Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department

Michael T. Russell

Cape Coral Fire Department, Cape Coral, Florida

Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: 

Abstract

Contained within the Cape Coral Fire Department's Vision 2025 Strategic Plan is a goal of "Providing Value Beyond the 911 Call." As such, programs, services, and the overall business model provided to the community necessitate regular reassessment to ensure quality services are being provided to the residents. A problem was identified that the Cape Coral Fire Department (CCFD) receives numerous requests from the community for sandbags in preparation for tropical disturbances. The purpose of this research was to determine if the CCFD should develop a community sandbag distribution program. The evaluative research method was used to answer the following research questions:1) What current hazard mitigation strategies does the CCFD provide the community in preparation for tropical disturbances? 2) What current hazard mitigation strategies are other coastal communities providing to the community during tropical disturbances? 3) Why have the coastal communities who distribute sandbags as part of hazard mitigation chosen to do so? 4) Is a community sandbag distribution program a viable hazard mitigation strategy during tropical disturbances for the CCFD? A combination of quantitative and qualitative research that included a survey instrument, literature review, and personal communications in the form of interviews were utilized for this study. Findings from the research supported the need to affect change by providing clear concise direction to the community on the CCFD's sandbag policy. Recommendations resulting from the research included the need for public education campaigns and creating a unified position with our local partners on the use of sandbags.

Table of Contents

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department

Due to its tropical climate, warm water, and geographical location on the Gulf Coast of Florida, the City of Cape Coral is pre-disposed to the risk of tropical disturbances such as hurricanes. With tropical disturbances come a variety of risks including high winds, heavy rains, and flooding. Individually, these risks can cause significant damage, but when combined together in a tropical disturbance, the damage becomes even greater and more widespread.

Under the authority of Lee County, the Cape Coral Fire Department (CCFD) operates an emergency management division to lead the City's mitigation, preparedness, response, and recovery efforts for all-hazard events. Neither the CCFD nor Lee County Emergency Management have a formalized sandbag program for residents to utilize. The problem is the CCFD receives numerous requests from the community for sandbags in preparation for tropical disturbances.

The purpose of this research is to determine if the CCFD should develop a community sandbag distribution program. The evaluative research method was utilized to answer the following research questions: 1) What current hazard mitigation strategies does the CCFD provide the community in preparation for tropical disturbances? 2) What current hazard mitigation strategies are other coastal communities providing to the community during tropical disturbances? 3) Why have the coastal communities who distribute sandbags as part of hazard mitigation chosen to do so? 4) Is a community sandbag distribution program a viable hazard mitigation strategy during tropical disturbances for the CCFD? The conclusion of the research will provide recommendations that will enhance the CCFD’s response to the needs of the community during tropical disturbances.

Background and Significance

Chartered in 1962, the CCFD was the first organized form of government in the City. Cape Coral has been dubbed the “waterfront wonderland” (Cape Coral Historical Museum, 2018). It is bordered by the Caloosahatchee River to the East and barrier islands and the Gulf of Mexico to the West (Figure 1). Cape Coral also boasts 400 miles of navigable canals. Current population estimates have the City at approximately 200,000 permanent residents with a seasonal surge of an additional 40,000 part-time residents.

Figure 1. Cape Coral Overview. Retrieved from https://www.google.com/maps/@26.6154918,-81.9137749,30649m/data=!3m1!1e3

As an all-hazards agency, the CCFD provides traditional fire suppression activities, advanced life support first-response capabilities, wildland fire suppression, and emergency management. Additionally, the CCFD is responsible for fire prevention programs, community education, and commercial fire inspections. The CCFD also operates specialized teams

responsible for marine, dive, and hazardous materials incidents. The CCFD is a non-accredited, Insurance Services Office Class 3 agency.

The CCFD is organized into five major divisions with 232 full-time personnel. The Administrative Division is responsible for the overriding management of the Department including the $35 million-dollar budget, policy, and leadership. The Operations Division is the largest division and operates out of 11 fire stations strategically spread throughout the City and responds to calls for services from the community. Logistics is the primary planning and procurement division, overseeing everything from fire truck purchases and fire station design and build to ensuring each station has an ample supply of toilet paper. The Professional Standards Division is the human resource hub of the CCFD. In addition, they are charged with the management of specialized programs such as marine, dive, emergency medical services, and training. Emergency Management monitors current and potential large-scale emergency situations, including weather reports. They are also responsible for the City's emergency operations plan and its implementation during times of declared disasters.

On the ArcGIS Hurricane Risk Index, Cape Coral scores a six, which equates to very high risk for hurricanes (Krieger, 2018). As a peninsula, Florida is in the direct path of the majority of tropical disturbances that threaten the United States (U.S.). Cape Coral's coastal location in the southwest of Florida pre-disposes the City to increased activity from tropical systems. From 1995 through 2017, a total of 36 hurricanes directly hit the U.S.; 11 of those hit Florida, which makes it the state with the most direct hurricane impacts (Navarro, 2019). Since 1851, a total of 49 hurricanes have directly impacted Southwest Florida (SWFL), the second most impacted area of the U.S. by hurricanes, behind only Northwest Florida (Heil, 2019).

Hurricane Irma, in 2017, was the most recent storm to affect SWFL. Irma was projected to directly impact Cape Coral as a Category 4 or 5 hurricane with a projected storm surge of 10-15 feet (Masters, 2017). However, after hitting the Florida Keys as a Category 4 hurricane, Irma weakened significantly prior to making landfall in SWFL just south of Cape Coral as a Category 1 hurricane.

In 2017, just a month before Irma, an unnamed tropical disturbance dumped historic rainfall totals on the City, which resulted in widespread flooding (Figure 2). This was considered

Figure 2. 2017 Cape Coral flooding. Retrieved from Cape Coral Fire Department Photo Archives.

a no-notice, or limited notice, event, which provided little time for residents to prepare for the effects of the disturbance. Instead of moving through the area, the disturbance essentially "parked" itself over the area, causing the unexpected rainfall quantities. During this event, there was no water permeation into structures. All damage was isolated to vehicles and primarily to those that attempted to drive through floodwaters. No sandbags were provided for this event, partially because of the rapid onset and partially because no formalized plan is in place for sandbags during tropical events. In fact, in preparation for Hurricane Irma, all Lee County fire departments had a unified message to evacuate, but their sandbag distribution programs varied, and many were made up on the fly. This led to confusion, frustration, and even anger by the residents who had received mixed messages on the best way to protect their property. The CCFD

did not distribute sandbags and received both support (Figure 3) and backlash (Figure 4) for this decision on social media, though the negative responses were more predominant than the positive.

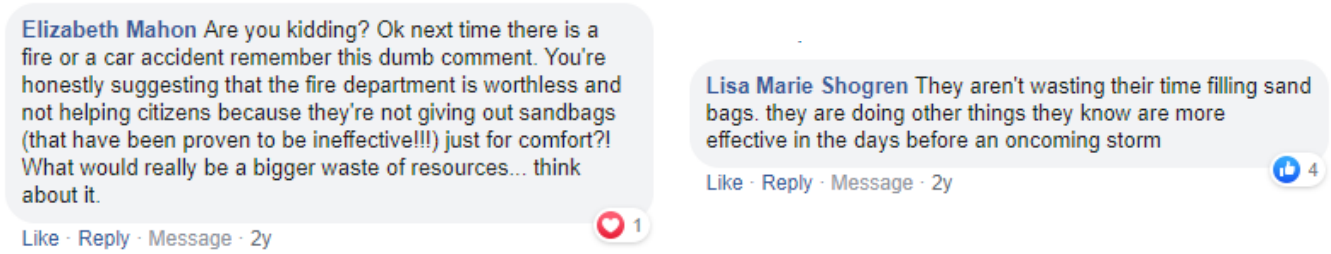


Figure 3. Examples of positive social media responses from residents. Retrieved from https://www.facebook.com/CapeCoralFD/

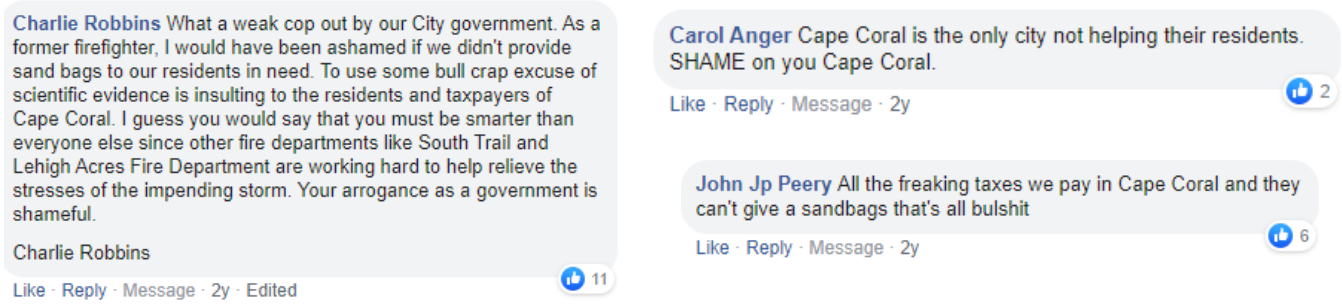


Figure 4. Examples of negative social media responses from residents. Retrieved from https://www.facebook.com/CapeCoralFD/

During the interview with Andrea Schuch, the Public Affairs Specialist for the Cape Coral Fire Department, she noted what an emotional, polarizing topic sandbags are. One resident was so upset he found the one photo on her personal Facebook page that was not set to private and wrote an angry and rude comment. Schuch believes that if the Department is not going to provide sandbags that the information needs to be shared in advance of the storm so that people can prepare and that, ideally, there is a unified agreement within the County. The mixed messages and short notice about the sandbag distribution decision was what she believes frustrated people the most. Residents also need to be educated on what actions, that don't include

sandbags, they should be taking to prepare for a storm (A. Schuch, personal communication, January 2020)

This applied research project (ARP) is directly linked to the Executive Analysis of Fire Service Operations in Emergency Management course goal of providing "the students with the knowledge and skills they need to effectively analyze fire service operations in emergency management to better prepare their communities for large-scale, multiagency, all-hazard incidents" (National Fire Academy, 2018, p. SM vii). Furthermore, the course teaches that all disasters are local, and communities should have plans to mitigate the effects of disasters (National Fire Academy, 2018, p. SM 4-8, 4-47). The ultimate goal of this ARP is to produce research that "reinforces local community all-hazard preparedness" as discussed during the course (National Fire Academy, 2018, p. SM 4-5).

The research is linked to two of the three goals in the U.S. Fire Administration Strategic Plan. The first goal is to "build a culture of preparedness in the fire and Emergency Medical Service," and this ARP aims at identifying and developing preparedness strategies can use to assist the residents within the local community. The second goal is to "ready the nation's fire and Emergency Medical Service for all hazards." The CCFD is an all-hazards agency with emergency management responsibilities, and this ARP is specifically directed at all-hazard type incidents (USFA, 2019, p. 1).

Literature Review

A thorough literature review was conducted for this ARP. A large portion of the literature is related to or directly linked to hurricanes as they are the tropical disturbance studied most extensively. Many weather experts believe that climate change is contributing to the increased

severity and quantity of tropical disturbances (Rahmstorf, 2017). This increased activity requires more comprehensive hazard mitigation planning and actions.

Traditionally, high winds are thought of as the primary risk during a hurricane. Media outlets show palm trees bent in half, blowing in the wind while their anchors struggle to hang on to road signs, nearly blowing away themselves. However, "storm surge is often the greatest threat to life and property from a hurricane" (NHC, 2020). The storm surge from Hurricane Katrina was estimated at more than 27 feet in some locations and was responsible for 1500 deaths. Storm surge is produced by water being pushed toward the shore by the force of the winds moving cyclonically around the storm (Figure 5).

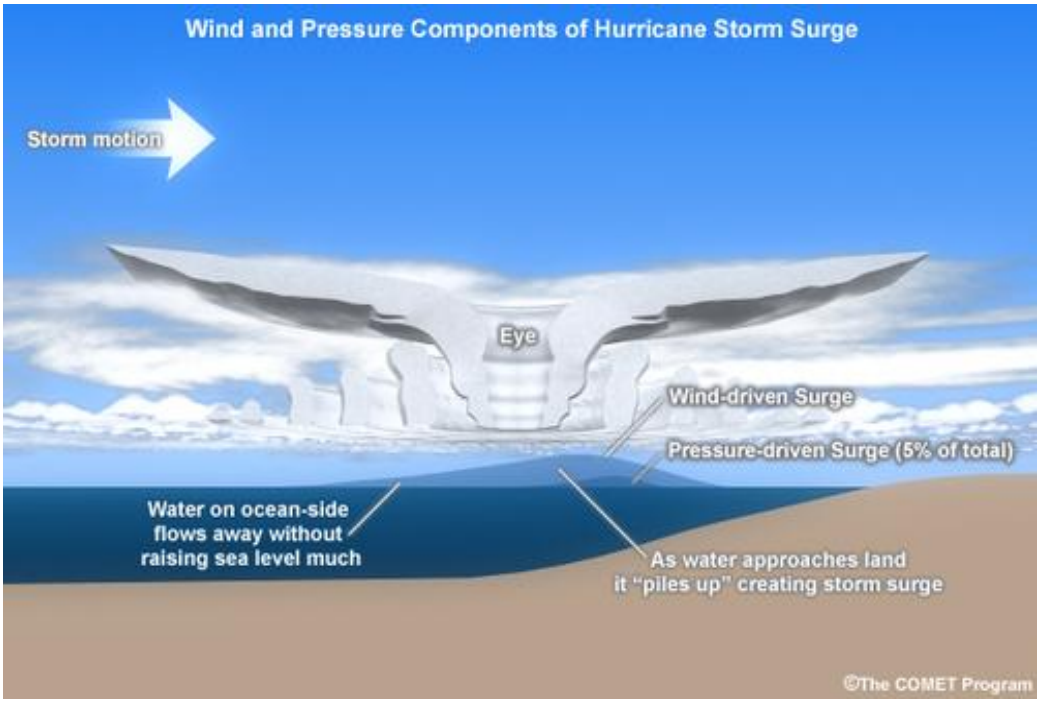


Figure 5. Storm surge illustration. Retrieved from https://www.nhc.noaa.gov/surge/

Climate change is not only contributing to the severity and frequency of tropical disturbances but is causing coastal flooding to increase in severity and frequency as well due to the rise sea in levels. As sea levels rise, inland water levels continue to encroach closer to homes and businesses even during non-tropical disturbance times. In turn, during a tropical disturbance,

rising water and storm surge is an even greater threat. A study by Garrett (2017) concluded that weather events previously thought to be a 500-year occurrence, in fact, may be increasing to a frequency of 5-years due to climate change.

Affecting 250 million people and causing $40 billion in losses annually, flooding is one of the most costly and frequent natural disasters (Organisation for Economic Co-operation and Development, 2016). According to the U.S. Army Corps of Engineers (2018), if used properly, sandbags can be an effective barrier against flooding. However, a properly constructed sandbag barrier is a costly and time-consuming endeavor. To simply seal the openings of a home such as exterior doors, garage, lanai, etc., it would take approximately 45 pallets of sandbags. This equates to more than two semi-trucks full of sandbags or three dump trucks worth of sand. The Hargett family of Arkansas was able to successfully protect their home from a flood in 2019 (Figure 6), but it required the help of the National Guard, a week's worth of work, and over 10,000 sandbags (5news web staff, 2019).

Figure 6. Hargett family home. Retrieved from https://5newsonline.com/2019/06/04/central-arkansas-family-uses-10k-sandbags-to-protect-home-from-flood-waters/

Research conducted by The Royal Melbourne Institute of Technology, a public research university based in Melbourne, Australia, supports the use of sandbags in some situations. The municipality must control two key components of the program: storage of ample supply materials and the necessary community education. Limitations of sandbagging were widely noted, including being a slow and labor-intensive practice (Padgham, et al, 2014). It is important to note that while this study was based on floodwaters not caused by tropical disturbances, it still provided valuable information.

Padgham (2014) developed a digital sandbag planning model for low-level river flooding events that allows officials to isolate areas where sandbagging will be most effective based on a predicted weather pattern. The tool allows municipalities to notify residents and establish sandbag depots. The research concluded that significant numbers of homes could be saved when warning time substantially exceeded 30 minutes which would allow time for residents to prepare. The establishment of numerous supply distribution points was key during the trial as it allows a larger number of residents to fill sandbags simultaneously and close to their intended destination.

The Institute for Environmental Studies concluded through their research that sandbags can be effective in certain situations. Effectiveness is regionally dependent as the severity of flooding varies due to a variety of variables such as “slow-onset river flooding or more rapid flash and coastal flooding” (Poussin, Botzen, Aerts, 2015). The study concluded that mitigation measures can be effective at reducing flood hazards and damages.

The use of sandbags may pose a problem for homeowners’ post-tropical disturbance. According to Seminole County, Florida (n.d.), floodwater can become contaminated with a variety of substances including fuel from spilled containers and vehicles, wastewater from septic systems, and chemicals from disturbed containers. As these contaminated waters come in contact

with sandbags, the contaminants are absorbed into the sandbags. According to Cape Coral Facilities Project Manager, Mark Ridenhour, the City of Cape Coral post-storm debris removal contract includes sandbags as they would be considered hazardous waste, however, the onus for proper disposal of contaminated sandbags is still placed on the homeowner, which could be a costly and time-consuming endeavor (Ridenhour, personal communications, February 2020).

Released in September of 2019 by the Federal Emergency Management Agency (FEMA), the 2018 National Household Survey (NHS) "assesses how the culture of personal disaster preparedness and resilience has changed over time in the United States" (NHS, 2019, p. 2). The NHS concluded that 98% of respondents acknowledged that at least one type of natural disaster could affect their home, and there was a 57% increase in adults who have taken three or more preparedness actions for a natural disaster since the 2017 survey. The hurricane section of the NHS reported a 5% increase in those who have made an emergency plan, and those who have sought information on preparedness rose 12%. Unfortunately, the survey exposed a 5% decrease in those who have gathered supplies for three or more days, and the number of those who have made an emergency plan remained unchanged at only 47% of respondents. However, overall, the key takeaway of the 2018 NHS was positive in that residents in areas at risk for hurricanes are most likely to have taken "key preparedness actions, have greater awareness, and are more likely to be prepared" (NHS 2019, p.19).

In 2017, Lee County Emergency Management updated the Joint Unified Local Mitigation Strategy (LMS) plan. The plan engages local communities to "promote mitigation initiatives to improve resilience to hazards posing a threat to communities within Lee County" (Lee County LMS, 2017, p.4). The document is a comprehensive plan encompassing a wide variety of potential hazards. Flood events remain a significant risk to Lee County residents, including the

coastal areas of Cape Coral as can be seen in Figure 7. Lee County coastal geography is low and flat, with 35% of the developed area of the County at or below 10 feet North American Vertical Datum (Lee County LMS, 2017).

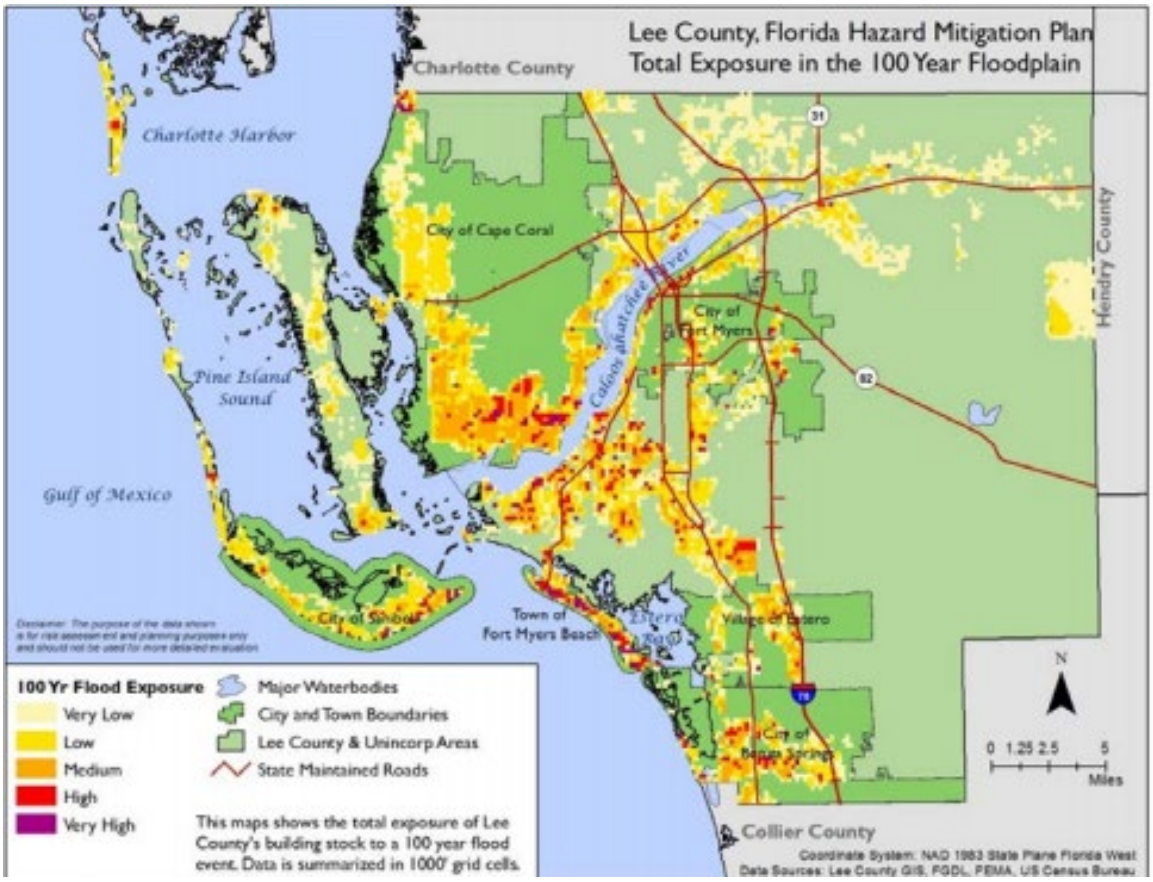


Figure 7. Lee County Flood Risk Map. Retrieved from http://www.leegov.com/publicsafety/Documents/Emergency%20Management/FINAL_LeeCounty_LMS2017.pdf

Storm surge is considered one of the most dangerous secondary effects of a tropical disturbance. As such, it is listed as a high hazard area in the LMS and affects all of Cape Coral (Figure 8). Storm surge causes significant coastal flooding and is exclusively associated with tropical disturbances. Just four feet of storm surge is considered high risk with the potential for extensive significant coastal erosion, structural flooding, and fatalities (Lee County LMS, 2017).

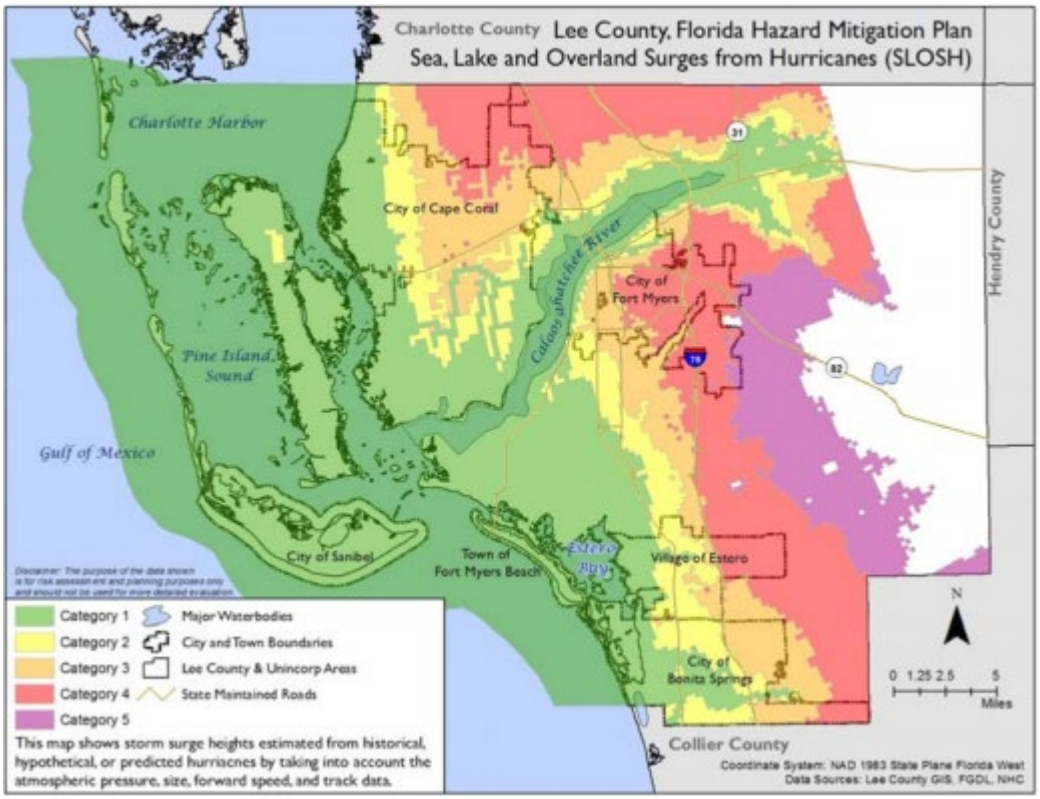


Figure 8. Storm surge risk map. Retrieved from http://www.leegov.com/publicsafety/Documents/Emergency%20Management/FINAL_LeeCounty_LMS2017.pdf

Procedures

This research project began at the National Fire Academy (NFA) during year three of the Executive Fire Officer course. It was there that the researcher identified the research topic based on the desire to mitigate hazards at the local level as discussed during the program. The researcher utilized the on-line learning resources as well as consulted with his peers to further define the problem at hand. Lastly, the researcher consulted several peers to develop the required ARP proposal submission form, which was approved by the ARP evaluator.

The next step in the research process was to determine the necessary research type and methods. The evaluative research style was chosen with a mix of quantitative and qualitative

research that included a survey instrument, literature review, and interviews. A pilot survey was sent to a sample group of three subjects to increase the validity and reliability of the research. Two of the three subjects responded with useful feedback. The target survey population was agencies in coastal Florida communities with geographic similarities to Cape Coral who provide hazard mitigation actions during tropical disturbances; 52 Florida coastal community fire departments or emergency management agencies were identified. The researcher sent a survey comprised of 10 questions to personnel responsible for hazard mitigation strategies/actions at each of the 52 agencies (Appendix A), and 23 responses were received for a 44% participation rate. Three individuals from the surveys were identified to be interviewed; 15 had volunteered.

A series of questions were asked to each interviewee related to their knowledge and use of sandbags, as well as other hazard mitigation strategies/actions. Only individuals with extensive emergency management knowledge were sent the survey, therefore, each is considered by the researcher to be a subject matter expert in the field. Additionally, if the interviewee made any interesting comments when answering the survey, they were given the opportunity to expound upon the comments during the interview. Questions were open-ended in nature, allowing each interviewee the chance to speak freely and elaborate as much as possible.

Amber Boulding is the Emergency Manager for the City of St. Petersburg Emergency Management. St. Petersburg is located on the Gulf Coast of Florida, two hours north of Cape Coral. Boulding is a Certified Florida Professional Emergency Manager and holds a bachelor's degree in health education and a master’s in public health degree. Boulding has been in emergency management for 10 years. She began her career with the Department of Health and started her current career with the St. Petersburg Emergency Management in 2016 (A. Boulding, personal communications, February 2020).

Flagler County, Florida Emergency Management Director Johnathon Lord has been in public safety for 17 years. Lord has a bachelor's degree in emergency medical services, is a Florida Professional Emergency Manager, and holds Department of Homeland Security Secret Clearance. Prior to serving in Flager County, Lord's experience includes a variety of roles with Miami-Dade County's Emergency Management including emergency management coordinator, branch manager, assistant director, and deputy director. He also served as deputy director of Florida's Division of Emergency Management where he oversaw statewide response to Hurricanes Hermine, Matthew, and Irma. Flagler County is located on the Atlantic Coast of Florida between Jacksonville and Cape Canaveral. (J. Lord, personal communications, February 2020).

Richard Zyvoloski is the Emergency Management Coordinator with Collier County, Florida. Collier County is the southernmost inhabited Gulf Coast county in the state and is the largest county by geographic size in Florida. Zyvoloski has a master's degree and is a certified Florida Professional Emergency Manager. He has worked in emergency management for nearly 20 years (R. Zyvoloski, personal communications, February 2020).

Lastly, Alvin Henderson, Emergency Management Division Manager, for the CCFD was interviewed to better understand the current hazard mitigation strategies employed by the CCFD during tropical disturbances. Henderson has been with the CCFD since April 2019. He is a certified emergency manager and has a bachelor's degree in business administration. He is currently pursuing a master's degree in emergency management. Henderson has attended numerous courses at or in conjunction with the NFA and Emergency Management Institute. Prior to serving with the CCFD, Henderson worked in various emergency management capacities in Allegheny County, Pennsylvania for 14 years, including fire chief for five years.

The research process continued by utilizing on-line resources to analyze a variety of comprehensive findings of other researchers. Google, Google Scholar, as well as the NFA online library were utilized for the research. Other online sources included news articles, product websites, and government publications. These sources were reviewed, analyzed, and included in the ARP where necessary. The research was only limited by the considerably narrow subject matter.

Results

The survey tool was used to determine what successful hazard mitigation strategies other agencies are using in an attempt to find an industry-standard or innovation the CCFD can use to assist the residents of Cape Coral. Of those polled, 78% reported that their agency provides hazard mitigation specifically geared towards storm surge and flooding to the residents of their community during tropical disturbances (i.e. tropical storm, hurricanes). Of those respondents, 91% of them report providing services such as pre-storm tree trimming and deploying temporary residential flood barriers such as portable flood gates or shields, inflatable floodwalls, and sandbags. However, only 30% report having a formal sandbag program while 13% report providing some type of informal assistance such as providing the sand but no bags.

No responding agency who provides sandbags reports allowing the household to obtain more than 24 sandbags. In fact, many reported scaling the number of bags distributed per household based on demand. Meaning the more people that want sandbags, the lower the number given to each household. The most common number of sandbags agencies report distributing, at 34%, is 10-24 per household. Respondents rated their sandbag program as only 40% effective. Only one of the responding agencies reports removing sandbags for homeowner's post-incident,

and the removal was limited to contaminated bags only. One agency reported providing information to residents on the proper disposal of clean and contaminated bags.

Of the agencies that do not provide residential sandbag distribution programs, 17% did not believe sandbags were effective, and 13% report not having sufficient staff. It is preferred by 22% of these agencies that residents focus on evacuating to safer areas versus sandbagging, and 57% of agencies reported that education was the most important hazard mitigation action they provide. Additionally, two of those surveyed believe that sandbags are great public relations items but question their actual effectiveness. When asked about hazard mitigation actions their agency was lacking, 52% reported none and responses for those that desired additional actions ranged from more education to better neighborhood planning to more shelters.

The CCFD's current hazard mitigation strategies include some education such as hosting an annual hurricane preparation seminar and infrastructure hardening such as improving drainage, adding generators to existing city facilities, and increasing the wind resistance on existing city structures. Additionally, the City has focused on partnerships with other local agencies including supplying generators to a local church and Army Reserve Center that could be used as shelters for personnel during tropical disturbances. Other than making the decision to not distribute sandbags during Hurricane Irma, no data was available on the CCFD's use of sandbags for past tropical disturbances.

Henderson believes that sandbags for tropical events have limited success; the sheer volume of sandbags and the person-power necessary to construct a proper barrier are unrealistic. Additionally, Henderson stated that if the storm surge was higher than the sandbag barrier, water would be trapped in between the house and the sandbags, causing additional hazards and damage. Henderson believes sandbags have greater success in the northern states where the

natural topography is pitched which allows for use of sandbags for diversion of water to the path of least resistance, away from structures. In South Florida, the topography is flat and near sea level which provides limited diversion capabilities.

Henderson feels that sandbags are a “feel-good measure that rarely provides the desired effects.” Instead, a good family plan is essential. He suggests having portable waterproof boxes for important documents and backing them up on a cloud storage server or flash drive. He also suggests that coastal construction should increase design standards on homes to increase their resilience to tropical events by taking actions such as evaluating the foundation and elevating air conditioning units. Henderson concluded that predicting mother nature is extremely difficult and that is it better to be safe than sorry (A. Henderson, personal communication, January 2020).

Boulding stated that during Hurricane Irma, the City of St. Petersburg gave out over 120,000 sandbags in what she describes as a public appeasement effort. This was done under a self-fill sandbags system that was extremely time-consuming for which the City received negative public feedback as the operation was poorly coordinated. An after-action report was performed, and the City now has a comprehensive plan that includes several city departments. The plan uses pre-determined fill sites and commercial sandbag filling machines such as the one pictured in Figure 9. The new plan provides for increased efficiency, lower personnel costs, and decreased stress on employees and the public.

Figure 9. Commercial sandbag filling machine. Retrieved from https://www.equipmentworld.com/video-genius-loader-attachment-can-fill-thousands-of-sand-bags-a-day/

According to Boulding, they utilized the new plan during Hurricane Dorian where they were able to disseminate 16,000 sandbags to City residents in two days. The new plan has essentially made the sandbags distribution station a drive-thru service. The City has enjoyed positive feedback with the implementation of the new sandbag distribution plan (Figure 10). Boulding believes that the increase in positive public perception leads to increased public trust. She further states that when the public trusts their government they are more likely to listen when orders are given, such as to evacuate, because the residents trust the information the City is providing.

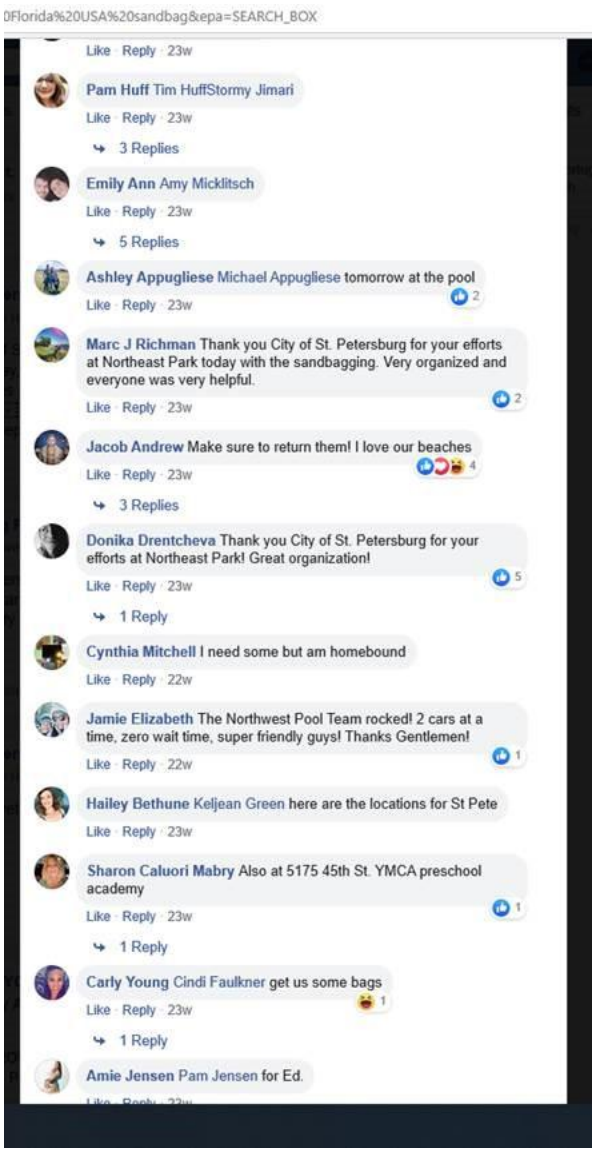


Figure 10. Comments from City of Saint Petersburg Facebook comments. Retrieved from A. Boulding during personal communications.

Boulding states that sandbags work best in slow rising waters of commonly flooded areas, particularly against the sloshing of water as vehicles pass through the area. She believes that sandbags provide limited success in rapidly rising water situations such as those attributed to tropical disturbances and recommends that in situations where storm surge is expected the best

course of action is to gather essential belongings and evacuate (A. Boulding, personal communications, February 2020).

In Flagler County, Lord operates a formal sandbag distribution program. While he feels sandbag success is limited, he believes that after Hurricane Dorian sandbagging may have helped some inland areas of the County. It is his professional opinion that sandbags are more beneficial to rising river waters and are not a sound investment in a tropical disturbance situation. However, during stressful tropical disturbances they meet the publics' expectations of their government, and the public wants something to make them feel at ease, even if that something is just a few sandbags.

To augment the increased staffing demand of a sandbag operation, Lord has an agreement with the county jail that allows him to utilize inmate labor. The inmates fill sandbags and place them in citizen's vehicles. The County keeps several palates of sandbags on hand and orders additional as storm preparations ramp up.

Lord attributes some of the success of his program to public education and information. A flyer with sandbag information is located on the County's website (Appendix B), and a disaster preparedness guidebook with valuable pre- and post-disaster information is provided to county residents. Lord states that all the municipalities in his county work under the same system, which provides a united message to the public. Overall, he feels the County's sandbag program is a political investment as it receives positive feedback from the public who largely support the organization (J. Lord, personal communications, February 2020).

Zyvoloski has not experienced any negative community backlash as a result of not having a formal sandbag program. He attributes this to having a unified position with all of the fire districts and municipalities within Collier County. Sandbags may be useful in sheet flow events

to divert water from the openings of homes as sheet flow waters are shallow and have no wake effect, but in areas where vehicles travel through flood water, their wake can cause water to spill over the top of sandbags barriers or even topple poorly constructed sandbag barriers. “Sheet flow is a natural flow of water south through the Florida peninsula and may cause flooding along rivers, creeks, and canals” (Lee County, All Hazards Guide, 2019, p. 8). Sheet flow dangers may be amplified during the rainy season. During tropical disturbances, though, he believes that sandbags have limited success and that they provide “symbolism over substance.”

Zyvoloski feels the most impactful thing residents can do is self-preparation. They should evaluate where they live and take necessary measures to prevent flooding. It is essential for the structure of new construction homes to be elevated as much as possible. If a homeowner feels they simply must use sandbags, he recommends they use large bags of topsoil from a local hardware store as it can be repurposed post-storm and requires no cost or manpower commitments from his staff. Lastly, Zyvoloski states that in cases of expected storm surge, residents need to evacuate to safe areas as storm surge is extremely dangerous. (R. Zyvoloski, personal communications, February 2020).

The principal objective of this ARP was to determine if the CCFD should develop a community sandbag distribution program and answer four specific research questions. The first research question was *What current hazard mitigation strategies does the CCFD provide the community in preparation for tropical disturbances?* Current hazard mitigation strategies for the CCFD are isolated to improving existing infrastructure and public education. CCFD emergency management, along with the City’s public works department, compiles a list of projects that could improve the City's resiliency during tropical disturbances. These projects could include the

hardening of structures, emergency generators, and weir enhancements. The CCFD applies for hazard mitigation grant funding for these projects on an annual basis.

CCFD public education information is disseminated in three primary ways. The Department holds an annual hurricane kick-off seminar where a variety of speakers give residents upcoming hurricane season preparation information. This seminar lasts about two hours and is attended by less than 200 residents annually. Secondly, the CCFD, in conjunction with Lee County, provides an annual all-hazards guide to residents. The all-hazards guide has no mention of sandbags and has limited information on storm surge and flooding. Lastly, the CCFD's primary means of delivering information to residents is via social media

The second research question was *What current hazard mitigation strategies are other coastal communities providing to the community during tropical disturbances?* The results of this analysis were widespread. Communities implemented strategies that were most effective for their specific needs. However, the two most prevalent hazard mitigation strategies were education and temporary residential flood-barriers. Education was rated the most effective hazard mitigation strategy by 57% of the respondents. The deployment of temporary flood barriers such as sandbags, flood gates or flood skirts was next with 43% of survey participants utilizing these actions.

The third research question was *Why have the coastal communities who distribute sandbags as part of hazard mitigation chosen to do so*? Throughout the survey instrument and personal communications, the resounding reason was "sandbags are great public relations." No survey respondent or interview participant could demonstrate tangible success for sandbag programs other than good public relations. Additionally, 91% of respondents report not assisting residents with post-storm sandbags removal or disposal.

The final research question was *Is a community sandbag distribution program a viable hazard mitigation strategy during tropical disturbances for the CCFD*? Based on the research findings, a full sandbag distribution program is not a viable hazard mitigation strategy during tropical disturbances for the CCFD. No substantial information was discovered to warrant a program. The agencies who have chosen to have a program do so for good public relations. The amount of water that surrounds and integrates Cape Coral is immense. "Due to low elevation and proximity to beaches and other tidal waters, storm surge can travel far inland in Lee County" (Lee County All Hazards Guide, 2019, p.8). The volume of sand and sandbags necessary to protect even a fraction of homes and business in Cape Coral is enormous and unrealistic in terms of material supplies and people-power requirements.

Discussion

A consistent theme was the need for the CCFD and other agencies responsible for emergency management to address the problem in three basic ways: education, self-reliance, and evacuation. Education provides the residents with the most current information allowing them to make good decisions and was the primary theme of the survey instrument. Evan Thompson, Director of the Meteorological Service of Jamaica, suggests that the recent tropical disturbance activity is a reminder of the importance of public education (Davis, 2017). Education should not only be focused on "in the moment" disaster information but rather should be a constant, year-round effort.

Self-reliance allows residents to create a disaster plan to fit their specific needs including keeping property in good order, having 72 hours' worth of food and water, and having an evacuation plan. The Department of Homeland Security recommends making a plan that includes knowing your risks and knowing evacuation routes (DHS, 2020). Zyvoloski suggests residents

should evaluate where they are living. If their surroundings make them prone to increased dangers due to disasters then they should take the necessary steps to improve their situation (R. Zyvoloski, personal communications, February 2020).

It is imperative that agencies responsible for emergency management communicate the dangers of storm surge to the public and provide ample notification to residents when evacuation is necessary. Evacuation from South Florida in particular can take extended amounts of time. Ghose (2017) suggests evacuations should commence 60 hours prior to the effects of tropical disturbances arriving in the area. Each interviewee expressed that in situations where storm surge is likely, it is indispensably important for the public to evacuate to safer areas. As an agency responsible for emergency management, a goal of the CCFD should be more than just good public relations. The Department should provide expert information to residents so they can make the best decisions and protect themselves. Schmidlin (2006) determined that one of the three most important factors determining if residents will evacuate is if they believe their government.

Disaster preparedness should be a year-round priority as natural disasters can occur at any time. Research conducted by Grant (2018) suggests that proper disaster preparedness reduces anxiety during and after the event. If the CCFD can teach residents who are able to take care of themselves, the Department can focus its efforts on those that cannot.

The researcher was unable to find any definitive data that shows effective use of sandbags during tropical disturbances. Most of the scientific research point to the use of sandbagging practices in flood prone areas cause by slow rising water. Sandbags were not found to be effective in tropical disturbances that bring heavy rains and storm surge. None of the

subject matter experts interviewed by the researcher indicated effective sandbagging practices, rather successful public appeasement practices were cited.

Recommendations

The key objective of this ARP was to determine if a sandbag program was right for the CCFD. Recommendation #1 is for the CCFD to enhance the public education that it provides on preparedness and response. This information can be provided on the Department's website for residents to access and prepare themselves year-round. This year-round information should garner public trust in that the public will see the constant attention the CCFD is paying to public safety. Information should focus on knowing flood and evacuation zones, having ample supplies, having an overall plan, and evacuation information. Additional information should include how the public can improve their surroundings such as keeping their property clear of debris, clearing storm drains, and other hazard mitigation measures to reduce risk. Public education will also provide clear information on the importance of evacuating when directed and include routes, expected time frames, and what to evacuate with and without.

Information that no sandbags will be provided for a tropical event should be upfront and readily available. Education as to why sandbags will not be provided, and alternative measures is necessary. Alternatives to government-provided sandbags, if the resident insists on this style of hazard mitigation, would include acquiring their own supply of sandbags, using topsoil bags, or commercial flood prevention devices. The CCFD should include more comprehensive sandbag and storm surge information in the annual hurricane kick-off meeting and the all-hazards guide for residents.

Recommendation #2 is to have a united front on sandbags. All three of the interviewees stated they had great success with and without providing sandbags. This is because all the

municipalities are united in the message and the decision. During Hurricane Irma, Lee County was not united. Municipalities and fire districts were giving different messages; some chose to provide sandbags at the last minute due to public pressure while others held strong on the initial decision to not provide sandbags. This conflicting information created confusion, anger, and a lack of trust in the government.

Both recommendations will take considerable coordination with Lee County Emergency Management as they are the parent organization to Cape Coral Emergency Management. They will have to agree upon the additions to the all-hazards guide and dictate a unified front within the County. However, public safety and success are a shared goal, therefore coordination should not be a difficult task.

References

5news web staff (2019). Central Arkansas Family Uses 10K Sandbags To Protect Home From Flood Watershttps://5newsonline.com/2019/06/04/central-arkansas-family-uses-10k-sandbags-to-protect-home-from-flood-waters/

Braun, M. Henson, S. (2017). Fort Myers, Cape Coral, south Lee County area hit by relentless rains, flooding. https://www.news-press.com/story/news/2017/08/27/fort-myers-cape-coral-south-lee-county-area-hit-relentless-rains-flooding/606528001/

Cape Coral Historical Museum. (2018) History. Retrieved from http://www.capecoralhistoricalmuseum.org

Davis, G. (2018). Public Education Important for Hurricane Season – Thompson. https://jis.gov.jm/public-education-important-for-hurricane-season-thompson/

Department of Homeland Security. (2019). https://www.ready.gov/plan

Federal Emergency Management Agency. (2018). National Household Survey Results. https://community.fema.gov/AP_2018_National_Household_Survey

Garrett, C. (2017). Impact of climate change on New York City's coastal flood hazard: Increasing flood heights from the preindustrial to 2300 CE. https://www.pnas.org/content/114/45/11861?ijkey=1582cba2de498d3c97c70f9312e3abc9639ae828&keytype2=tf_ipsecsha

Ghose. T. (2017). Hurricane Irma: How Do You Safely Evacuate 5.6 Million People? https://www.livescience.com/60365-how-to-safely-evacuate-for-a-hurricane.html

Grant, C. (2018). Disaster Preparedness to Reduce Anxiety and Post-Disaster Stress. https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/14267

Heil, J. (2020). 5 Most and Least Hurricane-Prone Areas in Florida. https://universalproperty.com/most-and-least-hurricane-prone-areas-in-florida

Krieger, J. (2018). Hurricane Risk Index. https://www.arcgis.com/apps/Cascade/index.html?appid=8f6013fdba6445e9a8732ff6cab9cd1a

Lee County Emergency Management. (2017) Joint Unified Local Mitigation Strategy. http://www.leegov.com/publicsafety/Documents/Emergency%20Management/FINAL_LeeCounty_LMS2017.pdf

Padgham, L, et al. (2014). Planning for sandbagging as a response to flooding: a tool and case study. https://ajem.infoservices.com.au/items/AJEM-29-04-06

Masters, J. (2017). Cat 4 Irma Makes Landfall in the Keys; SW Florida Next. https://www.wunderground.com/cat6/cat-4-irma-makes-landfall-keys-sw-florida-next

National Fire Academy. (2016). Executive fire service operations in emergency management (R0306) (7th ed.) Emmitsburg, MD: United States Fire Administration

National Hurricane Center and Central Pacific Hurricane Center. (2020). Storm Surge Overview. https://www.nhc.noaa.gov/surge/

Navarro, A. (2019). In-depth analysis of US hurricanes: Which states are hit most frequently by devastating storms? https://www.accuweather.com/en/weather-news/in-depth-analysis-of-us-hurricanes-which-states-are-hit-most-frequently-by-devastating-storms/347725

Organisation for Economic Co-operation and Development. (2016). Financial Management of Flood Risk https://www.oecd.org/daf/fin/insurance/OECD-Financial-Management-of-Flood-Risk.pdf

Poussin, J. Botzen, W. Aerts, J. (2015). Effectiveness of flood damage mitigation measures: Empirical evidence from French flood disasters. https://www.sciencedirect.com/science/article/abs/pii/S0959378014002167?via%3Dihub

Rahmstorf, S. (2017). Rising hazard of storm-surge flooding. https://www.pnas.org/content/114/45/11806

Schmidlin, T. (2006). ON EVACUATION AND DEATHS FROM HURRICANE KATRINA. https://www.jstor.org/stable/26217179?seq=1

Seminole County, Florida, Government. (n.d.) Important Sandbag Information. http://www.seminolecountyfl.gov/core/fileparse.php/4529/urlt/Sandbag-Info-Sheet.pdf

United States Army Corps of Engineers. (2018). Flood Fighting: How To Use Sandbags. https://www.nww.usace.army.mil/Portals/28/docs/Missions/Flood%20Assistance/20181219_NWW_How-to-use-sandbags.pdf

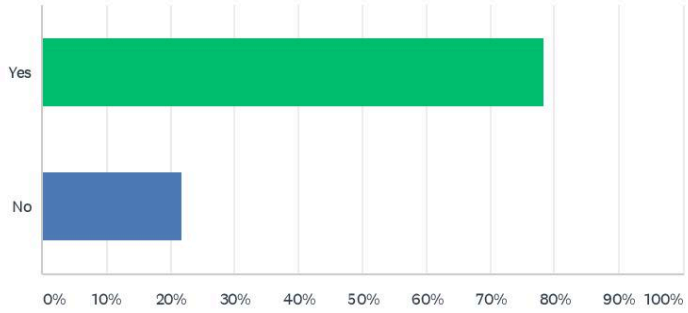
United States Fire Administration. (2019). Strategic plan fiscal years 2019–2023. Retrieved from https://www.usfa.fema.gov/downloads/pdf/publications/strategic_plan_2019-2023.pdf

Appendix A – Survey Results

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q1 Does your agency provide hazard mitigation, specifically geared towards storm surge and flooding, to the residents of your community during tropical disturbances (i.e. tropical storm, hurricanes)?

Answered: 23 Skipped: 0

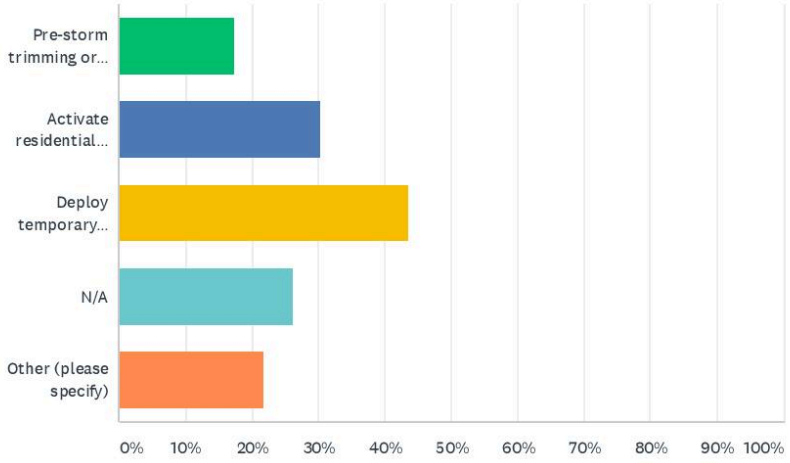


ANSWER CHOICES	RESPONSES	
Yes	78.26%	18
No	21.74%	5
TOTAL		23

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q2 Of the following hazard mitigation actions, which do you provide: (select all that apply)

Answered: 23 Skipped: 0

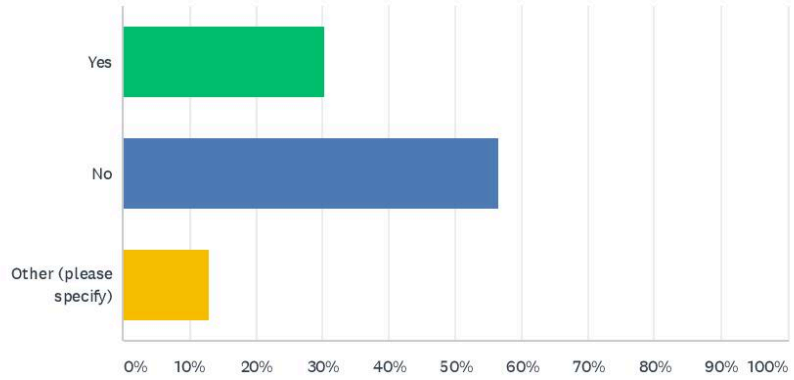


ANSWER CHOICES	RESPONSES	
Pre-storm trimming or removal of damaged trees and limbs (residential)	17.39%	4
Activate residential flood protection devices, i.e., turn on sump pumps and close back-flow valves	30.43%	7
Deploy temporary residential flood barriers, such as portable flood gates or shields, sandbags, inflatable flood-walls, and flood skirts	43.48%	10
N/A	26.09%	6
Other (please specify)	21.74%	5
Total Respondents: 23		

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q3 Does your agency have a formal residential sandbag distribution program?

Answered: 23 Skipped: 0

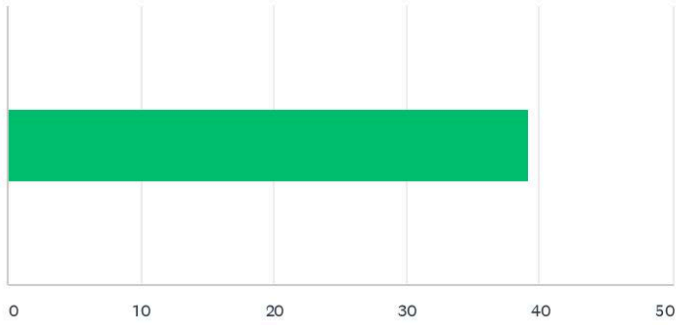


ANSWER CHOICES	RESPONSES	
Yes	30.43%	7
No	56.52%	13
Other (please specify)	13.04%	3
TOTAL		23

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q4 If your agency provides a residential sandbag distribution program do you feel it is effective?

Answered: 23 Skipped: 0

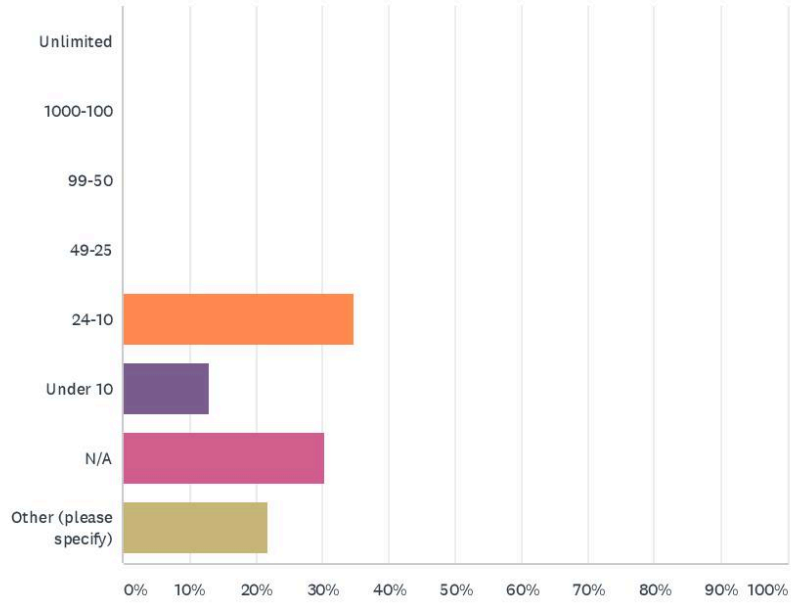


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	39	900	23
Total Respondents: 23			

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q5 If your agency provides a residential sandbag distribution program how many sandbags are provided per homeowner?

Answered: 23 Skipped: 0

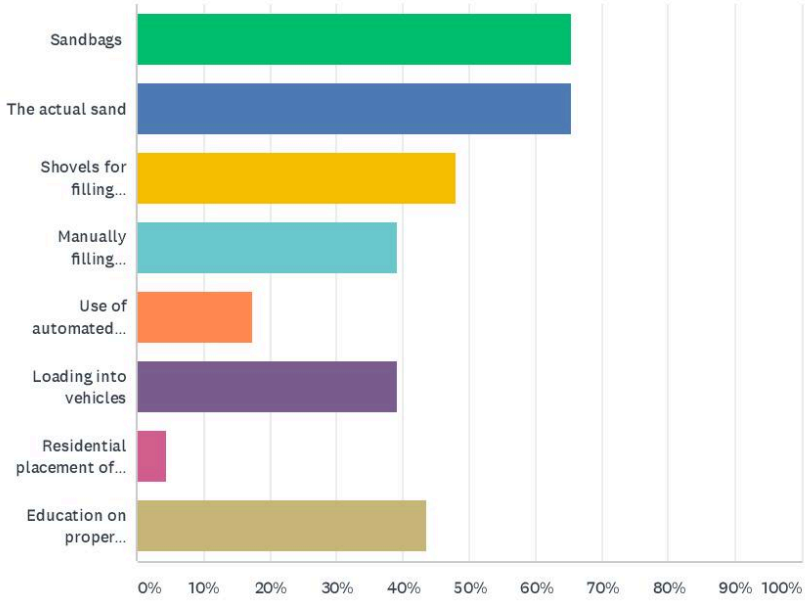


ANSWER CHOICES	RESPONSES	
Unlimited	0.00%	0
1000-100	0.00%	0
99-50	0.00%	0
49-25	0.00%	0
24-10	34.78%	8
Under 10	13.04%	3
N/A	30.43%	7
Other (please specify)	21.74%	5
TOTAL		23

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q6 Does your agency assist with or provide homeowners with any of the following? (Select all that apply)

Answered: 23 Skipped: 0

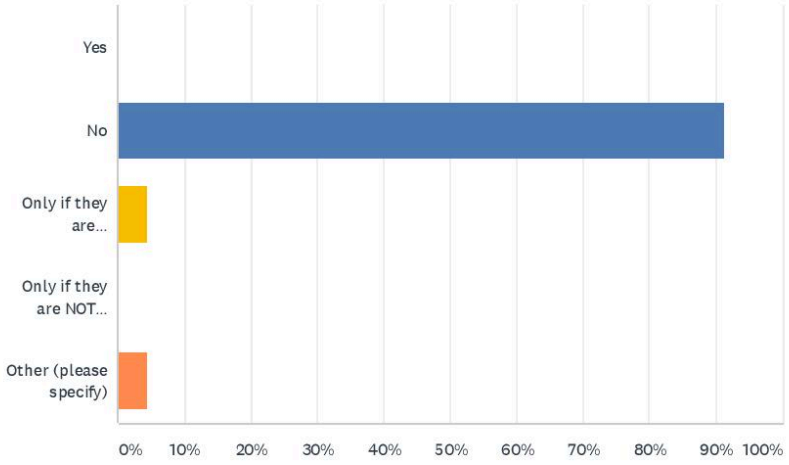


ANSWER CHOICES	RESPONSES	
Sandbags	65.22%	15
The actual sand	65.22%	15
Shovels for filling sandbags	47.83%	11
Manually filling sandbags	39.13%	9
Use of automated sandbag filling devices	17.39%	4
Loading into vehicles	39.13%	9
Residential placement of sandbags	4.35%	1
Education on proper placement of sandbags	43.48%	10
Total Respondents: 23		

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q7 Does your agency provide for the removal of sandbags, post incident?

Answered: 23 Skipped: 0

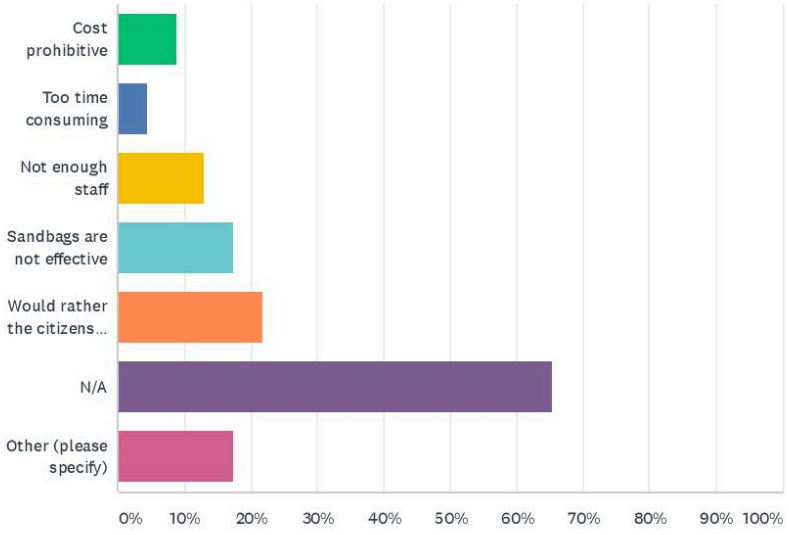


ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	91.30%	21
Only if they are contaminated	4.35%	1
Only if they are NOT contaminated	0.00%	0
Other (please specify)	4.35%	1
TOTAL		23

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q8 If your agency does not provide a residential sandbag distribution program, why not? (select all that apply)

Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Cost prohibitive	8.70%	2
Too time consuming	4.35%	1
Not enough staff	13.04%	3
Sandbags are not effective	17.39%	4
Would rather the citizens focus on other methods of preparedness and evacuation.	21.74%	5
N/A	65.22%	15
Other (please specify)	17.39%	4
Total Respondents: 23		

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q9 In your opinion, which hazard mitigation action your agency provides is the most effective?

Answered: 19 Skipped: 4

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q10 Is there a hazard mitigation action you wish your agency provided?

Answered: 19 Skipped: 4

Determining if a Community Sandbag Distribution Program is a Feasible Option for The Cape Coral Fire Department.

Q11 If you are willing to discuss your agency methods, please provide your contact information.

Answered: 15 Skipped: 8

ANSWER CHOICES	RESPONSES	
Name	100.00%	15
Agency	100.00%	15
Title	93.33%	14
Address 2	0.00%	0
City/Town	0.00%	0
State/Province	0.00%	0
ZIP/Postal Code	0.00%	0
Country	0.00%	0
Email Address	93.33%	14
Phone Number	93.33%	14

Appendix B – Flager County Sandbag Information Flyer

Sandbags

Sandbags are a simple, and sometimes effective solution to protect your home or business from minor flooding, by diverting water flow away from your property.

- The bags, typically burlap or polypropylene, are designed to be filled with sand, to protect openings in your home from water intrusion.
  Surrounding your home with sandbags is not recommended, as it could trap water within the protected area, doing more harm than good; the focus should be on diverting water.
- If your property has a history of flooding, you are encouraged to purchase and maintain a year round supply of sandbags, to adequately protect your home.
- Sandbags can be found through most hardware stores and a variety of online retailers.

Use

- **Filling:**
  The filling process should involve at least two people
  Sandbags should be filled approximately ½ full; leaving enough room to tie the bag, or fold over the top. You should expect the bags to weigh up to 40 pounds once filled
- **Stacking:**
  A water proof barrier, such as a tarp should be placed under and behind the stacked bags.
  Bags should be stacked no more than 3 layers high; unless placed in a pyramid (width 3x the height) or up against a structure.

Disposal

- It is recommended that clean bags always be kept for a future flood event.
- It is your responsibility to properly dispose of unwanted sand bags

DO NOT PUT FILLED SANDBAGS IN YOUR GARBAGE OR AT THE CURB FOR DISPOSAL.

- **Uncontaminated bags**
  If sandbags are clean, but breaking down, you may empty the sand into your yard and dispose of the empty bag in your regular trash.
- **Contaminated bags**
  If your bags show signs of contamination (oil, chemicals, sewage, etc.), please contact the appropriate household hazardous waste provider and inquire as to the appropriate procedures to dispose of contaminated sand.

Palm Coast:	386-986-2360
Remainder of Flagler County:	386-313-4020