imagine 2040

Coastal Management Element

Existing Policies:

- The Coastal High Hazard Area shall be sited on the Future Land Use Map. (Policy 1.2.2)
    - *(Potential Policy) Include an agreed upon sea-level rise scenario, or scenarios, on the Future Land Use Map.*
- Prioritize land purchases in the Coastal High Hazard Area. (Policy 1.3.3)
    - *(Potential Policy) Prioritize land purchases in defined areas of concern for future sea-level rise, using an agreed upon scenario.*
- Continue to inventory road segments at risk in vulnerable areas and develop mitigation plans as appropriate. (Policy 1.3.17)
- New development, redevelopment, and infrastructure in vulnerable areas shall use

best practices to address sea level rise. (Policy 1.3.18)

- The use of seawalls and rip rap to stabilize beach shoreline is prohibited unless it can be demonstrated that without it, beach erosion would pose serious threats to human life and property. (Policy 1.5.4)
- Pursue the development of a long-term working waterfronts program to develop and implement strategies to preserve and expand commercial working waterfront lands and enhance recreational use and enjoyment of the waterfront. (Policy 1.6.5)
- Minimize the use of fill as a means of meeting minimum flood elevations in order to reduce the destruction of native plant communities and maintain natural drainage patterns and water table levels. (Policy 1.2.7)
    - *(Potential Policy) This policy may need to be revisited for areas that will rely on fill to adapt to rising sea-levels.*
- Continue to implement a program of shoreline improvement and restoration on publicly-owned or controlled riverfront lands. (Policy 1.11.1)
    - *(Potential Policy) The City may want to expand this program to support living shorelines where private properties are open to changing their shoreline.*
- There are different opportunities for living shoreline installation depending on the character of the property and adjacent waterway. In canals with limited space, focus can be placed upon establishing oysters by adding relief to sea walls or by using other narrow structures adjacent to sea walls or shorelines. If a wide dimension of space is available, efforts can be made to install mangroves or marshes, in addition to protective oyster-inducing structure.
    - *(Potential Policy) Based on projected rates of sea-level rise, inventory all existing shoreline stabilization structures and determine their capacity to maintain functionality throughout the sea-level rise planning horizon (50 years, for example).*
- … Coordinate with the Tampa Port Authority and EPC to restrict all new construction that would extend waterward beyond the banks, over the river. (Policy 1.13.3)
    - *(Potential Policy) Flexibility may be required as property owners adapt to rising seas in the future.*
- Establish building setback lines from the water's edge, sufficient to provide for adequate open space and protection of the river and the waterfront, and encourage the provision of a public easement. (Policy 3.2.3 and 8.6.1)
    - *(Potential Policy) Add language to specifically address sea-level rise and habitat migration.*
- 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. (Policy 4.2.1)

Other Potential Policies:

- *Use an agreed upon future sea-level rise projection for planning, design and permitting, for public and private projects.*
- *Create sea-level rise overlay areas.*
- *Identify where impacts will occur through a mapping and inventory processes (initiated with this project).*
- *Create a subsurface future conditions groundwater map and use as the basis for future planning and permitting. Protect flood storage capacity as sea and groundwater levels rise.*
- *Incorporate the community in the hazard identification processes, including*

developing instruments such as a sea-level rise committee or commission, a citizen advisory group, a resiliency office, and include considerations of addressing sea-level rise in economic development. Establish neighborhood level planning groups and/or representation.

- *Create funding streams for mitigating or adapting to future challenges due to sea-level rise.*
- *Coordinate between agencies, within and external to government, and within and external to specific governmental departments, to address sea-level rise.*
- *Consider issues of equity, (climate) gentrification and other social factors of coastal communities when creating sea-level rise policy.*
- *Create a prioritized project list and/or map to provide guidance for buffer zones and setbacks locations that will enable habitat zones to migrate, prevent erosion and prepare property owners for future coastal conditions.*
- *Consider and prioritize buyouts for repetitive loss properties, especially where conservation goals can be met.*
- *Establish 'community receiving zones' that are committed to non-vehicular transportation access, in association with transfer of development rights policy.*
- *Promote shoreline stabilization practices that incorporate living systems and remove hard-edged solutions for separating land from sea.*
- *Educate the public about climate and environmental change.*
- *Create an online digital database for flood elevation certificates.*
- *Set targets and reduce greenhouse gas emissions.*
- *Restore hydrologic eco-hydric function in the ecosystem, as feasible.*
    - *Fund or undertake stream restoration and expansion projects for tidally influenced waterbodies.*
    - *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.*
- *Consider the effects of sea-level rise on the drainage systems and begin a path toward adapting to future water elevations. Identify and fund drainage improvement projects.*
- *Identify areas to remove septic, and consider higher groundwater elevations for future installation.*
- *Limit the amount of impervious surfaces.*
- *Encourage private owners of infrastructure to conduct a climate change vulnerability assessment.*
- *Require the protection of sediment supplies and natural processes.*
- *Provide tax incentives or density bonuses to encourage developers to site new development in lower-risk areas of a lot or a subdivision.*
- *Address potential impacts on the coastal aquifer from water quality changes and flooding of coastal and tidally influenced bodies of water that may occur due to more intense storms, higher surface water temperatures and rising sea levels.*
- *Promote clustered, mixed-use development, site development around infrastructure, and preservation of open space. Consider upstream activities, as they directly affect tidal waters.*
- *Increase and facilitate conservation incentives.*
- *Monitor changes in acreage of land held for conservation and recreation use.*
    - *Monitoring data and recommendations shall be included in the comprehensive plan implementation committee's annual report.*

- *Participate in the NFIP program, including the CRS, assist local municipalities who participate and make all reasonable efforts to maintain a Community Rating System (CRS) score of 5 or better.*
- *Promote and maintain tree plantings, as a way to reduce carbon emissions and to absorb water.*

Code of Ordinances

Ch. 5: Building Code (Flood Resistant Construction)

Potential Policies:

- *Use future groundwater conditions in construction, for infrastructure such as septic tanks, water distribution, roadway construction and other utilities.*
- *Require removal of old septic tanks as a condition of property transfer or utility hook up.*
- *Establish regulations for sea walls, including a standard top of wall height, and try to remove them going into the future. Sea walls are not a sustainable solution considering changing water levels and impacts to coastal environments.*
    - *In Broward County, sea walls must be verified to be at least 5 feet above NAVD88 and in good repair.*
- *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.*
- *Allow buildings to measure height from design flood elevation or a common first floor elevation (can be formalized by establishing a "reference plane"), depending on community preference.*
- *Trade width for added height, allowing buildings to encroach into established setbacks.*
- *Allow buildings within the .02% flood zone to access variance rules, to prepare for future conditions.*
- *Increase design flood elevations to 2 feet in specific flood zones.*
- *Create design guidelines (for appearance) for elevated buildings.*

Ch. 16: Parks and Rec

Existing Policies:

- There are seven separate landscape area trust funds for each of the seven separate landscape districts described in subsection 13-161(e) of Chapter 13, Landscaping, Tree Removal, and Site Clearing Code. The landscape area trust funds shall be used for the deposit, maintenance, and distribution of all monetary contributions made in lieu of providing the required landscape area for developments pursuant to section 13-161. All contributions made to and interest derived from any of the landscape area trust funds shall be used solely for the purpose of acquiring new park land and/or improving existing public park lands and/or public right-of-way by providing, enhancing, or reestablishing green space solely within the boundaries of the landscape district in which the contribution was collected. (Section 16-101, City of Tampa Land Use Code)
    - *(Potential Policy) Leverage the landscape area trust fund for the purchase and maintenance of parks in mitigating the effects of sea-level rise.*

Potential Policies:

- *Support efficient use of public open space by integrating drainage services and aquifer recharge with recreation and public service activities.*
- *Consider passive educational opportunities in public parks.*

Ch. 19: Property Maintenance and Structural Standards

Existing Policies:

- An "order to demolish" can occur when a structure is damaged, deteriorated or defective to such an extent that the cost of restoration or repair thereof will exceed seventy-five percent of the assessed building value. (Section 19-5, City of Tampa Land Use Code)
    - *(Potential Policy) Update language to match definition associated with substantially damaged structures. Possibly incorporate specific policy that relates to areas that are substantially inundated, whereby property owners must "Remove structures that come to be located on an intertidal zone (seaward of the mean high tide line) for a period of six consecutive months." (Implemented policy in Maine, see Grannis, 2011)*

Ch. 21: Stormwater Management

Existing Policies:

- It is unlawful … to grade, fill, excavate, construct or do any other act affecting drainage which results in the alteration of the surface or subsurface drainage patterns to the detriment of neighboring properties or public rights-of-way. (Section 21-8) A drainage and earthwork permit must be obtained from the city prior to engaging in excavating, grading, filling or stockpiling activities, otherwise, each activity shall be unlawful. In order to qualify for issuance of a drainage and earthwork permit, the applicant must submit an application in conformance with the department's technical standards manual. Such manual identifies requirements which must be satisfied so that the applicant's permit may be approved. (Section 21-27)
- A mitigation credit for a stormwater can be applied to properties through city council approval. (Section 21-123)

Potential Policies:

- *Storm drainage calculations for tailwater elevations and storage capacities shall be based on a target sea-level and ground-water rise scenario.*

Ch. 22: Streets and Sidewalks

Existing Policies:

- Plans for bridges shall be submitted to the City for approval.
    - *(Potential Policy) During this process, the bridge shall be evaluated against a target sea-level rise scenario.*

Other Potential Policies:

- *Roads that are projected to be or are currently significantly inundated shall be evaluated for termination of use, providing alternative access where necessary.*

Ch. 25: Transportation

Potential Policies:

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

Ch. 26: Utilities

Potential Policies:

- *Use a future sea-level rise benchmark for the placement of utilities, especially for multi-family residences.*

Ch. 27: Land Development Code

Existing Policies:

- Parcel boundaries at the waterfront: Boundaries are indicated as approximately following mean high waterlines or centerlines of rivers, canals, lakes, bays or other bodies of water… In the case of a change in mean high waterline, the boundary shall be construed as moving with the change, except where such moving would change the zoning status of a lot or parcel. (Section 27-27 (3))
- Development rules and compliance: The purpose, beyond typical review, is to provide technical assistance and guidance to achieve compliance with development standards established by the Code and to promote the goals and objectives of the adopted Comprehensive Plan. (Division 2, Section 27-67)
    - *(Potential Policy) Use this review to provide education and analysis of future sea-level rise conditions.*
- Side setbacks: Minimum dimensions are established for space between buildings. (Section 27-162)
    - *Potential Policy) Create variance for small lots that raise their house to meet future flood criteria, so that building height limits can be met and building square footages can be filled out horizontally rather than vertically.*
- Rear or waterfront setbacks: Setbacks for rear of lot vary between districts, from 0-20 feet. 20 feet is the maximum required. (Section 27-156, see table 4-2)
    - *(Potential Policy) In defined areas of the city, specify the upland or landward portion of the lot to be developed while the low-lying portion is reserved for soft or natural flood protection.*
    - *(Potential Policy) Use erosion-based setbacks and update every 10 years. For example, require structures to be set back 50 times the annual erosion rate plus 20 feet.*
    - *(Potential Policy) Create tiered setbacks for differently sized structures; the larger the building the bigger the setback.*
    - *(Potential Policy) Create mandatory low maintenance zones near waterbodies, or a percentage of waterfront access that must be low*

maintenance zone. This type of planting is a critical buffer for water cleansing and nutrient reduction, for habitat migration and water infiltration.

- Building height: Buildings shall conform to the Florida Building Code (considering height from Base Flood Elevation). (Section III.B)
    - (Potential Policy) Consider adding 1 to 2 feet of freeboard to mitigate compounding *issues of flooding for the lifespan of the building, which is typically considered to be a minimum of 30 years. In that time sea-level rise expectations are approximately 1.4 to 2.5 feet with the Intermediate or High scenarios.*
    - *(Potential Policy) Create design standards for landscape, façade fenestration and requirements for outdoor circulation for buildings that are raised. Regulatory code could include: "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, 2017 & 2019)*
- Preserve and protect existing, healthy grand and protected trees in the city. (Section 27-284.3)
    - *This is an important aspect of reducing carbon emissions and dissipating water, which alleviates pressure for water storage and detention.*
- The City currently has multiple district or overlay designations with place-based policy, such as "Planning Districts," "Zoning Districts" and "Overlay Districts." (Section 27-20, 156 and 171)
    - *(Potential Policy) Establish specific Sea-Level Rise Overlay Zones. These defined areas will help to coordinate and establish community strategies to address future property and infrastructural challenges. Options are defined as "Protection Zones," "Accommodation Zones" and "Density Decrease Zones."*

    Protection Zone

    For areas that include critical infrastructure and significantly dense development, there are few options for adaptation. In places like town or city centers or historic districts, commitment to continual resistance to the impacts of rising sea levels may be the preferred of the three strategies. When value and density align, the physical adaptive capacity is low but the economic capacity may be much higher. In these situations, the area may need to rely on and pay for hard armoring. Hard armoring of coasts often proves to be costly and relies on engineering, capital improvement projects, and, when considering the potentials for storm surge, may also include other post-disaster effects. This approach also involves negative environmental effects. It is recommended that compensatory fees help be required to mitigate such damage. In establishing a Protection Zone, a community is deciding that asset and cultural value is worth trying to maintain in-place. Some of the policies or comprehensive planning considerations for the Protection Zone may include:

        - *Establishing building standards, so that buildings and infrastructure will withstand a minimum service life of 50 years. This includes pumps, well heads and associated walls, sea walls, roads, utilities and sewer lines.*
        - *Permitting requirements, such that roads and sewer lines shall be*

elevated to be more resilient to flood impacts.

- *Developing a comprehensive shoreline stabilization strategy. To do so, all existing shoreline structures should be inventoried and their capacity to maintain functionality shall be evaluated. Once complete, this can initiate a list for capital improvements, some of which can be accomplished through alternative funding via the Local Mitigation Strategy and other granting mechanisms.*
- *Compensating for the loss of ecosystem services resulting from hard shoreline stabilization. Policy would require adequate mitigation of coastal environments through fees and the construction of living shorelines in front of hard shoreline stabilization structures where feasible.*

This zone will be burdened by infrastructure costs. Options for providing capital include:

- *Additional property or district tax, for all properties within the designated zone.*
- *Construction permit fees.*
- *Habitat impact fees.*
- *Fees assessed for future infrastructure maintenance.*

Accommodation Zone

This zone should be applied to moderate to intensely developed but non-critical areas. In this area the expectation is that flooding will occur in the future, or with storm surge, but that property owners will incorporate higher water levels into the built environment. Strategies in the Accommodation Zone include down-zoning and modifying property regulations to incorporate water into future conditions, concentrating flood areas and directing them away from critical places of resource or infrastructure. Other policies include:

- *Considering habitat needs by facilitating tidal wetland migration into upland areas, in response to sea level rise, and supporting the requirement of vegetated buffers (including low maintenance zone buffers).*
- *Only implementing hardened shoreline stabilization where critical or where there is no other alternative. Work at removing hardened shorelines and implement living shorelines.*
- *Setting development densities or water-dependent use requirements. This could include such strategies as prohibiting or limiting property subdivision, prohibiting or limiting expansion of building footprints, clustering development and requiring a greater percentage of open space and providing frameworks to expand agricultural and open space in coastal hazard zones.*
- *Incentivizing reduction of density. This can occur by:*
    - *Amending the conservation tax credit program to make the donation of unbuildable or threatened lots a more appealing option to homeowners, providing tax credits for other preservation of property open space.*

    - *Establishing and highly motivating a transfer of development rights program.*
    - *Use rolling easements, which provide homeowners future certainty and tax credits while putting coastal or wetland-adjacent land into conservation.*
- *Using design criteria so that buildings and infrastructure will withstand a minimum service life of 50 years, and that they can withstand periodic inundation due to sea-level rise.*
- *Raising the design flood elevation and allowing for increased freeboard (ie. up to 6 feet). For smaller lots (of a determined size), allow them to expand horizontally into setbacks, to maintain street character.*
- *Utilizing setbacks and buffers to allow space for future coastal migration. This may include:*
    - *Specifying that the upland portion of the lot be developed while the low-lying area is reserved or put into a conservation easement.*
- *Requiring a percentage of shoreline (ie. 50%) must include riparian vegetation at a minimum width (ie. 15'), and potentially include low maintenance plants.*
- *Establishing erosion-based setbacks, or tiered for different building types.*
- *Maintaining road access but removing roads where feasible, when servicing only a few occupied residences or when alternative routes are available.*
- *Purchasing of or incentivizing relocation for repetitive loss properties.*
- *Providing inspection services to homeowners to help identify ways in which they can retrofit their homes, to make them more resilient to sea-level rise.*

This option necessitates property owner flexibility, limited density reductions, and capital improvements. However, whereas a Protection Zone will necessitate capital improvements to oppose future conditions, the Accommodation Zone attempts to incorporate them. This may not be possible in all areas, though, if inundation is too great.

Density Decrease and Habitat Restoration Zone

In this area the goal is to reduce the density and intensity of future land use along unprotected shorelines. This could include areas comprised predominantly of single-family residential and lower density development, where expectations are of deep and permanent inundation due to sea-level rise, and/or where there are environmental interest. The process of reallocating property ownership can require significant property owner engagement and municipal investment (that can be offset by state and federal grants), but over time this may prove to be a net cost benefit when compared to maintaining communities in place (Climate Ready Estuaries, 2011).

Potential strategies include:

- *Incentivizing reduction of density through the programs described in the Accommodation Zone, such as transfer of development rights and rolling easements.*
    - *Use transfer of development rights with bonuses attached to encourage dense and inland development.*
    - *Rolling easements, either voluntary (and are connected to tax credits or other incentives) or purchased, allow property owners to stay on a property but ensure the long-term ability for coastal migration as water levels rise.*
- *Restricting shoreline armoring to soft or natural solutions. This includes creating plans to remove existing hardened shorelines.*
- *Creating plans to facilitate tidal wetland migration in response to sea-level rise, and support through the requirement of vegetated buffers.*
- *Long-term relocation by community zoning or land-use plans that identify a frontal zone of buildings likely to be impacted by known erosion rates or predicted flood levels from storm surge and coastal flooding. Support planning to work with community members.*
- *Establishing a goal to substantially reduce or eliminate currently developed building sites subject to repetitive flood loss events. Strategies include purchasing properties, incentives, zoning requirements, impact fees and special assessments.*
- *Target sites that have been flooded three or more times in the last 10 years.*
- *Place a priority on coastal land acquisition through the Florida Forever program.*
- *Extend floodplain buyout programs to properties threatened by future sea-level rise; governments can preemptively acquire developed properties in order to remove at-risk structures and restore floodplain function.*
- *Utilize money from the (City of Tampa) Landscape Area Trust Fund to purchase properties and create new parks.*
- *Enacting post-storm measures that include building moratoria and a program for rapid acquisition of land.*
- *Establish an erosion-based minimum setback or buffer zone for shoreline development. Include low maintenance zones where feasible*
- *Impact fees: Require developers to pay fees to supplement costs that may be incurred in the future due to sea-level rise or exacerbated erosion conditions*
- *Use (tax) incentives for property owners to raise structures out of the floodway, remove structures from the property or create conservation easements*
- *Allow FAR to be deducted or exchanged for property owners that modify buildings or utilities to adapt to sea-level rise.*
- *Prohibit densification in planning areas within the expected sea-level rise zone*
- *Property Disclosure: Disclosure laws may inform buyers of the risk they are assuming as conditions may change in the future, and lets the*

buyer assume that risk. However, by establishing overlay zoning areas the risk is codified and specific requirements or constraints may be established. An additional policy can be implemented that mandates special hazard zones be disclosed in property purchase transactions, creating a separate level of information to prospective buyers.

Potential Policies (for the Land Development Code):

- *Cluster development: In areas susceptible to future sea-level rise, create associative zoning practices that cluster new construction in order to maximize contiguous open space. This allows for flexibility, to change topographic conditions and to maximize on-site concentration of water.*
- *Require developers to pay a fee to cover the costs of future armoring, to mitigate the impacts to natural resources from armoring, or to flood-proof infrastructure that services a new development.*
- *Limit the development of oceanfront hotels and condominiums.*
- *Exclude heavy industrial use sites in areas vulnerable to sea-level rise or future levels of storm surge due to sea-level rise.*
- *Adopt policies requiring the removal of existing structures and the restoration of the site to its natural condition if waters rise to touch the structure for a specified amount (six, for example) of consecutive months.*
- *Require Coastal Erosion Management Permits for construction and other activities that occur within a designated erosion hazard area.*
- *Require coastal property owners to provide a coastal hazard assessment to all potential buyers.*

City of Tampa Stormwater Technical Standards

Existing Policies:

- All living space must be a minimum of 1.5 feet above the crown of the street adjacent to the respective property, with all other floor elevations being 1.0 feet above the crown. (Section III.B)
- Hold harmless agreements: In order to protect and advise the current and any future owners of the property, the City may require the owner to execute a Hold Harmless Agreement. This agreement will be required for properties red lined because of flooding potential. (Section III.D.1)
- If the lot is lower than the street and receiving runoff from the road due to a low point in the road located along the front area of the lot in question, a building permit may be issued. However, no fill will be permitted, except as follows: Within the foundation limits, sufficient fill may be allowed to raise the building floor elevation to meet the minimum floor elevation requirements. (Section III.D.2)
- In order to ensure that any proposed development will not decrease the floodplain storage capacity, all development will be evaluated for compliance with the following: a.) No earth fill may be placed within a flood hazard area unless an equal amount of flood storage volume is created by excavation below the base flood elevation and above the seasonal high groundwater table elevation. b.) No portion of any structure which reduces the storage capacity of the flood hazard area may be constructed within the limits of the flood hazard area unless equal replacement storage volume is provided by acceptable engineering techniques. c.) A flood

hazard area is defined as an area that has experienced flooding in 1979 or later and is recorded in either the City of Tampa Localized Flood Atlas or the City Flood Zone Building Map. (Section III.D.4)

- Detention and retention requirements are described in Section III.C and D.
    - *(Potential Policy) Future conditions should be used to evaluate flood storage capacities and percolation rates.*

Other Potential Policies:

- *Design to an established future sea-level rise scenario and time horizon, and work to upgrade existing infrastructure to those levels while incorporating flexibility through nature based solutions.*
    - *"With the assumption that a typical stormwater improvement project has a project useful life of approximately 30-40 years, this also aligns with the 2050 NOAA intermediate-high value of 1.44 feet… the modeled 1-year stillwater elevation with 1.44 feet SLR as the tailwater design condition (2.0 feet +1.44 feet = 3.44 feet NAVD88) is recommended to be applied when evaluating resiliency for future capital improvement projects. (Applied Science, 2020)*

City of Tampa Transportation Technical Manual

Existing Policies:

- A subsoil investigation report shall be submitted with the road, bridge and drainage plans and shall include: Seasonal high and existing ground water elevation data.
    - *(Potential Policy) A future conditions groundwater map should be used for the evaluation of projects, for base materials and heights.*

Other Potential Policies:

- *In technical planning of bridge heights, allow for navigation in future sea-level rise scenarios.*

REGIONAL POLICY

Policy at the county or regional level are out of the direct purview of the City's control, however there is usually some capacity for the City to have influence. Opportunities to address sea-level rise include:

Environmental Protection Commission (EPC), Hillsborough County

The EPC is responsible for coastal habitats and monitoring. This includes rules associated with mangroves and mangrove trimming. Mangroves are instrumental in soil accretion (TBEP, 2017), especially where found in wide groupings. The EPC also permits sea walls, however without any regulation.

Existing Policies:

- "It is the intent of the Commission to encourage waterfront property owners to voluntarily preserve mangroves, encourage mangrove growth, and plant mangroves along their shorelines. (See Chapter 1-14)

    - *(Potential Policy) A balance can be struck between mandating the protection of mangroves and providing property owner access and waterfront use. A possible strategy is to have a percentage of mangrove growth along the shoreline that is not trimmed, and that it is not allowed to limit the growth extending away from property shorelines unless approved by the EPC.*
- Sea wall height is not regulated (personal interview: D. Irwin, 2020)
    - *(Potential Policy) Create a standard for sea wall height. In Broward County, sea walls must be constructed to elevation 5 (NAVD88) by a target date, or face penalty. They must also be in good repair and are subject to inspection.*
    - *(Potential Policy) Create a sea wall removal masterplan and work with homeowners to remove sea walls, or to adapt them to living structures where possible.*

Potential Policies:
- *Minimizing impacts to natural resource lands and coastal habitats due to construction activities and/or drainage.*

Local Mitigation Strategy (LMS), Hillsborough County

This document is defined as, "A blueprint or guide intended to: Provide a unified and consistent course of action needed to eliminate or reduce the impact of disasters that threaten Hillsborough County and its municipalities." The City of Tampa participates in the creation of the document and must ratify it upon completion, for submission to the State.

This document and its processes can be used to:
- Establish and prioritize a list of mitigation projects to both mitigate and adapt to future sea-levels.
- Increase awareness in the community about how sea-level rise may impact the community.

Post Disaster Redevelopment Plan (PDRP), Hillsborough County

This document prioritizes areas to focus rebuilding, reconstruction and redevelopment after a major hazard event. This document offers an opportunity to plan, to use post-disaster situations as a moment to reconsider where and how to rebuild communities, using incentives or buy-outs to relocate structures and residents that are having to cope with previously unconsidered environmental factors. It will be important to understand the insurance industry and process for redevelopment.

Potential Policy includes:
- *The City of Tampa perform their own PDRP, rather than adopting Hillsborough County's*
- *Identify areas vulnerable to sea-level rise and create appropriate policy within the PDRP*
- *Post-storm moratoria on building*
- *Prioritized buy-back properties*

- *Prioritized assistance areas*
- *Education to property owners about building requirements associated with substantial damage or substantial redevelopment (when more than 50% of the structure value)*
- *Modify the Transfer of Development Rights program to be used as a post-disaster redevelopment tool.*

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PUBLIC MEETINGS

November 24, 2020: Introduction of the project
January 12, 2021: Initial findings and community workshop
April 7, 2021: Initial recommendations and community feedback
May 12, 2021: Final recommendations