



Coastal Resilience Partnership

Climate Change Vulnerability Assessment City of Boca Raton



Boca Raton's participation and support of the CRP reflects the City leadership's continued commitment to community sustainability and environmental stewardship. Staff recognize that the results of the CCVA will help identify additional opportunities to improve climate resilience through infrastructure, local rules and policy, public outreach and education, and capacity building throughout the region.

Key Study Findings for Boca Raton

- Highest levels for vulnerability to high winds are associated with the following asset categories: Parks and Cultural properties (100%), Health and Medical (57%), Energy and Communications (44%), and Food Infrastructure (43%).
- Residential properties have lower vulnerability compared to the study area as whole due to more recent residential building construction in the area.
- The highest levels of Citywide vulnerability and risk are associated with rainfall-induced flooding when compared to other flood threats.
- An especially high number of commercial properties (81%) in the census tract encompassing the industrial district located in the north-central area of the City have medium or high vulnerability and risk to rainfall-induced flooding (just North of the Boca Raton Airport and along the Clint Moore Road and Yamato Road corridors).
- Vulnerability and risk to 2020 conditions (100-year storm event only) for critical facilities ranges from 14-30% across critical facility asset types. With future change these ranges increase to 19%-57% by 2070 (2020 baseline + 33" SLR) with the largest percent increases associated with Energy and Communications, Food Infrastructure, and Health and Medical facilities.
- With 2020 conditions, about a third of the SNAP retailers are highly vulnerable to rainfall-induced flooding. By 2040 (2020 baseline + 5" SLR) about half of these food infrastructure facilities could be vulnerable to rainfall-induced flooding.
- Nearly 20% of residential properties in the City are highly vulnerable to 100-year rainfall-induced flooding.
- 8 of the 28 census tracts within the City have more than 67% of residential properties with medium to high vulnerability and risk. Most of these census tracts are in the western part of the city.
- About 80% of residential properties have medium to high vulnerability and risk to rainfall-induced flooding in an area in the southwestern corner of the City (between W. Camino Real and W. 18th Street and along S. Military Trail). A relatively high proportion of these households are below the poverty line (as well as relatively low median household income).

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- While the City-wide number of properties vulnerable to storm surge is less than those vulnerable to rainfall-induced flooding, within three census tracts in the eastern part of the City over 65% of the residential properties are highly vulnerable to storm surge inundation. Storm surge vulnerability extends further west than in other communities because of the El Rio Canal and the number of important assets which are located near the Canal. Regional studies conducted by South Florida Water Management District and Lake Worth Drainage District to prepare for climate change are significant to the future of the City. The area surrounding Lake Boca Raton has high vulnerability to shoreline recession and storm surge for both 2020 and future conditions. Future work should focus on the protection of shoreline and mitigation of future surge events.
- Many of the areas vulnerable and at risk to storm surge could potentially see flood depths of more than three feet, therefore, evacuation planning is critical for these areas.
- Vulnerability and risk to tidal flooding (2020) conditions is relatively low when compared to the remainder of the region. By 2070, vulnerability of commercial and residential properties to tidal flooding is expected to increase 7-10 fold.
- Under 2020 tidal flooding conditions, road inaccessibility is mostly limited to the coastal census tract south of Lake Boca Raton. However, by 2070 a high proportion of roads and properties (over 90%) along the Intracoastal Waterway and the coast could be potentially inaccessible.
- The area surrounding and to the South of the Boca Raton airport is identified as the most vulnerable to extreme heat due to relatively high development densities and low tree canopy coverage.

Top asset categories of concern, as identified by the study's planning tools (AccelAdapt and APEX), are listed below. The first list focuses on assets that the City owns and the second list are general categories of assets located within the City (but all these assets are owned by other parties). Both lists focus on the threats of tidal flooding, storm surge, rainfall-induced flooding, and high winds.

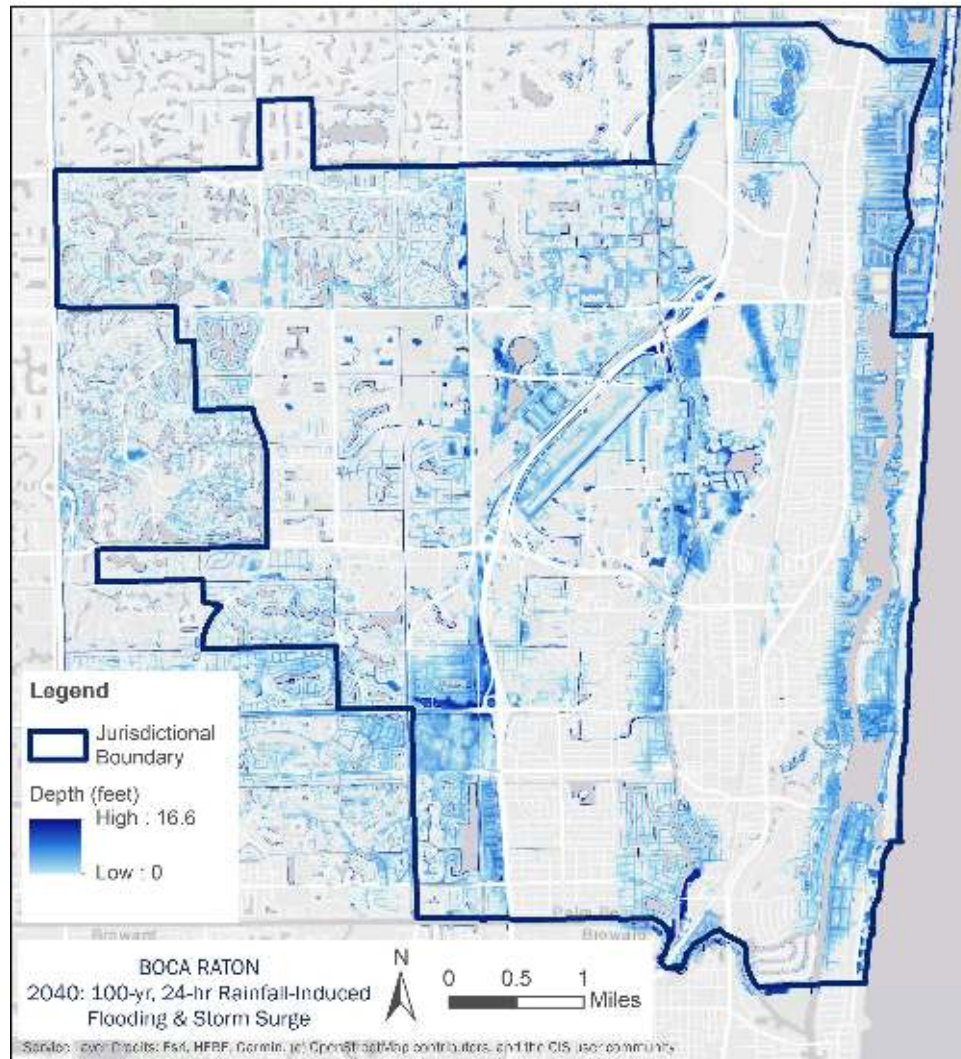


Figure A1-1: Predicted combined 100-year, 24-hour rainfall-induced flooding and storm surge in Boca Raton, Florida (2040).

Top 5 City-Owned Asset Categories of Concern

- All City-Owned Fire Stations near the Intracoastal Waterway and Canals as listed below:
 - City of Boca Raton Fire Rescue Station 3 (100 S Ocean Boulevard) is vulnerable to storm surge, tidal flooding, rainfall-induced flooding, and high winds due to its location near the coast.
 - City of Boca Raton Fire Rescue Station 6 (1901 Clint Moore Road) is vulnerable to rainfall-induced flooding and high winds, but it is not located on the Intracoastal Waterway or canals.
 - City of Boca Raton Fire Rescue Station 5 (2333 Glades Road) is vulnerable to rainfall-induced flooding and high winds and is located near the Gulf Stream Canal.
- Boca Raton Housing Authority – Dixie Manor (1350 N Dixie Highway) is vulnerable to rainfall-induced flooding and high winds, but it is not located on the Intracoastal Waterway or canals.


Top 5 Non-City-Owned Asset Categories of Concern

- Private educational facilities near the coast and/or canals as follows:
 - St Paul Lutheran Church and School (701 W Palmetto Park Road) is vulnerable to storm surge, rainfall-induced flooding, tidal flooding, and high winds and is located on the Gulf Stream Canal.
 - Grace Community Church and Preschool (600 W Camino Real) is vulnerable to storm surge, rainfall-induced flooding, high winds, and tidal flooding and is located on the Gulf Stream Canal.
- Higher education facilities - including buildings and various outparcels as follows:
 - Florida Atlantic University (777 Glades Road) is vulnerable to rainfall-induced flooding, storm surge, high winds, and tidal flooding.
 - Florida Atlantic University (1880 Florida Atlantic Boulevard) is vulnerable to storm surge, rainfall-induced flooding, tidal flooding, and high winds.
- FPL Substation North of SW 20th St, South of SW 19th Street, East of Gonzalo Rd, and West of SW 8th Avenue. This substation is vulnerable to rainfall-induced flooding, storm surge, and high winds. It is located near the Gulf Stream Canal.
- Suntrust Bank (880 E Palmetto Park Road) is vulnerable to storm surge, rainfall-induced flooding, tidal flooding, and high winds. It is located near the coast.
- Palm Beach County Schools:
 - Verde Community Elementary (6590 Verde Trail) is vulnerable to rainfall-induced flooding and high winds. It is located near the Gulf Stream Canal.
 - Calusa Elementary School (2051 Clint Moore Road) is vulnerable to rainfall-induced flooding and high winds. It is not located near a canal or the Intracoastal Waterway.

Over 500 adaptation strategies were investigated as part of the study. The top recommended strategies for the City of Boca Raton are highlighted in a portfolio format that follows.

Boca Raton: Portfolio of Recommended Adaptation & Mitigation Strategies


STRATEGY TYPE	ID	DESCRIPTION	APPLICABLE THREAT(S)
 <p>INFRASTRUCTURE</p>	INF-BR-1	<p>Maintain and restore existing coastal habitats, such as mangroves and maritime hammock, and develop incentives and strategies to expand the spatial extent of these systems on developed properties for the benefit of attenuation of storm surge waves and to prevent shoreline recession.</p>	<p>Shoreline Recession, Storm Surge, Harmful Algal Blooms (HABs)</p>
	INF-BR-2	<p>Expand renewable energy in the community by increasing solar installations on City property, creating solar ready requirements for commercial and residential property, and increasing incentives for solar energy systems which also address equity and energy burden related to cooling costs.</p>	<p>Extreme Heat</p>
	INF-BR-3	<p>Along canals and other upland water bodies potentially impacted by surge and/or rainfall-induced flooding, provide/enhance vegetated buffers and/or restore wetlands to provide more resilient habitats to improve water quality and reduce velocities of flood waters. This effort should be linked to the City's/region's development of any Low Impact Development (LID) Manuals.</p>	<p>HABs, Storm Surge, Rainfall-induced Flooding, Tidal Flooding, Shoreline Recession</p>
	INF-BR-4	<p>Evaluate and design strategic seawall projects to address vulnerable areas based on the findings of this study and staff recommendations. Design seawalls to withstand conditions for future tidal and storm surge to the greatest extent possible.</p>	<p>Tidal Flooding, Storm Surge, Shoreline Recession</p>
	INF-BR-5	<p>Evaluate and design strategic stormwater projects to address vulnerable areas based on the findings of this study and staff recommendations. Whenever possible, link Capital Improvement Projects (CIPs) to water quality and Federal Emergency Management Agency (FEMA) requirements for funding to increase likelihood of grants.</p>	<p>Rainfall-induced Flooding, HABs</p>



INFRASTRUCTURE (CONTINUED)	INF-BR-6	Assess existing shorelines in the City and identify needs and opportunity for seawall improvements and the implementation of natural shorelines or living seawalls to protect public infrastructure and mitigate erosion. Once assessed, begin strategic restoration projects and use nature-based solutions whenever possible.	Shoreline Recession, Storm Surge, HABs, Tidal Flooding
	INF-BR-7	Maintain and improve existing coastal dunes through exotic species removal and habitat restoration.	Shoreline Recession, Storm Surge, Tidal Flooding
 LAND USE BUILDING CODES AND STANDARDS	LU-BR-1	Review and consider revising requirements for commercial projects that require high percentages of native plants to achieve aesthetic and irrigation-related water reduction goals.	Saltwater Intrusion, HABs
	LU-BR-2	Improve resilience to heat and flooding in new development by creating code requirements which increase green space and pervious area.	Extreme Heat, Rainfall-induced Flooding, HABs
	LU-BR-3	Create safe and shaded walking and biking connectivity to schools, employment centers, and transportation hubs.	Extreme Heat
	LU-BR-4	Consider developing green building standards for multi-family and commercial developments focused on enhanced sustainable practices. Focus on reducing energy usage and enhancing the overall livability of communities in Boca Raton.	Extreme Heat, Rainfall-Induced Flooding
	LU-BR-5	Expand renewable energy purchasing options by encouraging investment in community solar and energy programs. Program including developing a consortium of Homeowners Associations (HOAs) to pilot and test solar and energy co-ops in various communities. Eventual programming to include City-wide rollout.	Extreme Heat



**PLANNING, POLICY,
AND MANAGEMENT**

	<p>PP-BR-1</p>	<p>Create a green infrastructure design manual to provide a toolbox of green infrastructure practices and site design options for municipal staff and consulting engineers and architects. The design manual should include pollutant removal efficiencies, design constraints, and appropriate settings and materials. The manual can serve as a reference for ordinances and regulations and be similar in nature to Florida Department of Environmental Protection’s (FDEP) guidance (https://floridadep.gov/rcp/coral/documents/low-impact-development-green-infrastructure-pollution-reduction-guidance-water) but would be modified for usage in Boca Raton. Consider incorporating the Boca LID Manual into the City’s codes and regulation by reference.</p>	<p>HABs, Rainfall-induced Flooding</p>
	<p>PP-BR-2</p>	<p>Develop and implement policies and design standards that recognize the transportation system’s most vulnerable users and incorporate sustainable design elements which address those vulnerabilities (shade trees, LID principles, pervious pavement, low energy usage, measures to make electronic vehicle (EV) and public transportation usage easier, etc.).</p>	<p>Extreme Heat, Rainfall-induced flooding, HABs</p>
	<p>PP-BR-3</p>	<p>Design public infrastructure and critical facilities with longevities of greater than 50 years to accommodate expected sea level rise based on the 2070 (National Oceanic and Atmospheric Administration (NOAA) high) projections according to the recommended projection from the Southeast Florida Regional Climate Compact Unified Projection for critical infrastructure.</p>	<p>Storm Surge, Tidal Flooding, Shoreline Recession</p>
	<p>PP-BR-4</p>	<p>Identify through vulnerability assessments and capital planning efforts vulnerable infrastructure and rehabilitate those that are at high risk of failure. Use capital planning processes to upgrade and rehabilitate vulnerable infrastructure identified by this assessment.</p>	<p>High Winds, Storm Surge, Tidal Flooding, Rainfall-induced Flooding</p>
	<p>PP-BR-5</p>	<p>Assess the feasibility of implementing solar energy and battery storage in critical facilities for emergency management and disaster</p>	<p>Rainfall-Induced Flooding, Storm Surge, Tidal Flooding, HABs,</p>

<p>PLANNING, POLICY, AND MANAGEMENT (CONTINUED)</p>		recovery and add solar/battery projects to the Capital Improvement Plan.	Extreme Heat, Pest & Disease, High Winds
	PP-BR-6	Create a program inspired by the Building Efficiency 305 Program in Miami geared towards increasing water and energy efficiency in large buildings.	Saltwater Intrusion, Extreme Heat
	PP-BR-7	Identify and expand incentives for sustainable businesses to locate within the area, such as those that research and add capacity to strategic workforce initiatives like the development of green jobs.	All Threats
	PP-BR-8	Create a strategic Stormwater Study that includes a potential Community Rating System (CRS) rating increase for the City. Study should focus on enhanced water quality measures that the City can use towards future Total Maximum Daily Load (TMDL) credits and other CIPs that are grant-worthy for the City (such as FEMA funding and 319 grants).	HABs, Rainfall-induced Flooding
	PP-BR-9	Continue exploring integration of Adaptation Action Areas (AAAs) into City planning processes based on the findings of this study.	Storm Surge, Tidal Flooding
 <p>CAPACITY BUILDING</p>	CB-BR-1	Build partnerships and opportunities for increasing sustainable infrastructure projects and/or voluntary incentives.	All Threats
	CB-BR-2	Provide/require training for municipal and private engineers on the menu of effective green stormwater practices. Discuss challenges due to climate, groundwater, and proximity to canals and waterbodies.	HABs, Saltwater Intrusion, Rainfall-induced Flooding
	CB-BR-3	Facilitate home weatherization and energy efficiency programs for low- and medium-income households. Consider the use of state and federal funding programs.	Extreme Heat, High Winds
	CB-BR-4	Help golf courses manage water use, plant littoral zones around their waterways so they do not have to complete chemical treatment	HABs
	CB-BR-5	Revise landscape codes to maintain and expand urban tree canopy.	Extreme Heat

 <p>PUBLIC OUTREACH</p>	PO-BR-1	Continue engagement with businesses and neighborhoods on issues of resilience and sustainability. Modify existing programs as needed to align with the findings of this study.	All Threats
	PO-BR-2	Work with community groups to fund and commission a credible third-party study assessing the risk and extent of climate gentrification, and possible solutions.	All Threats
	PO-BR-3	Create a volunteer flood watch system where local residents report observations to the City. A hotline and App can be employed to collect and manage this information.	Rainfall-induced Flooding, Tidal Flooding, Storm Surge
	PO-BR-4	Use heat maps to show "hot spots" for reported flooding (locations of calls over time).	Rainfall-induced Flooding, Tidal Flooding, Storm Surge
	PO-BR-5	Recruit a network of climate liaisons in vulnerable communities and neighborhoods to connect with residents and better understand how climate threats affect vulnerable populations and to disseminate information to their community. Liaisons should be advocates and communicators that live in Boca Raton and that are tied to each community.	All Threats
 <p>FUNDING AND FINANCE</p>	FF-BR-1	Seek new legislation and appropriate streams of revenue to support projects.	All Threats
	FF-BR-2	Develop incentives for construction of affordable housing designed for natural cooling to minimize the need for air conditioning and resultant energy use.	Extreme Heat
	FF-BR-3	Change City planning processes to include a "funding first" approach where economics, finance, and climate change are considered first and then throughout the planning processes.	All Threats
	FF-BR-4	Find ongoing funds to replant established canopy after wind events	High Winds, Extreme Heat
	FF-BR-5	Begin preparing key findings of this study to compete for funding with the landmark 'Always Ready' resilience law. Share lessons learned and resources as a part of the CRP.	Rainfall-Induced Flooding, Storm Surge, Tidal Flooding
	FF-BR-6	Collaborate with the Coastal Resilience Partnership (CRP) to locate resources regarding a diverse suite of financing and	All Threats

Appendix 1

FUNDING AND FINANCE (CONTINUED)		tools to assist individuals with personal home or business adaptation.	
	FF-BR-7	Consider re-evaluating the City’s Stormwater Utility rate structure. Set a schedule for routine revisions to the City’s rate structure based on the findings of the study.	Rainfall-induced Flooding, HABs
	FF-BR-8	Develop stormwater projects with multi-benefits (particularly geared to water quality) to align with State and Federal funding sources. Primary funding sources include but are not limited to FEMA and 319 Grants.	Rainfall-induced Flooding, HABs