

RESILIENT PORT ST. JOE

ADAPTATION PLAN

Florida Institute for Built Environment Resilience
Florida Resilient Cities Program

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ADAPTATION PLAN

INTRODUCTION

The Port St. Joe Adaptation Plan addresses the ongoing challenges the community faces from storm flooding, surges, and sea level rise. This strategic initiative aims to mitigate the adverse effects of these environmental stressors through a comprehensive, data-informed approach that prioritizes effective and impactful actions.

The previous Exposure and Sensitivity Analyses have identified specific areas within the town that are particularly vulnerable to flooding. These areas vary significantly in their needs, depending on their geographic location and the type of flooding threat they face. For example, while areas with low elevation grapple with risks associated with storm surges, often exacerbated by tidal influences, higher elevation zones are more concerned with the standing water during storm events.

The Port St. Joe Adaptation Plan presents a spatial framework designed to meet diverse community needs. This framework outlines specific adaptation actions, which vary from localized efforts or home owner actions to larger projects that incorporate multiple strategies. The goal is to mitigate flood impacts while improving the community's spatial quality and fostering new social dynamics.

The development of this plan was greatly informed by the community outreach meetings, where residents highlighted their concerns about specific areas, identified vital assets at risk, and discussed the community values associated with each asset category. This community-focused approach ensured that the proposed adaptation measures were not only an infrastructural response to flood risk but also closely aligned with the values and needs of the community.

The Adaptation Plan is organized in the following structure:

1. *Overarching Themes and Objectives, outline the guiding principles that will direct the adaptation strategies.*
2. *Adaptive Capacities, identify existing technical, planning, and policy elements available to address the adaptation needs.*
3. *Adaptation Needs, define the flood mitigation requirements that will shape the adaptation actions.*
4. *Adaptation Actions, set of measures to protect or mitigate the impacts of flooding followed by a prioritization.*
5. *Spatial Framework, city-wide spatial strategies, and city-wide organization of adaptation actions to address flood risk mitigation.*
6. *Adaptation Project Areas, specific projects that meet the goals of the spatial strategies in the spatial framework. The focus is to, through prototype interventions, address spatial relationships of the adaptation actions at the site scale.*
7. *Implementing the Adaptation Plan, recommendations of policies, and funding necessary and available to facilitate the implementation of the plan.*

The seven zones defined for the Vulnerability Assessment are then characterized by their risk mitigation needs and specific adaptation actions were identified and categorized for each zone by asset category. These actions were prioritized based on feasibility, benefit extent, and implementation timeframe.

The plan concludes with recommendations for policies and funding mechanisms that can support individual and community adaptation measures, ensuring a resilient future for Port St. Joe.

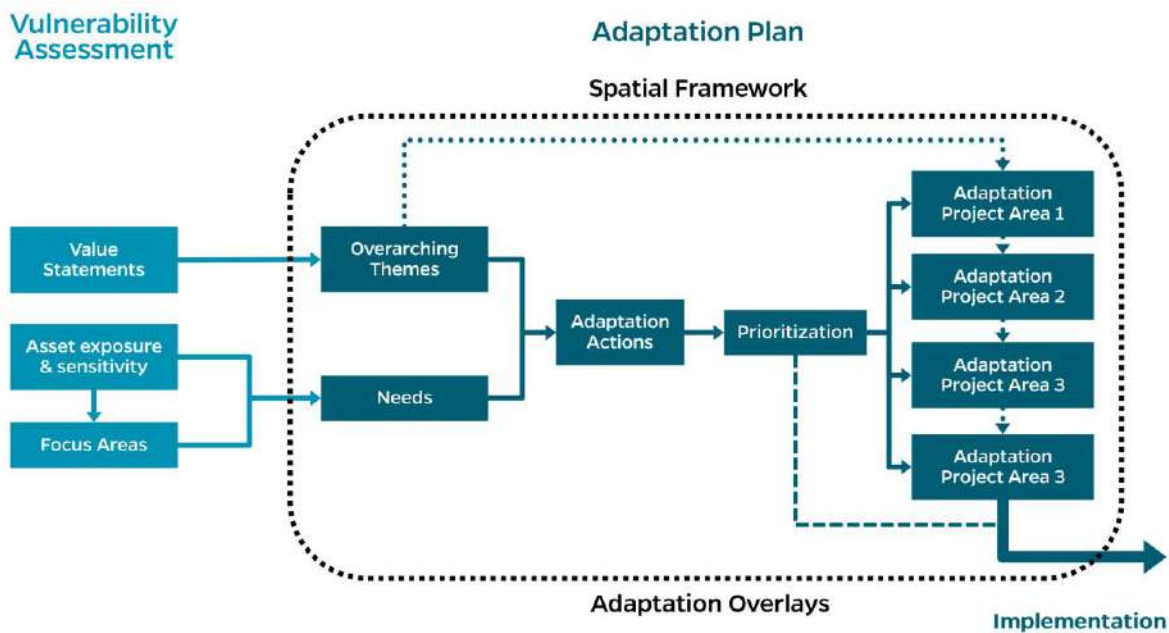


Figure 1. Adaptation Plan structure

OVERARCHING THEMES AND OBJECTIVES

The themes outlined below serve as the guiding principles of the Port St. Joe Adaptation Plan. These themes are the result of the discussions with the community during the outreach meetings, reflecting the core community value for the different asset types of the Vulnerability Assessment. These principles embody the essential characteristics of the local natural and built environment of Port St. Joe and are fundamental in shaping the **adaptation strategies across all the zones** in the city.

These guiding principles helped to determine the most suitable interventions for a base catalog of adaptation actions and define the general parameters of the specific **adaptation project areas**. The primary focus of these efforts is to enhance the community's resilience to flooding while preserving the identity of Port St. Joe.

Theme 1: Port St. Joe's Land Morphology Role in Flood Mitigation.

Approach: Enhance Current Hydrologic Conditions

Port St. Joe's landscape is characterized by distinct topographic strips (ridges and swales) parallel to the coast that dictate the water flow patterns and areas of flood vulnerability. By improving these hydrologic conditions and understanding the mitigation potential of each strip, we can develop more effective responses to future flood risks.

Theme 2: Vulnerability of Main Evacuation Routes to Severe Flooding

Approach: Strengthen the transportation network accessibility for emergency and evacuation through alternative routes.

The primary transportation routes in Port St. Joe, crucial for evacuations and emergency access, are closely connected to the shoreline and, therefore, easily disrupted during severe weather. Our goal is to ensure connectivity of alternative routes for emergency and evacuation roads during severe flood events.

Theme 3: Diversity of Districts in Port St. Joe

Approach: Tailor Adaptation Actions for Diverse Districts

Port St. Joe consists of various districts, each with unique spatial and social characteristics, connectivity, and elevation. These factors differentiate the vulnerabilities, and adaptation needs for each area. Our approach focuses on tailored adaptation strategies to meet the specific needs and attributes of each district.

ADAPTIVE CAPACITIES

REGULATORY AND PLANNING CAPABILITIES

Port St. Joe has undertaken several regulatory and planning efforts to address development and redevelopment challenges in response to increasing flood hazards and rising sea levels. The Coastal Management Element in the Comprehensive Plan is the primary regulatory tool, setting goals for protecting coastal resources and managing high-risk flood areas. In addition to this framework, Port St. Joe has developed a Stormwater Master Plan in 2021 to identify infrastructure deficiencies and improvements to reduce flood risks and enhance stormwater management. Complementary, the city works in collaboration with civic, environmental, and academic organizations to develop strategies to strengthen the resilience of its urban settlement and natural habitats. Below is a summary of the Coastal Management Element and the Stormwater Master Plan, two key components of Port St. Joe's current regulatory and planning capabilities.

Coastal Management Element in the Comprehensive Plan

Within the regulatory and planning capabilities, Port St. Joe has a general regulatory framework; the Coastal Management Element in the Comprehensive Plan has defined goals for protecting coastal resources and addressing future development in relation to flood hazards. The main goals of this element include:

Enforcing Building Codes: The City requires compliance with FEMA regulations for flood zones and coastal high-hazard areas (CHHA), ensuring that any new developments adhere to safety standards before receiving building permits.

Limiting Population Density in CHHA: A critical adaptation strategy is directing population concentrations away from high-risk areas. The City promotes land use plans that prioritize water-dependent uses in the CHHA and restrict developments that might increase vulnerability to flooding.

Protecting Infrastructure: The City embraces infrastructure projects designed to withstand natural disasters like hurricanes and flooding. These projects consider impacts on coastal zones, including emergency evacuation requirements.

Post-Disaster Redevelopment: Following a disaster, the City coordinates with regional and federal agencies to implement redevelopment strategies that reduce future flood risks. This includes relocating or modifying damaged infrastructure and limiting redevelopment in areas that have experienced repetitive losses.

Stormwater Management: The City integrates stormwater discharge permits and wetlands protection into its flood mitigation strategies. This ensures that new developments do not contribute to further environmental degradation or increase flood risks.

Protecting Natural Resources: Restoration and enhancement of degraded natural resources, including coastal wetlands and estuarine environments, are prioritized. This natural buffer helps mitigate the effects of storm surges and flooding.

While these goals focus on future development and protection of natural resources, they must result in visible and tangible changes in development practices. To achieve this, regulatory frameworks like the zone plan should be supported by regulations that enhance flood adaptation and mitigation. This can be accomplished through tiered zoning regulations based on flood risk and adaptive zoning that focuses future development in safer areas while planning for managed retreat. Additionally, urban guidelines for post-disaster redevelopment should be included. As tangible actions of the coastal management policies, a spatial framework for incorporating green infrastructure and flood-resilient standards for critical infrastructure should be developed. Strengthening this alignment will bridge the gap between policy objectives and practical outcomes, enabling more effective flood-resilient development for Port St. Joe.

Port St. Joe Stormwater Masterplan

The **Port St. Joe Stormwater Master Plan**, completed in 2021 by Dewberry Engineering, analyzed the city's seven stormwater basins, identified deficiencies, and provided infrastructure and policy improvement recommendations. The watersheds reviewed include the Bay Basin, Central Channel Basin, Jones Homestead Bay Basin, East Channel Basin, Avenue A Basin, North Channel Basin, and Intracoastal Basin. Three of these basins—Bay Basin, Central Channel Basin, and Jones Homestead Bay Basin—drain into St. Joseph's Bay, while the remaining basins flow northward toward the Intracoastal Waterway.

The Master Plan highlighted several significant issues, including corroded infrastructure, inadequate pipe sizing, incomplete stormwater systems, tidal flooding, lack of maintenance, and stormwater pollution. The Bay Basin, Central Channel Basin, and Avenue A Basin were identified as high-priority areas for improvement. In the Bay Basin, the focus is on addressing localized flooding and improving water quality. The Central Channel Basin requires larger pipes, canal enlargement, and measures to address flooding and water quality. The Avenue A Basin's incomplete system needs better connectivity and routine maintenance.

The suggested solutions include installing baffle boxes to filter pollutants, tidal check valves to manage tidal flooding, and larger pipes or channel expansions to improve stormwater flow. In addition to infrastructure upgrades, the Master Plan suggested adopting a **Modified Critical Duration Design Storm** to replace the standard 25-year, 24-hour storm model for better infrastructure planning and pipe sizing.

Second, the plan recommends that the city implement and enforce **stormwater performance standards** tailored to specific storm events. Finally, the plan advises developing and adopting **minimum maintenance standards**, ensuring the city maintains drainage ditches and swales, while property owners are responsible for maintaining stormwater systems on their land and keeping public systems unobstructed.

ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Port St. Joe, Florida, has limited in-house technical capabilities on sea level rise and flood adaptation. The city's planning department handles floodplain management and provides residents with basic flood information; more advanced tasks—such as resilience planning, flood modeling, and infrastructure design—are typically outsourced to external consultants.

The local government does not have a dedicated team of sea level rise experts, planners, engineers, or specialized GIS and modeling resources. Therefore, the city relies heavily on external support and resources, including state programs and regional experts, which significantly supplement the city's adaptation efforts.

FISCAL CAPACITY

Port St. Joe has a limited fiscal capacity to fund flood and sea level rise adaptation projects compared to larger municipalities. Tax revenues alone are insufficient to support comprehensive adaptation strategies. While the city does collect income from impact fees, none are specifically designated for flood or sea level rise adaptation. This financial limitation makes it difficult to address complex adaptation projects or implement city-wide adaptation strategies.

The city relies heavily on external funding sources for resiliency projects, a mix of local funding, grants, potential loans, and close collaboration with state and federal agencies and regional partners will be necessary to secure funding to fully implement comprehensive resilience strategies.

INFRASTRUCTURE

Port St. Joe has limited flood protection infrastructure. Several sections of the shoreline have reinforcements, but they are mostly related to the uses they host, such as boat ramps, the marina, and the bulkhead at the Port. The stormwater system in Port St. Joe faces several deficiencies that involve incomplete systems, replacing components, and establishing connectivity within the fragmented systems. The central channel is one of the most relevant components for stormwater management; however, its limited capacity could be overpassed by storm surge events.

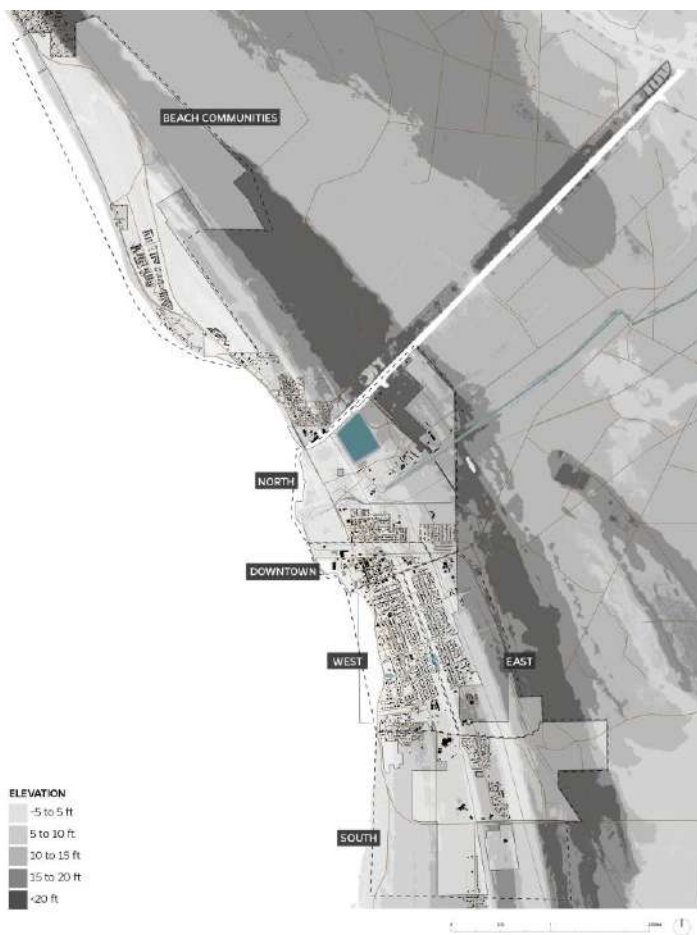
ADAPTATION NEEDS

The prior exposure and sensitivity analysis in the Vulnerability Assessment helped to identify the specific flood mitigation needs that will shape the adaptation actions and projects, which will be detailed further in

the document. The upcoming section details these needs by breaking them down by city zone and asset category.

Zone 1, Downtown

Downtown Port St. Joe is central to the town's identity, hosting the majority of its commercial activities with a smaller residential presence. The primary needs for this area include ensuring accessible alternative evacuation routes and relocating essential community services to higher ground. Additional strategies involve floodproofing buildings in the historic core, elevating utilities, and providing wave attenuation measures that also enhance recreational opportunities. Maintaining the functionality of boat ramps, the marina, and the port after severe flooding is essential to safeguard the local economy. The specific needs are as follows:



- *Maintain functionality of boat ramps following extreme flood events.*
- *Ensure accessible emergency routes in and out of western Downtown for evacuation during severe floods.*
- *Elevate the lift station at Marina Drive and 1st*
- *Survey and elevate hazardous waste locations to prevent contamination of flooding waters.*
- *Floodproof City Hall, buildings at Reid Avenue in the historic core.*
- *Elevate utilities in buildings where structural elevation is not possible.*
- *Implement shoreline interventions to mitigate the impact of storm surges.*

Zone 2, North Port St. Joe

North Port St. Joe is a diverse area characterized by its distinct zones: residential neighborhoods north of Avenue A, retail along Monument Avenue and W Highway 98, and industrial facilities near Industrial Road, including warehouses and fresh and wastewater treatment plants. This area, in general at a higher elevation, is intersected by Chicken House Creek, which

Figure 2. Port St. Joe, zone distribution

causes drainage challenges in the North Port St. Joe neighborhood. Improvements in drainage and water retention are critical; additionally, protecting vital infrastructure, such as lift stations and water treatment plants, from extreme flooding is essential. Specific needs for this zone include:

- *Elevate lift stations along W Highway 98 to protect against flood damage.*

- *Protect the freshwater canal from saltwater intrusion during extreme flood events.*
- *Maintain connectivity of Avenue A to Cecil Costin Blvd during severe floods.*
- *Re-structure Battles St. to increase the capacity of the drainage infrastructure.*
- *Implement drainage and acquire the land with subsidence and ponding problems at the Chicken House Creek covered area*
- *Reinforce dock structures along the canal*
- *Retrofit and relocate homes located on the course of the Chicken House Creek covered area.*

Zone 3, South Port St. Joe

South Port St. Joe is predominantly an elevated area that houses key community facilities, including PSJ High School, Gulf Coast State College, and Sacred Heart Hospital, all vulnerable to hurricanes above Category 3. The Oak Grove neighborhood on the western side is particularly susceptible to storm surge, necessitating building elevation and other protective measures to improve drainage. Specific needs for this area include:

- *Restore local marsh areas to natural conditions to enhance flood mitigation and ecological benefits.*
- *Implement vegetation protection strategies in Zone AE to reduce surge force.*
- *Improve drainage in the Oak Grove neighborhood to prevent water accumulation and flooding.*
- *Elevate homes in the Oak Grove neighborhood to protect against storm surge damage.*

Zone 4, East Port St. Joe

East Port St. Joe, along with the northern area, is one of the higher elevation zones with a moderated flood risk. This area is home to essential Gulf County community services, including the courthouse, jail, emergency management department, and critical infrastructure such as the electrical substation that powers Port St. Joe. Despite their high elevation, these facilities are only vulnerable to extreme flood events, such as hurricanes above Category 3. However, other critical infrastructures in this zone also need attention, including lift stations and key evacuation transportation routes. Specific needs for this area are:

- *Ensure accessible emergency routes in and out of west PSJ for evacuation during severe floods, mainly through 8th, 16th, and 20th St.*
- *Elevate lift stations' electric panels (exact elevations to be confirmed) and ensure that equipment is submersible.*
- *Restore wetland areas and enhance water retention capacity along the east central channel.*
- *Elevate homes north of Marvin Avenue and around Buck Griffin Park.*
- *Implement landscape adaptation strategies on parcels along the east side of the Central Channel to improve flood resilience.*

Zone 5, West Port St. Joe

West PSJ concentrates the highest number of residences in town and is also the lowest elevation area, it hosts most of the recreational areas and important community facilities, such as PSJ Elementary School and Centennial Building. This area requires several actions to protect the existing residences, the wastewater equipment, stormwater effective drainage for storm events, and ensure connectivity to evacuation routes. Specific needs for this zone include:

- *Ensure that emergency routes to and from Garrison Avenue are accessible for evacuation during severe floods.*
- *Elevate lift stations' electric panels (exact elevations to be confirmed) and ensure that equipment is submersible.*
- *Survey and elevate hazardous waste locations to prevent contamination of flooding waters.*
- *Dry-, wet-floodproof Gulf County Sheriff's Office*
- *Increase retention capacity and restore wetland conditions on the west side of the Central Channel.*
- *Restore and enhance the natural conditions of shorelines and parks to improve ecological resilience and flood mitigation.*
- *Improve drainage and parcel water retention zone between Monument Ave. and Central Channel.*
- *Large number of buildings need to be elevated*
- *Floodproof commerce buildings along Monument Ave./Constitution Dr.*
- *Elevate utilities in buildings where structural elevation is not possible.*

Zone 6, Beach Communities

Windmark Beach, designated as Zone 6, is predominantly a residential area still under development. Most of the housing is situated above the base flood elevation (BFE) within the 100-year special flood hazard area, and much of it is protected by the dune along the coast that serves as a surge buffer. However, in the southern part of this zone, residences are directly adjacent to the shoreline, making them and the nearby roads more vulnerable to flooding, particularly affecting evacuation routes heading south. Specific needs for this zone include:

- *Ensure connectivity evacuation routes to the south*
- *Elevate lift stations' electric panels (exact elevations to be confirmed) and ensure that equipment is submersible.*
- *Enhance natural protective measures for public spaces, urban furniture, and buildings to mitigate the impact of surge force.*

Zone 7, Influence Area

Zone 7 includes the areas outside the immediate boundaries of Port St. Joe that contain assets that critically impact the town's functionality. Critical assets include the boat ramp and fire station at White City and the freshwater canal, which is essential for water provision to Port St. Joe. Protection and maintenance of these assets are crucial, especially during extreme flood events. Specific needs for this zone include:

- *Ensure the White City Public Boat Ramp remains operational following extreme flood events.*
- *Protect the freshwater canal from saltwater intrusion during extreme flood events.*
- *Elevate the lift, boost stations' electric panels (exact elevations to be confirmed), and ensure that equipment is submersible.*
- *Floodproof or elevate critical emergency buildings (White City fire station).*

ADAPTATION ACTIONS

The adaptation actions correspond to individual measures to mitigate flood hazards across all the zones. These actions focus on improving drainage patterns, ensuring connectivity, enhancing ecological infrastructure, and protecting homes, businesses, and critical infrastructure. The adaptation actions are the components of the adaptation project areas, these combine several of these actions to not only mitigate flooding but also improve the community's environment, adding new spatial qualities and potentially influencing public life and the local economy.

The actions align with the strategies recommended by the Florida Adaptation Planning Guidebook: Protection, Accommodation, Retreat, and Avoidance, which serve as a framework for the expected outcomes of the adaptation efforts. Informed by FEMA's resources, the plan presents a catalog of potential adaptation actions for each asset category, addresses the specific needs of each zone, and provides a variety of project options to reduce flood risk. This catalog is applied in a list of adaptation actions per zone, following a prioritization to establish a foundation for the adaptation project areas.

Community Adaptation Actions

Asset Category	Adaptation action
Transportation	Road Network
	Reduce flood hazard <i>Increase roadway elevation</i> <i>Embankment creates a dam, ensure flow under it maybe not the best option if it gets often flooded</i>
	Culverts <i>Increase capacity</i> <i>Pipe, box, open bottom box, precast arc, bridged</i> Replace culvert with a bridge <i>Increase ditch capacity</i>
	Bridges <i>Build bridge</i>
	Piers and Boardwalks <i>Retrofit and reinforce structure</i> <i>Protect, replace piles</i>
	Boat ramps <i>Retrofit and reinforce structure</i> <i>Protect, replace piles</i> Reinforce revetments near boat ramp <i>Disperse wave energy protect boarding dock</i>
	Drinking Water System
	Water Intake <i>Elevate or Relocate</i> <i>Pump houses</i>
	Floodproof <i>Flood wall or berm to protect the facility, pumps to redirect water away, check valves</i> Provide redundant systems <i>Backup wiring and controls</i>
	Water Canal Floodproof <i>Berm or levee to protect canals</i>
Critical Infrastructure	

Critical Infrastructure	Booster stations and pumps, power supplies, electrical controls Elevate or Relocate <i>Instrumentation, computers</i> Floodproof <i>Flood barriers outside buildings</i> <i>Flood shields on openings</i> <i>Provide redundant systems</i> <i>Backup wiring and controls</i>
	Wastewater Treatment Systems Wastewater treatment plant Elevate or relocate <i>Elevate process tanks, instrumentation controls</i> Flood proof <i>Barriers, flood shields electrical components in water-resistant closets</i> Backup Systems Lift stations Elevate <i>Control panels, extent vent</i> <i>Lines above design flood elevation</i> Protect or divert <i>Divert away surge using green infrastructure</i> Flood proof <i>Temporary or permanent barriers, fully submersible pumps</i> <i>Components and circuitry in water-resistant cabinets</i> Backup Systems
	Stormwater Network Gray infrastructure <i>upgrade pipes</i> <i>control valves</i> Green Infrastructure <i>Bioswales</i> <i>Stormwater retention areas</i>
	Electric Power Generation, Transmission and Distribution Substations <i>Elevate and Strengthen Systems</i> <i>Elevate control house</i> <i>Floodproof open-air components</i> <i>Floodwall</i>
	Communication towers and antennas Equipment shelter <i>Elevate equipment</i> <i>Elevate equipment shelter. If shelter is not available, mount it on tower above design flood elevation</i>
	Community and Emergency Buildings Structure Relocate building <i>Normally limited to small non-residential buildings, most expensive measure</i> Elevate foundation <i>Open shallow foundations, not slab-on-grade, normally requires foundation reinforcement</i> Convert or abandon first floor <i>Lowest floor should have flood resistant materials,possibility of addition extra floor depends on structural conditions.</i>

	Retrofit structure Anchor <i>Improve resistance to horizontal forces, ground anchors and cross bracing.</i> Upgrade wall and window systems
	Flood proof Wet flood-proof <i>Crawl spaces, allow water enter and exit</i>
	Dry floodproof <i>Seal buildings outside walls, flood shields, seal openings</i> <i>Build a flood wall around building</i> <i>Backflow control valves</i>
Critical Community and Emergency Facilities	Utility Systems HVAC, Electrical, Plumbing Elevate or relocate <i>Elevate compressors, anchored platforms</i> Dry floodproof Wet floodproof Seal or isolate <i>Seal caps for tanks, check valves</i> Secure <i>Tanks, prevent flotation and movement</i>
	Shorelines
	Structural Stabilization Revetments <i>Protect shoreline from erosion</i>
Natural and Cultural Resources	Non-structural Stabilization Living shorelines, marsh and mangrove restoration <i>Protect against erosion</i> <i>Restore ecosystem functions</i> <i>Low maintenance stability</i> <i>Beach nourishment + groin field</i> Beach Nourishment Dune Restoration Revegetation

Individual Adaptation Actions

Asset Category	Adaptation action
Economy and Housing	Housing and economy buildings
	Structure Relocate building <i>Normally limited to small non-residential buildings, most expensive measure</i> Elevate foundation <i>Open shallow foundations, not slab-on-grade, normally requires foundation reinforcement</i> Convert or abandon first floor <i>Lowest floor should have flood resistant materials, possibility of addition extra floor depends on structural conditions.</i>
	Retrofit structure Anchor <i>Improve resistance to horizontal forces, ground anchors and cross bracing.</i> Upgrade wall and window systems

Economy and Housing	Flood proof
	Wet flood-proof
	<i>Crawl spaces, allow water enter and exit</i>
	Dry floodproof
	<i>Seal buildings outside walls, flood shields, seal openings</i>
	<i>Build a flood wall around building</i>
	<i>Backflow control valves</i>
	Landscape
	Stormwater collection
	<i>rain gardens individual rain capture</i>
	Utility Systems
	HVAC, Electrical, Plumbing
	Elevate or relocate
	<i>Elevate compressors, anchored platforms</i>
	Dry floodproof
	Wet floodproof
	Seal or isolate
	<i>Seal caps for tanks, check valves</i>
	Secure
	<i>Tanks, prevent flotation and movement</i>

Table 1. Compilation of Community and Individual Adaptation Actions applicable to Port St. Joe adaptation needs. Source: FEMA, "Hurricane and Flood Mitigation Handbook for Public Facilities," (2022). FEMA, "Building Community Resilience with Nature Based Solutions," (2021).

PRIORITIZATION OF ADAPTATION ACTIONS

The prioritization of adaptation actions is essential for effectively addressing the diverse impacts of flooding on Port St. Joe's critical assets, as identified through the exposure and sensitivity analysis in the Vulnerability Assessment. These effects will manifest differently according to asset type, service levels, and the amount of population affected; therefore, it is crucial to prioritize the adaptation efforts to implement actions more effectively, improving risk management and resilience in the long term.

The proposed prioritization framework is based on a scale that evaluates three key parameters: **benefit extent**, **implementation timeframe**, and **project feasibility**:

- **Benefit extent:** This parameter refers to the spatial extent as a general proxy for the number of residents that would benefit from the proposed action.
- **Implementation timeframe:** This parameter assesses the time period at which an adaptation action can be implemented.
- **Project feasibility:** Evaluated using the FEMA Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) criteria. This parameter incorporates the seven mentioned attributes into a multicriteria analysis to address the feasibility of the implementation of an adaptation action. Each criterion at the same time encompasses several factors, which are assessed in scale based on information from the vulnerability assessment from discussions with the community stakeholders and task force.

We have categorized each parameter into a practical three-tier scale, representing the most favorable (green), moderate (orange), and least favorable (red) conditions for implementing the adaptation actions. In summary, the projects with a stronger influence on the population, more feasible to implement, and in a

short time are all green in the scale, and projects with a local impact, difficult to implement and in the long term will be colored red.

The accompanying table provides the details of each evaluation parameter.

	City	Neighborhood	Block
Action extent	Influence on several districts, overall city	Influence on a district or several blocks	Influence on surrounding parcels or city block
	Short-Term	Mid-Term	Long-Term
Implementation timeframe	1 - 3 year	3 - 5 years	> 5 years
	Favorable	Intermediate	Less favorable
Risk reduction feasibility	The STAPLEE method does not yield a quantitative result, as the number of parameters for each criterion may differ with each adaptation action. Instead, we propose three feasibility levels that reflect an overall interpretation of the results of all criteria.		

Table 2. Parameters and prioritization scale for the implementation of adaptation actions.

ADAPTATION ACTIONS BY ZONE, ASSET CATEGORY AND PRIORITY

The subsequent tables outline a series of adaptation actions organized by zone. Each table categorizes the actions according to asset type and includes the factors for prioritization.

Zone 1 – Downtown Port St. Joe

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Transportation	Street Network	1	Elevate sections Marina Drive. Ensure connectivity Marina Dr. / First St. to Elevate to Garrison Ave. during severe flooding	Neighborhood	long-term	Favorable
		2	Reinforce structure boarding docks marina	City	mid-term	Intermediate
	Boat Ramps	3	Reinforce structure boarding docks boat ramp at 5th street	City	mid-term	Favorable
		4	Retrofit revetments boat ramp on 5th street	City	mid-term	Favorable
Critical Infrastructure	Lift Stations	5	Elevate Lift Station at Marina Drive	Neighborhood	mid-term	Favorable
	Hazardous Waste Locations	6	Elevate hazardous waste container, survey locations and heights	Block	short-term	Intermediate
Critical Community and Emergency Facilities	City Hall	7	Dry floodproof City Hall	Block	short-term	Favorable
	Fire Station	8	Dry floodproof Fire Station	Block	short-term	Favorable
		9	Elevate utilities (buildings that cannot be elevated)	Block	short-term	Favorable
Natural, Cultural and Historical Resources	Port Theater	10	Flood Proof Port Theater	Block	short-term	Favorable
		11	Dry floodproof adjacent blocks to Reid Avenue	Neighborhood	mid-term	Favorable
	Shorelines	12	Marsh Restoration	Neighborhood	mid-term	Favorable
		13	Dune Restoration and Beach Nourishment	Neighborhood	mid-term	Intermediate
		14	Vegetation Buffer	Neighborhood	mid-term	Favorable
Tourism and Economy	Retention Areas	15	Railroad retention Park	City	mid-term	Favorable
	Commerce Buildings	16	Dry floodproof adjacent blocks to Reid Avenue	Neighborhood	mid-term	Favorable
		17	Dry floodproof commerce buildings	Block	short-term	Intermediate
		18	Wet floodproof commerce buildings	Block	short-term	Intermediate
		19	Elevate utilities commerce buildings	Block	short-term	Intermediate
Housing	Houses western side Downtown	20	Provide training for residents on how to apply for funding to floodproof/repair their homes/elevate utilities	City	short-term	Favorable

Zone 2 – North Port St. Joe

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Transportation	Street Network	21	Elevate section Ave A. at Central Channel. Ensure connectivity to Garrison Ave. during severe flooding.	Neighborhood	long-term	Intermediate
	Port	22	Reinforce Bulkhead and improve drainage Port	City	mid-term	Intermediate
Critical Infrastructure	Lift Stations	23	Elevate Lift Stations W Highway 98	Neighborhood	mid-term	Favorable
	Fresh Water Canal	24	Flood protection freshwater canal (levees, storm surge protection)	City	long-term	Favorable
	Stormwater Network	25	Replace underground drainage in Battles St. and bioswale	Neighborhood	mid-term	Favorable
	Hazardous Waste Locations	26	Elevate hazardous waste container, survey locations and heights	Neighborhood	short-term	Favorable
	Wastewater Plant	27	Floodproof buildings (flooded cat.3 and above)	City	long-term	Favorable
Natural, Cultural, and Historical Resources	Retention Areas	28	NPSJ Retention Park	City	mid-term	Favorable
	Green Space	29	Clear covered area Chicken House Creek and pedestrian/bikepath	Neighborhood	long-term	Intermediate
	Historic Structure	30	Dry/Wet floodproof historic structure at Ave. C. Lodge (Club) Building	Block	long-term	Intermediate
Housing	Houses along Battles St and covered section Chicken House Creek	31	Provide training for residents on how to apply for funding to flood proof/repair their homes/elevate utilities	City	short-term	Favorable
		32	Elevate homes surrounding areas Chicken House Creek	Neighborhood	mid-term	Intermediate

Zone 3 – South Port St. Joe

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Critical Infrastructure	Stormwater Network	33	Drainage improvement Oak Grove neighborhood	Block	mid-term	Favorable
Natural, Cultural, and Historical Resources	Shorelines	34	Vegetation Buffer zone AE	Neighborhood	short-term	Favorable
		35	Marsh Restoration	Neighborhood	short-term	Favorable
Housing	Houses Oak Grove	36	Elevate homes	Neighborhood	mid-term	Intermediate

Zone 4 – East Port St. Joe

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Transportation	Street Network	37	Replace bridges, elevate road sections, 8th 16th and 20th St. Ensure connectivity from west zone to Garrison Ave.	City	mid-term	Intermediate
Critical Infrastructure	Lift Stations	38	Elevate lift station control panels, retrofit components	City	short-term	Favorable
Natural, Cultural and Historical Resources	Central Channel	39	Restore wetland along east side	City	mid-term	Favorable
		40	Revetment east side, Marvin Ave (6th-8th ST.) and Buck Griffin Park	City	mid-term	Favorable
Housing	Homes east side Central Channel	41	Provide training for residents on how to apply for funding to floodproof/repair their homes/elevate utilities	City	short-term	Favorable
		42	Elevate homes in flood-prone areas	Neighborhood	mid-term	Favorable
	Parcels surrounding areas Garrison Ave.	43	Rezoning parcels in low vulnerability areas to allow higher density.	City	short-term	Intermediate

Zone 5 – West Port St. Joe

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Transportation	Street Network	44	Elevate road sections, 8th 16th and 20th St. Ensure connectivity from west zone to Garrison Ave.	City	mid-term	Intermediate
Critical Infrastructure	Lift Stations	45	Elevate lift station control panels, retrofit components	Neighborhood	mid-term	Favorable
	Hazardous Waste Locations	46	Elevate hazardous waste container, survey locations and heights	Neighborhood	short-term	Favorable
	Stormwater Network	47	Bioswale Long Ave. (secondary connections)	Neighborhood	long-term	Intermediate
		48	Retention pond 6th St	City	mid-term	Favorable
		49	Retention pond 13th St.	City	mid-term	Favorable
		50	Increase channel, outlet St. Joseph Bay capacity	City	mid-term	Favorable
Critical Community and Emergency Facilities	Government Building	51	Dry-, wet floodproof Gulf County Sheriff's Office	City	mid-term	Intermediate
Natural, Cultural, and Historical Resources	Shorelines	52	Marsh restoration Constitution Dr. shoreline	Neighborhood	mid-term	Favorable
	Central Channel	53	Restore wetland along west side Central Channel	Neighborhood	mid-term	Favorable
		54	Increase capacity channel pipes under Baseball Fields	Neighborhood	mid-term	Intermediate
Housing	Houses area between 10th and 21st St.	55	Home elevation program	Block	short-term	Intermediate
	Houses in Zone 5	56	Parcel rain collection program	Block	short-term	Intermediate
	Commerce Building	57	Dry- wet-floodproof program homes and commerce	Block	short-term	Intermediate

Zone 6 – Beach Communities

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Transportation	Street Network	61	Ensure connectivity evacuation routes to the south	City	long-term	Favorable
Critical Infrastructure	Lift Stations	62	Elevate lift stations' electric panels (exact elevations to be confirmed)	Neighborhood	mid-term	Favorable
Natural, Cultural, and Historical Resources	Beach Accesses	63	Anchor elements, urban furniture, reinforce structures	Neighborhood	short-term	Favorable

Zone 7 – Influence Area

Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Implementation Timeframe	Risk Reduction Feasibility
Transportation	Boat Ramps	61	Reinforce structure boarding docks White City Public Boat Ramp	Region	short-term	Favorable
Critical Infrastructure	Fresh Water Canal	62	Protect the freshwater canal from saltwater intrusion during extreme flood events.	Region	mid-term	Less favorable
	Lift Stations	63	Elevate the lift, boost stations' electric panels (exact elevations to be confirmed)	Neighborhood	mid-term	Less favorable
Critical Community and Emergency Facilities	Fire Station	64	Floodproof or elevate critical buildings (White City fire station?).	Neighborhood	short-term	Less favorable

Table 3. Recommended adaptation actions categorized per Zone, Asset Category, and prioritization parameters

ADAPTATION ACTIONS ORGANIZED BY PRIORITY

Zone N.	Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Risk Reduction Feasibility	Implementation Timeframe
7	Transportation	Boat Ramps	61	Reinforce structure boarding docks White City Public Boat Ramp	Region	Favorable	short-term
1	Transportation	Boat Ramps	3	Reinforce structure boarding docks boat ramp at 5th street	Region	Favorable	mid-term
1	Transportation	Boat Ramps	4	Retrofit revetments boat ramp on 5th street	Region	Favorable	mid-term
1	Natural, Cultural and Historical Resources	Retention Areas	15	Railroad retention Park	City	Favorable	mid-term
2	Natural, Cultural and Historical Resources	Retention Areas	28	NPSJ Retention Park	City	Favorable	mid-term
4	Natural, Cultural and Historical Resources	Central Channel	39	Restore wetland along east side	City	Favorable	mid-term
4	Natural, Cultural and Historical Resources	Central Channel	40	Revetment east side, Marvin Ave (6th-8th ST.) and Buck Griffin Park	City	Favorable	mid-term
5	Critical Infrastructure	Stormwater Network	48	Retention pond 6th St	City	Favorable	mid-term
5	Critical Infrastructure	Stormwater Network	49	Retention pond 13th St.	City	Favorable	mid-term
5	Critical Infrastructure	Stormwater Network	50	Increase channel, outlet St. Joseph Bay capacity	City	Favorable	mid-term
2	Critical Infrastructure	Fresh Water Canal	24	Flood protection freshwater canal (levees, storm surge protection)	Region	Favorable	long-term
2	Critical Infrastructure	Wastewater Plant	27	Floodproof buildings (flooded cat.3 and above)	Region	Favorable	long-term
6	Transportation	Street Network	58	Ensure connectivity evacuation routes to the south	City	Favorable	long-term
4	Critical Infrastructure	Lift Stations	38	Elevate lift station control panels, retrofit components	Neighborhood	Favorable	short-term
2	Critical Infrastructure	Hazardous Waste Locations	26	Elevate hazardous waste containers, survey locations and heights	Neighborhood	Favorable	short-term
3	Natural, Cultural and Historical Resources	Shorelines	34	Vegetation Buffer Zone AE	Neighborhood	Favorable	short-term
3	Natural, Cultural and Historical Resources	Shorelines	35	Marsh Restoration	Neighborhood	Favorable	short-term
5	Critical Infrastructure	Hazardous Waste Locations	46	Elevate hazardous waste containers, survey locations and heights	Neighborhood	Favorable	short-term
6	Natural, Cultural and Historical Resources	Beach Accesses	60	Anchor elements, urban furniture, reinforce structures	Neighborhood	Favorable	short-term
1	Housing	Houses western side Downtown	20	Provide training for residents on how to apply for funding to floodproof/repair their homes/elevate utilities	Block	Favorable	short-term
2	Housing	Houses along Battles St and covered section Chicken House Creek	31	Provide training for residents on how to apply for funding to flood proof/repair their homes/elevate utilities	Block	Favorable	short-term
4	Housing	Homes east side Central Channel	41	Provide training for residents on how to apply for funding to floodproof/repair their homes/elevate utilities	Block	Favorable	short-term
1	Critical Community and Emergency Facilities	City Hall	7	Dry floodproof City Hall	Block	Favorable	short-term
1	Critical Community and Emergency Facilities	Fire Station	8	Dry floodproof Fire Station	Block	Favorable	short-term
1	Critical Community and Emergency Facilities	Community Facilities Bldgs.	9	Elevate utilities (buildings that cannot be elevated)	Block	Favorable	short-term
1	Natural, Cultural and Historical Resources	Port Theater	10	Flood Proof Port Theater	Block	Favorable	short-term

Table 4. Asset Priority Group 1

Zone N.	Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Risk Reduction Feasibility	Implementation Timeframe
4	Housing	Parcels surrounding areas Garrison Ave.	43	Rezoning parcels in low vulnerability areas to allow higher density.	City	Intermediate	short-term
5	Natural, Cultural and Historical Resources	Central Channel	54	Increase capacity channel pipes under Baseball Fields	City	Intermediate	mid-term
1	Transportation	Boat Ramps	2	Reinforce structure boarding docks marina	Region	Intermediate	mid-term
2	Transportation	Port	22	Reinforce Bulkhead and improve drainage Port	Region	Intermediate	mid-term
4	Transportation	Street Network	37	Replace bridges, elevate road sections, 8th 16th and 20th St. Ensure connectivity from west zone to Garrison Ave.	City	Intermediate	mid-term
5	Transportation	Street Network	44	Elevate road sections, 8th 16th and 20th St. Ensure connectivity from west zone to Garrison Ave.	City	Intermediate	mid-term
5	Critical Community and Emergency Facilities	Governemnt Building	51	Dry-, wetfloodproof Gulf County Sheriff's Office	Region	Intermediate	mid-term
7	Critical Infrastructure	Fresh Water Canal	62	Protect the freshwater canal from saltwater intrusion during extreme flood events.	Region	Less favorable	mid-term
1	Critical Infrastructure	Lift Stations	5	Elevate Lift Station at Marina Drive	Neighborhood	Favorable	mid-term
1	Natural, Cultural and Historical Resources	Historic District	11	Dry floodproof adjacent blocks to Reid Avenue	Neighborhood	Favorable	mid-term
1	Natural, Cultural and Historical Resources	Shorelines	12	Marsh Restoration	Neighborhood	Favorable	mid-term
1	Natural, Cultural and Historical Resources	Shorelines	14	Vegetation Buffer	Neighborhood	Favorable	mid-term
1	Tourism and Economy	Commerce Buildings	16	Dry floodproof adjacent blocks to Reid Avenue	Neighborhood	Favorable	mid-term
2	Critical Infrastructure	Lift Stations	23	Elevate Lift Stations W Highway 98	Neighborhood	Favorable	mid-term
2	Critical Infrastructure	Stormwater Network	25	Replace underground drainage in Battles St. and bioswale	Neighborhood	Favorable	mid-term
4	Housing	Homes east side Central Channel	42	Elevate homes in flood-prone areas	Neighborhood	Favorable	mid-term
5	Critical Infrastructure	Lift Stations	45	Elevate lift station control panels, retrofit components	Neighborhood	Favorable	mid-term
5	Natural, Cultural and Historical Resources	Shorelines	52	Marsh restoration Constitution Dr. shoreline	Neighborhood	Favorable	mid-term
5	Natural, Cultural and Historical Resources	Central Channel	53	Restore wetland along west side Central Channel	Neighborhood	Favorable	mid-term
6	Critical Infrastructure	Lift Stations	59	Elevate lift stations' electric panels (exact elevations to be confirmed)	Neighborhood	Favorable	mid-term
1	Transportation	Street Network	1	Elevate sections Marina Drive. Ensure connectivity Marina Dr. / First St. to Elevate to Garrison Ave. during severe flooding	Neighborhood	Favorable	long-term

Table 5. Asset Priority Group 2

Zone N.	Asset Category	Asset Type	N.	Adaptation Action	Asset Influence	Risk Reduction Feasibility	Implementation Timeframe
1	Natural, Cultural and Historical Resources	Shorelines	13	Dune Restoration and Beach Nourishment	Neighborhood	Intermediate	mid-term
2	Housing	Houses along Battles St and covered section Chicken House Creek	32	Elevate homes surrounding areas Chicken House Creek	Neighborhood	Intermediate	mid-term
3	Housing	Houses Oak Grove	36	Elevate homes	Neighborhood	Intermediate	mid-term
2	Transportation	Street Network	21	Elevate section Ave A. at Central Channel. Ensure connectivity to Garrison Ave. during severe flooding.	Neighborhood	Intermediate	long-term

2	Natural, Cultural and Historical Resources	Green Space	29	Clear covered area Chicken House Creek and pedestrian/bikepath	Neighborhood	Intermediate	long-term
5	Critical Infrastructure	Stormwater Network	47	Bioswale Long Ave. (secondary connections)	Neighborhood	Intermediate	long-term
7	Critical Community and Emergency Facilities	Fire Station	64	Floodproof or elevate critical buildings (White City fire station?).	Neighborhood	Less favorable	short-term
3	Critical Infrastructure	Stormwater Network	33	Drainage improvement Oak Grove neighborhood	Block	Favorable	mid-term
1	Critical Infrastructure	Hazardous Waste Locations	6	Elevate hazardous waste container, survey locations and heights	Block	Intermediate	short-term
1	Tourism and Economy	Commerce Buildings	17	Dry floodproof commerce buildings	Block	Intermediate	short-term
1	Tourism and Economy	Commerce Buildings	18	Wet floodproof commerce buildings	Block	Intermediate	short-term
1	Tourism and Economy	Commerce Buildings	19	Elevate utilities commerce buildings	Block	Intermediate	short-term
5	Housing	Houses area between 10th and 21st St.	55	Home elevation program	Block	Intermediate	short-term
5	Housing	Houses in Zone 5	56	Parcel rain collection program	Block	Intermediate	short-term
5	Housing	Commerce Building	57	Dry- wet-floodproof program homes and commerce	Block	Intermediate	short-term
2	Natural, Cultural and Historical Resources	Historic Structure	30	Dry/Wet floodproof historic structure at Ave. C. Lodge (Club) Building	Block	Intermediate	long-term
7	Critical Infrastructure	Lift Stations	63	Elevate the lift, boost stations' electric panels (exact elevations to be confirmed)	Neighborhood	Less favorable	mid-term

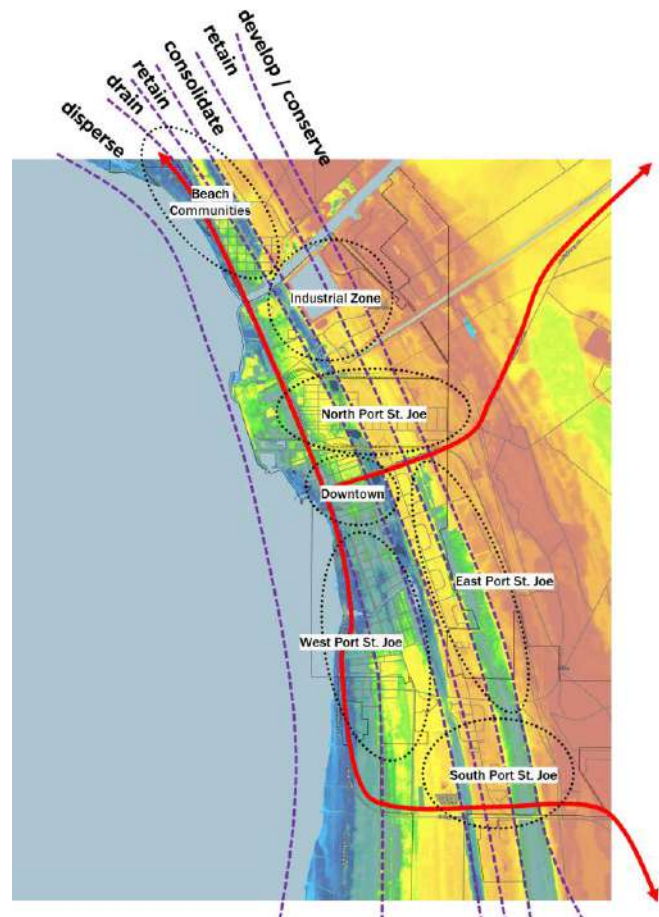
Table 6. Asset Priority Group 3

ADAPTATION PLAN. SPATIAL FRAMEWORK

The spatial framework provides an integrated view of all planned adaptation actions within Port St. Joe city limits. The plan presents the adaptation actions categorized into structural and non-structural types, displaying their spatial relationships, extents, and flood scenarios influencing their design parameters.

Port St. Joe's topography is characterized by bands running parallel to the coastline at different elevations. These bands consist of a sequence of ridges and low areas that work as large swales, where the elevation differences dictate flood vulnerability levels and flood patterns, affecting how quickly floodwaters recede after a storm.

To address the unique characteristics of each band, the Port St. Joe Adaptation Plan organizes them into zones, each with a specific role in reducing the city's overall flood vulnerability. These zones are defined based on proximity to the shoreline, elevation, and hydrologic features. By analyzing the hydrologic behavior and potential adaptation function of each band, the plan establishes the following zones:



- Disperse Zone
- Drain Zone
- Retain Zone
- Consolidate Zone
- Develop/Conserve Zone
- Special Conditions Zone

Figure 3. functional bands according to topographic and hydrologic characteristics

This spatial framework translates the "Description of Needs" into targeted adaptation strategies and actionable projects for each zone. By tailoring solutions to the city's unique topographic and hydrologic characteristics, the framework aims to enhance the flood and stormwater management capabilities of the whole system and ensures an effective and locally responsive approach to flood adaptation.

DESCRIPTION OF ADAPTATION ACTIONS PER ZONE

Disperse Zone

This zone includes all the areas connected to the shoreline. The focus of this zone is to disperse storm surge forces, helping to minimize the impact of coastal flooding. The Disperse Zone is critical in Port St. Joe's Adaptation Plan as it is the first line of defense against storm surge. By incorporating multiple layers of natural and engineered protections, the zone aims to dissipate storm energy before it reaches inland areas.

Below is a description of each protection layer and how it contributes to flood mitigation:

- **Marsh restoration**

Marshes serve as natural buffers, absorbing and reducing the energy of waves and storm surge. During storm events, the dense vegetation in marshes increases friction, which slows down the water flow and reduces the height and power of incoming surges. This buffering effect can significantly decrease the intensity of storm surges, protecting inland areas from severe flooding and storm damage.¹

The adaptation plan proposes to enhance the marsh areas at critical locations in the shorefront of the historical part of the Downtown at Lighthouse, Frank Pate Park, and along Monument Ave. and Constitution Drive, extending to the area near the Madison St. intersection.

- **Beach nourishment**



Figure 4. Disperse zone scheme, several layers of surge protection.

¹ Möller, I., Kudella, M., Rupprecht, F. et al. Wave attenuation over coastal salt marshes under storm surge conditions. *Nature Geosci* 7, 727-731 (2014). <https://doi.org/10.1038/ngeo2251>

Beach nourishment will add sand to the eroded beach in Port St. Joe, specifically at Lighthouse Park, restoring its original width and elevation. This is essential to enhance the disperse zone, absorbing wave energy before it reaches the dunes or upland areas. Additionally, the recovered beach will boost tourism and the local economy.

- ***Dune restoration***

Dune restoration is a complementary measure to beach nourishment to disperse surge force; dunes act as natural levees against high waves, significantly reducing the impact of surge forces and high tides on inland areas².

Port St. Joe's shoreline width at Downtown, Lighthouse Park, and Shipyard Cove/Maddox Park has been substantially reduced due to erosion influenced by adjacent uses at its north side, including the former paper mill and the current marina.

- ***Vegetation buffer, mix low and mid-height vegetation***

Incorporating a mix of low and mid-height vegetation helps reduce wave energy and regulate shoreline erosion, preventing the loss of land during storms. The root structures of coastal forest vegetation also provide soil retention, which helps stabilize the land and prevent erosion³. Beyond storm surge protection, diverse plant species support a wider range of wildlife and enhance the spatial quality of the shorelines.⁴

The adaptation plan suggests conducting efforts to revegetate the areas adjacent all along the shoreline, especially in the areas within the Coastal High Hazard Area.

- ***Vegetation buffer, high vegetation***

High vegetation can serve as natural windbreaks that diminish the force of storm winds. The canopies also play a crucial role in intercepting rainwater, which helps reduce the runoff volume. However, in the event of hurricanes, trees may become hazardous; they can break, uproot, or lose large branches, posing significant risks to safety and property. Planting wind-resistant tree species in buffer zones is essential to mitigate these threats while keeping the protective benefits of vegetation.

The adaptation plan suggests revegetating the large open areas on the west side of Monument Avenue at Downtown and at the northern area formerly occupied by the paper mill. By planting wind-resistant species in these locations, the buffer layer aims to establish a complementary natural barrier against storm winds, support stormwater management, and enhance the overall environmental quality of the area.

Drain Zone

The Drain Zone is situated in the low-lying areas between the Central Channel and Monument Avenue, extending from the residential area of North Port St. Joe to the northern edge of the Constitution Convention Museum State Park. Due to its low elevation, this zone is particularly vulnerable to storm

² U.S. Army Corps of Engineers (2013) Coastal Risk Reduction and Resilience, US Army Corps of Engineers Civil Works Directorate: Washington, DC

³ U.S. Army Corps of Engineers (2013) Coastal Risk Reduction and Resilience, US Army Corps of Engineers Civil Works Directorate: Washington, DC

⁴ Duryea, M. Kampf, E. (2021). Wind and trees: Lessons learned from hurricanes. University of Florida IFAS Extension. <https://edis.ifas.ufl.edu/publication/FR173>

surge flooding. Additionally, the minimal slope in the area contributes to potential ponding and localized flooding caused by rainfall.

The adaptation strategy for this zone addresses managing capacity and enhancing drainage at the individual and community scales.

- **Individual Scale.** *Local stormwater collection.*

Stormwater collection strategies to temporarily hold the excess and slowly release it into the stormwater system, preventing surface flooding. A Stormwater Collection Program should incentivize homeowners to adopt rainwater harvesting systems and other stormwater management solutions. The program should offer clear guidelines, educational campaigns, incentives, and training for proper installation and maintenance. It is recommended that the entire residential area in the Drain Zone adopt local stormwater collection systems to support the efficiency of the stormwater system and prevent standing water, especially surrounding areas of Long Avenue and 16th Street.

- **Community Scale.** *Bioswales to enhance the existing stormwater network*

Integrating bioswales to complement the existing stormwater network can significantly improve drainage capacity while filtering pollutants and improving water quality. By managing peak flows during heavy rains, bioswales can reduce stress on the other parts of the stormwater system. They are cost-effective, low-maintenance, support biodiversity, and provide environmental quality to the neighborhood.

The adaptation plan suggests implementing bioswales on the streets that currently have outlets to St. Joseph Bay and the Central Channel, aiming to increase the surface drainage capacity. This measure will also reduce the flow rate, lowering the risk of overloading the Central Channel and the outlet canal to Saint Joseph Bay in severe weather.



Figure 5. Drain zone scheme, bioswale network and local stormwater collection.



Retain Zone

The **Retain Zone** involves the adjacent areas of Central Channel, Chicken House Creek, and Depot Creek. This zone plays a critical role in the city-wide stormwater system by enhancing the water retention that will influence other zones. The primary goal is to increase the zone's ability to retain stormwater during severe weather.

Figure 6. Retain zone scheme, sequence of retention ponds and overall retention zone.

The adaptation plan proposes the construction of a sequence of **retention ponds** in the Central Channel and Chicken House Creek areas. These ponds will capture and hold excess stormwater, allowing it to gradually infiltrate or be released controlled, reducing the risk of downstream flooding at the outlet canal to St. Joseph Bay.

Complementary, by restoring the original wetlands and consolidating the western edge of the Forest Park to define a levee, the strategy aims to enlarge the retention capacity for extraordinary flood events, also protecting the adjacent neighborhood on the west side of Central Channel

This restoration effort aims to transform the zone into a flood management infrastructure while enhancing its recreational qualities and ecological value. Further details on specific adaptation actions will be outlined in the "Adaptation Action Areas" section of the report.

Consolidate zone

The Consolidate Zone involves the high-elevation areas between Central Channel / Chicken House Creek and Depot Creek. This zone has a strategic role in the adaptation plan because it has advantageous conditions to support future city growth.

Due to its favorable elevation and safe connectivity to evacuation routes, the Consolidate Zone is ideal for expanding building capacity. Therefore, it is necessary to develop upzoning strategies to address the increase in residential density.

However, it is also recommended to integrate water retention strategies, such as rainwater collection and permeable surfaces, to ensure that future growth does not provide excessive to stress to the Central Channel and Depot Creek.

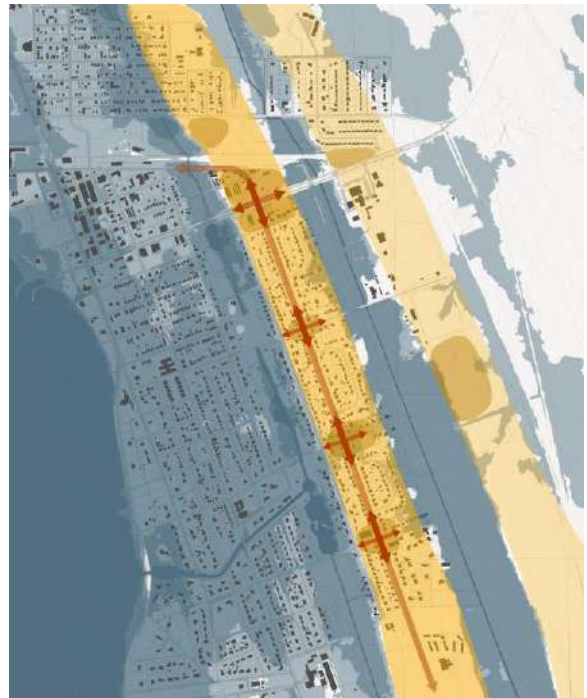


Figure 7. Consolidate zone scheme, areas suitable to increase building capacity.

Special Conditions Zone

The Special Conditions Zone includes the large industrial areas north of the freshwater canal. This zone has experienced significant changes in both topography and hydrology due to the presence of industrial infrastructure. Given the special use of the area, the adaptation plan does not assign a particular environmental focus to this zone.

However, the city may consider and approve using **hard armoring**, such as bulkheads and levees, to protect industrial and other critical infrastructure. These measures are intended to provide robust

protection against storm surge and flooding, ensuring the continued functionality of essential services like the fresh and wastewater plant or the freshwater canal.

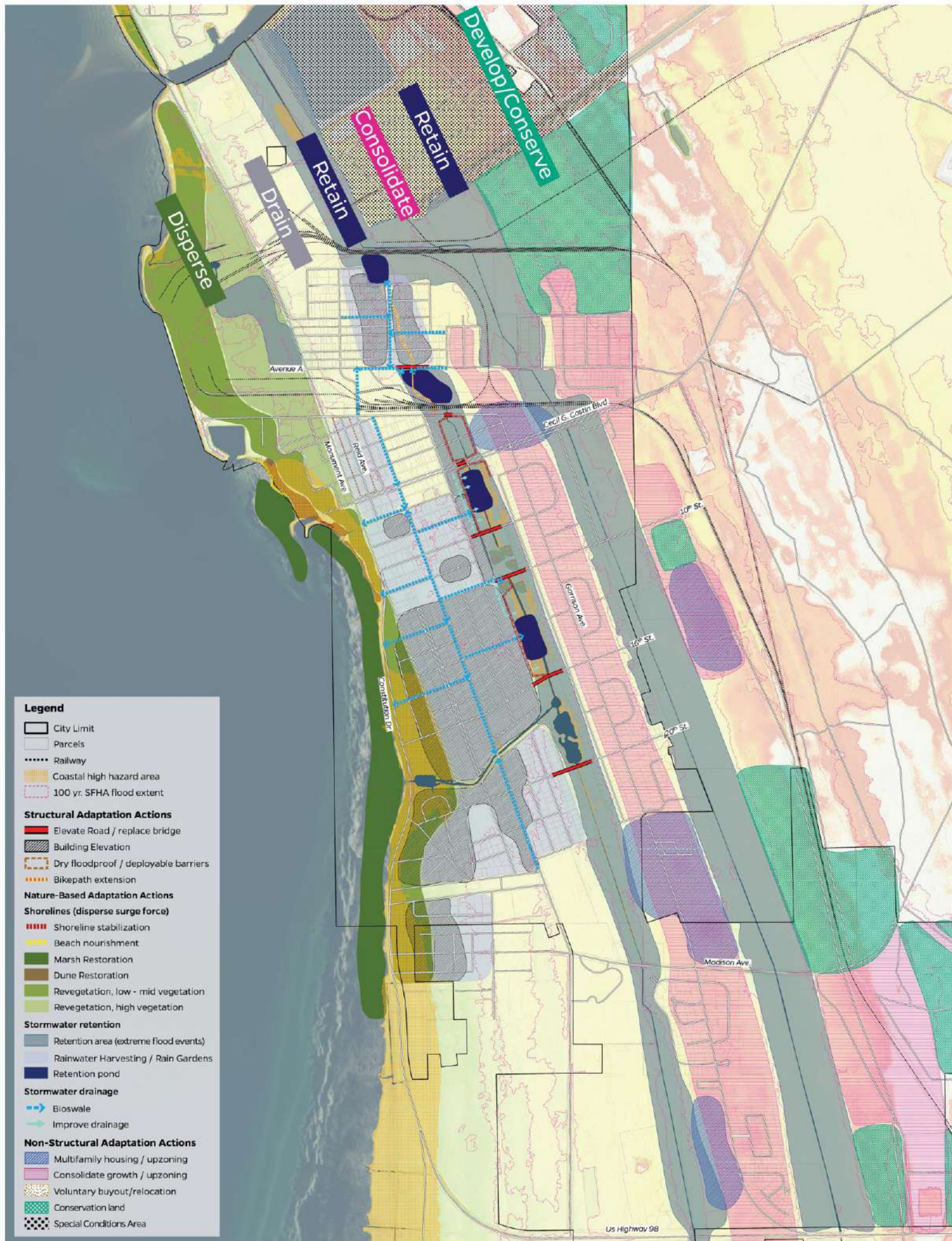
Develop / Conserve Zone

The Develop / Conserve Zone includes wetlands and forested lands on the eastern side of Depot Creek. The zone is designated for future development with a strong emphasis on supporting land conservation efforts and preserving the natural functions of the ecosystem.

To balance development with environmental conservation, it is recommended that the city modifies the future land use and zoning designations for areas outside of the wetlands and floodplains within this zone. Some of the essential development conditions should include:

Increasing Allowable Building Heights: By permitting multistory buildings, the city should aim to accommodate the required density or intensity of future growth reducing its footprint, limiting the impact on ecologically sensitive areas.

Raising Minimum Pervious Surface Requirements: Future development should include a higher percentage of pervious surfaces to contribute positively to the natural water cycle and minimize adverse impacts on surrounding ecosystems.



Port St. Joe Adaptation Plan Spatial Framework

ADAPTATION PROJECT AREAS

The Adaptation Plan defines specific project areas within the spatial framework to address the unique needs of each zone. These projects serve as practical prototypes, providing solutions that can be replicated in similar contexts throughout the zone, ensuring that adaptation efforts are both effective and scalable.

Below is an overview of each adaptation project, including its location and focus:

- **Project 1: Disperse Zone** — *George Core Park and Historic Core*: Focus on storm surge protection.
- **Project 2: Retain Zone** — *Central Channel*: Increase retention capacity and restore wetlands.
- **Project 3: Drain Zone** — *Battles Street*: Enhance surface drainage and create open space.
- **Project 4: Consolidate Zone** — *Civic Center*: Housing development and urban redevelopment.

PROJECT 1: DISPERSE ZONE, GEORGE CORE PARK AND HISTORIC CORE

The Storm Surge Protection Layers

Project 1 focuses on creating a protection buffer to mitigate the impact of storm surge on inland areas. By integrating natural and engineered measures, project 1 seeks to protect vulnerable locations particularly focusing on the Historic Core.

Natural protection layers

The protective layers primarily consist of natural enhancements. These include restoring the land and topographic conditions of shorelines affected by the past activities of the papermill and the current marina, as well as using vegetation to reduce water speed at ground level and wind speed at higher elevations. The natural protection layers include:

- **Marsh Restoration**: *Enhancing marsh conditions along the shorelines of George Core Park and Shipyard Cove/Maddox Park to reduce the speed of incoming surge water. This intervention serves as the first layer of protection.*
- **Beach Nourishment**: *Restoring the original beach width at Lighthouse Park to absorb wave energy. The beach at George Core Park has eroded over the last century due to adjacent uses in the north, reducing its effectiveness as a protective barrier(Figure.8). Project 1 proposes widening the beach, particularly in the section in front of the retention pond at the park.*
- **Dune Restoration and Revetment Retrofit**: *Although the current shoreline conditions of the park lack dunes, there is a transition space between the beach and the park with low vegetation that can be enhanced. Project 1 proposes creating a dune layer with native vegetation to complement the widened beach. This measure will help stabilize the shoreline and provide a natural barrier against storm surges. Additionally, due to the future sea level rise, tidal flooding may impact the parking area of the public boat ramp on 5th Street. Therefore, in the long term, it is recommended to retrofit the revetment on the south side of the boat ramp, extend it to the parking area, and elevate the parking level.*

- **Integration of low vegetation and deciduous trees:** Incorporating a mix of low and mid-height vegetation will help reduce wave energy and control shoreline erosion, preventing land loss during storms. Project 1 proposes incorporating this vegetation throughout George Core Park, specifically on the west side of Miss Zola's Drive and in Shipyard Cove/Maddox Park. This measure also aims to restore vegetation that has significantly decreased since the 1950s.
- **High vegetation windbreak layer:** Planting tall trees and other high vegetation grouped in strategic locations, away from buildings, will create natural windbreaks to protect the downtown area from strong winds during storms. Project 1 proposes revegetating the large open areas on the western side of Monument Avenue, which will also enhance the environmental quality of the area.

Engineered Flood Protection Layer

- **Dry floodproof Reid Avenue at the Historic Core:** Deployable flood barriers are recommended as an engineered solution to protect the surrounding blocks of Reid Avenue from potential flood damage. These barriers can effectively reduce flood risks for slab-on-grade buildings during moderate storm events, such as Category 2 hurricanes and 100-year flood events. However, this measure is not suitable for more severe hurricanes, with flood depths exceeding 4 feet and increased water velocity.

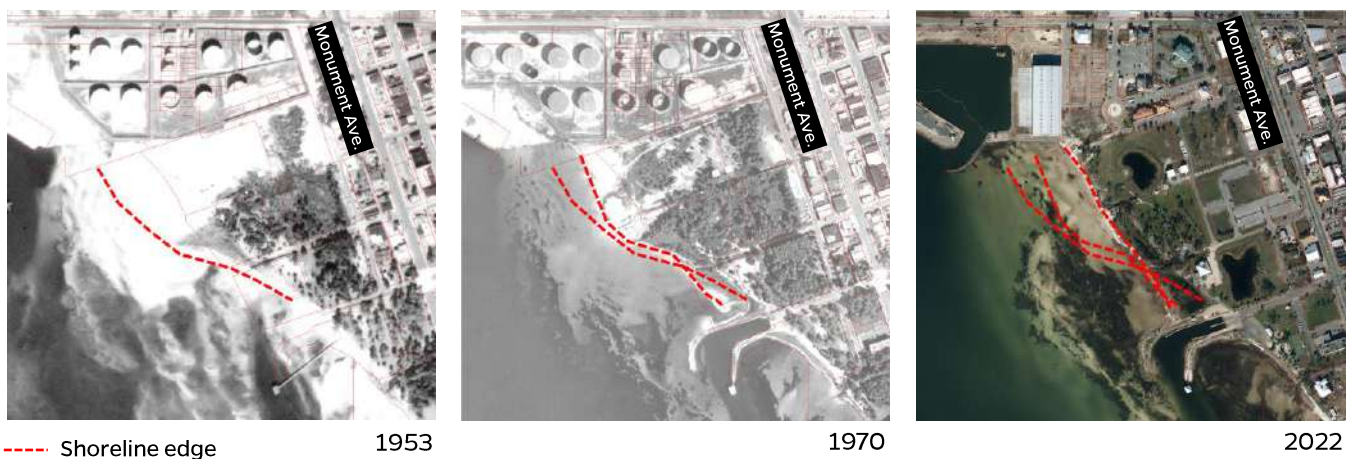


Figure 8. George Core Park, Aerial images from 1953 to 2022, changes on shoreline edge and vegetation cover.

Disperse Zone

George Core Park and Historic Core



Figure 9. Adaptation Project Area 1: Disperse Zone, George Core Park and Historic Core. Siteplan.





Figure 10. Adaptation Project Area 1: Disperse Zone, George Core Park and Historic Core. Schematic Visualization Interventions.

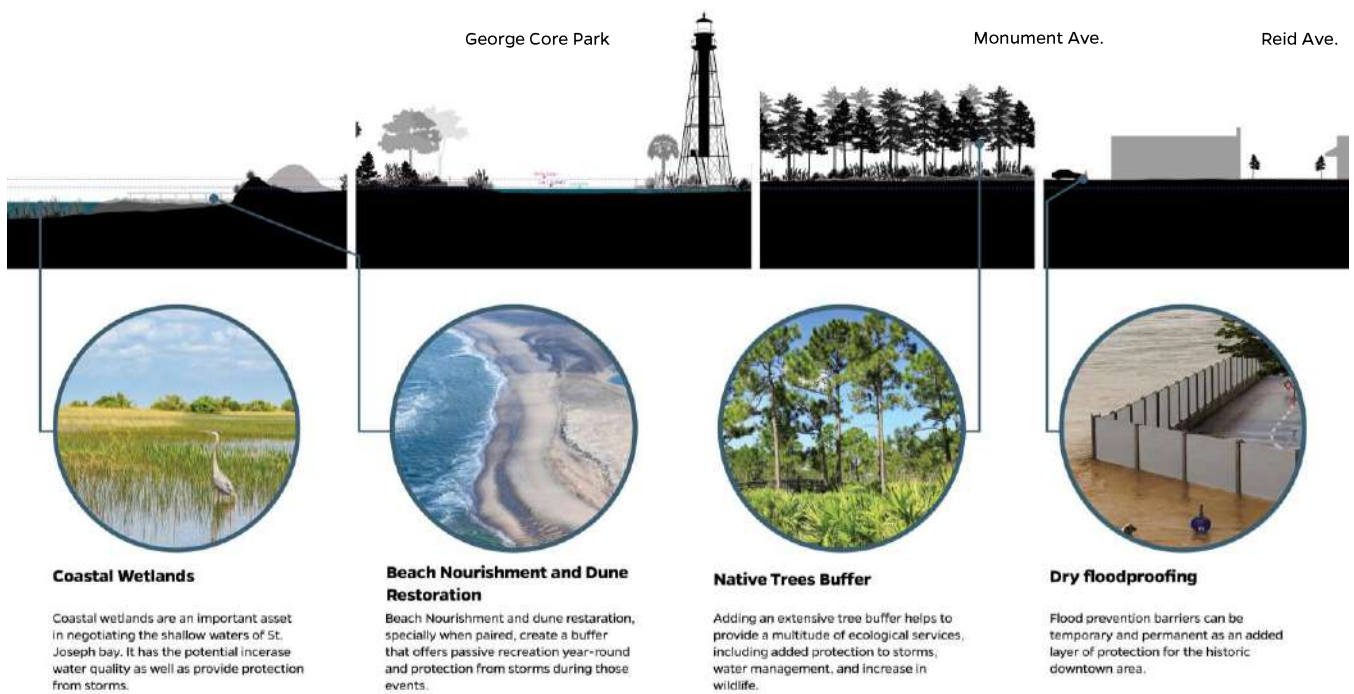


Figure 11. Adaptation Project Area 1: Disperse Zone, George Core Park and Historic Core. Section Protection Layers

PROJECT 2: RETAIN ZONE, CENTRAL CHANNEL

The Central Channel is a vital component of the stormwater management system in Port St. Joe, acting as the primary element of the Central Channel Basin. Originally a highly vegetated wetland, this area is part of ridges and swales topography structure; now, it is surrounded by the highest concentration of residences in the town. As the town expanded (Figure.13), the wetland was channelized, and further modifications, such as the construction of baseball fields, significantly diminished its retention capacity. Additionally, the use of culverts for road crossings has restricted the channel's drainage efficiency. These changes have led to increased flood risks, particularly overflow to residences in the western area of the channel.

The project of the central channel, as part of the retention zone, involves four primary actions: increase retention capacity, restore environmental qualities, retrofit transportation infrastructure across the channel, and improve drainage of the adjacent parcels.

Increase retention capacity

The retention function of the central channel will address two possible flood conditions: recurrent storm conditions through the retention ponds and extraordinary flood events such as hurricanes converting the whole width of the Forest Park into a retention area. To accomplish this function, the project proposes the following actions:

- ***Creation of retention ponds at 13th Street.*** This measure is proposed to enhance the retention capacity of the area in regular storms during peak flows and hold sediments to support the improvement of water quality. The ponds are part of a larger network across the retention zone, and their capacity should be designed based on a complementary study.
- ***Bike path level consolidation and drainage improvement.*** The bike path along Forest Park's western edge currently has uneven elevations, with higher sections diverting water into lower areas, causing flooding in adjacent residential parcels. Additionally, the lower section of the bike path works as a levee that hinders the stormwater drain from the residential parcels back to the Central Channel. The project proposes leveling the bike path to a consistent elevation, using the highest existing level as a reference and following the slope grade of the Central Channel. This adjustment will prevent increased flood vulnerability in low-lying areas of the path and transform the entire stretch of Forest Park, from 10th Street to 16th Street, into a retention area, helping to mitigate the impacts of severe storms on nearby residential areas on the western side of the Central Channel.

Restore environmental quality

Since the mid-20th century, the development of Port St. Joe has transformed the Central Channel from a forested wetland into an urban park, significantly altering its ecosystem. The project aims to restore the area's natural conditions while maintaining its current function. The proposed actions include wetland restoration and enhancing passive recreation opportunities.

- ***Wetland Restoration.*** This adaptation action involves assessing water quality, conducting a vegetation survey, and restoring the wetland to improve water filtration, reestablish native vegetation, and create habitats for wildlife. This measure should also support increasing the retention capacity of the channel.

- **Enhancing Passive Recreation Activities.** The restored natural areas will include features that enhance passive recreation, such as natural trails, boardwalks, and potentially a pedestrian bridge to connect 13th Street on both sides of the park. Additional amenities should include diverse seating areas and opportunities for closer access to the water.

Retrofit transportation infrastructure across the channel

The retrofit of transportation infrastructure aims to ensure the connectivity between the western area of the Central Channel to Garrison Avenue during severe storms. This action involves elevating the sections of the 10th and 16th streets. Currently, 10th Street is at a lower level than 16th Street, which is downstream and, with the bike path, creates ponding on the adjacent parcels. Adjusting the elevations of these three elements in conjunction will help consolidate this section of the Forest Park as a retention area and ensure connectivity during severe flooding to the evacuation routes on the east.

Elevate homes on the west side of Central Channel and improve local drainage

The western side of the Central Channel involves many homes that need to be elevated, and some parcels experience ponding due to the bike path that acts as a levee. A coordinated community support program is recommended to provide financial assistance, technical guidance, and streamlined permitting for homeowners looking to elevate their properties. Additionally, improving drainage in the parcels adjacent to the bike path at 10th and 16th Streets is essential. Drainage infrastructure should be installed at the edge of these parcels and beneath the bike path to drain the stormwater to the channel and prevent ponding, along with check valves to stop potential backflow on severe flooding.



Figure 12. Central Channel, Forest Park, Aerial images from 1953 to 2022, changes on vegetation cover.

Retain Zone

Central Channel Retention Park



Figure 13. Adaptation Project Area 2: Retain Zone, Central Channel / Forest Park. Siteplan.

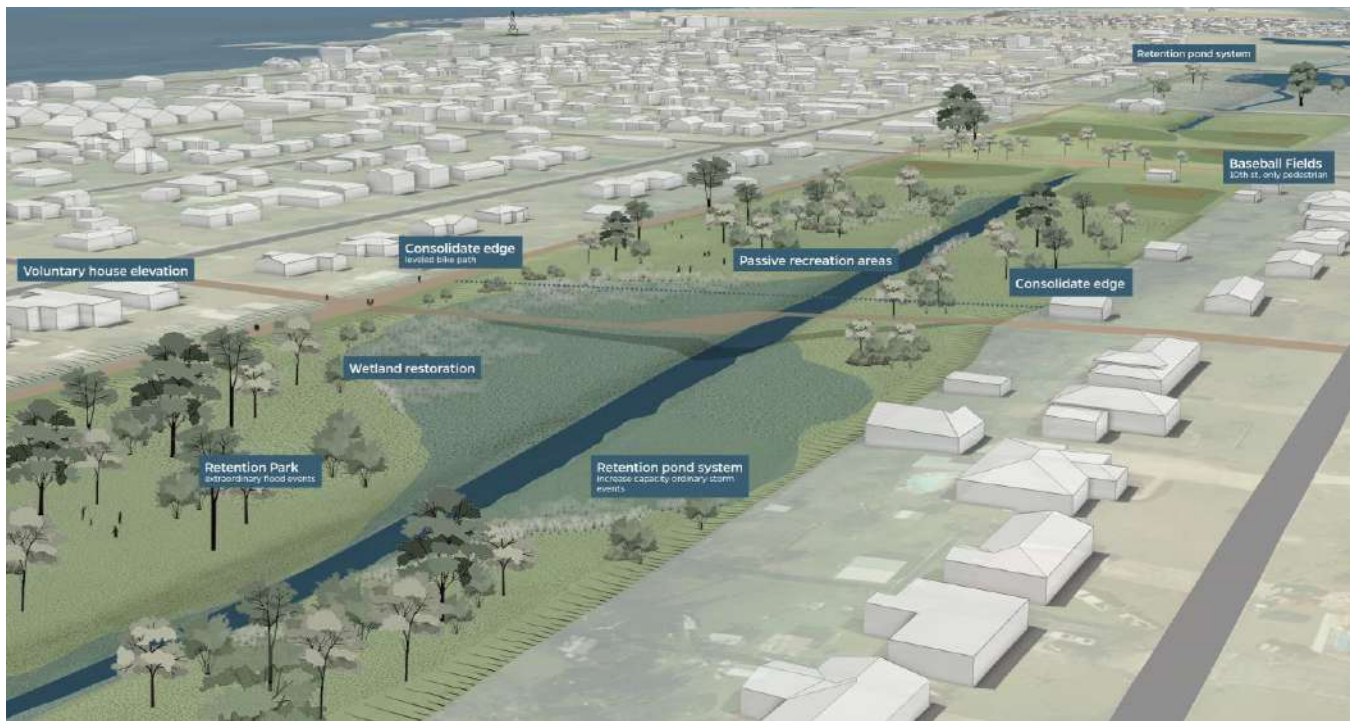


Figure 12. Adaptation Project Area 2: Retain Zone, Central Channel / Forest Park, Schematic Visualization Interventions



Figure 15. Adaptation Project Area 2: Retain Zone, Central Channel / Forest Park, Section.

PROJECT 3: DRAIN ZONE, BATTLES STREET

Despite its favorable elevation, the Battles Street area has faced persistent challenges from its urbanization process. Historically, wetlands in this area were filled and developed, disrupting the natural hydrologic patterns (Figure. . Over time, these alterations have created the ongoing issues with stormwater management, surface water ponding, and building subsidence, particularly on the western side of the covered portion of Chicken House Creek.

The area's low topographic slope and inadequate drainage exacerbate these problems, making it critical to increase the drainage capacity at the neighborhood scale while supporting individual retention strategies. The project for this area proposes enhancing the surface drainage network, clearing the subsidence areas along the creek, and enhancing natural conditions and public space qualities for the cleared area.

Improve drainage and enhance surface drainage network

This component focuses on reshaping the stormwater infrastructure along Battles Street and incorporating natural features to enhance environmental quality. The planned actions include:

- **Bioswale:** *A bioswale along Battles Street will increase the system capacity to collect surface stormwater from adjacent parcels and streets and redirect it to Chicken House Creek. The proposed location is on the east side of the Street, as the current stormwater network is on that side, and there are no conflicts with existing buildings or secondary pipe connections. The exact dimensions and necessary excavations for the swale will need to be confirmed in a detailed study. However, the proposal aligns with the Central Channel Stormwater Masterplan.*
- **Street planting:** *On the west side of Battles Street, the project proposes tree planting to enhance the area's environmental quality. Tree planting will provide shade, improve air quality, and increase stormwater retention capacity.*

Clearing Parcels in Subsidence Area

Due to the landfill that covered Chicken House Creek, several parcels in this area have experienced subsidence, leading to ponding and severe damage to buildings. The project for Battles Street includes clearing the affected area and restoring its natural environment.

- **Voluntary Buyouts of Parcels in Subsidence Areas.** *It is recommended that the city conduct an additional study to define a detailed perimeter of areas affected by subsidence and drainage issues and plan a land acquisition initiative for the vacant parcels and parcels with damaged or abandoned buildings in the subsidence area. This action will ensure that these areas will not be developed and assign them to uses that can benefit the community.*
- **Restore Environmental Conditions and Community Uses on Cleared Areas.** *It is recommended environmental restoration for the cleared areas; it should include planting vegetation strategies to increase water, stabilize and help to clean the soil. These cleared areas should also be repurposed for community uses, such as community gardens or recreational spaces.*

Increase retention capacity.

- **Individual Stormwater Collection Strategies.** *It is recommended that the parcels on both sides of Battles Street participate in the Stormwater Collection Program to incentivize homeowners to adopt rainwater harvesting systems and other stormwater management solutions.*
- **Retention Parks.** *The project includes the creation of two significant retention areas located at each end of Battles Street: the Railroad Retention Park, south of Avenue A, and the Wetland Retention Park, north of Avenue F. While these retention areas lie outside the Avenue A basin, where Battles Street is situated, they can help mitigate upstream flooding in a storm surge. Additionally, the Railroad Retention Park can alleviate stress on the Central Channel during extreme flood events, enhancing the overall capacity of the system .*

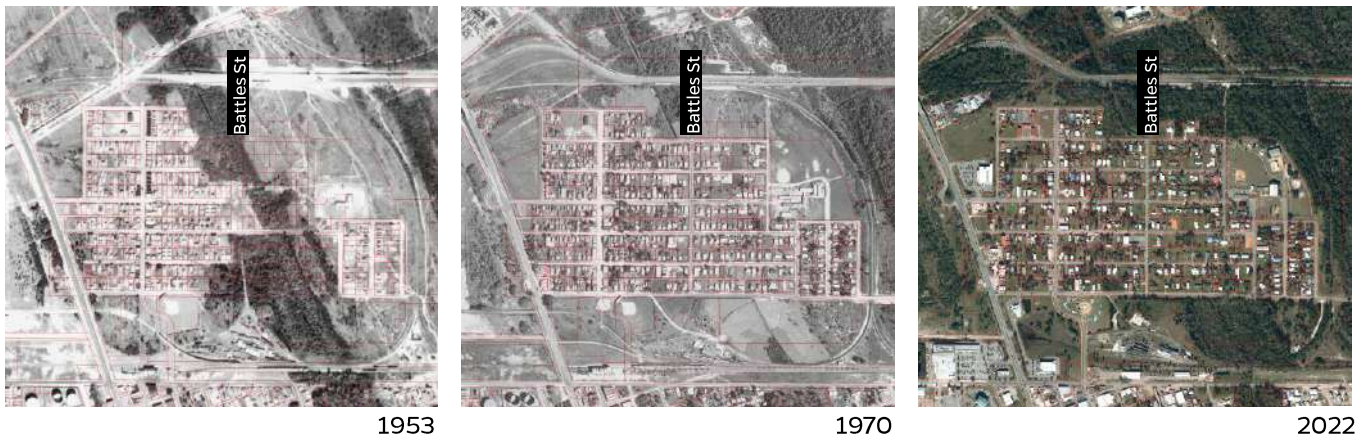


Figure 16. Battles Street, Aerial images from 1953 to 2022, changes in the wetland areas and vegetation cover.

Drain Zone

Battles St. Bioswale, Bikepath and Urban Agriculture

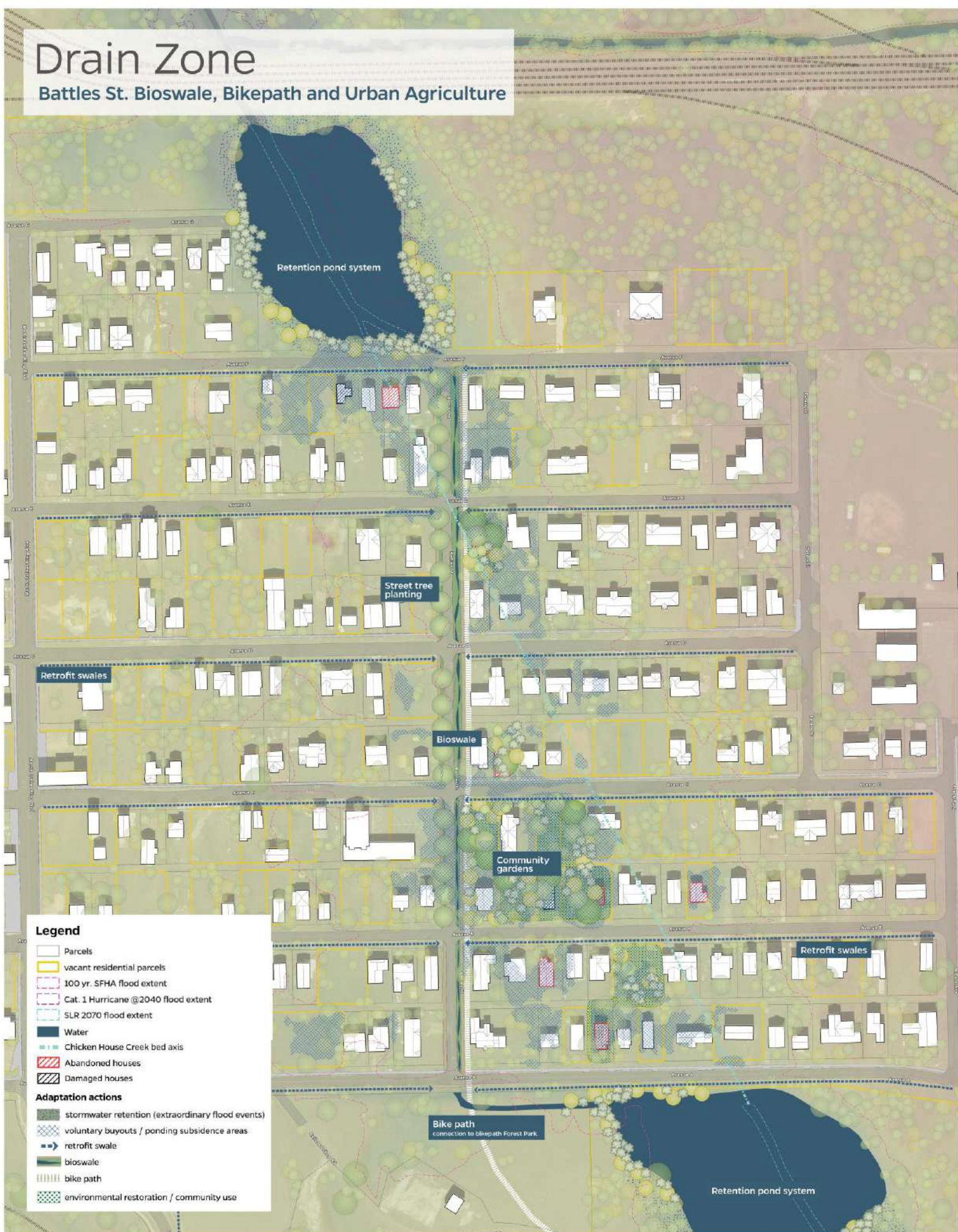


Figure 14. Adaptation Project Area 3: Drain Zone, Battles Street, Siteplan Interventions

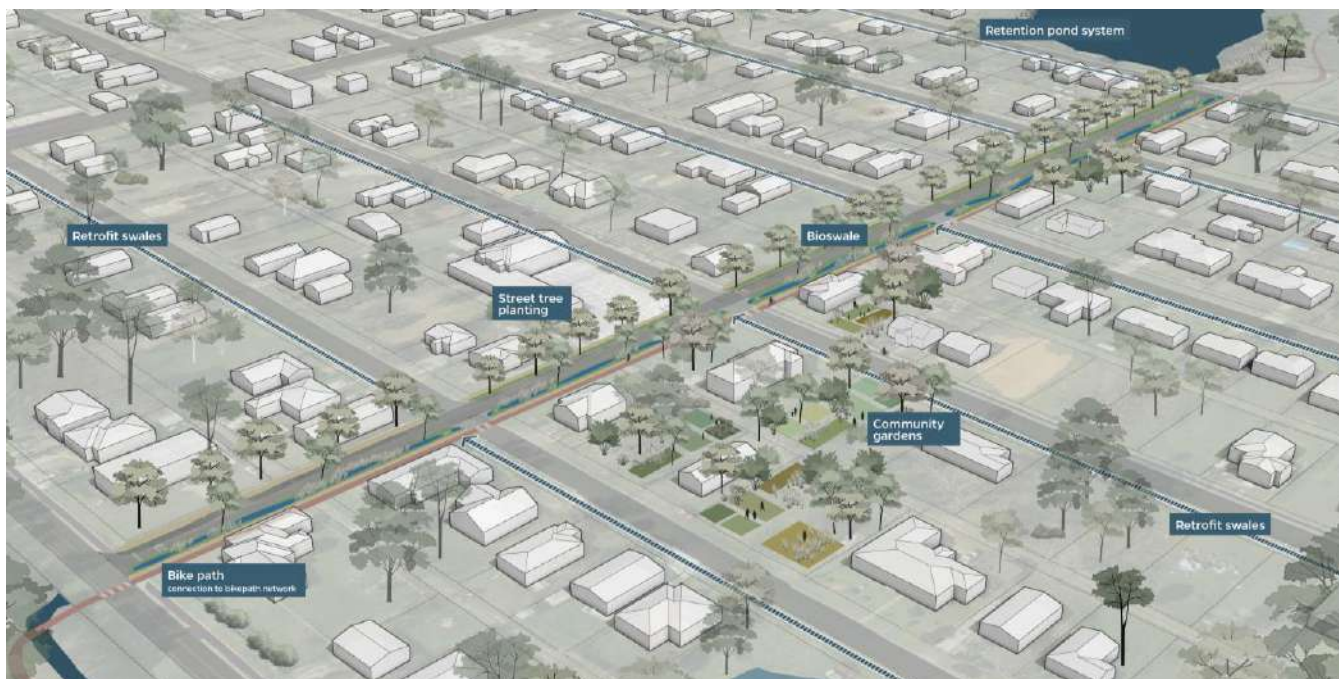


Figure 15. Adaptation Project Area 3: Drain Zone, Battles Street, Schematic Visualization Interventions.

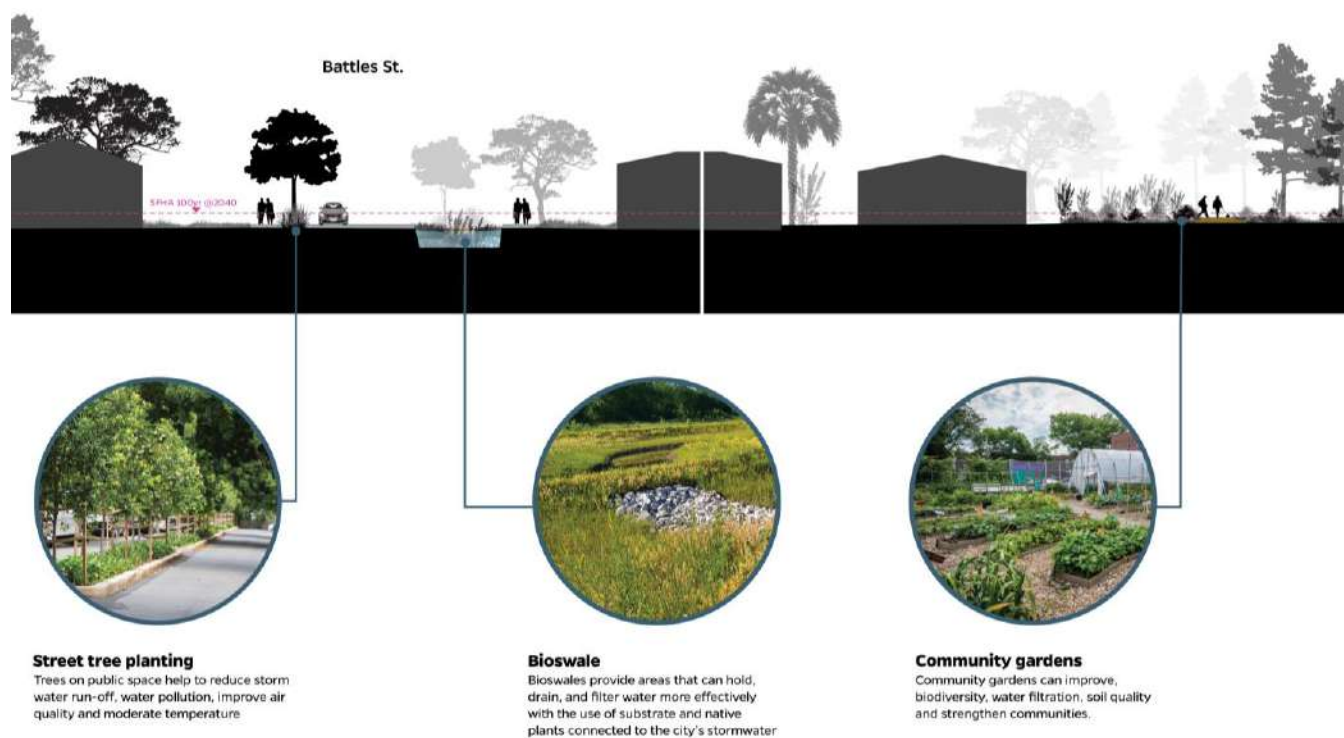


Figure 16. Adaptation Project Area 3: Drain Zone, Battles Street, Section.

PROJECT 4: CONSOLIDATE ZONE, CIVIC CENTER

The **Consolidate Zone** on the eastern side of the Central Channel is the most retreated zone from the shoreline at a higher elevation, offering a natural advantage against flood risks. Its safe connectivity to evacuation routes and strong links to the rest of Port St. Joe offer the necessary conditions to absorb future growth and resilient urban development.

The surrounding area of the Civic Center will constitute the heart of the Consolidate Zone, emphasizing a **mixed-use approach**, integrating residential, commercial, and institutional spaces. By concentrating future growth in this elevated area, the project aims to:

- *Enhance resilience against storms and flooding, capitalizing on the area's natural topography.*
- *Improve efficiency given its proximity to the utility distribution infrastructure such as power, water, and sewer.*
- *Support compact development along Garrison Avenue, reducing flood risk on urban expansion.*

The new Civic Center will be critical in transforming the area, hosting community services, public events, and emergency response operations. Surrounding it, carefully planned density increase and commercial zones will create a cohesive, adaptable, and resilient urban framework for Port St. Joe's future growth.

This initiative aligns with the broader goals of the Adaptation Plan by developing in relation to topography conditions, ensuring connectivity to evacuation routes and its specificity according to the urban context, ensuring that the Consolidate Zone becomes a model for resilient and inclusive urban development.

Consolidate Zone

PSJ Civic Center and uplands



Figure 17. Adaptation Project Area 4: Consolidate Zone, Civic Center. Siteplan Interventions

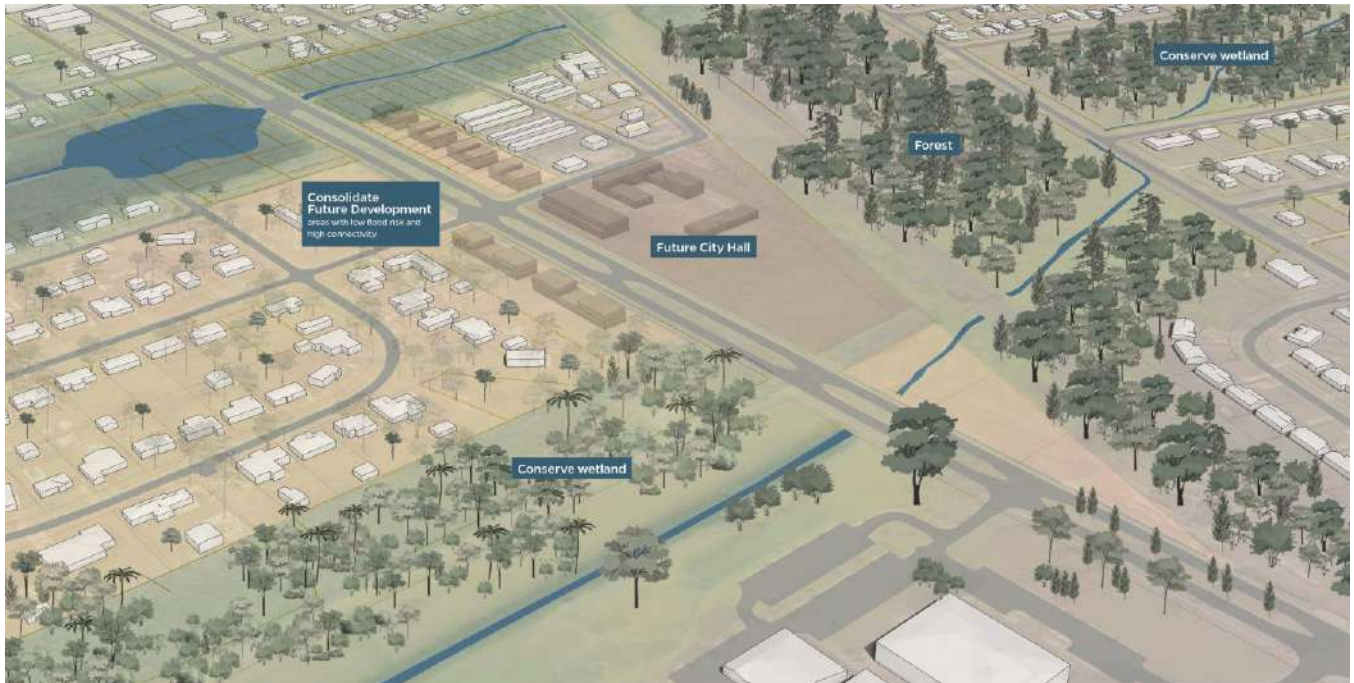


Figure 18. Adaptation Project Area 4: Consolidate Zone, Civic Center. Schematic Visualization Interventions.



Figure 19. Adaptation Project Area 4: Consolidate Zone, Civic Center. Schematic Visualization Interventions.

IMPLEMENTING THE ADAPTATION PLAN

POLICY NEEDS AND RECOMMENDATIONS

The Policy Needs section outlines the critical adjustments required in Port St. Joe Coastal Management Element to implement the Adaptation Plan effectively and achieve a flood-resilient future development. The primary goal of this component in the Comprehensive Plan is to make Port St. Joe resilient to storms and flooding through improved infrastructure and procedures.

The primary input of the adaptation plan to the policy component is to support risk- and context-conscious Land Development by Promoting sustainable land use practices that minimize environmental impact and reduce vulnerability to flooding while supporting future growth in suitable areas.

Adaptation Overlays

To address the diverse needs of Port St. Joe, the Adaptation Plan introduces five distinct overlays, each tailored to specific resilience strategies:

- **Disperse Overlay:** *applies to the land closest to the coast and involves bolstering infrastructure and defenses from waves, rising ocean waters, and extreme storm events.*
- **Drain Overlay:** *covers low-elevation areas that need improved drainage.*
- **Retain Overlay:** *emphasizes the restoration of wetlands, creation of retention basins, and development of flood retention parks to manage floodwaters and restore ecological and natural conditions.*
- **Consolidate Overlay:** *encourages compact, higher-density development in elevated, less flood-prone areas with good accessibility.*
- **Conserve Overlay:** *preserves ecosystem functions and manages building development.*
- **Special Conditions Designation:** *areas with preexisting nonconforming uses that require unique considerations for improving stormwater drainage and retention.*

The Coastal Management Element adjustments are described in the Peril of Flood Compliance section. By adopting these policies, Port St. Joe can ensure a balanced approach to development, conservation, and resilience, creating a robust foundation for implementing the Adaptation Plan.

FUNDING INSTANCES FOR RESILIENCE PROJECTS

Resilience projects in Port St. Joe can be funded through various federal, state, and local sources that are typically not restricted to particular adaptation measures. Below are key funding pathways and considerations for securing financial support:

Federal, State, and Local Funding Sources

- **Resilient Florida Program:** *A recommended starting point, this program supports developing projects identified in the Vulnerability Assessment. These funds are more accessible to apply with detailed designs.*

- **Federal Infrastructure Grants:** Larger-scale projects, such as infrastructure improvements, may qualify for federal funding from agencies like FEMA or the Federal Highway Administration (FHWA). However, these grants are highly competitive due to limited budgets and nationwide eligibility.
- **Disaster Relief Funding:** FEMA grants are a key resource, typically allocated in response to presidentially declared disasters.
- **Low-Interest Loans and Specialized Grants:** Smaller projects or those with unique contexts may benefit from low-interest loans subsidized by federal and state funds, or grants tailored to specific needs, such as private ownership or conservation goals.

Resources for Grant Research

Urban Ocean Lab Funding Guidebook

Provides up-to-date information on funding options, timelines, and supported project types. [Link](#)

American Flood Coalition Funding Finder

Offers a comprehensive list of grants for projects across a wide range of budgets. [Link](#)

Adaptation Actions and Funding Strategies

Once the **Vulnerability Assessment** is complete, the next steps involve engaging design professionals to develop project designs, feasibility studies, and projected budgets. These are critical prerequisites for securing implementation funding.

Key Funding Considerations

- **Project Scale:** The size and scope of the project determine eligibility for certain funding sources.
- **Priority Level:** Focus on projects with the highest urgency or alignment with adaptation goals.
- **Budget and Matching Funds:** Ensure the availability of matching funds where required by grant programs.
- **Community Impact:** Highlight the project's benefits to residents and businesses.

Additional Grant Programs

- **Building Resilient Infrastructure and Communities (BRIC):** Supports resilience projects that reduce risks from natural disasters.
- **Rebuilding American Infrastructure with Sustainability and Equity (RAISE):** Targets infrastructure projects promoting sustainability and resilience.
- **U.S. Fish and Wildlife Service:** Focuses on projects that conserve and restore wildlife habitats, aligning with nature-based solutions.

The following table identifies the most typical adaptation actions in the Port St Joe Adaptation Plan and the matching funding sources.

Category	Measure	Funding
Transportation	Road elevation	Rebuilding American Infrastructure with Sustainability Equity (RAISE) Discretionary Grants FHWA
	Elevate Bridges	Rebuilding American Infrastructure with Sustainability Equity (RAISE) Discretionary Grants FHWA
	Build Bridges	Rebuilding American Infrastructure with Sustainability FHWA
	Road improvement (widen section, improve sidewalks, create parking areas)	Rebuilding American Infrastructure with Sustainability Equity (RAISE) Discretionary Grants FHWA
	Retrofit boat ramps (reinforce boarding structures)	Rebuilding American Infrastructure with Sustainability Equity (RAISE) Discretionary Grants
Critical Infrastructure	Retrofit wastewater plant equipment	Interagency Nonstructural Flood Risk Management Projects Rural Development Water and Environmental Programs
	Wastewater network improvements (retrofit lift stations, replace components to avoid salty water infiltration)	Rural Development Water and Environmental Programs
	Stormwater network improvements (implement check valves, build retention areas)	Clean Water State Revolving Fund; Water Infrastructure Finance and Innovation Act Program
	Waterplant retrofit (elevate control rooms, elevate equipment)	Interagency Nonstructural Flood Risk Management Projects Rural Development Water and Environmental Programs
Community Facilities	Relocation (City Hall, Police Department, Fire Department,)	Interagency Nonstructural Flood Risk Management Projects
	Wet floodproofing	Interagency Nonstructural Flood Risk Management Projects
	Dry floodproofing	Interagency Nonstructural Flood Risk Management Projects
	Elevate utilities	State Community Development Block Grant Program
Natural Cultural Assets	Marsh and mangrove restoration	Vegetation and Watershed Management Projects (Federal) Watershed and Flood Prevention Program
	Revetment	BRIC Resilient Florida
	Sea wall	BRIC Resilient Florida
	Beach nourishment + groin field	U.S. Fish and Wildlife Service Coastal Program Watershed and Flood Prevention Program
	Land Conservation buyouts	
Economy and Housing (building assets)	Building Elevation	Gulf County Local Housing Assistance Plan
	Wet floodproofing	Gulf County Local Housing Assistance Plan
	Dry floodproofing	
	Voluntary buyout	
	Building relocation	Interagency Nonstructural Flood Risk Management Projects
	Flood insurance	

Table 7. Funding available classified by asset category and adaptation action.

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