City of Panama City, Florida
Resilient Florida Adaptation Plan

AVO 52770
December 2023

Prepared for the City of Panama City

halff SM

Firm Registration No. 312

FINAL REPORT

City of Panama City, Florida
Resilient Florida Adaptation Plan

for the

City of Panama City, Florida

Prepared by

Halff

This work was funded in part through a grant agreement from the Florida Department of Environmental Protection, Resilient Florida Program, by a grant provided by the Office of Resilience and Coastal Protection. The views, statements, findings, conclusions and recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida or any of its subagencies.

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AVO 53189

Ms. Jennifer Aldridge
Disaster Recovery Project Manager
City of Panama City
501 Harrison Avenue
Panama City, FL 32401

Re: City of Panama City Final Resilient Florida Adaptation Plan

Dear Ms. Aldridge,

Halff is pleased to submit the final adaptation plan to the City of Panama City documenting the recommended adaptation strategies. This report expands on the findings from the completed vulnerability assessment and provides actionable recommendations to support the city in building resilience to climate related hazards.

We would like to also recognize the Halff Team, comprised of Cummins Cederberg Coastal and Marine Engineering and Carpe Diem Community Solutions, for their invaluable contributions to this project via technical expertise and stakeholder engagement support. This project was a collaborative effort between Halff, each subconsultant, Panama City staff, and members of the public.

Halff appreciates the opportunity to be of service to you and the City of Panama City on this important project. Please do not hesitate to call if you have any questions or concerns regarding this project.

Sincerely,

HALFF

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Executive Summary

The City of Panama City, like many coastal communities in Florida, is particularly vulnerable to threats related to flooding because of its low-lying geography and coastal exposure. In responding to these threats, the City of Panama City received grant funding from the Florida Department of Environmental Protection's Resilient Florida Program to conduct and prepare a vulnerability assessment, completed in August 2023. This adaptation plan is a follow-up on the vulnerability assessment, to provide adaptation strategies to support the city in building resilience to climate related hazards.

The vulnerability assessment was conducted to assess the exposure and sensitivity of current and future flood hazard scenarios on public infrastructure. It assessed the specific risks posed by flooding and rising sea levels to critical infrastructure, public facilities, residential areas, natural resources, and the overall community. As a product of the vulnerability assessment, a catalogued inventory of public infrastructure and its associated risk to 15 flood hazard scenarios were provide to the city. Upon completion of the vulnerability assessment, feedback and recommendations from city representatives was solicited and included within this subsequent report.

This adaptation plan elaborates on the findings from the vulnerability assessment and identifies the most vulnerable areas as focus areas. The selection of the focus areas was a collaborative effort with input on priorities from city representatives, community members, experts, and the outcome of the exposure and sensitivity analyses. The selected focus areas are the Downtown District, St. Andrews Community Redevelopment Area, the Residential Areas of the Venetian Villas near Capri Drive, Transportation/Evacuation Routes, and Stormwater Improvements.

For each identified focus area, a variety of strategies for helping the city become more resilient to the effects of sea level rise and flooding are recommended. The adaptation recommendations outlined in this report include protection, accommodation, "managed" retreat/relocation, avoidance, and procedural strategies. Due to the City of Panama City's geographic location along Florida's Gulf Coast and coastal exposure, an emphasis on general citywide initiatives is provided.

The City of Panama City is tasked with balancing the demand for increasing development and protection of fragile environmental resources. This adaptation plan aims to support the city in promoting sustainable development through infrastructure improvements, policy recommendations, public engagement opportunities, and identifying funding sources.

Achieving community-wide resilience will require collaboration with citizens, businesses, organizations, and government entities, as well as a multi-year commitment of resources, monitoring, and active engagement across city departments. While the journey ahead will be complex, the results and outcomes from the City of Panama City's vulnerability assessment and adaptation plan will lay the foundation for the next steps to follow to enhance Panama City's overall resilience.

Figure 1. Flooding caused by Hurricane Idalia
Source: The Guardian

1. INTRODUCTION

The City of Panama City, located in the Florida Panhandle, received funding from FDEP's Resilient Florida Program in 2022 to develop a vulnerability assessment pursuant to requirements contained in Section 380.093, Florida Statutes. The vulnerability assessment was completed in October 2023 as the first part of the overall vulnerability assessment and adaptation plan for the City of Panama City.

The purpose of the vulnerability assessment was to identify and evaluate the vulnerabilities of critical and regionally significant assets to current and future tidal flooding, storm surge, sea level rise, rainfall, and compound flooding. This information was crucial to develop a comprehensive adaptation plan with actionable mitigation strategies. This final report expands on the findings from the vulnerability assessment and identifies focus areas to prioritize strategies and develop projects for adaptation implementation. Knowing a key driver of implementation is having available resources, applicable grant funding opportunities are also identified. A ten-step systematic process was used to evaluate citywide vulnerabilities and develop climate adaptation strategies. The last, and most important step in the process, is to monitor, assess, and adjust strategies once they are implemented to ensure their success.

The process included:

1. Select Steering Committee
2. Critical and Regionally Significant Asset Inventory
3. Identify Climate Projections
4. Exposure Analysis
5. Sensitivity Analysis
6. Vulnerability Assessment
7. Prioritize Vulnerabilities
8. Identifiy Adaptation Strategies
9. Adaptation Plan
10. Implement, Monitor, Assess, and Adjust Strategies

1.1 SEA LEVEL RISE TRENDS IN PANAMA CITY

Sea level rise trends have been closely monitored by scientists and organizations around the world for many years. Since the mid-nineteenth century, sea levels have risen at an accelerated rate and satellite measurements and tide gauge records have provided valuable data showing that global sea levels have risen at an average rate of about 1.4 to 3.6 mm per year (**Figure 2**).

The National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS) are two examples of such organizations, who often publish monitored data on sea level rise trends and projections for various waterfront and riverine locations. Through the monitoring efforts from NOAA, a community can pull real time measurements of water levels at a local scale. **Figure 3** shows the

local sea level trends at the nearest NOAA tidal gauge to Panama City. The Panama City tidal gauge is situated at the southeastern end of the Pier at the Panama City Marina. The Panama City gauge (Station ID No: 8729108) was installed in 1973 and has measured monthly mean water levels since, with a recorded trend of 3.01 mm/year (0.12 inch/year). As the Earth's climate continues to warm, addressing the causes and impacts of sea level rise has become a crucial part of global climate change mitigation and adaptation efforts.

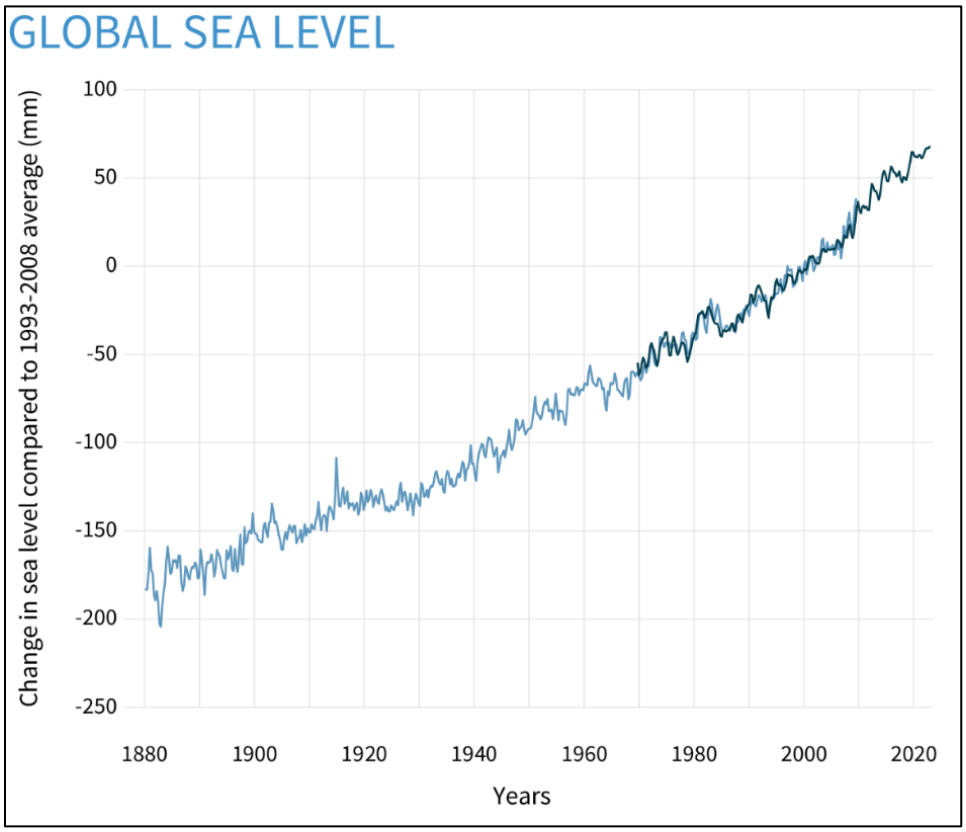

Figure 2. Global Sea Level Trend, NOAA

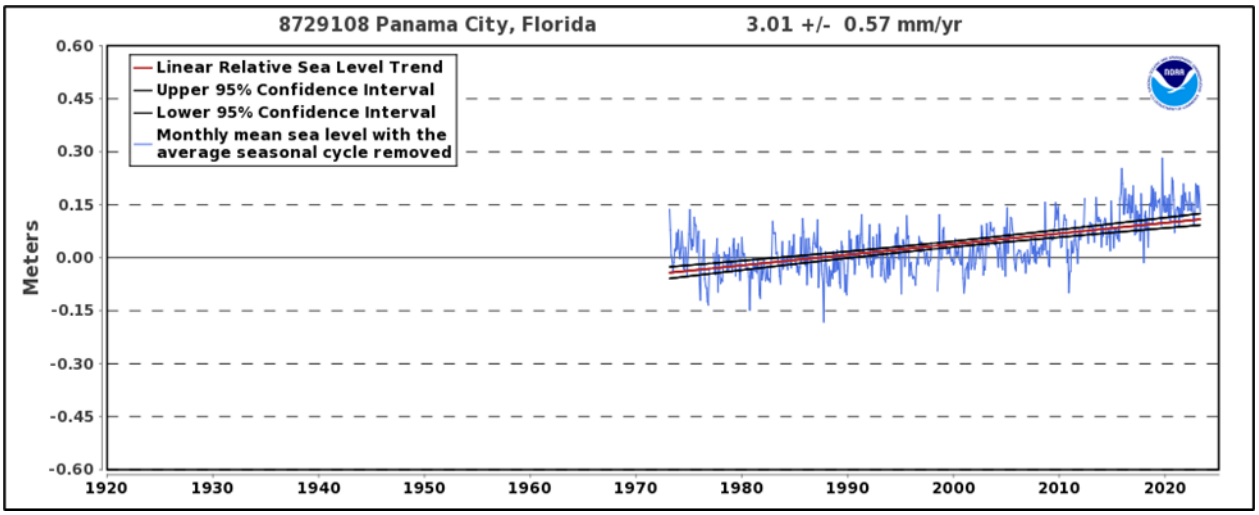

Figure 3. Relative Sea Level Rise Trend (Panama City, Florida), NOAA

1.2 LEGAL CONTEXT FOR CLIMATE ADAPTATION PLANNING

Climate Adaptation Planning has evolved over time in response to the growing awareness of the need to address impacts of climate change and sea level rise. The Intergovernmental Panel on Climate Change (IPCC), founded in 1988, plays a crucial role in assessing scientific information on climate change across the world. The IPCC published its first assessment report in 1990 and has updated it every 5 to 7 years with the latest being the AR6 published in 2021. Internationally and nationally, scientists, professionals, and governmental entities are continuing to encourage education and implementation of adaptation planning across all government and geographic scales.

All Florida counties and municipalities are required, by Florida Statues, to maintain a Comprehensive Plan, guiding the community's growth and development. Comprehensive plans are made up of land use policies that determine development patterns. Over the years, additional statues elaborating on coastal hazard mitigation and adaptation have been implemented. In 2011, the Community Planning Act provided the opportunity for communities to designate Adaptation Action Areas (AAAs). This is an optional, but highly recommended, comprehensive planning tool for designating areas that "…experience coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea levels for the purpose of prioritizing funding for infrastructure needs and Adaptation Planning." (Section 163.3164(1), Florida Statutes). By designating AAAs within the comprehensive plan, the community is better equipped to handle areas that are exposed to natural hazards and flooding.

In 2015, the Conservation and Coastal Management Element was introduced to the comprehensive plan, required by Section 163.3177(6)(g), Florida Statutes. Under law, each local government is required to include a "Conservation and Coastal Management Element" in its comprehensive plan that addresses policies and strategies related to the conservation, protection, and sustainable use of natural resources within the local jurisdiction, particularly focusing on coastal areas. Senate Bill 1094 was also signed into law in 2015, as "An Act relating to the peril of flood." In accordance with SB 1094, Section 163.3178(2)(f), Florida Statutes, or the Peril of Flood Florida Statute, now includes sea level rise as one of the causes of flood risk that must be addressed in the "redevelopment principles, strategies, and engineering solutions" to reduce flood risk. The statute further specifies components that must be contained in the coastal management element required for a local comprehensive plan, including how to eliminate inappropriate and unsafe development in the coastal areas when opportunities arise.

Figure 4. Dr. Wesley Brooks, Florida Chief Resilience Officer Meeting with Local Officials
Source: Town of Cutler Bay

To support localized comprehensive flood vulnerability and sea level rise assessments, the Resilient Florida Program was introduced in 2021 through Section 380.093, Florida Statutes. The program provides financial assistance to local governments, regional entities, and non-profit organizations to implement projects that address various aspects of resilience, including but not limited to coastal resilience, flood mitigation, green infrastructure, community resilience planning, and ecosystem restoration. More information regarding Section 380.093, Florida Statues, is provided in Section 2.

In response to the evolving understanding of climate change effects and legal requirements, various federal agencies have published guidance on adaptation planning. In 2010, the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean and Coastal Resource Management published the resource guide: Adapting to Climate Change Planning Guide for State Coastal Managers. This planning guide was one of the first comprehensive resources aiming to assist coastal managers in developing and implementing climate adaption strategies. Key elements and concepts covered in the guide includes climate change impacts, vulnerability assessments, stakeholder engagement, integration with existing programs, decision support tools, funding sources, and policy support.

The FDEP and then the Florida Department of Economic Opportunity (FDEO), now FloridaCommerce, collaborated and directed the development of the Florida Adaptation Planning Guidebook, published in 2018. The guidebook provides scalable steps to create effective adaptation plans for Florida communities including processes for conducting a vulnerability assessment, assessing, prioritizing, and identifying adaptation strategies, and methods for implementation capacities and actions.

Figure 5. Florida Adaptation Planning Guidebook
Source: FDEP

As more information became readily available and vulnerability assessments have been conducted across the State of Florida, the FDEP published the Standardized Vulnerability Assessment: Scope of Work Guidance in May 2022. The purpose of this resource is to assist local communities in assessing vulnerability through the Resilient Florida Program's planning grants, maximize funding awardees, provide technical guidance, and ensure that state-funded vulnerability assessments are standardized to meet the requirements set forth by Section 380.093, Florida Statutes.

These guidebooks emphasize the importance of proactive planning, collaboration, and integration of climate considerations into existing coastal management practices to safeguard the natural and social assets of coastal communities. By including conservation and coastal management elements in comprehensive plans, local governments can have direct impacts in promoting sustainable development, protecting valuable natural assets, and addressing the unique challenges posed by coastal hazards. The City of Panama City is responding to these legal requirements through efforts such as the completed vulnerability assessment, recommendations within this adaptation plan, and updates to the comprehensive plan.

2. VULNERABILITY ASSESSMENT FINDINGS

The City of Panama City was awarded grant funding from FDEP's Resilient Florida Program in 2023 and contracted Halff to conduct a vulnerability assessment and identify recommendations applicable to climate adaptation planning and grant funding opportunities. The flood analysis was conducted pursuant to the requirements set forth in Section 380.093 (F.S). The analyses included flood scenarios applicable to current and future tidal flooding, storm surge, sea level rise, compound flooding, and precipitation.

The key components of the vulnerability assessment included the **exposure analysis** of all critical asset "classes" defined in statutory requirements, including (1) transportation and evacuation routes; (2) critical infrastructure assets; (3) critical community and emergency facilities; and (4) natural, cultural, and historical assets. The exposure analysis consisted of overlaying each of the critical asset data layers and points with 15 flood scenarios, defined below:

- Current 100yr Storm Surge
- Current 500yr Storm Surge
- 100yr 2040 Int-Low Storm Surge
- 100yr 2040 Int-High Storm Surge
- 500yr 2040 Int-Low Storm Surge
- 500yr 2040 Int-High Storm Surge
- 100yr 2070 Int-Low Storm Surge
- 100yr 2070 Int-High Storm Surge
- 500yr 2070 Int-Low Storm Surge
- 500yr 2070 Int-High Storm Surge
- MHHW Current Conditions
- MHHW 2040 Int-Low
- MHHW 2040 Int-High
- MHHW 2070 Int-Low
- MHHW 2070 Int-High

Halff analyzed the intersections of where critical assets interacted with each flood scenario and results were then quantified and tabulated to produce asset "counts" based on each current and future flood inundation scenario. Once the number of affected asset categories were tabulated, the **sensitivity analysis** evaluated the impact of flood severity on each asset type at each flood scenario and assigned a risk level based on percentages of land area inundated and the number of critical assets affected for each type.

The City of Panama City's municipal area does not rise above a **low** vulnerability rating except when experiencing the worst-case scenario of a 500-year storm surge with 2070 intermediate high conditions which reaches 28.5% of the municipal area inundated, ranking a **medium** vulnerability on the scale shown in **Table 1**.

The results of the assessment indicate that under current and future high tide flooding conditions, Panama City's vulnerability to high tide flooding is **low**, with only 2.1% to 5.1% of the municipal area impacted, as shown in **Table 2**. However, transportation assets are most affected by current and future high tide flooding shown by the 28.1% to 35.3% of identified assets exposed to floodwaters, scoring **medium**, on the vulnerability rating. The location of transportation assets that are affected by seasonal high tide flooding are centralized to the waterfront boundaries of the city. Regular high tide flooding conditions on critical transportation assets will likely cause significant disruptions to essential services and increases in maintenance of roadways.

The City of Panama City 's critical assets are increasingly vulnerable to the current and future 100-year and 500-year storm surge events. Of the identified critical asset categories, it is evident that transportation assets are most at risk to exposure to floodwaters, impacting up to 62%, and critical community and emergency facilities impacted up to 37.7% of identified assets. Additional considerations of highly vulnerable assets should be taken to build long-term resilience and sustainability.

Table 1. Overall Vulnerability Ranges based on Areas.

Overall Vulnerability Rating	Critical Assets Inundated (% of total assets)	Land Area Inundated (% of municipality)
None	0	0
Low	< 25%	< 25%
Medium	25 – 50%	25 – 50%
High	50 – 75%	50 – 75%
Extreme	> 75%	> 75%

Table 2. Area of Inundation and Asset Exposure Count for Flood Hazard Scenarios.

	Transportation		Natural, Cultural, and Historical Resources		Critical Infrastructure		Critical Community & Emergency Facilities		Municipal Area	
	Count: 221	Inundation %	Count: 693	Inundation %	Count: 15,749	Inundation %	Count: 183	Inundation %	Count: 11,006.50 (ac)	Inundation %
High Tide Inundation Scenario										
SHT Current Conditions	62	28.1%	39	5.6%	87	0.6%	15	8.2%	227.3	2.1%
SHT 2040 Int-Low	64	29.0%	41	5.9%	123	0.8%	16	8.7%	254.5	2.3%
SHT 2040 Int-High	63	28.5%	42	6.1%	157	1.0%	17	9.3%	283.9	2.6%
SHT 2070 Int-Low	63	28.5%	42	6.1%	175	1.1%	17	9.3%	308.5	2.8%
SHT 2070 Int-High	78	35.3%	49	7.1%	614	3.9%	25	13.7%	557.5	5.1%
100-Year Storm Surge Inundation Scenario										
100yr Storm Surge Current Conditions	97	43.9%	88	13%	1,668	10.6%	34	18.6%	1,247.8	11.3%
100yr Storm Surge 2040 Int-Low	107	48.4%	95	14%	1,942	12.3%	37	20.2%	1,409.0	12.8%
100yr Storm Surge 2040 Int-High	112	50.7%	108	16%	2,259	14.3%	43	23.5%	1,583.9	14.4%
100yr Storm Surge 2070 Int-Low	112	50.7%	107	15%	2,201	14.0%	38	20.8%	1,547.4	14.1%
100yr Storm Surge 2070 Int-High	124	56.1%	147	21%	3,139	19.9%	48	26.2%	2,083.3	18.9%
500-Year Storm Surge Inundation Scenario										
500yr Storm Surge Current Conditions	125	56.6%	157	23%	3,369	21.4%	51	27.9%	2,169.0	19.7%
500yr Storm Surge 2040 Int-Low	129	58.4%	168	24%	3,687	23.4%	56	30.6%	2,348.6	21.3%
500yr Storm Surge 2040 Int-High	131	59.3%	180	26%	4,032	25.6%	57	31.1%	2,530.9	23.0%
500yr Storm Surge 2070 Int-Low	131	59.3%	178	26%	3,937	25.0%	56	30.6%	2,491.9	22.6%
500yr Storm Surge 2070 Int-High	137	62.0%	235	34%	5,047	32.0%	69	37.7%	3,140.0	28.5%

3. ADAPTIVE CAPACITY, NEEDS & STRATEGIES

The creation and implementation of a successful adaptation plan for coastal communities involves the assessment of **adaptative capacity, prioritizing needs, identifying adaptation strategies, and integrating the chosen strategy into plans and projects.** To assess adaptative capacity the community needs to consider their regulatory and planning capabilities, administrative and technical abilities, financial capacity, and infrastructure systems. Stepping back and evaluating what the community's current capabilities in terms of regulations, resources, and personnel provides a clear path to what they can take on internally and identify what external resources might be needed. In some municipalities, efforts to guide potential adaptation strategies already exist but are not implemented as clear strategies are not defined. In many cases, there are existing comprehensive plans, floodplain management plans, and stormwater plans that can be expanded upon to address sea level rise and flooding concerns. The adaptative capacity should consider short-term, intermediate, and long-term planning.

Once the community's adaptative capacity has been identified, prioritizing the biggest challenges faced from sea level rise and nuisance flooding to storm surge and hurricane events needs to be determined to choose a specific adaptative strategy. Community engagement is most crucial for this step in the process. This is the beginning of the framework for implementation of adaptation, with challenges identified and creating a clear understanding of the feasibility to address them.

Prioritization of the identified vulnerabilities is a function of urgency, scale of impact, and available funding. Through community led projects, the public is unified under the same resilience goal which enables residents to create adaptation plans within their own neighborhoods. This creates a sense of ownership within the community. Public training on flood risks, sea level rise, and adaptation approaches can help educate stakeholders and the public on how they can help.

3.1 RANGE OF ADAPTATION STRATEGIES

Adaptation Planning is neither linear nor cyclical and no two adaptation plans will be the exact same. Specific adaptation plans will vary depending on the unique characteristics and challenges faced by each community. A community can select a strategy from a range, or combination, of strategies in the following categories: (1) **Protection;** (2) **Accommodation;** (3) **"Managed" Retreat/Relocation;** (4) **Avoidance;** and (5) **Procedural**. The first three originated by the IPCC's 1990 Coastal Zone Management Subgroup (CZMS), and all five strategies combined are the worldwide standard used today.

Protection

Protection strategies include barriers or defensive measures against the impacts of sea level rise, storm surge, and erosion. Strategies can be green, grey, or hybrid. Examples of grey or hard solutions include building or reinforcing seawalls, bulkheads, rock revetments, and levees. In some locations, however, permanent structures are prohibited on the oceanfront as they can cause adverse effects on adjacent properties or public access. Examples of green or soft solutions include living shorelines and beach nourishment like the restoration project shown in **Figure 6**. Ecosystem restoration is preserving and restoring natural ecosystems like mangroves, wetlands, and dunes to function as natural buffers against coastal hazards. Hybrid solutions utilize both green and grey components such as restoring or expanding existing mangroves in conjunction with rehabilitating existing sea dikes.

The type of infrastructure proposed (green, grey, or hybrid) is a function of the shoreline characteristics, real estate and infrastructure, desired environmental affects, adjacent land use, and available funding.

Figure 6. Before (left, 2015) and After (right, 2017) of a breakwater and restoration project using native plant species and recycled oyster shells, completed by students at Deane Bozeman School at RiverCamps on West Bay.

Emergency

Protection strategies for emergencies can include temporary flood barriers or flood wrapping systems that can be proactively purchased and installed to protect structures or components in place. These systems can be installed by an individual homeowner for their property, or by city officials to protect an entire district. To prepare for a state of emergency, oftentimes local governments or counties will provide sandbags for residents to use as a form of temporary flood protection as depicted below in **Figure 7**.

Figure 7. Sandbags being made to prepare for Hurricane Idalia in Pasco County, 2023
Source: Naturecoaster.com

Stormwater Management Systems

Existing drainage systems are not always equipped to handle the compounding effects of sea level rise, storm surge, and rainfall. Stormwater drainage systems play a major role in preventing damages to structures and surrounding natural environments. Increased stormwater detention capacities can be created by installing larger pipes or culverts or by deepening and providing ongoing maintenance of streams, channels, or canals. Historically, stormwater infrastructure has consisted of pipes and manmade systems to convey and treat water, but as these systems age and struggle to keep up with the increased water levels, green and hybrid systems are being introduced to many communities. The Water Infrastructure Improvement Act of 2019, defines green infrastructure as *"the range of measures that use*

plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters." Green infrastructure is a vital way to protect ecosystems and the natural environment while providing recreational opportunities and increased drainage. Sustainable urban drainage systems are a combination of modern stormwater management with natural resources to minimize the impacts from development and to provide environmental, social, and economic benefits.

A multi-discipline design can help a location become more than a stormwater attenuation and treatment pond and can turn it into waterfront park space, with wildlife habitats and serve as a model for integrated design in floodways. The FDEP Green Stormwater Infrastructure website provides technical guidance and funding opportunities for implementation.

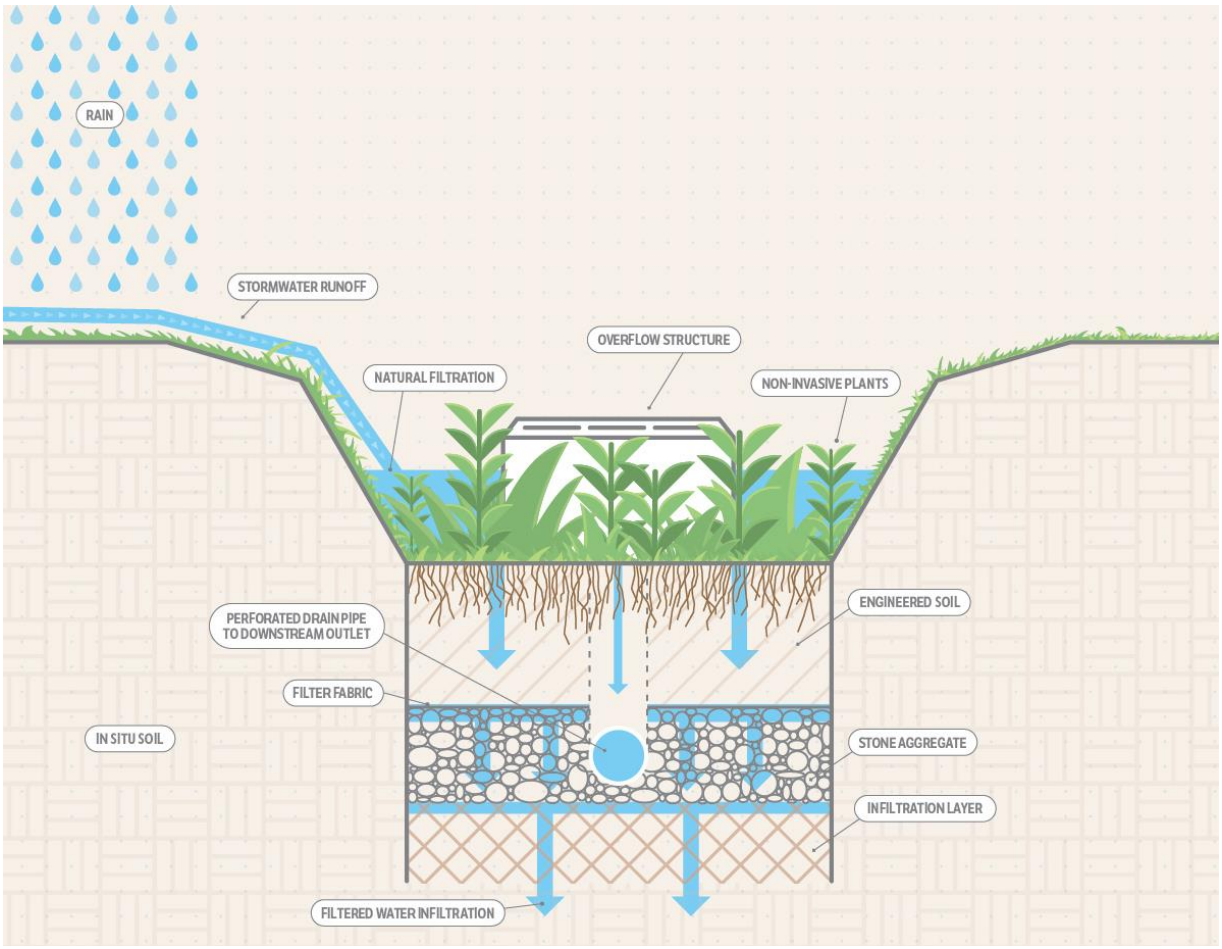

Figure 8. Bioswale Illustration.
Source: FDEP

Accommodation

Accommodation strategies modify the design or use of an asset to adapt to the effects of flooding. This includes designing, altering, and constructing buildings and infrastructure to withstand extreme weather events and flooding. Examples of accommodation include elevating structures and roadways, wet floodproofing structures, and establishing systems to provide timely alerts and information to residents about potential coastal hazards (**Figures 9 & 10**).

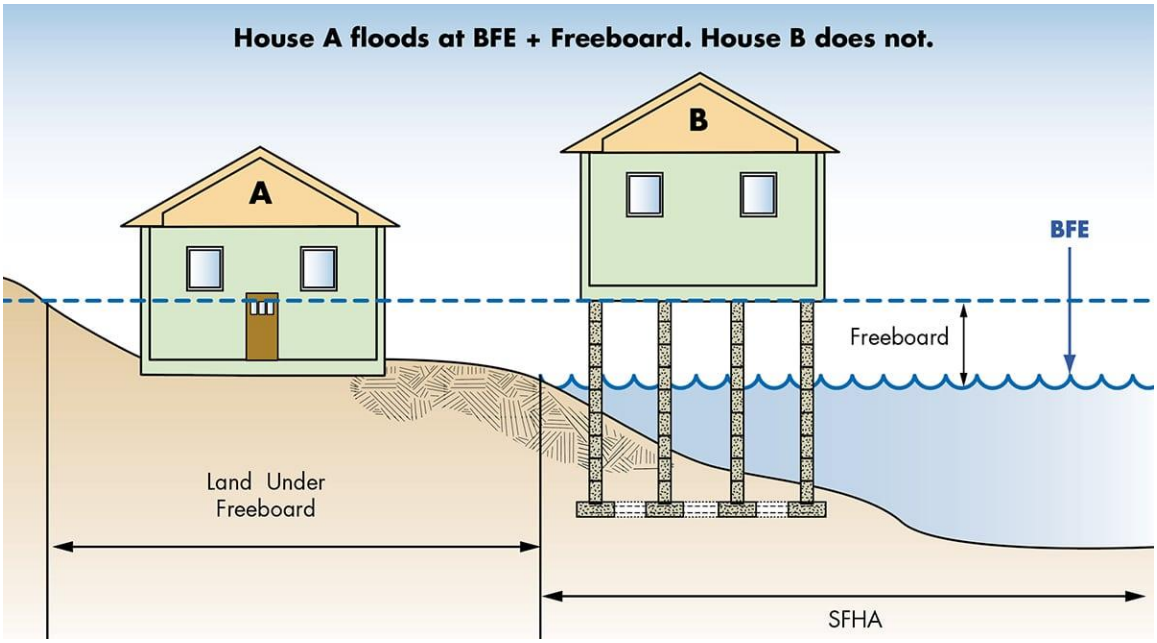

Figure 9. Example showing the impact of elevating structures.
Source: Association of State Floodplain Managers

Dry floodproofing, a protection strategy, is sealing off and preventing the floodwaters from entering by using watertight shields or sealants. Wet floodproofing, an accommodation strategy, allows the floodwaters to enter and exit an uninhabited portion of a structure to alleviate damages from the external pressures of the water. This method is common in public spaces, crawl spaces, or basements in homes.

Figure 10. Example of a vent installed on a home to allow wet floodproofing within a crawl space.
Source: Floodproofing.com

"Managed" Retreat/Relocation

"Managed" retreat/relocation strategies are either voluntary or incentivized relocation of critical infrastructure in areas that are prone to flooding and permitting that area to flood. This reduces the impacts to citizens and infrastructure and allows the natural environment to control the use. Examples of this strategy include buyouts of consistently flooded properties, rolling easements, and changing land uses and zoning.

Avoidance
Avoidance strategies involve moving new development away from vulnerable areas that are subject to coastal hazards by implementing policies, rezoning and land-use planning. Increased waterfront setbacks and buffers is another method of avoidance.

Procedural
Procedural strategies involve implementing zoning regulations to prevent development in vulnerable coastal areas, community education and outreach to raise awareness about climate change impacts and encouraging community engagement in adaptation efforts and collaborating with regional and national governments and international organizations to secure funding and resources for adaptation projects. Additional examples of procedural adaptation strategies include conducting vulnerability assessments, adapting findings into adaptation plans, and implementing action plans for specific capital improvement projects. Additional examples are provided below:

Building Codes
By incorporating stricter building codes and design standards that address the risks associated with natural hazards, communities can ensure that new construction and redevelopment projects are more resilient to these hazards. This can help reduce the risk of damage to buildings and infrastructure, protect public safety, and reduce the cost of recovery and reconstruction after a disaster.

Floodplain Regulations
Imposing additional regulations and restrictions on development in floodplains, above the National Flood insurance Program (NFIP) minimum standards, is one way a community can address resilience efforts. Incentives to homeowners and business owners who develop or redevelop structures above the minimum requirements is a common method to promote resiliency efforts.

Zoning and Overlay Zones
Zoning codes divide a community's land into districts based on the type of uses that are permitted. Design requirements are specified within each zoning district, including but not limited to setbacks, building height and density, and intensity of use. An overlay zone can be applied over one or more established land uses or zoning district and is often used to establish stricter development standards. By using zoning and overlay zones, communities can better manage land use and development to reduce risks from natural hazards and protect natural resources. An Adaptation Action Area (AAA) is an example of a specific overlay zone.

Transferable Development Rights (TDRs)
TDRs allow local governments to decrease intensity and density standards while conserving and/or protecting threatened properties in areas vulnerable to flooding. By allowing one landowner to dissolve development rights in exchange for compensation from another landowner who wants the development rights, TDR programs can reduce the risk of damage to buildings and infrastructure, protect natural resources, and reduce the cost of preservation by acquisition as a market for development rights increases. Mandatory TDRs are where both the sending and receiving areas are pre-designated and voluntary TDRs are where the landowner has the option to receive payment for their development rights.

Communities can implement these adaptation strategies to reduce critical asset's exposure to flooding, enhance assets functionality during and immediately following flooding, or increase adaptative capacity to adjust to the impacts from flooding. These are subject to additional factors such as financial investment, environmental impacts, societal impacts, and construction feasibility. The scale of the impact area affects the resources and funding that will be required and prioritization of the needs.

The selection of an appropriate and effective adaptation strategy requires the assessment of additional factors such as determining a *pro-active* or *re-active* response, scale of the impact area, method of infrastructure, and type of adaptation. Depending on the time frame, a *pro-active* or *re-active* response

will significantly affect the type of strategy and available funding sources. FEMA currently has two types of funding sources available; funds to implement pre-hazard: Pre-disaster Mitigation Grant Program and Building Resilient Infrastructure and Communities Program (pro-active) and funds to implement post-hazard: Hazard Mitigation Grant Program (re-active). Prioritizing which funding source to pursue is also based on the funding availability and overall eligibility. More information regarding these funding opportunities and more is provided in **Appendix A**. The key to any successful strategy is regularly assessing the effectiveness of the adaptation measure and adjusting as needed based on changing conditions.

To harness long-term prosperity, it is also important for the City of Panama City to engage and continue to participate in regional initiatives like the Emerald Coast Regional Council (ECRC) and the Emerald Coast Area Resilience Collaborative. These partnerships are essential for identifying best practices, leveraging regional networks, learning from neighboring governments, and building consensus around key priority areas. The value of such collaborations cannot be overstated. Panama City, like many communities, faces a unique set of challenges and opportunities. In an ever-changing world, cities must adapt and evolve to meet the needs of their residents while also preparing for the uncertainties of the future. This is where regional partnerships become invaluable.

First and foremost, the City of Panama City benefits from the wealth of knowledge and expertise that organizations like the ECRC and the Emerald Coast Area Resilience Collaborative bring to the table. These organizations serve as repositories of research data and best practices, offering insights into a wide range of issues, from urban planning and transportation to environmental sustainability and resilience.

By tapping into this collective wisdom, Panama City can make informed decisions that are based on evidence and best practices. This not only enhances the city's ability to address current challenges but also positions it to proactively plan for the future. For instance, by learning from neighboring communities' successes and failures, Panama City can avoid common pitfalls and implement strategies that have been proven to work. Furthermore, regional partnerships provide Panama City with access to a broader network of resources. In today's interconnected world, collaboration is key to success. The challenges facing Panama City, whether they be related to infrastructure, economic development, or environmental sustainability, are often not unique to the city alone. By engaging with regional partners, Panama City can pool resources, share costs, and benefit from economies of scale that would be unattainable on its own. This, in turn, allows the city to stretch its budget further and achieve more ambitious goals.

3.2 FOCUS AREAS FOR ADAPTATION

During the vulnerability assessment process, focus areas are assigned as an important method to monitor and evaluate adaptation strategies. The selection of the focus areas is a collaborative effort with input on priorities from the city representatives, community members, experts, and the outcome of the exposure and sensitivity analyses. The FDEP's Florida Adaptation Planning Guidebook defines Focus Areas as the selected locations where adaptation strategies components will direct its attention. The focus areas identified for adaptation planning are provided below and recommendations are provided in Section 4 of this report.

Coastal hazards come in different forms such as storm surge, tidal flooding, saltwater intrusion, groundwater flooding, stormwater flooding, shoreline erosion, and wave impacts. The City of Panama City is subject to experience all forms of coastal hazards and sea level rise will continue to exacerbate the negative effects of such hazards. Due to the city's coastal location, it is extremely vulnerable to coastal flooding events and mitigation of flood risks should be a priority for all of the city's residential and commercial properties as well as all exposed critical and regionally significant assets.

Downtown District Focus Area

Situated on the St. Andrews Bay and neighboring the Massalina Bayou, the Downtown District is vulnerable to high tides, storm surge, and expected sea level rise conditions. The Downtown District has had an impressive revitalization after the devastating destruction witnessed in 2018 from Hurricane Michael. The district is a popular tourist attraction home to numerous restaurants, shops, and art galleries. Beyond its variety of activities and attractions for residents and visitors, the district also has numerous critical and hazardous assets and infrastructure such as the Panama City Marina and Boat Ramp, Chevron USA Inc., Panama City Warehouse and Terminal, and Panama City Marine Institute.

As indicated by the Current 100yr Storm Surge flood event, shown in **Figure 11**, the Chevron Warehouse and Terminal will be significantly impacted, as well as the Marina and the main road Beach Drive. These areas will be directly affected by the rising sea levels anticipated over the next 25 years from storm surge and sea level rise. This area's proximity to the open water, relative elevation just above sea level, and aging stormwater management infrastructure makes it an extremely vulnerable location.

As an economic driver to the city, development within this area should prioritize opportunities to incorporate nature-based solutions for flood protection, shoreline stabilization, and drainage improvements. This area has the opportunity to be a leader in urban development that not only provides enhanced aesthetics and economic growth, but also provide multiple co-benefits of flood mitigation, heat reduction, community and waterfront resilience.

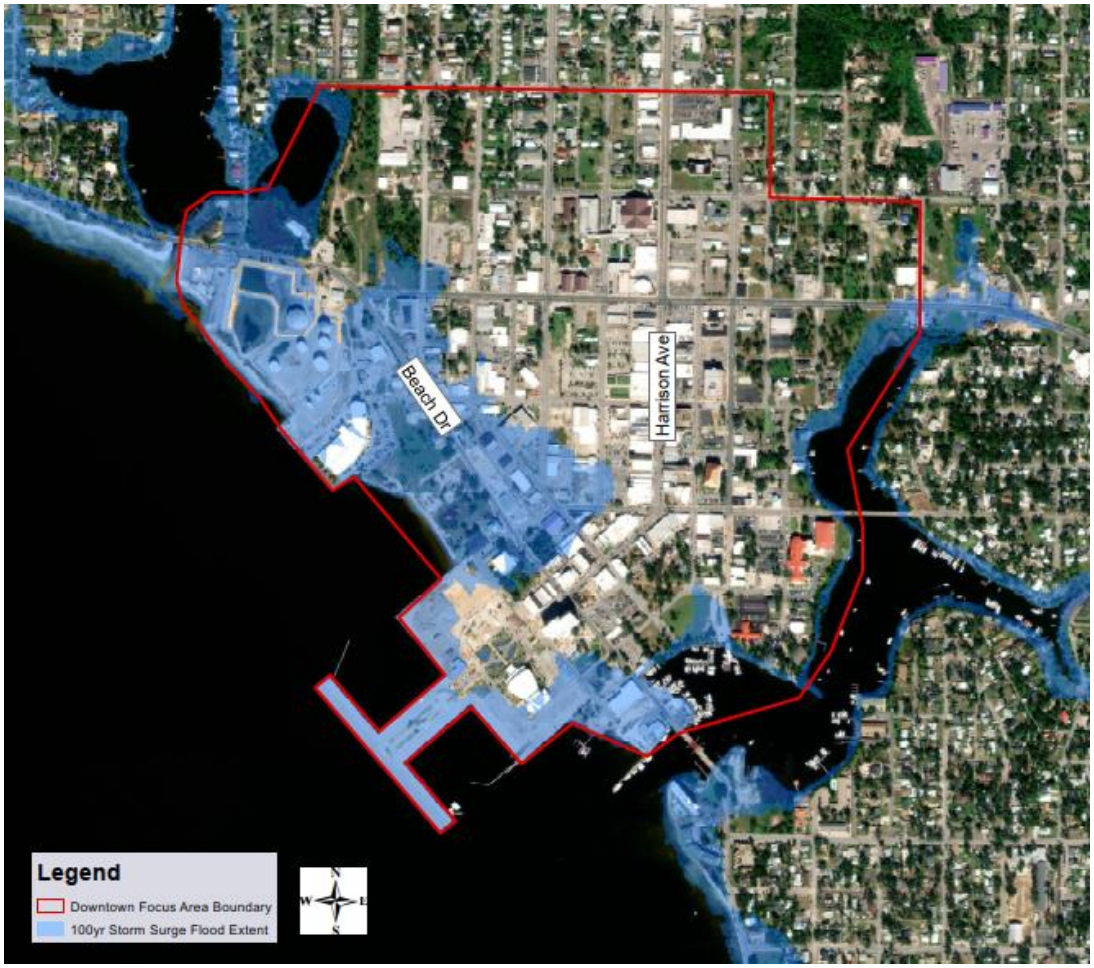

Figure 11. Downtown District Focus Area and 100yr Storm Surge Flood Extent

St. Andrews Focus Area

The St. Andrews waterfront district aims to be a vibrant riverwalk with pedestrian-friendly access, shops, and restaurants. Similar to the Downtown District, the St. Andrews historic and waterfront area is situated on the St. Andrews Bay and has inlets from the Bay into Lake Huntington and Lake Drake which could allow for upstream flooding into the residential and commercial areas. Its geographic location by nature makes it vulnerable to floodwaters. The boundary shown in **Figure 15** is the St. Andrews Community Redevelopment Area (CRA) extents published on the Panama City Zoning and Future Land Use GIS interface. As development continues within the St. Andrews CRA, consideration should be taken to build for the future and incorporate designs that will account for climate change, provide flood protection, and recreational benefits. Design elements on the water's edge should employ hybrid forms of infrastructure, with examples such as retrofitting existing seawalls, constructing new seawalls, implementing living shorelines/living seawalls, creating floating boardwalk with viewing platforms, developing a riverwalk with pervious pavement and underground water retention infrastructure, sculpting uplands to incorporate bioswales, rain gardens, exfiltration trenches, and raised berms, as well as integrating native tree canopy and appropriate groundcovers to maximize water capture and filtration into the river and water table.

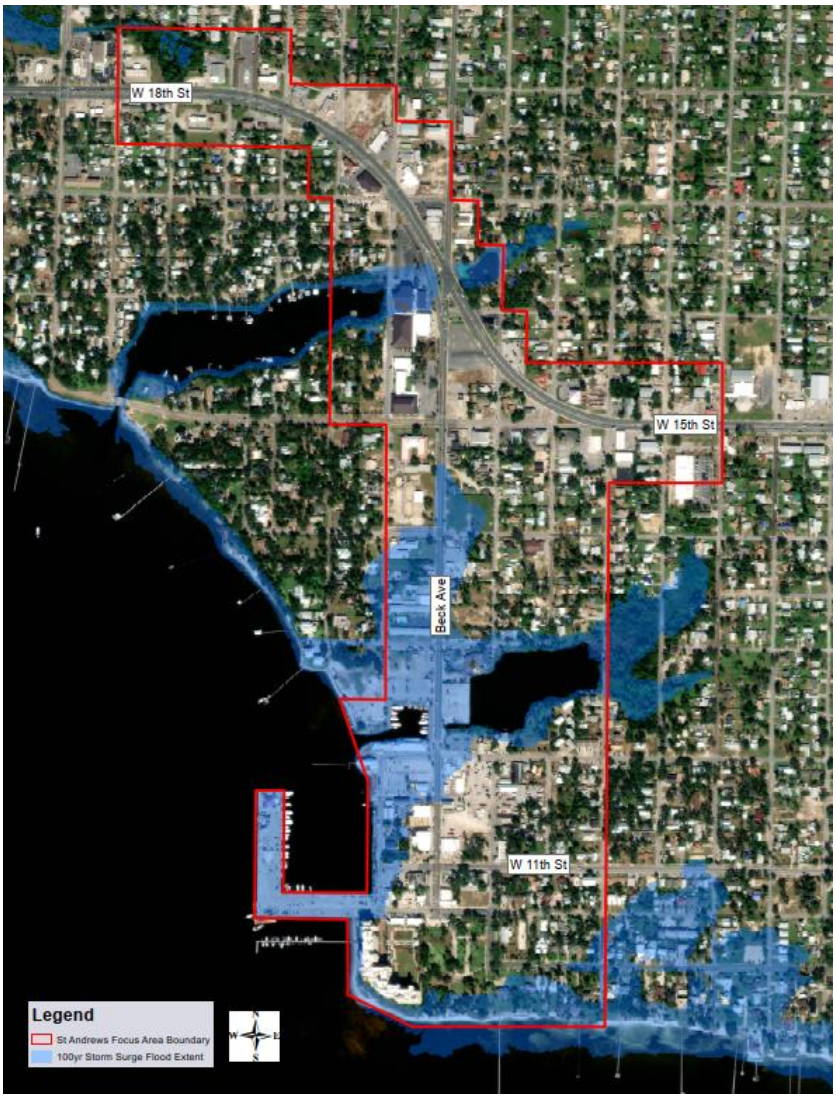

Figure 12. St. Andrews Focus Area and 100yr Storm Surge Flood Extent

Venetian Villas, Capri Drive, and Residential & Commercial Properties West of FL-390

Majority of the residential areas west of FL-390 are shown to experience occurrence of nuisance flooding, high tide flooding, and severe storm surge flooding. The Venetian Villas, Capri Drive, and numerous residential communities are expected to be entirely inundated by a 100-year storm surge event, as shown in **Figure 13**. The inundation of access roads and evacuation routes can cause significant delays in emergency resources reaching the area in times of distress.

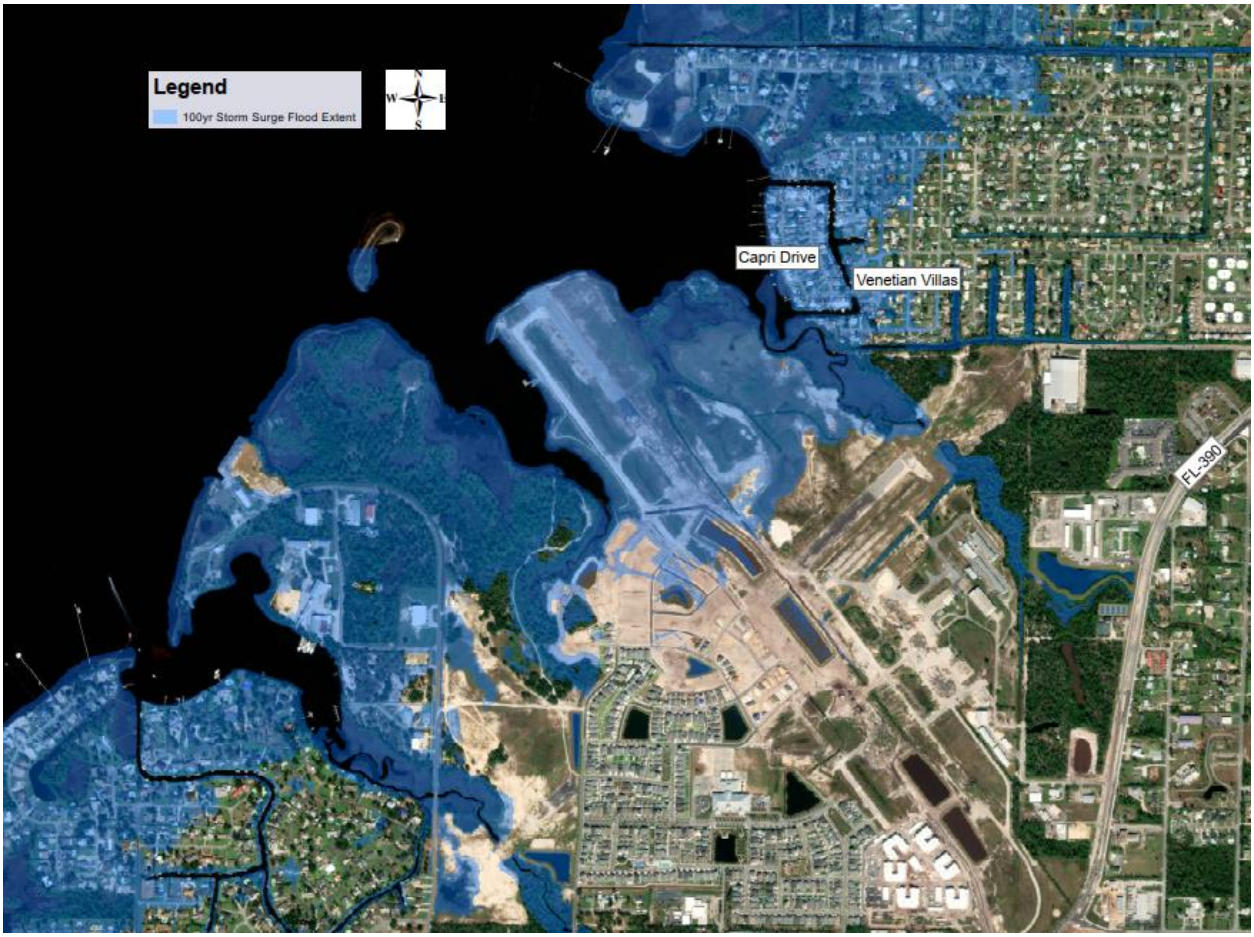

Figure 13. Venetian Villas, Capri Drive, and Residential & Commercial Properties West of FL-390 Focus Area

Stormwater Management Improvements

As sea levels rise and urban development increases, stormwater flooding becomes more challenging as water needs places to drain to. Local stormwater management should prioritize keeping water away from buildings and structures. Excess and untreated stormwater not only causes flood damage but can also introduce pollutants and toxins that could affect native environments and human health.

Wetlands/Marsh Preservation

Marshes, bayous, and coastal features are key protective measures and should be regulated, monitored, and maintained. The City of Panama City has an array of existing wetlands that currently act as the first barrier to storm surge, sea level rise, and shoreline erosion. Protections, restoration efforts, and limited development in these vulnerable areas should be a priority of the city.

3.3 CURRENT ADAPTATION STRATEGIES

Vulnerability Assessment

The vulnerability assessment (completed in October 2023) used existing and projected conditions to analyze flood hazard scenarios across catalogued critical assets. The vulnerability assessment not only identified the city's risks and most vulnerable assets but will assist in securing federal and state funding sources to implement mitigation projects. The findings, discussed in Section 2 of this report, guided the selection of focus areas to assist in prioritizing resources and adaptation recommendations.

Comprehensive Plan

A comprehensive plan for a community in Florida, is a document that serves as a long-term vision and policy framework for guiding the physical, social, economic, and environmental development of a local government jurisdiction. In Florida, comprehensive plans are legally required for local governments under the state's Growth Management Act.

The City of Panama City's Comprehensive Plan should be updated to include the Conservation and Coastal Management elements (as required by FL.ST 163.3177(6)(g).), with defined objectives and performance measures to protect, enhance, and conserve natural resources.

Community Rating System (CRS)

FEMA's Community Rating System is a program designed to encourage and reward communities for taking proactive measures to reduce flood risks and enhance floodplain management. The CRS operates within the National Flood Insurance Program (NFIP) and provides incentives for communities to go above and beyond the minimum floodplain management requirements.

The CRS assigns communities a rating based on a point system, with each community's rating corresponding to a percentage discount on flood insurance premiums for NFIP policyholders within that community. The goal is to incentivize communities to implement floodplain management practices that reduce the risk of flood damage and improve overall community resilience.

It's important for homeowners and residents in participating communities to inquire about the CRS rating and how it affects their flood insurance premiums, as it can lead to significant cost savings while promoting safer and more resilient communities in flood-prone areas.

The more points a community earns, the higher its CRS rating, and the greater the discount on flood insurance premiums for residents in that community. The discounts can range from 5% to 45% or more, depending on the CRS rating. To earn more points in the CRS and thereby lower insurance premiums for residents, communities must undertake various flood risk reduction activities and initiatives.

Participating in FEMA's Community Rating System (CRS) is of paramount importance for the City of Panama City. By engaging in this program, the city not only demonstrates its commitment to proactive floodplain management but also directly benefits its residents and the community as a whole. Through the CRS, Panama City can implement measures to reduce flood risk, enhance emergency preparedness, and improve floodplain management practices.

Some of the ways to earn points in the CRS include, but are not limited to:

Floodplain Mapping

Accurate and up-to-date floodplain mapping can earn a community points. This involves identifying and mapping flood-prone areas.

Floodplain Management Regulations

Implementing and enforcing stringent floodplain management regulations can result in more CRS points. These regulations may include building codes, zoning ordinances, and land use planning that mitigate flood risks.

Open Space Preservation
Preserving open spaces and natural floodplain functions can help reduce flood risks and earn communities CRS points.

Public Information & Outreach
Communities can earn points by educating residents about flood risks, flood insurance, and emergency preparedness. Public outreach programs, flood hazard disclosure requirements, and public meetings contribute to these points.

Flood Protection Information
The public library and/or community's website maintains references on flood insurance and flood protection like the International Association of Structural Movers (IASM) flyer in **Figure 14**.

Acquisition & Relocation
Acquire and/or relocate flood prone buildings so that they are out of the floodplain and the floodplain can remain open to flood naturally.

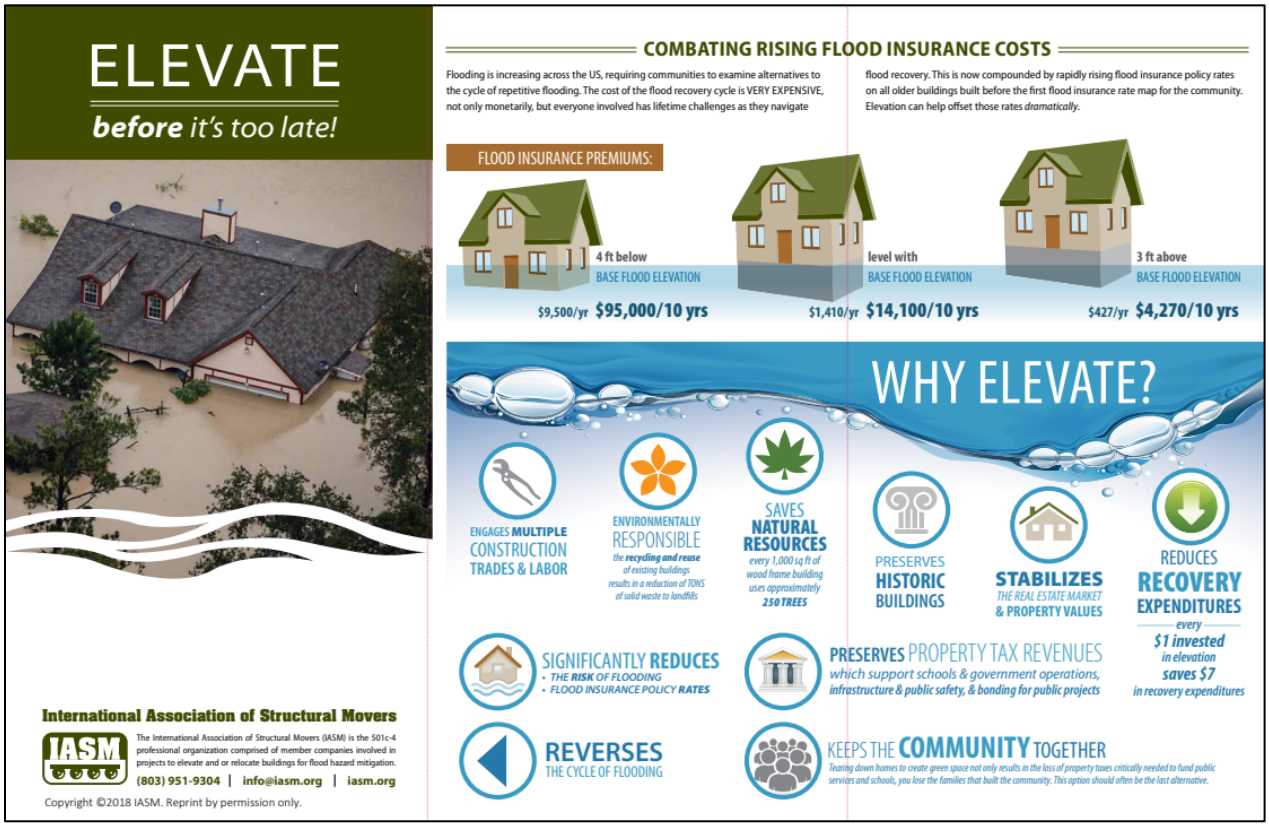

Figure 14. Flood protection information.
Source: International Association of Structural Movers (IASM)

4. RECOMMENDATIONS

4.1 RECOMMENDED STRATEGIES

This adaptation plan is the first of many iterations of adaptation planning for the City of Panama City. General recommendations for adaptation strategies are provided below as well as recommended strategies for the identified focus areas. These recommendations are based on best available information and should be updated after additional information becomes available, specific strategies are identified, and feedback from the community is obtained. An implementation schedule should be developed to prioritize strategies and projects as the city considers Capital Improvement projects.

The selection of an applicable and effective adaptation method requires assessment of multiple factors, such as cost, time to construct, impact on the infrastructure and surrounding area, timeline when needed, and type of adaptation. Tables 3 through 6 provide a grouping of recommended coastal strategies defined by the Florida Adaptation Planning Guides adaptation categories (accommodate, protection, relocation/retreat, and avoidance). A series of adaptation strategies may be considered for adaptation of vulnerable coastal assets including major coastal roadways and evacuation routes, bridges, ports, marinas, and shorelines.

Table 3. Accommodation Strategies

Type	Description	Green	Grey	Hybrid
Regrading/Fill	Use fill to increase the height of land. Consider creating minimum elevation requirements.	X	X	X
Beach Nourishment	Create or update State Beach Nourishment Program.	X		
Raising Utilities	Place/move utilities to a higher elevation. Raised platforms can be added to the side of buildings.		X	
Raising Structures	Use construction on pile methods to build structures at a higher elevation		X	
Impervious Materials	Incorporate impervious materials to provide adequate drainage.	X		X

Table 4. Protection Strategies

Type	Description	Green	Grey	Hybrid
Bulkhead	A bulkhead (i.e., seawall) is a hardened shoreline stabilization method. If not already in place, a seawall ordinance can be recommended to set a required elevation of the seawall.		X	X
Flood Panels	Glass flood panels are a relatively new flood control product that can be incorporated into a bulkhead to protect against direct tidal flooding while also maintaining viewsheds.		X	
Temporary Flood Barrier	Temporary, self-supporting flood barriers that can be assembled, moved into place, anchored, and filled with water, sand or gravel and then removed after flood threats have passed.		X	
Elevated Flood Wall/ Flood Gate	A flood wall can be constructed to protect individual vital buildings/facilities against flooding. They can be either permanent or dismountable. Sometimes gates are built in a flood wall to create space for roads. These gates are only closed during flood events.		X	

Revetment	Revetments are a hardened shoreline stabilization method. Provides protection from erosion and can be paired with regrading/fill.		X	X
Living Shoreline	A living shoreline uses natural elements such as coastal grasses, oysters, and mangroves to prove stabilization of the shoreline by protecting from the erosive. It should be noted the upland bank will remain exposed to erosion from stormwater runoff.	X		X
Outfall Backflow Preventor	Consider adding backflow preventors to outfalls to limit tidal flooding in stormwater systems.		X	

Table 5. Relocation/Retreat

Type	Description
Economic Incentives	Provide economic incentives for business to relocate.

Table 6. Avoidance

Type	Description
Municipal Codes and Policy	Support/develop design standards to address lower probability events.
Economic Incentives	Provide economic incentives for building in non-risk zones.
Deter Development in Vulnerable Areas	Guide future development out of areas vulnerable to flood hazards.

General Citywide

The entire city of Panama City is vulnerable to the impacts of rising sea levels and storm surge. Citywide adaptation initiatives, both procedural and infrastructure based, should be designed, and implemented to help the city better manage and adapt to changing vulnerabilities and flooding.

Procedural	Infrastructure
The city should aim to promote sustainable practices for site design, construction, and maintenance by encouraging practices that are environmentally friendly and reduces negative impacts.	Elevate properties to be above base flood elevations, and consider storm surge, wave impacts, and sea level rise.
Review other proactive Florida community's building and zoning codes for resilience related elements and update the City of Panama City's codes to reflect similar elements.	Consider the use of underground cisterns or wet wells in conjunction with pumps to store long term excess stormwater runoff.
Re-evaluate base flood elevation standards to consider projected sea level rise scenarios and flooding potential.	Elevate critical infrastructure and equipment, including roads, bridges, electrical components, etc.
Limit new development in vulnerable areas, especially in the waterfront areas, through stricter regulations and approval processes.	Elevate and protect stormwater and wastewater management systems and consider green stormwater infrastructure (GSI).
Establish a city resiliency fund to support the acquisition of public lands to convert to greenspace for climate mitigation.	Consider nature-based solutions (NBS) and green infrastructure to increase city protection, such as living shorelines.
Ensure that climate adaptation strategies are considered in the Capital Improvement Projects.	Replace/repair old and damaged pipes, manholes, and other system components.

Preserve wetlands and open spaces to prevent any further loss of native vegetation/ wetlands adjacent to the coast.	Utilize sustainable design standards on new construction and renovation projects.
Create and implement a community-wide survey and prioritize action areas based on resident feedback.	Prioritize improvements on stormwater management systems and infrastructure.
Evaluate and update evacuation planning to ensure that evacuation routes are not affected by nuisance, tidal, or storm surge flooding.	Reduce the amount of impervious surfaces throughout the city.
Develop a tree canopy initiative and educate the public on the importance of trees for stormwater mitigation, groundwater, and the urban heat index.	
Improve maintenance and monitoring requirements, with age restrictions of critical infrastructure such as stormwater management systems.	

Downtown District Focus Area Recommendations

Asset/Area	General Adaptation Strategies
Panama City Marina & Boat Ramp	• Raise seawall (implement seawall ordinance). • Replace asphalt with pervious surfaces (bioswales, infiltration • strips). • Replace concrete docks with floating docks. • Add and/or improve breakwater. • Enhance existing seawalls with living shoreline features such as oyster baskets, sea grass, mangroves, reef balls. • Add living shoreline elements to existing seawalls to help reduce wave impacts and property damage. • Consider the Waterfront Alliance's WEDG[88] standards for resilient, sustainable, and accessible infrastructure and design at the water's edge. • Install underground stormwater vaults. • Install a remote storm surge alert system.
Chevron USA Inc. Panama City Warehouse & Terminal	• Raise seawall (implement seawall ordinance). • Raise revetment and/or harden the shoreline.
Coastal Roadways	• Raise the road and harden the adjacent shoreline. • Raise major intersections above projected sea level rise elevations. • Collaborate with FDOT and other neighboring communities to ensure consistency in adaptation and evacuation plans. • Prioritize protection and reinforcement of major evacuation routes. • Raise road elevations to protect inland properties and divert water off the roadways. • Develop local Climate Resiliency Road Design Guidelines. • Consider alternate evacuation route for residents and business owners. • Raise utility systems and components above base flood elevations or relocate to less vulnerable areas. • Install elevated pumps with generators to pump water off roads and better manage flooding.

Residents and Businesses	• Educate residents on the severity of continued flooding and funding opportunities available to elevate homes. • The city should consider a buyout program for properties that repeatedly flood and where property owners cannot afford to elevate. • Limit new construction to higher regulations in terms of base flood elevations and wind ratings. • Consider programs that monitor and give citations to residents and businesses for any unrepaired or non-attached items that can become debris during a high flood or wind events.

St. Andrews Historic Neighborhood and Marina Recommendations

Asset/Area	General Adaptation Strategies
St. Andrews Marina & Boat Ramp	• Raise seawall (implement seawall ordinance). • Replace asphalt with pervious surfaces (bioswales, infiltration • strips). • Replace concrete docks with floating docks. • Add and/or improve breakwater. • Enhance existing seawalls with living shoreline features such as oyster baskets, sea grass, mangroves, reef balls. • Add living shoreline elements to existing seawalls to help reduce wave impacts and property damage. • Consider the Waterfront Alliance's WEDG[88] standards for resilient, sustainable, and accessible infrastructure and design at the water's edge. • Install underground stormwater vaults. • Install a remote storm surge alert system.
Oaks by the Bay Park	• Beach/berm nourishment. • Raise walkways. • Consider sponge park design, breakwaters, and additional coastal vegetation. • Create joint-use recreation areas that store stormwater.
Coastal Roadways	• Raise the road and harden the adjacent shoreline. • Raise major intersections above projected sea level rise elevations. • Collaborate with FDOT and other neighboring communities to ensure consistency in adaptation and evacuation plans. • Prioritize protection and reinforcement of major evacuation routes. • Raise road elevations to protect inland properties and divert water off the roadways. • Develop local Climate Resiliency Road Design Guidelines. • Consider alternate evacuation route for residents and business owners. • Raise utility systems and components above base flood elevations or relocate to less vulnerable areas. • Install elevated pumps with generators to pump water off roads and better manage flooding.

Residents and Businesses	• Educate residents on the severity of continued flooding and funding opportunities available to elevate homes. • The city should consider a buyout program for properties that repeatedly flood and where property owners cannot afford to elevate. • Limit new construction to higher regulations in terms of base flood elevations and wind ratings. • Consider programs that monitor and give citations to residents and businesses for any unrepaired or non-attached items that can become debris during a high flood or wind events.

Venetian Villas, Capri Drive, and Residential & Commercial Properties West of FL-390

Asset/Area	General Adaptation Strategies
Residential Properties and Docks	• Raise seawall (implement seawall ordinance). • Consider floating docks if not already in use. • Add living shoreline elements to existing seawalls to help reduce wave impacts and property damage. • Educate residents on the severity of continued flooding and funding opportunities available to elevate homes.
Venetian Sunset Park	• Beach/berm nourishment. • Raise walkways. • Consider sponge park design, breakwaters, and additional coastal vegetation. • Create joint-use recreation areas that store stormwater
Coastal Roadways	• Raise the road and harden the adjacent shoreline. • Raise major intersections above projected sea level rise elevations. • Collaborate with FDOT and other neighboring communities to ensure consistency in adaptation and evacuation plans. • Prioritize protection and reinforcement of major evacuation routes. • Raise road elevations to protect inland properties and divert water off the roadways. • Consider alternate evacuation route for residents and business owners. • Raise utility systems and components above base flood elevations or relocate to less vulnerable areas.

Stormwater Improvements

Improvements of stormwater management systems have many co-benefits and should be a priority when reviewing adaptation strategies. Adequate stormwater management provides flood mitigation from buildings and structures, roadway flooding relief, water quality and natural ecosystem improvements, expansion of green space and increased fishing and tourism opportunities. Stormwater management in coastal areas is a complex process with an array of factors that have to be taken into consideration. As sea levels rise, stormwater systems will be comprised as outfalls are partially or fully submerged and prolonged exposure to saltwater can damage infrastructure. Improvements should consider the compound effects of sea level rise, storm surge, groundwater, saltwater intrusion, and stormwater runoff. Stormwater management improvements should be considered for the entire City of Panama City, especially along all major roadways.

	General Adaptation Strategies
Stormwater Management Systems and Infrastructure	• Conduct a comprehensive stormwater management system study that assesses the entire watershed which feeds the city's stormwater components.

	• A comprehensive stormwater building code should encompass measures to safeguard the city's drainage system both during construction and after completion, including provisions for stormwater management requirements.
	• Install check valves at outfalls, this prevents backflow from canals due to high tides, storm surge, and sea level rise, from entering inland areas.
	• Assess all stormwater outfall elevations and update design requirements based on projected sea level rise scenarios, high tide flooding, and storm surge.
	• Create a maintenance plan to clean oysters or other natural growth from pipes and culverts.
	• Identify areas to install natural infrastructure for flood management.
	• Install/upgrade pump systems in flood areas.
	• Stabilize slopes/outfalls with riprap or native vegetation and seawalls with living shoreline features.
	• Identify available land near outfalls for increased stormwater retention.
	• Add infiltration elements or pervious surfaces in parking areas to absorb stormwater.
	• Develop a maintenance plan to maintain, monitor, and enhance drainage.
	• Increase stormwater capacity through dredging/sediment removal in the bay and canals.
	• Install storm surge protection barriers.
	• Install stormwater vaults under parking and open areas.
	• Consider partnership opportunities with the state, county, and neighboring communities to capture excess stormwater.
	• Reduce or eliminate oceanfront outfalls.
	• Improve weirs and control structures.
	• Develop funding sources and replacement requirements for redesign of assets.
	• Consider backup generators for pump systems during emergencies.
	• Replace materials with corrosion resistant equipment.
	• Install retention swales, bioswales, or other forms of green infrastructure in locations that vaults are infeasible.

Wetlands/Marsh/Environmental Preservation

As the community continues to develop, pressures to expand into sensitive areas could leave the community extremely vulnerable. Man-made protection enhancements and structures could conflict with natural assets and cause adverse effects. Water quality, ecosystems, and fish populations could be extremely impacted by increased flooding and warming water due to climate change. The natural features of the City of Panama City play an important role in the community and should be protected and integrated intro nature-based solutions.

	General Adaptation Strategies
Wetlands/ Marsh/ Environmental Preservation	• Revise Future Land Use Maps to prohibit development on vulnerable and sensitive wetlands and marshes.
	• Consider the use of Nature Based Solutions (NBS) and provide incentives to developers to promote its use in design and construction.

	• Conduct a study within the next 36 months to evaluate means of protecting the city on the west side of US HWY 19
	• Partner with the county or neighboring communities to conduct shoreline stabilization or restoration initiatives.
	• Replace concrete docks with floating docks.
	• Include living shoreline features on any existing seawalls that abut wetlands and marshes to attenuate wave action and accrete sand.
	• Initiate seawall revitalization/removal programs
	• Identify opportunities to expand greenspaces as opposed to hardened amenities.
	• Along the riverfront, utilize multi-purpose pedestrian zones and boardwalks/sidewalks to serve dual purpose of flood protection.
	• Develop maintenance guidelines to clean waterfront during and after red tide events and storm events.
	• Consider a plan for rolling easements to understand options to acquire public and private lands to buffer coastline.
	• Develop habitat and fishery enhancement programs.

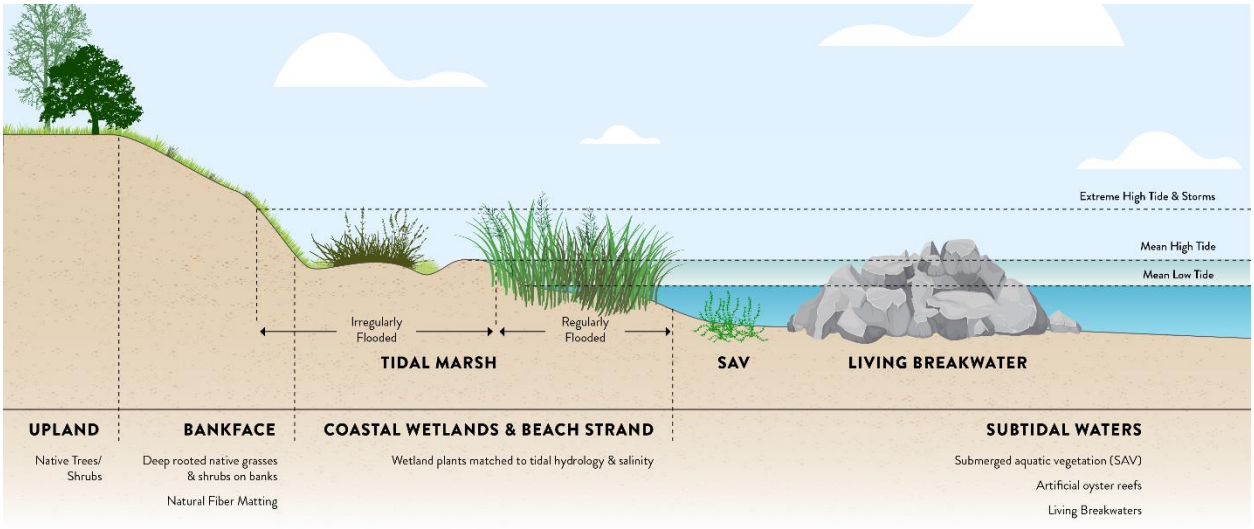

Figure 15. Coastal Environment
Source: Texas General Land Office

4.2 POLICY CHANGES AND THE COMPREHENSIVE PLAN

As part of the vulnerability assessment efforts, the City of Panama City's comprehensive plan is currently being amended to focus on compliance with the 'Peril of Flood' statutory requirements. In May 2015, Governor Rick Scott signed into law Florida Senate Bill 1094, "An Act relating to the peril of flood." SB 1094 requires consideration of future flood risk from storm surge and sea level rise in certain portions of local governmental comprehensive plans.

Halff provided the City of Panama City with draft Peril of Flood language for consideration. The city is now in the process of transmitting and adopting the comprehensive plan amendment. The amendment, in addition to the vulnerability assessment and adaptation plan, will confirm that the City of Panama City is in full compliance with Resilient Florida statutory requirements. Once the Peril of Flood goals, objectives,

and policies are fully adopted, the City of Panama City will be fully in compliance with state requirements and is able to develop plans of action for pursuing grant funding opportunities.

4.3 FUNDING SOURCES

External funding support is crucial for the City of Panama City's adaptation plan in order to comprehensively develop and implement adaptation strategies. A comprehensive list of available funding sources and/or grants in future implementation is provided in **Appendix A.** The list outlines federal and state funding sources and summarizes the type of funding, source, potential value, cost share amounts, application deadlines if available and any additional relevant details.

The list reflects the most current data at the time of delivery but due to the ever-changing nature of grants and available funding sources, the City of Panama City should thoroughly review and monitor any updates on funds the plan to pursue.

Figure 166. Hurricane Michael Batters Southeast
Source: Pensacola News Journal

5. CONCLUSION AND NEXT STEPS

Achieving community-wide resilience necessitates collaboration with citizens, businesses, organizations, and governmental entities. Long term sustainable solutions will require multi-year commitment of resources, monitoring, and active engagement across city departments. Over the coming year, the city should create a more detailed action plan with responsibilities assigned for each of the recommendations listed below. Some of the overarching adaptation strategies recommended for implementation by this Adaption Plan include:

1. Integrate climate projections (sea level rise, storm surge, compound flooding) into Capital Improvement Projects (CIP) and encourage a focus on climate resilience early in project planning.
2. Create a City of Panama City Resilience Manager position to identify funding, facilitate implementation of adaptation strategies, and provide annual reporting to the City Council on the recommendations set forth by this plan.
3. Establish a city resiliency fund/program to acquire public lands for habitat protection, stormwater management, innovative green and blue (water related) infrastructure projects and the expansion of green spaces.
4. Engage the community in the process to ensure that strategies meet local needs and build public support. Public education opportunities should be held more frequently to inform residents of identified flood hazards and mitigation measures available to them.
5. Support citywide drainage model revisions that will incorporate sea level rise and encourages additional model inputs to address future storm surge and extreme (inland) flooding.
6. Annually track and update available funding sources, including, but not limited to, public-private partnerships, grant opportunities (government, not-for-profit), and federal programs (FEMA, etc).
7. Partner with neighboring communities and regional planning councils to promote collaboration across entities and departments to prioritize comprehensive climate resiliency.
8. Prioritize strategies that provide co-benefits, consider cross-department collaboration, and provide area-scale protection to maximize public investment.

The City of Panama City is dedicated to addressing the challenges posed by climate change, including sea level rise, storm surge, and extreme weather which will impact various public assets. Through the efforts put forth in the City of Panama City's Vulnerability Assessment and Adaptation Plan, the city is taking the necessary steps toward greater resilience preparedness. This Adaptation Plan serves as a foundation for enhancing urban resilience.

Implementing adaptation measures outlined in this plan will require funding from various sources, including public-private partnerships, government programs, grants, bonds, and tax incentives. The goal is to position the city to identify and target these resources effectively. Implementation will require committed individuals and teams to take the necessary steps in understanding the associated costs and benefits of identified strategies and sourcing funding to take actionable steps to implement. It is recommended that an implementation/action plan that prioritizes the recommendations herein, is developed that includes community feedback on proposed strategies and implementation methods.

As strategies and projects are implemented, the city should continue to monitor and evaluate the effectiveness and reassess as appropriate. This Adaptation Plan should be maintained and updated periodically to evolve as updated flood hazard data becomes available. It is recommended that the City of Panama City acquire updated LiDAR survey data and more complete FFE data for publicly owned buildings and roadways. The elevations of critical roadways, particularly evacuation routes should be added for further adaption planning.

Achieving community-wide resilience necessitates collaboration with citizens, businesses, organizations, and government entities. It will require a multi-year commitment of resources and active engagement across city departments. The goal is to encourage community involvement and partnerships to enhance resilience in the face of climate change, making the City of Panama City an attractive and resilient place to live, work, and visit for future generations.

Figure 177. Panama City Staff/Leadership with Consultants from Halff
Source: Halff

6. REFERENCES

Fla. Stat. § 163.3167(1)(b)(2) (2015) (“Each local government shall maintain a comprehensive plan”). See also id. § 163.3177(1) (2015) (plans are meant to “provide the principles, guidelines, standards, and strategies for the orderly and balanced future economic, social, physical, environmental, and fiscal development of the area. . .” and to “establish meaningful and predictable standards for the use and development of land and provide meaningful guidelines for the content of more detailed land development and use regulations.”).

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