

Risk, Resilience and Sustainability: A Case Study of Fort Lauderdale

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I. INTRODUCTION TO THE CITY OF FORT LAUDERDALE

Overview

The City of Ft. Lauderdale is situated in Broward County between Miami-Dade and Palm Beach Counties along the southeast coast of Florida. It is bordered by the Atlantic Ocean with 23 miles of beach to the east, dissected by approximately 135 miles of inland canals and waterways, including the New River, and bordered on the west by the Florida Everglades. With the 337 miles of shoreline throughout the city, it is clear why Ft. Lauderdale has the designation as the “Venice of America” (Figure 1).



Figure 1. Downtown Ft. Lauderdale. Image Credit: [Wikipedia](#)

Government Structure

The City of Fort Lauderdale has a Commission-Manager form of government, in which the elected City Commission sets policies for the operation of the City. The City Commission consists of five members: the mayor and four district commission members. The administrative responsibility of the City rests with the City Manager, who is appointed by the City Commission. Fort Lauderdale is the county seat of Broward County which is governed by its nine-member County Commission who are elected by district in partisan elections.

Fort Lauderdale’s Sustainability Division is a driving force behind many of the City’s key climate change related initiatives. They achieve their mission by doing away with the traditional municipal model and focusing on innovation. This model brings together existing staff under one “umbrella” and challenges them to work together to re-think their operations. They have a city-wide influence that includes: climate change adaptation planning, climate mitigation (energy, fleet, fuel) and stormwater policy management.

Population and the Economy

Florida has a population of nearly 19 million people with approximately 14 million people living along the coast. The four counties of Southeast Florida (Palm Beach, Broward, Miami-Dade and Monroe) are home to 5.5 million residents and account for over one third of Florida’s total economy. The City of Fort Lauderdale is the seventh largest city in Florida and the largest of Broward County’s 30 municipalities. More than 11 million people visit the greater Fort Lauderdale area each year spending \$9 billion in the local economy.

The City of Fort Lauderdale encompasses more than 33 square miles and has a population of 170,000, which greatly increased by tourists during the winter. The City’s population density is over 4,000 people per square mile, which is much higher than the state average (approximately 285) and considerably higher than the national average of 81 people per square mile. Many of the City’s coastal assets are in

low elevation areas where water supplies, roads, storm sewers, power grids and other infrastructure are at risk from storm surges and flooding at high tide.

Vulnerability

Ft. Lauderdale’s vulnerability stems from numerous factors, many of which are related to its proximity to the coast. Most areas in Ft. Lauderdale have extremely low elevations, often less than 10 feet above sea level. This low elevation is compounded by its geology, having a porous limestone substrate and unusual hydrology. In addition to these geological vulnerabilities, Ft. Lauderdale is often subjected to meteorological events such as flooding from extreme high tides, prolonged heavy rains, and storm surge events from hurricanes and tropical storms. Providing proper water control in this changing environment is critical.

South Florida Drainage

South Florida’s substrate is made up of a porous limestone that acts as a sponge and storage for its water supply. Most of the well fields in Broward County (all built prior to 1950) are located within 5 miles of the coast and tap into the surficial Biscayne aquifer. In order to provide flood control to these early residents, a series of drainage canals and flood control structures were constructed around this same time (Figure 2). Flood control structures along these canals rely on gravity to function correctly; the water flows from the highest to lowest surface elevation. When built, these canals and flood control structures did provide the necessary flood control, but they also lowered the water table that allowed the gradual movement of saltwater inland toward local well fields.

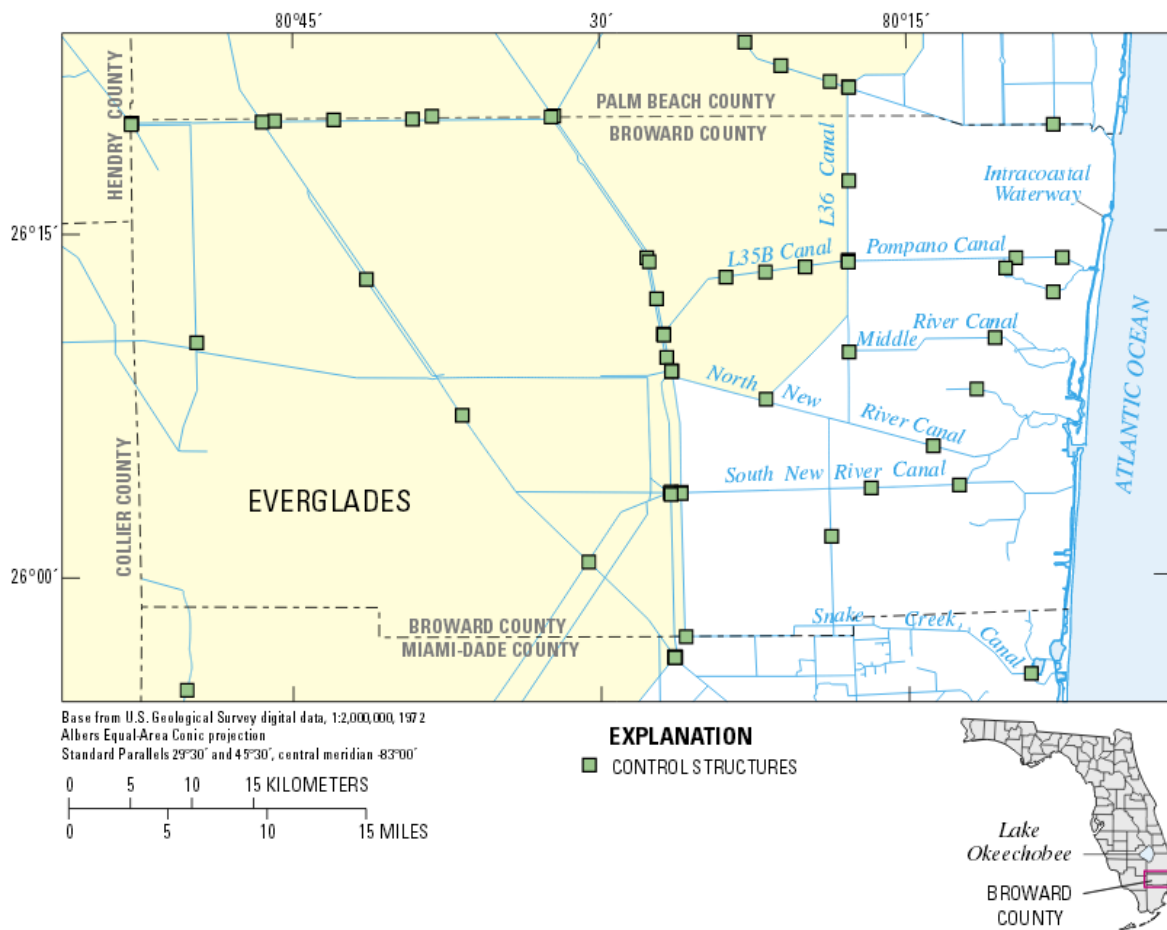


Figure 2. Canals and flood control structures in the Fort Lauderdale region. Source: [USGS](https://www.usgs.gov/)

II. RISKS

Long-term versus Short-term Risks

Long-term and short-term risks are being considered by the City of Ft. Lauderdale in future planning scenarios. The long-term risks include outdated flood control structures, saltwater intrusion and impacts of tidal flooding.

Since Ft. Lauderdale's flood control structures were built, sea levels have risen approximately five inches and many structures have lost some portion of their designed flow capacity. A further six inch increase in sea level could hinder drainage capacity even more significantly (Figure 3). While saltwater intrusion is already an

issue, this problem will be exacerbated as sea levels rise. The freshwater-saltwater interface has already moved inland and many coastal well fields will have to be relocated as this continues. Seasonal high tides are another major concern. Several times a year, typically October through December, tides can reach as high as six inches above the normal tide, rendering flood control structures useless and severely impacting several areas in the region (Figure 4). These long-term issues *are* being examined and addressed by the city as well as the South Florida Water Management District.

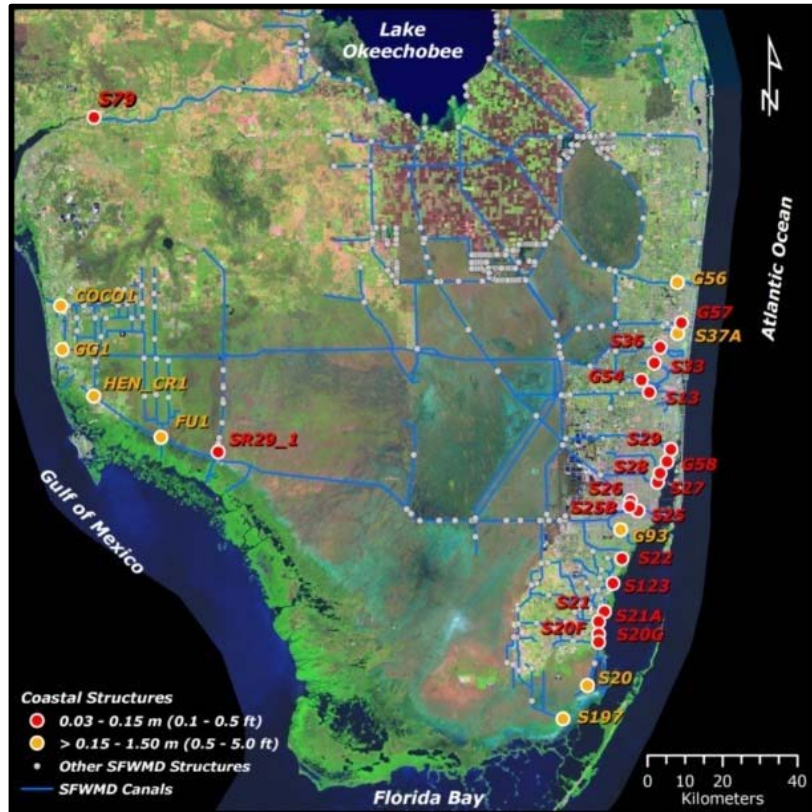


Figure 3. Coastal structures that may lose flow capacity in response to a 15 cm (6 inch) increase in sea level.

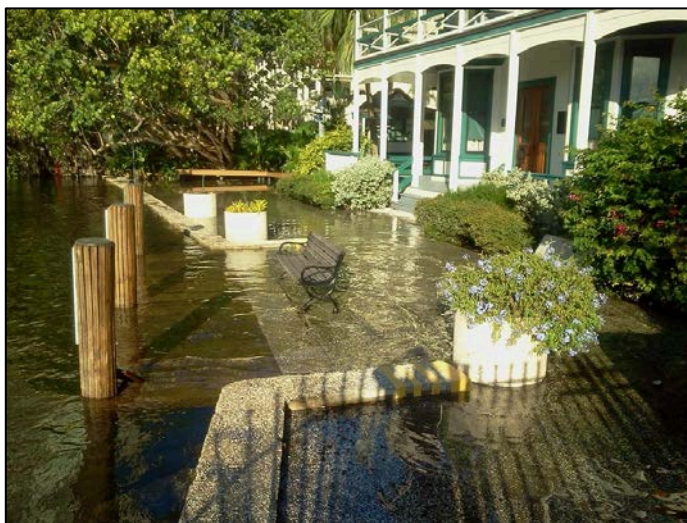


Figure 4. Lunar High Tide Flooding in Downtown Fort Lauderdale. *Image Credit: Alana Edwards*

The short-term risks from tropical storms and hurricanes can present themselves in several ways. Aside from heavy winds from tornadoes or the storm itself, severe flooding and storm surge can occur, wreaking havoc on the affected communities. Last June, at the start of hurricane season, tropical storm Andrea made her way across the state and, in her wake, more than 8 inches of torrential rains from a trailing band caused flash flooding in many parts Ft. Lauderdale in just a few hours.

In October 2012, when Super Storm Sandy moved up the east coast, the resulting storm surge pushed



Figure 5. A1A Fort Lauderdale - Post Super Storm Sandy. *Image Credit: Broward County Natural Resources Planning & Management Division*

approximately a foot of water over A1A, causing such severe erosion that the sidewalks crumbled along certain sections of the road. A year later, with sea level rise impacts in mind, rather than rebuilding all four lanes, the [City of Ft. Lauderdale](#) and the Florida Department of Transportation opted to convert the four-block stretch of A1A from four lanes to two and include pedestrian amenities. This type of adaptation measure is the kind of forward thinking that has put Ft. Lauderdale ahead of other communities in terms of planning for future sea level rise.

Translating the risk of storm surge to the public so that they can prepare for storm related emergencies is imperative and, in order to reach large audiences, we must consider multiple methods to reach the community. Remembering that preparing for the impacts of storm surge and sea level rise is not just a technical issue, but also a ‘people problem’, is important. Effectively informing and engaging the public, property owners, the business community, voters and taxpayers is a key and critical challenge to overcome.

Economic Impacts

Sea level rise poses enormous economic risks to coastal communities, threatening built environments, infrastructure, water supplies, natural, cultural and recreational resources and many other assets. The real estate, insurance and power industries are particularly at risk. Those industries and communities in general require long-term strategies and potentially dramatic policy changes – such as an end to viewing coastal and other flood-prone, environmentally sensitive land as high-value, habitable real estate – to adapt to a changing environment.

Some economic impacts of sea level rise are already apparent: for decades, residents of waterfront properties and other areas vulnerable to flooding have been given federal subsidies that cover approximately half of their true insurance costs. As claims mount and costs skyrocket -- many of these homes are worth more than \$500,000 -- the government is grappling with how to end the subsidies, and residents are facing the prospect of huge hikes in insurance costs. Insurers are already calculating increased risk into property insurance premiums, and bond agencies and mortgage backers may soon follow suit. Higher premiums and an end to policies that incentivize or allow development on flood-prone land may have consequences such as decreasing property tax bases, deterring people from moving to an area or inhibiting private investment. Power companies must make costly infrastructure investments to ensure that customers have reliable service despite storms, flooding and erosion and

communities must make difficult cost/benefit decisions about what they can afford to protect, and what they cannot.

Health Risks

Often overlooked are the public health impacts of sea level rise. With increased inland flooding, tides and storm surge, health risks due to mold and vector-borne infectious diseases will also increase. Among the most vulnerable are residents with low socio-economic incomes living at low elevations, as they will be the least able to respond. It is necessary to improve drainage system infrastructure, preventing flooding in coastal communities which lead to health issues. Researchers are currently conducting sea level rise vulnerability assessments for areas of Southeast Florida, including a historic neighborhood in Fort Lauderdale. Researchers have gathered data to locate the areas that are most vulnerable, both physically and socioeconomically, with physical vulnerability being determined based on elevation, storm surge zone, and flood risk. Preliminary recommendations include integrating health issues into adaptive planning and policy development.

III. CURRENT RESPONSE TO RISKS

The complex interactions in the built environment make storm surge and rising seas difficult to manage. Hurricane response in Ft. Lauderdale has been well-established with the city commission, mayor, city manager, assistant city managers, and all department directors serving as members of the Fort Lauderdale Emergency Preparedness Task Force. However, the response to the long-term risks has recently become a consideration for local decision-makers.

Southeast Florida Regional Climate Change Compact

Southeast Florida is probably one of the most active regions in the United States responding to the risks associated with sea level rise, although [many regions are taking action](#). In 2009, the four southeastern counties (Palm Beach, Broward, Miami-Dade and Monroe) formed the *Southeast Florida Regional Climate Change Compact*, referred to locally as the Four County Compact. The Compact, whose role is to coordinate mitigation and adaptation activities across county lines, represents a unique, collaborative effort and has created a [Southeast Florida Regional Climate Change Action Plan](#).

The plan features 110 action items in seven goal areas, including Risk Reduction and Emergency Management, Sustainable Communities and Transportation Planning, and Water Supply, Management and Infrastructure. Many of the recommendations in the plan call for the integration of climate change and sea level rise into planning and decision making processes in ways that have yet to be implemented by any local governments.

City of Fort Lauderdale Adaptation Action Area Pilot

In 2012, the Florida Department of Economic Opportunity (DEO) initiated a five-year project, entitled [Community Resiliency: Adaptation Planning in Florida](#), to integrate sea level rise adaptation strategies into current planning mechanisms including the local comprehensive plan, local hazard mitigation plan and post-disaster redevelopment plan. In addition, the DEO received funding to work with the City of Ft. Lauderdale to make it one of the pilot project cities. This pilot project would integrate "Adaptation Action Areas" into their local comprehensive plan and prioritize funding for infrastructure needs and adaptation planning. The results of this process will be compiled into a guidance document to assist Florida communities that choose to address Adaptation Action Areas in their local comprehensive plan.

Risk assessment challenges include balancing the potential cost of evacuation with the possible loss of life. According to a study on Superstorm Sandy, most people did not understand the life threatening potential of storm surge until after the storm, when infrastructure was destroyed or seriously compromised. Risk assessment needs to be translated in a way that the public can understand so they can better prepare for storm related emergencies.

IV. CREATING A SUSTAINABLE CITY

Although Fort Lauderdale has been working towards creating a more sustainable city for many years, their Sustainability Division was formed in 2012 to consolidate resources toward this goal. Under the umbrella of sustainability, this division manages public works not only to provide basic service or comply with the law, but also to reduce negative environmental impacts, to maintain the livability within the city, and to reduce the costs of these operations through innovative best green management practices. One of the primary responsibilities of the division is implementing, monitoring and updating of the city's [Sustainability Action Plan](#).

The City of Fort Lauderdale's Sustainability Action Plan

The [Sustainability Action Plan](#) (SAP) provides a means for articulating: 1.) the city's specific "green" goals, strategies and performance indicators, 2.) how sustainability will be integrated into all levels of City decision-making, and 3.) a system of accountability. The initial SAP was published in 2010 through a collaborative effort of the Sustainability Advisory Board, City staff, expert groups and concerned neighbors.

The final result considered what was working, what was missing and how each effort helped or hindered the others, was a coordinated statement introducing five priorities and 17 goals. There were eight goals including Leadership, Air Quality, Energy, Water, Built and Natural Environment, Transportation, Waste, and Progress Tracking. The SAP identifies new initiatives to encourage and assist residents, businesses, developers and others to practice sustainability.

Fast Forward Fort Lauderdale: Vision 2035

While impossible to completely predict what the next 22 years will hold for the City of Fort Lauderdale, over the course of several years the City gathered more than 1,500 [ideas](#) through the citywide Visioning Initiative, which included a massive community outreach effort. These ideas form the foundation of the [2035 Vision Plan](#), a plan meant to guide decision-making processes in the City.

City of Fort Lauderdale Greenhouse Gas Emissions Inventory

The City of Fort Lauderdale was allocated over \$2M from the US Department of Energy's Energy Efficiency and Conservation Block Grant Program. Along with funding their Sustainability Action Plan and other initiatives, they were able to develop a city-wide Greenhouse Gas Inventory. This initiative established baseline measurements, identified target reduction and energy efficiency objectives, prioritized projects for funding, and provided the overall institutional framework to support the program for years to come by accessing additional funding opportunities.

Seven50 Initiative

The City of Fort Lauderdale has been an active partner in the [Seven50](#) ("seven counties, 50 years") Consortium. This initiative has been developing a blueprint for growing a more prosperous, more

sustainable Southeast Florida during the next 50 years and beyond. The plan is being developed to help ensure a vibrant and resilient economy, and stewardship of the fragile ecosystem in what is quickly becoming one of the world's most important mega-regions.

V. CONCLUSION

A crucial and difficult aspect of adapting to sea level rise is the human element. Acting on adaptation to sea level rise is not just a technical problem, it is a people problem. We need to inform and engage property owners, businesses, voters, and taxpayers to get them involved enough to act, however, without risking overwhelming them into a state of inaction. We have greatly improved our understanding of flood risk, but last year, the International Panel on Climate Change (IPCC) noted that increases in losses from disasters is due to humans' continued reliance on building and investing in vulnerable coastal areas. It is also a political problem involving subsidies to insurance companies. The voting public needs to take action and communicate with elected officials and decision makers. The City of Fort Lauderdale provides an excellent example and model of proactive planning and decision making at the municipal level. At the state level, we need to follow the lead of the City of Fort Lauderdale to include sustainability, energy efficiency, and climate change/sea level rise vulnerabilities into planning, management and top level decision making to ensure a sustainable and resilient future for Florida's residents.

A dense population living at low elevations in a region of rising sea level which is subject to tropical storms and hurricanes results in a high risk environment.

The key teaching points are:

- The importance of understanding the holistic hydrological system contributing to flooding.
- The impact of sea level rise on people where they live and work; how they manage water.
- The meaning of sustainability for the various socio-economic segments of the community.
- The current and potential economic impacts (positive and negative).

This case study was prepared by Alana Edwards and Mary Beth Hartman under the direction of Dr. Leonard Berry for the May 14 – 16, 2014 InTeGrate Workshop titled: *Teaching about Risk and Resilience: Sea Level Rise, Flooding, and Earthquakes*. For more information please call 561-799-8554 or berry@fau.edu.