



Hurricane Mitigation: The Insurance Environment and Government Planning Efforts

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EXECUTIVE SUMMARY

Hurricane mitigation is a crucial component of the daily conversation affecting the lives of millions of residents in South Florida. The following report serves to provide insight into hurricane and flood hazard mitigation for the state, and provides the knowledge and analysis required for informed public sector decision makers. The information gathered in this report is fundamental for the thousands of vulnerable communities in South Florida who depend on the efforts of several government inter-agency efforts in order to mitigate the damages faced during and after hurricane season.

This study focuses on South Florida's area, including Miami-Dade, Broward and Palm Beach Counties. The tri-county area exhibit heightened risk of flooding from hurricanes and sea level rise. Disproportionately threatened by hurricanes and sea level rise due to geography and geology, these three counties are major drivers of the Florida economy and therefore, need the adequate planning in the face of imminent threat. As part of the analysis, the report first provides an in-depth overview of the effects of Hurricanes and flooding in the region. Followed by an analysis on how those natural disasters affect the cities infrastructures such as building codes and mapping. The report also provides the citizens perspectives by analyzing the different components of the flood insurance market in Florida. By analyzing, the different interactions among the different agencies, the observation can focus on how it affects the common household in South Florida. In addition, the report focuses on evaluating the Comprehensive Master Plans of several south Florida cities and counties to study the different proposed approaches to counter the effects of climate change, flooding hazards, Flood Insurance policies, and even sea level rise. The report also lays out a current overview of local, state, and national legal efforts to counter such threats in Florida, and provides an organized matrix of public sector responses.

As reported in the previous years, the ongoing trend nationwide towards hurricanes and climate change has been a post-disaster reactionary response, rather than a preemptive strategy. Observation of the reactional trends are the revising of Florida construction codes following Hurricane Andrew, the expansion and upgrading of defensive barriers around New Orleans following Hurricane Katrina, and the new plans for building mitigation and resiliency in New York and New Jersey following Hurricane Sandy. This trend has begun to be broken in Florida, where many municipalities and counties have decided to take a proactive approach by formulating a projected sea level rise and either accounting for it in future plans, or selecting locations within their jurisdiction to take more immediate action. The Comprehensive Master Plans are vital examples of these immediate actions. The study of this report show how they highlight the potential problems of their cities and municipalities and plan to counter act the effects. Some municipalities have also begun to implement specific interventions like new or larger pump stations, black

flow valves, flood barriers, and ecological defenses. However, based on the strategies of FEMA and other national agencies it is hard to identify if they are enough to change the future damages. This inner loop of chaos also creates other actors into play that include an extremely active insurance market.

The report reviewed how the calculation of current flood insurance rate is determined and how it affects the household market in south Florida. In addition, the creation of the FEMA Flood Insurance Rate Maps (FIRM) households determines which households need to purchase flood insurance. Analysis within the report reflects on the methods of how cities acquire insurance discounts or can be removed from the mandatory zoning area. These acquired benefits are given after certain actions are executed or adopted by their citizens.

The report conducted a geospatial analysis on the special flood hazard areas within the tri-county area of South Florida to examine vulnerable populations that are located within the most flood prone areas. By isolating these populations, policy makers can attain an understanding of how vulnerable these populations really are before and after a disaster-strikes and can incorporate adequate protection for them.

I. Hurricanes in Florida

As the most southern state, Florida is the most vulnerable and prone to tropical cyclones. Naturally placed between the Gulf of Mexico and the Atlantic Ocean, the state is nestled between two bodies of warm water, which is the major proliferator for catastrophic tropical cyclones. Hurricanes spawn when the warm air rises off the surface of the water, which creates a zone of lower air pressure below it.¹ The new air that attempts to enter this low-pressure area moves up when it makes contact with the low-pressure vacuum. As the water over the ocean evaporates, this circular rotation and exchange of winds and temperatures begins to create a vortex of clouds.

The longer the newborn cyclone remains over warm water, the more catastrophic the hurricane will become due to the constant evaporation from the ocean.² On August 24, 1992 hurricane Andrew made landfall off the east coast of Florida in Miami-Dade County, near Biscayne National Park (Elliot Key & Sands Key) as a category five hurricane with winds peaking at 167 mph. The destruction brought about by hurricane Andrew in South Florida was cataclysmic and considered one of the most expensive natural disasters in U.S. history. As August 24, 2017, is the 25th anniversary of hurricane Andrew, this report details how monumental this storm was by describing how the building codes in South Florida have evolved. This also involves the following: how insurance rates have skyrocketed, how national flood insurance is molded to assist homeowners, which vulnerable populations are most at risk, the property values at risk, and finally what actions specific municipalities are taking to increase hurricane mitigation efforts.

Building Code

As hurricane Andrew ripped through South Florida, it left a trail of death and destruction in its path, 44 deaths in State of Florida, and 40 of these deaths occurred in Miami-Dade County (91%). As the death toll is striking and tragic, the true influence of the hurricane reveals itself in the months after its landfall. After sifting through the damage, officials determined that negligent and sub-par building codes may have contributed to Andrew destroyed 25,524 homes and damaged another 101,241. It destroyed 90% of all mobile homes in southern Miami-Dade, and 99% of all mobile homes in the City of Homestead.³ The resulting damage tallied up to a total of 25 billion dollars in South Florida, which converts to \$10.2 million dollars per square mile in Miami-Dade, \$75,586 dollars per square mile in Broward, \$35,045 dollars per square mile in Monroe, and a total of \$13,015 per square mile in Collier Counties.⁴

¹ NASA, 2006

² Ibid.

³ Rappaport, E. (1993). *Preliminary Report Hurricane Andrew 16 - 28 August, 1992*

⁴ National Hurricane Center, 1992

After the damage assessment was completed and the insurance claims reviewed, it instantly became clear that the building codes in South Florida needed revision. Researchers found that the bulk of the damage was preventable, for instance if the roofs were reinforced with stronger structural methods. They determined two main natural forces that catastrophic hurricanes produce to pose a direct threat to homes and structures: wind shear and wind uplift. The following section reviews why these natural forces are so dangerous to homes, presents the history of building codes in South Florida, evaluate how these said codes have evolved to offer better protection to homeowners, and discusses potential building code changes.⁵

To begin, wind shear is the lateral wind force applied to the walls and gable-ended surfaces of a building and it manifests itself when wind blows directly towards the building's surface. Wind shear is as a change in wind speed and/or direction over a short distance.⁶ Next, is wind uplift, which occurs when the air pressure below the roofing assembly is greater than the air pressure above the building's roof.⁷ Wind uplift is not only a threat to residential homes and businesses but also serves as a major risk factor to high-rise buildings. When a gust of wind comes through and crashes into a large building, the energy must alter its course (upwards); this creates a small vortex as the wind travels up and blends with a negative suction on the top of the roof.⁸

The most common type of damage that occurs from these two forces are "separation of the roof components, buckling of the roof trusses, pullout of the anchorage, and collapse of structural support."⁹ Wind shear and wind uplift have become the focus of major concern for policy makers, analysts, and engineers in South Florida. This led to an increased focus on wind engineering technology when drafting or hardening the building code. An example of these codes can be found in appendix D, which highlights Chapters 15 (rooftop structures) and 16 (wind loads and wind-born debris regions) of the Florida Building Code. These wind concentric codes not only strengthen the newly developed structure's building envelope (e.g. walls, floors, roofs), but they also require buildings to be fashioned in a certain manner as to allow the wind to pass through fluidly without generating any shear or uplift. In this sense, the building codes create wind damage prevention through architectural design.

History of Building Codes in Florida before Hurricane Andrew

⁵ Gomez, A. (2017, August 10). As Hurricane Andrew memories fade, Florida weakens building codes.

⁶ Federal Aviation Administration, 2008, p. 2

⁷ King, J. (2009). Basic Wind Uplift Design, Factory Mutual and Alternative Criteria

⁸ Ron Blank and Associates, 2009

⁹ Bradford & Sen, 2004, p. 45

A string of catastrophic hurricanes in the 1950s, made clear that South Florida needed stronger building codes due to the amount of damage done to properties and the need to protect the public. After a local group of experts partnered with the American Society of Civil Engineers (ASCE), they realized that the current codes of the day were not up to par, as they were accounting for hazards such as snow loading weight on top of buildings, or seismic activity/forces, neither of which are a threat in Florida.¹⁰ Not even one of the present codes addressed the hurricane force winds or resistance measures to prevent damage from tropical cyclones - the true natural threat to South Florida. The science-based model produced by this group of experts evolved into The South Florida Building Code (SFBC). Miami-Dade County was the first to adopt it in 1957, Broward followed closely and adopted an altered version of the code soon after.

While both Counties now had a building code on which to base new development, there was no mandatory requirement to adhere to it. In addition, since Broward County adopted their own version of the SFBC, it showed that the codes be implemented differently across local governmental bodies as they saw appropriate. This also displays a lack of uniformity that allows every county/municipality to secure the same protections as the others. In 1974, Florida accepted the State Minimum Building Code (SMBC), which required that all local governments adopt some variation of a code with a minimum standard for newly developed buildings.¹¹ This policy led many local governments to adopt the SFBC while others created their own based off models provided by the SMBC.¹² However, the inherent flaw to this was that as local governments began adopting either their new codes or the SFBC, they had the power to amend and interpret the code as they saw fit within their jurisdiction.¹³ Therefore, was a great political pull on the panel of experts that were interpreting the code, which may have deteriorated the quintessential protection that the code was supposed to offer the public, this may have been the precursor to the destruction that followed in Andrew's wake.¹⁴

The Aftermath of Hurricane Andrew

Hurricane Andrew showed that a fragmented set of local codes was not sufficient to provide adequate protection against hurricanes. While the goal of the SMBC was supposed to be a 'universal' code, the power of local governments to amend and change the codes as they saw fit undermined the intention and rendered it impractical. Therefore, post-Andrew, Miami-Dade County piloted a program to revise the current minimum codes and further harden structures against storm damage. The State of

¹⁰ History of South Florida Building Code. (n.d.).

¹¹ Florida Building Commission Report to the 2008 Legislature, 2008

¹² Ibid

¹³ History of South Florida Building Code. (n.d.).

¹⁴ Ibid

Florida, acknowledging the express need for stronger building codes, also acted in 1996 and launched a study/review of the minimum code laws enacted in 1974.¹⁵ The study revealed that the state minimum building codes were too weak and recommended a standardized approach in the form of a statewide code.

In 1998, the Florida Legislature adopted the study commission's recommendations for a single state building code and an enhanced oversight role for the state in local code enforcement.¹⁶ The action resulting from this study was the framework for The Florida Building Code (FBC). In 2002, the first edition of the FBC swept through the state and replaced all local minimum codes. One of the major lessons learned from hurricane Andrew was that codes prior to the year 1996, did not account for withstanding high wind velocity. Chapter 16 of the FBC, in section 1602, titled "Structural Definitions", was the first formal classification of different types of loads (including wind) that impose themselves upon roofs.¹⁷ Chapter 16 of the FBC also brought about the concept of "wind-borne debris regions" and "high velocity hurricane zones." These zones, designed to set a firmer standard in certain areas that were more at risk to destruction and public safety. The jurisdictions delineated based on The American Society of Civil Engineers Standard (ASCE 7-98). Wind-borne debris regions (WBDR), are "hurricane-prone regions within 1 mile of the coastal mean high-water line, where the basic wind speed is 110 mph or greater; or portions of the hurricane-prone region where the basic wind speed is equal to or greater than 120 mph."¹⁸ It is important to note that in 1995, "WBDR were considered any zone that had a wind speed of 110 mph or greater, WBDR are now restricted to hurricane-prone areas and account for wind speeds 140 mph or higher."¹⁹ (See Appendix D for an example).

FEMA research shows most damage reported after a major storm is on broken doors, windows, or glazed openings.²⁰ Therefore, the focus of wind mitigation efforts has since concentrated on protection requirements for windows (such as the rise of hurricane impact windows). The first window provision came in the 1995 version of the ASCE 7, which focused on hardening the requirements for glazing (e.g.

¹⁵ FLORIDA BUILDING COMMISSION REPORT TO THE 2008 LEGISLATURE.

¹⁶ Florida Building Commission, 2006, p.7

¹⁷ A structural load is any type of pressure, stress, or weight that imposes upon a building's roof (Chapter 16 *Structural Design*, 16.1-16.48). Chapter 16 covers different types of loads such as dead loads (weight of the structural components), live loads (weight of external items such as humans, furniture, wind, snow, or rain), and impact loads (the weight of an accelerated shock) (Ciftcioglu, Yildizel, Yildirim, & Dogan, 2017). In this case, the wind load (live load) is the amount of weight/pressure it puts on the roof until it will cause destruction/significant damage.

¹⁸ IRC; IBC; and ASCE 7-05

¹⁹ FEMA, 2013

²⁰ *Windows, Doors, and Opening Protection* (Rep.). (n.d.).

windows, sunroofs, etc...) against windborne debris.²¹ According to FEMA, “the standard stated that glazing in the lower 60 feet of all buildings located in regions where the basic 3-second gust wind speed equaled, exceeded 110 mph had to be protected against windborne debris, or that buildings had to be designed to resist higher internal pressures.”²² These early efforts towards window resilience formed by the fact that when there is a hole in the building envelope (e.g. a broken window), the pressure within the building fluctuates and causes wind uplift and increases the chance of the roof being ripped off its supports. As glazed openings are the most vulnerable part of the building, the ASCE – 7 has thus strengthened its window protection requirements to mitigate damage. This allows the buildings to both protect against windborne debris and wind pressures.²³

When considering glazed openings, the FBC draws from the method used in the International Residential Code (IRC) section R301.2.1.2. This section dictates, “Glazed opening must be protected in accordance to the requirements of the Large Missile Test of an approved impact resistant standard, or ASTM E1996 and ASTM E1886.”²⁴ The ASTM E1886 is the Standard Test Method for Performance of Exterior Windows, Curtain walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials, is a consensus-based testing protocol that draws on the opinions of municipal code enforcement officials to determine compliance.²⁵ The ASTM E1996 augments the ASTM E1886 by specifying the weight and sizes of the missiles used in testing procedures.²⁶ This makes a more standardized code for one of the most vulnerable components of a building.

As defined by section 202 of the FBC, high velocity hurricane zones (HVHZ) are Miami-Dade and Broward counties.²⁷ The following sections lay out region specific instructions for buildings constructed within HVHZs. Section 1615 – Reflection, volume changes, and minimum loads, which state the general design requirements for roof loads. Section 1616 – Roof live loads, which states “roofs shall be designed for a live load of not less than 30 pounds per square foot (psf). Section 1617 – Roof drainage, which focuses on preventing the accumulation of water atop the roof, thus increasing the load. Section 1618 – Special load considerations, which focuses on specialized components/factors that may affect a building’s load such as floors, heliports, safeguards, railings, and vehicle safeguard barriers. Section 1619 – Live load

²¹ FEMA, 2013

²² FEMA, 2013, p.10

²³ FEMA, 2013

²⁴ FEMA, 2013

²⁵ Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials. (n.d.).

²⁶ ASTM E1996 Missile Levels and Definition. (n.d.).

²⁷ Jeld-Wen, 2011

reductions, which depict what, may or may not be done to decrease live loads. Section 1620 – Wind loads, which explicitly state, “Buildings and structures, and every portion thereof, shall be designed and constructed to meet the requirements of Chapters 26 through 31 of the ASCE 7.”²⁸ The ASCE 7 has added special ‘exposures’ into its literature to better protect certain areas that may naturally proliferate hurricane damage.

South Florida falls into the category of “exposure C,” which states that “open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30ft.”²⁹ This category includes flat open country, grasslands, and all water surfaces in hurricane prone regions.”³⁰ In accordance to the FBC, the areas that lie within 1,500 feet of the coastal construction control line (CCCL), or within 1,500 feet of the mean high tide line, whichever is less, exposure category C shall be applicable. This is set out in s. 161.55(5), Florida Statutes (Requirements for activities or construction within the coastal building zone).³¹ This exposure is relevant to South Florida because the landscape is primarily flat as well as the presence of barrier islands that are located off the coast. These stricter codes have not only defined special hazard areas (where properties are exposed to excess wind damage), but they have shaped the changes in the way roofs are constructed since hurricane Andrew (see Appendix D for technical explanation of roof top assembly changes).

Moving forward, the FBC must not only ensure that the codes are producing more wind resistant structures, but it must make sure the codes are being enforced and implemented in a uniform manner across the state. An up-to-date labeling system helps to achieve this goal. The American Architectural Manufacturers Association (AAMA) and the Window & Door Manufacturers Association (WDMA) are both organizations that dedicate to providing a standard of safety and effectiveness with the installation and maintenance of windows and doors. Labels present on the windows must clearly state the manufacturer, performance characteristics, and approved product evaluation entity.³² Either the AAMA or the WDMA labels windows, they have passed rigorous testing/inspection standards and are up to code.

The FBC also established a product approval system (PAS) to ensure only the safest products and technological advances used in the construction of new buildings. The PAS was officially brought into practice when the FBC was implemented 2002. However, any products that were coming into the construction market prior to October 1, 2003, implement the standard used in the past. After October 1,

²⁸ Chapter 16 Structural Design, 16.1-16.48

²⁹ Technical Data Sheet. (2015, November).

³⁰ ASCE 7-05

³¹ Florida Building Code, 2017

³² Florida Building Commission, 2017

2003, local jurisdictions needed to follow the standards laid out in the FBC for the PAS.³³ One of the main goals of the product approval system (PAS) is to encourage new products that can increase safety/meet safety requirements but also use less expensive manufacturing methods³⁴ (for a technical explanation of the PAS, see Appendix D).

Enforcement and Compliance

There are accreditation bodies that give credit and monitor the competency/performance of an agency carrying out specific tasks associated with the PAS.³⁵ Evaluation entities conduct product evaluations based on scientific tests and/or rational analysis, they are conducted within laboratories where the actual tests of the products are conducted (e.g. the missile test discussed previously).³⁶ Then there are certification agencies, who primarily conduct quality assurance and certify compliance with up to date standards.³⁷ Last, there are quality assurance agencies who monitor product production and validation entities that certify product approval applications.³⁸

The Florida Building Commission conducts the implementation of these methods and enforcement practices. The Florida Building Commission is a 23-member governor-appointed group of specialists from a vast array of fields. The membership composition is established via the American National Standards Institute (ANSI) criterion for representation.³⁹ The Florida Building Commission updates the FBC on a triennial basis. Along with these code updates, The Florida Building Commission must also make sure contractors stay up-to-date with the new additions and revisions. To maintain a high-quality standard, the Florida Building Commission provides training courses and educational material for both certified and registered contractors. Fourteen hours of board-approved continuing education is required every two years prior to the renewal of the FBC.⁴⁰

Keeping an active connection with contractors is an essential component to maintaining strong enforcement practices and ensuring that the building code remains standardized. This concept also led to the implementation of the Building Code Information System (BCIS). BCIS was developed in the early 2000s and serves as a multi-faceted database. It provides the public and professionals in the construction field access to the Florida Building Code, Manufactured Building Program, Product Approval System, The

³³ Ibid.

³⁴ Ibid.

³⁵ Ibid.

³⁶ Ibid.

³⁷ Ibid.

³⁸ Ibid.

³⁹ About ANSI. (n.d.).

⁴⁰ Building Code Administrators and Inspectors Board. (n.d.).

Prototype Program, local code amendments, declaratory statements, nonbinding opinions, and the interested party list.⁴¹ The implementation of the BCIS made enforcement practices for the Florida Building Commission more practical and application based.

Therefore, the active monitoring of consistent code violations is possible for enforcement practices. Contractors who consistently commit code violations are subject to penalization. Violations that pose a direct threat to the “health/safety of the public result in fines ranging from \$500 to \$5,000, and disciplinary action against the violating contractor’s license.”⁴² According to Cox, Issa, and Ligator (2006), “All the fines paid and disciplinary actions taken because of the code violations will be logged on an automated information system for review per jurisdiction.”⁴³ Criminal liability may ensue when there is a consistent trend of violations. Code violations deteriorate the consistent resilience efforts made by the FBC.

In a study conducted by Cox, Issa, and Ligator (2006), it is revealed that not only the top ten code violations in the state of Florida, but also that 7 out of those 10 violations are from the framing category (strapping, trusses, connectors, fire blocks, windows and doors, electrical rough-in, and wind braces).⁴⁴ The top two violations directly link to mechanisms that proliferate hurricane damage. The first is strapping, which are joints of galvanized steel that secure a building’s roof to its walls.⁴⁵ The second of the top two violations are against the trusses. Trusses, used to frame the roof of a building, carry the roof load to the exterior walls of a structure.⁴⁶ The building codes in the framing category are of particular interest when considering hurricane mitigation, because it encompasses the construction of the building envelope.

To clarify, the building envelope as defined by the Pew Research Center on Global Climate Change (2011) is the “interface between the interior of the building and the outdoor environment” (p.1). Weak building envelopes caused by poor/careless construction proliferate damage caused by hurricane force winds and can cause penetration to the house/windows. This was the main cause of damage to properties by hurricane Andrew. Cox, Issa, and Ligator (2006), also identified that the mean occurrence of code violations was far lower in coastal Florida counties than those within the inland counties. This is due to the destruction wrought by hurricanes on coastal counties; therefore, construction workers are more

⁴¹ Florida Department of Community Affairs, 2006, p.24

⁴² Cox, Issa, and Ligator, 2006, pg. 7

⁴³ Ibid

⁴⁴ Cox, Issa, and Ligator, 2006, pg. 25-26

⁴⁵ Ibid. pg.28

⁴⁶ Ibid.

diligent in adhering to the building codes while enforcement officials focus more on protecting the public.⁴⁷

The 2004/2005 Hurricane Season

The FBC, mandatorily updated on a triennial basis, is in accordance to Florida Statute 553.73.⁴⁸ The first edition of the FBC started its rotation in the drafting process in 2001 (nine years after Andrew) and was published in 2002. This was the first major step Florida took into building a stronger, more hurricane resilient society. Between 2001 and 2004 (the year of the second edition), there was only one hurricane that made landfall in Florida with category one force winds. Off the west coast of Florida, hurricane Gordon traveled north-northeast as a category one hurricane (74.8 mph), and then devolved into a tropical storm (63.2 mph) before it made landfall in Dixie County. While Gordon caused \$10.8 million dollars in damage to the State of Florida, the only reported insurance claims were for minor roof damages and flood damage caused by the storm surge.⁴⁹ Hurricane Gordon could hardly serve as a test for the new FBC, as it was weak in nature and did not hit any HVHZs.

The real test for the FBC came in the 2004 and 2005 hurricane seasons. Seven hurricanes of note consistently hit Florida those two years and considered the closest it had ever been to the devastation of Andrew. In 2004, hurricanes Ivan (category 3), Frances (category 2), Charley (category 4), and Jeanne (category 3) passed through the state. In 2005, hurricanes Katrina (category 1 in Florida), Dennis (category 3), and Wilma (category 3) put the building codes to the test. The seven hurricanes cost approximately \$22.47 billion dollars compared to hurricane Andrew's \$25 billion dollars in damages.

The major successes of the 2001 FBC versus the 2004/2005 hurricane season include "no catastrophic structure failures; windows, doors, and garage doors were able to withstand varying wind pressures, applied window protection drastically reduced the wind-borne debris damage, and shingle and metal roof coverings remained intact."⁵⁰ Nevertheless, the 2004/2005 hurricane season showed South Florida the grim reality that its strengthened building code system was still vulnerable. According to Dixon (2009), the seven hurricanes identified several weaknesses in the FBC such as "roof tile detachment at hips, ridges, and eaves, extensive soffit damage (area located under the drip edge of a roof), aluminum

⁴⁷ Ibid. , pg.29-30

⁴⁸ 553.73 FS, 7(a) (2017), states "The commission shall adopt an updated Florida Building Code every 3 years through review of the most current updates of the International Building Code, the International Fuel Gas Code, International Existing Building Code, the International Mechanical Code, the International Plumbing Code, and the International Residential Code, all of which are copyrighted and published by the International Code Council, and the National Electrical Code, which is copyrighted and published by the National Fire Protection Association" (The Florida Statutes, 2017)

⁴⁹ Stewart, 2000

⁵⁰ Dixon, 2009, p. 20

screen enclosure failures, wind-borne debris damage, and flood intrusions in the first story masonry and story wood walls, attic vents, and through windows.”⁵¹ In response to this trial run of the FBC, the Florida Building Commission made significant improvements to strengthen homes in the second edition (2004-2007).

These updates included a stronger focus on “requirements for wood to masonry wall interfaces, roof tile attachments, the adoption of a standard that rates asphalt shingles based on wind speed, improved roof deck nailing when re-roofing, the adoption of wind pressure criteria for soffits, and the elimination of partially enclosed design options (e.g. patios or partial carports).⁵² After surviving the 2004/2005 hurricane seasons, these observations, failures, and improvements redefined the FBC as one of the most resilient in the nation. It was not until 2017, that an accurate and quantified number displays how well the FBC was operating.

Simmons, Czajkowski, and Done (2017), analyzed 10 years of data from 2001 to 2010 to evaluate the economic effectiveness of the statewide policy. This included a special segment on the 2004/2005 hurricane seasons to assess the validity of the claims stating that the FBC massively reduced the amount of windstorm losses to the state of Florida. When interpreting the regression models run on all ten years and the 2004/2005 hurricane seasons, Simmons, Czajkowski, and Done (2017), found that “the effect of the FBC had a 72% reduction in losses.”⁵³ This finding further shows that the ongoing implementation of the FBC should be a top priority for policy makers to protect the public from catastrophic hurricanes.

The Future of Building Codes in Florida

As the above findings seem to be supportive of the fact that the FBC is the strongest in the nation, actions taken by the Florida Legislature directly contradict the true nature of these findings. There has been a shift in opinion about the strong protections the FBC provides, such as the topic of cost-impact on the housing market has appeared. It is common knowledge that as you further hurricane-proof a home, the more it will cost to purchase and maintain. Many officials in the Legislature have come to believe that the FBC is forcing contractors to over prepare and spend an unnecessary amount of money on building a hurricane-proof home.

With the introduction of Senate Bill 1312 and Senate Bill 1372, we can begin to see the potential for South Florida’s prestigious building codes to erode. SB 1312 and SB 1372 were introduced by Senator Keith Perry of District 8 which consists of Alachua, Putnam, and a portion of Marion County) in early 2017,

⁵¹ Ibid. p. 21

⁵² Ibid. pg. 22

⁵³ Simmons, Czajkowski, & Done, 2017, pg. 19

with the intention of amending many of the Florida Statutes on construction and the Florida Building Code.⁵⁴ The two codes will “(1) replace the I-Codes with the 6th edition (and subsequent editions) of the FBC as the foundation code for the FBC (meaning the current version will be frozen in time as a standard for the future)” and second, the code will “(2) replace the current mandatory three-year update of the FBC with a permissive review process (extended to every six years).”⁵⁵ On face value, these bills seem harmless as they simply change the process of updating the FBC. However, over time, this restructuring process will chip away at the consensus-based and scientifically proven method of making homes more hurricane resilient.⁵⁶ In other words, it freezes the current method in place for six years and while the science of protection advances, the building codes are left behind.

If these bills are signed into law, it would be a step-back towards the fragmented system of codes that we had pre-Andrew. With the mounting literature stating that the 2017 hurricane season will be more active than it has been in years, it only makes sense that South Florida’s building codes remain progressive and up-to-date.⁵⁷ For example, Hurricane Matthew (2016), showed that it is not a matter of “if” another catastrophic hurricane makes landfall, but rather “when.” The Federal Alliance for Safe Homes (2017), states that “Senate Bills 1312 and 1372 would leave updating the minimum safety requirements for every structure in the state, from residential housing to hospitals to schools, to a committee of individuals with limited resources.”⁵⁸ Meaning, the State of Florida, which is the most likely state to be hit by a hurricane would be taking steps backwards in a time where research in building science and hurricane resilience is rapidly moving forward.

⁵⁴ The Florida Senate: The Professional Staff of the Committee on Appropriations, 2017

⁵⁵ Federal Alliance for Safe Homes, 2017, p. 2

⁵⁶ Federal Alliance for Safe Homes, 2017

⁵⁷ National Oceanic and Atmospheric Administration, 2017

⁵⁸ Federal Alliance for Safe Homes, 2017, p. 10

II. The Florida Insurance Market

After hurricane Andrew swept through South Florida and left a trail of destroyed homes, the insurance claims overwhelmed the coverage pay-abilities of insurance companies. As the claims exceeded the monetary capabilities of most companies, an insurance crisis ensued that would leave an impact for years to come. Mittler (1998) shed light on the perspective that more proactive planning would have prevented the post-Andrew insurance crisis. When calculating insurance rates pre-Andrew, the insurance companies did not account for “low probability, high consequence hurricanes.”⁵⁹ This inherent flaw resulted in a price-driven insurance market within the state of Florida.

Therefore, the main competitive strategy used by insurance companies in 1992, was to keep their premiums on the lower end of the spectrum. Thus, after hurricane Andrew wrought all of its destruction in South Florida and the monetary losses counted, scientists identified the new risk areas. As a result, new insurance companies instantly became hesitant to provide suitable coverage to homes located in high velocity hurricane zones (HVHZ). It became clear that State action was required to maintain a valid insurance market in South Florida.⁶⁰

In an attempt to quell the crisis and retain insurance companies within the State of Florida, the insurance commissioner via The Florida Office of Insurance Regulation set out a series of emergency rules. Among these rules were 4ER92-11 and 4ER92-15, both of which played a role in the development of the contemporary insurance market. 4ER92-11 dictated that an insurance company attempting to withdraw business from Florida must provide an extensive write-up of their reasons for doing so, as well as provide evidence that it would not negatively influence the insurance market.⁶¹ 4ER92-15 led to the creation of the Florida Residential Property and Casualty Joint Underwriting Association (FPCJUA). The FPCJUA’s mission was to provide property insurance to the current breadth of abandoned policyholders whose insurance company either fled or went bankrupt.⁶²

To display the drastic changes in the insurance market before and after Andrew, we compare the total value of the property insurance market in 1980 and 1993. In 1980, the residential property insurance market was valued at \$178 billion; in 1993 (post-Andrew), it was valued at \$418 billion, a 135 percent increase.⁶³ Most property damage that accounted for the claims in the insurance crisis stemmed from wind damage. At the time, the only wind insurer available to coastal homeowners was the Florida

⁵⁹ Mittler, 1998, p.9

⁶⁰ Mittler, 1998

⁶¹ Ibid.

⁶² Ibid.

⁶³ Mittler, 1998, p. 4

Windstorm Underwriting Association (FWUA). The FPCJUA and the FWUA merged in 2002 to create Citizens Property Insurance.⁶⁴

Insurance premium rates have since skyrocketed due to information asymmetry, the restructuring of the insurance market in Florida, and certain abuses such as assignment of benefits fraud. Since the massive devastation of hurricane Andrew, an abundance of information was pouring into the insurance market for ratemaking. It ranged from the definition of risk, to the areas that are most prone to hurricanes, to the most effective building standards. This primarily placed valuable information in the hands of the insurance providers. Therefore, the policyholders experienced an increase in their insurance premiums due to rates created by unregulated information.

The Florida Legislature responded to this by instating the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) in 1995.⁶⁵ Still in practice today, the FCHLPM is a panel of experts that creates reliable projections on hurricane loss models.⁶⁶ These projections then serve as a check on insurance rates across the State of Florida to ensure that the coverage provided is proportional to the price the policyholder is paying. Information asymmetry increased premiums again in 2006, with the introduction of the near-term hurricane model.⁶⁷ Near-term hurricane models predict insurance losses caused by hurricanes over a five-year period.⁶⁸ This brought about an increase in insurance rates because it was a step away from the traditional means of calculating insurance premiums and again bringing about an abundance of new information into the market.

Another way that insurance rates began to climb since Andrew was the restructuring of the property insurance market. House Bill 1A (HB1A), introduced by Florida Governor Charlie Crist (2007-2010) in order to reduce the cost of reinsurance and increase the coverage provided by the State through the Florida Hurricane Catastrophe Fund (FHCF).⁶⁹ It increased the amount of reinsurance coverage available to homeowner's insurance companies from \$16 billion to \$28 billion.⁷⁰ This served as a major money saving opportunity for insurance companies because the new reinsurance provided by the FHCF was 50% less than what was available to them.⁷¹

⁶⁴“Citizens Property Insurance Corporation.”

⁶⁵ Weinkle, 2014

⁶⁶ “About the FCHLPM.”

⁶⁷ Weinkle, 2014

⁶⁸ Karen Clark & Company, 2008

⁶⁹ “The Florida Property Insurance Debate: Governor Rick Scott and Charlie Crist Campaign Review.” Johnson Strategies, 25 Sept. 2014,

⁷⁰ Johnson Strategic, LLC, 2014

⁷¹ Ibid.

HB1A met with controversy instantaneously because it shifted a massive portion of the FHC to the sale of reinsurance. This meant that in the event of a major hurricane, the FHC would not be able to pay its claims in full leaving many citizens without a home.⁷² In an effort to amend this void, Governor Charlie Crist signed HB 1495 into law, which increased premiums across the board in order to assure adequate coverage.⁷³ HB 1495 reduced the temporary increase in coverage limits (TICL) by \$2 billion dollars every year for six years, it increased the premiums for Florida citizens by 5% each year until capping it at 25% in 2013, it gave Citizen's Property Insurance Corporation the power to raise their rates by 10% per policy holder per year.⁷⁴ This notion of property insurance rising in premiums from one day to another correlates with the sentiments of most residents in South Florida. As reviewed in the next section of this document, residents of South Florida live in a continuous fear and expectation that insurance rates for their properties will continue to rise in the next years to come.

Ygrene-Pace

Ygrene is a clean energy-financing provider founded in 2009 serving the residential and commercial markets. It currently serves Florida, California, and as of 2017 Missouri. Their mission is to make energy-smart home improvements available to anyone. Ygrene provides instant financing with no upfront payments for home improvements, which include energy efficiency, renewable energy, and storm and wind protection. The main goal of Ygrene is to make energy-smart home improvements available to anyone.⁷⁵ Financing for improvements made by Ygrene is provided by the Property Assessed Clean Energy model (PACE).⁷⁶ PACE gives local and state governments the power to provide up-front cost of energy efficient improvements to residential and commercial buildings. The owners then slowly pay back the cost over a time-period of their choice through their property taxes (up to twenty years).

Insurance premiums have increased massively since Andrew due to abuses to the current set of statutory provisions set forth in State law. One such abuse is assignment of benefits fraud. Assignment of benefits (AOB) occurs when a third party takes the place of a policyholder. For example, a contractor may step in to repair a damaged roof and then request payment from the insurance company directly as if they were the policyholder. Therefore, the actual policyholder does not feel the direct impact of this statutory provision because they do not need to make any payments upfront. Contractors also set the stage by

⁷² "The Florida Property Insurance Debate: Governor Rick Scott and Charlie Crist Campaign Review." Johnson Strategies, 25 Sept. 2014,

⁷³ Ibid.

⁷⁴ Ibid.

⁷⁵ The Florida Legislature, n.d.

⁷⁶ PACE Nation, 2016

forcing policyholders into an AOB agreement by refusing to begin the work/repairs until the AOB finalizes.⁷⁷

However, loopholes in the system lead to litigation and lawsuits that directly drive up the costs of homeowner's insurance. According to Jeff Atwater (former Florida CFO), "in 2006, there were 405 AOB lawsuits across all 67 counties in Florida and in 2016, that number had risen to 28,200."⁷⁸ It is a common consensus that attorneys and private contractors are abusing the AOB system for their own benefit. AOB fraud occurs when the contractor preforms too much work and then sues the insurance company to get the payment they claim to deserve.⁷⁹ The legal fees and payouts to third parties is where the true issue begins to manifest. These legal fees are an additional expense next to claims that insurance companies must pay; therefore, to prevent bankruptcy the insurance company must raise the policyholder's premium to cover the cost.

To clarify, the main legislative loophole that is affecting the increase in homeowner's insurance premiums is within one-way attorney's fees. These fees, originally designed in the late 1800s, were a means of providing an equal opportunity to effective legal counseling for insurance claims.⁸⁰ David Altmair expressed in a Florida Cabinet meeting early February, 2017 that the purpose of one-way attorney fees was that "homeowners do not have to worry about paying attorney fees when they have been wronged."⁸¹ The one-way attorney fee details that the insurance company must pay for all legal fees associated with a claim if they lose the lawsuit. The main issue with this statute is that it extends its benefits to third parties by the signing of AOBs. According to David Altmair, this "provides an incentive/opportunity structure for contractors to get into disputes with insurance providers once the benefits have been assigned."⁸²

Should this trend keep up, owning a home in South Florida may be unattainable within the next five years. According to the Florida Office of Insurance regulation, if the State does not see statutory reform, premiums will skyrocket statewide from an average of \$1,232.08 in January 2017 to \$1,595.07 in January of 2022 for a new home (150k value).⁸³ Those numbers drastically change when honing in on

⁷⁷ Citizens Property Insurance Corporation, 2016

⁷⁸ Assignment of Benefits. (n.d.).

⁷⁹ Ibid.

⁸⁰ Committee on Banking and Insurance , 2005

⁸¹ Ibid.

⁸² Ibid.

⁸³ Florida Office of Insurance Regulation, 2017

Miami-Dade County. For a new home valued at \$150k, prices will jump from a projected average of \$2,732.95 in January of 2017 to an average of \$4,441.60 in January of 2022.⁸⁴

As a result, there were three bills drafted in 2017 to fix the AOB abuse issue, SB 1038, SB 1218, and HB 1421. SB 1038, drafted by the Office of Insurance Regulation (OIR) directly targeted the incentive for abuse, which was the one-way attorney fees. The bill dictated that AOB would remain intact, but the one-way attorney fees not be extended to the third party pursuant to the assignment provision.⁸⁵ Next, SB 1218, drafted by Senator Gary Farmer of Ft. Lauderdale, orders that AOB also remain intact. However, any assignment agreements be taken to the insurance company so a valid estimate can be drawn before the contractor attempts to file a lawsuit.⁸⁶ SB 1218 also requires that water restoration contractors acquire approval by the Department of Business and Professional Regulation, as the most AOB fraud claims stem from this field. HB 1421, sponsored by Representative James Grant, aimed to keep AOB and one-way attorney fees, but use a formula to determine when attorney fees be awarded.⁸⁷ SB 1038 and HB 1421 died in Banking and Insurance on 5/5/2017, SB 1218 died in Regulated Industries the same day.

The above-stated bills died due to indecision on whether AOB be ruled out or regulated. According to several news outlets such as The Daytona Beach News-Journal, The Ocala Star Banner, and The Florida Record, a decision on a valid course of action to combat AOB abuse deteriorates because of mixed opinions.⁸⁸ Those in favor of SB 1218 believe AOB not be ruled out, but rather regulated, which keeps the incentive for abuse intact. While proponents of a completed ban on AOB favor HB 1421 and SB 1038 with the intention of eliminating the incentive behind the abuse. Indecision over this issue is allowing contractors to run rampant in the usage of AOB, and is causing homeowner's premiums to rise at an accelerated rate.

⁸⁴ Ibid.

⁸⁵ The Florida Senate, 2017

⁸⁶ O'Connor, 2017

⁸⁷ The Florida Senate, 2017.

⁸⁸ The Daytona Beach news-journal, 2017; Kennedy, 2016; The Ocala Star Banner, 2016

III. Insurance Flood Policy in Florida

General

The National Flood Insurance Program (NFIP), created by the passage of the National Flood Insurance Act of 1968 (NFIA) and the Federal Insurance & Mitigation Administration (FIMA) brought to life by the NFIA, served as a means of managing and administering the NFIP.⁸⁹ It operates under the Federal Emergency Management Agency (FEMA). FIMA's main goal is to mitigate the full spectrum of natural hazards. There are three main components that FIMA must address when successfully mitigating hazards. The components are risk management, mitigation, and federal insurance.⁹⁰

First, risk management is the process of combining the evaluative findings of experts in all relevant fields to determine the probable impact that a hazard may have on the community. According to FEMA, program areas within risk management include "flood hazard identification and mapping, multi-hazard mitigation planning, national dam safety program, national levee safety program, HAZUS-MH, building science, and national earthquake hazards reduction program."⁹¹ The second component is mitigation, which reduces potential risk by administering "land use planning, floodplain management, and adopting sound building practices."⁹² The third component is federal insurance; this directorate manages the NFIP and all of its main components (e.g. enforcement of management ordinances).

Section 1360 of the NFIA authorized the Secretary of the Department of Housing and Urban Development to open communications to other federal departments, private organizations, or any source that would lead to the acquisition of useful information on the floodplain regions throughout the nation.⁹³ Section 1361 gave the NFIP permission to implement sound mitigation practices for the nation to apply based on the criteria for identifying flood hazard areas.⁹⁴ Lastly, when the NFIA began in 1968 it dictated identify that "flood-risk zones" in all flood prone areas in order to estimate the rates of probable flood caused losses for each risk zone.⁹⁵ The period for completion was 15 years, meaning that all flood maps and risk zones be established by 1983.

National Flood Insurance Policy

The main goal of the NFIP is to provide subsidized federal insurance to individuals who reside within a moderate to high risk flood zone. It provides financial aid to those who have been exposed to

⁸⁹ The American Institute for Research, 2005

⁹⁰ Federal Emergency Management Agency, 2016

⁹¹ Ibid.

⁹² Ibid.

⁹³ The American Institute for Research, 2005

⁹⁴ Ibid.

⁹⁵ Ibid.

flooding and have had their property damaged by it, even when the flood was not caused by a major disaster. The NFIP operates as a mutual umbrella across the federal, state, local governments, as well as the private sector. It is considered everyone's responsibility to pitch in and provide accurate data, research, and perspectives in order to provide the best forms of protection to the homeowners within the community. The NFIP is available to any community that buys in by agreeing to the adherence of ordinance administration, enforcement, reulation, and providing current and updated information/data when possible to enrich the current flood maps.

There are three main components that go into the management of the NFIP. They are mapping, insurance, and regulations. Mapping serves as one of the most important functions in the management of the NFIP because both the directorates of insurance and regulations rely on them to make data driven decisions. The management and maintenance of maps are implemented in the NFIP for several different purposes. According to French and Associates, LTD (1998), they are used by "municipalities, states, and the federal government as the foundation for regulating new floodprone construction; insurance agents use them when evaluating risk in the calculation of insurance premiums; and finally lenders and federal agencies use the maps to determine when a property owner must buy into flood insurance as a condition to a loan or form of financial aid."⁹⁶

The second component in the NFIP is the distribution and availability of insurance. Any property located within a municipality that has bought into the NFIP is entitled to flood insurance coverage at a subsidized rate. This includes homes and businesses that are not located in Special Flood Hazard Areas (SFHA). According to data provided by FEMA (2016), there are 25,051 communities bought into the NFIP nation-wide, 470 in Florida, 35 in Miami-Dade County, 32 in Broward County, and 39 in Palm Beach County.⁹⁷ The NFIP defines a flood as "a general and temporary condition or complete inundation of normally dry land areas from: (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff or surface waters from any source."⁹⁸ The premiums that homeowners of newly developed properties must pay on their flood insurance depends on the amount of flood protection they receive.⁹⁹ To clarify, Flood Insurance Rate Maps (FIRMS) identify risk by calculating the geographical elevations most at risk to flooding within a community. The flood insurance premiums base their assessments off the risk presented in these maps. According to FEMA (2017), pre-FIRM buildings, constructed before base flood elevations (BFE) came into effect and defined the risk the current rates are

⁹⁶ Federal Emergency Management Agency, 2007, p. 2-6

⁹⁷ Federal Emergency Management Agency, 2016

⁹⁸ Ibid. p. 2-7

⁹⁹ Ibid.

based on are entitled to a subsidized rate.¹⁰⁰ It ensures that anyone living within a floodplain receives adequate protection against potential flood hazards.¹⁰¹

The third component in the management of the NFIP is regulation. The regulations imposed on an active NFIP subscribed community are an essential factor for the continuance of their subsidized flood insurance coverage. According to French and Associates (1998), “in order for a community to participate in the NFIP, it must adopt and enforce floodplain management regulations that meet or exceed the minimum NFIP standards and requirements.”¹⁰² The minimum requirements for participation in the NFIP can be found in Chapter 44 of the *Code of Federal Regulations* (44 CFR), Section 60.3. These regulations include the hardening of newly developed structures, requiring specialized permits for building, and the mandatory collaborating of official data for areas of unknown flood risk.¹⁰³ All regulations submitted by a community must include effective enforcement provisions.¹⁰⁴

All floodplain regulations set forth by communities participating in the NFIP adhere to city ordinances and enforcement practices. Local floodplain ordinances vary across municipalities due to geological variations. The types of ordinances within floodplain regulations are zoning ordinances, building codes, subdivision regulations, sanitary regulations, and ‘stand-alone’ ordinances.¹⁰⁵ First, zoning ordinances regulate new development within a community in accordance to flood risk level. Then, building codes set resilience/preventative standards on newly developed properties.

The communities within the U.S. adopt an international building code model. For example, South Florida adheres to the Florida Building Code, which stems from the International Building Code. Building codes ensure that flood damage will be nonexistent or minimal to newly constructed buildings.¹⁰⁶ The third type of floodplain regulation administrates how plots of land separate into single parcels. According to FEMA (2007), they “set construction and location standards for the infrastructure the developer will provide, including roads, sidewalks, utility lines, storm sewers and drainage ways.”¹⁰⁷ The fourth type of ordinance - sanitary regulation, protects the environment against pollution induced by floods or the overflow of the water and sewer systems. Lastly, there are ‘stand-alone’ ordinances, which serve as a

¹⁰⁰ Federal Emergency Management Agency, 2017

¹⁰¹ Ibid.

¹⁰² Federal Emergency Management Agency, 2007, unit 5, pg. 4

¹⁰³The minimum requirements for participation in the NFIP can be found in Chapter 44 of the Code of Federal Regulations (44 CFR), Section 60.3.

¹⁰⁴ 44 CFR, 59.2b

¹⁰⁵ Federal Emergency Management Agency, 2007.

¹⁰⁶ Ibid.

¹⁰⁷ Federal Emergency Management Agency, 2007, unit 7, p.7

catchall regulatory mechanism that attempts to address all of the NFIP requirements under one statutory provision.

The ordinances set forth within a community must have enforcement practices in place. According to FEMA (2007), fair enforcement means, “(1) all development in a floodplain must have a permit and (2) all development with a permit must be built according to the approved plans.”¹⁰⁸ In order to effectively enforce the above ordinances, inspections must be conducted on newly developed property. For example, in unincorporated Miami-Dade County, officials from the Code Enforcement Department in conjunction with staff from the Department of Environmental Resources Management (DERM) conduct property reviews and inspections. DERM conducts floodplain construction inspections on several different tiers. There are “substantial damages/improvement inspections (\$65), inspection in lieu of elevation certificate (\$150), break away wall inspection (high hazard - \$275), tie beam inspection (high hazard - \$130), equipment inspection (high hazard - \$240), foundation inspection (high hazard - \$200), initial foundation inspection (\$210). DERM will also check is a property meets the federal flood criteria for both residential (\$460 per unit) and commercial (\$920 per unit).”¹⁰⁹ These prices may vary among municipality, as each is responsible for conducting their own inspections of flood prone properties.

Political Process of FEMA FIRM Implementation

The process of creating the FIRMs that determine whether a resident must buy into flood insurance through the NFIP is a complicated and lengthy operation. It is created this way to maintain FEMA’s ultimate goal in flood risk mitigation, which is to incentivize local mitigation activities.¹¹⁰ It is also very important that a uniform method is taken in the development of FIRMs to ensure that all residents are informed, treated equally, and most importantly kept safe from flood hazards. FIRMs are created for communities that have a dense population, or areas are re-mapped that have experienced a large population growth over the years.

The bureaucratic process in which FEMA creates FIRMs can be more easily understood when broken up into a series of public meetings. First, FEMA conducts their analysis and then reaches out to municipal/county officials, experts, scientists, and even homeowners for a collaborative assessment on the final FIRM. As this process is tedious, specific deadlines have been placed on many stages of the FIRMs development to insure timeliness. The meetings in which this collection of information is analyzed are the

¹⁰⁸ Federal Emergency Management Agency, 2007, unit 7, p. 41

¹⁰⁹ Miami-Dade County, 2015

¹¹⁰ FEMA, 2015

discovery meeting, the risk map meeting, the flood risk review meeting, the resilience meeting, and the open house meeting.

First, during the discovery meeting, FEMA partners together with “community and tribal officials, floodplain administrators, engineers, watershed council representatives, planners, emergency managers, GIS specialists, Federal, State, regional, and non-profit organizations” to gather current and historical flood data.¹¹¹ The data draws from the fields of “hydrology, infrastructure, hydraulics, land use, and any maps that may currently exist, such as floodplain maps or base maps.”¹¹² Based on this data, FEMA uses the discovery meeting to express the areas of risk or concern to the community, identify new or unidentified areas of risk, and keep the community informed on the impact of the potential FIRM development project. If the discovery meeting yields that a FIRM (or a re-map) is necessary, then it marks the “kick-off” of the project which is followed up by a newsletter and after action report for the community.¹¹³

After the “kick-off” is initiated, a Risk MAP project plan meeting is the next step in developing the communities FIRM. The Risk MAP project differs from a FIRM, it is a unique program that provides the community under investigation a vast array of useful tools to increase mitigation practices. This phase of the process is designed to illuminate the true risk that is posed against a community by using more in depth tools that officials can use to locate, analyze, and gather data on the specific areas that need scientific evaluation.

Then, in the flood risk review meeting, the data is scrutinized by scientists and engineers for validation. During this phase, it can still be determined that a FIRM is not necessary and specific mitigation practices will be sufficient. However, if it is determined that a FIRM is needed or a re-map is required, this meeting is used to communicate this risk to the impacted residents.¹¹⁴ Next, the resilience meeting or workshop, is conducted as an open and “collaborative discussion with impacted local residents about the risks of flooding.”¹¹⁵ During this meeting practical strategies are discussed and developed to increase mitigation efforts for newly developed properties within the SFHAs identified by the Risk MAP.

Finally, if the decision is made that a community requires either a re-map or new FIRMs, it is during the open house meeting that the preliminary maps are released. This meeting is held in conjunction with the FEMA Consultation Coordination Officer (CCO). According to FEMA (2017), “the CCO engages

¹¹¹ FEMA, 2012, p. 1

¹¹² FEMA, 2017, p.2

¹¹³ FEMA, 2017

¹¹⁴ FEMA: RiskMAP6, 2012

¹¹⁵ FEMA, 2017, p. 2

stakeholders and the public, explains the potential implications of the preliminary Flood Map, and provides information on the public comment and appeal process.”¹¹⁶ During this phase of FIRM development, the preliminary map is uploaded to the internet so that the impacted residents may review and analyze the data. If an impacted resident finds that their home has been placed within a high risk flood zone, it will require them to purchase flood insurance. As this concept may be perceived as controversial to many residents, each resident is provided with an opportunity to appeal the decision. Hence, the appeal process gives them the power to purchase and conduct their own BFE study on their property. Should residents want to execute their right to appeal, they have ninety days to do so, marked by the day the preliminary flood maps are made public. The appeal is processed through a letter of map change (LOMC), which, if approved, serves as a formal amendment to the FIRM. If the FIRM is updated as per the resident’s request, they may be eligible for a subsidized flood insurance premium, or be taken off the roster of property owners that are forced to purchase flood insurance.¹¹⁷ For example, many residents of Palm Beach County invoked their right to appeal this year when approximately 43,728 residents would be moved within fifty feet from a SFHA with the implementation of a new FIRM.¹¹⁸ Before October, 5th 2017, Palm Beach County had not had a re-map/updated FIRM since 1978.¹¹⁹

Once a FIRM has been finalized, all amendments made, and the public sufficiently informed, “a six month adoption period follows.”¹²⁰ This period is concerned with allowing the communities to weigh their options for providing flood insurance. Many communities decide to buy into the NFIP at this point, in order to allow their residents an affordable option to the newly adopted policy. Municipal leaders often initiate further mitigation/resilience practices in order to better protect their new developments from flood damage. A second benefit can be found within these new mitigation practices, for instance, many extra discounts are found through the NFIP’s Community Rating System.

Community Rating System (CRS)

The community rating system (CRS) provides a unique incentive for municipalities to both buy into the NFIP as well as strengthen flood resilience efforts. The incentive manifests itself in the form of premium discounts, which further subsidize the flood insurance provided by the NFIP.¹²¹ The CRS is an extension of the NFIP and is a completely voluntarily program. It operates on a scale from one to ten, class

¹¹⁶ FEMA, 2017, p.3

¹¹⁷ FEMA, 2017

¹¹⁸ FEMA, 2017

¹¹⁹ FEMA, 2017

¹²⁰ FEMA, 2017, p. 3

¹²¹ FEMA, 2017

one communities receive the maximum discount (45%) and class ten communities receive no discount at all, as they are not participating. Table 1 shows a descriptive overview of the flood insurance premium discounts. For example, Unincorporated Miami-Dade County is a CRS class 5, which awards a 25% discount on flood insurance premiums through the NFIP.

Participation in the CRS is bound to the municipal level. There are currently 1,391 municipalities nationwide that participate in the CRS, 233 (17%) of these communities are in the state of Florida, including both coastal and inland cities (refer to Appendix F for CRS municipalities in South Florida).¹²² For a municipality to be eligible for the CRS they must (1) actively subscribe to the NFIP, and (2) exceed the minimum NFIP standards of flood damage mitigation/resilience. According to FEMA (2016), the three main goals of the CRS are to “reduce flood damage to insurable property, strengthen and support the insurance aspects of the NFIP, and finally encourage a comprehensive approach to floodplain management.”¹²³ Therefore, the CRS operates on a credit system where communities are prescribed specific mitigation practices by FEMA that they can voluntarily engage in (refer to Table 2). The more activities that are implemented, the more credits will be earned by that community, which in turn places them into a discount class.

Overall, there are 19 operations that a community can undertake to receive credits and they fall under four main categories. Public information, mapping and regulations, flood damage reduction, and warning and response.¹²⁴ Table 2 shows an overview of the specific activities by category and the amount of credits that they offer. For example, Miami-Dade County provides a web-based mapping service, which allows its residents to check which flood zone they reside in (worth 90 CRS credits). Communities also have the opportunity to earn extra credits. According to FEMA (2015), “extra credit can be earned for regulating development outside the SFHA to the same standards as buildings within the SFHAs.”¹²⁵

Table 1: Community Rating System Discount Classes

Class	SFHA Discount	Non-SFHA Discount	Credit Conversion
1	45%	10%	4,500 +
2	40%	10%	4,000 – 4,499
3	35%	10%	3,500 – 3,999
4	30%	10%	3,000 – 3,499
5	25%	10%	2,500 – 2,999
6	20%	10%	2,000 – 2,499

¹²² FEMA, 2016

¹²³ FEMA, 2016, p.1.

¹²⁴ Ibid.

¹²⁵ FEMA, 2015, p.8

7	15%	5%	1,500 – 1,999
8	10%	5%	1,000 – 1,499
9	5%	5%	500 – 999
10	0%	0%	0 - 499

Source: Federal Emergency Management Agency, 2015

Table 2: FEMA Prescribed Community Rating System Practices

Public Information		Credits
Elevation Certificates Maintain elevation certificates for newly developed properties within a floodplain		116
Map Information Service Make FIRMs available to the public		90
Outreach Projects Send information to residents living in SFHAs or all residents in the community		350
Hazard Disclosure Real-estate agents must disclose when a property is prone flooding. Regulations require notice of the hazard		80
Flood Protection Information The public library/community website must maintain references on flood insurance and protection		125
Flood Protection Assistance Provide technical advice to inquiring residents on how to protect their buildings from flooding		110
Flood Insurance Promotion Publicize the availability and benefits of enrolling in flood insurance		110
Mapping and Regulations		Credits
Floodplain Mapping Develop new flood elevations, floodway delineations, wave heights, or other regulatory flood hazard data for an area not mapped in detail (e.g. Zone A)		802
Open Space Preservation Guarantee that currently vacant parcels located on a floodplain will be kept free from development		2,020
Higher Regulatory Standards Require freeboard (buildings constructed 1ft. above BFE), require soil tests or engineering foundations, require compensatory storage, zone the floodplain for minimum lot sizes of 1 acre or larger, require coastal construction standards in AE Zones, and have regulations tailored to protect critical facilities prone to unique flood hazards (e.g. alluvial fans or coastal erosion)		2,042
Flood Data Maintenance Keep flood and property data on computer records, use better base maps and maintain elevation reference marks		222
Flood Damage Reduction		Credits
Floodplain Management Planning Prepare, adopt, implement, and update a comprehensive flood hazard mitigation plan		622
Acquisition and Relocation Acquire and/or relocate flood-prone buildings so that they are out of the floodplain		1,900

Flood Protection Protection of existing floodplain development via flood proofing, elevation, or minor structural projects	1,600
Drainage System Maintenance Conduct periodic inspections of all channels and retention basins, and remove debris as needed	570
Flood Preparedness	
Flood Warning and Response Provide early flood warnings to the public, and have a detailed flood response plan keyed to flood crest predictions	395
Levee Safety Maintain existing levees	235
Dam Safety Communities in a state with an approved dam safety program that have at least one building subject to inundations from the failure of a high-hazard- potential dam receive some credit	160

Source: Federal Emergency Management Agency, 2015

Miami-Dade County

Within the Tri-County area of South Florida, the best CRS class rating caps at level five. According to FEMA, CRS class 5 is the average discount provided to communities within the United States. This means that the specific municipality or unincorporated county area is going beyond the minimum requirements of the NFIP, and is creating a more resilient flood-proof community. The Metropolitan Center research team collected from FEMA on the CRS and mapped within Miami-Dade, Broward, and Palm Beach Counties to show which municipalities participate in the CRS and receive the highest premium rate discounts on flood insurance. In Miami-Dade, the municipality of North Miami and unincorporated Miami-Dade County hold a CRS class rating of five (25% discount on premiums). The majority of the municipalities hold a CRS class rating of seven, which allocates a 15% discount on insurance premiums. These municipalities include Doral, Sunny Isles, South Miami, Hialeah, Miami Beach, Miami, Key Biscayne and Aventura. Only four municipalities receive a CRS class rating of eight, receiving a 10% discount- Palmetto Bay, Surfside, Opa-Locka, and Bal-Harbour. Homestead falls in the category of CRS class rating of nine receiving a 5% discount and Golden Beach receives the worst classification with a CRS class rating of ten, receiving no discount.

Broward County

In Broward, there are no class five CRS ratings, instead, the majority of the Broward municipalities fall in CRS class seven, receiving a 15% discount on their premiums. These areas include Pembroke Pines, Oakland Park, Weston, Davie, Deerfield Beach, Cooper City and many more. Only three municipalities

earned CRS rating of eight- Coral Springs, Miramar, and Lighthouse Point. Broward County has three municipalities -Dania Beach, Parkland, and North Lauderdale receiving a five percent discount on their premiums. Hillsboro Beach receives the worst classification with CRS class rating of ten receiving no discount.

Palm Beach County

In Palm Beach County, Juno Beach, Jupiter, and the unincorporated areas of the County hold a CRS class rating of five. This is the highest CRS ratings and highest discount attained by Palm Beach municipalities, receiving 25% of discount on their premiums. Unlike Broward and Miami-Dade, Palm Beach County has the largest number of municipalities in this category; however, they also have the largest number of municipalities with CRS rating of ten. These four areas include Highland Beach, Mangonia Park, Gulf Stream, and Glen Ridge. The majority of the municipalities in Palm Beach County are in the CRS class rating of eight -Lake Park, Lake Worth, Palm Springs, Delray Beach, Boca Raton and Palm Beach Shores. The county also holds the largest number of areas with CRS ratings of nine in South Florida, receiving only 5% discount on their premiums. The following map visualizes which areas within Palm Beach County receive the highest discounts.

Outside Comparison of CRS Premium Discounts

FEMA recognizes the communities that go beyond the minimum requirements of the NFIP (class four through one). Aside from receiving the highest discounts on their homeowners' flood insurance premiums, they receive an award for excellence directly from FEMA. The only community to earn a class one rating (45% discount on premiums) is the City of Roseland, California. In Roseland, the municipality used almost every single CRS credible activity listed in Table 2 in response to a devastating flood in 1995.¹²⁶ Some of the major activities the City of Roseville undertook in were "elevating flood-prone homes, quadrupling the size of a culvert, adding, enlarging, and improving culverts, replacing a bridge to widen a creek for a larger stream capacity, removing culverts from underneath railroads, and acquiring homes in the floodplain."¹²⁷ Within the State of Florida, the only municipality that ranks below a five is the City of Ocala, with a CRS class rating of three (35% discount on premiums). Ocala jumped from a class eight to a three in the span of a year, now regarded as one of the most progressive community in regards to floodplain management and mitigation. Ocala's motivation for undertaking extra CRS mitigation practices

¹²⁶ FEMA, 2015

¹²⁷ Louisiana Resiliency Assistance Program, 2013

stems from the overflowing of a drainage retention area (DRA) and the damaging of residential properties because of the floods.

The Ocala Engineering Department purchased two parcels for \$50,000 dollars where the DRA was located.¹²⁸ The city then expanded this DRA by approximately 40%, to increase its capacity, effectively collect, and store storm water.¹²⁹ Other measures included the city took were “replacing existing water pumps with more powerful ones, adding backup pumps in the event of an emergency, repaired wells, and expanded various other DRAs.”¹³⁰ Ocala also prioritized the upgrading and enriching existing facilities, as opposed to the construction of new facilities in floodplains.¹³¹ Designed to discourage urban sprawl into high-risk flood zones, which would in turn harm their CRS class rating.

¹²⁸ Stevens, 2013

¹²⁹ Hiers, 2015

¹³⁰ Hiers, 2015

¹³¹ The City of Ocala, 2013

IV. Flood Maps

FEMA produces two different types of maps for usage within the NFIP. Flood hazard boundary maps (FHBM) and flood insurance rate maps (FIRM). The FHBMs are maps that use approximate data to illuminate the boundaries of the SFHAs within a specific community.¹³² A FIRM is produced when a municipality buys in to the NFIP and a flood risk assessment is conducted. Usually these assessments are dovetailed by a flood insurance study (FIS). A FIS utilizes engineering tactics to analyze flood areas to determine the specific types of flooding hazards that will be exposed within a specific community. According to FEMA's *Answers to Questions About the NFIP* (2011), the types of data utilized within an FIS are "historic information (such as river flow, storm tide, and rainfall data), meteorologic data, topographic data, hydrological data, hydraulic data, open-space conditions, flood-control works, and development data."¹³³ Once an FIS has been conducted on a geographic location or within a community it will reveal the base flood elevations (BFE) which predict how high (in feet) water should rise in a flood. Based on the data that was found, different spatial locations are labeled (a detailed explanation is given in section III). The FIRMs are then used to calculate actuarial rates for flood insurance in accordance to level of risk for current homes and newly developed properties.¹³⁴

Flood Zones

The most common flood zones found in South Florida's geological composition are A, AE, AH, AO, VE, D, and X. The zones that have a higher risk of inundation are special flood hazard areas (SFHA). They are encompassed by zones A, AE, AH, AO, and VE and require mandatory flood insurance by homeowners residing within them (also referred to as the 100-year flood). Zone A is high risk because within 100 years it has a 1-percent annual chance of flooding and has not had detailed hydraulic analysis conducted and have no scientifically measured base flood elevations (BFEs).¹³⁵ Zone AE encompassed swaths of land that are subject to flooding by the same annual 1-percent figure, but the BFEs are known, rendering a moderate to high risk probability with flood depths greater than three feet.¹³⁶

Zone AH, also a moderate to high-risk floodplain encompasses areas in which the average flood depth is between one and three feet, the BFEs are known, and has a 1-percent annual chance of shallow

¹³² Federal Emergency Management Agency, 2011

¹³³ *Answers to Questions About the NFIP* (2011), p.27

¹³⁴ Federal Emergency Management Agency, 2011

¹³⁵ Federal Emergency Management Agency, 2017

¹³⁶ Federal Emergency Management Agency, 2017; Miami-Dade County, 2016

flooding.¹³⁷ Zone AO holds the same statutory definition by FEMA as AH, but these zones pertain to sheet flow (a thin film of water) trickling down a sloping terrain (Federal Emergency Management Agency, 2017; Broward County, 2014). Zone VE is the highest risk flood zone because it is located near the coast, has an annual 1-percent chance of flooding, BFEs are known, and they hold the probability of additional hazards occurring due to storm-induced velocity wave action.¹³⁸ Zones D and X are considered low risk floodplains and do not require homeowners to buy into mandatory flood insurance.

Table 3: Vulnerable Populations within Special Flood Hazard Areas (SFHA) Stratified by Block Groups

SFHA	Miami-Dade	Broward	Palm Beach
Zone A	Population in Poverty – 1,537 Older Population (55+) – 9,631 Child Population – 10,364 Disabled Population – 2,510 Non-English Speakers – 2,961	Zone A not present in Broward County.	Population in Poverty – 1,802 Older Population (55+) – 16,121 Child Population – 10,779 Disabled Population – 4,032 Non-English Speakers – 834
Zone AE	Population in Poverty – 59,537 Older Population (55+) – 466,224 Child Population – 377,734 Disabled Population – 117,874 Non-English Speakers – 136,614	Population in Poverty – 39,566 Older Population (55+) – 457,372 Child Population – 353,458 Disabled Population – 131,825 Non-English Speakers – 29,917	Population in Poverty – 23,130 Older Population (55+) – 283,510 Child Population – 179,414 Disabled Population – 73,658 Non-English Speakers – 17,916
Zone AH	Population in Poverty – 53,674 Older Population (55+) – 375,234 Child Population – 298,717 Disabled Population – 95,478 Non-English Speakers – 145,814	Population in Poverty – 37,427 Older Population (55+) – 369,266 Child Population – 304,299 Disabled Population – 113,284 Non-English Speakers – 28,035	Population in Poverty – 2,345 Older Population (55+) – 46,827 Child Population – 20,679 Disabled Population – 11,385 Non-English Speakers – 962
Zone AO	Zone AO not present in Miami-Dade County.	Population in Poverty - 144 Older Population (55+) – 7,154 Child Population - 933 Disabled Population – 1,678 Non-English Speakers – 0	Population in Poverty – 1,831 Older Population (55+) – 29,198 Child Population – 23,560 Disabled Population – 6,454 Non-English Speakers – 1,425
Zone VE	Population in Poverty – 2,574	Population in Poverty - 519	Population in Poverty – 1,361

¹³⁷ Federal Emergency Management Agency , 2017

¹³⁸ Ibid.

(Coastal)	Older Population (55+) – 38,011 Child Population – 26,081 Disabled Population – 10,024 Non-English Speakers – 3,090	Older Population (55+) – 23,741 Child Population – 3,989 Disabled Population – 5,770 Non-English Speakers – 224	Older Population (55+) – 31,366 Child Population – 6,340 Disabled Population – 6,567 Non-English Speakers – 773
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Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates

Analysis of Chart-Vulnerable Population

Miami-Dade County

The most critical zones in Miami-Dade County is considered Zone A, rated high risk with no hydraulic analysis and a total vulnerable population of one percent (27,003). This area is a mandatory flood insurance area with 1,537 individuals living under poverty and a children population of 10,364. Within the borders of these areas, we find an older population of 9,631 individuals and 2,961 non-English Speakers. These individuals are extremely vulnerable in relation to receiving information related to threatening situations or in the process of evacuation. Following Zone A, Zone VE is considered the second highest at-risk. This area is within the borders of the coastal areas with a total vulnerable population of three percent, reporting 2,574 individuals below poverty, 38,011 elderly, 26,081 children, 10,024 individuals with disabilities, and 3,090 non-English Speakers. Overall, within the county, we find 225,886 individuals with disabilities living in mandatory flood insurance zones, the majority (117,874) residing in Zone AE (Moderate Risk) with flood depths greater than three feet. The majority of the individuals (44%) live in this zone. Within this zone, there are 59,537 individuals living under poverty, 377,734 children, 466,224 elderly, and 136,614 non-English Speakers. The second highest populated mandatory flood zone is Zone AH, which is considered a moderate risk area with flood depths of one feet to three feet. Within this area, 968,917 individuals are part of the vulnerable population at-risk. These groups are composed of 298,717 children, 95,478 individuals with disabilities, 145,814 non-English Speakers, 375,234 elderly, and 53,674 individuals living under poverty. When facing direct threats and flooding hazards these individuals will be in the direct path of chaos.

Broward County

In the case of Broward County, Zone A is not present. The most at risk zone of the county is Zone VE of the coastal area; this area holds two percent of the vulnerable population (34,243), including 3,989 children, 5,770 individuals with disabilities, and 519 individuals living under poverty. In comparison, the largest category is composed of elderly individuals, which is composed of 23,741 individuals. Nonetheless, overall, the majority (55%) of the vulnerable population in Broward County is in Zone AE, considered as moderate risk with flood depths greater than three feet. The two largest groups of these groups are

children (353,458) and elderly (457,372). Also important to note is the great number of individuals with disabilities, (131,825) who would need assistance in the case of a disaster. The second most populated mandatory flood zone is ZONE AH with a vulnerable population of 852,311 (46%). The two largest vulnerable groups were elderly and children, together composing of 673,565 individuals vulnerable to flooding hazards of all scales. It is also important to note, the great number of individuals with disabilities (113,284) and non-English Speakers (28,035) who would also not receive the information needed to evacuate and prepare correctly in face of disaster.

Palm Beach County

Unlike the other two counties, Palm Beach County has the representation of all the mandatory flood insurance zones within their borders. In Zone A they have a vulnerable population of 33,568, including 10,779 children, 4,032 individuals with disabilities and 16,121 elderly. Zone VE is composed of 46,407 individuals, the majority (31,366) are composed of the elderly population. Zone AO composed of five percent vulnerable population has a substantial number of individuals with disabilities and living under poverty. The zone with the greatest population is Zone AE. In this area, 577,628, individuals are children and of the older population. However, it is important to note that 23,130 of those individuals are in poverty, 73,658 are individuals with disabilities and 17,916 are non-English speakers.

Table 4: Tri-County Area: Total Population and Properties at Risk

SFHA	Miami-Dade	Broward	Palm Beach
Zone A	Population—block group 38,941 Parcels within 15,199 Property value at risk \$1,029,347,003	Zone A not present in Broward County.	Population—block group 10,959 Parcels within 56 Property value at risk \$85,894,576
Zone AE	Population—block group 1,758,412 Parcels within 121,750 Property value at risk \$106,328,388,090	Population—block group 1,633,725 Parcels within 217,972 Property value at risk \$27,982,685,410	Population—block group 421,145 Parcels within 45,960 Property value at risk \$45,136,373,117
Zone AH	Population—block group 1,396,981 Parcels within 158,131 Property value at risk \$68,406,867,749	Population—block group 1,382,026 Parcels within 159,672 Property value at risk \$27,306,413,240	Population—block group 111,077 Parcels within 5,577 Property value at risk \$2,927,233,077
Zone AO	Zone AO not present in Miami-Dade County.	Population—block group 12,642 Parcels within 8,098 Property value at risk \$107,161,160	Population—block group 201,767 Parcels within 29,791 Property value at risk \$13,251,977,628
Zone VE (Coastal)	Population—block group 131,919 Parcels within 1,581 Property value at risk \$6,112,256,372	Population—block group 43,293 Parcels within 25,664 Property value at risk \$358,919,030	Population—block group 34,379 Parcels within 758 Property value at risk \$4,874,132,078

Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates; Miami-Dade Property Appraisers Office, 2017; Broward County Appraisers Office, 2017; Palm Beach County Appraisers Office, 2017

South Florida

The Flood Map Modernization (Map Mod), a multiyear Presidential initiative funded by Congress from fiscal year (FY) 2003 to FY2008, helped Miami-Dade, Palm Beach and Broward adopt new digital Flood Insurance Rate Maps (FIRMs). The development of FIRMs occurs within the interaction between government inter-agencies and local municipalities. After in-depth discussion and numerous meetings between FEMA and local representatives, maps are given to residents in an industry-standard Geographic

Information System (GIS) format.¹³⁹ FIRMs include statistical information such as data for river flow, storm tides, hydrologic/hydraulic analyses and rainfall and topographic surveys.

Miami-Dade:

The current FEMA maps of Miami-Dade County became effective on September 11, 2009. The adoption of these maps are a requirement for the County to continue participating in the NFIP program which guarantees flood insurance to residents within unincorporated Miami-Dade County.¹⁴⁰ During the development process, FEMA collaborated with Miami-Dade County, its municipalities and the South Florida Water Management District to gather both engineering and topographic information. During the process of the development of the maps, the city of Sweetwater went from unclassified by the FEMA to high-risk flood zone. This caused great controversy and resistant, led by Mayor Manuel Marono who stated to local newspapers "I find it extremely ironic since we spent over \$20 million on improvements. The city bought huge pumps and other upgrades to fix notorious drainage woes. State and federal agencies, FEMA among them, spent \$50 million on two massive storm water basins."¹⁴¹ Because of the changes that occurred in the 2009 mapping of the area, homeowners of Sweetwater pay, according to Marono -- about \$1,400 a year for flood policies many residents will now require."¹⁴² However, not all areas of the county had a negative change. For instance, "A third of unincorporated Miami-Dade was dropped from high-risk to lower-risk zones." Nonetheless, pockets within certain areas became affected that were overseen in the previous creation of the 1980's FIRMs. For instance, "at the Kendale Lakes Townhomes, six miles west of Dadeland, the shocked homeowners' association was forced to shell out \$32,000 for flood insurance and another \$3,000 for surveys."¹⁴³ Scenarios such as these became the norm during the transition process.

Palm Beach:

Based on the mandate of the Modernization program, Palm Beach County is currently working with FEMA and other inter-agencies such as local municipalities in completing a re-evaluation of flood hazards for the county. The proposed new maps were the first new flood maps in the county since the 1980s.¹⁴⁴ Overall, the process of the adaptation of the new maps is a lengthy process of various contradictions and responses. The discrepancy between the local governments and FEMA began when

¹³⁹ Ibid.

¹⁴⁰ Flood Zone Maps. (2017, June 20).

¹⁴¹ Flood-map updates could cost some in Dade, Broward [The Miami Herald]. (2009, November 29).

¹⁴² Ibid.

¹⁴³ Ibid.

¹⁴⁴ Hurtibise, R. (2016, September 21). FEMA: Palm Beach County's new flood zone maps now projected for August 2017

“FEMA released revised flood-zone maps in July of 2013 to replace maps that were over 30 years old.”¹⁴⁵ Once the first drafts of the maps were developed, FEMA hosted information sessions in public libraries in West Palm Beach informing residents on the impact of the changes. The sessions were divided into sections labeled ““Property Look-up,” “Insurance Information,” “Appeals and Comments,” and “Community Assistance.”¹⁴⁶ FEMA provided the communities with the Preliminary and revised Preliminary copies of the “FIRM and Flood Insurance Study (FIS) report that identified existing flood hazards.¹⁴⁷ As a result, there was “a public outcry from Palm Beach County property owners. Residents and public officials said the updated maps didn't factor in three decades worth of flood-control and building improvements in certain areas.”¹⁴⁸

Consequently, certain local Palm Beach citizens refused the shift of 62,041 parcels from low-risk flooding zones into high-risk zones. They refused what the shift would mean to their financial pockets, residents in these parcels would have to purchase flood insurance as a mandatory option. Therefore, if the appeals would be approved and revisions would be made to the proposed maps, “...tens of thousands of property owners millions of dollars by shielding them from being placed into the mandatory flood insurance zones.”¹⁴⁹ County leaders and residents were given 6 months to have their local residents review and prepare for what is called “sticker shock.” Resident had the opportunity to make changes for instance creating elevation for their properties that would remove them from the high flood risks. It was expected that the “New flood zone maps would take effect in August 2017.”¹⁵⁰ However, further delays at the local levels pushed the effective date to October 5, 2017, this date saw no obstacles or changes.

Broward

FEMA completed the first comprehensive review of Broward County on August 18, 2014. After 14 years without newly updated FIRMs, FEMA utilizing new technology called “vertical datum,” created new FIRMS for the county. The results affected about 266,000 homes who were removed from high-risk flood zone into a moderate or low-risk flood zone.¹⁵¹ Consequently, much of the county ‘west’ of the Florida turnpike was removed from the high-risk flood zone.¹⁵² These changes affected mostly the residents of

¹⁴⁵ Ibid.

¹⁴⁶ DiMattei, C. (2014, September 9). Palm Beach County Gets First Look At New Flood Zone Maps.

¹⁴⁷ Rodriguez, L. (2017, April 5). Federal Emergency Management Agency Notification.

¹⁴⁸ DiMattei, C. (2014, September 9). Palm Beach County Gets First Look At New Flood Zone Maps.

¹⁴⁹ Hurtibise, R. (2016, September 21). FEMA: Palm Beach County's new flood zone maps now projected for August 2017

¹⁵⁰ Hurtibise, R. (2016, September 21). FEMA: Palm Beach County's new flood zone maps now projected for August 2017

¹⁵¹ New Flood Maps in Broward County. (2014, August 24).

¹⁵² Murray, J. (2014, April 29). New Broward Flood Zones Give Some Homeowners Break On Insurance.

Miramar, Pembroke Pines and Weston.¹⁵³ What changed in those parcels since the last updated FIRM's? According to reports, "those cities required developers to elevate land with fill dirt and install improved drainage making the parcels less prone to flooding."¹⁵⁴ However, the good news was not for everyone in Broward, the data changed the status of 31,000 Broward properties that were "...found to be more vulnerable to flooding than previously thought, meaning they'll need flood insurance if they have federally regulated or insured mortgages."¹⁵⁵ These areas included those who live near Fort Lauderdale. According to the City of Fort Lauderdale, by always adopting the latest flood maps, the residents "...are assured that FEMA will offer assistance during emergencies and provide flood insurance coverage for county residents."¹⁵⁶

United States- Other major cities

City of New Orleans

In September 2016, FEMA assigned new flood maps for the city of New Orleans. As a direct consequence, "...half the population moved out of the so call high-risk zone."¹⁵⁷ However, the reactions were highly mixed, as some residents are worried "these new maps send the wrong message."¹⁵⁸ Nonetheless, for some homeowners it meant they were no longer required to have flood insurance. According to FEMA, the changes show "...that 53 percent of the city's properties (in green) are no longer in a so-called high-risk zone and do not need to carry flood insurance. Areas in gray have no change in their flood zone. Areas in red (roughly 5 percent) are now in a "higher risk" zone. FEMA insists the maps are insurance rating tools and should not be interpreted as life and safety flood maps."¹⁵⁹

¹⁵³ Ibid.

¹⁵⁴ Ibid.

¹⁵⁵ New Flood Maps in Broward County. (2014, August 24).

¹⁵⁶ Flood Zone Designations & Flood Maps. (2014, August).

¹⁵⁷ Kailath, R. (2016, September 30).

¹⁵⁸ Ibid.

¹⁵⁹ Ibid.

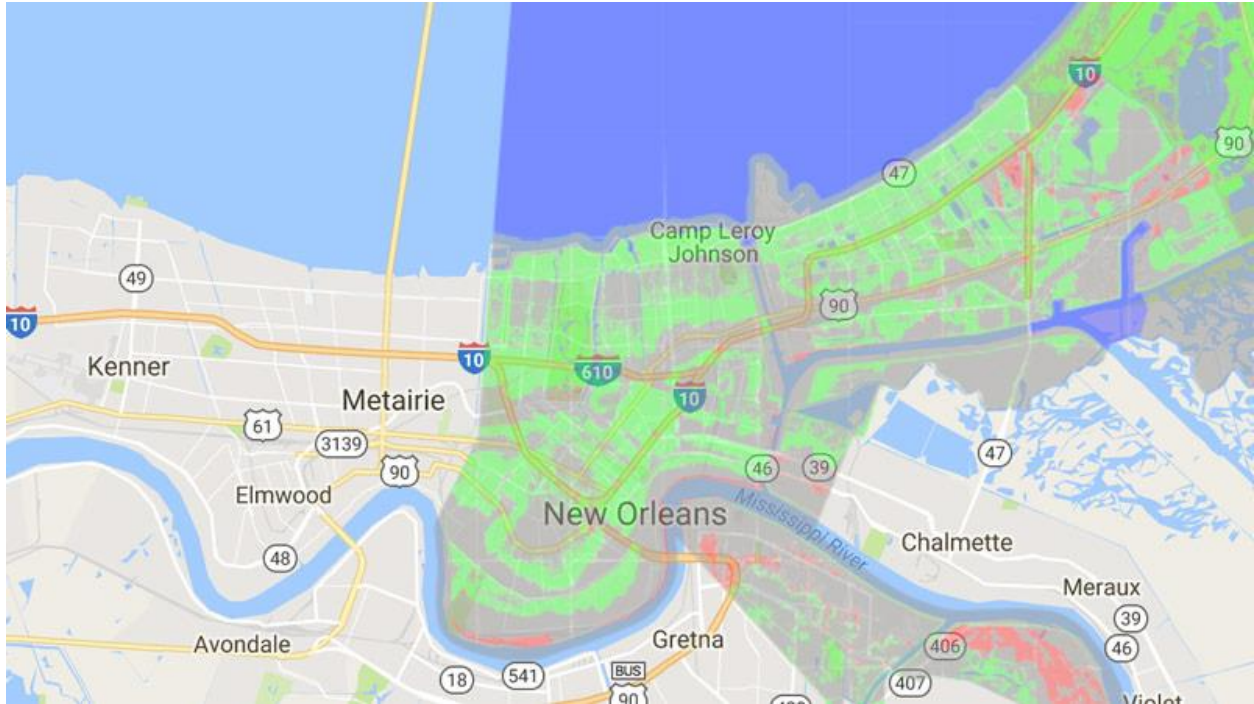


Figure 1: FEMA New Orleans

Source: FEMA, 2016¹⁶⁰

Individuals like Jared Munster, director of safety and permits in New Orleans, stated that the label of high risk, which made properties less affordable and scared development away, devastated the city.¹⁶¹ According to the local officials, the new maps now account for the infrastructure built after Hurricane Katrina, which amounted in \$14.5 billion in flood protection system. This flood protection system includes the West Closure Complex, the largest pump station in the world. However, the negative effects of the new maps is that now an enormous amount of property are uninsured in New Orleans, and homeowners are unprotected.¹⁶² For some, this is an example of how “FEMA’s maps are compromised by politics around redevelopment and property values.”¹⁶³

Tampa Florida (Hillsborough)

One of the most vulnerable areas in Florida is Hillsborough County located near the Tampa area. According to the historical narratives, the Tampa Bay region has not seen a direct hit by a major hurricane since 1921. However, today, climate change has created a great threat to the area, with rising sea levels

¹⁶⁰ Kailath, R. (2016, September 30).

¹⁶¹ Ibid.

¹⁶² Ibid.

¹⁶³ Ibid.

and the severity of inland flooding every hurricane season is an active season for the Tampa bay area.¹⁶⁴ Within this target area, approximately 22% of the population reside in areas in risk of flooding. Based on detail landscaping, “All coastal areas (158 mi. shoreline) of the 1,051 square mile Hillsborough County, and the flood plains along the three county rivers (Hillsborough, Alafia, and Little Manatee), are considered hazard areas for hurricane storm surge.”¹⁶⁵ Furthermore, the flooding hazards and vulnerabilities of the areas are expected to worsen as climate change continues to make flooding more often and more severe. According to reports, “planners and emergency management professionals worry about ‘The Big One,’ a Category 5 hurricane with a northeasterly path over adjacent Pinellas County.”¹⁶⁶ The counterclockwise swirl of the hurricane will push massive storm surge into Tampa Bay, inundating the cities of St. Petersburg and Tampa.”¹⁶⁷ Consequently, a new project called the 2010 Project Phoenix simulated a Hurricane named Phoenix of Category 5 magnitude to target the Tampa Bay area. The simulation provided catastrophic results; these include Downtown Tampa inundated by a 26 ft. storm surge, roadways and bridges flooded, an economic loss of over \$200 billion and over 1000 lives lost.¹⁶⁸ In addition to the chaos, the simulation projected that “over half of the region’s 3.3 million population are displaced, creating temporary shelter needs for 200,000.”¹⁶⁹ According to the experts, with climate change rising, and the warm waters of the Gulf of Mexico increasing, the chances of a hurricane of category five strength affecting the Tampa Bay area is also increasing. Overall, the purpose of an exercise such as this was to provide policy makers as well as the public the ability to imagine chaos in their own backyards and realizing the great levels of efforts needed to mitigate the aftermath of chaos. The combination of the climate change and Hillsborough County’s flat topography and heavy urbanization, the consequences are beyond flash flooding when placed in simulation of these proportions.¹⁷⁰ In general, the simulation was extremely effective in helping bring attention to the great need the county and the region need to undertake in order to prepare effectively and strategically for great levels of distress.

To alleviate the burden of the expected chaos that may occur at any moment, Hillsborough County was recently awarded a \$132,000 grant by the Federal Highway Administration (FHWA) to help identify mitigation projects for the Plan Hillsborough 2040 Transportation Plan.¹⁷¹ The overall purpose of the

¹⁶⁴ FHWA 2013 Climate Change & Extreme Weather Vulnerability Assessments & Adaptation Options Analysis Application. (2013, January 22).

¹⁶⁵ Ibid.

¹⁶⁶ Ibid.

¹⁶⁷ Ibid.

¹⁶⁸ Ibid.

¹⁶⁹ Ibid.

¹⁷⁰ Ibid.

¹⁷¹ Inland flooding. (n.d.).

funded project is to develop strategies to offset the effects of inland flooding, storm surge, and sea level rise. The transportation system resiliency pilot project is the result of a collaboration between the Metropolitan Planning Organization (MPO), the Planning Commission, Hillsborough County, the Tampa Bay Regional Planning Council, and the University of South Florida.¹⁷²

Houston, Texas

Published in April 2016, an article written on the Houston Chronicle called Houston the Flood City. The article narrates the overall consensus among conservationists, engineers, ecologists, hydrologists, urban planners, climatologists and other experts regarding Houston's prospects in a time of climate change and the ineffective quality in which the neither the city nor county officials have taken adequate steps to address the realities the city faces.¹⁷³ In a reflective manner, "decades of intense residential and commercial development across Harris County, especially on the relatively higher ground north and west of Houston's center, have taken place with only modest attempts to compensate for change to the area's natural drainage system."¹⁷⁴ The problem is developers have never taken into serious consideration the region's climate, geography and the effects of climate change. As mentioned by a HARC geographer, "You are dealing with a flat and gradually sloping environment and a drainage system that goes into one central area to drain out to," Bass said.¹⁷⁵ "You combine those things, and then add more impervious coverage and fewer wetland areas; you have an issue that needs to be addressed. You can only widen the bayous so much. You need to keep water in some of these systems and out of the bayou in the first place."¹⁷⁶ Flood maps in the Houston area became effective on January 6 2017.¹⁷⁷ The maps became the first major revisions in a decade. The changes included incorporating 400 property owners out of the flood risk areas

¹⁷² Ibid.

¹⁷³ McGuire, K., & Tolson, M. (2016, April 23).

¹⁷⁴ Ibid.

¹⁷⁵ Ibid.

¹⁷⁶ McGuire, K., & Tolson, M. (2016, April 23).

¹⁷⁷ FEMA releases new Houston flood map. (2016, September 27).

removing their mandate to purchase flood insurance.¹⁷⁸ Additionally, about 8,000 moved into a higher risk category known as the Special Flood Hazard Area.¹⁷⁹

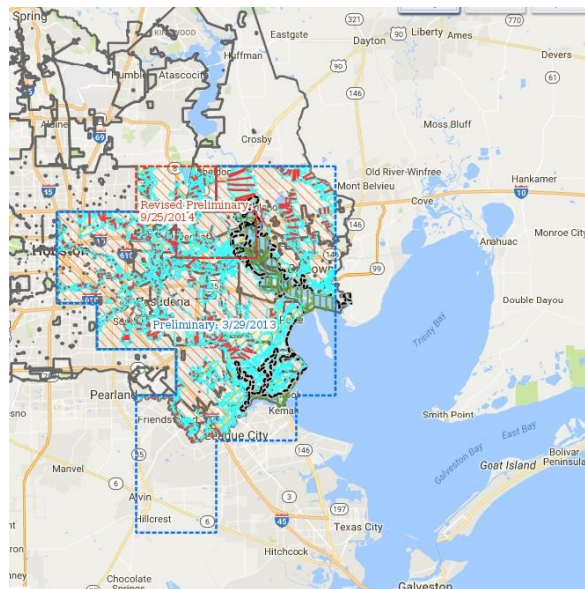
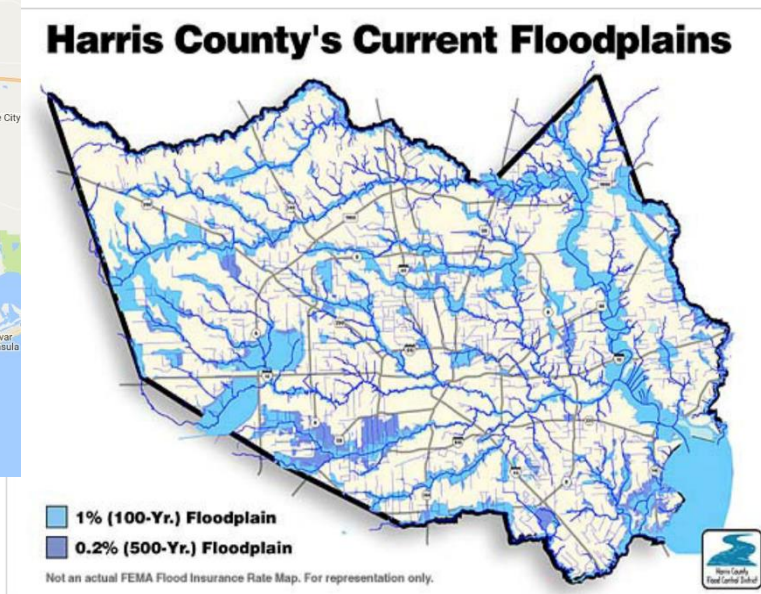


Figure 2: FEMA Houston

Source: FEMA, 2016¹⁸⁰



As observed in the images above, much of the focus was given to the areas outside of the city. The new maps place “...special emphasis on areas on the far western edge of the county, near the Addicks Reservoir, and vulnerable areas west of the Grand Parkway near Katy Hockley Road that saw substantial flooding this spring. Much of those areas has been elevated to the Special Flood Hazard Area risk level.”¹⁸¹ Other affected regions included northeastern Harris county and “regions east of the Beltway extending to San Jacinto College Central and along Armand Bayou in Pasadena.”¹⁸² According to FEMA, after the first year, flood insurance policies will increase by 18 percent per year until homeowners reach their full risk rate, which has been described as a “moving target” because there's always a chance insurance rates can increase. FEMA also advised homeowners who live in low- to moderate-risk areas to consider flood-insurance policies because 30 percent of flood-insurance claims that FEMA receives come from homeowners in non-special flood hazard areas.¹⁸³

In order to discover the specific efforts being conducted in the South Florida area to attain these premium discounts, an evaluation is conducted by the Metropolitan Center on the comprehensive master

¹⁷⁸ Pitman, D. (2016, September 26).

¹⁷⁹ Ibid.

¹⁸⁰ Flynn, M. (2016, September 29).

¹⁸¹ Ibid.

¹⁸² Ibid.

¹⁸³ Ibid.

plans of each county and municipality. The purpose is to analyze and describe the specific efforts taken towards flood plain management. The overall findings suggest a fragmented and scattered planning process that impede the communities from receiving premium discounts.

V. Florida Comprehensive Master Plans

Comprehensive Development Master Plan (CDMP) – Miami-Dade County

The following section will review the comprehensive plans for the several counties in Florida to determine the legitimacy of their efforts in reducing the effects of flood hazards in their areas. They are fundamental to local governments in addressing the need to prepare for hurricanes and sea level rise in their planning efforts. For example, the Comprehensive Development Master Plan (CDMP) of Miami-Dade County expresses the county's general objectives and policies regarding the development or conservation of land and natural resources for the next 10-20 years, and the delivery of County services to accomplish the Plan's objectives.¹⁸⁴ The overall goal of the master plan is to establish "...the broad parameters for government to do detailed land use planning and zoning activities, functional planning and programming of infrastructure and services."¹⁸⁵ The CDMP establishes a growth policy that encourages development, however, accommodates the demands of population growth utilizing three guidelines. First, at a rate commensurate with projected population and economic growth, second, in a contiguous pattern centered on a network of high-intensity urban centers well connected by multi-modal intra-urban transportation facilities and finally, in locations which optimize efficiency in public service delivery and conservation of valuable natural resources.¹⁸⁶ These have now become countywide requirements in addressing the future development of Miami-Dade. These guidelines are fundamental in their relation to how the county expects to tackle climate change and flood hazards in the future.

The CDMP covers the topics of land use, transportation, coastal management, conservation, aquifer recharge and drainage, intergovernmental coordination, housing, capital improvements, recreation and open space, public school facilities, economic, community health and design and water, sewer and solid waste. The section on coastal management hold the most valuable information on how Miami-Dade County plans to protect property and human lives in relation to the topic of flooding and hurricane mitigation. The coastal management has its own goals, objectives and policies, and highlights in relation to population growth that "Miami-Dade County shall continue to orient it's planning, regulatory, and service programs to direct future population concentrations away from the Coastal High Hazard Area (CHHA) and FEMA "V" Zone."¹⁸⁷ It also mentions that "if rebuilt, structures with damage exceeding 50 percent of pre-storm market value shall be reconstructed to ensure compliance with the High Velocity Hurricane Zone portion of the Florida Building Code and the requirements of Chapter 11-C

¹⁸⁴ Comprehensive Development Master Plan (CDMP)- Miami-Dade County

¹⁸⁵ Ibid.

¹⁸⁶ Ibid.

¹⁸⁷ Ibid.

of the Miami-Dade County Code for structures located in the "V" Zone and the 100-year floodplain."¹⁸⁸ As defined by FEMA, the zone V are "areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply."¹⁸⁹ Nonetheless, the research shows no sections in the county classified as zone V.¹⁹⁰ Within the sections of the Land Use Element, the document reports that even though the county is planning for the years 2020 and 2030, "the pattern of land use and urban growth follows the guidelines of the original 1975 edition of the CDMP, thus essentially remains unchanged."¹⁹¹ Continuing with previous plans from 1975 is not a practice observed by other tri-county Comprehensive Reports.

President Obama-Era Flood Standards Revoked

On August 15, 2017, President Trump announced a roll back on Obama-era flood standards for infrastructure projects, resembling roads and bridges. The new executive order removed the obligation for these projects to be designed to survive the effects of climate change and the consequences of heavy flooding. When former President Barrack Obama signed the mandate in 2015, the primary purpose was to "...protect taxpayer dollars spent on projects in areas prone to flooding and to improve 'climate resilience' across the U.S.- that is, communities ability to cope with the consequences of global warming."¹⁹² The new executive order correlates with President's Trump not treating climate change as national security threat. Additionally, environmental groups have denounced the order since its revealing.

One of the fundamental components of the CDMP are the objectives required to address the growth of Miami-Dade County. The CDMP commits not to promote development growth on Coastal High Hazard Areas.

"Miami-Dade County shall not sponsor any growth-subsidizing programs which promote future population growth and residential development on the barrier islands of Miami-Dade County or within the coastal high hazard areas (CHHA). Miami-Dade County shall coordinate with municipalities in Coastal High Hazard Areas, and areas with repetitive losses due to flooding or

¹⁸⁸ Ibid.

¹⁸⁹ Zone V. (2017, March 03).

¹⁹⁰ Ibid.

¹⁹¹ LAND USE ELEMENT (Rep.). (2015, February 4).

¹⁹² Domonoske, C. (2017, August 16)

storm damage, to minimize demand for facilities and services that result from redevelopment and increases in residential densities. The provision of facilities and services to accomplish the timely evacuation of already-developed barrier islands in advance of approaching hurricanes shall be a priority of Miami-Dade County's transportation planning and hurricane preparedness programs.”¹⁹³

In similar stance, Miami-Dade also commits that “In order to address and adapt to the impacts of climate change, Miami-Dade County shall continue to improve analysis and mapping capabilities for identifying areas of the County vulnerable to sea level rise, tidal flooding and other impacts of climate change.”¹⁹⁴

The analysis should be based on the analysis and recommendations of the Regional Climate Change Action Plan for the Southeast Florida Regional Climate Change Compact Counties, and include the following elements:

“...a) an evaluation of property rights issues and municipal jurisdiction associated with the avoidance of areas at risk for climate hazards including sea level rise; b) an evaluation of the current land supply-demand methodology to consider and address, as appropriate, the risk associated with infrastructure investments in flood prone areas; and c) an evaluation of the CDMP long-term time horizon in relation to addressing projected long-range climate change impacts. Recommendations from the analysis shall address appropriate changes to land use designations and zoning of impacted properties, and development standards, among other relevant considerations.”¹⁹⁵

Another section related to flooding hazards is the water, sewer, and solid waste section. The section states “Miami-Dade County shall coordinate with municipalities and the State of Florida to monitor existing septic tanks that are currently at risk of malfunctioning due to high groundwater levels or flooding and shall develop and implement programs to abandon these systems and/or connect users to the public sewer system.”¹⁹⁶ The County also plans to “identify which systems will be adversely impacted by projected sea level rise and additional storm surge associated with climate change and shall plan to target those systems to protect public health, natural resources, and the region’s tourism industry.”¹⁹⁷

¹⁹³ Ibid.

¹⁹⁴ Ibid.

¹⁹⁵ Ibid.

¹⁹⁶ WATER, SEWER, AND SOLID WASTE ELEMENT (Rep. No. 15-11).

¹⁹⁷ Ibid.

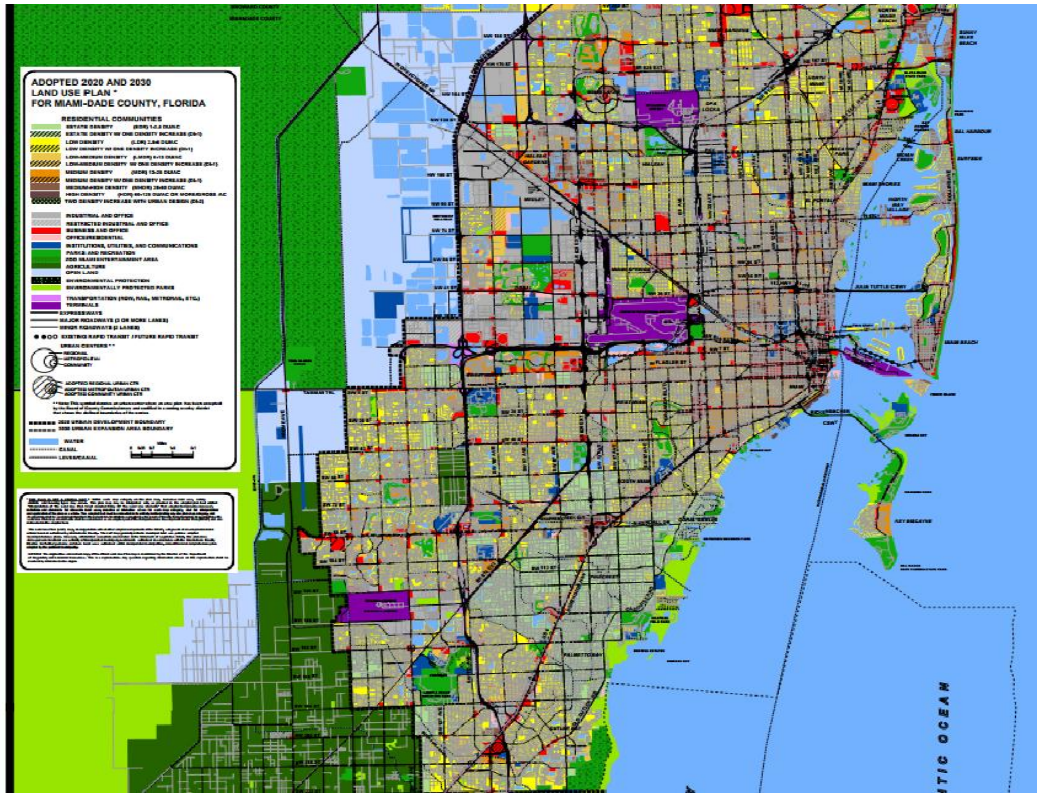


Figure 3: Land Use Plan – Miami-Dade

Source: Miami-Dade County¹⁹⁸

The CDMP includes the Land Use map. Based on the counties landscape, the master plan highlights “the countywide land use plan broadly defines land use categories, with the smallest distinguishable area of the Land Use map set at 5 acres.”¹⁹⁹ This map reinforces that future land use will direct future population concentrations away from the Coastal High Hazard Area (CHHA) and FEMA “V” Zone.

In various moments, the CDMP undergoes review or a process of amendments describing it as a living document. The body of individuals behind the changes of the CDMP, referred as the Metropolitan Planning Section includes the participation of the Board of County Commissioners, the Planning Advisory Board, and affected Community Councils, and communications with applicants and other government jurisdictions involved in the process is coordinated by the CDMP Administration Unit. Once the modifications are determined, the changes to the CDMP are adopted as County Policy by the Board of

¹⁹⁸ Comprehensive Development Master Plan (CDMP)- Miami-Dade County

¹⁹⁹ Comprehensive Development Master Plan (CDMP)- Miami-Dade County

County Commissioners and added to the "Adopted Components - Comprehensive Development Master Plan" book.²⁰⁰

In addition, every seven years, CDMP is reviewed and updated, the recommendations and analysis are developed into a report called the Evaluation & Appraisal Report (EAR) which “evaluates the progress in implementing the goals, objectives, policies, maps and text of the CDMP and recommends changes through EAR-based plan amendments...”²⁰¹ The next EAR will be drafted and adopted in 2018. In June 2017, six town hall workshops were conducted to discuss the EAR process and obtain feedback. In addition, the EAR2018 survey is available online for Miami-Dade county residents.²⁰² According to the workshop presentations, the EAR2018 challenges the questions of major issues facing Miami-Dade these include where and how does county grow. The challenge is seen as a major problem as the county’s population is projected to grow to over 3.1 million by 2040.²⁰³ The EAR2018 challenges the question if the county needs to expand the Urban Development Boundary (UDB) hence, creating sections that will need to be reevaluated in the upcoming flooding maps drawn by FEMA. The EAR2018 also challenges modes of transportation creating questions such as “How do we reduce transportation related greenhouse gas emissions?”²⁰⁴ In relation to climate change, the EAR2018 ask the fundamental question “How should we adapt to the impacts of climate change?”²⁰⁵ To answer this question, the EAR2018 proposes to think on how the county will adapt to the impacts of sea level rise and how it can better protect coastal resources that provide natural protection against flooding and storm surge. According to the data presented by the EAR2018, sea level is projected to rise three feet by 2070 and Miami-Dade County has the largest amount of exposed assets in the world and the greatest amount of exposed population in the United States.²⁰⁶ The next expected steps in adopting the EAR2018, a draft plan is expected in mid-2018 and the final adoption hearings will be held by the end of next year. In addition to the EAR, there is a tri-annual CDMP amendment process for periodic review of the development capacity of the urban area. Overall, “the tri-annual CDMP amendment process is initiated in January, May and October each year when applications to amend the CDMP can be filed with the Department of Regulatory and Economic Resources.”²⁰⁷ The amendment process lasts approximately 10 months, with the core exception that “small-scale”, generally

²⁰⁰ Ibid.

²⁰¹ Evaluation and Appraisal Report (EAR) 2018. (n.d.).

²⁰² Ibid.

²⁰³ *Miami-Dade County* [Evaluation and Appraisal Report Presentation]. (2017, June 22).

²⁰⁴ Ibid.

²⁰⁵ Ibid.

²⁰⁶ Ibid.

²⁰⁷ Comprehensive Development Master Plan (CDMP) Amendment Process. (2017, May 11).

Land Use Plan map amendment requests for property not more than 10 gross acres in size, may be concluded within seven months.²⁰⁸ Miami-Dade County is currently adapting a new version; however, the earliest Master Plan Amendment Cycles began in April 2007.²⁰⁹

City of Miami

The comprehensive report for the City of Miami called the Miami Comprehensive Neighborhood Plan (MCNP) addresses flooding hazards caused by climate change through two distinctive sections, first the section of future land use and second, sanitary and storm sewers. As described in the table below, both sections focus on protecting vulnerable sectors of the county in minimizing the impact future environmental degradation may have on those specific zoning areas.

Table 5: Future Land Use- City of Miami

<p>Goal LU-1: Maintain a land use pattern that</p> <ul style="list-style-type: none"> (1) protects and enhances the quality of life in the City's neighborhoods; (2) fosters redevelopment and revitalization of blighted or declining areas; (3) promotes and facilitates economic development and the growth of job opportunities in the city; (4) fosters the growth and development of downtown as a regional center of domestic and international commerce, culture and entertainment; (5) promotes the efficient use of land and minimizes land use conflicts while protecting and preserving residential sections within neighborhoods; (6) protects and conserves the city's significant natural and coastal resources; and (7) Protects the integrity and quality of the City's existing neighborhoods by insuring public notice, input and appellant rights 	<p>Objective LU-1.8: The location, design and management practices of development and redevelopment in the City shall ensure the protection of natural resources and systems by recognizing, and sensitively responding to constraints posed by climate change and sea level rise.</p>	<p>Policy LU-1.8.1: The City shall assist Miami-Dade County in their analysis on climate change and its impacts on the built environment addressing development standards and regulations related to investments in infrastructure, development/redevelopment and public facilities in hazard prone areas including areas vulnerable to sea level rise, tidal flooding and other impacts of climate change. Recommendations from the analysis shall address appropriate changes to land use designations and zoning of impacted properties, and development standards, among other relevant considerations.</p>
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²⁰⁸ Ibid.

²⁰⁹ Comprehensive Development Master Plan (CDMP) Amendment Cycles. (2017, July 26).

regarding changes in existing zoning and land use regulations.

Sanitary and Storm Sewers- City of Miami

Goal SS-2: Provide adequate storm water drainage to reasonably protect against flooding in areas of intensive use and occupation, while preventing degradation of quality in receiving waters.

Objective SS-2.1: In accordance with the 1986 Storm Drainage Master Plan and subsequent updates, the City will address the most critical drainage problems. The City's goals for retrofitting sub catchment areas within the City will meet or exceed the five-year frequency, 24-hour duration standard while utilizing water quality design criteria. The City will confer with local agencies, namely the Miami-Dade County Department of Environmental Resources Management (DERM) when retrofitting City projects to incorporate design criteria and best management practices (BMPs).

*Source: City of Miami*²¹⁰

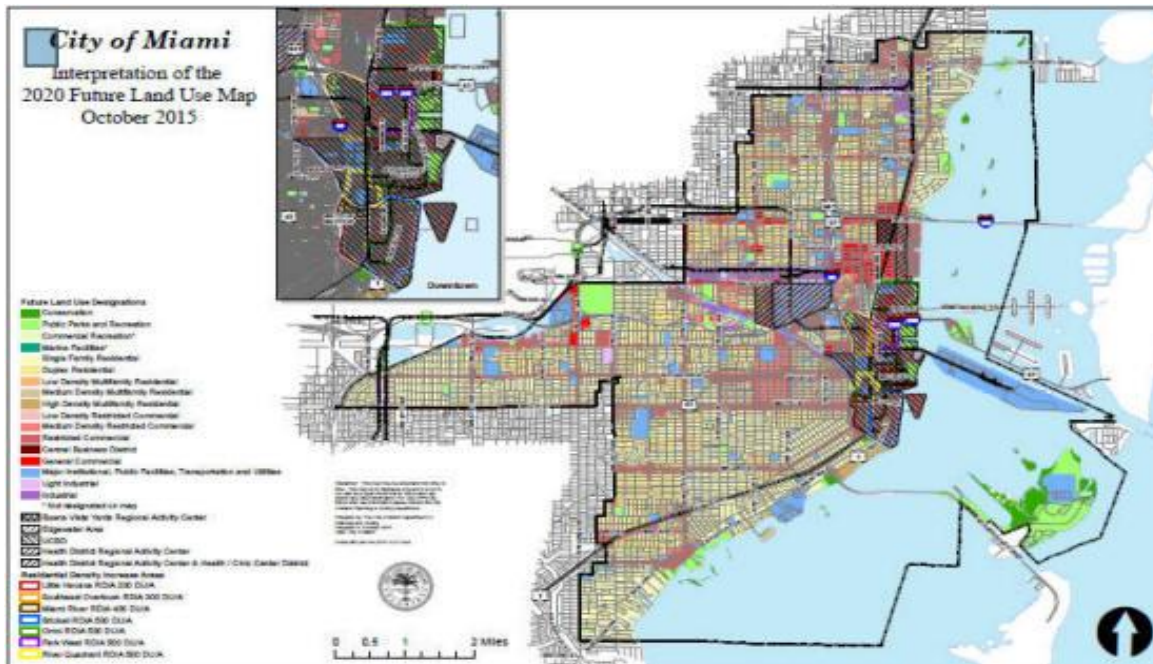
According to their Future Land Use Map 2020 (as seen below), the expansion of the city follows the provisions provided by the MCNP that protects future populations from the outcomes of climate change and the possible impacts on the environment. In relation to the City of Miami's EAR, "Revisions to the Miami Comprehensive Neighborhood Plan are currently underway through the Evaluation and Appraisal Review (EAR)."²¹¹ Hence, the report should have its final submission of the EAR-based amendments to the Miami Comprehensive Neighborhood Plan by November 28, 2017.²¹²

Figure 4: 2020 Future Land Use Map

²¹⁰ Miami Comprehensive Neighborhood Plan. (n.d.).

²¹¹ Ibid.

²¹² Ibid.



Source: City of Miami²¹³

Comprehensive Plan- Broward County

The Broward CDMP is composed of 18 Elements that contain goals, objectives, and policies organized by topics.²¹⁴ It is important to analyze the CDMP in order to determine the efforts implemented by the county to alleviate the effects of flooding hazards and climate change. Unlike Miami-Dade County, Broward as added sections to their plan not found in the CDMP of Miami-Dade. For instance, the report includes sections “Natural Disaster Component” or “Climate Change.”²¹⁵ These are all mandatory elements that directly affect the viewpoint Broward county has towards the impact of climate change and flooding hazards. As the Metropolitan Center reviewed these key elements, a specific language promotes different forms of change that create sustainability and protection against climate change impacts. For instance, the climate change element states in policy 19.3.9. “Broward County, in conjunction with its municipalities and partner agencies, shall work to ensure that adaptation to climate change impacts, especially sea level rise, is incorporated into the planning, siting, construction, replacement and maintenance of public infrastructure in a manner that is cost-effective and that maximizes the use of the infrastructure throughout its expected life span.”²¹⁶ These type of statements illustrate the high levels of

²¹³ Miami Comprehensive Neighborhood Plan. (n.d.).

²¹⁴ What is the Comprehensive Plan? (n.d.).

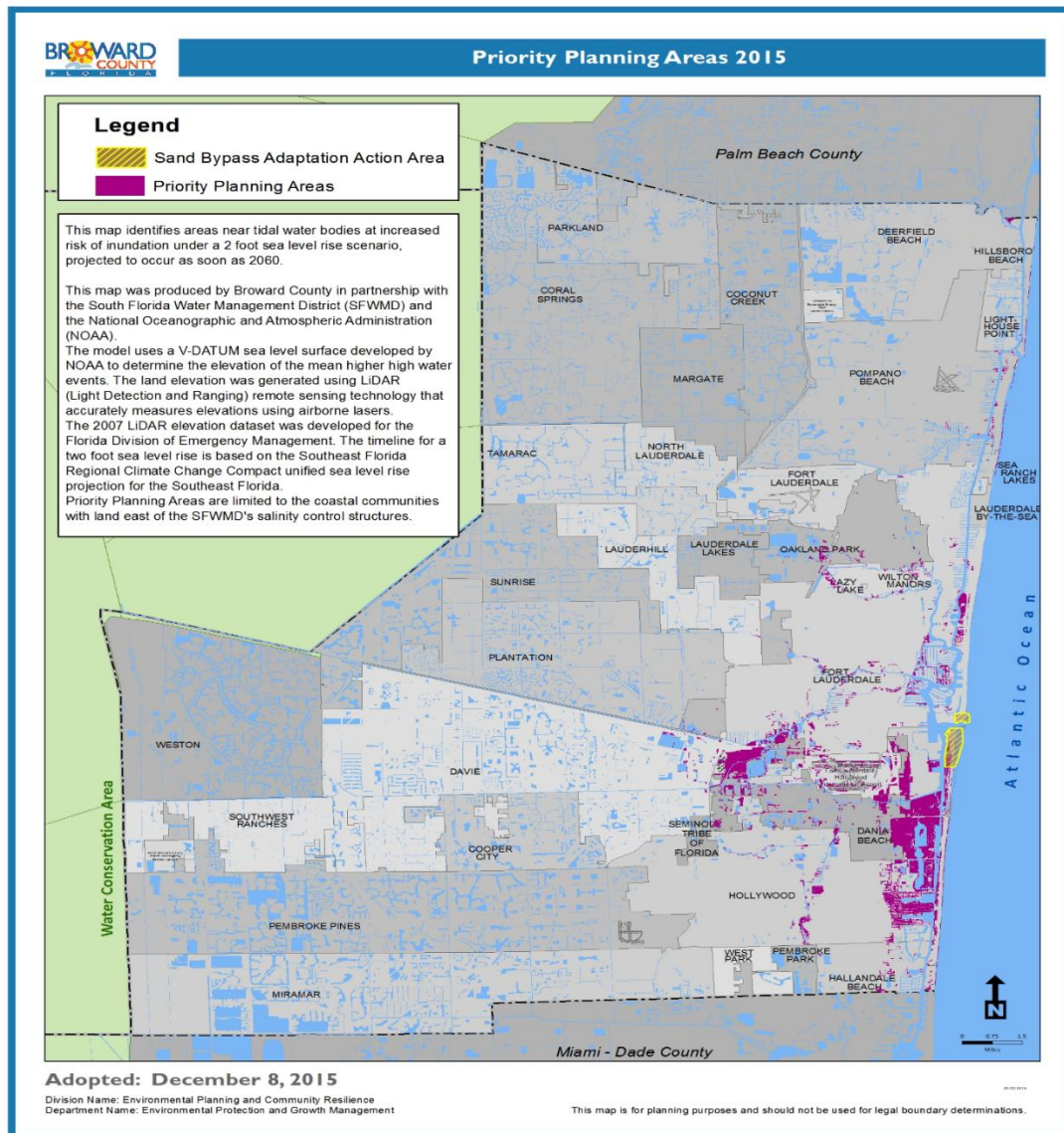
²¹⁵ Comprehensive Plan Elements. (n.d.).

²¹⁶ Ibid.

commitment Broward County contributed in their CDMP to the prevention towards the inevitable impacts of climate change by committing to what is beyond required of them.

The following section will include the Broward County Land Use Plan for Priority Planning Areas for Sea Level Rise Map. The map, produced by Broward County in partnership with the South Florida Water Management District (SFWMD) and the National Oceanographic and Atmospheric Administration (NOAA) utilizing V-DATUM, which is a method, developed to determine the sea rise elevation. The importance of this map is to exemplify how determined Broward County is in incorporating the effects of climate change in all their future planning. Hence, due to the outcome of the mapping, priority-planning areas are limited to the coastal communities with land east of the SFWMD’s salinity control structures.

Figure 5: Broward County Land Use Plan Priority Planning Areas for Sea Level Rise Map



*Source: Broward County*²¹⁷

The Broward County Land Use Plan (see above) highlights the regional issues of the county including a ‘climate change resilience vision.’ The strategic objective is to “increase the resilience of our community to the effects of climate change.”²¹⁸ The objective of the planning strategy is to reduce the impact of climate change by considering priority planning that addresses reduction methods to the effects that may occur in the future.²¹⁹ Within the planning structure, the County attained the following objectives to reduce the impact of climate change to future planning projects,

- (1) Requiring all land use and planning decisions within the Priority Planning Areas to consider and effectively address future climate predictions for a 50-year planning horizon, including 2 feet of sea level rise,
- (2) Designating Adaptation Action Areas to identify areas vulnerable to coastal flooding, implement adaptation policies, and enhance and prioritize the funding of infrastructure adaptation projects,
- (3) In coordination with municipalities, adopting land use regulations to limit development and redevelopment in areas particularly vulnerable to flooding due to sea level rise, storm water inundation, and other impacts of climate change,
- (4) Applying the unified sea level rise projection for Southeast Florida when considering land use (including areas of potential population growth, natural system restoration, and infrastructure adaptation) and long-term functionality of appurtenant infrastructure, especially water management, drainage, water supply and water treatment systems, both coastal and inland.²²⁰

In addition to adopting future planning objectives, the plan also elaborates on how the county will adopt practical examples on methodologies to alleviate the loss of disaster impact.²²¹ For instance, the county has an objective to purchase and/or redevelop Repetitive Loss Properties is to reduce future property damages and losses. The report defines “A “repetitive loss property” as an insurable property where the National Flood Insurance Program has paid at least two (2) claims of more than \$1,000 within 10 years. Based on the data, “there are over 700 such properties in Broward County, in every municipality

²¹⁷ Comprehensive Plan Elements. (n.d.).

²¹⁸ Broward County Land Use Plan. (2017, June).

²¹⁹ Ibid.

²²⁰ Ibid.

²²¹ Ibid.

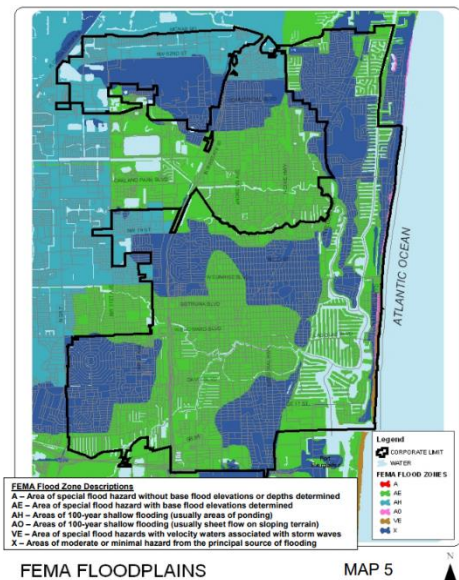
except Sea Ranch Lakes.”²²² The efforts will include that the county will provide and utilize public funds to purchase repetitive loss properties.

City of Fort Lauderdale

The Comprehensive Plan of the city of Fort Lauderdale adopted in 2008 followed major updates in 2015. The plan focuses on reducing the impact of climate change and flooding hazards. One of the sections that highlights the counties legislation that addresses disaster mitigation. Under the section of Future Land Use Element- Data and Analysis, which serves as a guide for land development in an acceptable manner, the report mentions flooding concerns as it elaborates on the population projections of the city and the ultimate need for additional housing. According to the plan, “much of the City’s land area is located within the flood plain, including intensely developed locations east of Federal Highway. The most susceptible flood prone areas are located along the New River, the Intracoastal Waterway and the Atlantic Ocean.”²²³ As a method to minimize the effects, “Waterfront sites in the City were developed with a continuous bulkhead and backfill to provide elevated sites. Homes and other buildings along the waterways are well maintained.”²²⁴

The second element of the Comprehensive Plan th policies is the coastal management element; it directly discusses coastal erosion of developed areas and disaster planning.”²²⁵ For instance, it mentions that coordination with County, regional and state authorities regarding construction in flood zones will be a focus point over the next planning period.²²⁶ For the City of Fort Lauderdale, the EAR was adopted in 2016. The EAR 2015 questionnaire, asked 605 individuals a variation of questions. Most relevant to climate change was the question that asked participants “what impacts do you think climate change has had, or will have, on the city?”²²⁷ The responses varied, 71.7% responded sea level rise, 66.1% responded increased flooding, 45.4% responded increased storm

Figure 6: City of Fort Lauderdale- FEMA



²²² Ibid.

²²³ FortLauderdale.gov. (n.d.).

²²⁴ Ibid.

²²⁵ Ibid.

²²⁶ Ibid.

²²⁷ Evaluation and Appraisal Report of the Fort Lauderdale Comprehensive Plan (pp. 1-101, Rep.). (n.d.).

events, 40.1% responded increased energy costs and 14% responded no impact.²²⁸ In total, 601 individuals were asked, “What steps should the city take to address climate change?” The highest response (66.2%) was infrastructure improvements, 63.4% responded increased flood protection, 32.8% responded more shade, 51.6% answered more landscaping, 46.9% answered reduced energy consumption, and 22.8% stated no action necessary.”²²⁹

The newly developed EAR of 2016 included a section on climate change and highlighting that “elevation is the key factor in identifying areas most at risk for sea level rise and/or increased storm frequency impacts.”²³⁰ The EAR focused on demonstrating the economic cost flooding has on the city as well as creating a sense of urgency on addressing the issues created by climate change.²³¹ The EAR also analyzes how environmental insecurity affects real estate in the city. The text states, “Real estate development is a main sector of the City’s economy. If significant areas of the City become essentially off limits to development due to flooding risk, this economic sector could be severely affected if the City failed to plan for future development in areas less vulnerable to this risk.”²³² Therefore, the EAR is placing great emphasis for the city to address an essential problem that will eventually affect the pockets of the city.

According to the EAR report, resiliency against the damages caused by climate change should be one of the primary objectives of the City of Fort Lauderdale. In order to protect human life, the city has prioritized “Raising building elevations and designing areas that can accept tidal or stormwater flooding without major damage are types of adaptation methods.”²³³ In addition, construction and design of future projects will need to “...withstand and adapt to sea level rise.”²³⁴ Separate to building codes, the EAR also highlights the achievements and goals of the cities drainage system. The report indicates, “The City’s

Figure 7: City of Fort Lauderdale- Hazard areas



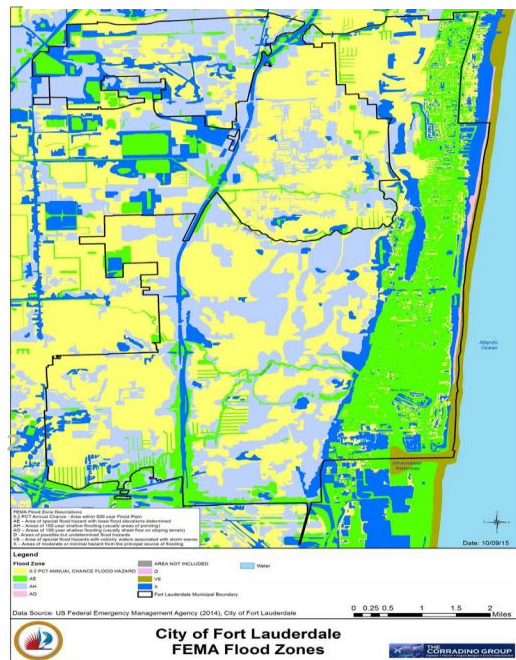
²²⁸ Ibid.
²²⁹ Ibid.
²³⁰ Ibid.
²³¹ Ibid.
²³² Ibid.
²³³ Ibid.
²³⁴ Ibid.

storm water drainage infrastructure includes 171 miles of storm water pipes, 2,324 manholes, 1,258 outfalls, 37 drainage wells, and 8,288 catch basins. The EAR report highlights how the performance of the City’s drainage infrastructure is a key component of the City’s storm water drainage and flood management efforts.²³⁵ The city believes that by addressing these problems the City’s storm water drainage and flood management efforts, the community will be better suited for any disaster of any type.

The following are highlights of the efforts of the City of Fort Lauderdale in reducing the impact of climate change:

- In 2011, the City of Fort Lauderdale updated its Sustainability Action Plan (SAP), which outlines strategies for increasing sustainability in a number of areas including preparation for climate change impacts, and reduced greenhouse gas emissions.²³⁶ The plans calls for “enhanced communication about climate change adaptation in intergovernmental coordination efforts, and partnerships with agencies and institutions to increase disaster preparedness.”²³⁷
- The City of Fort Lauderdale Sustainability Action Plan Progress Report titled Making Waves was completed in May 2015 and found that 42% of the actions identified in the Sustainability Action Plan have been implemented, with another 30% in progress.²³⁸
- In order to realize the vision expressed in the Fast Forward Vision Plan (to strive to be “a resilient and safe coastal community”) the City adopted the Press Play Strategic Plan 2018 in 2013.²³⁹ Under Goal 2, the city pursues to “reduce flooding and adapt to sea level rise.”²⁴⁰ Highlighting the efforts to reduce flooding within a macro level. In addition, strategic initiatives under Objective 2 include incorporating sea level rise and resiliency projections in the storm water management

Figure 8: City of Fort Lauderdale



²³⁵ Ibid.

²³⁶ Sustainability Action Plan. (n.d.).

²³⁷ Ibid.

²³⁸ City of Fort Lauderdale Sustainability Action Plan Progress Report Making Waves (pp. 1-48, Rep.). (2015).

²³⁹ FortLauderdale.gov. (n.d.).

²⁴⁰ Press Play Fort Lauderdale, Our City, Our Strategic Plan 2018 (pp. 1-131, Rep.). (n.d.).

plan and flood hazard mitigation program. Objective 3 under Goal 2 states the city aims to “improve climate change resiliency by incorporating local, regional, and mega-regional plans.”²⁴¹ Identifying a unifying methodology of all strategic approaches in reducing the effects of climate change.

- Specifically, the City hosted the 2013 Southeast Florida Regional Climate Leadership Summit, and improved its Community Rating System Score from seven to six, resulting in a 20% discount in flood insurance premiums for many residents.²⁴²
- In 2015 an innovative citywide climate change and sustainability training program was conducted for all City employees, nearly 2,600 in total, likely making the City the first in the nation to implement a mandatory training initiative of this type and magnitude. This training used science to raise workforce awareness and actively engage them in addressing this formidable challenge.²⁴³

Comprehensive Plan- Palm Beach County

Last revised in 2015, the Comprehensive Plan of Palm Beach County has certain elements that addresses the concerns of flood areas and the effects of natural disasters. For instance, the storm water management sub-element department learns and adapts from the recommendations produced by studies and plans of the County's drainage, water control, and improvement and water management districts. Utilizing these resources, the county has been able to develop the goal of ensuring the city's storm water system both technically and economically sound. The city's also mandates for the necessary steps for the system to maintain the proper levels of protection from flooding and Stormwater inundation for existing and future land uses.

According to the county, the new EAR for Palm Beach County will begin in 2018, followed by a presentation to the Florida Department of Economic Opportunity (DEO) by 2019. The last updated and finalized EAR was in November 2012. The primary issues recognized by the writers in 2012 was strengthening and managing the growth tier system, meeting the new state requirements in dealing with energy efficiency, shifting from general planning to local solutions, adoption of a new Future Land Use Atlas (FLUA), and the future of the Glades Tier region in Palm Beach County.²⁴⁴

Boca Raton

The 2010 Comprehensive Plan of the City of Boca Raton is the latest working edition for the city. In relation to flood hazards and the prevention of the effects of climate change, only certain elements of

²⁴¹ Ibid.

²⁴² The Summit. (n.d.).

²⁴³ Press Play Fort Lauderdale, Our City, Our Strategic Plan 2018 (pp. 1-131, Rep.). (n.d.).

²⁴⁴ Issue: Strengthening the Managed Growth Tier System (pp. 1-6, Publication). (n.d.).

the plan address preventative indicators. The elements of Future Land Use states, “Additional intensities or densities will not be granted to any properties located in (Federal Emergency Management Agency) (FEMA) Flood Zone A or Flood Zone V areas.”²⁴⁵ That is the only mention of flooding in relation to future land use, indicating a limited scope of detail for an area extremely prone to hurricane effects.

The City of West Palm Beach

The City of West Palm Beach Comprehensive Plan also contains minimal to almost no specifics on the flooding hazards or policies in the prevention of damage. The last EAR for the City of West Palm Beach was adopted in 2007. The EAR identified four major planning issues. First, the city needs to address the great need for attainable/workforce housing. Second, the city must address opportunities for green space linkages and enhancements. Third, a great need to encourage economic development. Finally yet importantly, the city must address the transportation system to meet the City’s existing and future needs.²⁴⁶

²⁴⁵ *Coastal management element* [PDF]. (2010, October 26).

²⁴⁶ *Ibid.*

VI. FLORIDA RESIDENT SURVEY RESULTS

The Metropolitan Center has been collecting Floridians’ opinions for eleven years, with the Center’s residential survey providing the detail and chronological trends between 2006 and 2017. At the core of this survey understands residents’ perceptions of risks, preparations for potential impacts, and preferences for government policy. **Table 16** illustrates some of the basic questions asked through all years: how vulnerable do residents feel to hurricane damage, how certain are they in their access to hurricane-related information, do they have a plan prepared in advance of a forecasted storm, and if they would evacuate when ordered to. While 2008 remains the highest affirmative response rate across all four questions, 2017 reported the same numbers as 2016 in information access, at 92%. In addition, it is significant to note that there was a 22 percent increase for those who reported having a plan of action, from 61% in 2016 to 83% in 2017.

In general, the survey evaluates the response of 600 individual residents of Miami-Dade County. The majority of the participants owned their homes while the minority of the responders rent their homes.

Table 16. Florida Residential Survey Trends

	2006	2007	2008	2009	2010	2011	2013	2015	2016	2017
Perception of vulnerability	46%	54%	58%	48%	43%	50%	57%	46%	46%	52%
Information access	87%	90%	95%	93%	92%	90%	93%	92%	92%	92%
Plan of action	85%	85%	89%	87%	78%	70%	75%	77%	61%	83%
Evacuate if ordered	28%	37%	43%	40%	37%	40%	38%	36%	38%	36%

Hurricane Preparedness

- Of the respondents, 83.3% reported having a plan in the wake of serious hurricane threatening their homes. The majority of households (89.5%) reported that they are adequately prepared for a hurricane. However, only 45.2% have only experienced a Tropical Storm, 36% have experienced a category 1 hurricane or higher and 18.8% have never experienced none of them.
- Only 35.8% of respondents indicated that their home was already prepared and have the ability in being secure within a few hours of receiving news of a hurricane warning. In comparison, 20% of the respondents indicated they would prepare their home when a hurricane warning is issued

(within 36 hours of impact) while 28.8% indicated their homes would be ready for a hurricane when a hurricane watch is issued (within 48 hours of impact).

- If an evacuation were to be issued, 22.7% would go to a local shelter, 24.3% to a friend or family members home, 18.3% would go to another location within the state. Only 8.7% would not leave under any circumstance their homes.
- Residents have also significantly changed where they would go in the event of evacuation, with those reporting a local shelter declining from 26% in 2016 to only 22.7% in 2017, going to a nearby friend or family member's house declining from 27% to 24.3%, and leaving the state rising from 17% to 19.7% over the same time period;
- Only a third (31%) of respondents reported having personally experienced hurricane damage to their home.
- While access to information has remained high (92%), the sources have changed with internet rising from 10% in 2016 to 11.3% in 2017, and TV falling from 87% in 2006 to 71.8% in 2017;

Sea Level Rise

- There was a significant increase in those that believe in sea level rise, from 47% in 2015 to 61% in 2017, and a general rise of those that believe they will be affected by it, from 20% in 2015 to 25.5% in 2017;
- When respondents answered if they believe sea level rise is occurring in Florida, the collected responses reflect a divided audience. According to their responses, 25.5% believe sea level rise is occurring in Florida and can be affected by the natural phenomenon, while 13.5% reported they believe in sea level rise occurring in Florida yet do not know if they will be affected. In comparison, 22.0% believe sea level rise is occurring in Florida but do not believe they will be affected and 25.7% do not believe sea level rise is occurring at all.

Homeowners Insurance

- When asked if homeowners would consider removing their insurance policies after their mortgage is paid off, the majority (78.6%) indicated they would not drop their insurance.
- The respondents also indicated that a majority of the respondents (60.0%) expects their insurance rate to change in the next 1-3 years.
- A significantly low number of respondents currently had a renters insurance (4.7%); however, the number of respondents with active homeowners insurance was extremely high at 82.7%.

- The respondents indicated that 48.2% receive discounts on their homeowner insurance policy for hurricane loss-mitigation improvements (shutters, wind-resistant windows, reinforced roofs, doors, etc.). Compared to 40.1% of the respondents who do not receive any form of discount for home improvements.

Survey Results Presentation



Summary

- Annual Florida poll with 600 coastal county residents
- Poll conducted in the beginning of hurricane season (June)
- Track changes in homeowner perceptions of hurricane threat, risk and potential mitigation measures
- Sea Level Rise awareness and adaptation
- Trend analysis of hurricane risk in coastal counties

Culture of Preparedness?

Sandy

	2006	2007	2009	2011	2013	2015	2016	2017
Perception of vulnerability	46%	54%	48%	50%	57%	47%	46%	52%
Information access	87%	90%	93%	90%	93%	91%	92%	92%
Plan of action	85%	85%	87%	70%	75%	78%	61%	83%
Evacuate if ordered	28%	37%	40%	40%	38%	26%	38%	36%

2017 Results:

Homeowners' Views: Preparedness

- Only 36% percent consider their homes prepared.
 - 49 percent would begin to prepare when a hurricane warning (20%) or a hurricane watch (29%) is issued.
 - Approximately eight percent will not make any additional preparations.

Although 89.5% of respondents reported their household's preparation as adequate, 96% of respondents were actually prepared by objective measures, and only with the basics.

Flashlight: 87%
 Water (one gallon per person per day): 75%
 Food (three-day supply): 81%
 First aid kit: 74%
 Radio and batteries: 77%

2016 Results: Awareness

- One in eight (12%) do not know if their home is in a flood or evacuation zone. Additionally, of those who said they are not (59%), one third actually are.
 - Population in floodplain: Miami-Dade 48%, Broward 79%, Palm Beach 18%
- One in seven homeowners (16.4%) are without home insurance and of those who have it, 16% would cancel their insurance once their mortgage is paid off. up from 9% in 2015
- 50% do not receive any discounts from their insurance company for mitigation, and 13% are not aware of any discounts being offered. up from 13% in 2015

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2017 Results: Sea Level Rise

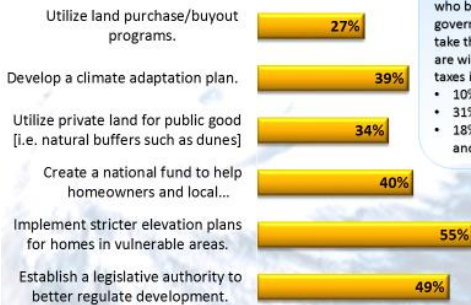
- 39% do not believe sea level rise is happening or they do not know.
- Only 26 percent think they will be affected.

How much do you think each of these actors should do to reduce the effects of rising sea level in the future?

	A great deal (leading role)	Some (supporting role)	A little (minor role)	Nothing
Federal Government	59%	23%	5%	13%
State government and agencies	68%	18%	4%	10%
Local governments near the coast	66%	21%	5%	8%
Businesses near the coast	52%	28%	8%	12%
Homeowners near the coast	57%	25%	9%	9%
Real estate developers	67%	17%	6%	10%
General public	42%	37%	8%	13%
Scientists	63%	21%	3%	13%

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2017 Results: What should governments do reduce the effects of rising sea level in the future ?



The majority of those who believe government should take the leading role are willing to have taxes increased.

- 10% income
- 31% property
- 18% both income and property

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Conclusions

- There has been a decline in risk awareness and preparedness.
- The majority of Florida homeowners are not aware of the effect of sea level rise or they do not believe they will be affected.

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Appendix A: Florida Homeowner Survey

Hello, I am _____, calling from Florida International University. We're conducting a survey on residents' perceptions of hurricane threats and damage reduction. The identity of people answering our questions will be kept completely confidential, but your answers will help Florida be better prepared the next time a big hurricane approaches. I need to talk to one of the adults responsible for your household, 18 or older. Would that be you?

Q1 Is your home a

- Single Family Home, Detached (2)
- Townhome (1)
- Apartment/Condominium (3)
- Manufactured or Mobile Home (4)
- Other (5) _____

Q2 Do you own or rent your home?

- Own (1)
- Rent (2)

Q3 Please tell me, in what year was your home built? _____ [yyyy]

Q4 How many years have you been a permanent resident of Florida?

- Less than 1 (1)
- 1-3 (2)
- 3-5 (3)
- 5-10 (4)
- Over 10 (5)

Q5 Have you or any adults in your household experienced any of the following? [ASK ABOUT THE NAME OF THE EVENT AND/OR YEAR]

- Tropical Storm (1) _____
- Category 1 Hurricane (2) _____
- Category 2 Hurricane (3) _____
- Category 3 or Higher (4) _____
- NONE OF THE ABOVE (5)

If NONE OF THE ABOVE is Selected, Then Skip To Q9 How vulnerable do you feel to ...

Q6 Have you or any adults in your household lived in a home physically damaged by a hurricane?

- Yes (1)
- No (2)

If No Is Selected, Then Skip To Q9 How vulnerable do you feel to ...

Q7 How badly was it damaged? Would you say the damage was slight, moderate, or major?

- Slight (1)
- Moderate (2)
- Major (3)

Q8 Can you tell me what were the primary causes of damage to your home? Was it the debris in the wind breaking your windows, wind damaging your windows, wind damaging your roof, ocean surge, flooding, or something else? [MARK ALL THE RESPONSES MENTIONED]

- Wind Debris Breaking Windows (1)
- Wind Damaging the Roof (2)
- Ocean Surge (3)
- Flooding Related to a Hurricane (4)
- Trees Falling on House (5)
- Something Else (SPECIFY) (6) _____

Q9 How vulnerable do you feel to damage from a hurricane, related tornado or flooding hazards? Do you feel...

- Extremely Vulnerable (1)
- Somewhat Vulnerable (2)
- Not Too Vulnerable (3)

Q10 Considering yourself and others in your household, how certain are you that your household would have all the information needed to protect yourselves and your home from hurricane damage? Are you ...

- Very Certain (1)
- Somewhat Certain (2)
- Not Certain At All (3)

Q11 Where do you receive the majority of your hurricane information from when a hurricane is approaching?

- Internet (1)
- Radio (2)
- TV (3)
- Newspapers/Print media (4)
- Friends and family (5)

Other (6) _____

Q12 Do you have a plan for what you would do if a serious hurricane threatens your home?

- Yes (If yes, what is your plan?) (1) _____
- No (2)

Q13 When would you begin to prepare your home for a hurricane? [READ LIST]

- When a hurricane watch is issued (hurricane conditions are *possible* within **48 hours**) (1)
- When a hurricane warning is issued (hurricane conditions are *expected* within **36 hours**) (2)
- Your home is already prepared and could be secured within a few hours (3)
- You won't make any special preparations to your home (4)
- Other (5) _____
- Not sure (DO NOT READ) (6)

Q14 Overall, would you describe your household preparation for a hurricane as...

- Adequate (1)
- Inadequate (2)

Q15 Do you have a Basic Emergency Supply Kit with the following: [Mark as many as indicated]

- Water, one gallon of water per person per day for at least three days
- Food, at least a three-day supply of non-perishable food
- Battery-powered radio and extra batteries for it
- Flashlight and extra batteries
- First aid kit
- Whistle to signal for help
- Dust mask, to help filter contaminated air and plastic sheeting and duct tape to shelter-in-place
- Personal sanitation items, e.g. moist towelettes, garbage bags
- Wrench or pliers to turn off utilities
- Can opener for food [if kit contains canned food]
- Local maps
- Other [SPECIFY]: _____
- I do not have an Emergency Supply Kit

Q16 Is your home located in a flood or evacuation zone? [ASK WHAT IS THE LETTER DESIGNATION FOR THE FLOOD OR EVACUATION ZONE, READ OPTIONS IF NECESSARY]

- Yes, flood zone (1) _____ [MARK LETTER: A (HIGH FLOOD RISK), B (MODERATE) OR C (LOW RISK)]
- Yes, evacuation zone (2) _____ [MARK LETTER: A (EVACUATE FOR ALL HURRICANES), B (EVACUATE FOR CATEGORY 3 AND ABOVE HURRICANES), C THROUGH E (EVACUATE IF ADVISED BY AUTHORITIES)]
- Yes, both flood and evacuation zone (3) _____ [MARK LETTERS]
- Neither flood, not evacuation zone (4) _____
- Don't know (DO NOT READ) (5) _____

Q17 When would you evacuate? (READ LIST and SELECT ONE)

- If a hurricane watch is issued (hurricane conditions are *possible* within **48 hours**) (1)
- If a hurricane warning is issued (hurricane conditions are *expected* within **36 hours**) (2)
- If a category 3 hurricane or stronger was going to hit your home within 24 hours (3)
- If emergency management officials ordered you to evacuate (4)
- Probably never (5)
- Other (6) _____

Q18 If you needed to evacuate, where would you go?

- To a local shelter (1)
- To the house of a nearby friend/family (2)
- Another location within the State (3)
- As far as possible – to another State (4)
- You would not leave under any circumstances (5)
- Other (6) _____

Q19 Do you currently have homeowners' or renters' insurance?

- YES Homeowner's insurance (1)
- YES, Renters' insurance (2)
- No (3)
- Don't know (DO NOT READ) (4)

If YES, Renters' insurance Is Selected, Then Skip To Q26 Do you believe sea level rise is happening in Florida...

If No Is Selected, Then Skip To Q26 Do you believe sea level rise is happening in Florida

Q20 How has your home insurance rate changed in the last:

	Decreased Significantly (Over 10%) (1)	Decreased Somewhat (1-10%) (2)	Remained the Same (3)	Increased Somewhat (1-10%) (4)	Increased Significantly (Over 10%) (5)	Don't Know
One Year (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1-3 Years (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3-5 Years (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5-10 Years (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If Remained the Same Is Selected, Then Skip To Q22 Do you currently have Citizens...

Q21 With regards to the changes in your insurance rate...

	Yes (1)	No (2)	Uncertain [DO NOT READ] (3)
Do you understand the reasons for the change? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you believe the change was justified? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you anticipate that your rate will change again in the next 1-3 years? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q22 Do you currently have Citizens Insurance?

- Yes (1)
- No (2)
- Don't know [DO NOT READ] (3)

Q23 In recent years there has been a trend among homeowners who have paid off their mortgage to cancel their homeowner insurance policies. Would you consider it if your mortgage was paid off?

- Yes (1)
- No (2)
- I have already dropped my insurance (3)
- Not Applicable (Don't have insurance) (4)

Q24 Are you currently receiving any discounts on your homeowner insurance policy for hurricane loss mitigation improvements you may have on your home (for example shutters, reinforced roofs, doors etc.)?

- Yes (1)
- No (2)
- Don't Know

Q25 Do you believe sea level rise is happening in Florida, and do you think your property or finances will be affected?

- Yes, I believe it is happening and I will be affected (1)
- Yes, I believe it is happening but I do not know if I will be affected (2)
- Yes, I believe it is happening but I will not be affected (3)
- No, I do not believe it is happening (4)
- I don't know if it is happening (5)

If YES Is NOT Selected, Then Skip To Q30 Most of Florida's coastal areas...

Q26 How much do you think each of these actors should do to reduce the effects of rising sea level in the future – a great deal, quite a bit, some, a little, or nothing?

	A great deal (should play a leading role) (1)	Some (Should play a supporting role) (2)	A little (very minor role) (3)	Nothing (4)
A. Federal Government (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. State government and agencies (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Local governments that are located near the coast of the U.S. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Businesses located near the coast (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Homeowners located near the coast (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Real estate developers (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
G. General public (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H. Scientists (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If A little (very minor role) (3) OR Nothing (4) Is Selected for A. B. and C. Then Skip To Q30 Most of Florida's coastal areas...

Q27 What should the government be doing to combat sea level rise? [Multiple Choice]

- Establish a legislative authority to better regulate development. (1)
- Create a national fund to help homeowners and local governments take action on sea level rise. (2)

- Implement stricter elevation plans for homes in vulnerable areas. (3)
- Utilize land purchase/buyout programs. (4)
- Develop a climate adaptation plan. (5)
- Utilize private land for public goods (i.e. natural buffers such as dunes). (6)
- The government is not responsible. (7)
- There is no sea level rise. (8)
- Other (9) _____
- Don't Know/No Response

Q28 If you believe the government should take any action, to pay for any initiative, the government could increase everyone's income taxes, or the government could charge higher property taxes to companies and people who own buildings near the coast. In which way would you prefer that the government pay for those initiatives?

- Increase income taxes (1)
- Increase property taxes (2)
- Increase both income and property taxes (3)
- Other (4) _____
- Neither (DO NOT READ)

Q29 Most of Florida's coastal areas have a very low elevation (under 10 meters (33 feet) above sea level) and are especially vulnerable to flooding associated with storm surges. How concerned are you about flooding in your area?

- Extremely concerned (1)
- Moderately concerned (2)
- Somewhat concerned (3)
- Slightly concerned (4)
- Not at all concerned (5)

Finally, I just have a few general background questions and we will be finished.

Q30 Could you please tell me your age? [READ AGE RANGES AND LET RESPONDENT PICK]

- 18-34 (1)
- 35-54 (2)
- 55-64 (3)
- 65 OR OLDER (4)
- NO RESPONSE (5)

Q31 Including yourself, how many people ...

- live in your household (1) _____
- are under 12 years old (2) _____
- are 65 or older (3) _____

Q32 What is your marital status?

- Single/Never Married (1)
- Married or Living with partner (2)
- Widowed (3)
- Divorced (4)
- Separated (5)
- Other (6) _____

Q33 What is the highest grade of school completed by an adult member of your household?

- Less than high school (1)
- High school (2)
- Some college (3)
- College graduate (4)
- Graduate Degree (5)
- Other (6) _____

Q34 What racial groups do you identify yourself with?

- White/Caucasian (1)
- Black/African American (2)
- Asian (3)
- Native American (4)
- Other (5) _____

Q35 Are you of Hispanic/Latino descent?

- Yes (1)
- No (2)

Q36 What language is most often spoken in your home? [DO NOT READ, MARK RESPONSE]

- English (1)
- Spanish (2)
- Other (3) _____

Q37 Please tell me which is the income range for your household.

- Under \$20,000 (1)
- \$20,000-30,000 (2)
- \$30,000-\$50,000 (3)
- \$50,000-\$75,000 (4)
- \$75,000-\$100,000 (5)
- Over \$100,000 (6)
- Don't know/No response (7)

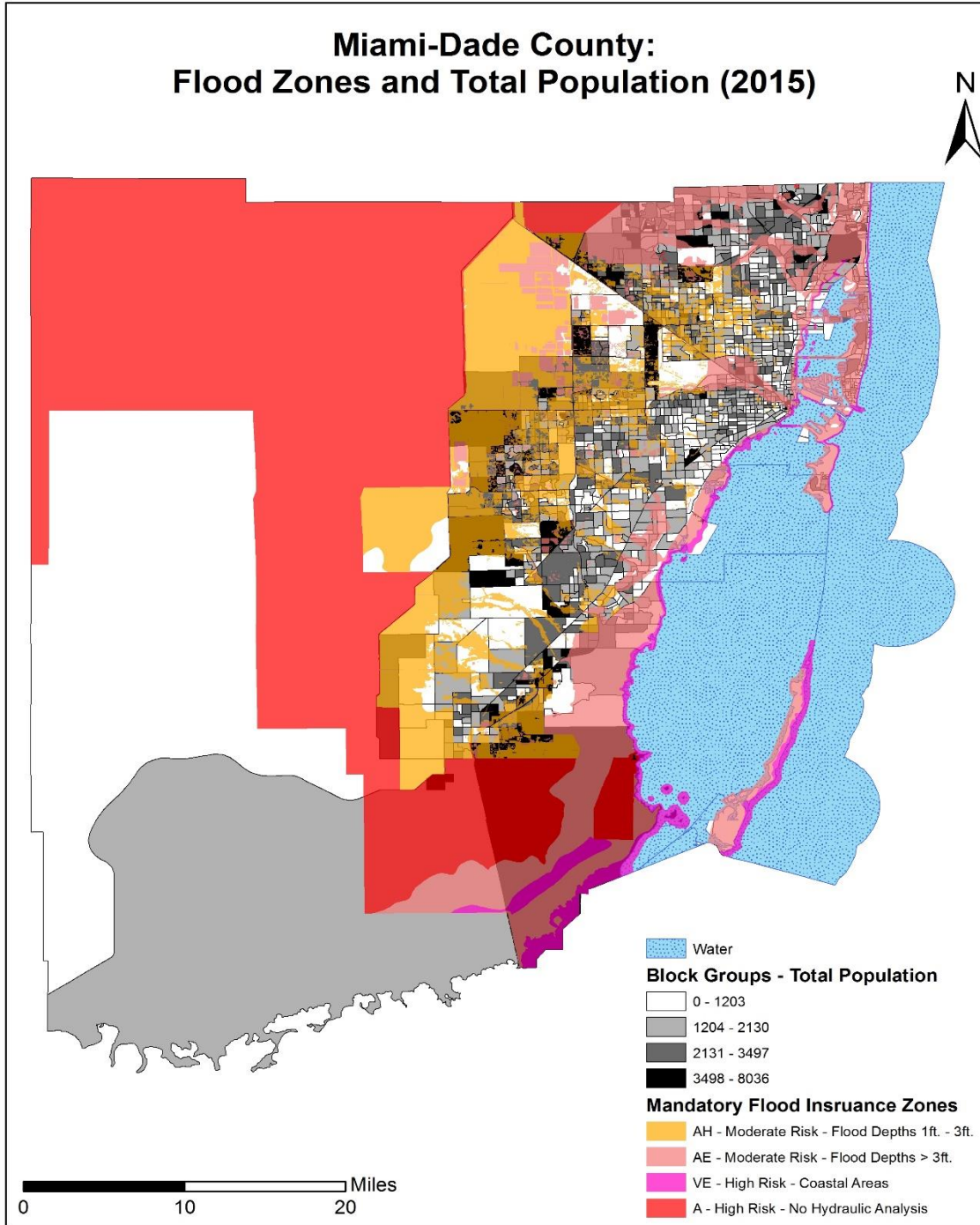
These were all the questions I had. Thank you very much for your responses. Have a nice evening.

Q38 Please record information from call list.

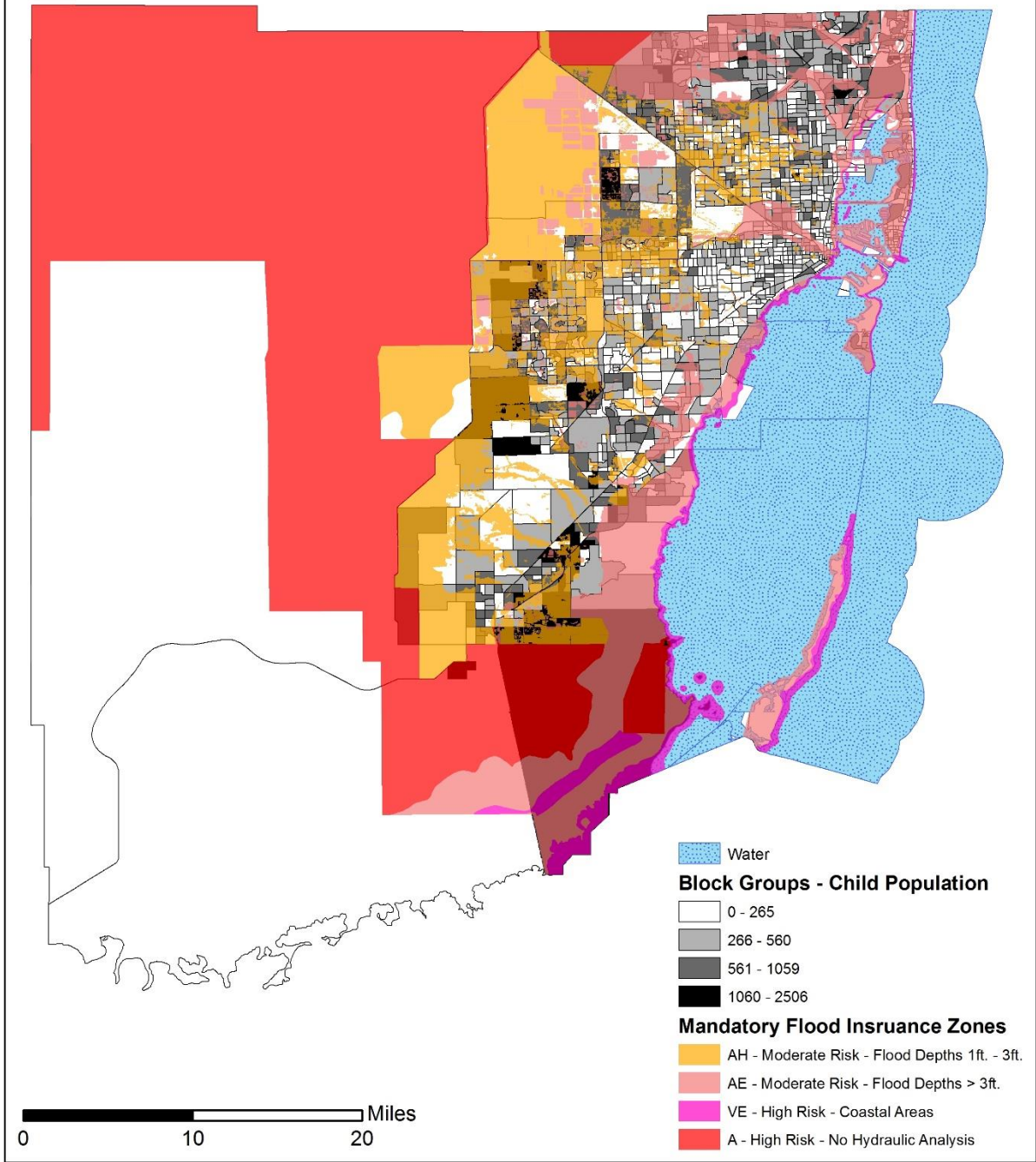
Address (1) _____
City (2) _____
ZIP Code (3) _____
Phone Number (4) _____

Appendix B: Flood Zones

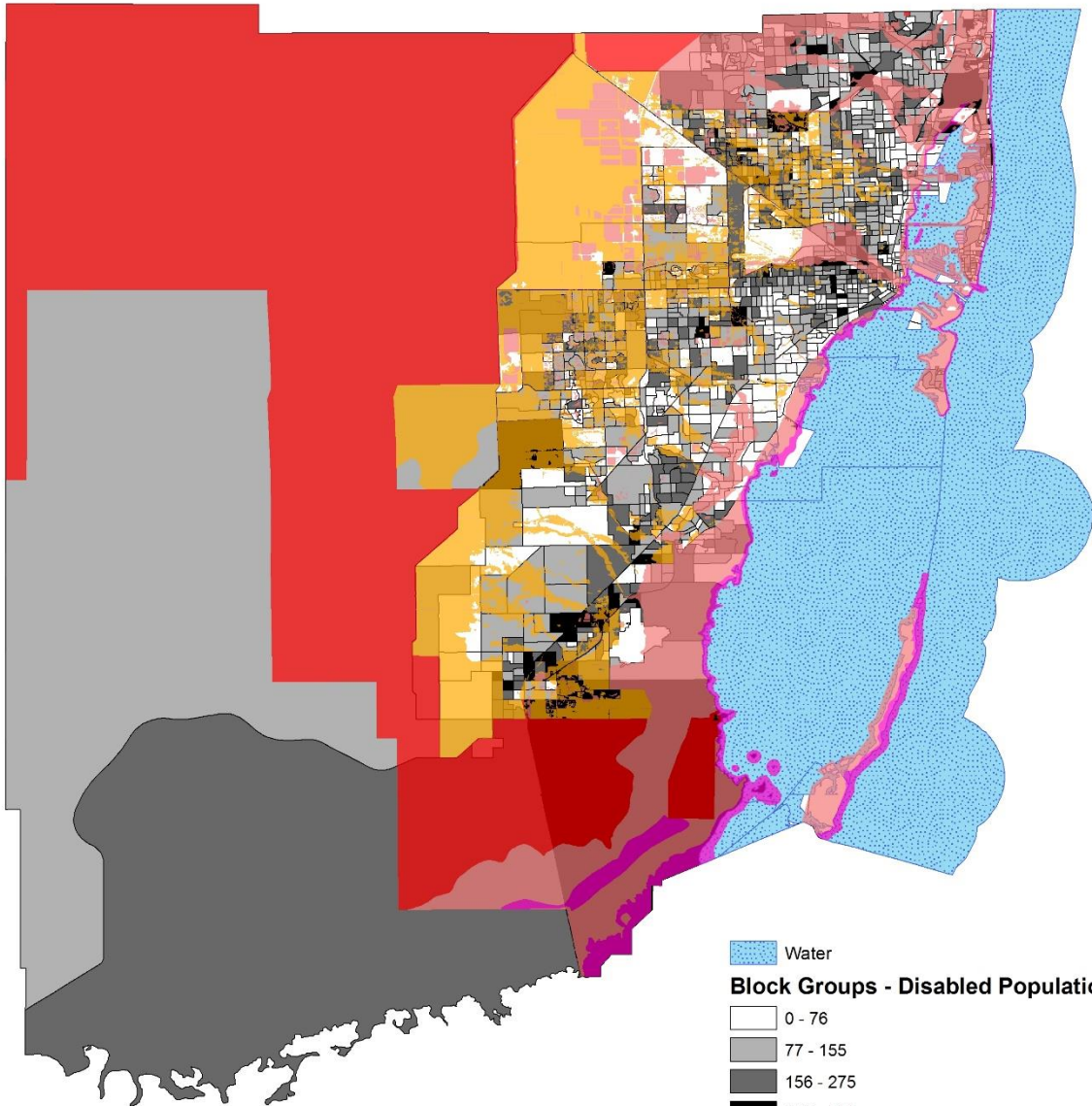
Miami-Dade County












Miami-Dade County: Flood Zones and Child Population (2015)



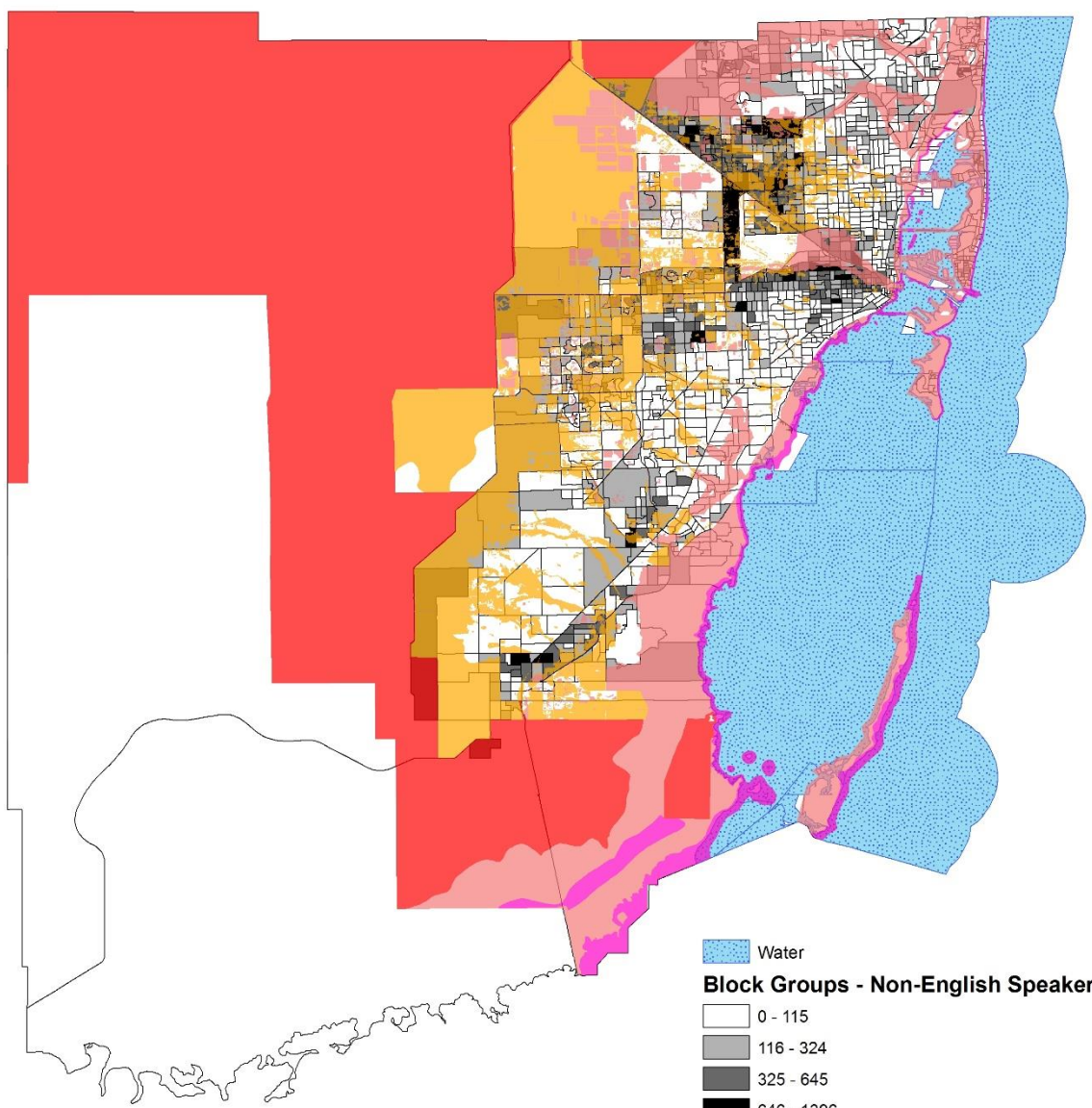
Miami-Dade County: Flood Zones and Disabled Population (2015)












-  Water
- Block Groups - Disabled Population**
 -  0 - 76
 -  77 - 155
 -  156 - 275
 -  276 - 519
- Mandatory Flood Insurance Zones**
 -  AH - Moderate Risk - Flood Depths 1ft. - 3ft.
 -  AE - Moderate Risk - Flood Depths > 3ft.
 -  VE - High Risk - Coastal Areas
 -  A - High Risk - No Hydraulic Analysis

0 10 20 Miles

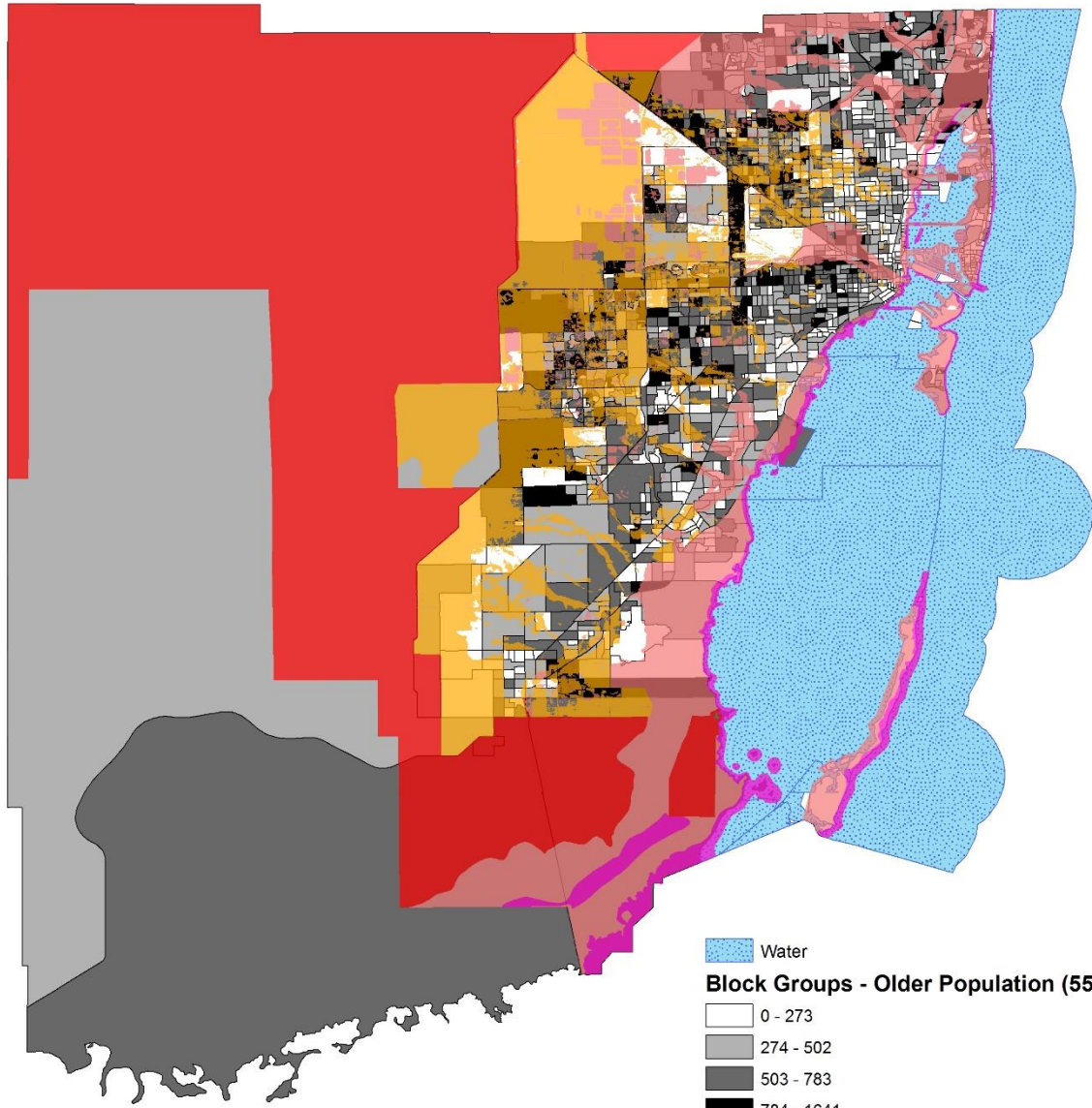
Miami-Dade County: Flood Zones and Non-English Speakers (2015)



-  Water
- Block Groups - Non-English Speakers**
-  0 - 115
-  116 - 324
-  325 - 645
-  646 - 1396
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1ft. - 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  VE - High Risk - Coastal Areas
-  A - High Risk - No Hydraulic Analysis

0 10 20 Miles

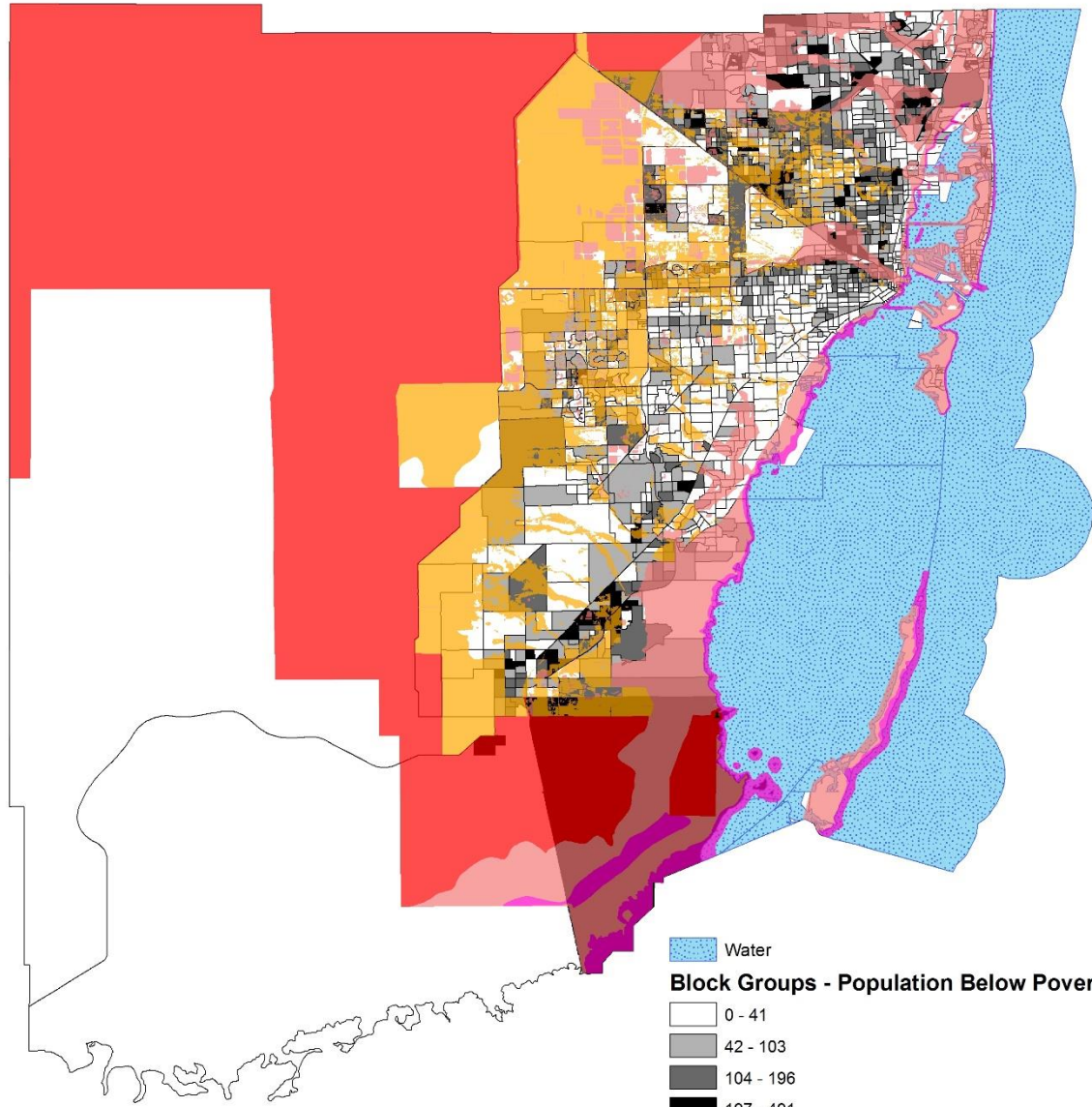
Miami-Dade County: Flood Zones and Older Population (2015)












- Water
- Block Groups - Older Population (55+)**
 - 0 - 273
 - 274 - 502
 - 503 - 783
 - 784 - 1641
- Mandatory Flood Insurance Zones**
 - AH - Moderate Risk - Flood Depths 1ft. - 3ft.
 - AE - Moderate Risk - Flood Depths > 3ft.
 - VE - High Risk - Coastal Areas
 - A - High Risk - No Hydraulic Analysis

0 10 20 Miles

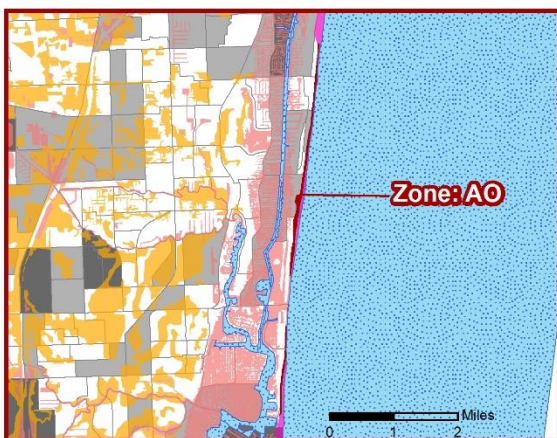
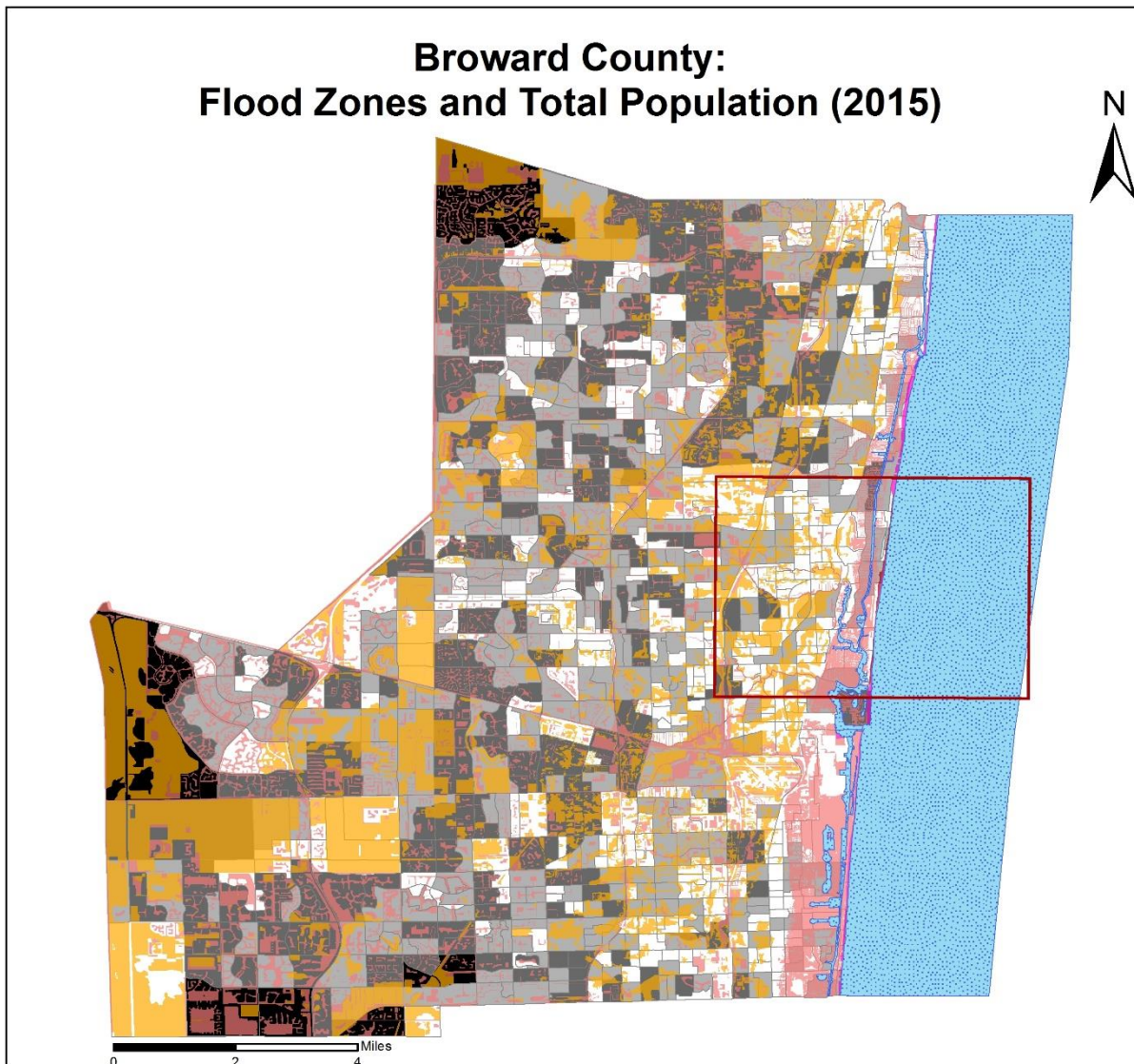
Miami-Dade County: Flood Zones and Population Below Poverty (2015)



-  Water
- Block Groups - Population Below Poverty**
-  0 - 41
-  42 - 103
-  104 - 196
-  197 - 491
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1ft. - 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  VE - High Risk - Coastal Areas
-  A - High Risk - No Hydraulic Analysis

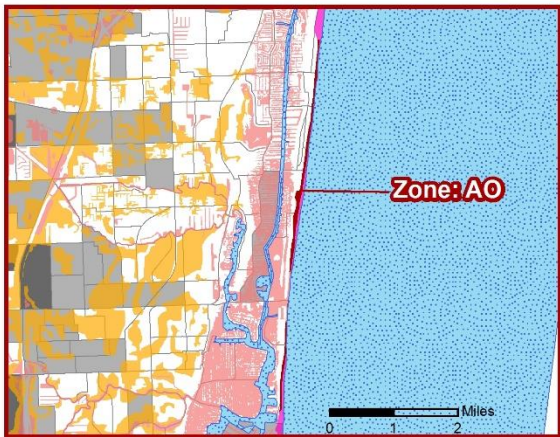
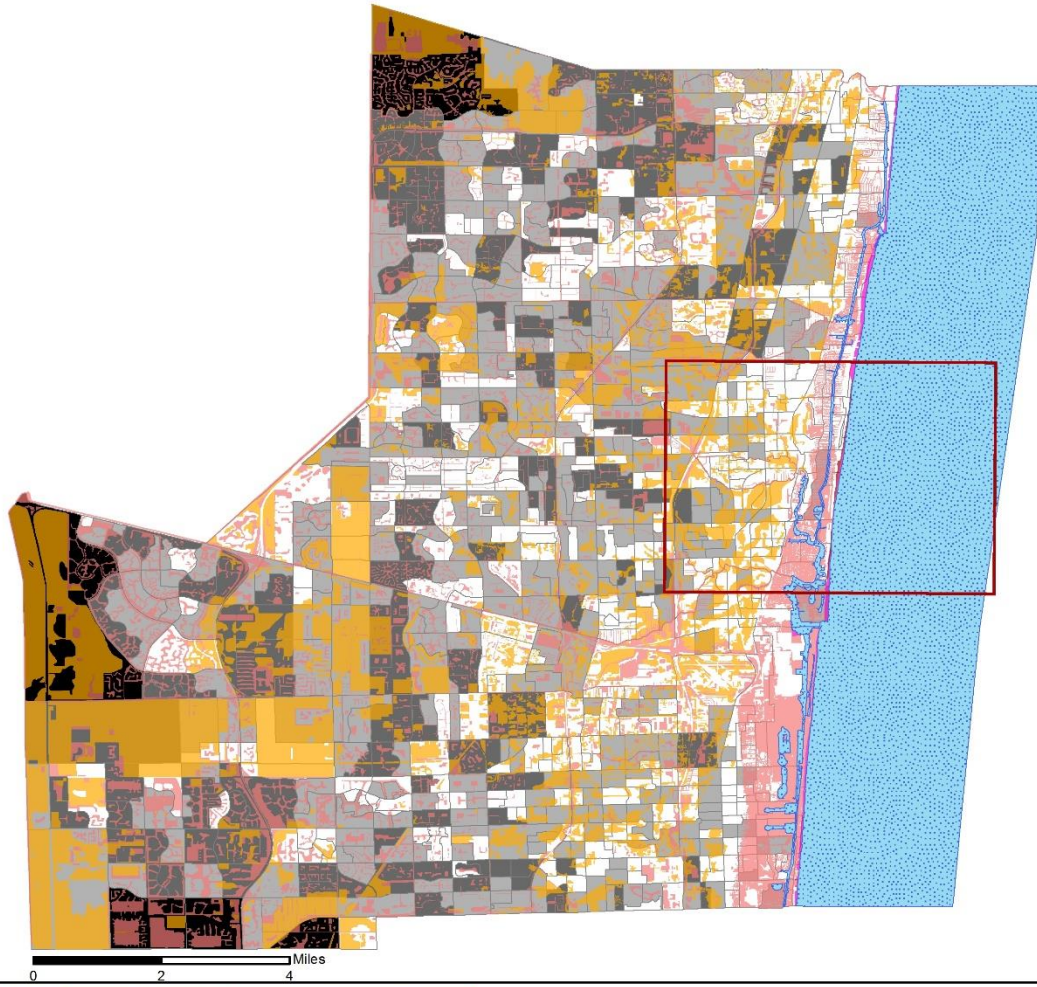
0 10 20 Miles

Broward County: Flood Zones and Total Population (2015)



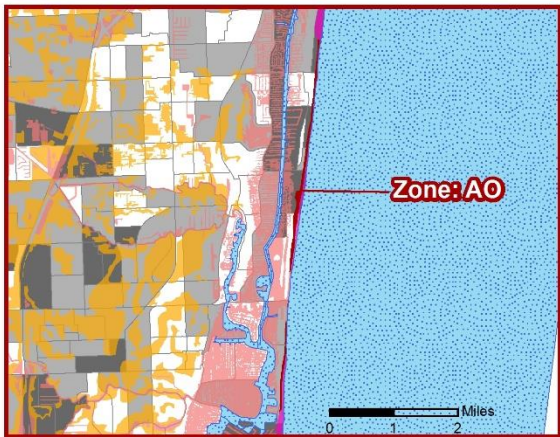
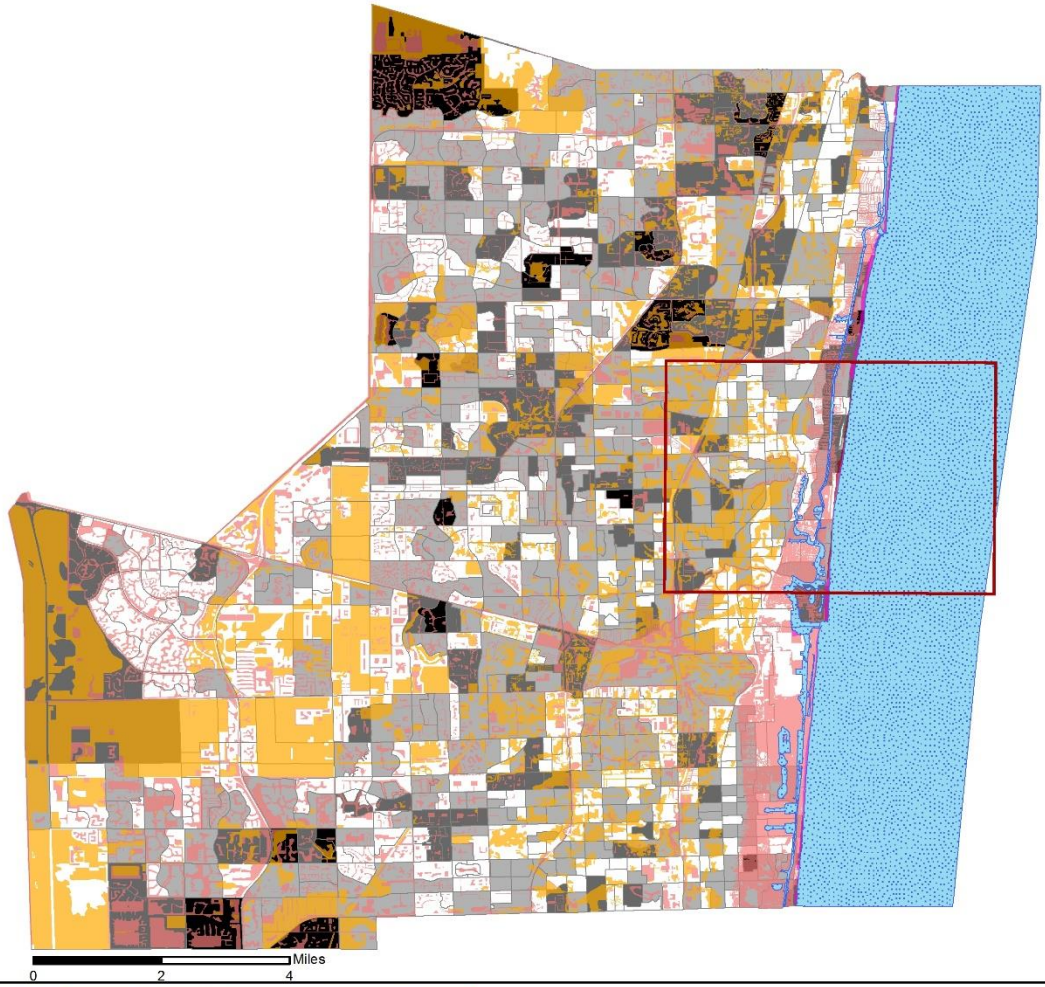
- Water
- Block Groups - Total Population**
- 0 - 1579
- 1580 - 2701
- 2702 - 6272
- 6273 - 15719
- Mandatory Flood Insurance Zones**
- AH - Moderate Risk - Flood Depths 1 ft.- 3ft.
- AE - Moderate Risk - Flood Depths > 3ft.
- AO - Moderate Risk - Sloping Terrain
- VE - High Risk - Coastal Areas










Broward County: Flood Zones and Child Population (2015)



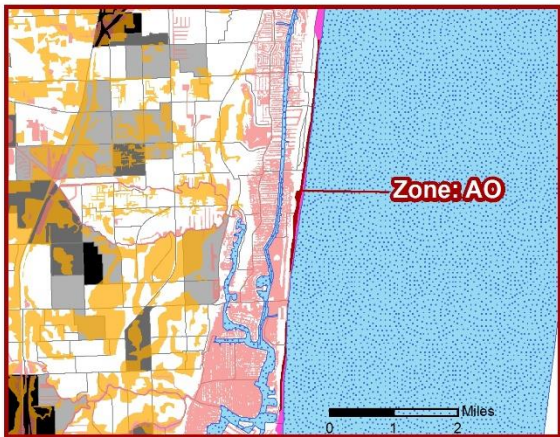
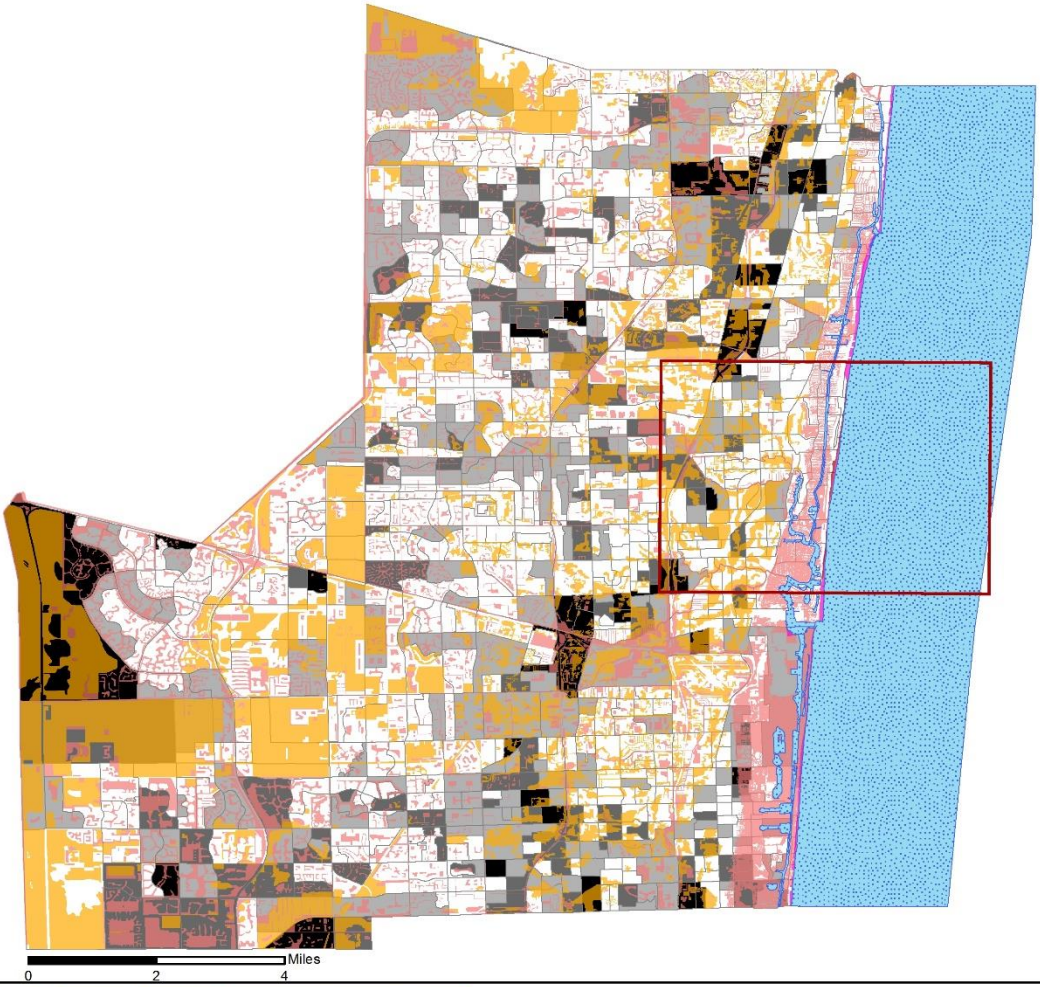
- Water
- Block Groups - Child Population**
- 0 - 336
- 337 - 727
- 728 - 2180
- 2181 - 5764
- Mandatory Flood Insurance Zones**
- AH - Moderate Risk - Flood Depths 1 ft.- 3ft.
- AE - Moderate Risk - Flood Depths > 3ft.
- AO - Moderate Risk - Sloping Terrain
- VE - High Risk - Coastal Areas










Broward County: Flood Zones and Disabled Population (2015)



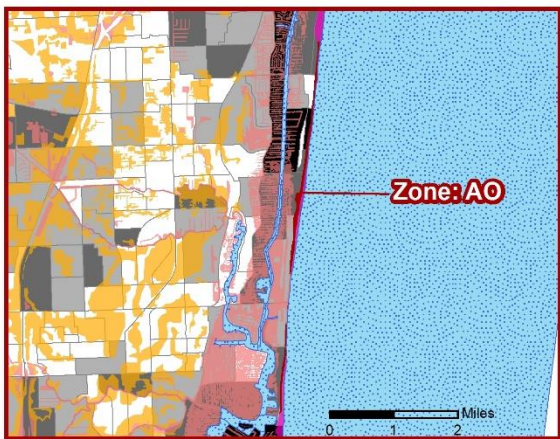
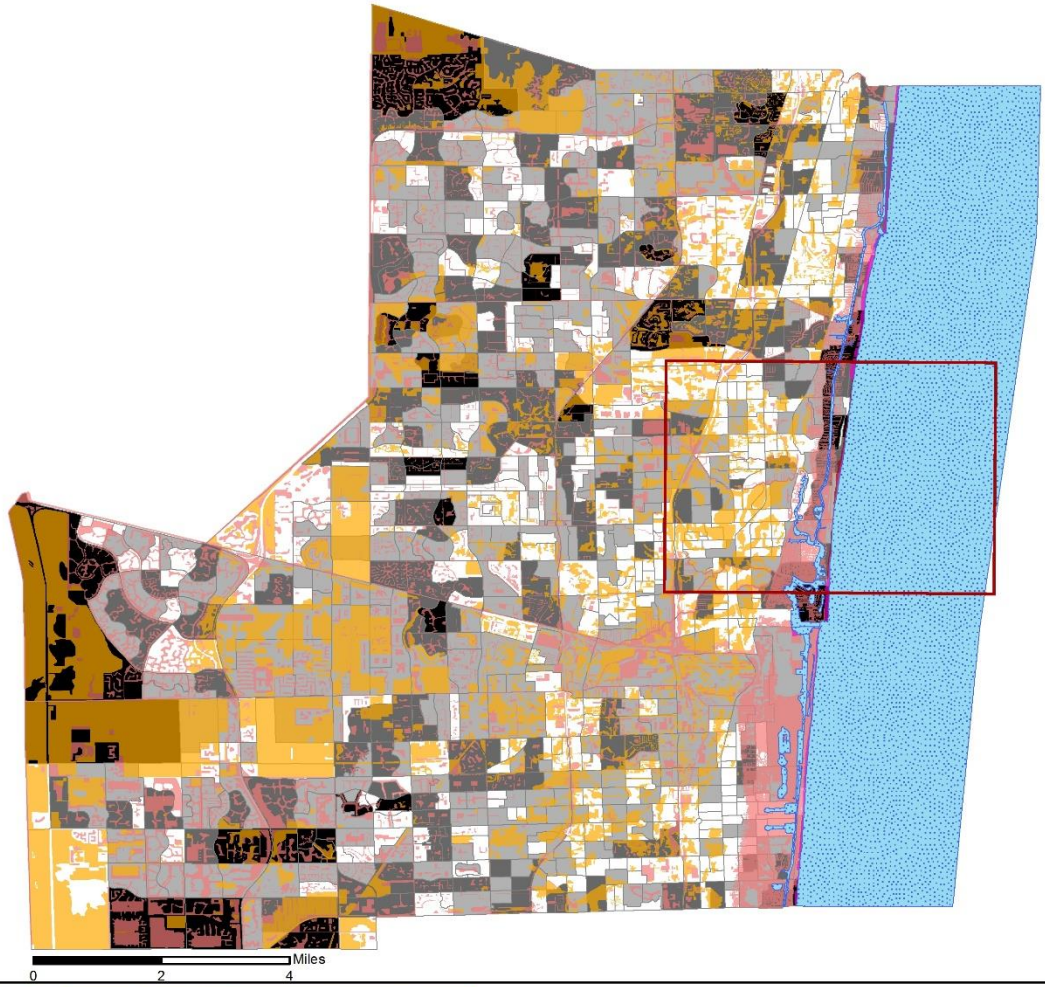
-  Water
- Block Groups - Disabled Population**
-  0 - 123
-  124 - 247
-  248 - 458
-  459 - 945
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1 ft.- 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas










Broward County: Flood Zones and Non-English Speakers (2015)



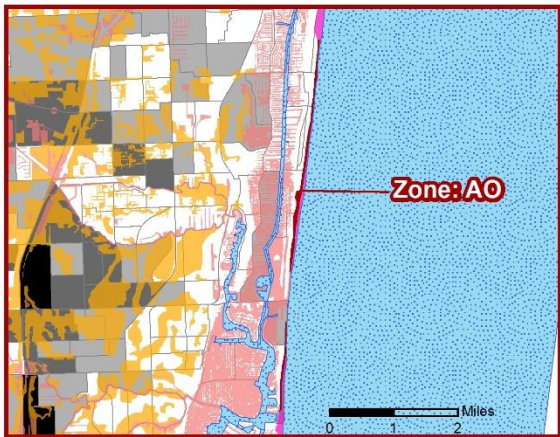
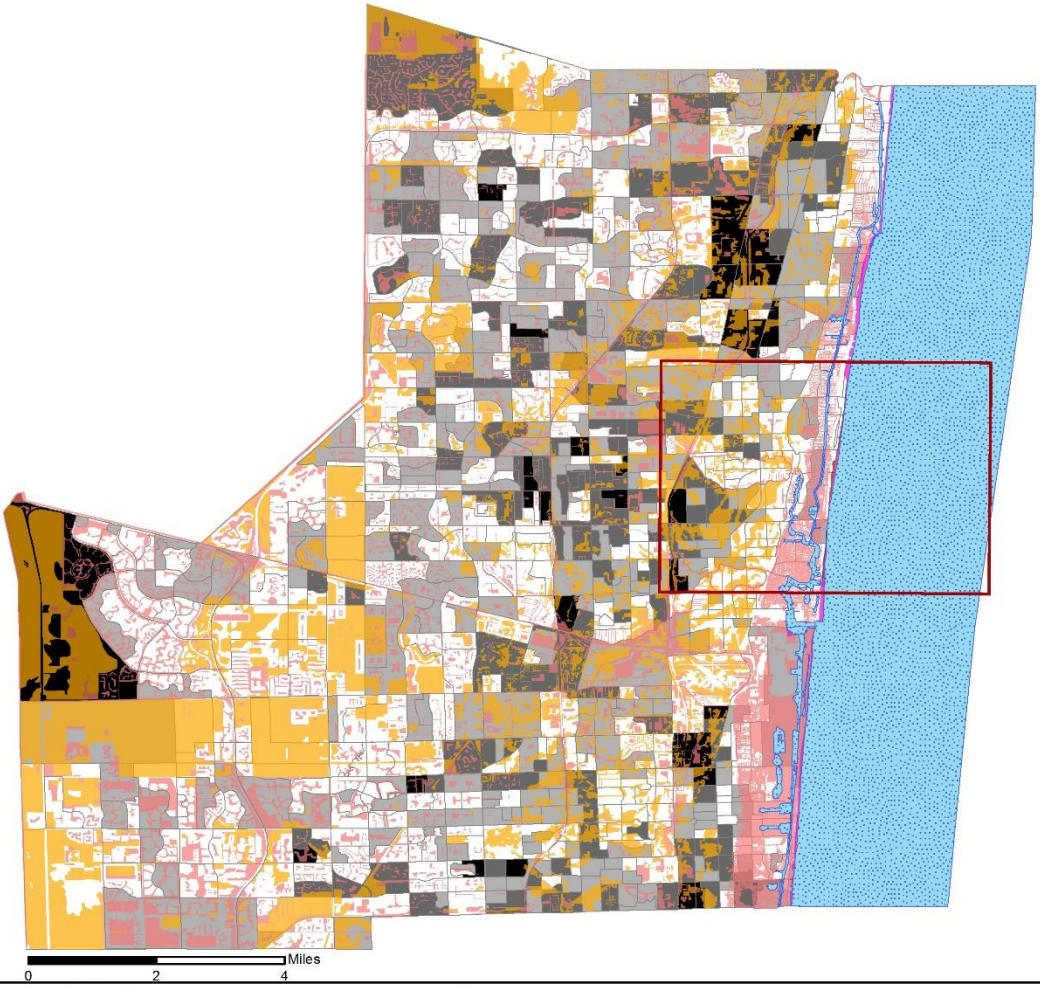
-  Water
- Block Groups - Non-English Speakers**
-  0 - 27
-  28 - 82
-  83 - 195
-  196 - 614
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1 ft.- 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas










Broward County: Flood Zones and Older Population (2015)



-  Water
- Block Groups - Older Population (55+)**
-  0 - 402
-  403 - 720
-  721 - 1236
-  1237 - 2399
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1 ft.- 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas

Broward County: Flood Zones and Poverty (2015)




-  Water
- Block Groups - Population Below Poverty**
-  0 - 35
-  36 - 91
-  92 - 175
-  176 - 396
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1 ft.- 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas


Miami-Dade County: Flood Zones and Total Population (2015)



 Water

Block Groups - Total Population

 0 - 1171

 1172 - 1956

 1957 - 3153

 3154 - 10770


Mandatory Flood Insurance Zones

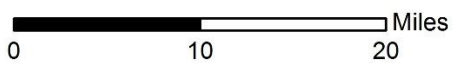
 AH - Moderate Risk - Flood Depths 1ft. - 3ft.

 AE - Moderate Risk - Flood Depths > 3ft.

 AO - Moderate Risk - Sloping Terrain

 VE - High Risk - Coastal Areas

 A - High Risk - No Hydraulic Analysis




Miami-Dade County: Flood Zones and Child Population (2015)



 Water

Block Groups - Child Population

 0 - 189

 190 - 468

 469 - 895

 896 - 3672


Mandatory Flood Insurance Zones

 AH - Moderate Risk - Flood Depths 1ft. - 3ft.

 AE - Moderate Risk - Flood Depths > 3ft.

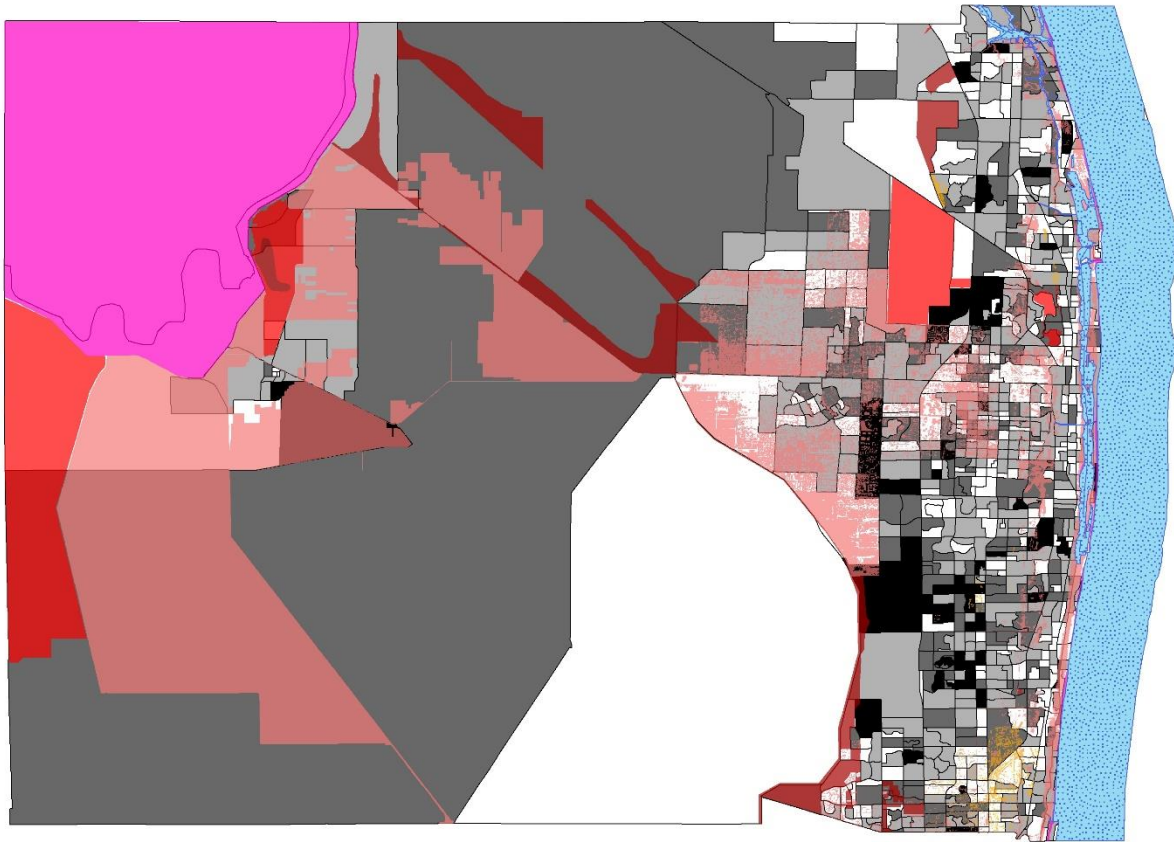
 AO - Moderate Risk - Sloping Terrain











 VE - High Risk - Coastal Areas

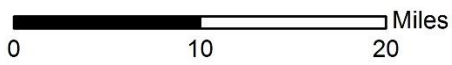
 A - High Risk - No Hydraulic Analysis



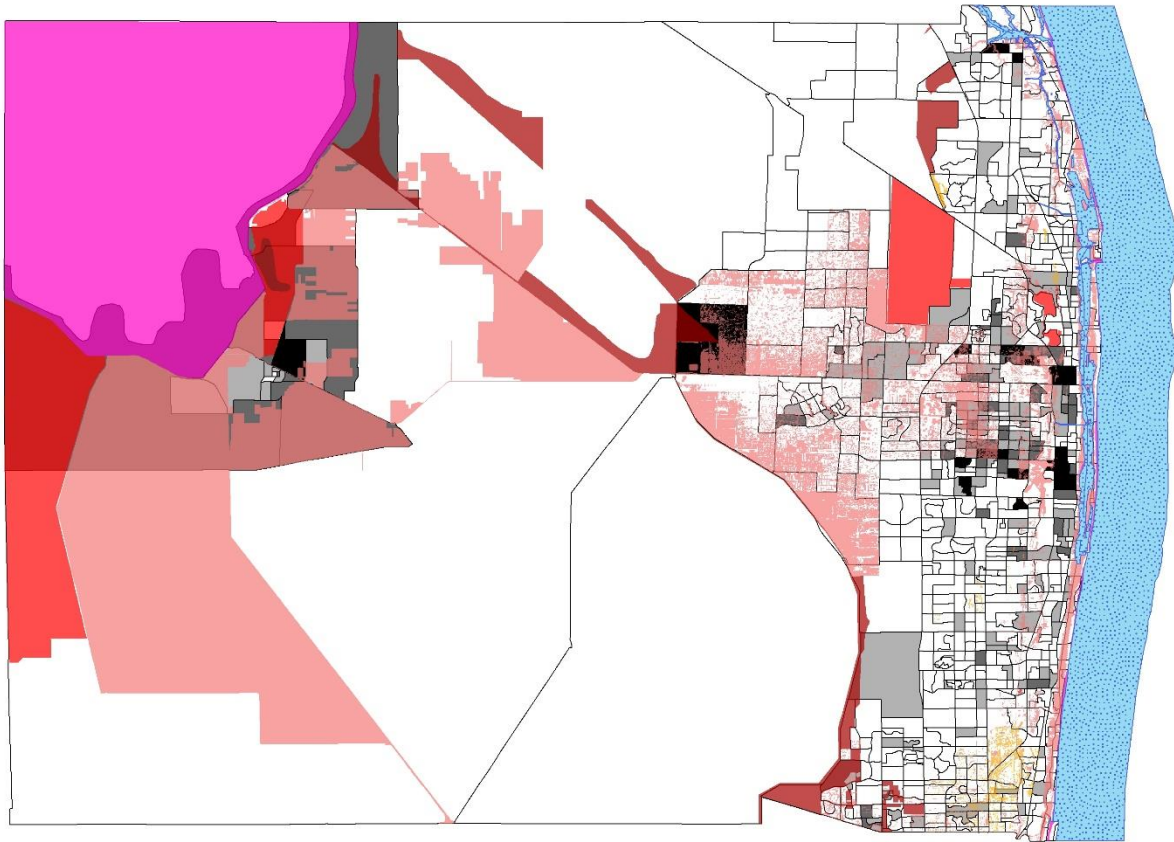
Miami-Dade County: Flood Zones and Disabled Population (2015)













-  Water
- Block Groups - Disabled Population**
-  0 - 91
-  92 - 175
-  176 - 288
-  289 - 517
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1ft. - 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas
-  A - High Risk - No Hydraulic Analysis



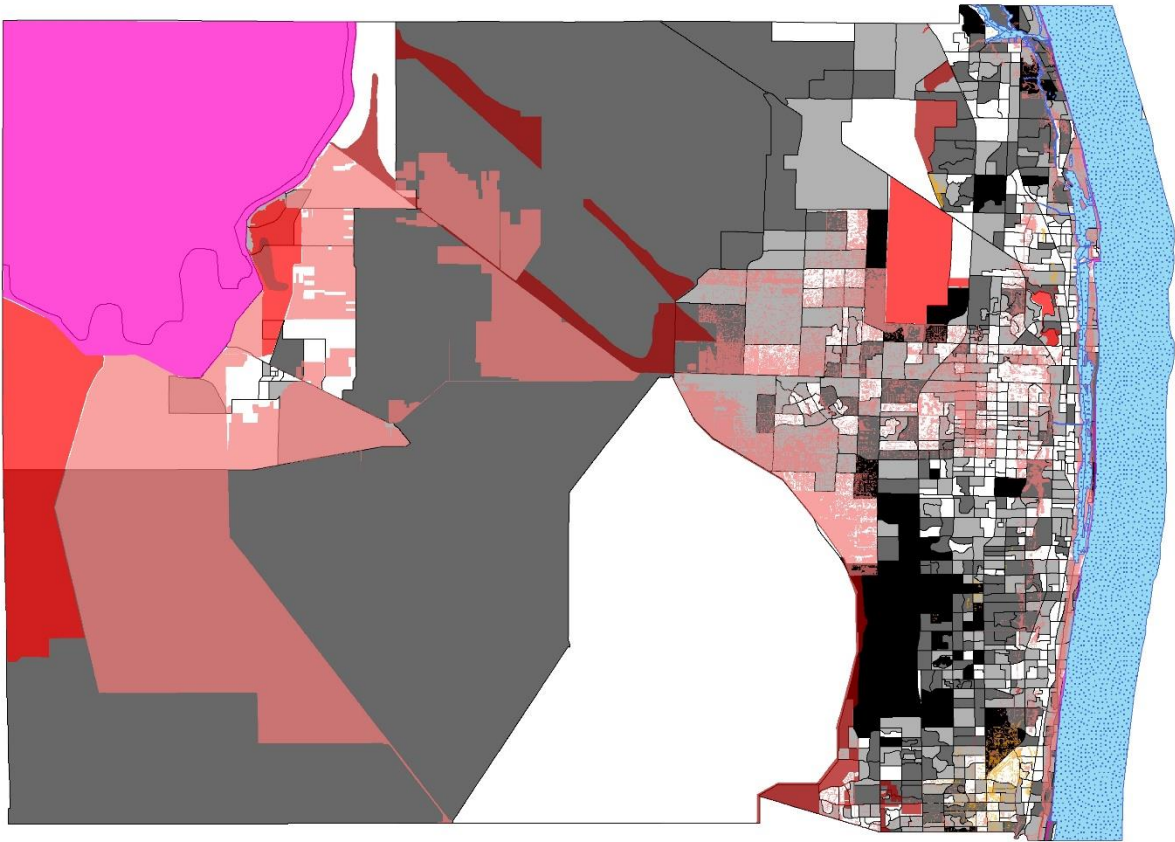
Miami-Dade County: Flood Zones and Non-English Speakers (2015)



-  Water
- Block Groups - Non-English Speakers**
-  0 - 29
-  30 - 103
-  104 - 238
-  239 - 584
- Mandatory Flood Insurance Zones**
-  AH - Moderate Risk - Flood Depths 1ft. - 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas
-  A - High Risk - No Hydraulic Analysis







Miami-Dade County: Flood Zones and Older Population (2015)



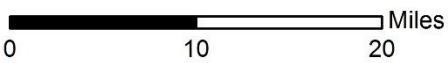
 Water

Block Groups - Older Population (55+)

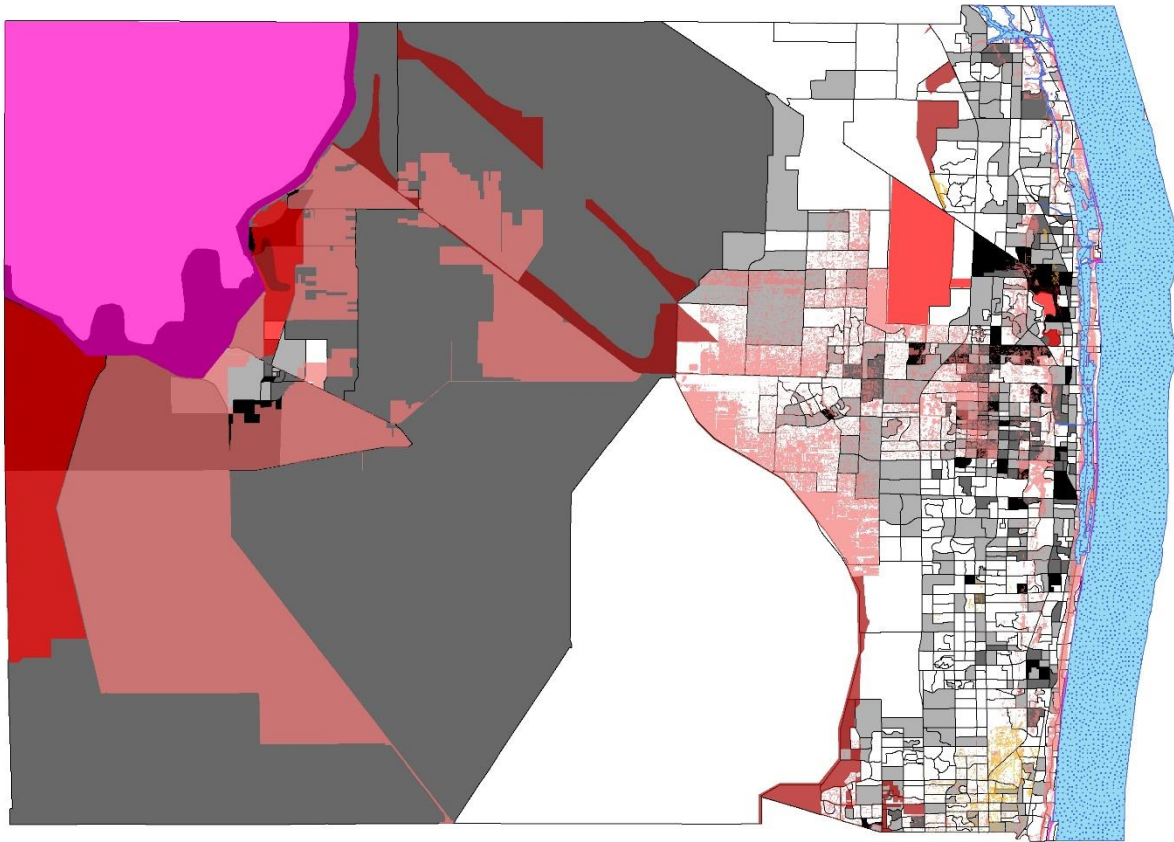
-  0 - 395
-  396 - 702
-  703 - 1155
-  1156 - 2223

Mandatory Flood Insurance Zones

-  AH - Moderate Risk - Flood Depths 1ft. - 3ft.
-  AE - Moderate Risk - Flood Depths > 3ft.
-  AO - Moderate Risk - Sloping Terrain
-  VE - High Risk - Coastal Areas
-  A - High Risk - No Hydraulic Analysis



Miami-Dade County: Flood Zones and Population Below Poverty (2015)




 Water

Block Groups - Population Below Poverty

 0 - 32

 33 - 81


 82 - 150

 151 - 284


Mandatory Flood Insurance Zones

 AH - Moderate Risk - Flood Depths 1ft. - 3ft.

 AE - Moderate Risk - Flood Depths > 3ft.

 AO - Moderate Risk - Sloping Terrain

 VE - High Risk - Coastal Areas

 A - High Risk - No Hydraulic Analysis



Appendix C: Florida Building Code Supplements

Chapter 15 of the Florida Building Code: Rooftop Assemblies

Chapter 15 of the FBC is associated with these changes in roof assemblies and rooftop structures. Section 1504 is the most relevant section that lays out the performance requirements expected of rooftop assemblies' post-Andrew. Some of these requirements are wind resistance of roofs (1504.1-1504.3), ballasted low-slope roof systems (1504.4), edge securement for low-slope roofs (1504.5), physical properties (1504.6), and impact resistance (1504.7).²⁴⁷ It is important to note that all roof coverings added to a building must adhere to the load requirements discussed above in chapter 16 of the FBC. There are also special requirements attached to rooftop coverings to ensure the foundational elements of the roof are unexposed during hazardous storm conditions.

Section 1507 of the FBC covers the requirements for roof coverings. Sub-section 1507.3.6, states that fasteners shall be corrosion resistant and of a standardized size.²⁴⁸ Code requirements for fasteners are very important because they are responsible for holding the roof cover down. Different roof materials and metals require different grades of fasteners; section 1507.3.6 lays the requirements for each type of roof. Galvanized fasteners are for steel roofs; copper, brass, bronze, copper alloy, or 300 series stainless-steel fasteners are for copper roofs, aluminum-zinc coated fasteners are acceptable for aluminum-zinc coated roofs, and stainless-steel fasteners are acceptable for all types of metal roofs.²⁴⁹

Shingles are also a very important construction element that requires regulation by the FBC because they can very easily become destructive projectiles if they dislodge. Therefore, section 1507.2.7 lays out the minimum number of fasteners per shingle that lock on the roof. Asphalt shingles secure to the roof with no less than four fasteners per strip shingle or two fasteners per individual shingle.²⁵⁰ These requirements hold in wind zones up to 110 mph, and are based on ASTM D 3161 Class F (National Roofing Contractors Association), TAS107 (International Code Council), or ASTM D 7158 Class H (National Roofing Contractors Association). The above codes are wind speed test procedures conducted to provide a guideline for roof system assemblies, as well as providing insight into where more preventative/prescriptive protection methods should be employed.

²⁴⁷ 2014 Florida Building Code. (n.d.).

²⁴⁸ Ibid.

²⁴⁹ Ibid.

²⁵⁰ Chapter 15. (n.d.).

The Florida Building Code: Product Approval System

The PAS operates on two separate levels, a mandatory local product approval system and an optional state product approval system. On the local level, an approved product is only valid in that specific jurisdiction. When the product is approved on the state level it can be used anywhere in Florida²⁵¹. The local and state PAS is circular in nature and travels through the local building department, then through the FBC to make sure the product follows structural wind requirements and other products. Then, finally, the product is compared against Florida Statute 553.8425 (or 553.842 for state approvals).

Statute 553.8425 states, “for local product approval, products or systems of construction shall demonstrate compliance with the structural wind load requirement of the Florida Building Code through one of the following methods.”²⁵² (a) A certification mark, listing, or label from a commission-approved certification agency indicating that the product complies with the code; (b) A test report from a commission-approved testing laboratory indicating that the product tested complies with the code; (c) A product-evaluation report based upon testing, comparative or rational analysis, or a combination thereof, from a commission-approved product evaluation entity which indicates that the product evaluated complies with the code; (d) A product-evaluation report or certification based upon testing or comparative or rational analysis, or a combination thereof, developed and signed and sealed by a Florida professional engineer or Florida registered architect, which indicates that the product complies with the code; (e) A statewide product approval issued by the Florida Building Commission; or (f) Designation of compliance with a prescriptive, material standard adopted by the commission by rule under s. 553.842(15).²⁵³ The above Statute, coupled with Rule 9N-3, which dictates that any of the following subcategories of 9N-3.010(31) are filtered through the PAS as a mandatory requirement: “panel walls, exterior doors, roofing products, skylights, windows, shutters, and structural components.”²⁵⁴ This is so because these products directly connect in some way to the building’s envelope, and as previously discussed is the most important part of the structure to protect during episodes of high winds. The Florida Building Commission approves both public and private organizations to perform tests, evaluate, and certify products.²⁵⁵

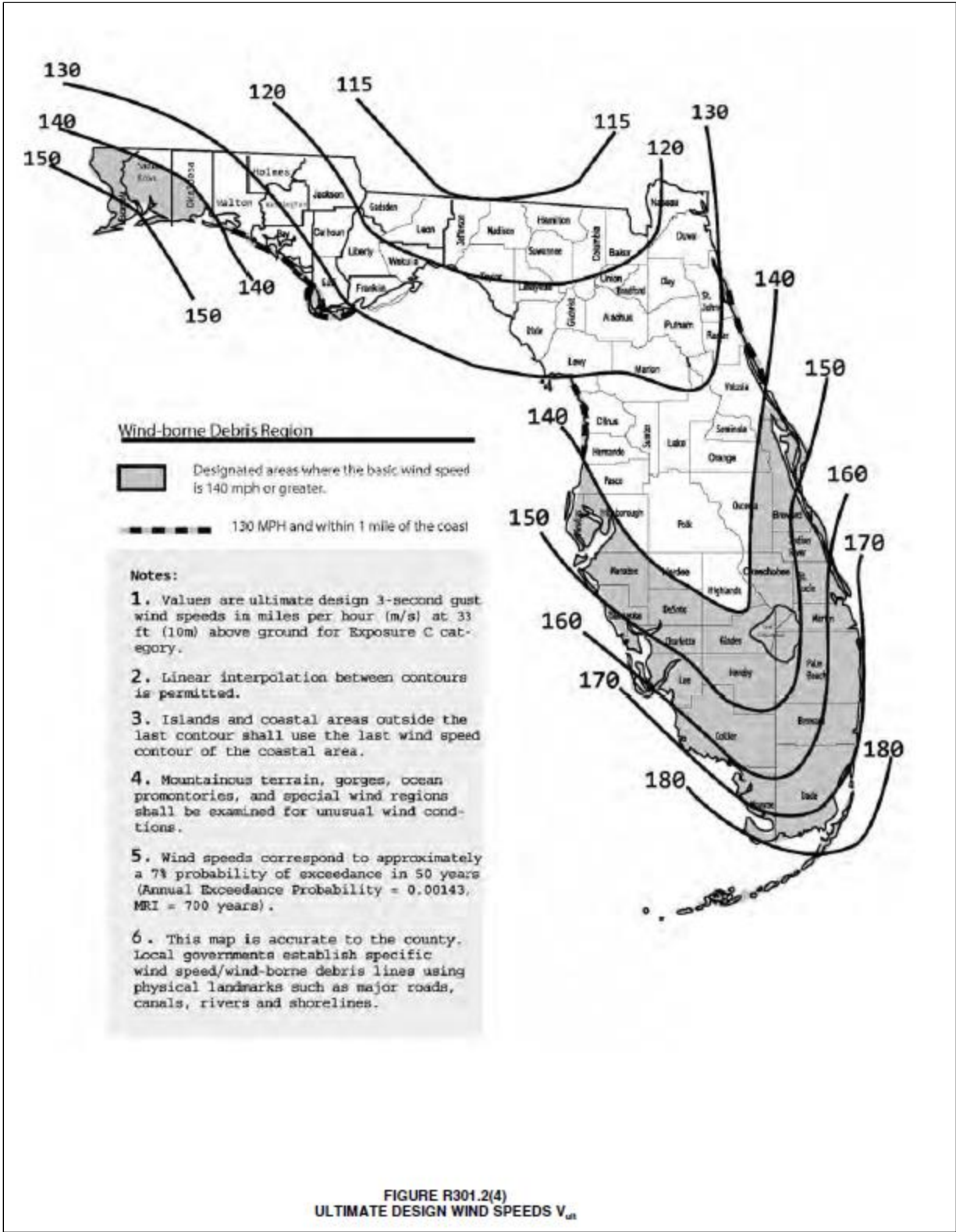
²⁵¹ The Florida Building Commission, 2003

²⁵² The 2017 Florida Statutes. (2017, August 23).

²⁵³ Ibid.

²⁵⁴ Ibid.

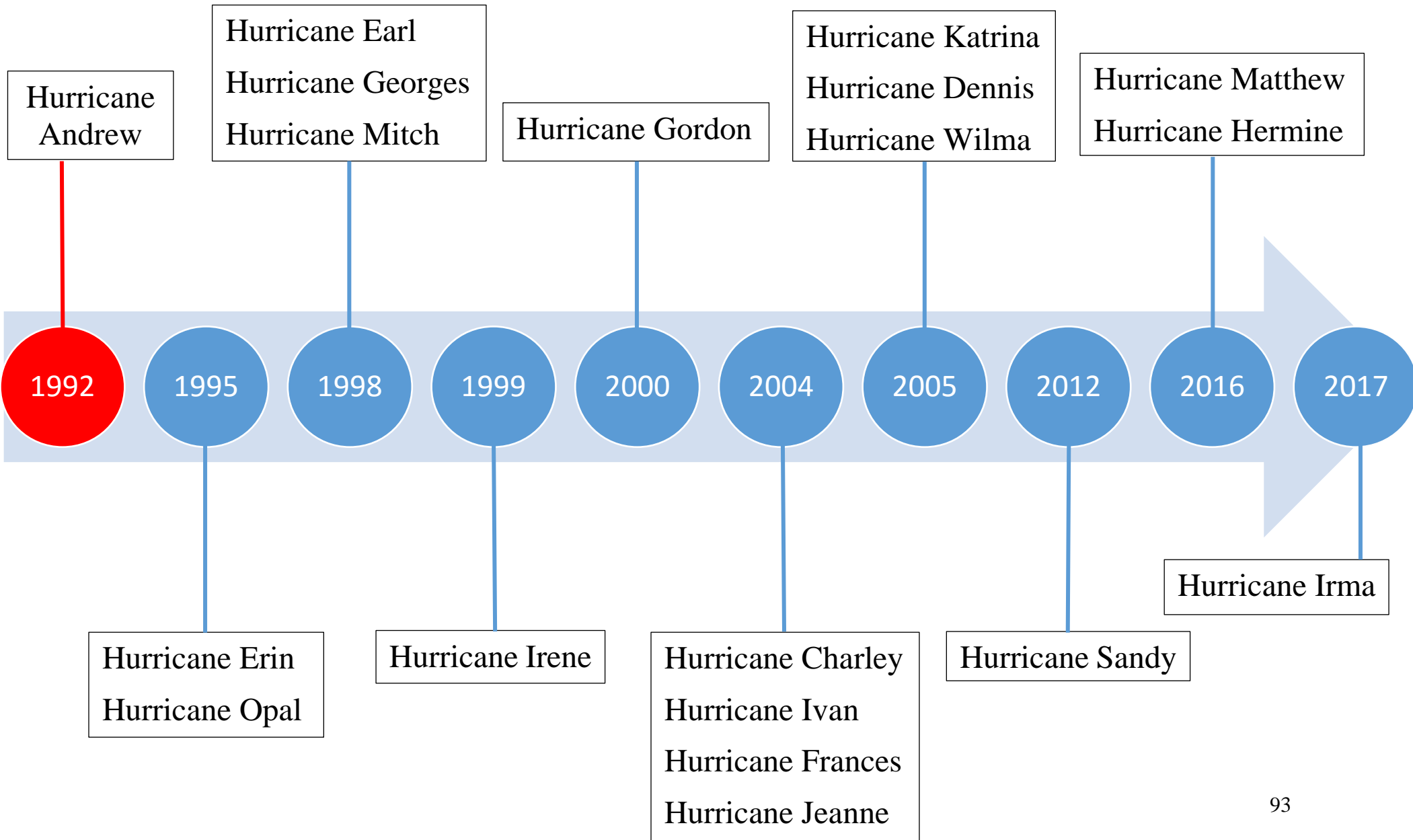
²⁵⁵ Florida Building Commission, 2017



Source: Florida Building Code Wind Maps, 2014

Hurricanes Impacting Florida since 1992

Includes Hurricanes that did not make landfall



Hurricane Andrew – 1992

Made landfall on August 24, off the east coast of Florida in Miami-Dade County, near Biscayne National Park (Elliot Key & Sands Key) as a category five hurricane with winds at 167 mph (145 kts).²⁵⁶

Hurricane Erin – 1995

Made landfall on August 2, off the east coast of Florida in Indian River County, near the town of Gifford, as a category one hurricane with winds at 86 mph (75 kts). It dissipated into a tropical storm near Lakeland northwest of its touchdown location with winds at 58 mph (50 kts).²⁵⁷

Hurricane Opal – 1995

Made landfall on October 4, in southern Santa Rosa County, through the East Bay as a category three hurricane with winds at 115 mph (100 kts). It traveled northeast through Florida's Panhandle and exited the state on the northern Santa Rosa/Okaloosa county lines.²⁵⁸

Hurricane Earl – 1998

Made landfall on September 3, in the panhandle off Saint Andrew Bay, near Panama City, as a category one hurricane with winds at 81 mph (70 kts). After making landfall in Bay county, it traveled northeast across the panhandle, crossing through Calhoun, Jackson, and Gadsden counties before passing into Georgia.²⁵⁹

Hurricane Georges - 1998

Made landfall on September 25, in Key West as a category two hurricane, with winds at 104 mph (90 kts). It remained near Key West briefly and then exited Florida to the northwest into the Gulf of Mexico.²⁶⁰

Hurricane Mitch - 1998

While Mitch was only a tropical storm when it passed through Florida, it still caused a significant amount of damage and claimed the lives of two individuals in Monroe County.²⁶¹

Hurricane Irene - 1999

Made landfall in the Florida Keys (just east of Key West) on October 15, as a category one hurricane with winds at 75 mph (65 kts). Irene maintained a consistent wind speed as it traveled north-northeast through the state until it departed in Martin County near the city of Stuart.²⁶²

Hurricane Gordon – 2000

Hurricane Gordon hit the west coast of Florida with hurricane force winds at 75 mph (65 kts). Once Gordon made landfall in Dixie County it dissolved into a tropical storm with winds at 63 mph (55 kts).²⁶³

²⁵⁶ Rappaport, 1992

²⁵⁷ Rappaport, 1995

²⁵⁸ Mayfield, 1995

²⁵⁹ Mayfield, 1998

²⁶⁰ Guiney, 1999

²⁶¹ Guiney, Lawrence, 2000

²⁶² Avila, 1999

²⁶³ Stewart, 2000

Hurricane Charley – 2004

Made landfall off the west coast of Florida over the Pine Island Sound (just west of Cape Coral) on August 13, as a category four hurricane with winds at 150 mph (145 kts). It traveled north-northeast until it began to deteriorate over the inland region of Florida in Polk County, where it dropped to a category one hurricane with winds at 86 mph (75 kts).²⁶⁴

Hurricane Ivan – 2004

The hurricane force winds from hurricane Ivan hit Florida’s entire west coast. The closest Ivan got to making landfall was in Escambia County where the winds were recorded at 120 mph (105 kts).²⁶⁵

Hurricane Frances – 2004

Made landfall on September 5, off the east coast of Florida in Martin County (just east of Stuart), it was a category two hurricane with winds at 104 mph (90 kts). It traveled northwest through Florida and dropped down to a category one hurricane with winds at 92 mph (80 kts) in Okeechobee County, then deteriorated into a tropical storm in Polk County with winds at 69 mph (60 kts).²⁶⁶

Hurricane Jeanne – 2004

Made landfall on the east coast of Florida in Martin County (just east of Stuart) on September 26, as a category three hurricane with winds at 121 mph (105 kts). Jeanne traveled west-northwest into St. Lucie County where it devolved into a category two hurricane with winds at 109 mph (90 kts), it continued on this route until it hit Polk County and fell to a category one hurricane with winds at 86 mph (75 kts).²⁶⁷

Hurricane Katrina – 2005

Made landfall on the east coast of Florida in Broward County (over the City of Hollywood) on August 25, as a category one hurricane with winds at 81 mph (70 kts). Katrina remained a category one hurricane while it traveled southwest through Miami-Dade County and finally exiting the state in Monroe County over the Everglades National Park. Katrina continued into the Gulf of Mexico, where it eventually proliferated into a category five hurricane and devastated New Orleans.²⁶⁸

Hurricane Dennis – 2005

Made landfall in Santa Rosa County near Pensacola on July 10, as a category three hurricane with winds at 121 mph (105 kts). Dennis traveled north-northwest through Escambia County and into Georgia.²⁶⁹

Hurricane Wilma – 2005

Made landfall on the west coast of Florida on October 24, in Collier County (just under Marco Island). It was a category three hurricane, with winds at 121 mph (105 kts).²⁷⁰

Hurricane Sandy – 2012

²⁶⁴ Pasch, Brown, & Blake, 2004

²⁶⁵ Stewart, 2004

²⁶⁶ Beven, 2004

²⁶⁷ Lawrence, Cobb, 2005

²⁶⁸ Knabb, Rhome, & Brown, 2005

²⁶⁹ Beven, 2005

²⁷⁰ Pasch, Blake, Cobb III, & Roberts, 2005

Hurricane Sandy traveled in a northerly direction on October 26, far to the east of Florida (over the Bahamas). Though the storm did not make landfall, locations ranging from Miami-Dade to Palm Beach Counties experienced strong winds and rain.²⁷¹

Hurricane Matthew – 2016

Hurricane Matthew rode along the east coast of Florida on October 7, as a category five hurricane with winds ranging from 138 mph (120 kts) to 109 mph (95 kts). Though Matthew did not make landfall in Florida, the state experienced hurricane force winds from Indian River County to Bunnell County.²⁷²

Hurricane Hermine – 2016

Made landfall off the Apalachee Bay (Wakulla County) in The Big Bend region of Florida's pan handle on September 2, as a category one hurricane with winds up to 81 mph (70 kts). Hermine traveled north-northeast up through Jefferson County and deteriorated into a tropical storm with winds up to 69 mph (60 kts) before crossing the state line into Georgia.²⁷³

Hurricane Irma – 2017

Official tropical cyclone report yet to be released by the National Hurricane Center.

²⁷¹ Blake, Kimberlain, Berg, Cangialosi, & Beven, 2012

²⁷² Stewart, 2016

²⁷³ Berg, 2016

Appendix D: Comprehensive Florida Plans

Comprehensive Plan for Broward County

1. FUTURE UNINCORPORATED AREA LAND USE ELEMENT	2. CLIMATE CHANGE ELEMENT
<p>Goal 2.0: Broward County shall provide for a distribution of land use by type, density, and intensity to meet the needs of the current and future resident and seasonal population in a manner that; protects, improves, conserves and sustains the natural and manmade environment; that discourages urban sprawl; is energy efficient; that promotes the reduction of greenhouse gases; that ensures the timely, cost-effective provision of public facilities and services while retaining the unique variety of lifestyles and quality of life; and that facilitates the annexation or incorporation of Unincorporated Areas.</p>	<p>Goal 19.0. Achieve a sustainable, climate resilient community by: promoting energy efficiency and greenhouse gas reduction strategies; protecting and adapting public infrastructure, services, natural systems and resources from climate change impacts; and continuing to coordinate and communicate locally and regionally to monitor and address the changing needs and conditions of the community.</p>
<p>Objective 2.2. Insure that future land uses adequately reflect soil conditions, topography, and the availability of facilities and services.</p>	<p>Objective 19.3. Improve the climate resiliency and energy-efficiency of new and existing buildings and public infrastructure, and develop adaptation strategies for areas vulnerable to climate change-related impacts.</p>
<p>Policy 2.2.5. Broward County shall continue to utilize the development review process of the Land Development Code to implement its standards and criteria for construction and operation of water management works to provide for drainage and storm water management and to control seasonal and/or periodic flooding in the Unincorporated Area.</p> <p>Policy 2.2.6. Broward County shall continue to implement the floodplain management provisions of the Broward County Code of Ordinances, which establish flood hazard standards for the Unincorporated Area.</p>	<p>Policy 19.3.1. Broward County shall, by 2015, encourage greener, more efficient and climate resilient construction practices locally by: Reevaluating base finish floor elevation standards with respect to projected sea level rise scenarios and flooding potential; and f) Incorporating building design specifications that increase resistance to impacts from more intense storm events.²⁷⁴</p> <p>Policy 19.3.7. Broward County shall continue to improve analysis and mapping capabilities for identifying areas of the County vulnerable to sea level rise, tidal flooding, and other impacts of climate change. Activities shall include acquisition of increasingly accurate Light Detection And Ranging (LiDAR) data, or other state-of-the-art elevation data, and other necessary modeling data and programs every 5 years to update the Priority Planning Area for Sea Level Rise Map in the County’s Land Use Plan and</p>

²⁷⁴ CLIMATE CHANGE ELEMENT (pp. 19-1-19-16, Rep.). (n.d.).

	<p>improve available information needed to make informed decisions regarding adapting to the impacts of climate change.²⁷⁵</p> <p>Policy 19.3.8. Broward County shall, by 2015, develop new 100 year storm water elevation projections in the Broward County 100 year flood map for use in storm water management permitting and other planning processes, which incorporate current and projected conditions for sea level rise.</p> <p>Policy 19.3.9. Broward County, in conjunction with its municipalities and partner agencies, shall work to ensure that adaptation to climate change impacts, especially sea level rise, is incorporated into the planning, siting, construction, replacement and maintenance of public infrastructure in a manner that is cost-effective and that maximizes the use of the infrastructure throughout its expected life span.</p> <p>Policy 19.3.12. Broward County shall by 2012, designate areas that are at increased risk of flooding due to, or exacerbated by, sea level rise over the next 50 years within the Broward County Land Use Plan Priority Planning Areas for Sea Level Rise Map, and work to make these areas more climate resilient by discouraging density increases and encouraging the use of adaptation and mitigation strategies.</p>
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Additional section of the Broward Comprehensive Plan that address flooding hazards.

1. Deepwater Port Component	2. Natural Disaster Component	3. Drainage and natural aquifer groundwater recharge element
GOAL 12-D. The PED shall reduce exposure of human life and property to harm by natural hazards through use of hazard mitigation and hurricane evacuation measures and shall strive to protect Port employees, tenants, users, and the public as well as Port facilities from acts of terrorism or criminal activities through safety and security programs.	GOAL 11.0. Protect human life and limit public expenditures in the Coastal Area subject to destruction by natural disaster.	GOAL 7.0. To optimize integrated storm water management in order to reduce damage and impacts from sea level rise and flooding, promotes recharge to the Surficial Aquifer System (SAS), improve and protect water quality in surface and ground waters, protect canal system functionality, and protect the functions of urban wetlands.

²⁷⁵ Ibid.

<p>Objective 12-D.2. Coastal High Hazard Areas. The PED shall follow Broward County’s requirements for Coastal High Hazard Areas (CHHA), which shall be defined as the Category 1 and 2 Hurricane Evacuation Zones identified within the Broward County Land Use Map (Series), entitled "Flood Plains, Flood-Prone Areas, and Coastal High Hazard Areas."</p>	<p>Objective 11.2. Direct population concentrations away from known or predicted coastal high-hazard areas.</p>	<p>Objective 7.2. Storm water management facilities shall be provided to meet the County's short-term and long-term future surface water management needs.</p>
<p>Policy 12-D.1.1. Flood Zone Compliance. The PED shall ensure that any habitable, non-residential buildings in special flood hazard areas are designed and constructed to reduce the potential for flooding and wind damage. All structures within the defined flood zones (AE and VE) shall be constructed in accordance with the provisions specified in Broward County's Building Code and in the Florida Building Code (2007 with 2009 revisions). Buildings and parking areas shall also be designed and constructed in accordance with the provisions of Rule 62-25, Florida Administrative Code</p>	<p>Policy 11.2.1. The Broward County Planning Council shall maintain a Broward County coastal high-hazard area map with information received from the Emergency Management Agency as part of the Natural Resource Map Series of the Broward County Land Use Plan.</p>	<p>Policy 7.2.1. Broward County shall formally document where high tide impacts are contributing to coastal flooding and limiting drainage systems and shall provide support and coordination with municipalities and drainage/water control districts in planning for adaptation and drainage system improvements.</p> <p>Policy 7.2.2. Broward County shall continue to improve analysis and mapping capabilities for identifying areas of the County vulnerable to sea level rise, tidal flooding, and other impacts of climate change, and improve available information needed to make informed decisions regarding adaptation strategies, including infrastructure improvements, modifications, and management strategies.</p> <p>Policy 7.2.3. Broward County shall, every 5 years, review and update the Priority Planning Area maps to reflect areas at increased risk of flooding based on updated 50 year sea level rise projections, commencing in 2015.</p>

		<p>Policy 7.2.13. Broward County shall implement the County-wide Integrated Water Resources Plan to optimize flood protection, water quality treatment and protection, storm water storage, wetlands sustainability, and groundwater recharge functions in support of climate resilience and the long-term water resource needs of the Broward community.</p> <p>Policy 7.4.3. Broward County shall coordinate regionally to advance the Water Management Master Plan and Reuse Master Plan to optimize flood protection, water quality treatment and protection, storm water storage, wetland sustainability, ground water recharge, and increase use of reclaimed water in support of water resource protections and development of integrated climate resilience.</p> <p>Policy 7.4.6. Broward County shall manage the construction and operation of its facilities which dam, divert, or otherwise alter the flow of surface waters to minimize damage from flooding, soil erosion or excessive drainage.</p>
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1. GOAL 1 STORMWATER MANAGEMENT AND PROTECTION FROM INUNDATION AND FLOODING		
<p>OBJECTIVE 1.1 Levels of Protection The levels of protection adopted for surface and storm water facilities shall be adequate to: 1. Provide protection from flooding and inundation consistent with the</p>	<p>OBJECTIVE 1.2 Impacts on Existing Flood Protection Palm Beach County's land development shall continue to implement policies and regulations in the Unified Land Development Code (ULDC),</p>	<p>OBJECTIVE 1.3 Cost of Improvements Palm Beach County shall ensure that the cost of drainage improvements required to serve</p>

<p>severity of the potential threats to health, safety, welfare, and property; 2. Maintain Stormwater runoff rates at levels compatible with safe conveyance capacities of receiving waters; and 3. Mitigate degradation of water quality in surface and ground waters.</p>	<p>which require that new development does not adversely affect the existing drainage, or flood protection capabilities of off-site lands.</p>	<p>Development be borne by those directly benefiting from such improvements.</p>
<p>Policy 1.1-a: The levels of protection from flooding and inundation are used as a basis for establishing minimum design requirements for tertiary drainage systems.</p> <p>Policy 1.1-b: The level of protection provided by on-site secondary drainage systems for discharge control shall not exceed the discharge limit established by the agency having jurisdiction over the receiving water at the point of outfall. If not otherwise specified, post-development peak discharge shall not exceed the pre-development peak rate based on the 25-year, three-day storm.</p> <p>Policy 1.1-c: The level of protection provided by on-site secondary drainage facilities for treatment of Stormwater runoff shall be, as a minimum, the volume and duration of required retention or detention as specified by South Florida Water Management District Criteria.</p> <p>Policy 1.1-d: No permit authorizing construction shall be issued by the County without adequate assurance of concurrent construction, by the</p>	<p>Policy 1.2-a: Development orders subject to requirements of the Unified Land Development Code (ULDC) shall provide for the conveyance of all off-site discharge to legal positive outfall via drainage facilities which are constructed in appropriate easements, with adequate capacity to accommodate the allowable discharge, without overflow to adjacent lands, or by providing alternative methods to meet the stormwater level of protection standards, approved by the County's Engineering Department and consistent with South Florida Water Management District's criteria.</p> <p>Policy 1.2-b: Development orders subject to requirements of the Unified Land Development Code (ULDC) shall provide for continued conveyance of existing inflows from off-site lands, in a manner that will not increase inundation elevations on adjacent lands, or downstream rates of discharge resulting from storms, up to and including the 25-year, three-day event.</p>	<p>Policy 1.3-a: Where funding or construction of off-site road improvements by the developer are required as a condition to development approval, provision of adequate secondary drainage facilities and conveyance to legal positive outfall shall be considered as part of the developer's obligation for off-site road improvements.</p>

<p>developer, of tertiary and secondary drainage designed to provide protection in accordance with adopted level of protection standards</p>		
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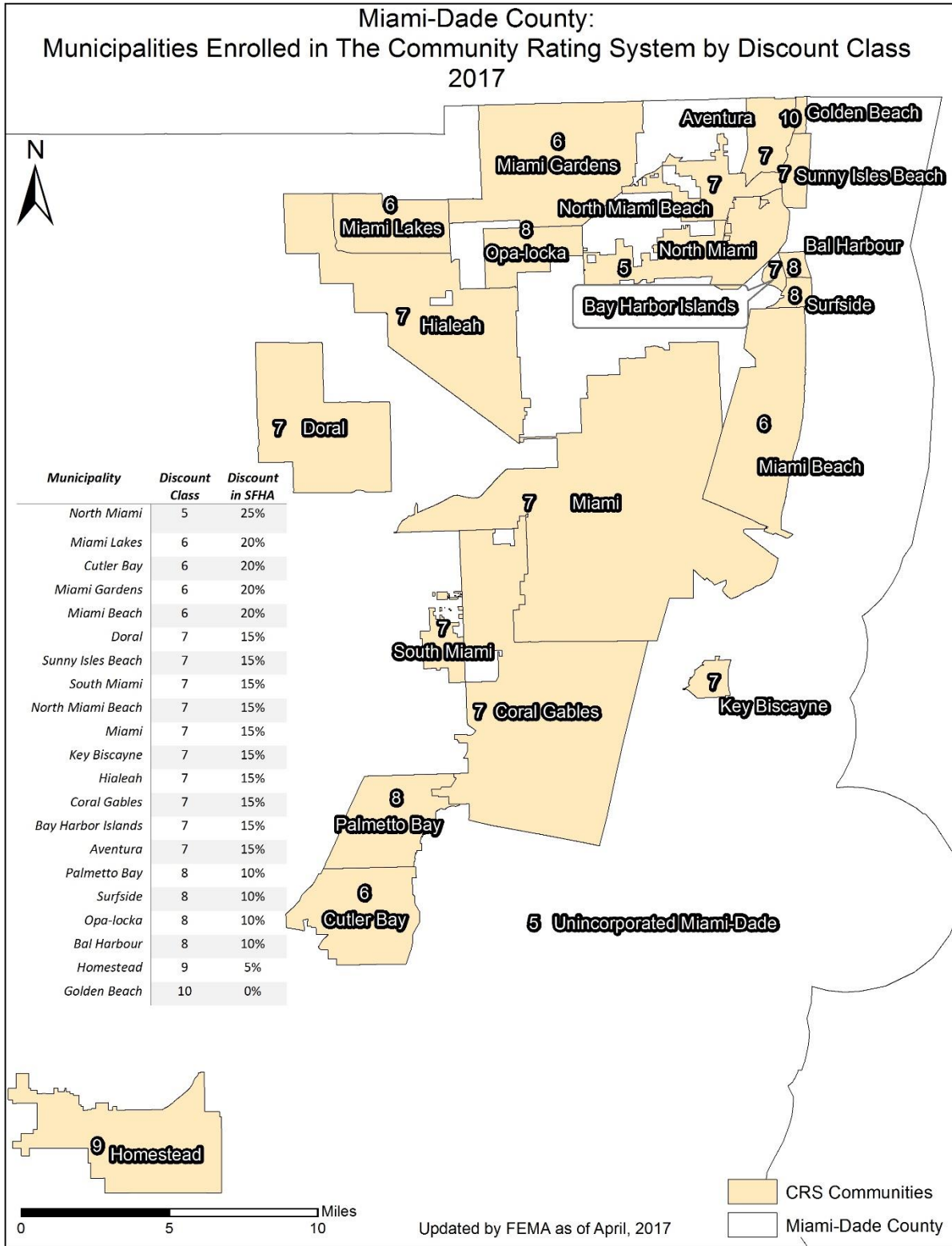
Source: Comprehensive Plan. (2017, January). Palm Beach County

1. LAND USE	2. INFRASTRUCTURE: SANITARY SEWER, SOLID WASTE, DRAINAGE AND POTABLE WATER	3. CONSERVATION/COASTAL ZONE MANAGEMENT
<p>OBJECTIVE: The City shall coordinate future land uses with the appropriate topography; see policy for measurability. (Note: An objective 9J-5.006(3)(b) as it relates to soil conditions is not applicable as the City's soils consist entirely of man-made soils and beach sand).</p>	<p>OBJECTIVE 4: FLOODPLAIN MANAGEMENT Enforce minimum floor level building elevations in accordance with FEMA requirements and flood zone maps as updated from time to time.</p>	<p>OBJECTIVE 4: HURRICANE EVACUATION The existing period required to complete the evacuation of people from Miami Beach prior to the arrival of sustained gale force winds shall be maintained or lowered by 1995.</p>
<p>Policy 9.1 The City shall continue to require that first floor elevations be constructed at FEMA's required minimum flood elevation at mean low tide to allow maximum protection during flood conditions. This provision shall not apply within Historic Preservation Districts where first floor elevations may be set below the minimum flood elevations, but shall be set at the highest level consistent with the historic character of the area.</p>	<p>Policy 4.1 Continue site plan review for new construction with the requirement that the minimum first floor elevation for living quarters be at least at the minimum FEMA requirement to allow for maximum protection during flood conditions.</p>	<p>Policy 4.1 All future improvements to evacuation routes shall include remedies for flooding problems and the anticipated increase in the level of the water of Biscayne Bay, local waterways, and the Atlantic Ocean programming transportation improvements to increase the capacity of evacuation routes, eliminating congestion at critical links and intersections, implementation of a traffic plan on the MacArthur Causeway and other critical intersections, adjusting traffic signalization or use directional signage, and public information programs to expedite safe evacuation.</p> <p>Policy 5.7 Unsafe conditions and inappropriate uses identified in the post-disaster recovery phase will be eliminated as opportunities arise, in accordance to the requirements of the Land Development Regulations</p>

		of the City Code. If rebuilt, structures with damage exceeding 50 percent of pre-storm market value shall be reconstructed to ensure compliance with the High Velocity Hurricane Zone portion of the Florida Building Code for structures located in the "V" Zone and the 100-year floodplain.
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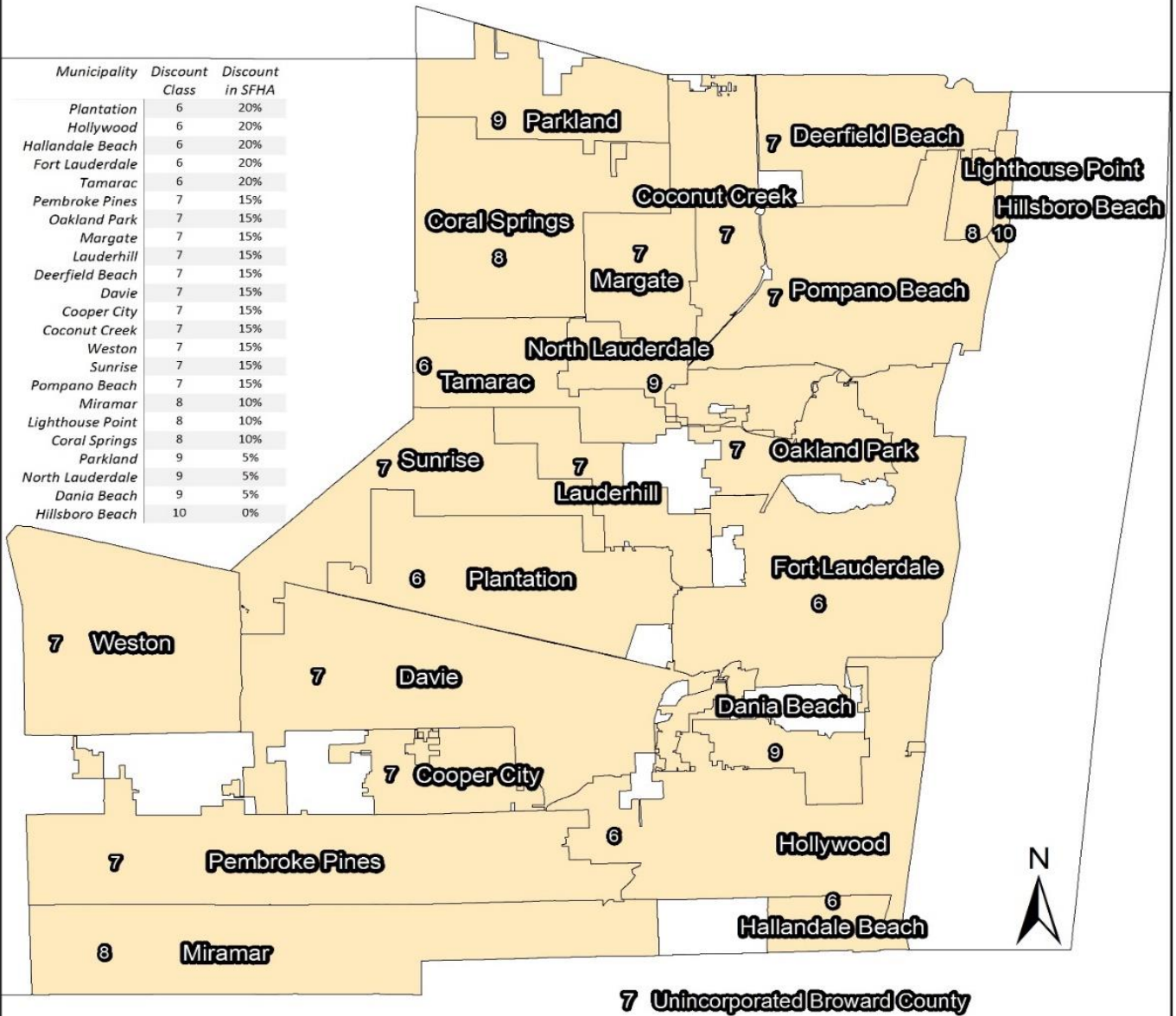
Source: Comprehensive Plan. City of Miami Beach

Appendix E: Municipalities Enrolled in the CRS in South Florida



Broward County: Municipalities Enrolled in The Community Rating System by Discount Class 2017

Municipality	Discount Class	Discount in SFHA
Plantation	6	20%
Hollywood	6	20%
Hallandale Beach	6	20%
Fort Lauderdale	6	20%
Tamarac	6	20%
Pembroke Pines	7	15%
Oakland Park	7	15%
Margate	7	15%
Lauderhill	7	15%
Deerfield Beach	7	15%
Davie	7	15%
Cooper City	7	15%
Coconut Creek	7	15%
Weston	7	15%
Sunrise	7	15%
Pompano Beach	7	15%
Miramar	8	10%
Lighthouse Point	8	10%
Coral Springs	8	10%
Parkland	9	5%
North Lauderdale	9	5%
Dania Beach	9	5%
Hillsboro Beach	10	0%

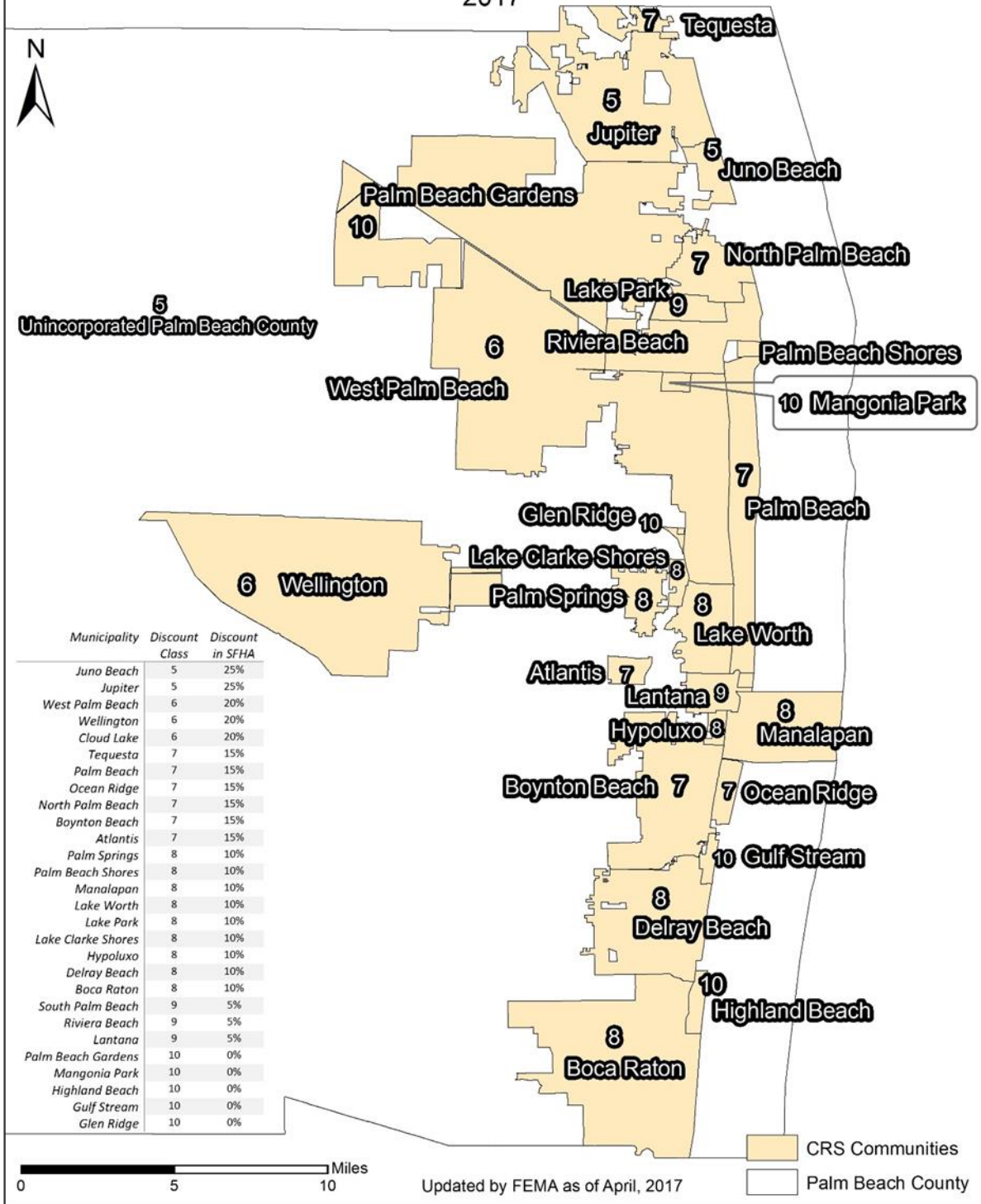


0 5 10 Miles

Updated by FEMA as of April, 2017

CRS Communities
 Broward County

Palm Beach County:
Municipalities Enrolled in The Community Rating System by Discount Class
2017



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