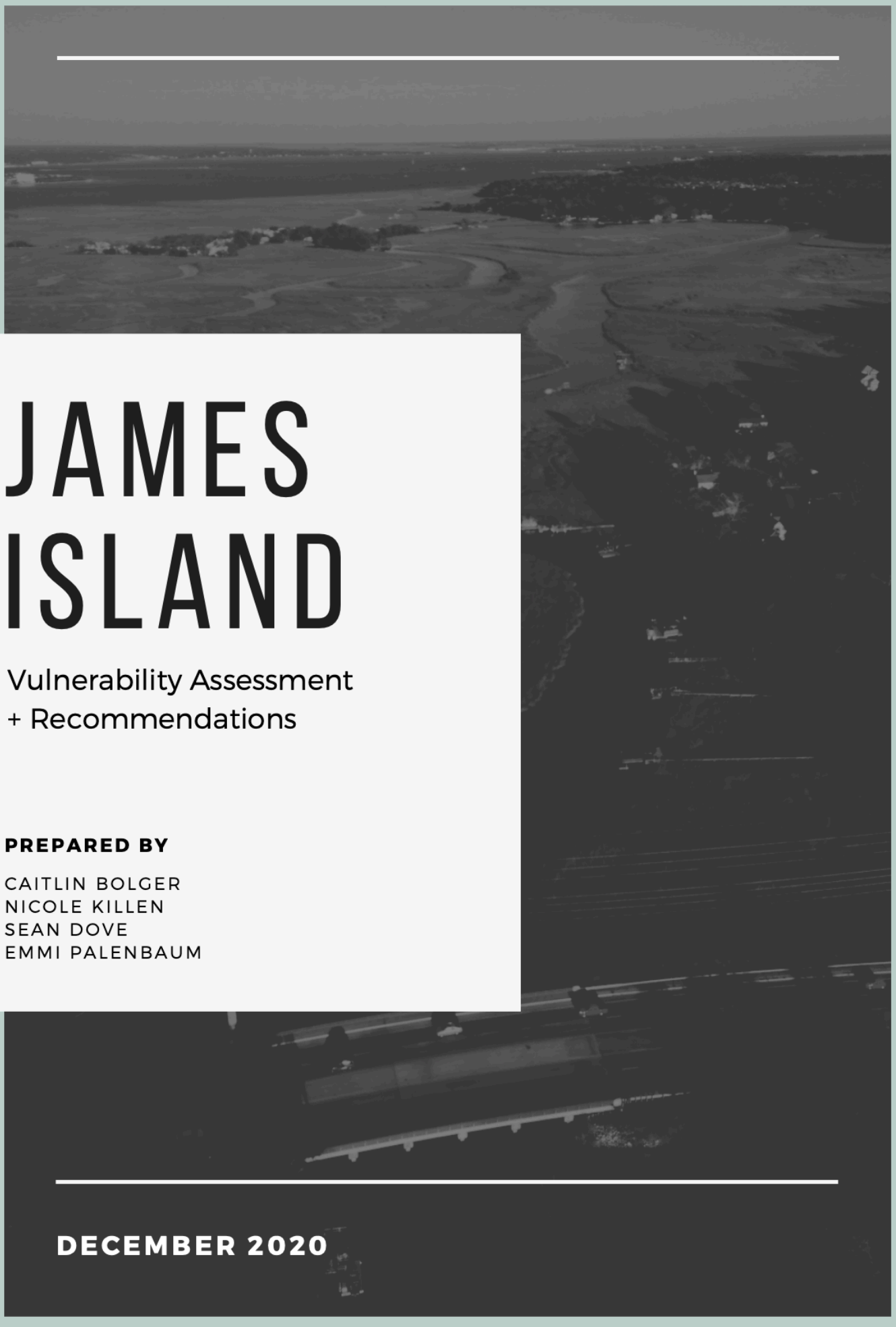

JAMES ISLAND

Vulnerability Assessment + Recommendations

PREPARED BY

CAITLIN BOLGER
NICOLE KILLEN
SEAN DOVE
EMMI PALENBAUM

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EXECUTIVE SUMMARY

Located adjacent to Charleston, SC, James Island is a low lying coastal community, surrounded by the Atlantic Ocean, Ashley River, and Charleston Harbor. The area of focus in this report is a section of James Island located to the east of Folly Road including the Town of James Island, City of Charleston, and Unincorporated Charleston County. Within this area, there are approximately 22,730 residents and 9,478 households. Being a low lying coastal community that is also located within a subduction zone, the James Island area is especially vulnerable to sea level rise, rain events, hurricanes, and earthquakes. This report consists of a review of relevant plans and studies within the state of South Carolina and the lowcountry. Local data and climate science data was used for a GIS, economic, and social analysis of the area's vulnerability to the aforementioned hazards. The analysis showed that the study area has dense pockets of low lying residential areas that are susceptible to flooding from sea level rise and storm surge. Flooding from rain events and hurricanes will be exacerbated by sea level rise. The findings also show that the community is not equipped to deal with heavy rainfall and that flooding in higher elevated areas can negatively impact non-elevated structures. The area is also particularly susceptible to an Earthquake where many of roads, structures, and critical infrastructure in the study area would be badly damaged. The recommendation report covers mitigation efforts such as new approaches to planning, diversifying outreach, higher regulatory standards, and other focused efforts to attract funding and lessen the damage from hazards. The final outputs of the project are an in depth vulnerability assessment and a recommendations report for future steps in strengthening resilience planning.

This report was developed for a College of Charleston Environmental and Sustainability Studies graduate-level course called "Case Studies in Applied Coastal Resilience" in Fall 2020. The final version of this report was submitted to Sarah Watson, instructor of the course, on January 11, 2021.

FOUR HAZARDS: SEA LEVEL RISE, HURRICANES, RAIN EVENTS, AND EARTHQUAKES

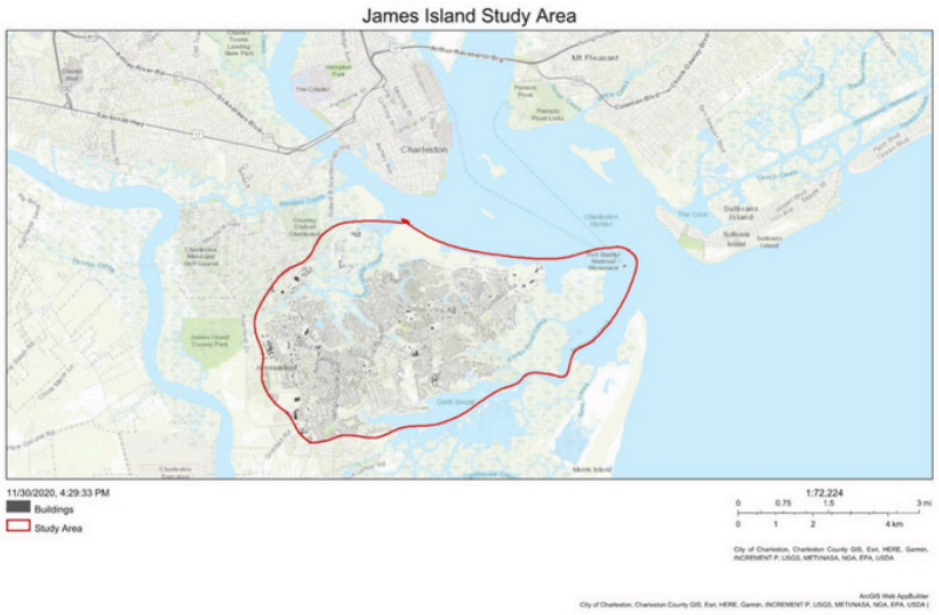
INTRODUCTION

The study area focuses on a section of James Island that is east of Folly Road, a main throughway that connects James Island to the West Ashley area of Charleston and the City of Folly Beach.[1] The study area is mostly developed with areas of residential and commercial land use. Within the study area, there are 9,478 households, a population of 22,730 residents, and 421 businesses.[2] Many of the homes within this area were built between the 1950s and 1980s; those constructed prior to 1974 would have been built Pre-FIRM, before the initial Flood Insurance Rate Maps, which puts older structures and systems more at risk for environmental disasters.[3]

There are multiple municipalities and service providers within James Island which includes: Town of James Island, City of Charleston, Charleston County, South Carolina Department of Transportation (SCDOT), James Island Public Service Department (JIPSD), and the Fire District of James Island.[4] In order to complete this vulnerability assessment, officials of these jurisdictions were interviewed during a stakeholder meeting and contacted via email to better understand the issues/concerns of James Island. Historically, James Island has been directly impacted by hurricanes, rain-bomb events, and an earthquake: Earthquake of 1886, Hurricane Hugo (1989), Rain-Bomb of 2015, Hurricane Matthew (2016), Hurricane Irma (2017), and Hurricane Dorian (2019). The drainage system of James Island has also been known to contribute to flooding issues throughout the study area. After uncovering James Island's history with storms and drainage issues, as well as, being located along the coast and within a subduction zone, it was determined that sea level rise, rain-bomb events, hurricanes, and earthquakes pose the greatest threat to James Island and would be areas of focus for the vulnerability assessment.

STUDY AREA

Figure 1: James Island Study Area Map



James Island is a low lying coastal community that is located adjacent to the peninsula of Charleston, South Carolina. It is surrounded by intricate waterways and contains large areas of wetlands and marsh. It is bordered by the Atlantic Ocean, Ashley River, and Charleston Harbor with intricate waterways that snake through the island.

1 City of Charleston. (2016). Rethink Folly Road: A Complete Streets Study. https://www.charleston-sc.gov/DocumentCenter/View/20538/Rethink-Folly-Road-Study-2016?bidId=
2 Esri Data. (2020). https://drive.google.com/file/d/1uG5UbOhO4Z28ZVF99gsZjn132tRIZceP/view?usp=sharing
3 FEMA. "Pre-FIRM vs. Post-FIRM" https://emilms.fema.gov/IS1101b/groups/98.html
4 Stakeholder Meeting, September 23, 2020

EXISTING PLANS REVIEW

Charleston County

The Charleston Regional Hazard Mitigation Plan was developed as a required component of Project Impact, an initiative sponsored by FEMA to assist communities in being more resistant to disasters. This mitigation plan was a community-wide effort to address the hazards that impact the Charleston Region, the purpose of which is to serve as a guide for hazard mitigation efforts. Through a survey, the Charleston Regional Hazard Mitigation Plan identified hurricanes, flooding, sea level rise and earthquakes as some of the top hazards of the Charleston area.[7]

City of Charleston

The City of Charleston recently released their All Hazards Vulnerability and Risk Assessment which identified eight hazards: floodplain inundation, storm surge, tidal flooding, sea level rise, earthquakes, hazardous material release, extreme heat, and water shortage.[8] This assessment identified that there are vulnerabilities to flooding, storm surge, and earthquakes citywide; and those areas that are vulnerable to hazards are also socially vulnerable.[9] In addition to identifying vulnerabilities, this report addresses opportunities for the city to build resilience to these hazards.[10]

5 Charleston Regional Hazard Mitigation Plan. (2020). Retrieved from https://www.charlestoncounty.org/departments/building-inspection-services/files/2020-Hazard-Mitigation-Plan-update.pdf
6 Charleston Regional Hazard Mitigation Plan. (2020).
7 Charleston Regional Hazard Mitigation Plan. (2020).
8 City of Charleston. (November 2020). "All Hazards Vulnerability and Risk Assessment" Retrieved from https://www.charleston-sc.gov/DocumentCenter/View/27993/All-Hazards-Vulnerability-Assessment-Executive-Summary
9 City of Charleston. (November 2020). "All Hazards Vulnerability and Risk Assessment"
10 City of Charleston. (November 2020). "All Hazards Vulnerability and Risk Assessment"

MAJOR **RAIN EVENTS**

50-55

inches of annual rainfall

June & Sept. peaks

October 2015

Hurricane Matthew (2016)

Background Information

James Island is positioned in a low-lying coastal landscape, making it susceptible to the threat of increased rainfall, storm systems, and associated flooding and runoff. Rain events can drastically range in duration from several hours to several days, and fluctuate in levels of precipitation; this is reflected in the available data. Varying elevation throughout the study area results in a range of potential impacts, severity, and repetitive loss areas. In addition, outdated and or overwhelmed stormwater drainage systems in the study area heavily contribute to flooding hazards, raising economic, social, and safety concerns for residents and businesses within the study area.

Recent Significant Rain Events

For the purposes of this assessment, focuses were placed on baseline data concerning annual precipitation within James Island. In the selected area of the South Carolina coast, annual rainfall averages between 50 and 55 inches.[14] The current annual average at the Charleston AFB station is 51.03 inches, with monthly averages peaking between June and September.[15] The average number of rain days per year is 119, with predictions of increased weather activity.[16] Two of the most notable rain events in recent years that affected the study area were that of the severe flooding event that occurred October 1-5, 2015 and the rainfall associated with Hurricane Matthew in October 2016.

14 SCDNR, "Extreme Rainfall Events," Retrieved from https://www.dnr.sc.gov/climate/sco/extremerainfall/rainfall.html

The historic rain event in 2015 is responsible for breaking several records in the Charleston area, including the highest amount of rainfall in a two, three, and four day period.[17] Linked to this event, the highest recorded rainfall in a 24-hour period was also broken at the Charleston International Airport on October 3, 2015, totaling 11.5 inches.[18] On the fourth day of the event, the precipitation levels surpassed the 1000-year average recurrence interval, totaling close to 20 inches in certain areas.[19] This major rainfall event is considered a 1000-year event, meaning its chance of occurring is 0.001% in any given year.

The following year, extreme rainfall was recorded again in association with the impacts of Hurricane Matthew. While the 2015 event lasted multiple days, precipitation from Hurricane Matthew consisted of a 24-48 hour period. Totals from Hurricane Matthew exceeded ten inches within a 24-hour period. [20]

The lowcountry also experiences short-term heavy rainfall bursts, known as “rain bombs”, which are difficult to predict and thus challenging to collect data. While these events are a growing problem in the James Island area, there is limited data available to fully understand their effects. It will be important to address this gap of information moving forward to inform resilience planning.

Draining and Flooding

After significant rainfall events, James Island has historically encountered issues with stormwater drainage and pipe maintenance, which has led to ineffective diversion of increased water levels and severe flooding. The Stormwater Management Plan - James Island Drainage Study compiles drainage complaints between January 2015 through January 2019 to address points of concern. An average of 230 complaints were reported annually for these four years.[21] An ArcGIS interactive map was constructed to display the total number of stormwater complaints to Charleston County within the study area since 2015. The map shows that a total of 507 claims have been made to Charleston County alone within the study area since 2015, with 73 reported in 2020 so far. Figure 4 in the report displays the Federal Emergency Management Association (FEMA) flood claim graphs in the City of Charleston dating back to 1979, excluding Hurricane Hugo.

15 US Climate Data, “Charleston AFB”, Retrieved from https://www.usclimatedata.com/climate/charleston-afb/south-carolina/united-states/ussc0052
16 US Climate Data, “Charleston AFB”,
17 National Weather Service. “Historic Flooding.” Retrieved from https://www.weather.gov/chs/events
18 National Weather Service. “Historic Flooding.”
19 National Weather Service. “Historic Flooding.”
20 DNR, “Hurricane Matthew in SC”, Retrieved from https://www.arcgis.com/apps/MapJournal/index.html?appid=2ac87a4a698c4e26902c1babbdba871b
21 Thomas & Hutton. Stormwater Management Report: James Island Drainage Study. https://www.charlestoncounty.org/departments/public-works/files/Drainage-Findings-Compiled.pdf?v=229

The highest number of reports totaled 87 in 2015 associated with Hurricane Joaquin, followed by 74 reports during the 2016 rainfall after Hurricane Matthew.[22] A comparison of these complaints with the work order requests in Figure 5 clarifies the source of the issue in each location, while Figure 6 shows the frequency of work order requests across three jurisdictions. This displays that most work orders were filed in the James Island Creek Basin, primarily concerning high- and medium-priority drainage problems.[23] Table 2 can be found in Appendix D, which also tallies the flooding complaints to Charleston County and the Town of James Island in each of the basins.

Figure 5: Charleston County Work Order Requests

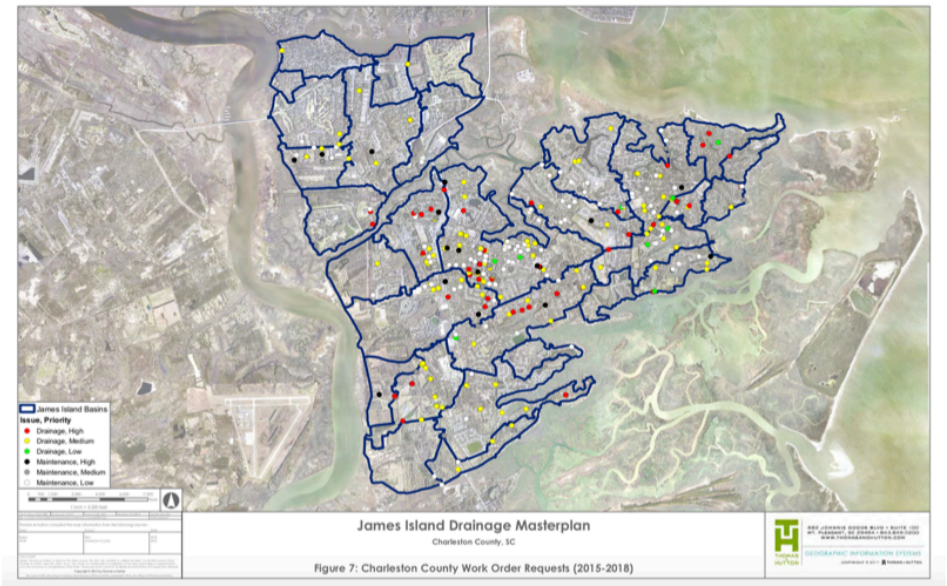
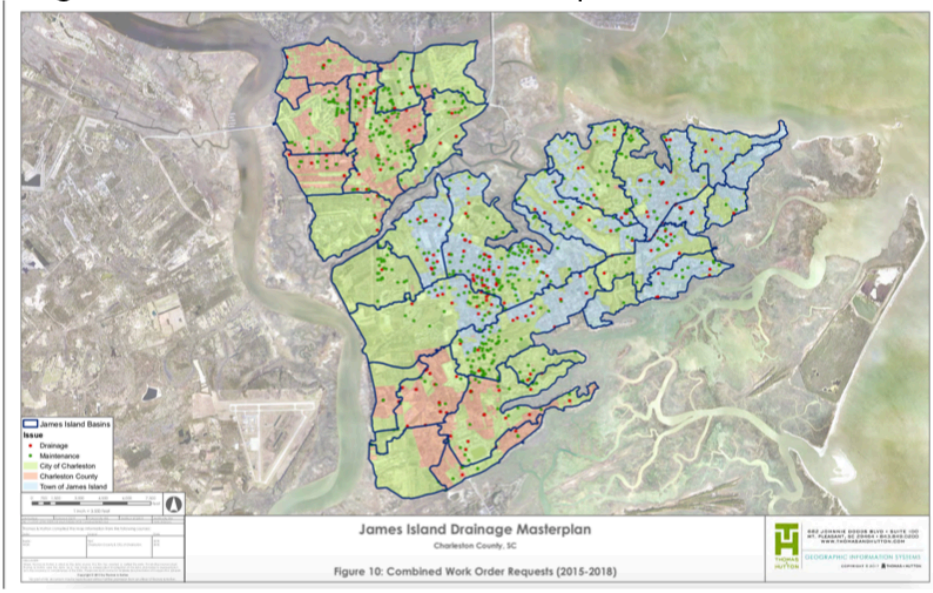


Figure 6: Combined Work Order Requests



James Island Creek Basin and Camp Road Basin had the highest numbers of flooding reports and maintenance complaints. Signal Point Basin also reported high numbers of flooding complaints, while Dills Bluff Road Basin and Kushiwah Creek complained of maintenance issues.[24] Table 3 combines all complaints made to the City of Charleston surrounding ditch cleaning, flooding or standing water, stormwater drains or pipe cleaning, and structure flooding. Within the study area, James Island Creek Basin and Mill Creek Basin reported the highest numbers of complaints.[25] An arcGIS map layer showing all study area stormwater complains can be viewed in Figure 7 in Appendix D.

22 Thomas & Hutton. Stormwater Management Report: James Island Drainage Study.
23 Thomas & Hutton. Stormwater Management Report: James Island Drainage Study.
24 Thomas & Hutton. Stormwater Management Report: James Island Drainage Study.
25 Thomas & Hutton. Stormwater Management Report: James Island Drainage Study.

The James Island Drainage Study also ranks the drainage basins in order of priority for assessing drainage conditions. A reference map for the parameters of each drainage basin can be found in Appendix D as Figure 8. Figure 9 in Appendix D visualizes basin prioritization, where James Island Creek Basin is number one, with Lighthouse Point Basin, Mill Creek Basin, and Lake Francis Basin all falling into the top ten of concern.

These drainage and maintenance issues can lead to severe flooding, causing inconveniences and safety hazards for residents. The depth of water can be misleading on blocked roadways, which can often lead to accidental drownings and emergency rescues. Limited access to roadways also prevents emergency services from reaching residents and problem areas. Frequent flooding in neighborhoods poses significant danger and economic concern for residents. In 2015, 78 insurance claims were made in the study area, equaling $534,000 and in 2016, 17 were made for a total of $307,000. An astounding $1,306,473 was paid for the 47 claims made in 2017. Other repercussions from extensive flooding and drainage overflow include sewage and runoff issues.

Economic and Social Vulnerability

Damage and other impacts from rainfall and major rain events exacerbate economic and social vulnerabilities throughout James Island. Such impacts from increased rainfall include personal and commercial property damage, business losses, bridge collapses, road washouts, emergency evacuations, travel disruptions, and more. In the days and weeks following the historic rainfall in October 2015, transportation, emergency services, and utilities were suspended and or impacted. One of the largest societal risks associated with increased rainfall and associated flooding is the safety hazard posed to citizens. Past events have resulted in many flood-related fatalities due to the lack of public awareness of the dangers of driving through flooded roadways. Inadequate stormwater infrastructure and overwhelmed drainage systems also cause sewage overflows, causing unsafe conditions for recreational use of the James Island Creek and other waterways.[26] Following the 2015 storm, 259 FEMA flood claims were filed in the selected area.[27]

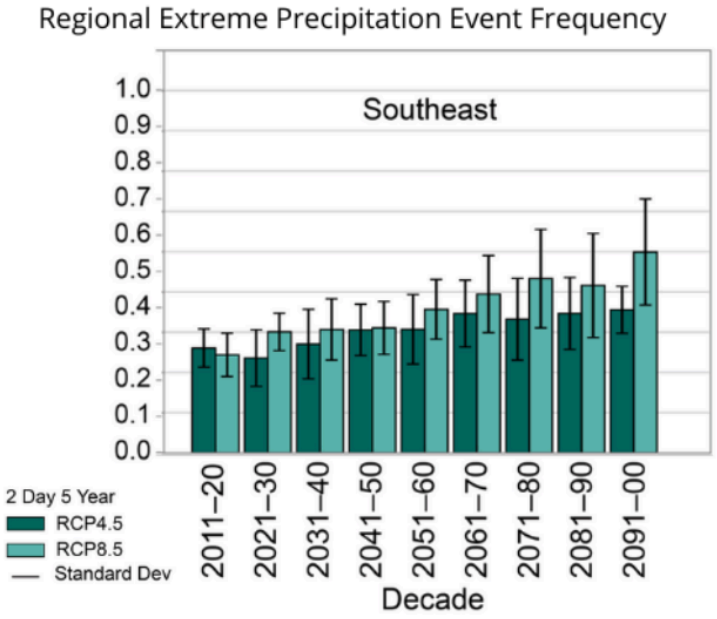
The historic flood in 2015 resulted in several deaths in coastal counties and an estimated $1.492 billion in damage costs statewide.[28] Consider strategizing how to collect localized data in response to disasters and major events. Residents in affected communities will encounter rising experiences with displacement and damage. As population increases and leads to further development, this will also contribute to risks.

26 Wade, T & Hallman, J. (August 2020). "Commentary: There Has to Be a Better Way to Handle Flooding on James Island." Post and Courier.
27 DNR Story Map https://scdnr.maps.arcgis.com/apps/MapJournal/index.html?appid=bc1ea6edf5eb495189be4968e0cd0edb
28 U.S. Department of Commerce. (July 2016). "The Historic South Carolina Floods of October 1-5, 2015" Retrieved from https://www.weather.gov/media/publications/assessments/SCFlooding_072216_Signed_Final.pdf

Uncertainty and Future Hazards

The predictions for significant rainfall events increase in both lower and higher scenarios. Major rain events have recently become an increased threat to the coastal community, but will only continue to grow in both frequency and severity. For each degree Celsius of temperature increase due to climate change, air saturation will also increase, with opportunity for extreme precipitation events to form. The National Climate Assessment states that this relationship will lead to about a 6-7% increase in the intensity of events.[29]A report done by the National Science and Technology Council states that the most powerful storms in the Southeast have seen a 27% increase of precipitation from 1958 to 2012. [30]

Figure 10: Extreme Participation



The Fourth National Climate Assessment used two scenarios, lower and higher, to approximate the increase of rainfall events in regions around the nation. Figure 10 displays the example of two-day precipitation events with a five-year return period, showing a projection that doubles the current occurrence under the higher scenario noted as RCP8.515. [31] In the same scenario, precipitation days with a 20-year return interval will also have a 21% increase in their rainfall amount.[32] Current projections expect a scenario that is greater than RCP4.5, but not quite the RCP8.5 projection.[33]

Monthly and annual rainfall data will distinctly vary depending on the scenarios mentioned above. Regardless, the increase of significant rainfall events over the next century will pressure infrastructure and stormwater systems in the James Island study area. As these critical systems decline, the threat of coastal flooding will worsen. While there is high confidence that rainfall will progressively intensify in the decades to come, fluctuation of occurrence and magnitude will be dependent on climate change circumstances and natural activity. This will require consistent monitoring and frequent reevaluation of adaptation strategies for effective resilience planning.

29 Dow, K., et al. (n.d.) Chapter 19: Southeast. Retrieved from https://nca2018.globalchange.gov/chapter/19/
30 Holleman, J. (2016). "Communities Under Water" https://www.scseagrant.org/communities-under-water-lessons-learned-from-extreme-floods/
31 Dow, K., et al. (n.d.) Chapter 19: Southeast.
32 Dow, K., et al. (n.d.) Chapter 19: Southeast.
33 Climate Action Tracker. https://climateactiontracker.org/global/cat-thermometer/

RAIN RECOMMENDATIONS

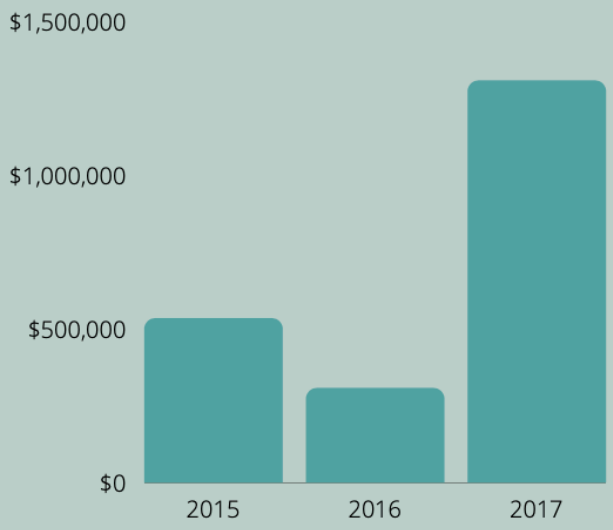
After reviewing previous reports and the available data, there are a few areas that can make a big difference. First, there is a gap in data pertaining to 'rain bombs', which complicates resilience efforts. While it is acknowledged that obtaining this data is difficult, it will be essential to future planning. Thus, it is suggested that a plan be constructed for researching and collecting 'rain bomb' data; this may require the formation of partnerships in the area.

The James Island Drainage Study is a valuable source in evaluating the area's problem sites and resident complaints regarding flooding and pipe maintenance issues. However, continued research in this area will further assist in allocating resources and help make funding decisions in a situation that is constantly changing. Similarly, it is suggested that insurance claim information be utilized more. Examining insurance claim data can display areas that are already feeling the effects from today's conditions, as well as help predict future problem sites. With the combination of these datasets, more effective planning can be done to ensure proper distribution of economic resources and protection of residents. These recommendations are discussed in more detail later in the report.

Rain bombs

- unpredictable
- difficult to measure

Insurance Claim Data by Year



Overview

1) Create plan for research and data collection for 'rain bombs'

2) Continue drainage system research

3) Utilize insurance claims data