

Population and Housing in the Floodplain Battered by Hurricanes Harvey and Irma



Population and Housing in the Floodplain Battered by Hurricanes Harvey and Irma

As sea levels rise due to climate change, planners and policymakers in flood-prone areas must plan ahead to protect vulnerable residents from the effects of flooding. To plan effectively, they need vital information about the people and housing located in the floodplains. To meet this need, the NYU Furman center, with funding from the Kresge Foundation, designed Floodzone-Data.us, a tool that describes the housing stock and population in floodplains¹ at the national, state, county, and census tract level. These data can help policymakers assess needs and formulate plans and policies for floodplain management.

The NYU Furman center's accompanying data brief series summarizes and highlights the data available at FloodzoneData.us. The first brief described the housing in the nation's floodplains; the second brief discussed the population in the floodplains. This third brief examines the housing and population in floodplains within metropolitan areas that recently experienced significant flooding events.

Introduction

This brief is the last of a three-part series on the people and housing in the nation's floodplains. It explores metropolitan areas in Florida and Texas that have recently experienced significant hurricanes. We use data from FloodzoneData.us to aggregate information for metropolitan areas ("metros") to examine the affected regions in Florida and Texas. This brief demonstrates how the data can be used by planners and policymakers to better understand areas threatened by flooding and to plan for a more resilient future. To accompany this brief, we have released metro-level data

on FloodzoneData.us and we use that unit of analysis here, unlike the previous two briefs in which we looked at data at the national and state, and neighborhood (census tract) levels.² Background information on FloodzoneData.us, including how we define the floodplains, can be found in the first brief in this series, *Housing in the U.S. Floodplains*.³ The second brief, *Population in the U.S. Floodplains*, describes the population living in the floodplain nationwide and explores variation by state.

In this brief, we look at tenure, size, and age of the housing stock, the number of subsidized housing units, and population demographics including poverty rates, households with children and seniors, and race and ethnicity. As we discussed in detail in our earlier briefs in this series, these indicators are important to consider when developing policies to address the effects of flooding. For example, children and seniors may face a particular set of challenges when flooding occurs.

1 FloodzoneData.us combines U.S. Census Bureau data and data from the National Subsidized Housing Database with the National Flood Hazard Layer (NFHL), which contains the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs). FEMA is the entity that defines the boundaries of the 100 and 500 year floodplain. The NFHL covers 71 percent of the counties in the U.S., and approximately 92 percent of the population. Some areas with flood risk are not covered by the NFHL. For more information about the NFHL see FEMA, "The National Flood Hazard Layer," April 2017, https://www.fema.gov/media-library-data/1492206395397-ddb37681a7ad12e4ae9365b3aa5f84ed/The_National_Flood_Hazard_Layer.pdf.

2 The data made available on FloodzoneData.us and the analyses in the corresponding brief series is based on the National Hazard Flood Layer (NHFL) as of May 2016. While most of the country is covered by the NHFL, not all counties are included, including coastal counties. Specifically, Brazoria and Galveston Counties, both on the Gulf Coast of Texas, are not covered by the NHFL.

3 The Federal Emergency Management Agency (FEMA) publishes and maintains Flood Insurance Rate Maps to administer the National Flood Insurance Program (NFIP). These maps divide the United States into two zones based on current flood risk: the 100-year floodplain and 500-year floodplain. The 100-year floodplain includes areas with a one percent probability of flooding each year, and the 500-year floodplain includes areas with a 0.2 percent probability of flooding each year. See FEMA, "Flood Zones: Definition/Description," <https://www.fema.gov/flood-zones>.

The financial resources of floodplain residents have important implications for the ability of a community to make resilience improvements and its ability to cope with the costs of disasters. Building size and tenure play a role in whether buildings have professional ownership and management. The age of a building may suggest how easily it can be adapted for flooding risk. Whether residents are owners or renters may also inform local needs assessments and planning as it may be easier for renters to move whereas owners may be more tied to at-risk properties, though this may not be the case for low-income renters or renters faced with low vacancy rates and high rents.

Hurricane Harvey

In late August 2017, Hurricane Harvey made landfall on the Texas Gulf Coast, in the Houston metro area.⁴ Over the next several days, the once-in-a-1,000-years storm⁵ stalled over Houston and much of the Gulf region, dumping more than 50 inches of rain in some areas.⁶ Below, we use data from FloodzoneData.us to describe the housing and population in the 100-year and combined (100- and 500-year) floodplain in the Houston metro area in 2011-2015.⁷ The 100-year and combined floodplain areas are designated by the Federal Emergency Management Agency's (FEMA) Flood

Insurance Rate Maps (FIRMs) and are not necessarily the areas that experienced flooding during Hurricane Harvey. The 100-year and combined floodplain areas are, however, the areas most vulnerable to flooding in the metro area.⁸

Housing and Population in the Houston-The Woodlands-Sugar Land, TX Metro Area

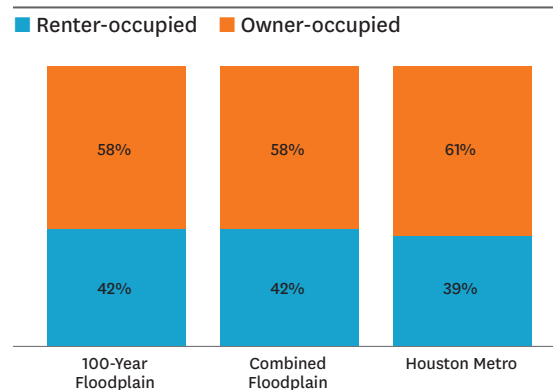
Housing

In the Houston-The Woodlands-Sugar Land ("Houston") metro, nearly 545,000 housing units (23% of all housing units in the metro) were located within the combined floodplain in 2011-2015.

Tenure, Size, and Age of Housing Stock

There were nearly 201,500 renter-occupied housing units and nearly 282,700 owner-occupied housing units in Houston's combined floodplain in 2011-2015. Figure 1 shows housing units broken out by tenure. The combined floodplain contained a higher share of renter-occupied housing units (42%) than the general Houston metro area (39%).

Figure 1: Housing Units by Tenure, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center
Note: Labels may not sum to 100% due to rounding.

4 National Weather Service, "Major Hurricane Harvey - August 25-29, 2017," http://www.weather.gov/crp/hurricane_harvey; U.S. Geological Survey, "Flood Event Viewer," <https://stn.wim.usgs.gov/fev/#HarveyAug2017>.

5 Jason Samenow, "Harvey is a 1,000-year flood event unprecedented in scale," *The Washington Post*, Aug. 31, 2017, https://www.washingtonpost.com/news/capital-weather-gang/wp/2017/08/31/harvey-is-a-1000-year-flood-event-unprecedented-in-scale/?utm_term=.4ae630099a8c.

6 Javier Zarracina and Brian Resnick, "All the rain that Hurricane Harvey dumped on Texas and Louisiana, in one massive water drop," *Vox*, Sept. 1, 2017, <https://www.vox.com/science-and-health/2017/8/28/16217626/harvey-houston-flood-water-visualized>.

7 We describe the housing and population in the floodplains included in the NHFL. The areas affected by Hurricane Harvey may differ. The 100-year and combined 100- and 500-year floodplains do represent areas at risk of flooding. Unless otherwise noted, the data in this report are based on the American Community Survey 2011-2015 five-year estimates. These data are period estimates and should be interpreted as a measure of the conditions during the full date range.

8 See Appendix A for a floodplain map for this area.

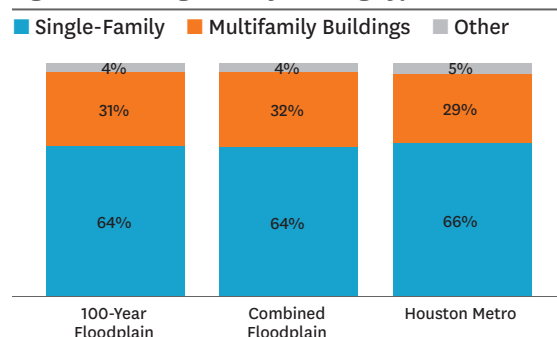
Figure 2 shows Houston's housing stock by building type. In the combined floodplain, approximately 64 percent of housing units (349,000 units) were single-family homes and approximately 32 percent (175,000 units) were in multifamily buildings. About four percent (21,000 units) of the housing units in Houston's combined floodplain were in other types of units, including mobile homes, houseboats, and recreational vehicles occupied as an individual's current place of residence.

More than 67,000 housing units, or 12 percent of the housing stock in the Houston metro's combined floodplain, were built prior to 1960⁹ (see Figure 3). Most units in the combined floodplain (62%) were built between 1960 and 1999.

Subsidized and Public Housing in the Floodplain

There were more than 550 units of public housing within the combined floodplain area in Houston in 2015, which represent 12 percent of the total stock of public housing units in the metro. There were more than 14,600 privately owned subsidized rental housing units in the combined floodplain in 2015 (24% of all privately owned subsidized rental housing units in the Houston metro). Table 1 provides more information about public and privately owned subsidized housing in the Houston metro.

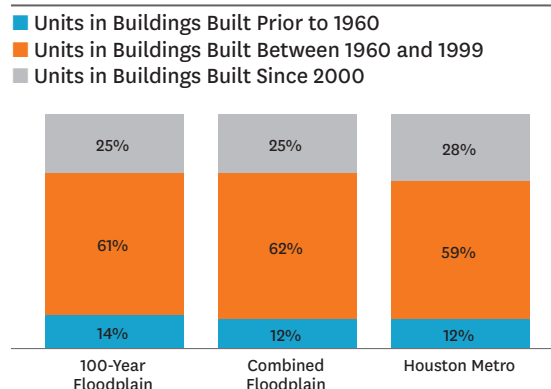
Figure 2: Housing Units by Building Type, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center
Note: Labels may not sum to 100% due to rounding.

⁹ The National Flood Insurance Program was created by Congress in 1968 though the city of Houston did not enroll in the NFIP until 1979. See FEMA, "Community Status Book Report Texas," <https://www.fema.gov/cis/TX.html>.

Figure 3: Housing Units by Year Built, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center
Note: Labels may not sum to 100% due to rounding.

Table 1: Subsidized Housing Units, 2015

	Public Housing		Privately Owned Subsidized Housing	
	Number of Units	Share of Metro	Number of Units	Share of Metro
100-Year Floodplain	451	10%	7,804	13%
Combined Floodplain	551	12%	14,603	24%
Houston Metro	4,479	100%	61,024	100%

Sources: National Housing Preservation Database, U.S. Federal Emergency Management Agency, NYU Furman Center

Population

For all the characteristics we explore, the demographics of the population in and outside of the floodplain in Houston are similar.

In the Houston metro, 1.43 million people (23% of the metro's population) lived in the combined floodplain in 2011-2015. Table 2 provides more information about the population within the Houston metro and floodplains.

Table 2: Population, 2011-2015

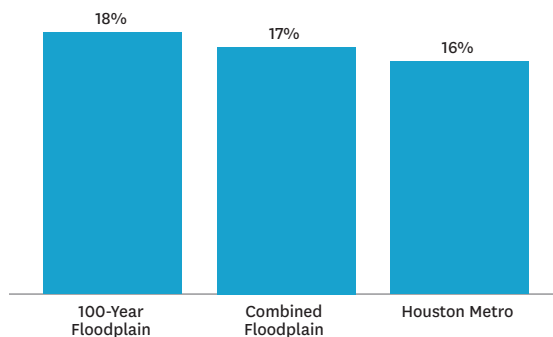
	Total Population	Share of Metro
100-Year Floodplain	713,796	11%
Combined Floodplain	1,431,220	23%
Houston Metro	6,341,175	100%

Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Poverty

The share of the population in the Houston metro living below the poverty line was 16 percent in 2011- 2015. The poverty rate was about the same within the combined floodplain area, where 17% of the population (more than 245,000 people) was living below the poverty line.

Figure 4: Share of the Population in Poverty in the Houston Metro Floodplain, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Households with Children and Seniors

There were nearly 195,100 households with children and more than 94,300 households with seniors in the combined floodplain in 2011-2015. In both the metro as a whole and in the combined floodplain, 40 percent of households included children and approximately 20 percent of households included seniors.

Table 3: Households with Children and with Seniors in the Houston Metro Floodplain, 2011-2015

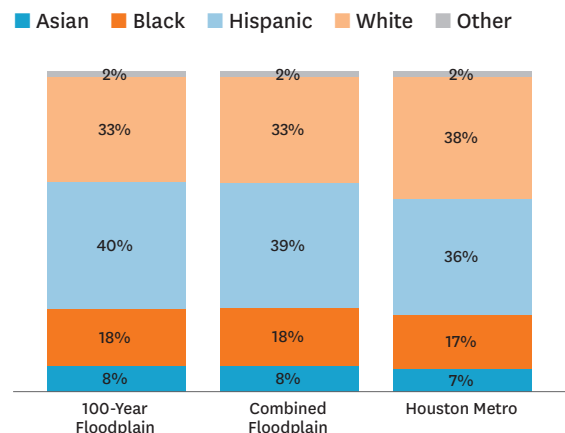
Households with Children		Total	Share
100-Year Floodplain		96,431	40%
Combined Floodplain		195,069	40%
Houston Metro		856,257	40%
Households with Seniors		Total	Share
100-Year Floodplain		48,071	20%
Combined Floodplain		94,362	19%
Houston Metro		429,572	20%

Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Race and Ethnicity

In the Houston metro area, the racial and ethnic composition of the population in the combined floodplain and the metro as a whole was about the same. In the metro, 38 percent of the population identified as non-Hispanic white, followed by Hispanic (36%). In the combined floodplain, 39 percent of the population identified as Hispanic.

Figure 5: Population in the Houston Metro Floodplain by Race and Ethnicity, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center
Note: Labels may not sum to 100% due to rounding.

As Houston continues to recover from Hurricane Harvey, policymakers and planners will need to consider the needs of the nearly one and a half million people living in the combined floodplain, including about 20,000 households living in mobile homes. They also must consider how to make a housing stock that includes about 67,000 units built prior to 1960, and over 15,000 units of public or privately owned subsidized housing, more resilient.

Hurricane Irma

In September 2017, shortly after Hurricane Harvey made landfall in Texas, Hurricane Irma struck Florida, after devastating parts of the Caribbean, including the U.S. Virgin Islands.¹⁰ Hurricane Irma brought severe storm conditions to most of the state. Below we describe the housing and population in the floodplains of three of the hardest hit Florida metro areas:¹¹ Jacksonville, Miami,¹² and Tampa.¹³

Housing and Population in the Jacksonville, FL, Miami-Fort Lauderdale-West Palm Beach, FL, and Tampa-St. Petersburg-Clearwater, FL Metro Areas

Housing

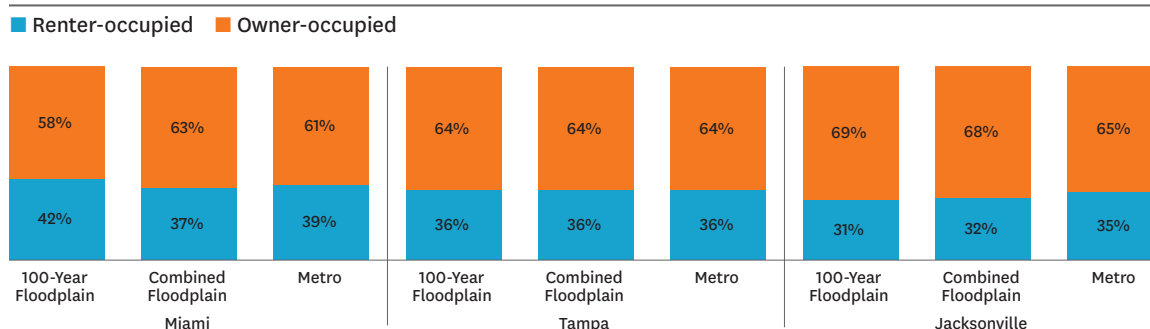
In the Miami metro, two-thirds of all occupied housing units—1.3 million units—were located in the combined floodplain in 2011-2015; the combined floodplain in Tampa's metro had about 357,000 units, about 31 percent of the metro's housing stock; and in the Jacksonville metro, nearly 100,000 housing units were located in the combined floodplain (19% of the metro's housing).

Tenure, Size, and Age of Housing Stock

Figure 6 shows housing units by tenure. In Miami, households in the 100-year floodplain were more likely to be renter-occupied (42%) than in the combined floodplain (37%), or in the Miami metro as a whole (39%). In Tampa, the renter-occupied share was the same across the combined floodplain and the metro. The Jacksonville metro area had the highest homeownership share in 2011-2015 of the three metros, and a higher share of households in Jacksonville's combined floodplain (68%) were owner-occupied than the metro as a whole (65%).

In the Miami metro, nearly half of housing units in the combined floodplain were in multifamily buildings in 2011-2015 (compared to 34 percent in the Tampa metro and 26 percent in the Jacksonville metro)¹⁴ (Figure 7). In the Miami metro, 16 percent of housing units were built prior to 1960, and in the Tampa and Jacksonville metros, 13 percent and 16 percent of housing units, respectively, were built prior to 1960.

Figure 6: Housing Units by Tenure, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Note: Labels may not sum to 100% due to rounding.

10 See National Weather Service, "Detailed Meteorological Summary on Hurricane Irma," https://www.weather.gov/tae/irma_technical_summary.

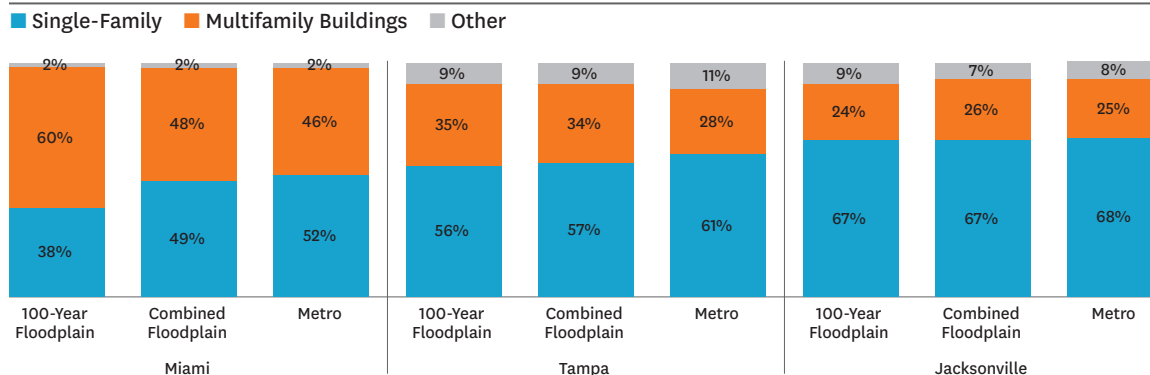
11 See Aaron Mak, "The Latest Reports of Damage in the Parts of Florida Hit Hardest by Irma," *Slate*, Sept. 12, 2017, http://www.slate.com/blogs/the_slatest/2017/09/12/damage_reports_from_areas_of_florida_hit_hardest_by_hurricane_irma.html.

12 In October 2017, FEMA updated the NHFL layer to include Palm Beach County, Florida, one of the three counties in Miami. The estimates in FloodzoneData.us were last updated in April 2017 and do not include estimates for Palm Beach County. For the purpose of this brief, however, we have included Palm Beach County data.

13 See Appendix B for a floodplain map for these areas.

14 Initial Flood Insurance Rate Maps (FIRMs) for the city of Miami were created in 1972; in Tampa, the first FIRMs were created in 1980; and in the city of Jacksonville, the initial firms were created in 1977. See: <https://www.fema.gov/cis/FL.pdf>.

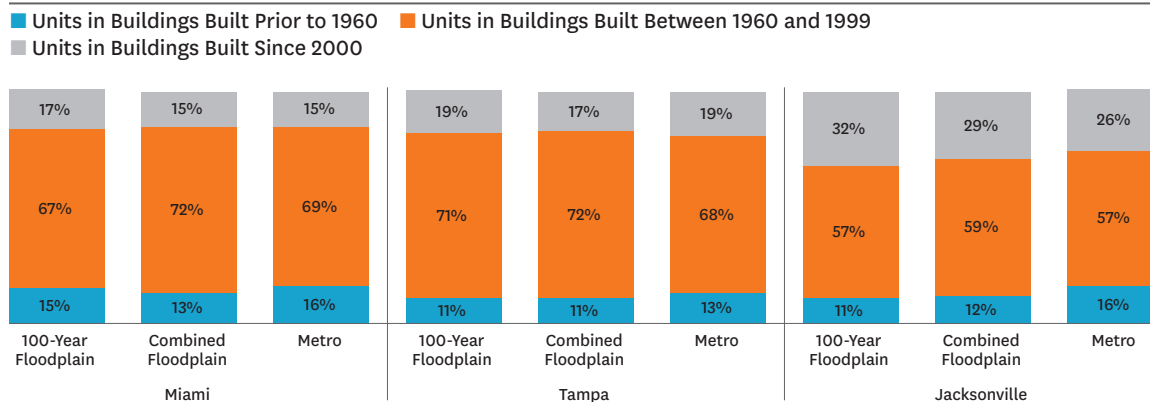
Figure 7: Housing Units by Building Type, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Note: Labels may not sum to 100% due to rounding.

Figure 8: Housing Units by Year Built, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Note: Labels may not sum to 100% due to rounding.

Subsidized and Public Housing in the Floodplain

In the Miami metro, over 4,000 public housing units (30% of all public housing units in the Miami metro) and 40,000 privately owned subsidized housing units (54% percent of all privately owned subsidized housing units in the Miami metro) were located in the combined floodplain. In the Tampa metro, about 500 units of public housing (11%) and about 7,700 units (23%) of privately owned subsidized housing were in the combined

floodplain. About 500 public housing units were located in Jacksonville's combined floodplain (15%) along with more than 1,500 units (7%) of privately owned subsidized housing.

Population

In 2011-2015, 4.6 million people lived in the combined floodplain in the Miami, Tampa, and Jacksonville metros, representing about 20 percent of the entire state of Florida's population. Nearly 60 percent of the Miami metro's population lived in

Table 4: Subsidized Housing Units, 2015

Metro	Public Housing		Privately Owned Subsidized Housing	
	Number of Units	Share of Metro	Number of Units	Share of Metro
Miami				
100-Year Floodplain	2,937	21%	17,253	23%
Combined Floodplain	4,180	30%	40,003	54%
Metro	14,085	100%	74,740	100%
Tampa				
100-Year Floodplain	423	9%	6,087	18%
Combined Floodplain	500	11%	7,703	23%
Metro	4,615	100%	33,974	100%
Jacksonville				
100-Year Floodplain	298	9%	618	3%
Combined Floodplain	507	15%	1,564	7%
Metro	3,312	100%	21,051	100%

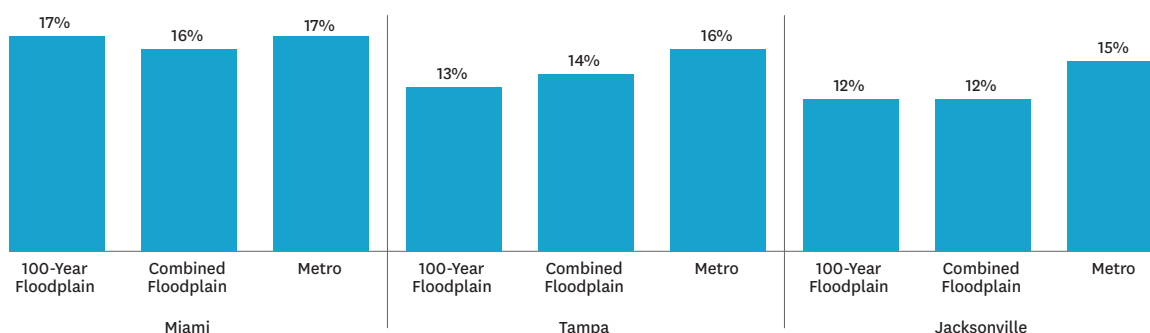
Sources: National Housing Preservation Database, U.S. Federal Emergency Management Agency, NYU Furman Center

Table 5: Population, 2011-2015

Metro	Population	Share of Metro
Miami		
100-Year Floodplain	1,209,589	21%
Combined Floodplain	3,507,316	60%
Metro	5,861,000	100%
Tampa		
100-Year Floodplain	751,270	26%
Combined Floodplain	865,495	30%
Metro	2,888,458	100%
Jacksonville		
100-Year Floodplain	190,788	14%
Combined Floodplain	253,355	18%
Metro	1,401,600	100%

Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Figure 9: Poverty Rate, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center

Table 6: Households with Children and with Seniors in the Miami, Tampa, and Jacksonville Metro Floodplains, 2011-2015

	Households with Children	Share of Households	Households with Seniors	Share of Households
Miami				
100-Year Floodplain	130,818	29%	135,084	30%
Combined Floodplain	380,857	29%	424,016	33%
Metro	635,021	31%	659,288	32%
Tampa				
100-Year Floodplain	77,755	25%	99,756	32%
Combined Floodplain	88,508	25%	118,238	33%
Metro	309,037	27%	365,387	32%
Jacksonville				
100-Year Floodplain	21,541	30%	20,439	28%
Combined Floodplain	28,425	29%	27,781	29%
Metro	163,683	31%	133,983	26%

Sources: National Housing Preservation Database, U.S. Federal Emergency Management Agency, NYU Furman Center

the combined floodplain, compared to 30 percent in the Tampa metro and 18 percent in the Jacksonville metro. Table 5 provides additional information about the population in the Miami, Tampa, and Jacksonville metros and their floodplains.

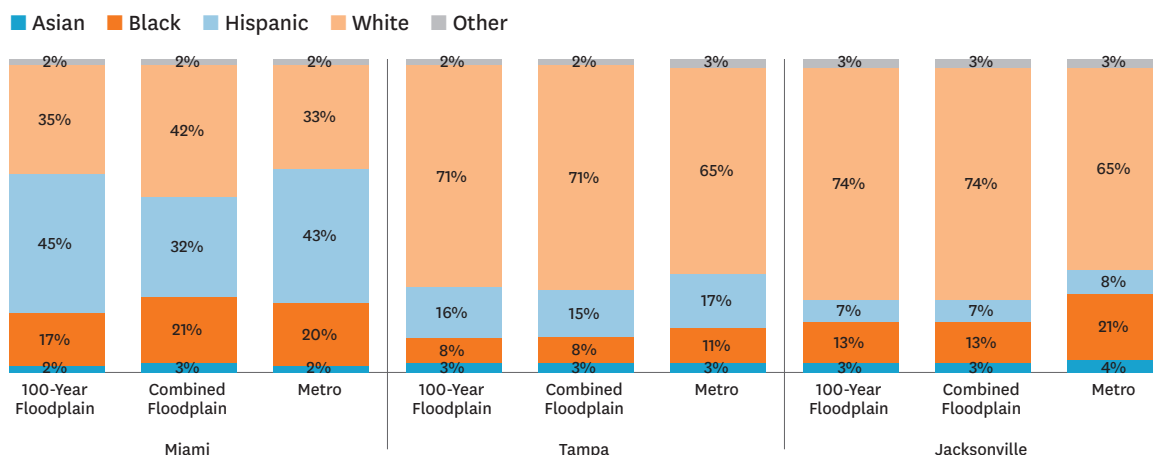
Poverty

In Miami, the poverty rate in the combined floodplain was about the same as the metro as a whole—16 percent versus 17 percent in 2011-2015. In the Tampa and Jacksonville metros, the poverty rate was higher in the metro as a whole (16% in Tampa and 15% in Jacksonville) than in the combined floodplain (14% and 12%, respectively).

Households with Children and Seniors

Households in the Miami metro overall were somewhat more likely than households in the combined floodplain to have a child (31% versus 29%) and slightly less likely to have a senior member (32% versus 33%) in 2011-2015. In Tampa, a quarter of households in the combined floodplain had a child, compared to 27 percent of households in the metro; a third of households had a senior member, compared to 32 percent metro wide. In the Jacksonville metro, 29 percent of households in the combined floodplain had at least one child in the household, compared to 31 percent in the metro overall; and households in Jacksonville's

Figure 10: Population in the Miami, Tampa, and Jacksonville Metro Floodplains by Race and Ethnicity, 2011-2015



Sources: American Community Survey, U.S. Federal Emergency Management Agency, NYU Furman Center
Note: Labels may not sum to 100% due to rounding.

combined floodplain were more likely to have a senior member (29%) than in the metro overall (26%).

Race and Ethnicity

In the Miami metro's combined floodplain, 42 percent of the population identified as white in 2011-2015, compared to 33 percent in the metro as a whole; the Hispanic population represented 43 percent of the metro's population, but about 32 percent of the population living in the combined floodplain. In Tampa, the white population was more likely to live in the combined floodplain than the black and Hispanic population. In Jacksonville, 21 percent of the metro's population identified as black, whereas in the floodplain, just 13 percent of the population identified as black in 2011-2015.

The Miami, Tampa, and Jacksonville metros contain over half of Florida's population. In these metros, there were 4.6 million people living in the combined floodplain in 2011-2015. Planners should take note of the different needs of these three metros; in the Miami metro's combined floodplain, for example, less than half of housing units are single-family homes, compared to 67 percent in the Jacksonville metro's combined floodplain.

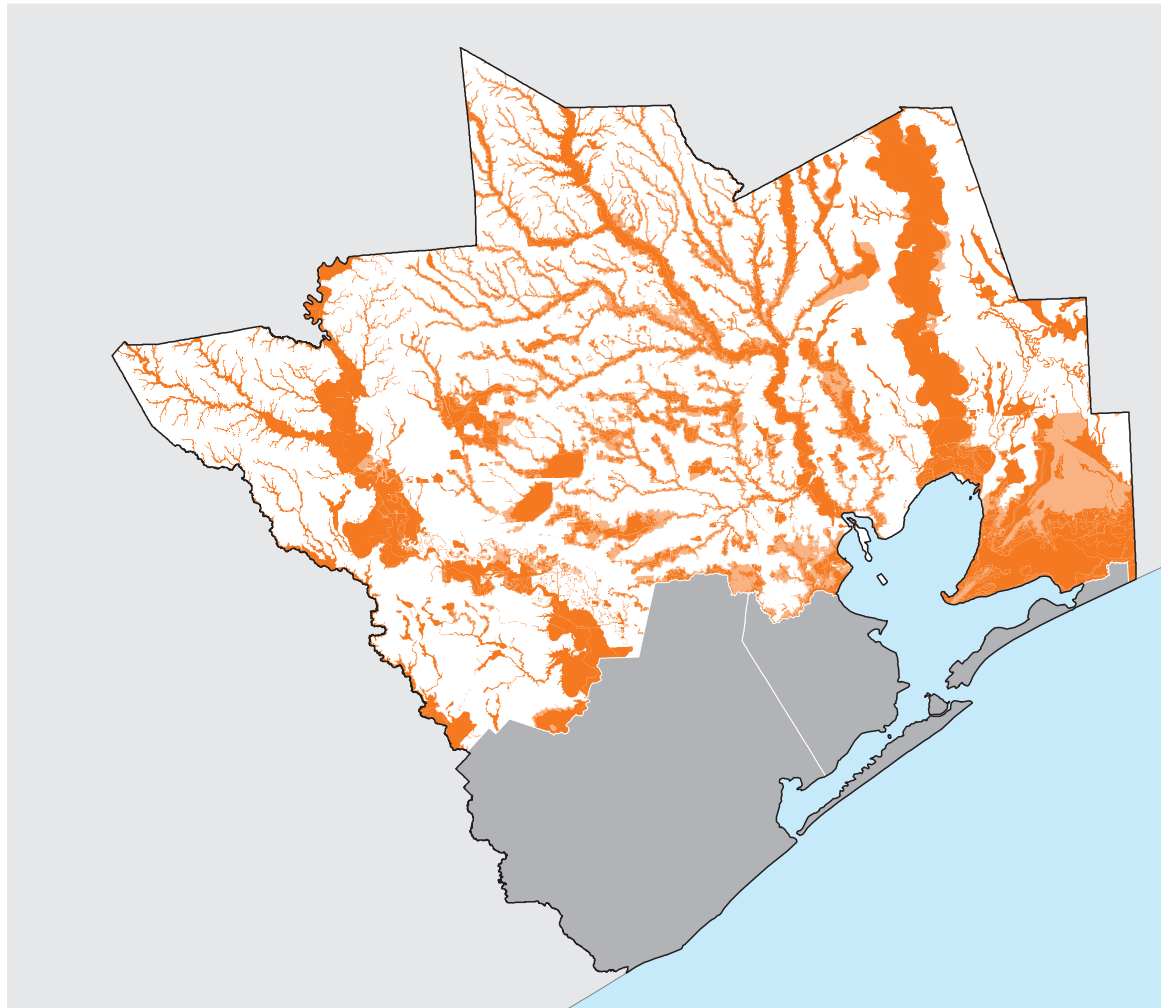
Conclusion

This brief examined the housing and population in the floodplains of several metro areas that recently experienced hurricane-related flooding. The Houston, Miami, Tampa, and Jacksonville metro areas, however, are only a handful of the coastal metro areas in the United States. Data from FloodzoneData.us can be used to study other regions that may be at risk of flooding. We use the data to both broadly estimate the number of people and housing units in the floodplain, but also to explore differences in the characteristics of the floodplain compared to the metro as a whole. The characteristics of the housing and the population in the combined floodplains of the Houston, Miami, Tampa, and Jacksonville metros are surprisingly similar to the metros as a whole. While this may suggest that the fairness of disaster relief policies is unlikely to be an issue, it is still important for planners and policymakers to consider the different types of housing and the differing needs of people in the floodplain, and to thoughtfully plan for those with special needs, such as households with seniors or children.

Appendix A

The Houston Metro Area Floodplain

□ Metro boundary ■ Counties not covered by NHFL ■ 100-year floodplain ■ 500-year floodplain



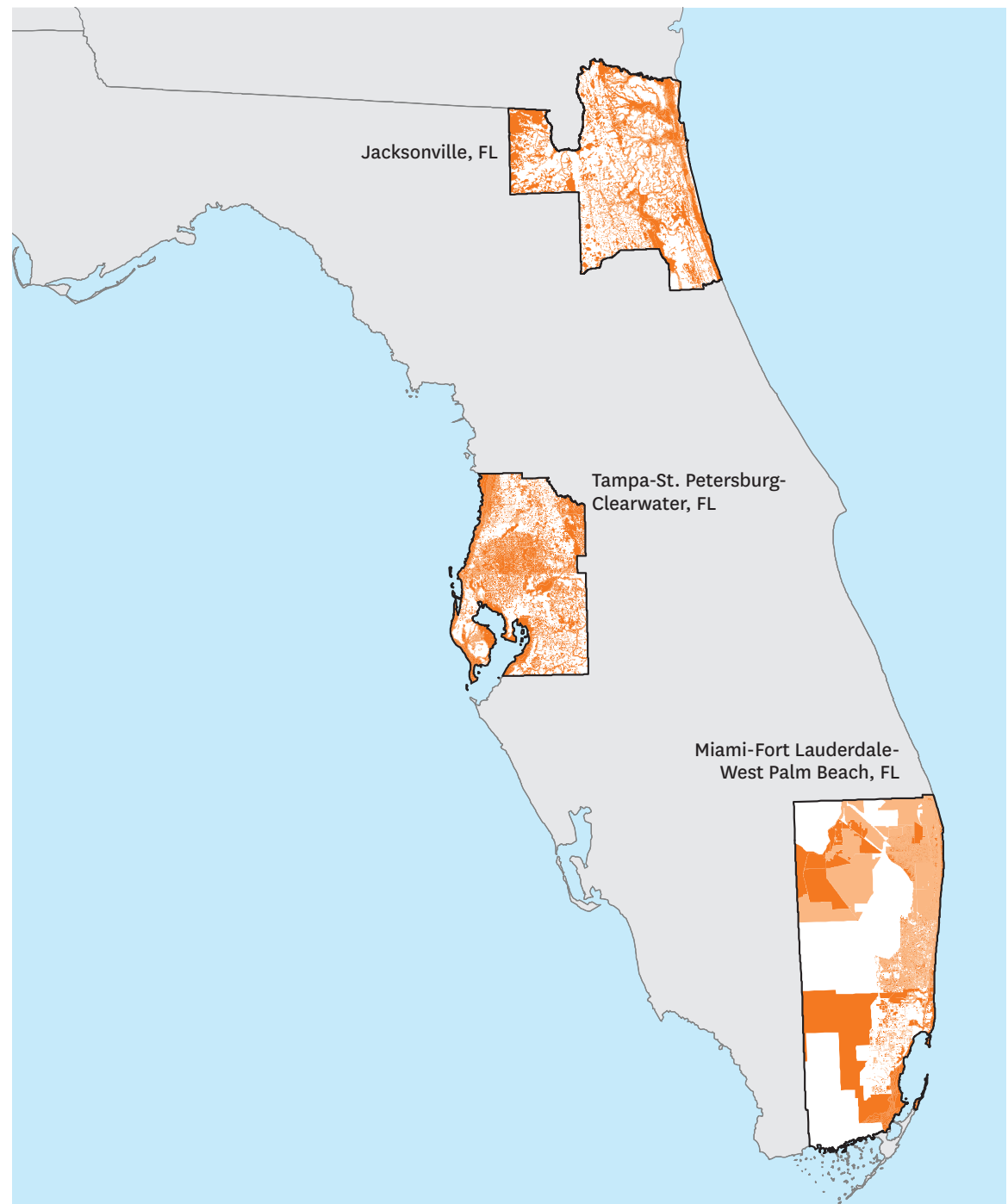
Sources: U.S. Federal Emergency Management Agency, NYU Furman Center

Note: The data made available on FloodzoneData.us and the analyses in the corresponding brief series is based on the National Hazard Flood Layer (NHFL) as of May 2016. While most of the country is covered by the NHFL, not all counties are included, including some coastal counties. Specifically, Brazoria and Galveston Counties, both on the Gulf Coast of Texas, are not covered by the NHFL.

Appendix B

The Miami, Tampa, and Jacksonville Metros Floodplains

□ Metro boundary ■ 100-year floodplain ■ 500-year floodplain



Sources: U.S. Federal Emergency Management Agency, NYU Furman Center



Authors

Caroline Peri
Stephanie Rosoff
Jessica Yager

Special Thanks

Vicki Been
Rachel Flaherty
Rigel Jarabo
Eftihia Thomopoulos

***The NYU Furman Center advances research and debate
on housing, neighborhoods, and urban policy.***