Risk Assessment and Mitigation in Cantera

WPI

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Abstract

This proposal, prepared for La Compañía para el Desarrollo Integral de la Península de Cantera (CDIPC), provided a risk assessment, guidelines for the mitigation of damages, and guidelines for the optimization of recovery for the community of Cantera. Through the use of literature research, interviews, Geographical Information Systems (GIS) mapping, and a survey we described the vulnerabilities that restrict this community. We delivered an informational resource packet containing guidelines to mitigate damages and optimize recovery. We also provided the CDIPC with a community presentation and script for them to present to the residents highlighting this information, as well as an analysis of survey data on the lack of flood insurance in the region.

Executive Summary

Background

Puerto Rico is a small tropical island in the northeastern region of the Caribbean Sea, and as such, it is remarkably vulnerable to natural disasters, most notably hurricanes, flooding, earthquakes, and tsunamis (Small & Nicholls, 2003, p. 2). In the island, larger disasters have the potential for catastrophic destruction; damages from hurricanes, flooding, and earthquakes combine to account for over 4.5 billion dollars of damages annually ("Puerto Rico Disaster & Risk Profile", 2014). The capital city of San Juan has been pushing to minimize future impact of disasters through a variety of agencies, and has made significant progress in their campaign. However, some smaller communities that are vulnerable to disasters lack funding due to the economic stressors currently affecting the island government. For the underdeveloped community of Cantera, natural disasters have the potential to be particularly catastrophic due to the region's geography, socioeconomic status, and inadequate disaster preparedness.

In order to address this issue, San Juan joined the 100 Resilient Cities initiative, which is an organization that promotes high-level, integrated urban planning to increase disaster resilience of coastal cities. This initiative highlights both the importance of a city's ability to survive, adapt, and grow in the face of natural disasters (Berkowitz, 2016). Over the three years since its acceptance into the program, San Juan's resilience program has created five community adaptation plans for five communities across the municipality.

For this project, we worked alongside La Compañía para el Desarrollo Integral de la Península de Cantera (CDIPC), a government organization that strives to improve the living conditions of the residents through community development. Since its inception in 1992, the CDIPC has accomplished many community-wide projects in Cantera, such as installing a new sewer system, and also creating better living conditions by relocating residents in the barriadas of Cantera into government subsidized housing. The barriadas are characterized by homes built on collections of waste along the shores of the local channel and do not adhere to construction codes nor have access to basic services and utilities. The CDIPC is now concerned with ways that residents in the barriadas can protect themselves and mitigate damages from natural disasters. This task revolves around the goal of improving the safety for the community members in the Cantera Peninsula.

Methodology

The overall goal of this project was to perform a risk assessment in the Cantera Peninsula and provide guidelines for mitigation of damages and the optimization of recovery for the community. This goal was fulfilled through the following objectives:

1) Interviews – Conduct interviews and meet with local, city, and national agencies to discuss region-specific issues
2) Assessment - Assess the disaster vulnerability of the Cantera community through a community walkthrough, mapping, and a survey of the residents

3) Development of Materials - Compile information on building techniques, flood insurance, and disaster preparedness and refine research findings into comprehensive guidelines tailored to the needs of the Cantera community
4) Distribution of Deliverables - Present findings and guidelines to the community and provide the CDIPC with resources to present, distribute and edit as they see fit

To provide context for the issues within the community, we conducted interviews in order to understand how we can help the Cantera community. These meetings gave our team a jump-start in terms of background and familiarity with the issues. The interviews we conducted included the CDIPC and its social workers, the *Consejo Vecinal*, the Municipality of San Juan, and a National Flood Insurance Program (NFIP) expert.

We were able to perform an assessment of disaster vulnerabilities in the Cantera Peninsula through the use of a community walkthrough, ArcGIS mapping, and a survey of the residents to explore their experiences with flooding and their knowledge of flood insurance. The walkthrough gave us a first hand experience of the quality of the infrastructure of the community. The ArcGIS software allowed us to present area hazards in geographic context and create informative maps that show community-specific vulnerability. Finally, the survey of residents allowed us to understand and quantify resident perception and awareness of flooding and flood insurance.

The team then compiled information on building techniques, flood insurance, and disaster preparedness and then refined those findings into a comprehensive resource packet tailored to the

needs of the Cantera community. These findings included guidelines to improve the structural integrity of a household, flood insurance information, and basic disaster preparedness guidelines for the community.

The team then distributed the deliverables of a community presentation and script as well as an informational resource packet to the CDIPC to continue the education of residents using the team's research, assessments, and products. This objective ensured that our findings were delivered to the residents of the neighborhoods in order to improve collective safety in the event of a large disaster.

Results

From the interviews conducted with the multiple agencies, we were able to identify the specific issues that revolve around the Cantera community. In order to elaborate on the issues in the community, we used ArcGIS software to create informative map overlays highlighting the specific vulnerabilities that encompass the region. This was useful to allow for a visual representation of the hazards in the community, as it refers to natural disasters. The results show that a majority of the Cantera Peninsula is in a multi-hazard vulnerability zone. These hazards being liquefaction, the 100-year flood, storm surges, and tsunamis. We used this mapping assessment to provide context for our basic disaster preparedness guidelines in our informative resource packet.

The survey conducted allowed for the team to quantify residents perceptions on flood insurance. It focused on determining the community's understanding of their risk to flooding, their understanding of what flood insurance is and what it offers, and their willingness to get

flood insurance. In order to distribute the survey, we consulted with the Consejo Vecinal who assisted in the editing of the survey and gaining responses. We analyzed the data and used the knowledge we received from the survey to tailor our flood insurance information guidelines within our informative resource packet to better assist the community.

We developed a community presentation, complete with a script, to be given to the CDIPC to be presented at later dates educating the residents on building techniques to mitigate damages during natural disasters, flood insurance information, as well as basic disaster preparedness tips. We identified this as a useful deliverable because it will be stored within the CDIPC and used for years to come to continue to educate the community and improve safety and resilience.

In order to supply the residents of Cantera a more informative deliverable than just the community presentation, we also supplied a resource packet. This packet includes guidelines to improve the structural integrity of a household, flood insurance information guidelines, and basic disaster preparedness guidelines. The first set of guidelines focus around finding affordable options to retrofit a structure, in order to improve its structural integrity and brace for a natural disaster. Information in the flood insurance guidelines is geared towards the importance of having flood insurance, and also showing how to apply for flood insurance and file a claim post-event. The basic disaster preparedness guidelines provide the reader with tips on what to do before, during, and after specific natural disasters such as earthquakes, hurricanes, and flooding, in order to improve the safety of the resident and their family. Based off of our interviews with

agencies and assessments of the area, we believe that this information will be very useful in mitigating physical damages and optimizing recovery for the residents of Cantera.

Recommendations and Conclusions

In conclusion, we assisted the CDIPC in assessing the vulnerabilities of the area and providing the residents with informational material to better prepare themselves and mitigate damages in the event of a natural disaster. Through this informational material, we have provided the CDIPC with the resources to continue moving forward with improving the general safety of their residents and mitigating physical damages. One of our key recommendations to the CDIPC was to encourage residents to obtain flood insurance, and to work with the municipality of San Juan to attempt to establish a community based insurance program. We also recommend that the CDIPC assist the community in retrofitting their homes to prevent damages from natural disasters by supplying trustworthy contractors and materials for the residents to utilize. Another recommendation for our sponsors is to continue to distribute and deliver our findings to the community, as we believe it is useful information for the well-being of the community.

Authorship

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Chapter 1: Introduction

Over the past 20 years, more than 600,000 people have died from natural disasters; two-thirds of these deaths were due to storms and flooding (Chan, 2015). Government agencies across the world work tirelessly to improve disaster preparedness and response, but some agencies lack the proper resources to do so. The island of Puerto Rico lies in one of the most susceptible zones to natural disasters in the world, yet struggles to provide necessary services and proper mitigation planning during natural disasters. The most prominent natural disasters that occur in Puerto Rico are hurricanes, earthquakes and flooding; each of which requires thorough preparation by citizens and coordinated federal and local assistance in order to minimize damages (Small & Nicholls, 2003, p. 2). Low income areas, however, are disproportionately affected by natural disasters and need mitigation and response strategies tailored to their specific vulnerabilities. Due to the lack of proper mitigation and recovery measures, the community of Cantera, a peninsula in San Juan, is subject to increased risk in the event of a natural disaster, putting the safety of its residents in jeopardy. Ideally, the Cantera Peninsula would have a complete and effective risk mitigation strategy and a specific recovery effort. Despite the efforts of the local government, the Cantera Peninsula is ill-equipped to handle the frequent natural disasters in the Caribbean. This indicates a need for proper mitigation strategies and coordinated disaster response strengthened by close communication between the government and community leaders in order to provide necessary aid.

Since 1992 our sponsor, La Compañía para el Desarrollo Integral de la Península de Cantera, has worked in the area of Cantera to create a safer and more prosperous life for its residents. The efforts of the CDIPC are mostly focused towards community development and economic growth in local businesses. The company has developed housing projects, built a boardwalk and worked to enhance the area with the goal of stimulating business. (Rojas, 1995). Additionally, the company has also sponsored two projects in cooperation with Worcester Polytechnic Institute (WPI) teams over the past three years. In 2014, a WPI group worked with the CDIPC to analyze the feasibility of a waste management facility in Cantera. The WPI team in 2015 built upon this research to design a composting facility to be constructed in the peninsula. Both of these projects were geared towards sustainability, and have a day-to-day effect on the members of the community. More recently, the CDIPC has turned its focus towards risk factors in the peninsula (Perez Zapata: personal communication, September 16, 2016).

The Municipality of San Juan is actively trying to improve their resilience as it pertains to natural disasters. Smaller communities such as Cantera lack specific mitigation strategies for natural disasters, and suffer greater damages as a result. In order to properly minimize risk and mitigate damages, the infrastructure of the Cantera Peninsula must be analyzed. Along with evaluating infrastructure, it is important to methods research into the types of aid that could be received after a natural disaster occurs.

The overall goal of this project was to perform a risk assessment and provide guidelines for mitigation of damages and the optimization of recovery for the community of Cantera. To accomplish this goal, our group identified four main objectives. The first objective was to

conduct interviews and meet with local, city, and national agencies to discuss region-specific issues. The second objective was to assess the disaster vulnerability of the Cantera community through a community walkthrough, mapping, and a survey of the residents Building on the first two objectives, the third objective was to compile information on building techniques, flood insurance, and disaster preparedness and refine those research findings into comprehensive guidelines tailored to the needs of the Cantera community. The final objective was to develop a presentation and a resource packet with instructional guidelines to the community and provide the CDIPC with resources to present, distribute, and edit as they see fit. We believe that this research will allow us to develop specific mitigation and response strategies to assist the Cantera neighborhood and create a safer community altogether by lessening the impact of future natural disasters.

Chapter 2: Background and Literature Review

This chapter will explore the effect of natural disasters including hurricanes, flooding, and earthquakes in Puerto Rico as well as the strategies and importance of emergency operations planning in low income areas. Furthermore, the chapter will describe the general flood risk factors specific to the region and assess the spatial vulnerabilities on the Cantera Peninsula. This chapter also examines the community and history of the peninsula.

2.1 Natural Disasters

As an island nation located in the Caribbean sea, Puerto Rico is quite vulnerable to a variety of natural disasters (Small & Nicholls, 2003, p. 2). The three main types of natural disasters that are most prevalent in the Caribbean are hurricanes, floods and earthquakes. These disasters have led to severe economic losses in the countries affected; combined, hurricanes, floods and earthquakes account for over 4.5 billion dollars of damages annually in Puerto Rico ("Puerto Rico Disaster & Risk Profile", 2014).

2.1.1 Hurricanes

When looking at the effects of natural disasters, it is important to understand that hurricanes are directly fueled by increased energy in the climate system. This increased energy comes from the emission of greenhouses gases into the atmosphere, and can result in more intense wind speed and rainfall (Van Aalst, 2006, p.6). The greenhouse gas emitted also

contributes to the rising average temperature of the world, also known as global warming. The climate change caused by global warming has had a range of secondary effects on hydrological systems (Van Aalst, 2006, p.7). Between 1970 and 2005, surface temperature of the Earth has increased proportionally with the rising number of hurricanes reaching category 4 or 5 worldwide (Webster et. al, 2005, p. 1884).

In the history of Puerto Rico, there have been several-large scale hurricanes that have caused widespread damages across the island. In 1899, the San Ciriaco hurricane brought 23 inches of rain in a 24 hour period, leading to over 2,000 deaths and 35 million dollars in overall damages (Palm & Hodgson, 1993, p. 282). In 1928, one of the biggest hurricanes in Puerto Rico's history struck: the Okeechobee hurricane, winds peaking at over 160 mph, ripped roofs off hotels and other major buildings. As a result of proper planning, the death toll only reached 312, but towns hit by the eyewalls of the storm were left in ruins ("San Juan, Puerto Rico's", 2015). Damages were so extensive that United States President Calvin Coolidge turned to US citizens to send money to help with relief efforts. More recently, hurricane Hugo passed along the coast of Puerto Rico in 1989. With peak wind speeds of 125mph, Hugo caused moderate damages on the mainland of Puerto Rico but made direct landfall on Culebra, a small island off the coast of Puerto Rico, causing considerable damage (Palm & Hodgson, 1993, p. 280). About a decade later in 1998, hurricane Georges made landfall on Puerto Rico. Unlike Hugo, Georges passed directly over the entire island sustaining wind speeds peaking of 115 mph. Georges caused catastrophic damages all over the island and damaged over 72,000 homes, 28,000 of which were completely destroyed ("San Juan, Puerto Rico's", 2015). Based on insured property

damage estimates, Georges caused over $3 billion in damages across Puerto Rico. In addition, it crippled farms across the island, destroying 95% of plantain and banana crops as well as 75% of coffee crops, adversely affecting the local economy (Guiney, 1999, p. 7-8). Puerto Rico is affected by a tropical storm or hurricane every 3.5 years and is impacted by a large scale hurricane every 13 years (“San Juan, Puerto Rico's”, 2015).

2.1.2 Flooding

There are three different types of flooding: coastal, fluvial and pluvial. While different in location and origin, each type of flood has the potential to be life-threatening and extremely damaging to infrastructure.

Coastal flooding is caused by extreme tidal conditions near the shore. Hurricanes, tropical storms, and earthquake-induced tsunamis generally cause coastal flooding. The severity of these floods can vary from minor beach erosion to road and house destruction and serious threats to the lives of inhabitants. This type of flooding is especially dangerous due to the speed of the flooding; often, the water levels can rise from sea level to critical levels in only a few hours (Maddox, 2014).

Fluvial floods occur when prolonged periods of rainfall lead to rivers overflowing. They can also be caused when large amounts of snow melt or when ice blocks part of a river. Most damage caused by fluvial flooding is due to flash flooding, not the initial flood itself. The flash flooding is damaging to most infrastructure both because of its speed and the debris that it carries (Maddox, 2014).

Pluvial floods are floods that are caused simply by high rain volume, independent of any other water source. Pluvial flooding is most common in urban areas due to low absorption rates of rainfall in the surrounding terrain. Pluvial flooding is often overlooked as a potential danger due to the misconception that a large body of water nearby is required for a flood (Maddox, 2014). Pluvial flooding is most damaging when it occurs in places unprepared for floods. Cities without nearby water sources are often unprepared for flooding and have little to no precautions to prevent damages (Houston et al, 2011).

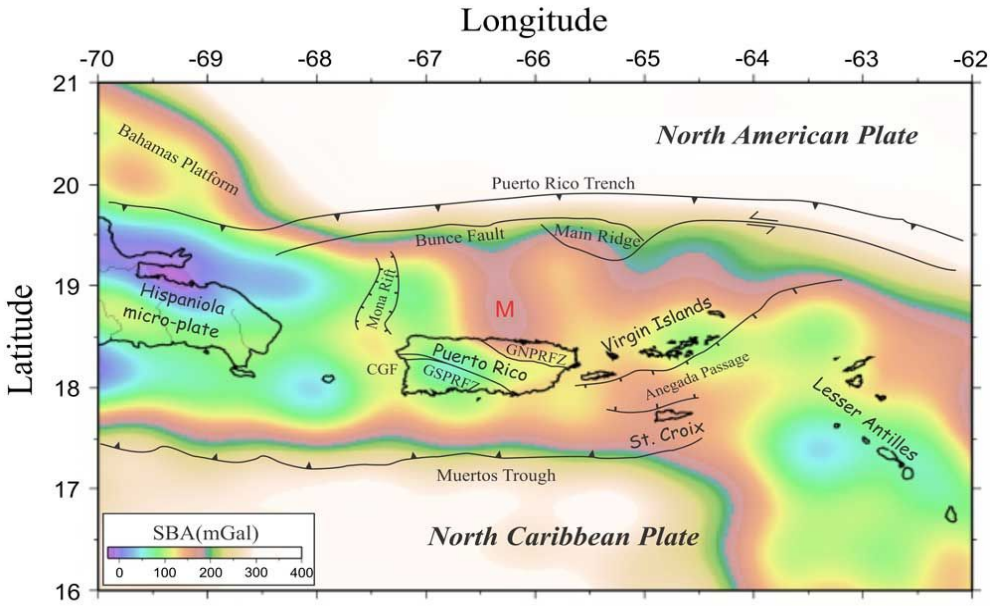
In Puerto Rico, the major flood risks are mostly coastal and fluvial. Since 2000, four of the ten most damaging natural disasters have been floods; three of which were fluvial flooding and one pluvial. These floods led to five deaths and over $140 million in damages ("Country Profile", 2016). It has been estimated that the three types of flooding lead to an average annual loss of $330 million in Puerto Rico. One of the largest floods in Puerto Rico was in January of 1992. The Puerto Rican government reported 167 injured, 17 requiring hospitalization and 23 dead; FEMA estimated $155 million in damages caused by the flood alone. Rivers near San Juan and more across the island flooded; Río Sabana and Río Fajardo overflowed their banks and exceeded previous water level peak records by almost half of a foot. Flooding was so severe that the gage house for the Río Fajardo was washed away and found 2 miles downstream (Torres-Sierra, 1996).

2.1.3 Earthquakes

There are three types of earthquakes: tectonic, volcanic, and induced. Tectonic earthquakes are the most common earthquakes and are caused by the displacement of tectonic plates. Volcanic earthquakes result directly from volcanic activity or large naturally-occurring cave-ins. These earthquakes are typically weaker because they occur closer to the surface, lowering the distance over which the tremors travel. The last type of earthquakes are called induced quakes, caused by human tampering that interferes with tectonic stability. Examples of human tampering include nuclear tests, drilling, mining, and other large construction projects ("Schweizerischer Erdbebendienst", 2014). While destructive earthquakes are the least common of the natural disasters in Puerto Rico, they can be a serious threat to the population ("Puerto Rico Disaster & Risk Profile", 2014).

Puerto Rico is located near the subduction zone of the North American and Caribbean tectonic plates (See Figure 1), an area that has been susceptible to earthquakes for thousands of years (Hays & Gori, 1984, p.13). In terms of tectonic influence, Puerto Rico is bordered by the Puerto Rican Trench to the north and by the Muertos Trough to the south. It is also influenced by the Mona Passage to the west and the Anegada Trough to the south east (McCann, 1984, p. 34-37).

Figure 1: Display of fault lines in the Caribbean



Note: Retrieved from Caribbean Tectonics

The concentration of submarine formations and trenches surrounding Puerto Rico leaves it and surrounding islands unusually susceptible to earthquakes. The first recorded earthquake in Puerto Rico occurred in the 1520's when an earthquake destroyed the home of Ponce de León (McCann, 1984, p. 41). Earthquakes in the 1700's led to extensive damages to the San Felipe Church, El Morro Fort and the San Cristóbal Fort (McCann, 1984, p.41-43).

However, the most destructive earthquakes in Puerto Rico are not directly the cause of damage. Seismically-induced tsunamis represent over 80% of all tsunamis that have occurred in the world, and are an exceptionally dangerous hazard to coastal and island communities (Gusiakov, 2011). In 1918, the Central Mona Passage was hit by an earthquake of magnitude 7.1 on the Richter scale that quickly produced a tsunami . The quake itself was felt on the island, but

the vast majority of damage was caused when the tsunami made landfall, killing more than 100 (Doser, Rodriguez, & Flores, 2005).

2.2 Risk Management Plans

Risk is defined as the probability of potential impacts affecting people, assets, or the environment (Mechler, 2005). Risk management plans seek to mitigate the risk of certain events through the use of precaution and emergency protocols. Risk management plans regarding natural disasters focus on vulnerability and hazards to the community or area in question.

Vulnerability is the ability for the residents of a particular area to prepare for and minimize damage from natural disasters (Vatsa, 2004). This encompasses physical, social, economic, and environmental factors. Physical factors include the structural integrity of buildings and other constructions. The population's resilience and ability to respond to the impacts of natural disasters fall under social factors. The financial ability of individuals and companies to recover and get back on track compose the economic factors. Environmental factors take into account water, land use and the biodiversity and stability of ecosystems (Mechler, 2005).

Hazard is the frequency and magnitude of disasters in the particular area (Vatsa, 2004). Hazards are broken down into two classes: slow-onset, consistently reoccurring disasters like droughts and famines, and sudden-onset which happen with little to no warning such as hurricanes, earthquakes and volcanic eruptions (Mechler, 2005).

2.2.1 Assessing Natural Disaster Risk Factors

Hurricane risk factors can be narrowed down to high winds and flooding. High winds can cause physical damages to people and property through the sheer force of the wind. High winds can also create airborne hazards like branches, rocks, and house debris among other things. Suburban and wooded areas typically suffer more damages because the amount of possible airborne projectiles is higher in these areas. In rural areas, the sheer force of the wind sometimes rips houses off of their foundations. The massive amounts of rainfall that come with hurricanes can cause flash flooding which damages private properties, housing. municipal infrastructures and the local ecosystem (Huang, Rosowsky, & Sparks, 2001, p. 239-240).

The most important earthquake risk factor is the proximity to earth fault lines. Additionally, damage to natural and manmade structures often results in crumbling infrastructure that is potentially harmful to residents of the area ("United States Geological Survey", 2016). These damages may be even more pronounced in urban areas where the presence of many buildings increases the risk of severe damages and casualties ("United States Geological Survey", 2016).

Many factors contribute to flood risk. One major flood risk factor is rainfall. Certain countries like the United States use a percentage system to categorize excessive rainfall, otherwise known as meteorological flooding. Another factor is the hydrological parameters of the specific location, which focuses on why rivers and larger bodies of water flood and how the excess fluid is shed. The third flood risk assessment factor has to do with socio-economic

standing. Developing areas typically have either unsatisfactory drainage systems or no drainage system at all, which increases the rate of standing water buildup. Additionally, urban areas are more susceptible to flooding because pavement does not absorb stormwater as well as soil (Ologunorisa & Abawua, 2005). Natural disasters may increase social divides; low income families typically have a harder time rebuilding than wealthy families who may have greater access to the resources needed to rebuild. This divide may further negatively impact the economic status of the most poor while also increasing the future risk of damages in poor communities in the event of another natural disaster (Vatsa, 2004). Therefore, it is critically important that socioeconomic factors are considered in natural disaster risk assessment: the combination of fragile infrastructure and the vicious cycle of rebuilding creates a population that need significant support in order to prevent disaster damage.

2.2.2 Risk Management Plans in the Caribbean

Several risk management programs for the Caribbean region have been created over the years. The Disaster Mitigation Facility for the Caribbean (DMFC) created guidelines and methods to minimize natural hazards in the Caribbean. They hosted workshops and training sessions on how to incorporate disaster risk management techniques into local development policies (Jones & Atwell, 2002). The Caribbean Disaster Emergency Management Agency (CDEMA) was created in 1991 with the main focus of coordinating emergency response and and relief efforts to 18 states in the caribbean. Their projects have encompassed everything from outside funding from Canada and European nations to creating a comprehensive disaster

management plans. The CDEMA is currently in the process of creating a comprehensive disaster management framework for the Caribbean area ("What is CDEMA?", 2016). The Caribbean Disaster Management Project (CADM) was a Japanese funded program that worked on flood risk mapping and educated regional workers on floodplain mapping and disaster management planning while also collecting disaster data from the Caribbean (Jones & Atwell, 2002). Unfortunately there is no readily available information about the products from these programs and projects.

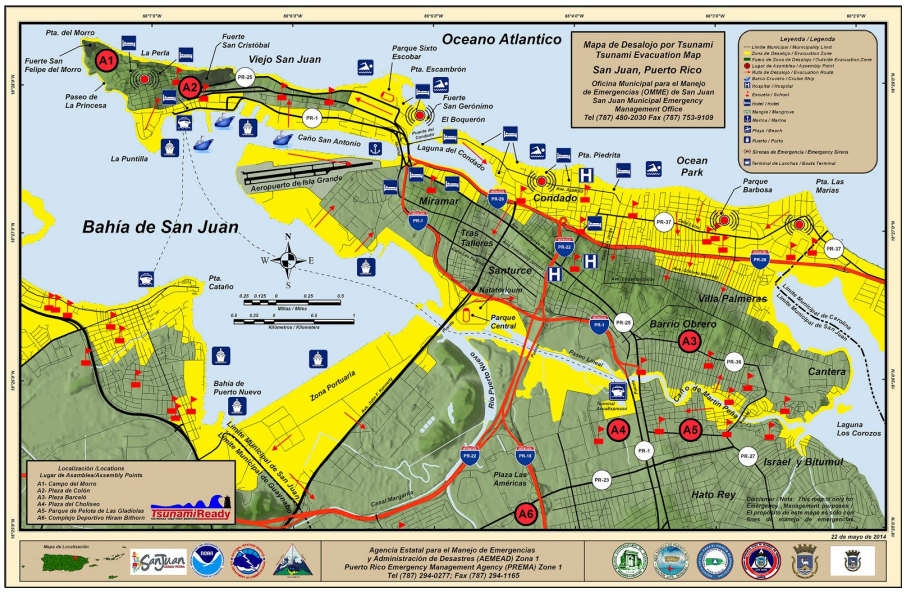
The Dominican Republic, with aid from the United Nations, created a national risk management plan in 2010. This plan encompasses a risk management policy, national risk management plan, and a risk management plan for earthquakes. In order to form these policies and plans, extensive risk assessment took place. The risk assessment took into account past natural disasters and hydro-meteorological data. It also weighed the hazards, vulnerabilities, and risks of the country as a whole (Jaime, 2013).

2.2.3 Disaster Readiness and Specific Vulnerabilities of San Juan

As of October 2016, San Juan follows the Puerto Rican government website, where basic tips are available for residents in the event of a hurricane or flood. These tips specific for San Juan include following orders of local officials, putting together a disaster preparedness kit, and active emergency awareness of debris and downed power lines ("Department of Homeland Security", 2016). The Municipality of San Juan has developed an evacuation map in case a tsunami were to occur, but the map is vague in its details of where to go and is labeled as a

"draft" subject to change (See Figure 2). In addition, the city has an assortment of tsunami evacuation route signs, but they are non-uniform and often ambiguous in direction ("Department of Homeland Security", 2016).

Figure 2: San Juan, Puerto Rico: Evacuation Map



Note: Retrieved from Evacuation Plan

Additionally, roadways in San Juan are particularly vulnerable to flooding, as a result of two main factors. The first is an accumulation of rain runoff due to the low rate of permeable ground in the city, but the second condition is a systematic output issue: the city of San Juan is discharging more than 2.2 billion gallons of untreated sewage into the local waterways ("Puerto Rico's Government", 2015). As a response to these issues, San Juan plans to implement a stormwater management plan to protect the communities against flooding and keep contaminants out of the surrounding bodies of water. This stormwater management plan will also take into account community involvement through education programs that focus on water quality issues,

proper wastewater disposal and stormwater regulations. Other programs have been proposed that would increase maintenance efforts of the new stormwater drains or create natural flood prevention strategies ("San Juan Stormwater Management", 2014). A revamped stormwater drain system will greatly impact all of San Juan and its communities as Puerto Rico attempts to lower the risk and duration of flooding in its urban areas.

2.2.4 San Juan Resilience Program

Over the past several decades, local and federal governments across the globe have devoted significant resources in the name of reducing vulnerability to natural disasters in coastal regions. However, the aftermath of the 2004 Indian Ocean Tsunami and Hurricane Katrina demonstrated that simple preventative measures were insufficient in the event of abnormally large disasters (Mayunga, 2007, 1). These two cases, combined with the ever-increasing frequency and intensity of natural disasters as a result of climate change have prompted a shift in thinking with regards to disaster management (López-Marrero & Tschakert, 2011, 1). Cities began to move beyond basic risk mitigation strategies and started to consider the new high-risk environment we live in today.

Resilience has to do with both a community's ability to recover from disaster and its ability to mitigate damages from disaster. In an ecological sense, resilience is defined as "...the measure of the ability of an ecosystem to absorb changes and still persist" (Holling, 1973). In many ways, this definition holds true for communities as well. A resilient community can shrug off disaster where a weaker community would have been damaged and set back. The National

Institute of Standards and Technology published a set of guidelines for resilient community planning and development; of all resilient communities, the ever-present characteristic is reflectivity (David, 2016). The power to systematically examine and learn from past events, successes, and mistakes is crucial in the resilience of communities.

Resilience is a fairly young concept in disaster management, and only very recently has it become popular in government and business. The foremost example is the 100 Resilient Cities program, one of the first initiatives designed to promote resilient thinking in major cities across the world. This agency was launched in 2013 and is sponsored by the Rockefeller Foundation; the overarching goal is to create a network of resilient cities, supported by resilient thinking in both the public and private sector ("100 Resilient Cities", 2016). Any city that applies to and qualifies for the program is provided with financial support for the hiring of a Chief Resilience Officer and is given access to a network of resources and contacts, all intended to aid in resilience planning and efforts (Berkowitz, 2016). In 2014, San Juan was inducted into the program and has been receiving funding over the past two years, with many successes in community outreach and planning ("100 Resilient Cities", 2016). The Municipality of San Juan has a strong interest in city resilience due to its multi-hazard vulnerability, large population, and vital infrastructure; strong, sustainable, and integrated mitigation strategies are necessary for the continued development of the city in the face of frequent natural disasters (Berkowitz, 2016).

2.2.5 FEMA Impact

The Federal Emergency Management Agency's (FEMA) mission is to "sustain and improve our capability to prepare for, protect against, respond to, recover from and mitigate all hazards" (About the Agency, 2016). Recently, FEMA has become much more involved in Puerto Rico. In 2010, the Hazard Mitigation Grants Program (HMGP) allowed FEMA to provide funds to reimburse local Puerto Rican government and organizations for their eligible projects to implement hazard mitigation measures ("Developing and Maintaining", 2010). Hazard mitigation measures that were proposed by the HMGP includes improving the drainage system in San Juan in order to appropriately carry water away ("Selecting Appropriate Mitigation", 2007 p.26).

The HMGP came on the heels of one of Puerto Rico's major disaster declarations due to one specific severe storm, now known as Incident 1919 within the FEMA system. Since Incident 1919 in May of 2010, FEMA has allocated almost $5 million in reimbursements, public assistance, and hazard mitigation grants to emergency management efforts (See Table 1). The importance of FEMA allocating funds after a natural disaster is important for the recovery of a community. The HMGP has helped FEMA improve the acts of responding to, recovering from, and mitigating all hazards in Puerto Rico; their assistance with Incident 1919 is one example of many in the history of natural disasters in Puerto Rico. Projects that can receive funding from the HMGP must provide a long term solution to the problem. For example, elevating your home to

reduce the risk of flood damaging, compared to just purchasing sandbags to fight the flood ("Hazard Mitigation Grant Program", 2016).

Table 1: Financial Assistance for Incident 1919 in Puerto Rico

	Total Public Assistance Grants	**Emergency Work**	**Permanent Work**
Total Amount	$4,798,561.96	$198,341.92	$4,387,442.04

Note: Retrieved from Puerto Rico Severe Storms and Flooding (DR-1919)

In the wake of this disastrous event, FEMA launched a campaign to raise awareness for natural disasters and offer resources to local agencies to mitigate future damages. FEMA encourages citizens to be fully prepared and alert in the event of a natural disaster. An example of FEMA's influence in Puerto Rico is the 2010 All Hazards Preparedness Campaign, enacted throughout stores across the island. The campaign reached over 13,500 people over the span of 3 months and advised residents on how to rebuild by implementing mitigation measures to prevent future damages ("Developing and Maintaining", 2010). By extending their support to Puerto Rico, FEMA has allowed both the Puerto Rican government and their citizens to properly prepare for natural disasters of all kinds through educational campaigns and "preparedness toolkits" ("Hurricane Preparedness Week", 2016).

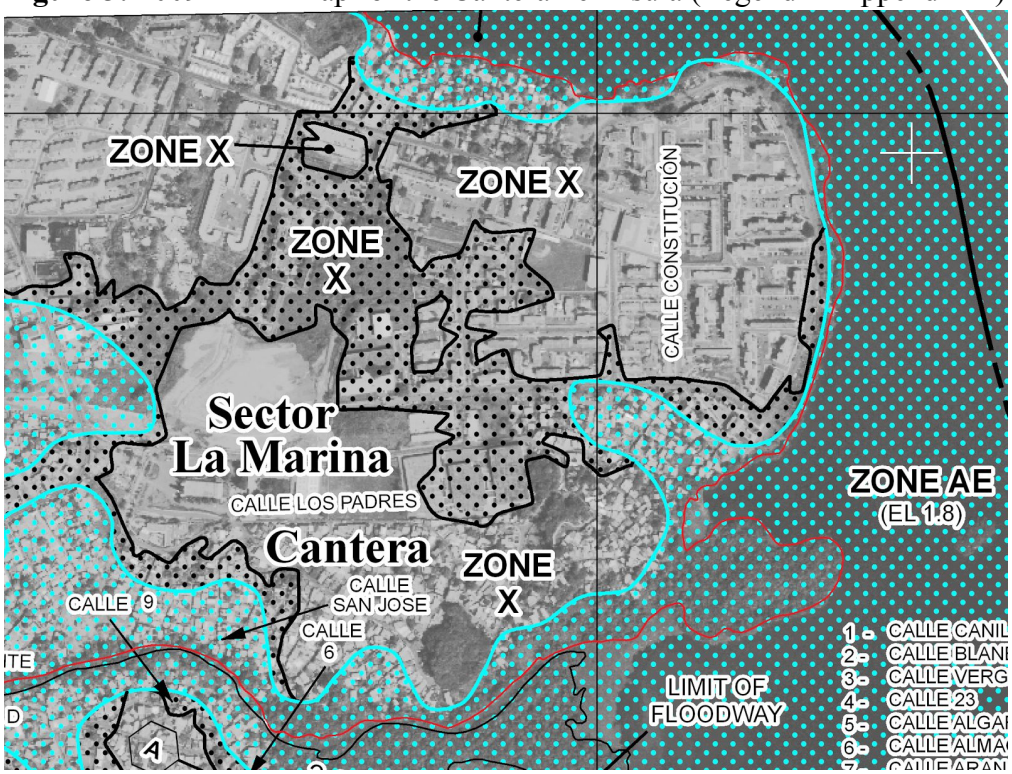
2.3 Flood Insurance

According to FEMA's flood risk management branch, flooding is the most common natural disaster in the United States ("Official NFIP Site", 2016). Between 2011 and 2014, the average residential claim after a flood was $43,000 ("Highlights of ASCE", 2015). Many people think that if they don't live near the beach or a lake they are safe from flooding. The truth is that everybody is at risk of flooding whether it comes in the form of heavy rain, melting snow, river floods or storm surges ("Official NFIP Site", 2013).

In order to determine the risk level for a particular area, FEMA produces Flood Insurance Rate Maps (FIRMs) which categorize areas on a map to different groups of flood risk. This map combines a number of factors including the Base Flood Elevation (BFE) and Special Flood Hazard Areas (SFHAs). The BFE is the water level that has a 1% chance of being reached during a flood in any given year. This is also referred to as the 100-year flood. The BFE is the governmental benchmark for minimum level to construct houses other structures. SFHAs are areas that that lie below the BFE for their area. There are several categories of SFHAs that allow the areas to be more accurately understood. For example, Zone AE is the area that lie below the 100-year flood line. Zone V are areas subjected to coastal flooding with velocity hazard (waves). Zone D is areas where the flood hazards haven't been determined but are possible. Zone X (shaded) is areas that lie somewhere between 1% and 0.2% chance of flooding annually. Finally, Zone X (unshaded) is areas determined to fall outside of the 500-year flood line (0.2% chance of flooding). The FIRMs combine all of the SFHAs and the BFE into one comprehensive map to

show risk levels ("Special Flood Hazard", 2009). These maps are one of the main factors considered when obtaining flood insurance. Figure 3 below shows the 2009 FIRM for the Cantera Peninsula in San Juan, Puerto Rico.

Figure 3: 2009 FIRM map for the Cantera Peninsula (Legend in Appendix A)



Note: Retrieved from The FEMA Flood Map Service Center

Due to the destruction caused by flooding, the US government created the National Flood Insurance Program (NFIP) in 1968 in order to help property owners protect their homes from flooding ("Official NFIP Site", 2016). The NFIP works to provide flood insurance, improve floodplain management and develop FIRMs. The NFIP provides insurance by having insurance agencies that follow the ideas and regulations of the NFIP. Homes outside of the 100-year floodplain (Zone X) are qualified for low-cost insurance since insuring their homes for floods is

only recommended by the US government. Homes inside the 100-year floodplain (Zone A, Zone V) with a mortgage that is federally regulated or insured are required to have flood insurance for their homes and the annual premiums can vary greatly. For example, the elevation of the lowest floor, not including the basement, is one of the biggest factors analyzed when estimating premiums. Other factors focus on the construction of the house taking into account building material, quality of foundation, etc. ("Official NFIP Site", 2016).

When applying for flood insurance, the agent will first determine what zone the home lies in. For homes in Zone X, low cost premium estimates are located online and vary based on how much coverage is desired and whether or not the house has a basement ("Official NFIP Site", 2016). For other zones, agents will require an Elevation Certificate (EC) to be filled out by a licensed contractor in order to determine the risk level. Key factors to be analyzed will be those mentioned before such as elevation, structural stability etc. Premiums for Zone A and Zone V houses scale up with decreasing elevation; however, there are a number of ways to improve homes to make them more ready for flooding and other natural disasters to lower the premiums ("NFIP FAQ", 2013).

2.4 Flood Resistant Infrastructure

In underdeveloped communities in Puerto Rico, they often do not have the structural integrity to withstand powerful natural disasters. Also, being underneath the Base Flood Elevation (BFE) severely increases the risk of damaging flooding in the area. In order to address this situation, there are many regulations that contractors and engineers consider when protecting

a building in an area that is prone to these types of natural disasters. According to the highlights of *Flood Resistant Design and Construction* published by the American Society of Civil Engineers (ASCE), it states that the contractor must meet or exceed the minimum requirements and expected performance for the design and construction of buildings and structures in flood hazard areas in order to adhere to the National Flood Insurance Program requirements ("Highlights of ASCE", 2015 p. 1). These minimum requirements include the elevation of the structure to be at least 2 feet above the BFE, all structural fill must be compacted appropriately and side slopes must be filled into no steeper than to a 1:1.5 ratio. Non-mandatory requirements include creating flood openings in at least two walls to allow for the automatic entry and exit of flowing water; and using breakaway walls which are designed to break free under high loads, but do not jeopardize the structural integrity of the elevated house ("Highlights of ASCE", 2015 p. 2). In Puerto Rico however, there are no specific requirements to be apart of the National Flood Insurance Program due to its general low income and susceptibility to natural disasters (Juan Moscoso: personal communication, November 10, 2016).

Flood damage resistant material is defined as any building product capable of withstanding contact with floodwaters and suffering no damage ("Flood Damage-Resistant", 2008 p. 2). These materials are integral in the protecting of a structure built in a floodplain zone. The use of these materials will lower the cost of flood insurance for your home, according to the NFIP. However, the NFIP will not cover for finished materials in the basement of homes, even if these materials are said to be flood resistant. The NFIP claims under the BFE are limited to utilities and equipment, such as water heaters and furnaces ("Flood Damage-Resistant", 2008 p.

3). The materials are split up into two groups: Structural materials, which include floor slabs, beams, and framing; and finish materials consisting of floor coverings, cabinets, doors, and windows. The specifics of the materials are broken into classes. These classes range from class 1 to class 5, where classes 4 and 5 are acceptable by the NFIP for below the BFE as floodwater-resistant material. Class 1, 2, and 3 materials are considered unacceptable for below-BFE applications. Some of these materials and why they are considered unacceptable are shown in the table below:

Table 2: Unacceptable Building Materials

For one or more of the following reasons:

■ Normal adhesives specified for above-grade use are water soluble or are not resistant to alkali or acid in water, including groundwater seepage and vapor.
■ The materials contain wood or paper products, or other materials that dissolve or deteriorate, lose structural integrity, or are adversely affected by water.
■ Sheet-type floor coverings (linoleum, rubber tile) or wall coverings (wallpaper) restrict drying of the materials they cover.
■ Materials are dimensionally unstable.
■ Materials absorb or retain excessive water after submergence.

Note: Retrieved from Flood Damage-Resistant Materials Requirements

These materials will be severely damaged in the event of flooding, therefore increasing the insurance premium for the house. In order to create a more flood resistant home, simple changes to finish materials can be altered to become acceptable by the NFIP. These alterations include removing carpeting and replacing it with concrete or ceramic tiles with mortar setting, and ensuring all paint finishes are latex or polyester-epoxy based, which are waterproof (“Flood

Damage-Resistant", 2008 p. 9). The importance of flood-resistant infrastructure in underdeveloped, urban communities is imperative in improving the sustainability of the structures.

2.5 Overview and History of Cantera

The Cantera Peninsula is a small region in the north-east part of San Juan, Puerto Rico; and is bordered on three sides by la Laguna San José and the Caño Martín Peña. Prior to the industrialization of San Juan, the peninsula was almost entirely covered by a dense and swampy mangrove forest, which prohibited settlement efforts for many years. Up until the 1930s, no claim had been laid to the land since it seemed unworkable and hazardous; nevertheless, a local business by the name of Rexach Co. purchased the rights to a significant plot of the marsh and began development. This fairly trivial venture would lay the metaphorical and literal foundation for a thriving community of workers in the decades to come, but would also cause trouble for the same inhabitants as they built their homes (Rojas, 1995, p. 6). In order to understand the unusual development of the Cantera Peninsula, it is essential to first study the industry that shaped it.

2.5.1 Industry and Development

San Juan has been the center of political activity in Puerto Rico for some time, but during the early 20th century as it began to industrialize, it became an increasingly attractive area for struggling farmers and other rural inhabitants. The influx of rural citizens into the city created a need for more housing, and as housing development began, it demanded even more workers. The

first half of the 20th century showed an explosive rise in population growth: from 25,000 to 170,000 inhabitants over the course of fifty years (Baralt, 1993). San Juan was just beginning a period of its most rapid urbanization in the midst of an industry that would firmly shape the development of each region in distinct ways (Lassus, 2001, p. 30).

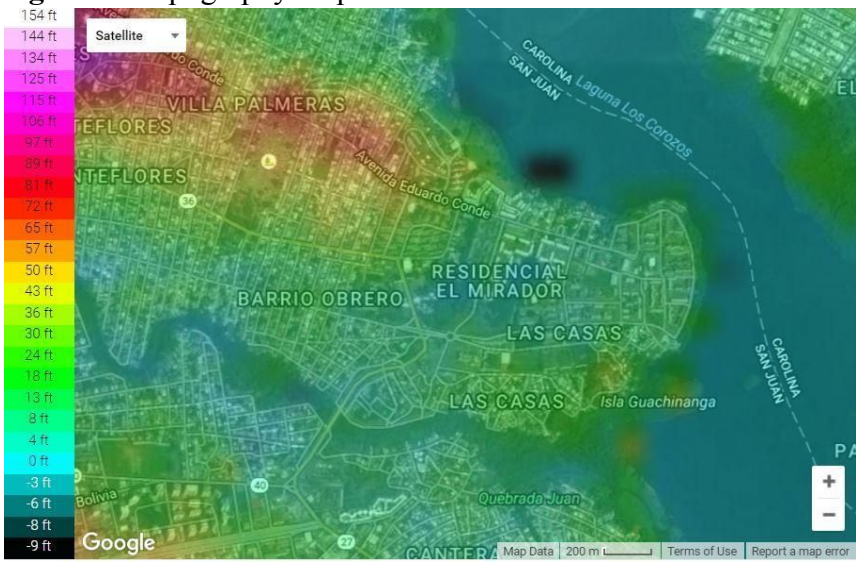
Cantera lies apart from many other regions in terms of development because of the company that held ownership of the land prior to settlement. Rexach Co. had been a large contributor in the region, and was known mostly for the management of a large quarry on the peninsula. Their first serious endeavour in the peninsula was to cut down and drain the mangrove swamps in order to create workable land; however, the wetlands proved to be difficult to work with, so the Puerto Rican Reconstruction Administration stepped in to fill in the swamp. Immediately, workers flocked to the new grounds and set up improvised housing for their families (Rojas, 1995, p. 6). New construction, such as the Aeropuerto de Isla Grande in 1939, attracted hundreds of workers who, in the same way, would settle in the already crowded boroughs. This pattern repeated over the next decade: an influx of workers would create the need for more land, which would result in the company clearing more of the swamp to make room. Finally, in 1953, the marshes were filled in completely, although the citizens mostly used construction waste and garbage to accomplish the task (Rojas, 1995, p. 6-7).

2.5.2 Cantera Geography and Topography

The Cantera Peninsula's geography is generally lacking in undulating terrain as a direct result of the land development over the past 80 years. The extensive manipulation of terrain

around the quarry combined with the efforts to fill the mangrove swamp significantly increased the size of the peninsula. (Rojas, 1995, p. 6). Much of the Cantera Peninsula is less than 10 feet above sea level, which is quantified as a major flood risk (See Figure 4). Due to the quarry operation many years ago, the peninsula has a bowl-like topography which leads to extensive flooding .

Figure 4: Topography map of Cantera Peninsula



Note: Retrieved from Topographic Map Puerto Rico

2.5.3 Demographics and Housing

Over 93% of the Puerto Rican population is classified to live in an urban area. These urban areas have an extremely high population density of 407.6 people/km^2 (See Table 3). This high density substantially increases the risk in the event of a natural disaster; more residents in the area makes the region much more susceptible to the impact of disasters.

Table 3: Basic Country Statistics and Indicators (2014)

Population of Puerto Rico

Population	million people	3,615,086
Urban	% Total population	93.676
Rural	% Total population	6.324
Urban population growth	% Annual	-1.053
Population density	People / km^2	407.6

Note: Retrieved from Puerto Rico Disaster & Risk Profile

Specifically, high density stresses evacuation and rescue efforts in the initial stages of disaster response (Dilley, 2005, 45). The 2008 socio-economic study in the Cantera Peninsula, the *Perfil Socioeconómico de las Barriadas de Cantera*, represented 2267 persons in Cantera. Of the people interviewed, 3 out of every 5 identified as being of the working age (16-64). The average monthly income per household in Cantera ranges between $626 and $833, which is around $10,000 per year and is largely identified as being impoverished ("Perfil Socioeconómico", 2008, p. 51). The average annual income is directly reflected by the housing quality in the Cantera neighborhoods (Perez Zapata: personal communication, September 16, 2016).

The main problem of the citizens interviewed is the overall poor condition of housing and its susceptibility to frequent flooding, with over 25% of interviewees reporting that they believe that they need a new home altogether ("Perfil Socioeconómico", 2008, p. 16). This need stems from the peninsula's old infrastructure: leaky pipes, lack of sewage systems, and faulty electrical systems ("Perfil Socioeconómico", 2008, p. 3). The majority of housing in the Cantera peninsula

can be divided into one of two categories: *barriadas* or *proyectos multifamiliares*. The *barriadas* started as the aforementioned "improvised housing" constructed by the workers; over the years, new housing replaced the shacks that once populated the old quarry (Rojas, 1995, p. 7). The *proyectos multifamiliares* were initially built with partial government funding and offered a large number of living units to the Cantera community. Initially, the *proyectos* were intended as transitional housing: families in need would move in, secure financial independence, and then move to a dwelling of their own. In practice, however, the residents of these complexes are more likely to live there permanently (Rojas, 1995, p. 7-8).

2.6 Summary

The lack of proper mitigation and recovery strategies is a pressing issue in Cantera. The region's natural geography/topography and the lack of effective hazard mitigation guidelines leave the peninsula susceptible to extensive damage if a hurricane, flood, or earthquake were to occur. In order to guarantee that the mitigation and recovery strategies are successful, it is important to look at the effects of natural disasters in the area, as well as approved mitigation strategies for areas with the similar vulnerability to natural disasters. The understanding of the effects of natural disasters is crucial to the development process of providing guidelines for mitigation of damages and recovery for the Cantera Peninsula.

Chapter 3: Methodology

The overall goal of this project was to perform a risk assessment of the Cantera Peninsula and to provide guidelines for the mitigation of damages and optimization of recovery for the community. This goal was fulfilled through the following objectives:

1) Interviews - Conduct interviews and meet with local, city, and national agencies to discuss region-specific issues
2) Assessment - Assess the disaster vulnerability of the Cantera community through mapping, community walkthroughs and a survey of the residents
3) Development of Materials - Compile information on building techniques, flood insurance, and disaster preparedness and refine research findings into comprehensive guidelines tailored to the needs of the Cantera community
4) Distribution of Deliverables - Present findings and guidelines to the community and provide the CDIPC with resources to present, distribute and edit as they see fit

The first objective to accomplish our goal involved conducting interviews and meeting with local, city, and national agencies to discuss region-specific issues. These meetings gave our team a jump-start in terms of gathering background and becoming familiar with the issues. The second objective dealt with risk assessment. We were able to perform an assessment of disaster vulnerabilities in the Cantera Peninsula through the use of a community walkthrough and ArcGIS mapping of disaster risk. We also conducted a survey of the residents to investigate the

community's perspectives on flooding and other issues. The community walkthrough gave us a first hand experience of infrastructure quality of hundreds of buildings in Cantera. The ArcGIS software allowed us to present area hazards in a geographic context and create informative maps that show sector-specific vulnerability. Finally, the survey of residents allowed us to understand and quantify resident perception and awareness of flooding and to gauge their knowledge of flood insurance. The walkthrough, mapping, and survey were all important components in assessing the disaster vulnerability of the peninsula, which allowed our group to properly tailor our objectives for the greatest possible relevance to the Cantera community.

The third objective was the development of materials, which required the team to compile information on building techniques, flood insurance, and disaster preparedness and then refine these findings into a comprehensive resource packet tailored to the needs of the Cantera community. These findings included guidelines to improve the structural integrity of a household, flood insurance information, and basic disaster preparedness tips for the community. The guidelines were intended to educate residents on how to prepare their homes in the barriadas for the physical effects of flooding and hurricanes, and on the recommended actions to take before, during, and after a natural disaster. The flood insurance information educated the residents on the easiest way to find and purchase flood insurance, and the disaster tips provided the residents with a plan of what to do in the subsequent moments of a natural disaster. The final objective was to distribute the resource packet to the CDIPC with the materials to continue to educate residents using the team's research, assessments, and products: and do a presentation to the community highlighting our findings. This objective ensured that our findings were delivered

to the residents of the neighborhoods in order to improve collective safety in the event of a large disaster. In this chapter, we will explain the methodology and purpose behind each step taken in the development process.

3.1 Interviews

When we developed our final objectives for this project, we had met with our sponsors to discuss major goals and deliverables several times already. In the first few meetings, we discussed the issues and factors in the community that make them particularly susceptible to physical damages in the event of a flood or hurricane. These issues had to do mostly with the quality of the structures that residents are living in. Because of this, our team agreed that the development of disaster-resistant construction guidelines for residents could be an important part of our project. Our sponsors believed that distribution of construction guidelines would be an invaluable strategy that would begin to address a massive issue in the community, and with widespread support could eventually benefit the residents in the barriadas to a great degree. They also stressed the importance of finding strategies that are feasible for the members of the Cantera community, given their low income per household. The interviews with our sponsors made it clear that the development of guidelines for improving disaster resistance of housing structures needed to be a significant focus for our project. However, most of our communication with our sponsors was informal in nature and therefore was not recorded.

Our next meeting was with a representative from the Municipality of San Juan. During this meeting we were able to obtain census block group data from 2013 including a database file

and shapefile for the Peninsula of Cantera. This meeting was particularly useful, as it helped us produce maps highlighting the specific hazards and vulnerabilities in the Cantera region. Additionally, the representative suggested that our team consider the distribution of basic disaster preparedness tips to the residents as a potential area of focus, as the Cantera Peninsula is fairly unfamiliar with disaster preparedness methods and strategies. The meeting with this representative from the municipality lead us to a meeting with a NFIP expert. In our meeting with the NFIP expert, our interviewee provided information about the state of flood insurance in the areas of both San Juan and Cantera that would have been unavailable to us otherwise. For the entire city of San Juan, there are currently only 838 flood insurance policies that the NFIP has record of. Our contact voiced his concern: for a coastal city with a population of almost 400,000 people and 165,000 houses, 838 policies represents an extremely low percentage of the population with insurance. In addition, of the 838 policies in San Juan, only 24 belong to homes that are within the area codes of Cantera; with over 1,300 homes located in the barriadas alone, this indicates a flood insurance ownership rate of less than 2%. This is a clear issue for a community that, for a large part, falls within a high risk flood zone. The NFIP expert expressed his hope that our project would shed some light on the causative factors in the low purchase rates of flood insurance in Cantera, and that our project would attempt to sway the opinions of flood insurance in the community. This meeting with the NFIP expert led us to create a resident survey to gauge their opinions on flooding and their knowledge of flood insurance.

The final interviews we conducted were with social workers in Cantera and the *Consejo Vecinal*. The social workers are members of the CDIPC who meet with community members to

provide support in a variety of ways. The *Consejo Vecinal* is a group of local community leaders who represent the different parts of the Cantera community. The first of the two meetings was with one of the social workers from the CDIPC, who helped edit the survey and provided some ideas on distribution methods. One distribution method was through the *Consejo Vecinal*, which required a meeting at the CDIPC's headquarters. The goal of the second meeting was to further develop the survey and explore other potential distribution strategies. Some of the key points from the meeting included the community's lack of knowledge on the topic of insurance and the necessity for it. Members of the *Consejo Vecinal* also offered to take copies and distribute them to members of their respective barriadas of Cantera. The minutes for the aforementioned meetings can be found in Appendix B. The second distribution method discussed was AmeriCorps. AmeriCorps is a service organization that works out of the CDIPC and holds after school programs. The social workers suggested that our team visit a local Cantera elementary school and distribute copies of the survey to the parents when they picked up their kids.

3.2 Assessment

The next component of our project involved an assessment of the Cantera Peninsula and an analysis of our group's potential impact in the community setting. Our assessment was intended to highlight the prominent issues in the community: infrastructure susceptible to flooding and high winds, lack of knowledge of disaster vulnerability, and lack of flood insurance.

3.2.1 Community Walkthrough

A simple method for vulnerability analysis in a community is to conduct a walkthrough. In meetings, our sponsors consistently stressed the fact that the damages that result from flooding and high winds in the area are amplified due to the poor construction quality of the residences in the barriadas. During this walkthrough, we took photos of the neighborhoods that were particularly susceptible to damage from flooding or high winds due to the structural integrity of their home or unfavorable street location (See Appendix C for photos). Organizing the community walkthrough was important to understand the range of issues within the infrastructure in Cantera. It allowed us to put the problems into context so that we could assess what would be optimal to research and develop to provide aid to the community. A few photos from our walkthrough are shown below:

Figure 5: Example of Poor Infrastructure (1)

Figure 6: Home in Cantera

Figure 7: Example of Poor Infrastructure (2)

Figure 8: Flooded Street in Cantera

3.2.2 Survey

The survey we created (See Appendix D) aimed to gather information on flooding and flood insurance in Cantera. In our interview with the NFIP expert, we learned that there is a lack of flood insurance policies in Cantera and San Juan as a whole, but the factors behind this low purchase rate are not completely understood by the government. The survey was also used to validate the estimate of the number of premiums in Cantera obtained from the NFIP. The final part of the survey was used to gauge the community's understanding of how flood insurance functions and how much they would be willing to pay for base coverage. These questions were suggested to us during our meeting with the *Consejo Vecinal*.

The team determined that the most effective way to distribute the survey was through the members of the *Consejo Vecinal* and through AmeriCorps. Some members of the *Consejo*

Vecinal agreed to distribute copies of the survey to members of their respective districts. In addition, the CDIPC social worker recommended that we distribute copies though the AmeriCorps afterschool programs. The distribution of our survey relied on AmeriCorps and the *Consejo Vecinal* since the residents tend to be reserved and likely would not have responded if our team had asked.

The data from the survey was processed using Microsoft Excel and the results were taken into account when creating the community presentation and resource packet. The survey helped us better understand their perception of flooding in Cantera and the residents' knowledge of flood insurance. It became clear from the survey that not only did we need to inform the public on how to get flood insurance, but we also needed to explain what flood insurance is and why it is critical in the peninsula. In addition, there were many misconceptions surrounding governmental funding that needed to be addressed. There was a common misconception that if your house or possessions were damaged by a flood, FEMA would provide financial support each time. This is false; FEMA will only provide financial aid for the first occurrence of flood damage. After that, FEMA expects the residents to purchase insurance to protect against further damages. The need for clarification on these misconceptions and the necessity of insurance were two major factors of our final deliverables that resulted from these interviews.

3.2.3 Mapping

In order to evaluate the vulnerability of the Cantera Peninsula, we created a comprehensive assessment in the form of a collection of maps. We used ArcGIS to compile

geographical database files and shapefiles to create informative map layers. ArcGIS is a geographic information systems software that allows the user to visually represent raw geographical data in the form of map overlays (ESRI, 2004). The map layers in GIS are visual representations of geographical data overlaid on a base map of Cantera. Each piece of data is linked to either a specific area or a geographical point; these geographic points correlate to points on the base map in order to correctly align the map layers. We created individual maps with layers containing hazard vulnerabilities, flood elevation model, dependency ratios, and population density.

The census data that was supplied to us from a representative from the municipality had a surplus of information, including demographic, socioeconomic, and geographical data. The first step was to isolate the census tracts specific to the Cantera region in order to avoid information overload. The first columns looked at were separate hazard (natural disasters) vulnerabilities. The census used 5 separate hazard situations and were rated as either vulnerable or not vulnerable. The five hazards simulated were the 100-year floodplain, tsunami, liquefaction, storm surge, and landslide. We created a new field to store the sum of hazards, and used a field calculator to store the sums of the five hazards in each respective tract .

To create the population density map, we once again isolated the Cantera Peninsula census tracts. There was no population density field in the attribute table, so we created one. Population density is the ratio of total population to land area. After attempting to use the field calculator in order to automatically fill in the population density field, we realized the population data type was different from the land area data type. The land area field was also in meters

squared, where population density is usually represented by kilometers squared. Due to the discrepancy in the units, we decided to manually calculate the population density data and fill in the field ourselves with total population per kilometer squared.

A dependency ratio field was included in the census block group data. This field represents the ratio of dependent to independent people. The dependent category included the elderly (over 65), children (under 18) and the disabled population. The independent category is comprised by the rest of the population. We used a color ramp in order to distinguish different value ranges. Using a different color ramp, we also created the unemployment map. The unemployment ratios were provided in the census data.

The representative also supplied us with a detailed topographical contour map created by the municipality planning board. The map supplied us with elevation information for the entire peninsula. This was a great tool to visualize and further grasp the flooding issues that Cantera faces.

3.3 Development of Materials

The third component of our project involved a large amount of gathering and sifting through information in order to compile a set of guidelines for the community. Our research and development covered three categories: methods to improve the structural integrity of a person's home, natural disaster preparedness guidelines, and flood insurance information.

3.3.1 Guidelines to Improving the Structural Integrity of a Household

After our meetings with our sponsors and conducting the community walkthrough, we had a much better idea of how we could serve Cantera. In order to best serve the community in the context of infrastructure integrity, it was determined that research would be done on the most effective ways to protect a household structure in the event of a natural disaster. To mitigate damages, standard construction methods to make a home more flood proof and wind resistant were researched. This research included sifting through multiple FEMA packets and guidelines, and also through specific building contractor's guides. Compiling information to make improvements in an underdeveloped community such as Cantera provided enough context to determine which methods would be included in our final guidelines.

For this objective, we took the most relevant and successful mitigation strategies obtained through our research and created guidelines for homeowners to prevent physical damages from both flooding and severe winds from hurricanes. These guidelines were specifically tailored to the Cantera community, and only included tips that are most feasible for the residents and their structures. These guidelines were necessary to properly inform the residents in Cantera of a comprehensive set of construction tips to better prepare for a natural disaster. The FEMA material most useful included *Flood-Damage Resistant Material*, *Reducing Flood Risk for Residential Buildings that Cannot be Elevated*, and *Avoiding Hurricane Damage: A Checklist for Homeowners*, all of which offered unique information to guide us in the development of this necessary objective.

The *Flood Damage-Resistant Material* packet published by FEMA in 2008 highlights the specific building materials that are approved by the NFIP as "acceptable". Materials labeled as "acceptable" will suffer little to no physical damage in the result of a flood. *Reducing Flood Risk for Residential Buildings that cannot be Elevated* included information regarding both wet and dry flood-proofing projects. This FEMA publication was particularly useful because it had already ruled out elevating the structure, which was deemed impractical for any of the structures in the Cantera Peninsula by the Municipality, so it provided more affordable measures for flood-proofing housing structures (A. Castrodad-Rodriguez, personal communication, October 31, 2016). *Avoiding Hurricane Damage: A Checklist for Homeowners* allowed us to branch out from flood resistance and start to investigate the protection of housing from high winds and hurricanes. Although the foremost risk in Cantera is flooding, it is also important to be prepared for other prevalent hazards that could result in damage to the homes on the peninsula. Through this series of information, we were able to determine viable options for the residents of Cantera to mitigate the physical damages accordingly. The options included in the guidelines range from extensively involved methods that may need a contractor to complete to simpler choices that are cheaper and easier to implement.

Some of the challenges for developing these guidelines included the financial barrier that restricts the majority of the community. Because of the low average household income for the residents of the Cantera Peninsula, some of the most effective tips for preventing flood damage in homes were not feasible to be included in the guidelines. These tips include massive construction overhauls such as completely elevating the home and revamping the storm water

management system in the neighborhood. Other challenges that remain also revolve around finances. Even though the guidelines developed included far cheaper options to improve the households' structural integrity against flooding and high winds, some of the tips still may not be feasible for all community residents based on their income. However, the guidelines also consist of tips that are both cheap and effective for all households.

3.3.2 Flood Insurance Information

After we assessed the current state of flood insurance in Cantera through the community survey, we worked to develop guidelines for the community. A list of flood insurance agents was obtained from the NFIP expert, which included ten different agents serving San Juan who could be contacted for obtaining flood insurance. We also found a list of information that the residents should have before they call on the NFIP website, FloodSmart.gov. It was understood that for many residents, it would be their first time purchasing flood insurance, so a list of necessary information to have on hand would make the process easier and more comfortable. Additionally, premium estimates for residents in Zone X were obtained from FloodSmart.gov. We attempted to provide estimates for people living in Zone AE, but insurance companies were unwilling to provide rough estimates for these premiums. This is due to the fact that homeowners in Zone AE are required to submit an Elevation Certificate (EC) when applying for flood insurance and premiums for these homes are considered on a case-to-case basis. However, it should be noted that premiums increase as elevation decreases; for some homes, annual premiums would be very expensive, as they are just feet above sea level. The final pieces of information gathered were

from FEMA. The first aims to inform people with flood insurance on practices that they should do before a flood. The second instructs on what needs to be done when returning to a house after a flood. We included these so that residents know what they need to do in order protect their homes from damages and have the required knowledge to file a claim after a flood.

3.3.3 Disaster Preparedness Guidelines

One point brought up within our interviews with the municipality contact and the sponsors was that it takes time for emergency response teams to arrive. The residents are on their own until help arrives, so it is necessary that they know what to do until response teams arrive. Basic disaster preparedness can significantly lower risk of injury to person, home, and belongings during the natural disaster and help ease the recovery process. In order to compile disaster preparedness guidelines, we first looked at a variety of agencies and non-governmental organizations that deal firsthand with natural disasters. The first agency on the list was the Department of Homeland Security, a parent agency to FEMA. The Department of Homeland Security has a website called ready.gov which has a compilation of tips on how to prepare for every natural and man-made disaster. Our team focused on the flood, earthquake, hurricane, and tsunami categories, the four most prevalent disaster in Cantera. Inside each category are subcategories that focus on what to do before, during, and after each natural disaster. The second organization researched was the American Red Cross. They have a similar webpage that contains a variety of tips on what to do in case of any natural disaster already listed earlier. Many of the Red Cross tips overlapped the ready.gov tips. The final agency website we visited was the Center

for Disease Control and Prevention (CDC) natural disasters and severe weather page. They also have a setup similar to ready.gov's with categories for each type of natural disaster with guidelines on how to prepare for the disasters, what to do during the disasters, and how to recover after.

3.4 Distribution of Deliverables

The final objective of the project was focused on the dissemination of the assembled guidelines to the community. The team achieved this goal with a two-pronged approach consisting of a presentation to the community members and an instructional packet to be kept on hand at the CDIPC for reference and distribution through social workers. Additionally, we delivered all resources used in the presentation and a script so that it could be performed at a later date by the members or associates of the CDIPC.

The team decided to break the distribution strategy into two parts because of the wide range of both subjects and depth of information that was gathered. With a single-part distribution, the project would be too specific at times, give unnecessary instruction and wouldn't be entirely relevant to the average resident of the peninsula. This problem was solved by the combination of a presentation and an informational packet. The presentation was aimed at the wider community, offering information that can be used by all members and just touching on the more specific guidelines. The informational packet is a denser collection of information created for the use of the CDIPC and includes all of the specific guidelines refined in the development of materials section.

3.4.1 Informational Resource Packet

The first half of the delivered materials is the resource packet aimed to inform the public on measures they can take to minimize the risk of damages to both families and homes due to natural disasters. It was split into three sections: disaster-resistant construction guidelines, flood insurance information and general disaster preparedness tips. The first section of the packet outlined a variety of methods by which residents can make their homes more resistant in the case of different natural disasters, which were chosen based on viability in the peninsula community. Each method was chosen after comparing costs, difficulty of construction, specific disaster resistance, and relevance to the infrastructure in the community. The resulting guidelines were tailored to the needs and limitations of the residents.

The second section of the packet dealt with purchasing flood insurance and filing a claim in case of disaster. Our meeting with the NFIP expert showed us that the community of Cantera is, for the most part, entirely uninsured in the case of flooding. Moving forward, we decided that our informational packet would focus on the process of purchasing flood insurance. We also included a section on the importance of having flood insurance and potential rate plans, in order to attempt to try and sway the resident's opinions on flood insurance.

The final section of the packet gave a general overview of standard disaster preparedness tips specific to a handful of the most prevalent disasters in Puerto Rico. This section was suggested to us during our meeting with the Municipality of San Juan, during which the representative expressed that an important focus of our disaster preparedness section should be

on, "...the small things that make a big difference" (A. Castrodad-Rodriguez, personal communication, October 31, 2016). In so many words, they believed that the presentation of general disaster preparedness information to the residents would be critical in the development of a disaster-resilient mindset in the Cantera community.

3.4.2 Community Presentation

Our second distribution strategy involved a presentation to the community that covered the same three main areas of focus as the packet: disaster-resistant construction guidelines, flood insurance information, and general disaster preparedness tips. We decided to aim the content of the presentation towards the average homeowner in the peninsula in order to provide the informational resources to groups that can make use of them. Additionally, the text and script was translated into Spanish for the convenience of Spanish-speaking listeners. The presentation was composed of a condensed set of guidelines that were pulled directly from the resource packet, and was to be presented with the packet as a handout resource for interested attendants. Due to time constraints and a projected lack of attendance, the team was unable to present to the community, and instead provided the presentation and script to the CDIPC. Moving forward, the presentation would be presented periodically to a group of community members by a team chosen by the CDIPC, and is open to feedback and any revisions that may be suggested by presenters.

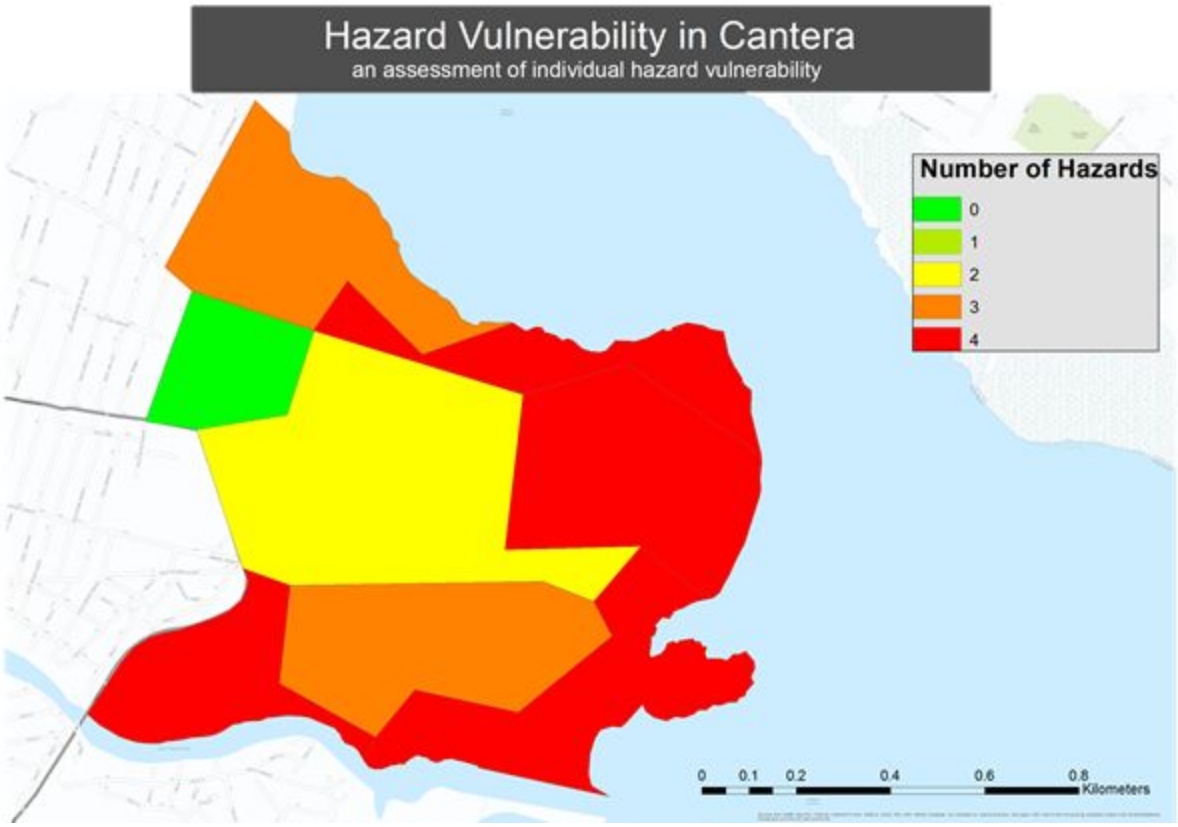
Chapter 4: Results and Analysis

This section addresses the results that were obtained from the project. These results include the GIS maps, results of the survey and the two deliverables: the community presentation and the informational resource packet. The key information from the survey is highlighted in this section as well as an overview of the information provided in both the community survey and the informational resource packet.

4.1 Vulnerability Maps Overlays

The creation of maps allowed for the visual representation of vulnerabilities and hazards in the Cantera Peninsula. These maps were created using the 2013 census tract and independent maps provided to our team from the municipality of San Juan. The collection of maps include information regarding natural hazard vulnerability, dependency rate, unemployment, and population density.

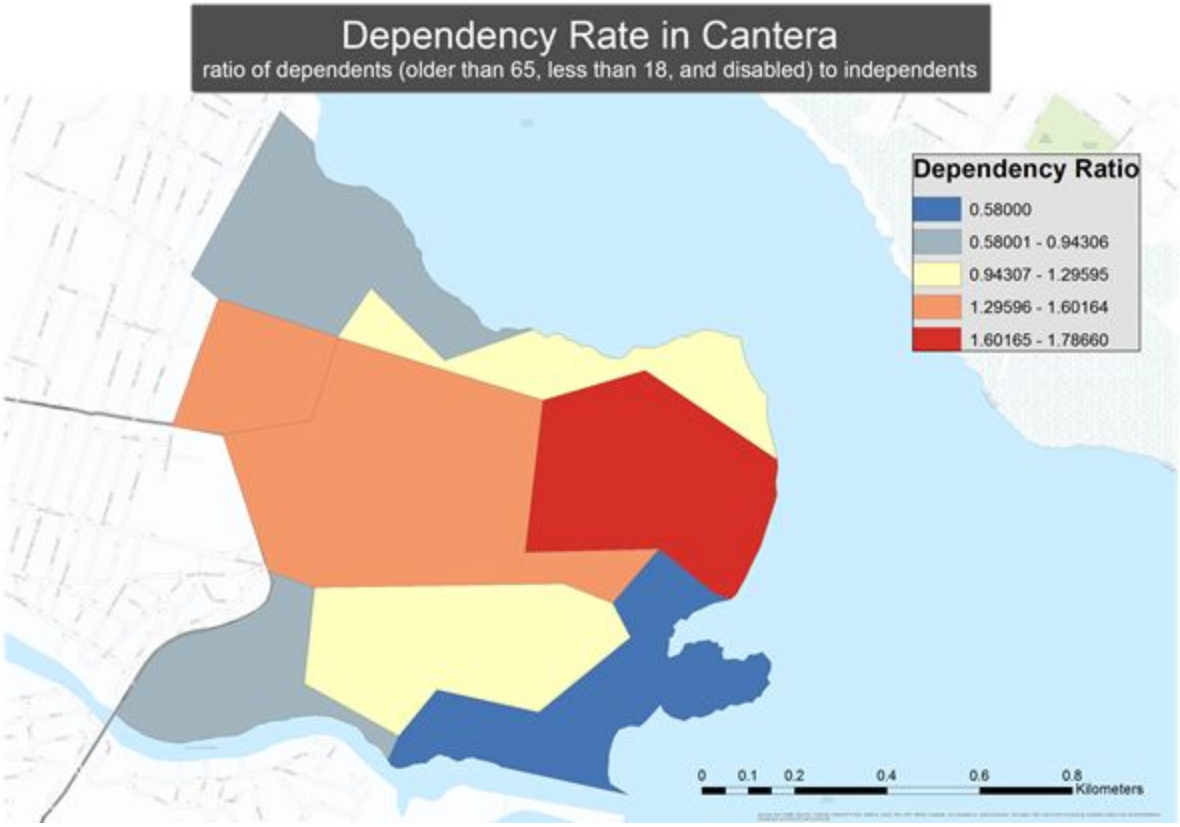
Figure 9: Hazard Vulnerability in Cantera



The hazard vulnerability information given to us had a total of five different hazard vulnerabilities. However, the hazard of landslides was not included in the hazard mapping since no regions of Cantera are susceptible to landslides. The first included hazard is liquefaction which is the shifting of soil due to an earthquake. The second hazard is the 100 year floodplain which is the area that has at least a 1% chance of flooding in any given year. The next hazard threatening the region is a tsunami. The fourth and final hazard that affects the Cantera Peninsula is a storm surge, which is the rise in water level due to hurricanes and heavy storms. As shown in

the map, the tracts most susceptible to natural disasters are located on the coastline of the peninsula.

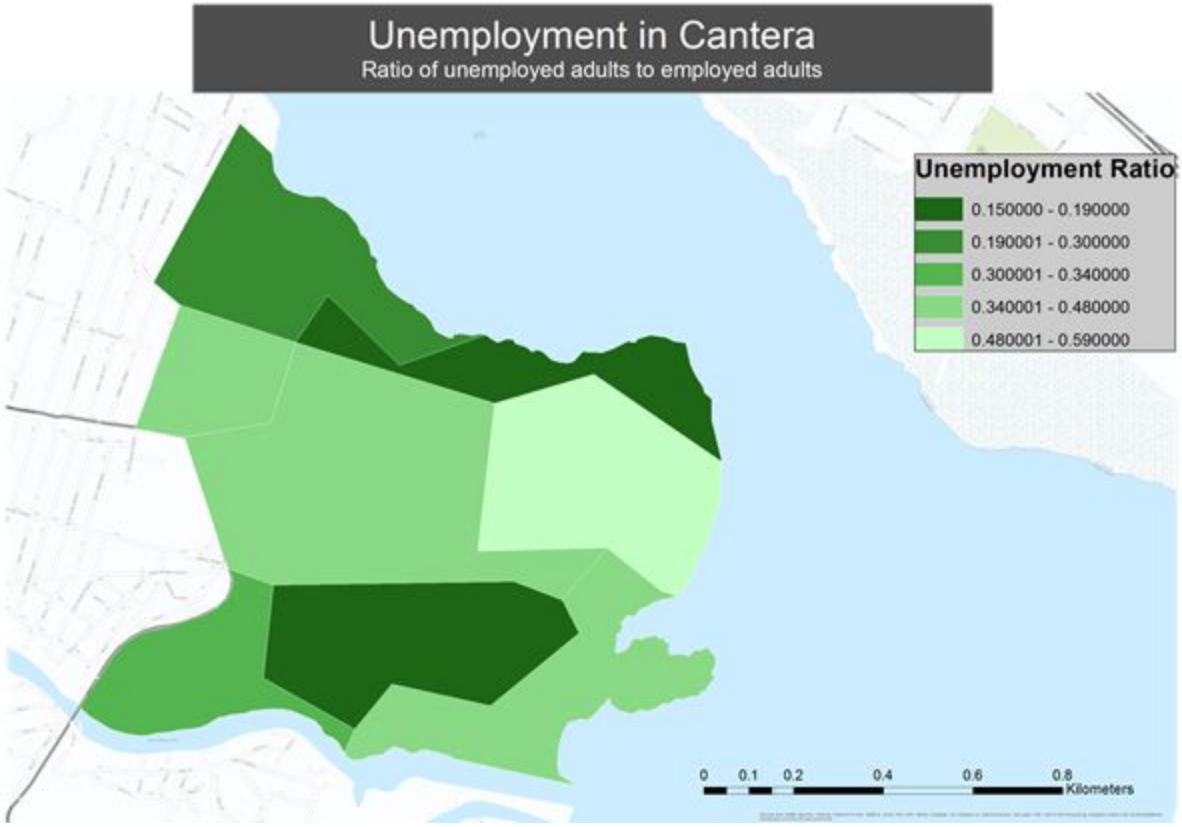
Figure 10: Dependency Rate in Cantera



Dependency rate is the ratio of children under 18 years old, elderly over 65, and disabled compared to the rest of the population. As shown by the figure above, the dependency rate for the Cantera community ranges from 0.58 to 1.7866, well above the island average of 0.5 ("Dependency Ratios", 2016). A dependency rate of over 1 means there is a higher dependent population compared to the independent population. This is an indication that a significant

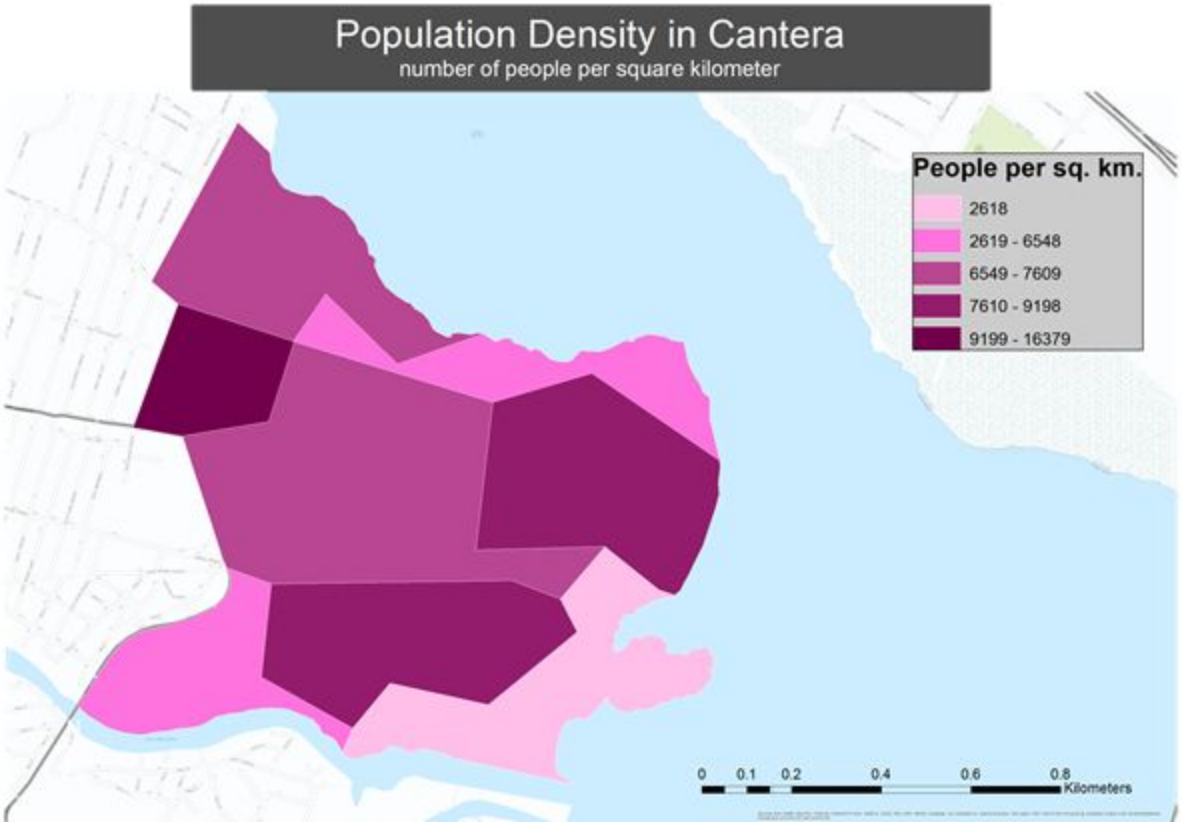
portion of the Cantera community will need help when preparing for storms and assistance in evacuating if a natural disaster occurs.

Figure 11: Unemployment in Cantera



Puerto Rico's average unemployment rate in 2013 was 14.2% ("Local Area Unemployment Statistics"). Every tract in Cantera produced a higher unemployment than the island average. This above average unemployment rate could be an indication that recovery efforts are inhibited by lack of income in the Cantera community.

Figure 12: Population Density in Cantera



The population density of Cantera is higher in the government subsidized housing and more developed barriadas. The more densely populated areas require more organized emergency response efforts. In addition, the more densely populated the area is, the greater chance of debris in the event of a high wind storm, heightening the vulnerability in the area.

4.2 Survey

The survey was created to better understand the communities outlook on flooding and flood insurance. Surveys were distributed through the *Consejo Vecinal* and at an Americorps

meeting with the community. Each survey was assigned a number to maintain anonymity. The spreadsheet of responses can be found in Appendix E.

4.2.1 Key Survey Data

Of the surveys distributed, we received responses to 92% of them. Of those surveyed, the average rating of the issue of flooding is in Cantera was 8.2 out of 10 (See Figure 13).

Figure 13: Survey Question 4

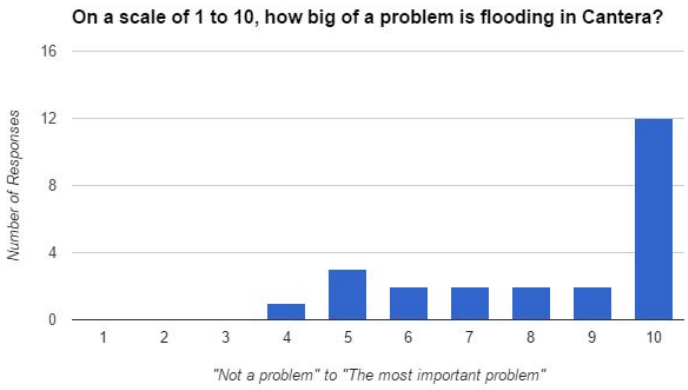
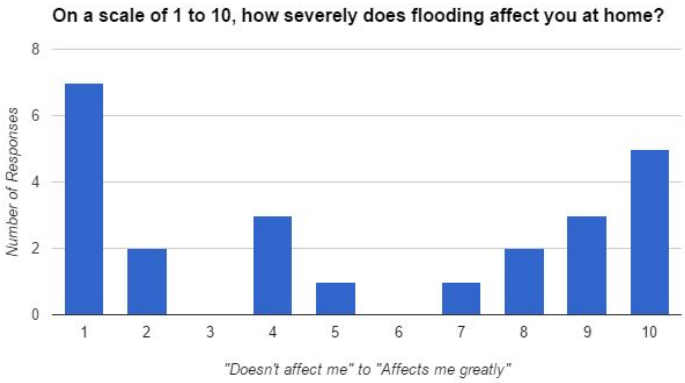
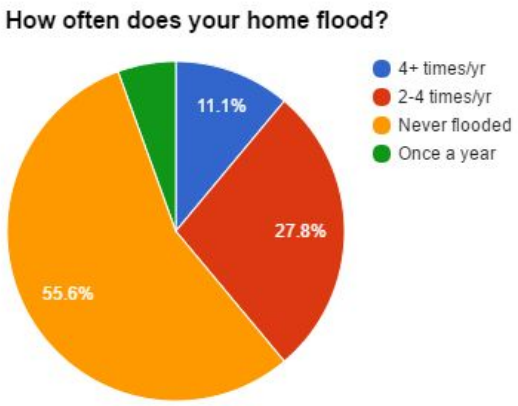


Figure 14: Survey Question 5



However, the responders said that flooding was, on average, a 5.3 out of 10 as an issue for their home (See Figure 14). There was also agreement between residents whose homes had been flooded that flooding events happens between two and four times per year (See Figure 15).

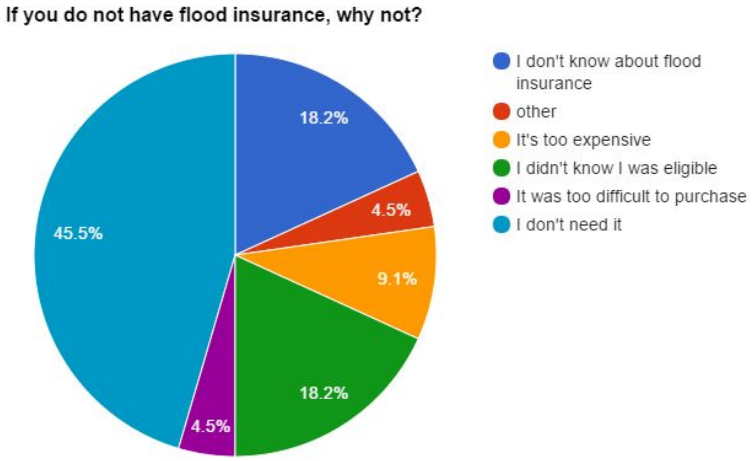
Figure 15: Survey Question 7



Despite the unanimity on the issue of flooding, only one resident surveyed reported that they currently have flood insurance. Of the rest of

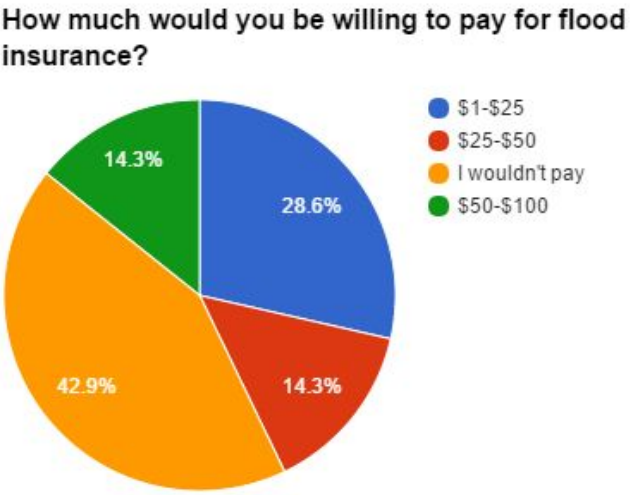
those surveyed, 45% said that they don't believe that they need flood insurance and 36% don't think that they are eligible for flood insurance or don't know enough about it (See Figure 16).

Figure 16: Survey Question 11



Slightly under half of the residents surveyed would not consider purchasing flood insurance. Of the same group, 78% believed they did not need flood insurance. Of the residents who said that they would be willing to purchase flood insurance with $8,000 worth of coverage, half were not willing to pay more than $25 per year. (See Figure 17).

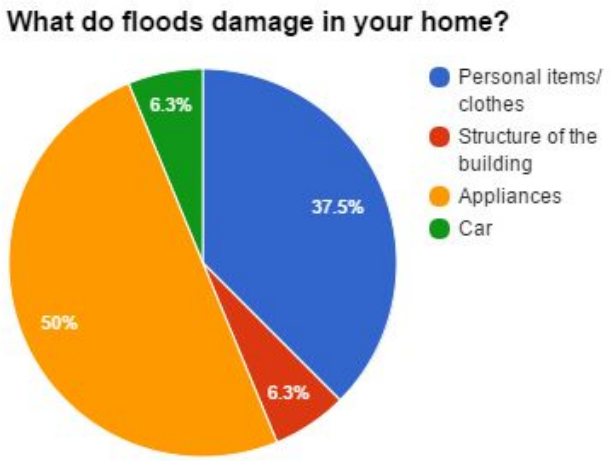
Figure 17: Survey Question 13



Forty-six percent of residents also reported that they have other forms of insurance, namely health and auto insurance, and cited a total average cost of $200 per year on all policies combined. However, a few weren't sure how much they were paying per year for their insurance (Appendix E). Fifty percent of responders report that when a flood

occurs, appliances are most frequently damaged within a home, while 38% say that personal items are also damaged. Surprisingly, only six percent reported structural damage to their homes (See Figure 18).

Figure 18: Survey Question 8



4.2.2 Survey Analysis

The feedback that the team received from the survey gave insight into the community's perception of flooding and flood insurance. The results indicated that the community understands that flooding is a significant problem in the Cantera Peninsula, but several residents reported that flooding was not a problem in their homes at all. Some of the reported items damaged during flooding included appliances, clothes and personal belongings, and the overall structure of the home. All of the damages reported could be covered under an insurance policies, but our survey also indicated that the residents are unfamiliar with both the function and the purpose of flood insurance. Backing these results up, many residents also said that they would be unwilling to purchase flood insurance. For the few who would, most wouldn't be willing to pay more than

$25-$50 per year. We believe this could be due to the financial issues that residents of the area face, some ambiguity about why flood insurance is important, or widespread belief that flood insurance isn't needed for homes that don't flood often. Additionally, many of the responders said that they have other types of insurance, which provides an educational base to build upon when educating the community about flood insurance.

From these results, we determined that the deliverables should focus on convincing the community members that it is necessary to take preventative measures and to connect the community to affordable flood insurance. As a part of connecting the community to affordable flood insurance, we also determined that a primary focus should be on convincing the community that flood insurance is not only necessary, but is fairly affordable and beneficial in the long run.

4.3 Informational Resource Packet

The compilation of the guidelines into an informative resource packet was performed based off of the interviews and assessment we conducted in order to best serve the Cantera community. Our team identified issues within the community and provided the CDIPC with an informational resource packet to be distributed to the residents in Cantera to mitigate damages and optimize recovery in the region. This packet consists of: Guidelines to Improve the Structural Integrity of a Household, Guidelines for Flood Insurance Before, During, and After a Flood; and Basic Disaster Preparedness Guidelines, which can be found in Appendix F.

4.3.1 Guidelines to Improving the Structural Integrity of a Household

The information provided within the first set of guidelines included material compiled from FEMA packets and building contractor's guides most relatable to assisting the residents in Cantera for retrofitting their households. The first set of guidelines provided the reader with informative tips to protect their home from the physical damages that could occur from a flood or a hurricane. The guidelines clearly express the importance of retrofitting in order to prepare for a flood or hurricane and mitigate all physical damages.

Examples of the FEMA material looked through were previously touched upon in the methodology. The information provided in the guidelines discusses the prevention of damages due to flooding through wet and dry floodproofing methods, such as elevating or providing barriers to protect the interior and exterior utilities of the home. The important difference between wet and dry floodproofing is that dry floodproofing prevents floodwaters from entering, whereas wet floodproofing allows water to enter the structure but precautions are taken on the interior to prevent physical damages to the structure. For alternative dry floodproofing methods, the guidelines suggests the application of additional sealant on the exterior surfaces of the home to prevent the entry of floodwaters. Other specific wet floodproofing methods consist of abandoning the first floor of the home and also applying appropriate waterproof interior finishes to the walls of the home. In addition, other FEMA publications provided a checklist to help show the reader the importance of reducing damage from high winds and hurricanes. They also provided tips to increase the durability of the household, such as utilizing hurricane ties or straps

and storm shutters, which were included in the guidelines. Also included in the guidelines are the classifications of structural and finish materials and the determination of whether or not it will be severely damaged in the event of a flood. This data allowed us to display in the guidelines which materials are highly susceptible to flooding, and hopefully dissuade community members from using it during construction or retrofitting of their household.

In addition to research on specific mitigation strategies for the Cantera Peninsula, this set of guidelines included an approximate price range for each method of construction. It was determined that this information will better allow Cantera residents to choose disaster resistant construction methods that fit their budgets. In order to achieve this, many construction contractors sites were visited to gauge prices for certain building techniques and materials. Also, some of the FEMA information included roughly estimated costs for specific mitigation strategies.

4.3.2 Guidelines for Flood Insurance Before, During, and After a Flood

The second set of guidelines provided in the resource packet revolves around the importance of obtaining flood insurance, how to do so, and the benefits that a homeowner is entitled to. Flood insurance is an important mitigation technique because it allows for the residents to have coverage before damage occurs, and allow for them to receive necessary funding to recover.

Before a flood occurs, it is important to have flood insurance in order to protect home and property. The 2009 Flood Rate Insurance Map (FIRM) for the Cantera Peninsula is provided so

that residents can understand their flood risk and determine what zone they live in. Additionally, a table outlining annual premium estimates for low to moderate-risk areas is provided. For example: $8,000 of contents insurance for residents in low to moderate-risk zones costs $50 per year (see Figure 3). Unfortunately, we were unable to provide premium estimates for residents in high-risk areas due to the requirement by insurance companies that each house submit an Elevation Certificate (EC) in order to receive a quote. The guidelines then provide information on how to find flood insurance agents and supply a set of important questions to ask the agent in order to receive the best possible coverage when obtaining flood insurance. Also provided are a list of ten insurance agents with contact information.

Once flood insurance is obtained, there are many steps that should be taken to prepare for a flood. Some of these preparations include the safeguarding of copies of important documents in waterproof locations and performing a full inventory of your house and belongings. Some simple ways to safeguard important documents is to put them in a ziplock bag and bring them to the highest highest floor in your home. The house inventory should include pictures of all appliances, furniture and valuables such as jewelry and artwork. Receipts for these items will also make the appraisal process easier if they are damaged during a flood.

For during a flood, the guidelines highlight evacuating and proceeding to one of the two structures in Cantera that serves as a shelter: the San Juan Bosco School and the Boys and Girls Club of Las Margaritas. Before evacuating, ensuring to move all valuables to the second floor or a higher location in order to prevent damage is very important. When returning to your home after a flood, the guidelines suggest that you take note of any structural damages that may have

occurred, and document them appropriately in order to receive compensation for them from the flood insurance agency.

The next step is to contact the insurance agency to begin the process of filing a claim in order to receive the appropriate amount of compensation for the property damaged suffered. An adjuster will be assigned to the case and will make contact within the 48 hours. When the adjuster arrives, they will assess the damages from what they can see. At this point, the house inventory from before and after the flood becomes incredibly important as it will aid the adjuster in assessing damages. Once the adjuster has assessed the damages, they will aid in the process of filling out a proof of loss form. This is the official form that will be submitted to the insurance company to receive compensation for loss.

4.3.3 Basic Disaster Preparedness Guidelines

The final set of guidelines included in the informational resource packet for the residents of Cantera are basic tips for a wide range of natural disasters. The natural disasters included are earthquakes, floods, hurricanes, and tsunamis. These guidelines highlight the precautions and actions to be taken before, during, and after each natural disaster occurs. Before an earthquake, it is most important to be able to identify safe, sturdy places in your home where it will be easy to take cover. It is also important to practice how to drop, cover, and hold on for the event of an earthquake. This means to cover your head and neck region with your arms and find a safe place to provide protection. During an earthquake, proper actions depend on where you are located. If you are inside a building, use the “drop, cover, and hold on” technique previously described. If

you are outdoors, be sure to find an open area before utilizing “drop, cover, and hold on” in order to avoid being hit by debris. After an earthquake, be prepared to drop, cover and hold on for the likely event of aftershocks.

In preparation for a flood, it is important to restock your emergency preparedness kits; be sure to include extra flashlights, batteries, money, and first-aid supplies. Also, be prepared to pack extra water and snacks in the event of an extended period of flooding and to include copies of personal documents. During a flood, be aware of water levels; six inches of moving water can knock you down and two feet of water can sweep a car away. When cleaning up after a flood, avoid standing water that may be electrically charged.

To prepare for a hurricane, you should bring all loose, lightweight objects inside to prevent them from becoming airborne projectiles. Your refrigerator and freezer should be set to the lowest temperature in order to preserve food if you lose power. After the hurricane, refrain from drinking tap water until it is deemed safe to drink by local authorities.

Tsunamis can come with little to no warning so familiarize yourself with the local tsunami evacuation route. Head to higher ground at the first sign of a tsunami. Good indicators are large earthquakes and a rapid recession of the tide. Do not return to your house after a tsunami until officials indicate that it is safe to do so; your presence might disrupt emergency response operations. These precautions and more are all included in the resource packet.

4.4 Community Presentation

The community presentation was developed directly from the informational packet, and contains a condensed set of the same information. It was designed to provide disaster vulnerability information to the community and to spread awareness of actions that citizens can take to protect themselves from disaster. Consequently, each section has a slightly different area of focus than in the packet; the sections are tailored for live presentation while the packet serves as a resource for interested community members. The community presentation was created in English but translated to Spanish since the target audience speaks almost exclusively Spanish. A script for the community presentation was also created in both English and Spanish so that the CDIPC can continue to use the presentation to educate the community after the project is over. The community presentation slides and script can be found in Appendix G.

4.4.1 Guidelines to Improving the Structural Integrity of a Household

For the most part, the guidelines for structural improvement remained the same between the packet and the presentation; the only difference is in the formatting and presentation of the information. The slides cover a variety of damage-resistance guidelines determined to be feasible for the Cantera community. The guidelines are broken up into subsections based on hazard, and the methods are organized by price and ease of installation. Visuals for the different methods were also included to aid in the understanding of the material.

4.4.2 Guidelines for Flood Insurance Before, During, and After a Flood

Unlike the structural improvement guidelines, the flood insurance information presented in the resource packet differs significantly from the information distributed in the presentation. The packet explains how a citizen can obtain flood insurance and file claims; the presentation seeks to explain to the citizens the necessity of flood insurance, and why it is in their best interest to purchase it. This section of the presentation was shaped once the team received the results of the flood insurance survey performed in the peninsula. Once it was determined that a majority of the community members were unfamiliar with flood insurance, the team decided to focus mainly on spreading awareness of the costs, requirements, and benefits of flood insurance in a flood-prone area.

4.4.3 Basic Disaster Preparedness Guidelines

The final section of the community presentation cover basic disaster preparedness tips for all residents of Cantera, and is directly condensed from the corresponding section of the resource packet. This section, like the resistant construction section, is split up by types of disaster: earthquake, flood, hurricane, and tsunami. Each subsection outlines the actions to take in case of each disaster, which are in turn divided into three more sections: before, during, and after the disaster. This information was boiled down to a compilation of the most necessary and relevant material for the Cantera community, but is also supported by the comprehensive guidelines in the resource packet.

Chapter 5: Recommendations and Conclusions

In this chapter we highlight the recommendations to the CDIPC through the results gathered in the previous chapter. Our recommendations for the CDIPC are geared towards mitigating physical damages and optimizing recovery in the community of Cantera. We also include our final conclusion of the project in this chapter.

5.1 Recommendations for the CDIPC

As one of the most prominent organization in the Cantera Peninsula, the CDIPC is instrumental in the facilitation of outreach to the community. Therefore, a significant portion of our suggestions are aligned with supplying the CDIPC with recommendations to benefit the community.

5.1.1 Recommendations for Distribution of Deliverables

We recommend the CDIPC conducts periodic presentations to the community with our provided powerpoint and script. Ideally, this will distribute the information gathered in our project to a variety of groups and will help to foster a disaster preparedness mindset in the community.

We also recommend that the CDIPC keep copies of the resource packet on hand for distribution to citizens. The packet can be split into its individual parts if necessary; Guidelines to Improving the Structural Integrity of a Household; Guidelines for Flood Insurance Before,

During, and After a Flood; and Basic Disaster Preparedness Guidelines to cater to the citizen's needs. This could be left as a resource for social works to use and distribute to interested community members.

5.1.2 Disaster-resistant Construction Recommendations

We recommend that the CDIPC encourage and assist the community in helping homes become more resistant to natural disasters. One of the easiest methods could be to provide the community with trustworthy contractors that will be able to retrofit their homes and modify them to meet building codes; this will mitigate damages in the event of a natural disaster and directly help the community. Additionally, the CDIPC could assist in providing damage resistant materials to the residents of the barriadas. **Also, we recommend that the CDIPC ensures that homes are rebuilt and improved upon following appropriate building codes after a natural disaster occurs.** This is to establish a community that is more resilient and is able to recover more quickly after the following natural disaster.

5.1.3 Flood Insurance Recommendations

From our findings, we recommend that the CDIPC informs the public on flood insurance and why it is important. We learned from the interviews conducted and the survey that many community members don't understand the purpose or function of flood insurance. Therefore, the resources prepared for the CDIPC were aimed at both of these problems. The resource packet can be used during social worker meetings and community presentations can be

organized using the presentation and script provided. The goal of increasing perceived importance by the community is covered in the provided material by the multi-hazard GIS map, pictures of flooding after Hurricane Irene, and pictures from our community walkthroughs. The issue of explaining insurance, how to obtain it, and how to use it is covered in the material by a list of NFIP insurance agents, a list of FAQs for insurance agents and guidelines on how to file a claim.

We also recommend that the CDIPC collaborate with the Municipality of San Juan and the NFIP to investigate the possibility of establishing a community flood insurance program. In a community flood insurance program, the risk of flooding is shared throughout the community rather than each household holding it's own risk. A community flood insurance program could provide a lower cost alternative compared to each individual buying insurance from agencies. This can be approached by the CDIPC through communication with the NFIP representative referenced in this project.

5.2 Conclusion

In this chapter, we provided a summary of our key findings and recommendations for mitigating damages and optimizing recovery for the Cantera Peninsula in the event of a natural disaster. Through our general interviews and assessment of the community we gained an understanding of the issues on hand for the residents of the barriadas in Cantera. We analyzed these issues in the results section, and provided deliverables and recommendations to assist in the improvement of the community. We believe that our informational resource packet including

disaster-resistant building techniques, flood insurance information, and basic disaster preparedness tips will be able to aid the community of Cantera. In addition, the resource packet information highlighted in the community presentation will be key in the survival and long-lasting impact of our project. We believe that our recommendations of distribution to the community, assisting the community in improving the structural integrity of their home, and obtaining community flood insurance will continue to improve resilience and disaster preparedness in the Cantera region for years to come. Our hope is that our results and deliverables can be further utilized as a steppingstone for research in similar underdeveloped communities in Puerto Rico.

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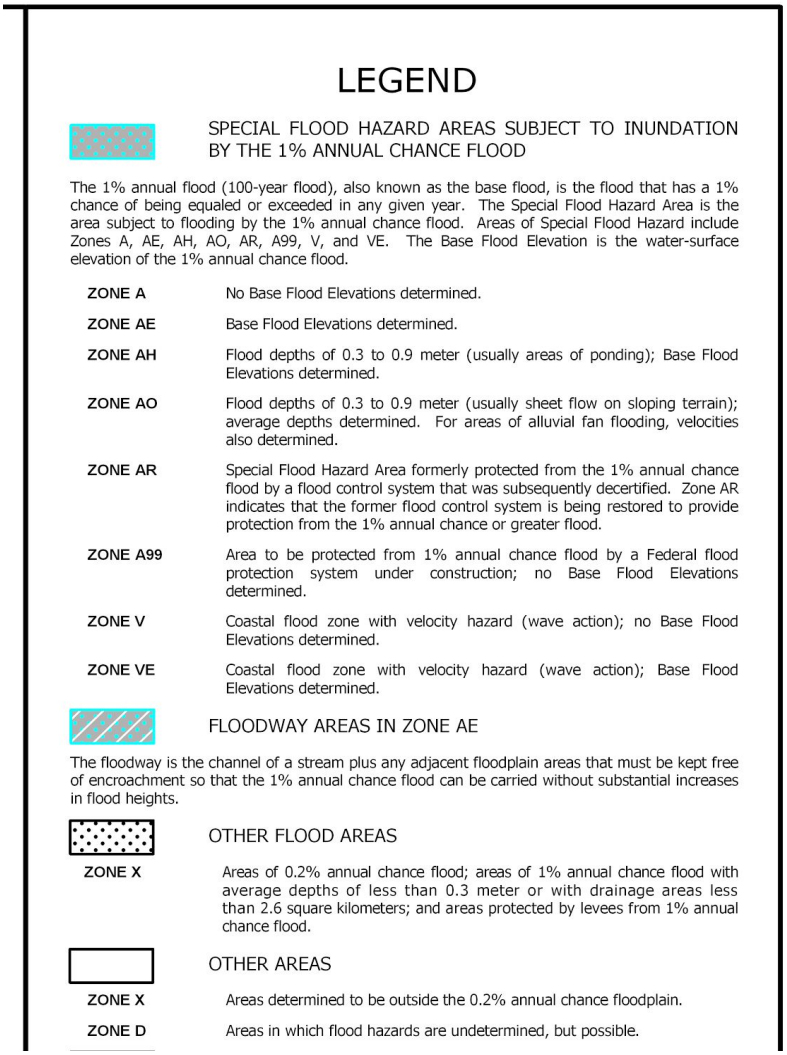
Appendices

Appendix A: Legend for 2009 FIRM map



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 0.3 to 0.9 meter (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 0.3 to 0.9 meter (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 0.3 meter or with drainage areas less than 2.6 square kilometers; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

Appendix B: Interview Minutes

10/31/16

Meeting with Alejandra from Municipality of San Juan

- Chief resilience officer- helps making communities more resilient
- Rockefeller foundation- resilience foundation
- Current and future needs
- Consider ECONOMIC Impact, and knowing what is already there
- Cantera has 4 Hazards
- Can't elevate these buildings, cannot overhaul water management- not feasible
- Things that Municipality is trying to do: Apps, data gathering, **Community based insurance program**
- Recovery- mostly financial for business, all replacement, no guidelines to prevent happening again, incentivizing to leave floodplains and relocating communities
- Habitat for Humanity- urban development housing
- City of San Juan more “boots on ground” response
- Strategy Framework- exposure, sensitivity, adaptability

City Resilience Framework

- Contains measurables to establish resilience
- Health and well being, economy and society, infrastructure and environment, leadership and strategy (emergency management)
- Qualities- reflexive, resourceful, flexible, inclusive, integrated
- **Sustainability** is the main objective
- Minimize impact and adapt

San Juan Basics

- 38% water
- 30% jobs located in San Juan
- 79% access to internet

Hazards

- Hurricanes, Earthquakes- Tsunami, Flooding, Drought, Landslides, storm surge
- Most important- Inequity (emergency response), water (flooding, drought), economic depression

- Capacity to mitigate
- Eliminate physical and economic barriers to access to essential services
- Post disaster recovery fund, Cantera does not get the necessary funds because of lack of reporting
- 6% floodplain population insured

11/10/16
Meeting with Juan from the National Flood Insurance Program

- Census block group data 2013 - gis maps
- Would not use disability data
    - Don't use data extrapolated from basic census tracts
- Elevation maps- need list of data for mapping points- send to Alejandra the pdf so she can try to find us data for it
- Homes do not need to be inspected before applying for NFIP
- Floodplain Management Plans- identify hazards
- Two types of flooding- coastal flooding and riverbed flooding
- Flood elevation model- email Alejandra for it "Shane" file from JP elevation map in geology folder
- USGS topographic for Puerto Rico
- Rates not based on condition of building
- Lack of info on homes that have flood insurance in PR in 2012 approx 36,000 -> now approx 7,000
- Can give numbers of idea of people who have insurance in Cantera
- Can provide a list of different carriers
- No governmental agency in Puerto Rico is supplying insurance
    - Must go through private agent to get policy
- Required to have insurance if receiving any federal funding for housing (mortgage, grants, etc.)
- Community-based insurance policies
    - Lower rate insurance for maintenance of home/stormwater
    - Collectively community begins to lower the risk (UN in India)
- Gain knowledge on why Cantera does not have flood insurance
    - Many different theories
- Setting up survey- For why residents of Cantera don't have flood insurance
    - Our theories:

        - Money
        - Non-obligation
        - Lack of understanding
- Community Rating System- San Juan will never qualify
    - Community NFIP
    - List of objectives that need to be completed/integrated
        - Rating rises as more are completed, giving reductions on policy pricing
        - Small island divided by municipalities
        - Began to develop autonomy, operate separate from the state
    - Only useful as a recommendation for the final paper
- Think about other forms of insurance
    - Lost income
    - Health insurance
        - Vector-borne diseases
        - Sewer system flooding
- Look for the basic stuff
    - Give them the basic actions that will make a big difference
        - Elevated equipment, protect windows etc
        - Preparedness action- understanding event then communicating amongst themselves
        - Taking pictures of damage- capture event as it happens
        - High-water mark

Minutes from meeting with Tania 11/30

Tony, Nate and Tania present
Done in Spanish

Intro: General project overview and what we are trying to do here

- Grammatical corrections on the survey
- Recommended that we meet with the Consejo Vecinal
- No good days in the time we have left to hold the community presentation. No matter what day or time we chose we would most likely only get 5-10 people to attend because of christmas season.
- Meeting with the Consejo Vecinal scheduled for friday 12/2 at 2pm
- Distribution strategies:
    - Maybe Consejo Vecinal (20 per barriada)
    - AmeriCorps

Meeting with Consejo Vecinal 12/2

Tony, Nate, Luis, Alfredo, Tania, representatives from 5 barriadas were present
Done entirely in spanish

Start with brief overview of project as a whole
Passed survey for review.

- The communities issues with flood insurance: What even is it? What does it do?
- How affordable is it? Is it affordable for people with low or no income (Pensions/retirement plans)?
- Showed FIRM and Zone X estimates for premiums
- Need to get rough estimates for Zone AE
- Add questions about how much was lost in the worst flood they remember?
- How frequent does it flood?
- Do they know what benefits insurance offers?
- Need to hammer in the necessity of insurance because of how susceptible their region is
- The people know that flooding is a problem but their either don’t think it's a big enough problem to fix or they don’t know how to fix it.
- Research insurance for organization buildings like schools and churches if there is time
- Change the price range on question 13

Appendix C: Community Walkthrough Photos

Appendix D: Flood Insurance Survey Questions

English Version:
We are a team of students from Worcester Polytechnic Institute, a university in Massachusetts, working with La Compañía para el Desarrollo Integral de la Península de Cantera (CDIPC). We are working to analyze vulnerabilities of the communities to flooding and analyzing possibilities for flood insurance for your homes. If you wish to omit an answer to any question, you may leave it blank.

1. In which *barriada* or housing complex do you live in?
   _____

2. How many years have you lived in your home?
   a. 0-5 years
   b. 6-10 years
   c. 11-15 years
   d. 16-20 years
   e. 21+ years

3. Do you rent or own your home?
   a. I rent
   b. I own
   c. Other:_____

4. On a scale from 1 to 10, how important is the problem of flooding in Cantera? Circle the corresponding number.
   1 2 3 4 5 6 7 8 9 10

5. On a scale from 1 to 10, what effect does flooding have on your home? Circle the corresponding number.
   1 2 3 4 5 6 7 8 9 10

6. Has there ever been a flood in your home? If no, skip to question 10.
    a. Yes
    b. No
    c. I don't know

7. How frequent does your home suffer damages caused by flooding?
    a. More than 4 times per year
    b. 2-4 times per year
    c. Once per year
    d. Less than once per year

8. What items suffered damages during the flood?
    a. Clothing or personal items
    b. Air conditioners or fans
    c. Building structure
    d. Domestic appliances
    e. Other:_____

9. Have you received federal funds for repairs from flood damage?
    a. Yes
    b. No
    c. I don't know
    d. My home has never flooded

10. Do you have flood insurance?
    a. Yes, and I pay $_____ per year
    b. No
    c. I don't know

11. If you don't have flood insurance, why not?
    a. I don't know about flood insurance
    b. I don't know if I am eligible for flood insurance
    c. I don't need it
    d. It is too expensive
    e. I had trouble buying it
    f. I couldn't find a broker
    g. Other:_____

12. Do you know of the benefits of flood insurance? What does insurance offer?

_____

13. If you don't have flood insurance, how much would you pay for a policy that covers up to $8,000 for damages caused by flooding?
    a. $1-$25
    b. $25-$50
    c. $50-$100
    d. $100-$200
    e. I wouldn't buy it

14. On a scale from 1 to 10, how important is flood insurance? Circle the corresponding number.

    1 2 3 4 5 6 7 8 9 10

15. What other types of insurance do you have? Circle all that apply.
    a. Life insurance
    b. Health insurance
    c. Renter's insurance
    d. Property insurance
    e. Car insurance
    f. House insurance
    g. Other:_____
    h. I don't have any other type of insurance

16. In total, how much do you pay for insurance every year?

    _____

Spanish Version:
Somos un equipo de estudiantes de Worcester Polytechnic Institute, una universidad en Massachusetts. Trabajamos con La Compañía para el Desarrollo Integral de la Península de Cantera (CDIPC) y querríamos analizar la vulnerabilidad de la comunidad a inundaciones y recoger información sobre el seguro de inundaciones en la comunidad. Si no quiere contestar una pregunta, la puede omitir.

1. En cual sector o proyecto de vivienda vive Ud.?

   _____

2. ¿Desde hace cuánto años vive Ud. en su hogar?
   a. 0-5 años
   b. 6-10 años
   c. 11-15 años
   d. 16-20 años
   e. 21+ años

3. ¿Alquila o es dueño de su hogar?
   a. Alquilo
   b. Soy dueño
   c. Otro: _____

4. En una escala del 1 al 10, ¿qué importancia tiene el problema de inundaciones en Cantera? Marque el número que corresponde.

   1 2 3 4 5 6 7 8 9 10

   No es un gran problema — Es el problema mas importante

5. En una escala del 1 al 10, ¿qué efecto tiene las inundaciones en su hogar? Marque el número que corresponde.

   1 2 3 4 5 6 7 8 9 10

   No me afectan Me afectan enormemente

6. ¿Alguna vez se ha inundado su hogar? Si no, pase Ud. a la #10
   a. Sí
   b. No
   c. No sé

7. ¿Cómo frecuentemente ocurren daños a causa de inundaciones en su hogar?
   a. Mas de 4 veces por año
   b. 2 - 4 veces por año
   c. Una vez por año
   d. Menos de una vez por año
   e. Nunca ha inundado mi hogar

8. ¿Cuales cosas sufrieron daños durante la inundación?
   a. Ropa y otras objetos personales
   b. Acondicionador o ventilador
   c. La estructura del edificio
   d. Aparatos domesticos
   e. Otras: _____

9. ¿Recibió Ud. fondos federales por los daños de inundaciones?
   a. Sí
   b. No
   c. No sé
   d. Nunca se ha inundado mi hogar

10. ¿Tiene Ud. un seguro contra inundaciones?
    a. Sí, yo pago $_____ por año
    b. No
    c. No sé

11. Si no tiene seguro contra inundaciones, ¿por qué?
    a. No sabía nada del seguro contra inundaciones
    b. No se si tengo derecho a un seguro contra inundaciones
    c. No lo necesito
    d. El seguro es demasiado caro
    e. Tenía dificultad para comprarlo
    f. No podia encontrar agente o agencia de seguros
    g. Otro: _____

12. ¿Sabe sobre los beneficios del seguro de inundaciones? ¿Que ofrece el seguro?

    _____

13. Si no tiene seguro contra inundaciones, ¿cuánto pagaría Ud. por una póliza que cubre hasta $8,000 de daños en caso de inundacion?
    a. $1 - $25 por año
    b. $25 - $50 por año
    c. $50 - $100 por año
    d. $100 - $200 por año
    e. No lo compraría

14. En una escala del 1 al 10, ¿qué importancia tiene el seguro de inundaciones?

1 2 3 4 5 6 7 8 9 10

No me importa Me importa mucho

15. ¿Tiene Ud. cualquier otro tipo de seguro? Escoge todo lo que corresponda.
    a. Seguro de vida
    b. Seguro de salud
    c. Seguro para inquilinos (Renter's insurance)
    d. Seguro de propiedad
    e. Seguro de auto
    f. Seguro para propietarios de casas (Homeowner's insurance)
    g. Otro: _____
    h. No tengo ningún otro tipo de seguro

16. En total, ¿cuánto paga Ud. por todos otros tipos de seguros en un año?

    _____

Appendix E: Survey Results

Survey	Question 1	Question 2	Q3	Q4	Q5	Q6	Q7	Q8
1	Ultimo Chance	21+ years	Own	10	9	Yes		Clothes/personal objects, Appliances
2	Las Margaritas	21+ years	Rent	10	10	Yes	4+ times/yr	Clothes/personal objects
3	Ultimo Chance	6-10 years	Rent	10	10	Yes	2-4 times/yr	Clothes/personal objects, Appliances
4	Santa Elena	0-5 years	Rent	5	1	No	Never flooded	Structure of the building
5		6-10 years	Own	5	5	No		
6	Corea	21+ years	Rent	10	4	No	Never flooded	
7	Parque Victoria	0-5 years	Rent	8	8	No	2-4 times/yr	Car
8		0-5 years	Own	6	2	No		
9		6-10 years	Own	5	8	No	2-4 times/yr	Appliances
10		21+ years	Rent	7	9	No	Never flooded	
11		6-10 years	Rent	10	1	No	Never flooded	
12		21+ years	Rent	10	4	No		
13	Bravos de Boston	21+ years	Own	10	10	Yes	4+ times/yr	
14	Corea	21+ years	Own	7	1	No	Never flooded	
15	Santa Elena	21+ years	Own	9	1	No	Never flooded	
16	Santa Elena	16-20 years	Own	4	1	No	Never flooded	
17	Santa Elena	21+ years	Own	10	1	Yes		
18	Santa Elena	21+ years	Own	10	1	No	Never flooded	
19	Santa Elena	0-5 years	Rent	6	4	No		
20	Santa Elena	21+ years	Own	9	9	Yes	Once a year	Clothes/personal objects, Appliances
21	Puente Guano	21+ years	Own	10	10	Yes	2-4 times/yr	Clothes/personal objects, Appliances
22	Bravos de Boston	21+ years	Own	8	7	Yes	2-4 times/yr	Clothes/personal objects, Appliances
23	Puente Guano	21+ years	Own	10	10	No	Never flooded	Appliances, Washing Machine
24	El Mirador	0-5 years	Rent	10	2	No	Never flooded	

Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Yes	Yes	I don't know about flood insurance	No			No other type	$0
No	No	La compania de vivienda publica	No	$1-$25	10	No other type	$0
Yes	No	It's too expensive	No	$1-$25	7	No other type	$0
No	No	No tengo dinero			8	Health	
	I don't know			$1-$25	5	Auto	
No							
No	No	I didn't know I was eligible	No	$25-$50	10	No other type	$0
	No	I don't know about flood insurance	No	I wouldn't pay		No other type	$0
No	No	It was too difficult to purchase	Yes	$50-$100	10	Health, Auto	$500
	No	I don't need it	No	I wouldn't pay	1	No other type	$0
	No	I don't need it	No	I wouldn't pay	1	No other type	$0
	No	I don't need it	No	I wouldn't pay	1	Life, Health	I don't know
No	No	I don't know about flood insurance	No	I wouldn't pay	1	Life, Health, Auto	$4,632
	No	I don't need it	No	I wouldn't pay	1	Health, Auto	$99
Yes	No	I don't need it	No	I wouldn't pay	1	No other type	$0
	No	I don't need it	No	$25-$50	2	Health, Auto	$99
	No	I don't need it	No	$25-$50	3	No other type	$0
	No	I don't need it	No	I wouldn't pay	1	No other type	$0
	No	I don't need it	No	I wouldn't pay	1	No other type	$0
No	No	I don't know about flood insurance	No	$50-$100	6	Health, Auto	$200
No	No	I didn't know I was eligible	No	$50-$100	10	Health, Auto	$200
No	No	I didn't know I was eligible	No	$1-$25	5	Health	
No	No	I didn't know I was eligible	No	$1-$25	3	Auto	$99
No	No	I don't need it		$1-$25	2	No other type	$0

Appendix F: Resource Packet

Natural Disaster Readiness Resource Packet

Created by students of Worcester Polytechnic Institute in conjunction with La Compañía para el Desarrollo Integral de la Península de Cantera

Table of Contents

Introduction

This resource packet is comprised of three different sets of guidelines to improve the safety of the Cantera community. These guidelines include, *Improving the Structural Integrity of a Household, Guidelines for Flood Insurance Before, During, and After a Flood,* and *Basic Disaster Preparedness Guidelines.*

The first set of guidelines offers advice on retrofitting a home in order to mitigate physical damages from natural disasters. These tips range from more expensive options to alternative options that are far cheaper but still effective.

The second set of guidelines highlights the importance of flood insurance and also contains information on how to obtain flood insurance and file a claim post-storm. Also within these guidelines are frequently asked questions for insurance agents in order to obtain the appropriate amount of coverage.

The final set of guidelines are basic disaster preparedness tips that are important for each family to follow in order to ensure safety in the community. These tips cover all sorts of hazards such as earthquakes, hurricanes, flooding, and tsunamis. Within each hazard, there are detailed tips for what to do before. during, and after the natural disaster occurs.

Guidelines to Improve the Structural Integrity of a Household

Against High Winds and Hurricanes:

During a hurricane, strong winds that result from it can be detrimental to a household structure. High winds can blow debris around and can break windows and doors, highlighting the importance of protecting the structure from such damages. There are a series of affordable measures that can be taken to better improve the house's structural integrity and mitigate the damages against high winds and hurricanes. These measures range from permanent hurricane ties that are applied to the main structural finishes, to shutters that can be applied just before a storm hits.

Feasible Methods

- **<u>Storm Shutters</u>** - one of the most economical solutions for homeowners to protect window openings in a storm. Storm shutters are important because the heavy winds from hurricanes could shatter windows. Also, storm shutters prevent the entrance of wind, rain, and debris into the household.

- Plywood – the least expensive alternative. Use a 5/8-inch exterior grade plywood, and for masonry houses, it is recommended that expansion bolts and galvanized expansion anchors are used. **Estimated Cost: $1-$5 per sq. foot**
- Storm Panel Hurricane Shutters - steel or aluminum shutters that attach to walls around windows. **Estimated Cost: $7-$8 per sq. foot**
- Accordion Hurricane Shutters - aluminum shutters *permanently* fixed outside of the windows. **Estimated Cost: $16-$20 per sq. foot**
- Bahama Hurricane Shutters - a one piece louvered shutters attached directly above the window that opens down to provide protection. **Estimated Cost: $18-$30 per sq. foot**

- **<u>Hurricane Ties</u>** – hurricane ties provide a connection between the truss/rafters and the wall. Hurricane ties are effective due to it increasing the resistance to wind and seismic forces. There are both ties that are meant specifically for structures where the walls and roof are comprised of wood, but also for masonry and wood. **Estimated Cost: $0.42-$0.71 per each tie (assembly required)**

Against Flooding:

Flood damage to the interior contents the household and to the mechanical and electrical equipment could prove very costly when attempting to repair it. Because of how costly it is to repair, it is very important to properly mitigate the physical damages that occur from flooding. The most effect ways to mitigate flood damaging include:

Dry Floodproofing- watertight below the level that needs flood protection to prevent floodwaters from entering or damaging home.

Wet Flood Proofing- prevents or provides resistance to damage from flooding while allowing floodwaters to enter the structure or area.

There are a series of affordable measures that can be taken to better improve the structure and mitigate the damages against flooding. These measures range from relocating and elevating utilities, to ensuring that there is an acceptable waterproof wall finish on the interior of your home.

Feasible Dry Floodproofing Methods

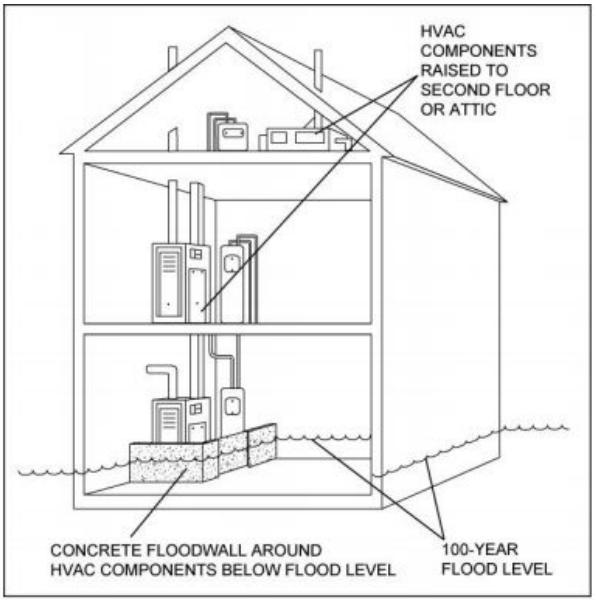
- **Floodwalls around Exterior Utilities** – can be built around outdoor utilities, which involves installing a reinforced concrete floodwall. It can be very effective at reducing and eliminating damage during flood events. The expected useful life cycle for a well-constructed flood wall of reinforced concrete is around 50 years. A much cheaper but less effective option instead of floodwalls can be multiple sandbags.

- **Sealant on Exterior walls-** before applying sealant on the exterior walls, it is important to make sure that the walls are cleaned. Basic store bought sealant can range anywhere from **$29.99 - $127.99.** Sealant must be reapplied every 1-2 years to maintain its maximum effectiveness.

- **Elevating Exterior Utilities and Meters** – If constructing reinforced concrete floodwalls proves to be unfeasible, elevating these outdoor utilities or electric meters can be an alternative. It is recommended that the utilities and meters are elevated at least one foot above the Base Flood Elevation (BFE). A method of doing this includes elevating equipment using a solid pad such as masonry or concrete shown in the picture below.

Feasible Wet Floodproofing Methods

- **Relocate Utilities from first floor to a second floor** – this task requires the work of a licensed contractor because it involves making changes to the plumbing, electrical system, and ventilating ductwork. This method will allow for water to enter the first level of the structure, yet not severely damage the important mechanical and electrical finishes. **Estimated Cost: $1,500**
- **Floodwalls around Interior Utilities** – this option is an alternative to a total relocation of interior utilities. Similar to the floodwalls that would be installed to protect exterior utilities, the concrete wall will greatly reduce the physical damages done to the mechanical and electrical finishes. The estimated cost of this method depends on the size of the wall needed to be constructed to protect flooding. To provide an example: **A 3-foot-high wall with a perimeter length of 35 feet would cost approximately $2,500**.



- **Abandon First Floor** – things to consider before completely abandoning the first floor is whether or not the household is large enough to do so. This also involves moving all valuables from the first floor up to higher floors from protection from floodwaters. This method is effective because it allows for water to flow into the first floor of the structure, but not damage anything in the area. **Estimated Cost: Free**

- **Applying Appropriate Interior Finishes** – the use of polyester-epoxy or oil based paint when applied to an interior concrete structural wall is an effective measure to prevent flood damage. Beware, this same paint is not effective when applied to a wood wall. The same goes for vinyl tile over a concrete floor, it proves to withstand flood damage very well, but not when it is applied over a plywood structural floor. Also be sure to avoid carpeting in your home, it is severely affected by flooding.

What makes a Building Material Unacceptable?

It is important to be able to understand why certain building materials fail during severe flooding. Materials can be unacceptable for one or more of the following reasons:

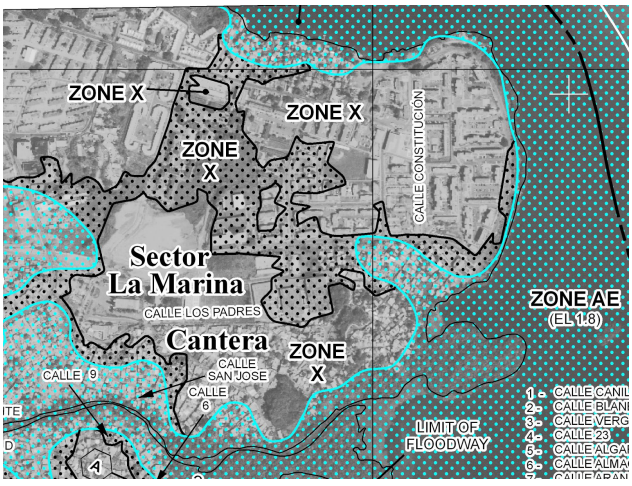
■ Normal adhesives specified for above-grade use are water soluble or are not resistant to alkali or acid in water, including groundwater seepage and vapor.
■ The materials contain wood or paper products, or other materials that dissolve or deteriorate, lose structural integrity, or are adversely affected by water.
■ Sheet-type floor coverings (linoleum, rubber tile) or wall coverings (wallpaper) restrict drying of the materials they cover.
■ Materials are dimensionally unstable.
■ Materials absorb or retain excessive water after submergence. (carpeting)

Note: Retrieved from Flood Damage-Resistant Materials Requirements

Guidelines for Flood Insurance Before, During and After a Flood

Before a Flood:

The Cantera Peninsula lies in an area very susceptible to flooding of all kinds. Hurricanes bringing heavy winds and rain can lead to flooding but even heavy rainfall can lead to flash flooding within a few hours. Evidence of this has been demonstrated by storms in the past such as Hurricanes Irene, Georges and Hugo. These all took place within the last 30 years and caused devastation in San Juan. The only reliable way to make sure that your house and property will be safe against a flood is to have flood insurance. If a flood causes damages to your house and you don't have flood insurance, the cost of repairs will be entirely on you. For this reason, flood insurance is essential to ensure that your home and possessions are safe.



How to Obtain Flood Insurance

The process of obtaining flood insurance is actually quite simple. Before you call an insurance agent, you should have some information ready. This information includes number of floors in your home, whether or not you have a basement and what flood zone your home is in. The flood zone is based on the Flood Rate Insurance Map (FIRM) provided by FEMA and can be found below. Once you have this information ready, you can contact a flood insurance agent in order to obtain an estimate for your annual premiums. Premium estimates for homes in Zone X is shown in Appendix A. A list of good questions to ask the insurance agent are shown below.

- **What flood zone do I live in? What is my property's flood risk?**
- Is flood insurance mandatory for my property? Will the lender require it?
- Do I qualify for a Preferred Risk Policy?
- **What will and won't be covered?**
- Will the Federal Government back my flood insurance policy?
- How much coverage should I get for my building and for my contents?
- How can I reduce my premium?
- Are there additional expenses or agency fees?
- Will my policy provide Replacement Cost Value or Actual Cash Value—and what's the difference between the two?
- Who should I call if I have a flood claim?
- How can I pay for my policy?

How to Prepare for a Flood in Terms of Insurance

The most important part of preparing for a flood in terms of insurance is to have a full inventory of your home. There should be a list of all appliances, furniture and other valuables including their dates of purchase, value and receipts if possible. Pictures of these items would also be greatly beneficial if they are damaged in a flood. You should also have copies of all important documents kept in a safe, waterproof place. These include insurance policy papers, insurance agent's contact information and the home inventory mentioned above.

During a Flood:

Once you are notified that a flood is imminent, there are several precautions that you should take to minimize damages sustained by the flood both to your home and yourself. These precautions include:

Preparing your Home

In order to prevent extensive damages to your home, there are several simple things you can do to minimize damage. The first is moving furniture and valuables to higher ground. If your home has an upper floor, move anything important and valuable to the upper floor to minimize the chance that they get destroyed by the flood. In addition, things that you are unable to move upstairs should be anchored to prevent them from floating away and causing damage to the structure of your house. Walk around your house and attempt to clear any loose debris or rubble that could become a projectile due to winds or rapidly moving water. Finally, if advised by local officials, turn off utilities and gas to prevent further damages during the flood.

Evacuating your Home

If local officials advise you to evacuate your home due to flooding, it is strongly suggested that you do. In Cantera, there are two nearby evacuation shelters: **San Juan Bosco School** and the **Boys and Girls Club of Las Margaritas**. Once flood levels get too high, evacuation will become too dangerous. If flood waters enter your house before you can evacuate, do not try to leave. Go to the top floor and listen for more news about the flood on a battery powered radio.

Returning to Your Home After a Flood:

Upon returning to your home, there are many precautions that need to be taken. The first is to inspect the outside of your home for any structural damages that could make it unsafe to enter. Once structural integrity is ensured, enter the house and begin to document information on the damages. Take note of water levels, damaged or lost property and damage to the building. This information will be critical for receiving reimbursement for damages. Make a list of all damaged property and take pictures if possible.

Filing a Claim

Call your insurance agent as soon as possible after returning to your home. He or she will contact an adjuster who will contact you within the following few days. If you are not contacted by the adjuster, reach out and contact the insurance agent again. Next, gather the information from both before and after the flood and have it prepared for when the adjuster arrives. The adjuster will examine the information from before and after the flood to evaluate how much money was lost during the flood. The final part of the claim is to submit a proof of loss. This is the official document to the insurance agency where you state how much you lost. The adjuster will assist you in creating this and must be submitted to the insurance agency within 60 days of the flood. A list of insurance agents can be seen in Appendix B.

Basic Disaster Preparedness Guidelines

Earthquakes:

Earthquakes are sudden tremors in the earth due to shifting of rock beneath the earth's surface. Earthquakes can happen at any time and without warning. Here are guidelines for how to prepare for, react during, and proceed after an earthquake.

Before an Earthquake

- Identify safe places in your home such as sturdy pieces of furniture or an interior wall to lessen the chance of debris falling and injuring you.
- Practice how to drop, cover, and hold on. Cover your head, and neck with your arms, find a safe place to get cover and wait out the earthquake.
- Secure items that could fall and cause injuries.
- Store critical supplies like water, medication, food, and documents.
- Plan how you will communicate with family members, including multiple methods by making a family emergency communication plan
- Keep a flashlight and sturdy shoes by each person's bed in case the earthquake strikes in the middle of the night.
- Bolt and brace water heaters and gas appliances to wall studs.
- Learn how to shut off the gas valves in your home and keep a wrench handy for that purpose.

During an Earthquake

- **If inside**
    - Stay where you are until the shaking stops. Do not run outside. Do not get in a doorway as this does not provide protection from falling or flying objects, and you may not be able to remain standing.
    - Drop down onto your hands and knees so the earthquake doesn't knock you down.
    - Cover your head and neck with your arms to protect yourself from falling debris.
    - If you are in danger from falling objects, and you can move safely, crawl for additional cover under a sturdy desk or table.
    - If there is low furniture or an interior wall or corner nearby, and the path is clear, these may also provide some additional cover.

    - Stay away from glass, windows, outside doors and walls, and anything that could fall, such as light fixtures or furniture.
    - Hold on to any sturdy covering so you can move with it until the shaking stops. Stay where you are until the shaking stops.
- **If getting safely to the floor to take cover won't be possible**
    - Identify an inside corner of the room away from windows and objects that could fall on you. The Earthquake Country Alliance advises getting as low as possible to the floor. People who use wheelchairs or other mobility devices should lock their wheels and remain seated until the shaking stops. Protect your head and neck with your arms, a pillow, a book, or whatever is available.
- **If you are in bed**
    - Stay there and Cover your head and neck with a pillow. At night, hazards and debris are difficult to see and avoid; attempts to move in the dark result in more injuries than remaining in bed.
- **If you are outside when you feel the shaking**
    - Move away from buildings, streetlights, and utility wires. Once in the open, "Drop, Cover, and Hold On." Stay there until the shaking stops. This might not be possible in a city, so you may need to duck inside a building to avoid falling debris.
    - If you are in a moving vehicle, stop as quickly and safely as possible and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires. Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that the earthquake may have damaged.
        - If a power line falls on your vehicle, do not get out. Wait for assistance.

After an Earthquake

- When the shaking stops, look around. If there is a clear path to safety, leave the building and go to an open space away from damaged areas.
- If you are trapped, do not move about or kick up dust.
- If you have a cell phone with you, use it to call or text for help.
- Tap on a pipe or wall or use a whistle, if you have one, so that rescuers can locate you.
- Once safe, monitor local news reports via battery operated radio, TV, social media, and cell phone text alerts for emergency information and instructions.
- Be prepared to "Drop, Cover, and Hold on" in the likely event of aftershocks.
- Look quickly for damage in and around your home and get everyone out if your home is unsafe.

- Check the telephones in your home or workplace to see if you can get a dial tone. Make brief calls to report life-threatening emergencies.
- Look for and extinguish small fires. Fire is the most common hazard after an earthquake.
- Clean up spilled medications, bleach, gasoline or other flammable liquids immediately.
- Open closet and cabinet doors carefully as contents may have shifted.
- Help people who require special assistance, such as infants, children and the elderly or disabled.
- Watch out for fallen power lines or broken gas lines and stay out of damaged areas.
- Keep animals under your direct control.
- Stay out of damaged buildings.

Floods:

Before a Flood

- Build or restock your emergency preparedness kit. Include a flashlight, batteries, cash, and first aid supplies.
- Put supplies in a safe spot and be ready to take it with you when evacuating
    - Water—at least a 3-day supply; one gallon per person per day
    - Food—at least a 3-day supply of non-perishable, easy-to-prepare food
    - Copies of personal documents (medication list and pertinent medical information, deed/lease to home, birth certificates, insurance policies)
    - Sanitation and personal hygiene items
    - Multi-purpose tool
    - Baby and Pet Supplies
    - Extra Clothing
- Avoid camping or parking along streams, rivers, and creeks during heavy rainfall. These areas can flood quickly and with little warning.
- Bring in outdoor furniture and move important indoor items to the highest possible floor. This will help protect them from flood damage.
- Disconnect electrical appliances and do not touch electrical equipment if you are wet or standing in water. You could be electrocuted.
- If instructed, turn off your gas and electricity at the main switch or valve. This helps prevent fires and explosions.

During a Flood

- Turn Around, Don't Drown! ® Just 6 inches of moving water can knock you down and 2 feet of water can sweep your vehicle away.
- Avoid walking or driving through flood waters.
- If there is a chance of flash flooding, move immediately to higher ground. Flash floods are the #1 cause of weather-related deaths in the US.
- If floodwaters rise around your car but the water is not moving, abandon the car and move to higher ground. Do not leave the car and enter moving water.
- Evacuate if directed.
- Move immediately to higher ground or stay on high ground.

After a Flood

- Return home only when authorities say it is safe.
- Be aware of areas where floodwaters have receded and watch out for debris. Floodwaters often erode roads and walkways.
- Do not attempt to drive through areas that are still flooded.
- Avoid standing water as it may be electrically charged from underground or downed power lines.
- Photograph damage to your property for insurance purposes.
- Before entering your home, look outside for loose power lines, damaged gas lines, foundation cracks or other damage.
- Parts of your home may be collapsed or damaged. Approach entrances carefully. See if porch roofs and overhangs have all their supports.
- Watch out for wild animals, especially poisonous snakes that may have come into your home with the floodwater.
- If you smell natural or propane gas or hear a hissing noise, leave immediately and call the fire department.
- Materials such as cleaning products, paint, batteries, contaminated fuel and damaged fuel containers are hazardous. Check with local authorities for assistance with disposal to avoid risk.
- Make sure your food and water are safe. Discard items that have come in contact with floodwater, including canned goods, water bottles, plastic utensils and baby bottle nipples. When in doubt, throw it out!

Hurricanes:

Basic Preparedness Tips

- Know where to go. If you are ordered to evacuate, know the local hurricane evacuation route(s) to take and have a plan for where you can stay. Contact your local emergency management agency for more information.
- Put together a disaster supply kit, including a flashlight, batteries, cash, first aid supplies, and copies of your critical information if you need to evacuate
- Hurricane winds can cause trees and branches to fall, so before hurricane season trim or remove damaged trees and limbs to keep you and your property safe.
- Secure loose rain gutters and downspouts and clear any clogged areas or debris to prevent water damage to your property.
- Reduce property damage by retrofitting to secure and reinforce the roof, windows and doors, including the garage doors. This includes boarding your windows up.

36 Hours Before a Hurricane

- Turn on your TV or radio in order to get the latest weather updates and emergency instructions.
- Plan how to communicate with family members if you lose power. For example, you can call, text, email or use social media. Remember that during disasters, sending text messages is usually reliable and faster than making phone calls because phone lines are often overloaded.
- Review your evacuation plan with your family. You may have to leave quickly so plan ahead.
- Keep your car in good working condition, and keep the gas tank full; stock your vehicle with emergency supplies and a change of clothes.

18-36 Hours Before a Hurricane

- Bookmark your city or county website for quick access to storm updates and emergency instructions.
- Bring loose, lightweight objects inside that could become projectiles in high winds (e.g., patio furniture, garbage cans); anchor objects that would be unsafe to bring inside (e.g., propane tanks); and trim or remove trees close enough to fall on the building.
- Cover all of your home’s windows. Permanent storm shutters offer the best protection for windows. A second option is to board up windows with 5/8” exterior grade or marine plywood, cut to fit and ready to install.

- Turn on your TV/radio, or check your city/county website every 30 minutes in order to get the latest weather updates and emergency instructions.
- Charge your cell phone now so you will have a full battery in case you lose power.

6 Hours Before a Hurricane

- If you're not in an area that is recommended for evacuation, plan to stay at home or where you are and let friends and family know where you are.
- Close storm shutters, and stay away from windows. Flying glass from broken windows could injure you.
- Turn your refrigerator or freezer to the coldest setting and open only when necessary. If you lose power, food will last longer. Keep a thermometer in the refrigerator to be able to check the food temperature when the power is restored.
- Turn on your TV/radio, or check your city/county website every 30 minutes in order to get the latest weather updates and emergency instructions.
- Turn off propane tank.
- Unplug small appliances.

After a Hurricane

- Drive only if necessary and avoid flooded roads and washed out bridges.
- Keep away from loose or dangling power lines and report them immediately to the power company.
- Inspect your home for damage. Take pictures of damage, both of the building and its contents, for insurance purposes.
- Use flashlights in the dark. Do NOT use candles.
- Avoid drinking or preparing food with tap water until you are sure it's not contaminated.
- Check refrigerated food for spoilage. If in doubt, throw it out
- Wear protective clothing and be cautious when cleaning up to avoid injury.
- Watch animals closely and keep them under your direct control.

Tsunamis:

Before a Tsunami

- To begin preparing, you should build an emergency kit and make a family communications plan.
    - Talk to everyone in your household about what to do if a tsunami occurs. Create and practice an evacuation plan for your family. Familiarity may save your life. Be able to follow your escape route at night and during inclement weather.

Practicing your plan makes the appropriate response more of a reaction, requiring less thinking during an actual emergency.
    - If the school evacuation plan requires you to pick your children up from school or from another location. Be aware telephone lines during a tsunami alert may be overloaded and routes to and from schools may be jammed.
    - Knowing your community's warning systems and disaster plans, including evacuation routes.
- If you are a tourist, familiarize yourself with local tsunami evacuation protocols. If you are concerned that you will not be able to reach a safe place in time, ask your local emergency management office about vertical evacuation. Some strong (e.g., reinforced concrete) and tall buildings may be able to provide protection if no other options are available.
- If an earthquake occurs and you are in a coastal area, turn on your radio to learn if there is a tsunami warning.
- Know the height of your street above sea level and the distance of your street from the coast or other high-risk waters. Evacuation orders may be based on these numbers.

During a Tsunami

- Follow the evacuation order issued by authorities and evacuate immediately. Take your animals with you.
- Move to high ground or inland and away from water immediately.
- Stay away from the beach. Never go down to the beach to watch a tsunami come in. If you can see the wave you are too close to escape it. CAUTION - If there is noticeable recession in water away from the shoreline this is nature's tsunami warning and it should be heeded. You should move away immediately.
- Save yourself - not your possessions.
- Remember to help your neighbors who may require special assistance - infants, elderly people, and individuals with access or functional needs.

After a Tsunami

- Return home only after local officials tell you it is safe. A tsunami is a series of waves that may continue for hours. Do not assume that after one wave the danger is over. The next wave may be larger than the first one.
- Go to a designated public shelter if you have been told to evacuate or you feel it is unsafe to remain in your home. Text **SHELTER** + your ZIP code to **43362** (4FEMA) to find the nearest shelter in your area (example: ***shelter 12345***).

- Avoid disaster areas. Your presence might interfere with emergency response operations and put you at further risk from the residual effects of floods.
- Stay away from debris in the water; it may pose a safety hazard to people or pets.
- Check yourself for injuries and get first aid as needed before helping injured or trapped persons.
- If someone needs to be rescued, call professionals with the right equipment to help. Many people have been killed or injured trying to rescue others.
- Help people who require special assistance—infants, elderly people, those without transportation, people with access and functional needs and large families who may need additional help in an emergency situation.
- Continue using a NOAA Weather Radio or tuning to a Coast Guard station or a local radio or television station for the latest updates.
- Stay out of any building that has water around it. Tsunami water can cause floors to crack or walls to collapse.

Appendices

Appendix A: Table 1: Premium estimates for homes located in Zone X

BUILDING & CONTENTS			CONTENTS ONLY		
Coverage	**Annual Premium**		**Coverage**	**Annual Premium**	
	Without Basement or Enclosure	**With Basement or Enclosure**		**Contents Above Ground**	**All Other Locations**
$20,000/ $8,000	$146	$177	$8,000	$48	$71
$30,000/ $12,000	$184	$215	$12,000	$68	$101
$50,000/ $20,000	$246	$277	$20,000	$106	$145
$75,000/ $30,000	$291	$327	$30,000	$123	$169
$100,000/ $40,000	$324	$360	$40,000	$138	$189
$125,000/ $50,000	$341	$378	$50,000	$153	$210
$150,000/ $60,000	$364	$400	$60,000	$168	$231
$200,000/ $80,000	$400	$442	$80,000	$196	$255
$250,000/ $100,000	$425	$474	$100,000	$226	$280

Note: Retrieved From National Flood Insurance Program

Appendix B: List of Insurance Agents

1. American National Insurance Company
    - Name: Tyler Cockrum
    - Position: Broker Relationship Mgr.
    - Phone: 417-887-4990 x4431
    - E-Mail: tyler.cockrum@AmericanNational.com
2. Assurant, DBA: American Bankers Insurance Company of Florida
    - Name: Patricia A. Mulvania
    - Position: Vice President
    - Phone: 800-423-4403 ext 5165772
    - E-Mail: patricia.mulvania@assurant.com
3. Hartford Fire Insurance Company
    - Subsidiary: Hartford Fire Insurance Company of The Midwest
    - Name: Robert Nadeau
    - Position: AVP, Flood
    - Phone: 860-547-8756
    - E-Mail: robert.nadeau@thehartford.com
4. Integrand Assurance Company
    - Name: Julio Torres
    - Position: Branch Manager
    - Phone: 787-781-0707 ext 113
    - E-Mail: juliotorres@integrand-pr.com
5. Mapfre PRAICO Insurance Company
    - Name: Alexis Sanchez
    - Position: Sr. VP Und & Reins.
    - Phone: 787-250-5292
    - E-Mail: asanchez@mapfrepr.com
6. New Hampshire Insurance Company
    - Name: Anthony Morro
    - Position: Underwriting Analyst
    - Phone: 610-941-9877, x257
    - E-Mail: avmorro@nsminc.com
7. Philadelphia Indemnity Insurance Company
    - Name: Pamela Moats
    - Position: Flood Product Manager

    - Phone: 877-672-7945 ext 8295
    - E-Mail: pamela.moats@phly.com
8. Triple-S Propiedad
    - Name: Jose del Amo
    - Position: SVP Udw. & Op.
    - Phone: 787-749-4600
    - E-Mail: jose.del.amo@ssspr.com
9. United Surety & Indemnity Company
    - Name: Janice M. Pagan
    - Position: CISR Manager
    - Phone: 787-625-1108
    - E-Mail: janice.pagan@usicgroup.com
10. Universal Insurance Company (PR)
    - Name: Michelle Diaz
    - Position: Flood Insurance Coordinator
    - Phone: 787-706-7372
    - E-Mail: midiaz@universalpr.com

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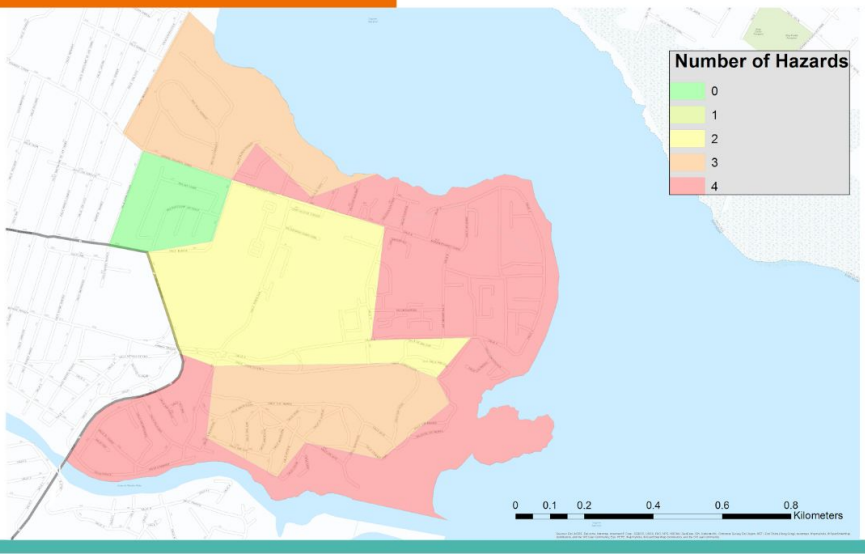
Appendix G: Community Presentation Slides and Script

Preparación para los Desastres Naturales

Evan Lacroix, Connor Mastropoll, Nate McNeill, and Tony Rodriguez

Vulnerabilidad a Desastres

- Licuación
- "Storm Surge"
- Tsunamis
- Inundación de 100 años



Preparación para Desastres

¿Por qué me importa?

- Reacción lento de los servicios de emergencia
- Garantizar la seguridad de la familia
- Facilitar la recuperación de la comunidad

Preparación para Desastres

- Inundaciones
- Huracanes
- Tsunamis
- Terremotos

Inundaciones

- Cree un kit de emergencias
- Evacue si es aconsejable
- No toque aguas estancadas

Huracanes

- Ajuste refrigerador y nevera al nivel más frío
- Zapatos/linterna cerca la cama
- No bebe agua de pluma hasta que diga el Municipio que es seguro

Tsunamis

- Evacue a terreno alto
- Deje pertenencias atrás--su vida es más importante
- Espere que los servicios de emergencia ya hayan terminado antes de volver

Terremoto

- Asegurar los pertenencias y electrodomésticos
- Quédese cerca de una pared interior o un mueble fuerte

Preparación para Desastres

Consejos universales:

- Haga un plan de comunicación familiar
- Conozca bien una ruta de evacuación
- Cree un kit de emergencias
- Escuchan a los oficiales locales y estatales

Construcción Resistente a Desastres

¿Por qué me importa?

- Prevenir daños estructurales durante desastres
- Garantizar la seguridad de la gente en los edificios
- Facilitar el recuperación de la comunidad

Improving Structural Integrity of a Household

Métodos de Construcción:

- Contra huracanes/viento fuerte
- Contra inundación

Materiales de Construcción:

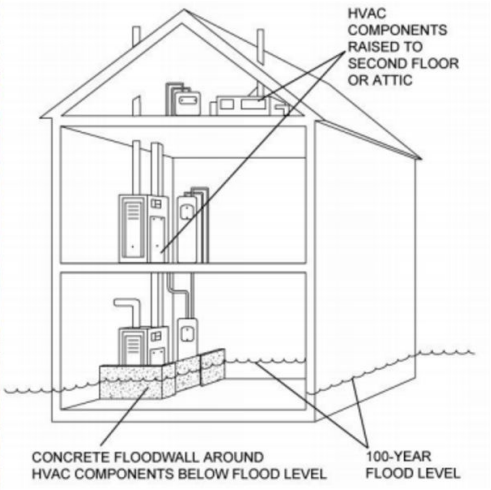
- Materiales resistentes a inundación
- Materiales inaceptables

Evitar Daños de Huracanes:

- Hurricane Ties
- Contraventanas

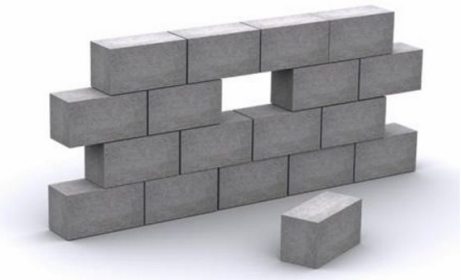
Reducir el Riesgo de Daños debido a Inundación

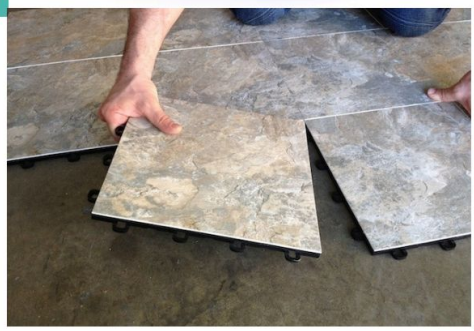
- Elevar o reubicarse los electrodomésticos
- Sellador exterior



Materiales resistente a inundaciones

- Concreto
- Azulejo de vinilo
- Pintura resistente al agua





Materiales Inaceptables

- Madera
- Paneles de yeso
- Papel pintado
- Alfombra

Seguros Contra Inundaciones

¿Por qué me importan?

- **Inundaciones son gran problema en Cantera**
- **Los seguros pagarán por lo menos 80% de daños debido a inundaciones**

Seguros Contra Inundaciones

- ¿Por qué debo comprar una póliza?
  - Sin seguro, no se recibirá ayuda financiera por daños
  - Premios anuales empiezan a las $50
- ¿Cómo funciona?
  - Registre cosas dañadas después de una inundación
  - Un tasador de reclamación le ayudará llenar y enviar una forma de prueba de pérdidas
  - Entonces, reciba su reembolso

Seguros Contra Inundaciones

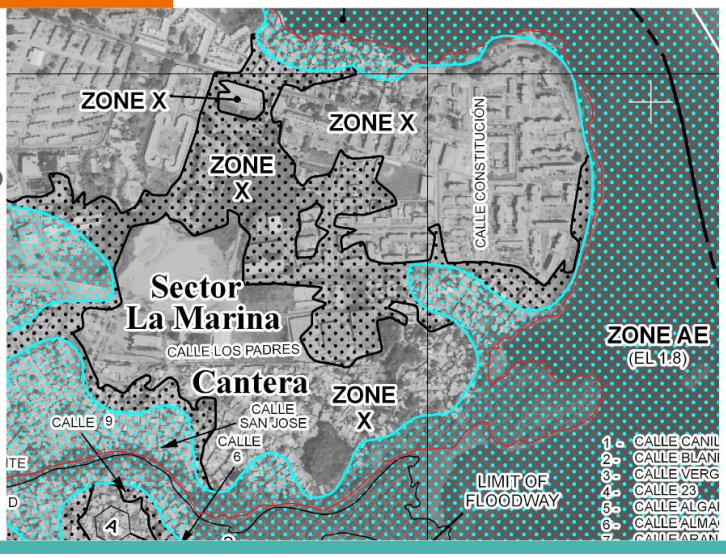
- ¿Cómo lo uso?
  - Antes de la inundación:
    - Guarde sus posesiones y documentos
    - Tome una inventoria completa de cosas de valor
  - Después de la inundación:
    - Contacte su agente si encuentra daños
    - El tasador le contactará entre 48 horas
    - Envíe la forma de prueba de pérdidas

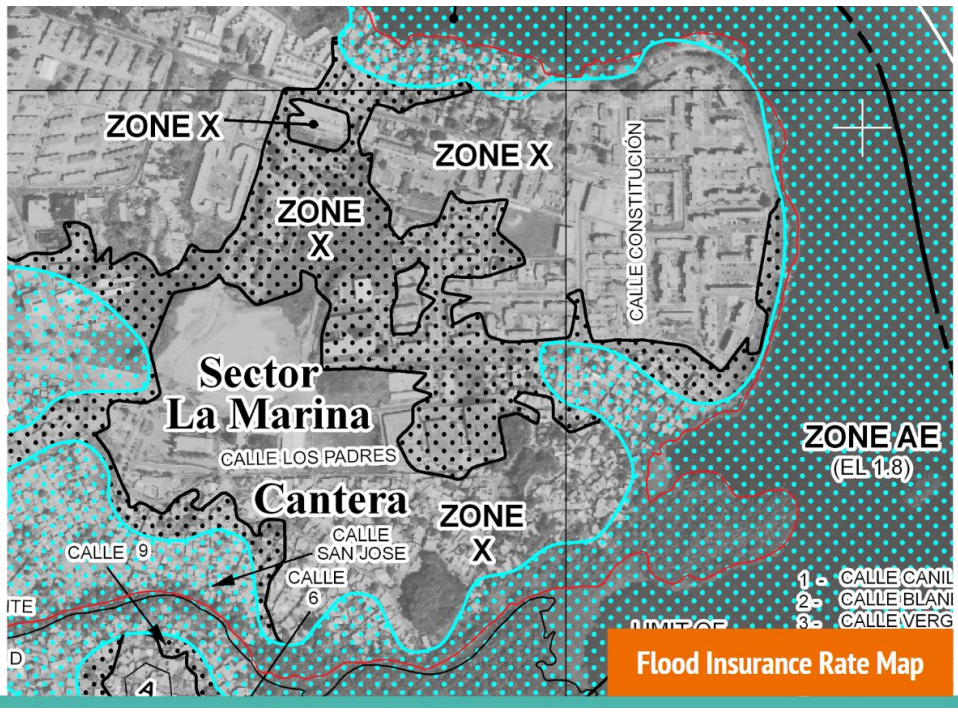
Flood Insurance Rate Map

Flood Insurance Rate Map (FIRM)

Zona X: Poco a moderado riesgo
- Cumplen los requisitos para la prima rebajada

Zona AE: Alto riesgo
- Primas aumentan con la disminución de la altura

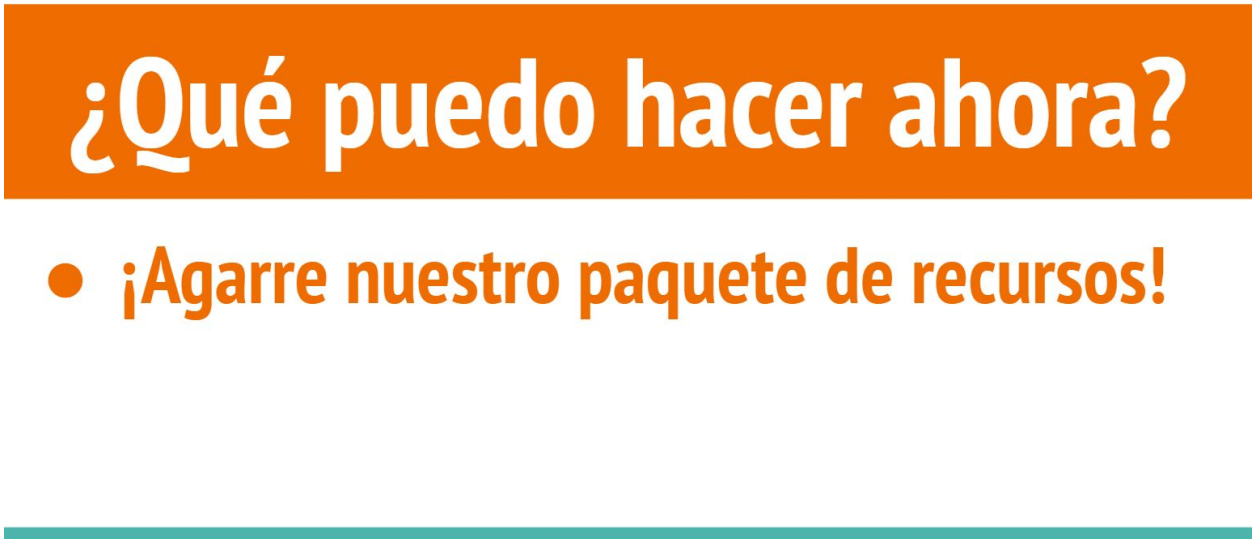




Seguros Contra Inundaciones

- ¿Cuánto costará?

BUILDING & CONTENTS			CONTENTS ONLY		
Coverage	Annual Premium		Coverage	Annual Premium	
	Without Basement or Enclosure	With Basement or Enclosure		Contents Above Ground	All Other Locations
$20,000/ $8,000	$146	$177	$8,000	$48	$71
$30,000/ $12,000	$184	$215	$12,000	$68	$101
$50,000/ $20,000	$246	$277	$20,000	$106	$145



Community Presentation Script

Slide 1
Slide 2

- Este mapa es una representación de la vulnerabilidad de los desastres naturales diferentes que le afectan a la gente en Cantera
- Los cuatro desastres son:
    - Licuación, cuando la tierra mojado actúa como si fuera un líquido durante un terremoto
    - "Storm surge", que refiere al aumento del nivel de agua debido a una tormenta tropical o huracán
    - Los tsunamis
    - Y el riesgo de la inundcion de cien años, que refiere al aumento de nivel de agua mas alto de 100 años
    - Como se puede ver, la mayoría de la costa es vulnerable a todos los cuatro riesgos

Slide 3
Slide 4

- La preparación para desastres naturales marca un gran diferencia en los efectos de desastres en las familias de la comunidad.

- Los servicios de emergencia toman mucho tiempo en llegar a la península después de un desastre; pues ser preparado se asegura de que Ud. y su familia estén seguros.
- Además, puede acortar el tiempo de recuperación después de desastres

Slide 5

- Las guías generales de preparación para desastres son divididas en cuatro partes específicos de cada desastre común.
- Cada parte se divide en tres secciones: consejos antes de, durante, y después de un desastre.

Slide 6

- Las inundaciones son el desastre más prevalente que nada en Cantera. Unos ejemplos de consejos son:
    - Cree un kit de emergencias para ser preparado si ocurre desastre natural
    - Evacue durante inundación sería si es seguro hacerlo
    - Ni maneje ni camine por los aguas estancadas
    - Al llegar a casa después de un gran desastre, no toque los aguas estancados; es posible que sean cargados de electricidad debido a cables de alta tensión caídos

Slide 7

- Los huracanes suelen llevar muchos avisos antes de llegar, pues es mas facil preparar.
    - Ajuste el refrigerador al nivel más frío para preservar la comida en caso de apagón
    - Guarde zapatos robustos y una linterna pegados a la cama
    - No beba agua de la pluma hasta que diga el Municipio que es seguro; las tuberías pueden rasgar y contaminar el agua

Slide 8

- Los tsunamis llegan rápidamente y a veces sin aviso, pues mandan acción inmediata.
    - Evacue a terreno alto y deje las pertenencias atrás--su vida es más importante
    - Espere que los servicios de emergencia ya hayan terminado su trabajo antes de volver a casa-- a ellos les estorban los ciudadanos durante sus operaciones

Slide 9

- Los terremotos ocurren sin aviso. Un método de preparar es asegurar los pertenencias y electrodomésticos con soportes para que no caigan. En el momento de terremoto, manténgase calmado y quédese cerca de una pared interior o debajo de un mueble fuerte

Slide 10

- Para asegurarse durante cualquier tipo de desastre o emergencia, haga un plan de comunicación entre su familia y conozca bien una ruta de evacuación
- Cree un kit de emergencias con suministros médicos y tres días de comida y agua para cada persona
- Oficiales locales y estatales siempre tienen información en el tele y el radio sobre el desastre y lo que deben hacer las familias

Slide 11

- Ahora pasaremos a la importancia de la construcción resistente a desastres en su hogar

Slide 12

- Es muy importante tener construccion de materiales de alto calidad para mantener la integridad estructural del hogar y para proteger los residentes durante un desastre natural

Slide 13

- Hay dos tipos de métodos de construcción principales para proteger su hogar contra dos tipos de desastre: contra huracanes y viento fuerte, y contra inundación
- También tenemos una lista de materiales impermeables y una otra lista de materiales que descomponen ante inundaciones frecuentes

Slide 14

- El primer ejemplo de un método contra huracanes se llama “hurricane ties” y puede verlos en las dos fotos de arriba. Son muy baratos y ayudan a amarrar el techo a las paredes durante viento fuerte.
- El otro ejemplo son las contraventanas, que pueden ser permanente o temporales como las de contrachapado

Slide 15

- Para bajar el riesgo de daño debido a inundación, hay que elevar los electrodomésticos interiores y exteriores. Puede elevarlos con ladrillos o si no los puede elevar, también se puede construir un muro de cemento alrededor de los electrodomésticos

Slide 16

- Algunos ejemplos de materiales resistentes a inundaciones incluyen concreto para los paredes, azulejo de vinilo para los pisos y pintura resistente al agua para el interior y exterior de la casa.
- Estos materiales son muy efectivos en la prevención de los daños los hogares que se inundan frecuentemente.

Slide 17

- No se debe usar madera y paneles de yeso para la construcción porque se deterioran durante y después de inundaciones.
- También, evite materiales como papel pintado y alfombra porque absorben y llevan agua y previenen las materiales al bajo de secar.

Slide 18

Slide 19

- Es muy importante tener seguro de inundaciones en lugares vulnerables. En un cuestionario de unos residentes de Cantera, la mitad estaban de acuerdo que las inundaciones son un problema grande y las votaban un problema de 10/10. Cada persona dijo que es a lo menos 5/10.
- En el evento de una inundación, FEMA solo puede darle dinero la próxima vez que hay daños. Después, FEMA anticipa que Ud. va a obtener seguro.

- Según la NFIP, unas pocas pulgadas de agua pueden causar cientos o miles dólares de daños.

Slide 20

- Estimados para seguro es fácil para obtener y puede tomar menos de veinte minutos.
- Si su hogar sufre daños durante una inundación, documentarlos por sacar fotos. Saque fotos de posesiones dañados y el nivel altísimo del agua. Entonces, contacte su agente para empezar el proceso de reclamación.
- Un tasador de reclamación le contactará entre las próximas 48 horas y vendría a su casa para analizar los daños. Fotos antes y después de la inundación pueden ayudar el proceso mucho.
- Él le ayudará crear una forma de prueba de pérdidas. Mande la prueba de pérdidas a la agencia dentro de 60 días.

Slide 21

- Una cosa muy importante en el uso de seguro de inundaciones es tomar inventoria de sus posesiones. Saque fotos de los muebles, electrodomésticos y otras cosas de valor.
- También, mantenga una colección de copias de documentos importantes en un lugar protegido de inundaciones.
- Esto es para asegurar que reciba la cantidad de dinero correcto

Slide 22

- Este mapa muestra como agencias de seguros determinan las primas anuales. Áreas azules había determinado a ser zonas de riesgo alto y residentes que viven en esta zona necesitan pagar más para el seguro.
- Las áreas negras o sin color son zonas de poco o moderado riesgo y están calificados para primas reducidas.

Slide 23

Slide 24

- Esta tabla muestra estimados para primas anuales en Zona X. Como se puede ver, primas empiezan en menos de $50 por año y provienen hasta $8,000 en cobertura por el mismo año. La representa $120 de cobertura por cada $1 gastado.

Slide 25