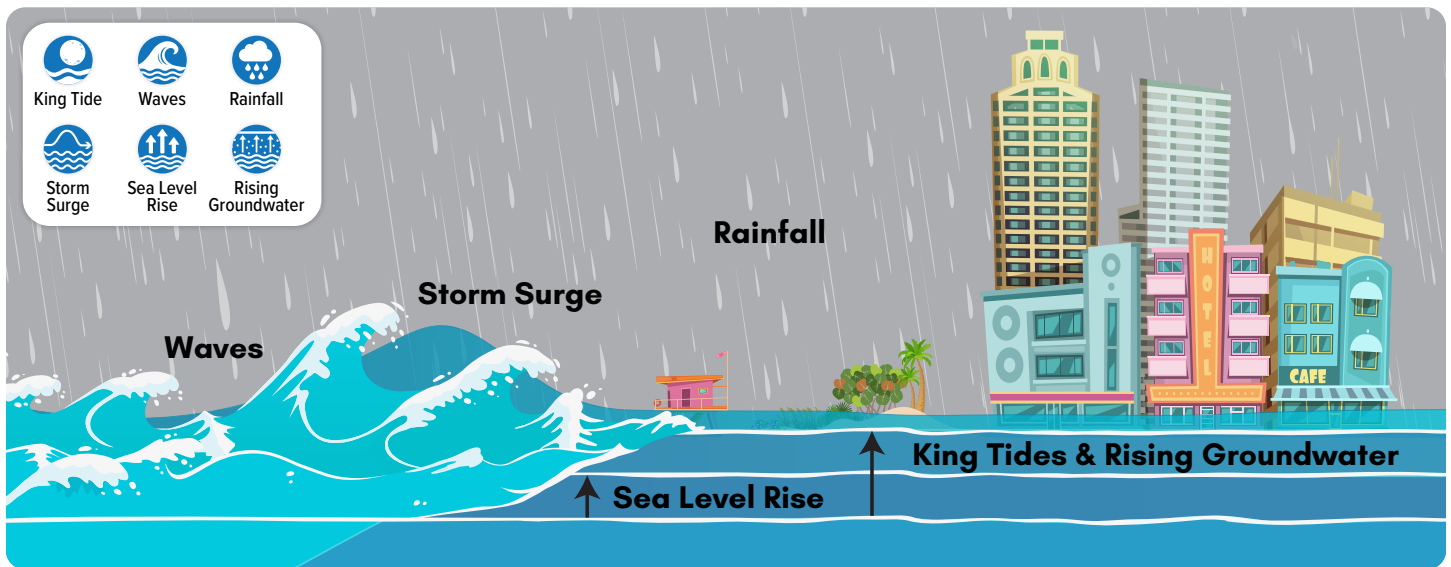


Sea Level Rise Vulnerability Assessment & Adaptation Plan - Executive Summary

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Rising Waters, Rising Challenges and Possibilities

The City of Miami Beach (City) is working to reduce flood risk through incrementally adapting to sea level rise. The City's setting on a low barrier island with porous limestone bedrock makes the area vulnerable to flooding during heavy rainfall events, annual king tides, wave overtopping during windy days and storm surge, and periods of high groundwater conditions. As sea level rises, flooding due to these factors will extend further inland, increasingly affecting City infrastructure and facilities. Miami Beach worked with consultant AECOM to perform a Sea Level Rise Vulnerability Assessment (Assessment) through the Resilient Florida grant program to **identify and prioritize over 67,000 assets** vulnerable to flooding through 2070 based on 2017 NOAA sea level rise projections.



Prioritizing What's At-Risk

The Assessment evaluated a range of asset types that support the community and provide essential services, including adding highly valued assets identified by input from over 150 City residents. Utilizing best available data and modern stormwater modeling techniques, vulnerability was assessed based on asset's exposure to flooding scenarios through 2070, sensitivity to floodwaters, and the potential community consequences of their failure. **Findings from the assessment will be used to target improvements and pursue grant funding to address the identified flood vulnerabilities and reduce the City's risk.**



What is a Sea Level Rise Vulnerability Assessment?

A process of evaluating the structural and social assets likely at risk to future flooding due to sea level rise.

Citywide Sea Level Rise Vulnerabilities

- The timing and extent of future flooding impacts will vary across the City's regions based on relative ground elevations and current flood protection infrastructure in place.
- Assets with higher vulnerability are generally located adjacent to canal shorelines, with the west ("Bay") side of the City at the greatest risk of flooding due to the low elevation of mostly privately-owned seawalls.
- The City's beach and coastal dune system provides a natural buffer from most ocean wave impacts, but extreme coastal storms, such as the effects felt by Hurricane Ian and Helene on the Florida West Coast, could flood certain areas of the City by up to 5 feet, even without additional sea level rise.
- The water and wastewater pipeline network contains several areas with pipelines that are over 70 years old, that are more susceptible to corrosion or may contain small cracks that can be infiltrated by elevated groundwater.
- With 1-foot of sea level rise (since the year 2020), over half of the City's roadways are projected to experience flooding during heavy rainfall events that coincide with king tides, potentially restricting traffic and limiting mobility within the City.
- By 2040, a 25-year, 24-hour rainfall event combined with a king tide could cause flooding at four emergency response facilities, including Mt Sinai, Police Station HQ, Sailport Substation, and Fire Station #1. By 2070 this number increases to include the majority of emergency response facilities across the City.

Multiple Paths to Achieve Adaptation

The Assessment findings highlight the increasing flood risks facing the City and the need for adaptation strategies that provide long-term resilience for residents and infrastructure. The City has several existing policies, studies, and plans that detail flood protection strategies. However, the full implementation of these strategies may take decades, leaving many areas of the City at risk. To address gaps, **the City's Sea Level Rise Adaptation Plan (Adaptation Plan) identifies additional and supplemental strategies to provide flood protection through the end of the century.**

The proposed strategies are organized by geographic area or asset type and include key implementation details, such as a strategy timeline and critical considerations for successful implementation. The Adaptation Plan also identifies additional metrics beyond sea level rise amounts that can be used to help guide the initiation or phasing out of strategies based on observed levels of flood protection effectiveness. Lastly, to support future decision-making, the **strategies were summarized using six adaptation pathway diagrams**, which provides a decision tree planning framework to guide transitions between strategies as conditions evolve. **This flexible approach provides a structured, yet adaptable roadmap to inform major flood protection investments.**

Next Steps

The Vulnerability Assessment and Adaptation Plan work in tandem to identify the City's growing sea level rise-driven flood risks and document targeted strategies to address both near- and long-term flood protection gaps in existing efforts. The organization of the strategies into **adaptation pathways provides decision-makers with a phased implementation plan that can be adjusted to changing environmental conditions to better support the City's sea level rise adaptation process.**

The City can foster successful implementation of the Adaptation Plan by:

- Continuing inter-departmental coordination to discuss strategies, potential metrics, and a monitoring plan that will serve as a tool to provide consistent long-term flood protection of City assets.
- Integrating adaptation strategies into new iterations of the City's existing planning and visioning documents as they are updated to avoid projected flood impacts of future projects.
- Establishing ongoing monitoring programs to track observed impacts and inform flood-protection decision-making and investments.
- Identifying funding sources to implement prioritized flood strategies for near- and long-term planning horizons.
- Continuing to engage with the community as part of the decision making process to understand how flooding impacts the quality of life for residents and how infrastructure improvements have decreased observed flooding.



What is a Sea Level Rise Adaptation Plan?

A strategic planning document that establishes a process to implement actions that minimize future flood impacts.



Bayfront Flood Protection Strategies

The following presents a list of strategy options for the City to consider over time as sea level rise changes flood conditions. The implementation timing of listed strategies will be dependent on the rate of future sea level rise and observed impacts. Please refer to the full Sea Level Rise Adaptation Plan for more information.

Strategy Name and Description	Flood Hazards Addressed
<p>Elevate Seawalls to Current Ordinance Modify existing public and privately owned seawalls to comply with the existing seawall ordinance (5.7 feet NAVD88).</p>	
<p>Temporary Seawall Flood Barriers Install deployable flood barriers (e.g., Tiger Dams) along low-lying seawalls to provide short-term flood protection while longer-term solutions are being designed or constructed.</p>	
<p>Install Canal Tide Gates Closable tide gates could be installed at the openings of the Collins Canal to provide flood protection for properties along the canal and reduce the number of seawalls requiring higher elevation.</p>	
<p>Update Seawall Ordinance Revise the existing seawall ordinance to reflect the latest sea level rise amounts and future projections to provide continuous flood protection through the end of the century.</p>	
<p>Elevate Seawalls to Updated Ordinance Modify existing public and privately owned seawalls to comply with the updated seawall ordinance.</p>	
<p>Add Living Shoreline to Seawalls To protect seawalls from local scouring while also enhancing the ecological conditions of the Bay, a living shoreline could be added to the seaward side of seawall structures.</p>	
<p>Restore Natural Shorelines Frequently flooded properties that are cost-prohibitive to maintain could be restored to coastal wetlands, allowing the shoreline to return to a natural state of transitional wetland habitat between the built and natural environment.</p>	
<p>Expand Waterfront Setback for Increased Resilience Expanding waterfront setbacks involves revising land use regulations for shoreline-adjacent development to reduce the risk of property damage due to flooding.</p>	

Strategy Theme:

Keeping Water Out, **Nature-Based Flood Protection**, **Strategic Relocation**, **Plans and Policies**

Flood Hazards:



King Tide



Waves



Rainfall



Storm Surge



Rising Groundwater



Oceanside Protection Strategies

The following presents a list of strategy options for the City to consider over time as sea level rise changes flood conditions. The implementation timing of listed strategies will be dependent on the rate of future sea level rise and observed impacts. Please refer to the full Sea Level Rise Adaptation Plan for more information.

Strategy Name and Description	Flood Hazards Addressed
<p>Continue Routine Beach Renourishment Maintain beach width based on the updated CRSM renourishment schedule to replenish eroded sand.</p>	
<p>Dune Enhancement Increase the height and width of dune features and fortify with natural elements to provide an increased natural buffer for inland infrastructure and assets.</p>	
<p>Redesign Public Access Alter the traditional access path angle or install walkover structures that span over the City's dune system, allowing for public beach access while minimizing potential flood pathways and negative dune impacts.</p>	
<p>Hybrid Dune Systems Reinforce dunes with armoring materials behind or under the dune features as a final line of defense to prevent shoreline retreat impacts to inland infrastructure and assets.</p>	
<p>Reimagine Coastal Areas Reimagine how the coastal beachfront is utilized, including scaling back or eliminating development in favor of expanded recreational opportunities and enhanced natural spaces.</p>	
<p>Expand Offshore Wave Attenuation Create a network of offshore structures, such as artificial reefs or breakwaters, to absorb wave energy and reduce erosion impacts on the shoreline.</p>	

Strategy Theme:

Keeping Water Out, Nature-Based Flood Protection, Strategic Relocation

Flood Hazards:





Critical Infrastructure Flood Protection Strategies

The following presents a list of strategy options for the City to consider over time as sea level rise changes flood conditions. The implementation timing of listed strategies will be dependent on the rate of future sea level rise and observed impacts. Please refer to the full Sea Level Rise Adaptation Plan for more information.

Strategy Name and Description	Flood Hazards Addressed
<p>Implement current Neighborhood Improvement Projects Carry out infrastructure improvement projects, such as replacing aging infrastructure and pipelines, which were prioritized at the neighborhood scale.</p>	
<p>Update Neighborhood Prioritization Plan for future sea level rise The Neighborhood Prioritization Plan will likely need to be revised over time to reflect evolving environmental conditions due to sea level rise and the shifting implementation landscape.</p>	
<p>Implement future Neighborhood Improvement Projects An updated Neighborhood Prioritization Plan would facilitate the implementation of Neighborhood Improvement Projects that consider the potential project impacts from future sea level rise through the end of the century.</p>	
<p>Floodproof Critical Infrastructure Apply dry (e.g., waterproof coverings, sealants) and wet floodproofing (e.g., flood resistant materials, adding sump pumps) techniques to critical infrastructure in flood prone areas of the City to reduce or prevent flood damage.</p>	
<p>Elevate Critical Infrastructure Elevate critical infrastructure components to be above projected flood levels to reduce the risk of flood damage.</p>	
<p>Relocate Frequently Flooded Critical Infrastructure Assess the feasibility of relocating key infrastructure from flood-prone areas to enhance resilience, particularly when existing floodproofing and elevation strategies are not feasible or effective.</p>	

Strategy Theme:

Keeping Water Out, Strategic Relocation, Plans and Policies

Flood Hazards:





Roadway Flood Protection Strategies

The following presents a list of strategy options for the City to consider over time as sea level rise changes flood conditions. The implementation timing of listed strategies will be dependent on the rate of future sea level rise and observed impacts. Please refer to the full Sea Level Rise Adaptation Plan for more information.

Strategy Name and Description	Flood Hazards Addressed
<p>Incremental Roadway Elevation</p> <p>Coordinate the elevation of prioritized roadways with other infrastructure projects based on the recommendations of the Road Elevation Strategy to reduce potential flood risks of critical access routes.</p>	
<p>Temporary Roadway Flood Barriers</p> <p>Deploy temporary flood barriers along critical roadways that frequently flood to safeguard evacuation routes and essential access points during flood events.</p>	
<p>Update Road Elevation Strategy</p> <p>Revise the Road Elevation Strategy to prioritize the most vulnerable roadways in need of elevation based on latest sea level rise observations and end of century projections.</p>	
<p>Implement Updated Road Elevation Strategy</p> <p>Continue the coordinated elevation of select roadways with other infrastructure projects as specified in the revised Road Elevation Strategy to reduce potential flood risks of critical access routes through the end of the century.</p>	
<p>Transition to Stormwater Streets</p> <p>Designate specific low-lying roadways to intentionally accumulate floodwater during heavy rainfall, allowing them to serve as stormwater retention areas and reduce widespread flooding risks elsewhere.</p>	
<p>Repurpose Rights-of-Way</p> <p>Transition the use of certain rights-of-way, including the removal of roadway infrastructure, to maintain mobility and reduce maintenance commitments.</p>	

Strategy Theme:

Keeping Water Out, Living with Water, Strategic Relocation, Plans and Policies

Flood Hazards:





Critical Facilities Flood Protection Strategies

The following presents a list of strategy options for the City to consider over time as sea level rise changes flood conditions. The implementation timing of listed strategies will be dependent on the rate of future sea level rise and observed impacts. Please refer to the full Sea Level Rise Adaptation Plan for more information.

Strategy Name	Flood Hazards Addressed
<p>Continue to Floodproof Critical Facilities Continue to implement wet or dry floodproofing measures for facilities to reduce potential flood damages.</p>	
<p>Temporary Facility Perimeter Flood Walls Erect temporary flood walls around critical facilities during high water events to provide short-term protection against flooding and safeguard essential services.</p>	
<p>Include SLR in FFE for Critical Facilities Establish building design criteria for City facilities that exceed federal and state minimum standards and consider projected sea level rise.</p>	
<p>Elevate Existing Critical Facilities Elevate structures above projected flood elevations using structural fill or pilings.</p>	
<p>Repurpose Frequently Flooded Critical Facilities Remove or relocate facilities that are frequently flooded and cannot be feasibly elevated or floodproofed to repurpose the space for stormwater management or recreation.</p>	

Strategy Theme:

Keeping Water Out, Living with Water, Strategic Relocation, Plans and Policies







Flood Hazards:





Stormwater Flood Protection Strategies

The following presents a list of strategy options for the City to consider over time as sea level rise changes flood conditions. The implementation timing of listed strategies will be dependent on the rate of future sea level rise and observed impacts. Please refer to the full Sea Level Rise Adaptation Plan for more information.

Strategy Name	Flood Hazards Addressed
<p>Implement Stormwater Modeling and Master Plan Recommendations</p> <p>Execute Critical Needs Projects identified in the Stormwater Modeling and Master Plan to improve the City’s stormwater management system flood control and water quality performance for the next 20 years.</p>	
<p>Create Network of Blue Green Stormwater Infrastructure Projects</p> <p>Integrate Blue Green Stormwater Infrastructure elements throughout City infrastructure improvements to develop a cohesive network of projects that utilize nature-based features to improve stormwater management.</p>	
<p>Update Stormwater Modeling and Master Plan</p> <p>Revise the stormwater modeling setup to include system updates and the latest rainfall and coastal tailwater conditions. Use the modeling output to identify new Critical Needs Projects to provide the continued level of service through the year 2100.</p>	
<p>Promote Easement Acquisition</p> <p>Land use policies may require updates to acquire additional easements necessary for additional stormwater infrastructure upgrades (e.g., pump stations).</p>	
<p>Implement Updated Stormwater Modeling and Master Plan Actions</p> <p>Execute the newly identified Critical Needs Projects from the updated Stormwater Modeling and Master Plan to retrofit stormwater infrastructure to provide enhanced flood protection through 2100.</p>	
<p>Increase Floodable Areas</p> <p>Identify city locations, such as parks and designated retention areas, that can be designed to temporarily absorb and manage excess floodwater during heavy rainfall or coastal high water level events.</p>	

Strategy Theme:

Keeping Water Out, Nature-Based Flood Protection, Plans and Policies, Living with Water

Flood Hazards:



King Tide



Waves



Rainfall



Storm Surge



Rising Groundwater

For more information:

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