Policy Actions of Texas Gulf Coast Cities to Mitigate Hurricane Damage: Perspectives of City Officials.

By
James Parker Wilson

An Applied Research Project
(Political Science 5397)
Submitted to the Department of Political Science
Texas State University
In Partial Fulfillment for the Requirements for the Degree of
Masters of Public Administration

Faculty Approval:

_____
Patricia M. Shields, PhD

_____
Charles Brown, PhD, J.D.

_____
Dustin McLemore, MPA

Fall 2009

Abstract

Purpose: The purpose of this study is to describe the policy actions of Texas Gulf Coast cities to mitigate the risk for potential hurricane damage. After conducting a review of the scholarly literature on hurricane damage mitigation policy, fourteen mitigation policy actions were identified, and then divided into the following five categories: building codes, the planning process, incentives to mitigate, assess vulnerability and resilience, and mitigation through zoning. After administering a survey to city officials in the Texas Coastal Zone, a preliminary assessment of the utilization of the fourteen mitigation policy actions was conducted.

Method: Survey research was the sole method of data collection for this study. The survey was sent to 71 city officials for cities located in the Texas Coastal Zone with some form of local government. The fourteen policy actions identified in the scholarly literature served as a framework that was used to develop the survey instrument. Descriptive statistics were utilized to analyze the collected survey data; this included the mean, median, mode and frequency distribution.

Findings: Preliminary findings suggested respondents were utilizing policy actions in some categories while neglecting other categories. Specifically, respondents were not using zoning practices to mitigate nor were they offering incentives to landowners to encourage mitigation efforts.

About the Author

James P. Wilson is a Master of Public Administration candidate at Texas State University – San Marcos. He received his bachelor's degree in Criminal Justice in 1995 from Valparaiso University and is currently employed by the Travis County Juvenile Probation Department. Mr. Wilson can be reached via email at jpwilso@yahoo.com.

The inspiration to research hurricane damage mitigation policy started after visiting New Orleans, Louisiana five months after Hurricane Katrina and witnessing the catastrophic damage first hand.

Dedication

This research is dedicated to the memory of those souls who lost their lives to a hurricane disaster.

Table of Contents

Figures

Tables

Chapter 1 : Introduction

Hurricanes pose a significant threat to cities along the Gulf Coast of the United States. The overwhelming property damage that followed Hurricanes Katrina and Ike served as stark reminders of how vulnerable coastal areas can be. The aftermath of Hurricane Katrina was particularly traumatic: The national news displayed video images of rooftop rescues of stranded citizens and flood waters ravishing neighborhoods.[1] It is estimated that Hurricane Katrina resulted in approximately 1500 deaths and $81 billion dollars in damage (Blake et al. 2007, 7-8). Did the aftermath of Hurricane Katrina elevate policy makers' concern for the threat hurricanes pose to our coastal communities?

The literature on disaster management supports the idea that a "triggering event" influences disaster management policy, scholars (Prater and Lindell, 2000; Birkland and Waterman, 2008) suggest disaster policy is event driven. Prater and Lindell (2000, 73) maintain, "...the risks involved in developing hazardous areas tend to be discounted by residents and local governments unless they have recently experienced a disaster." This suggests there is a connection between the amount of time that has passed since the last disaster, in this case a major hurricane, and the community's motivation to mitigate potential future disaster (hurricane) damage. A good deal of federal disaster management legislation can be connected to a specific disaster event (Birkland and Waterman, 2008), and it is widely recognized that federal policy influences local policy through federal assistance for disaster

1. The following U.S. Coast Guard video found on YouTube taken in the Katrina aftermath displays dramatic images of rooftop rescues along with the catastrophic damage caused by the storm. (http://www.youtube.com/watch?v=jI7F84mRCJ0).

response and recovery.[2] For example, Birkland and Waterman (2008, 695) suggest that Hurricane Camile (1969) led to the Disaster Relief Act of 1969; just as the Alaskan Earthquake of 1964, the San Fernando earthquake of 1971, and Hurricane Agnes (1972) resulted in the Disaster Relief Act of 1974. Interestingly, that act was one of the first pieces of legislation that explicitly discussed the concept of disaster mitigation (Birkland and Waterman 2008, 696).

Disaster management has four aspects: mitigation, preparedness, response, and recovery.[3] Because disaster management policy is typically event driven, the policy historically has been reactive in nature, and thus for many years focused on response and recovery. Recently, as disaster management policy has evolved, the focus has shifted to mitigation,[4] which has become the theme in disaster management policy discussions, it recognizes preemptive steps communities can take to minimize damage caused by natural disasters.

Detailed later (in Chapter 2 , Setting), Texas has 367 miles of coastline[5] in a region with frequent hurricane activity. According the National Oceanic and Atmospheric Administration (NOAA), since 1950, 26 hurricanes and 32 tropical storms have passed within 65 nautical miles of the Texas coastline (See **Tables 2.1 and 2.2 in** Chapter 2 for details). Nearly 25 percent of Texans live in the 18-county coastal region.[6] Houston is the

---

2. See Clary, (1985), Bogard (1988), Wamsley and Schreoder (1996), Boswell et al. (1999), Pilkey and Young (2005), and Birkland and Waterman (2008).
3. See Clary (1985), McLoughlin (1985), Godschalk and Brower (1985), Waugh (1994), and Edwards (2007).
4. See Clary (1985), McLoughlin (1985), Cutter et al. (2000), Mileti and Peek-Gottschlich (2001), McLean (2004), Edwards (2007).
5. The University of Texas Bureau of Economic Geology as referenced by the Texas General Land Office (2003, 2)
6. 2003 Total Population Estimates for Texas Counties, Texas State Data Center, Office of the State Demographer, The University of Texas at San Antonio as referenced by the Texas General Land Office (2003, 2).

third largest metropolitan area in the United States close to a coast (FEMA 2009, 8-9), thus a substantial portion of the Texas population resides in a zone at high risk for hurricane activity. As of September 2009, Hurricane Ike was the most recent hurricane to strike the Texas Coast. Even though Ike was only a Category 2 storm, it caused an estimated Ike $21.3 billion in damage, making it the fourth costliest hurricane in history.[7] **Figure 1.1** displays a map of the Crystal Beach area along the Bolivar Peninsula of Texas, an area that suffered catastrophic damage following Hurricane Ike. The "**1**" and "**2**" in **Figure 1.1** map the location of the photos in **Figures 1.2 and 1.3,** respectively. **Figures 1.2 and 1.3** display before-and-after pictures for an area of Crystal Beach inundated by the storm surge of Hurricane Ike. Please note that the yellow arrows in **Figures 1.1** and **1.2** indicate landmarks and highlight structures that survived the storm. These structures likely survived because they were elevated above the required height set by the building code (FEMA, 2009). (The following YouTube video: http://www.youtube.com/watch?v=ofvDTeN807I shows U.S. Coast Guard aerial footage of the Crystal Beach area in the immediate aftermath of Ike).

7. See Blake et al. (2007) as referenced by FEMA (2009, 1-2).

Figure 1-1 Map of Crystal Beach, TX, on the Bolivar Peninsula

Figure 1.1

Source: http://coastal.er.usgs.gov/hurricanes/ike/photo-comparisons/bolivar.html

Figure 1-2 Crystal Beach, TX, before and after Hurricane Ike

Figure 1.2

Source: http://coastal.er.usgs.gov/hurricanes/ike/photo-comparisons/bolivar.html

Figure 1-3 Crystal Beach, TX, before and after Hurricane Ike

Figure 1.3

Source: http://coastal.er.usgs.gov/hurricanes/ike/photo-comparisons/bolivar.html

The risk for hurricane damage along the Texas coast is significant, the potential risk for catastrophic damage can be reduced if communities take action to mitigate their vulnerability. Chapter Three (Hurricane Damage Mitigation Policy) highlights 14 policy actions local communities can implement to reduce their risk for hurricane damage. These 14 policy actions were identified after this author conducted a comprehensive review of the literature on hurricane damage mitigation policy. Unlike the reactive response-and-recovery aspects of disaster management, mitigation efforts can address more than a single event, and are designed to address the next disaster and all future ones (McLoughlin 1985, 171). In other words, mitigation policy and action are not simply reactions to the most recent disaster, but, proactive, long-term actions to reduce future losses. An examination of current mitigation policy actions along the Texas coast will shed light on the overall vulnerability of the Texas coast to future hurricanes.

Research Purpose

As a descriptive study,[8] this paper will first, identify several categories of policy local governments can implement to mitigate the risk of hurricane damage. Second, this study will describe the policy actions of Texas Gulf Coast cities to mitigate potential hurricane damage from the perspective of city officials based on a survey. The aim is to shed new light on the role of mitigation planning along the Texas Gulf Coast.

8. See Shields (1998) and Shields and Tajalli (2006) for a discussion regarding descriptive research and the use of descriptive categories.

Chapter Summaries

This paper is divided into six chapters. Chapter two describes the history of disaster management policy in the United States,[9] offering an overview of the Texas coast and examining the history of hurricane activity along that coast. Chapter Three describes the 14 policy actions communities can implement to mitigate the risk for hurricane damage; these were derived from a careful examination of the scholarly literature. Chapter Four describes the methodology used: the research technique; the strengths and weaknesses of the research method; the population; human subject issues; and statistics. Additionally, within Chapter Four the descriptive categories are operationalized (see **Table 4.1**). Chapter Five highlights the results of the survey and provides an analysis of the data. Chapter six sums up the survey results and gives a preliminary assessment of Texas coastal cities' utilization of the 14 mitigation policy actions outlined in Chapter Three (based on the survey).

9. See Phillips (1998), Ellis (2001), Gatlin (2006), Petersen (2006), and Cox (2006) for additional information regarding disaster management policy.

Glossary of Abbreviations

BFE – Base Flood Elevation

CARRI – Community and Regional Resilience Initiative

CBRA – Coastal Barrier Resources Act

CCA – Coastal Coordination Act

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Maps

GIS – Geographic Information Systems

GIWW – Gulf Inter-coastal Water Way

NFIP - National Flood Insurance Program

NGA – National Governor's Association

NOAA – National Oceanic and Atmospheric Administration

SLOSH – Sea, Lake and Overland Surges from Hurricanes

TCMP – Texas Coastal Management Program

TDR – Transfer of Development Rights

Chapter 2 : Setting

Chapter Purpose

This chapter describes the history of disaster management policy in the United States. It offers an overview of the population and economy along Texas Gulf Coast, and examines the history of hurricane activity along that coast. Reviewing the history of disaster management policy, demonstrating the economic significance of the Texas Gulf Coast region, and examining the history of hurricanes in the region, provides a perspective on the region needed for the later discussion of policy actions that communities can take to mitigate potential hurricane damage along the Texas Gulf Coast.

History of Disaster Management Policy

Disaster management policy is not a new discipline; in fact, policies for disaster management have been in existence for over 200 years. In 1803, Congress passed the first piece of disaster legislation (Clary 1985, 20); its purpose was to provide assistance to Portsmouth, New Hampshire, in the wake of a disastrous fire. In the century that followed, special legislation was passed more than one hundred times in response to hurricanes, earthquakes, floods and other natural disasters.[10]

According to Frances (2007, 31), the 10th Amendment implies that the responsibility for emergency management preparedness for natural disasters falls on the states; well into the twentieth century, disaster response, relief, and recovery were viewed primarily as a state and local function.[11] This was true for both constitutional and practical reasons. State and local

10. Source: http://www.fema.gov/about/history.shtm
11. See Haddow, et al. (2007), and Sylves (2007) as referenced by Birkland and Waterman (1988, 695).

governments are typically "first" at the scene when responding to a natural disaster.[12] Also, natural disasters tend to be regional, involving only a few states or a local area. Therefore, it makes sense that response, relief, and recovery efforts were historically treated as a state and local function.

However, in the late 1940s the federal government began to pay more attention to disaster management. According to Kreps (1990), increased federal attention to emergency management was rooted in preparations taken during the Second World War to mitigate damage from potential enemy bombing.[13] But, following World War II, federal attention to emergency management began to gradually shift away from civil defense and toward natural hazards (Birkland & Waterman 2008, 695). The Disaster Relief Act of 1950 set in motion the first comprehensive, nationwide system of disaster response and relief, and for the first time authorized a coordinated federal response to disasters. Before 1950, the Red Cross operated as the primary disaster relief agency in the United States and was the major source of funds for disaster recovery.

In 1979, the National Governors Association (NGA) studied the issue of disaster response and found there was no systematic plan for addressing disasters comprehensively.[14] The governors discussed and embraced the four-phase concept of emergency management: mitigation, preparedness, response, and recovery (Birkland and Waterman 2008, 695) which remains widely accepted by experts today. The Federal Emergency Management Agency (FEMA) was formed in 1979 by President Carter's Executive Order (12127) in response to the NGA. FEMA was designed to merge government disaster-related responsibilities into one

12. See Schneider (2008) as referenced by Birkland and Waterman (2008, 695).
13. See Kreps (1990) as referenced by Birkland and Waterman (2008, 695).
14. Waugh 2000, Haddow and Bullock, 2006 as referenced by Frances (2007, 31).

agency. In 1983, FEMA adopted the four-phase cycle developed by the NGA and required each local government to have an emergency operations plan to address natural disasters (Frances 2007, 31).

Even though FEMA was formed in 1979, the transformation from civil defense focus to natural hazard response did not fully take root until the enactment of the Stafford Act in 1988 (Birkland and Waterman 2008, 697). The passage of the Stafford Act provided a relatively clear statement of how the federal government viewed its disaster management role with regard to states. The Stafford Act officially recognized state and local governments as "first responders" in nearly all disasters, and defined the federal role as supportive. Amendments to the Stafford Act in 1993 and 2000 were intended to improve its performance and to stress mitigation efforts, but these amendments did not alter the federal government's supportive role to state and local governments during disasters (Birkland and Waterman 2008, 696). Although the 1993 and 2000 amendments to the Stafford Act discussed mitigation and signaled the shift to a mitigation strategy, it was the Disaster Mitigation Act of 2000 that finally required all jurisdictions to develop plans aimed at helping reduce the effects of future disasters (Edwards 2007, 32). The Disaster Mitigation Act of 2000 required communities to have a federally approved mitigation plan in place before being eligible to receive federal mitigation funding (McLean 2004, 9). With this Act, it appears the federal government officially adopted hazard mitigation action as clear strategy to address natural disasters and reduce damage associated with them.

The Texas Gulf Coast

Texas has 367 miles of coastline and more than 3,300 miles of bay shores.[15] Nearly two-thirds of the state's Gulf shoreline is protected in parks, wildlife refuges and natural areas where development is prohibited.[16] However, even though nearly two-thirds of the Texas coast is off limits to development, nearly 25 percent of Texans live in the 18-county coastal region.[17] Consider that Houston is now the fourth largest city in the United States, and the third largest metropolitan area close to a coast (FEMA 2009, 8-9). In addition, a recent population trend has shown a rapid rise in development along the upper Texas coast, and this trend is expected to continue (FEMA 2009, 8-9).

The growth along the Texas Coast has played a vital role in the state's economy. Galveston Bay supports the nation's largest concentration of oil refineries[18] and a sizable chemical industry, which is ranked first in the nation in size and production.[19] The coast is home to three of the top ten ports in the country (based on total cargo tonnage).[20] Texas' commercial fishing fleets bring in more than $170 million annually,[21] and more than 66 million short tons of cargo move along the Texas portion of the Gulf Inter-coastal Water Way (GIWW) each year with a commercial value of more than $25 billion (See Figure 2.1).[22] But ports and petrochemical production are only a part of the economic benefit derived from the

15. The University of Texas Bureau of Economic Geology as referenced by the Texas General Land Office (2003, 2).
16. "Shoreline Inventory," Beach/Dune Team, Coastal resources Program, as referenced by the Texas General Land Office (2003, 2).
17. 2003 Total Population Estimates for Texas Counties, Texas State Data Center, Office of the State Demographer, The University of Texas at San Antonio as referenced by the Texas General Land Office (2003, 2).
18. NPRA United States Refining & Storage Capacity Report, National Petrochemical and Refiners Association, Washington, D.C., July 2004, p. 2. as referenced by the Texas General Land Office (2003, 2).
19. Texas Chemical Industry Fact, Business and Industry Data Center, Office of the Governor as referenced by the Texas General Land Office (2003, 2).
20. American Association of Port Authorities — 2002 as referenced by the Texas General Land Office (2003, 2).
21. National Marine Fisheries Service – 2002 data as referenced by the Texas General Land Office (2003, 2).
22. Gulf Intracoastal Canal Association as referenced by the Texas General Land Office (2003, 2).

coast. Tourists spend more than $7.5 billion annually in Texas' coastal counties and the coast accounts for more than one-quarter of the money spent on travel in Texas, making it the second most popular tourist destination in the state.[23] In 2000, the city of Galveston opened its first cruise line terminal and since then more than 1 million people have sailed from the Port of Galveston on cruise ships.[24] It is estimated that cruise ships pour more than $445 million into the Texas economy each year.[25]

Figure 2-1 GIWW – Port of Houston

Figure 2.1

Source: http://lonestartimes.com/2008/09/18/port-of-houston-gears-back-up-after-ike/

23. Texas Department of Economic Development – 2002 as referenced by the Texas General Land Office (2003, 2).
24. The Port of Galveston as referenced by the Texas General Land Office (2003, 3).
25. International Association of Cruise Lines as referenced by the Texas General Land Office (2003, 3).

As more and more people come to the Texas coast to play, live, and conduct business, the region struggles to accommodate the growth. This continued growth has put pressure on natural resources, and balancing the growth in tourism, population, and industry has become a major challenge (Texas General Land Office 2003, 8). In response, the state of Texas has created two major programs to address the issues along the Texas Coast: (1) The Texas Coastal Management Program (TCMP), (2) The Coastal Texas 2020 Initiative.

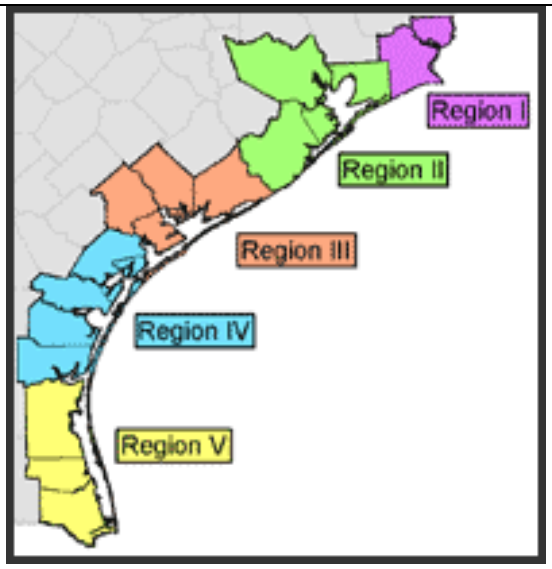
The TCMP started in the late 1980s when Texas coastal communities initiated a grassroots campaign for state assistance in resolving the problem of fragmented management of coastal resources. In 1991, the Texas Legislature passed the Coastal Coordination Act (CCA), which called for the development of a comprehensive coastal program based on existing statutes and regulations (Texas Coastal Management Program Report, 2008). The TCMP essentially gave Texas the authority to review proposed federal activities in the Coastal Zone that might affect land and water resources, including reviews of permits issued by the United States Army Corps of Engineers for pier and dock construction along the coast and evaluations of the routine maintenance dredging of navigation channels. The goal of the TCMP is to ensure that the state's interest is fairly represented and to see that the state has the opportunity to provide input into policies, procedures, or actions by the federal government that could affect the management of coastal areas.

The Coastal Texas 2020 Initiative was launched in June 2003. It began with a series of public meetings along the coast to gather public comment on issues facing the region. More than 500 people attended the meetings and helped shape the goals of the 2020 Initiative (Texas General Land Office, 2003). The Initiative divided the Texas Coast into five regions that included the eighteen coastal counties in the Texas Coastal Zone (See **Figure 2.2**). A

regional advisory committee was then assembled for each region and these committees held regional public hearings and developed a list of the key coastal issues affecting their coastal areas. Interestingly, the committee determined one of the eight most important issues facing the Texas Coastal Zone was damage to infrastructure (roads, bridges, homes) caused by tropical storms (Texas General Land Office 2003, 6).

Figure 2-2 Coastal Texas 2020 Initiative Regions

Figure 2.2



Source: http://www.glo.state.tx.us/coastal/ct2020/2005report/index.html

Region 1: Jefferson and Orange counties
Region 2: Brazoria, Chambers, Galveston and Harris counties
Region 3: Calhoun, Jackson, Matagorda and Victoria counties
Region 4: Aransas, Kleberg, Nueces, Refugio and San Patricio counties
Region 5: Cameron, Kennedy and Willacy counties

The Texas coastal region clearly plays a critical role in both the Texas economy and the economy of the United States. However, as critical as the Gulf Coast is to the economic health of the region, it is equally vulnerable to hurricanes and tropical storms that can bring coastal industries to a standstill and devastate the economy.

Texas Hurricane History 1950-2009

Hurricanes and tropical storms come onshore along the Gulf Coast of Texas rather frequently. According to the National Oceanic and Atmospheric Administration (NOAA) as of September of 2009, 26 hurricanes[26] have come within 65 nautical miles of the Texas coast since 1950 (See **Table 2.1**). **Table 2.1** displays the date of the storm, the name of the storm, the wind speed (in miles per hour), and the category (H1-H5). In addition to the 26 hurricanes since 1950, another 32 tropical storms that have come within 65 nautical miles of the Texas coast (See **Table 2.2**). A total of 58 major storms that have come within 65 nautical miles of the Texas coast in the past 59 years.

26. Category 1-5 on Saffir-Simpson Hurricane Wind Scale (explained below **Table 2.1** on the next page)

Table 2-1 Hurricanes within 65 nautical miles of the Texas Coast 1950-2009

Table 2.1

YEAR	MONTH	DAY	STORM NAME	WIND SPEED	CATEGORY
1954	6	25	ALICE	70	H1
1957	6	27	AUDREY	115	H4
1959	7	24	DEBRA	65	H1
1961	9	11	CARLA	150	H5
1963	9	17	CINDY	70	H1
1967	9	20	BEULAH	140	H5
1970	8	3	CELIA	90	H2
1971	9	16	EDITH	85	H2
1971	9	9	FERN	75	H1
1974	9	8	CARMEN	75	H1
1980	8	9	ALLEN	125	H4
1983	8	18	ALICIA	100	H3
1983	8	28	BARRY	70	H1
1985	8	15	DANNY	70	H1
1985	10	28	JUAN	75	H1
1986	6	26	BONNIE	75	H1
1989	8	1	CHANTAL	70	H1
1989	10	16	JERRY	75	H1
1999	8	22	BRET	125	H4
2003	7	15	CLAUDETTE	75	H1
2003	8	16	ERIKA	65	H1
2005	7	20	EMILY	110	H3
2005	9	24	RITA	105	H3
2007	9	13	HUMBERTO	80	H1
2008	7	23	DOLLY	85	H2
2008	9	13	IKE	95	H2

Source: http://csc-s-maps-q.csc.noaa.gov.libproxy.txstate.edu/hurricanes

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 categorization based on a hurricane's intensity at the indicated time.[27] The scale provides examples of the type of damages expected in the United States associated with winds of the indicated intensity. In general, damages rise by approximately a factor of four for every category increase. The

27. See National Hurricane Center website: http://www.nhc.noaa.gov/aboutsshs.shtml

maximum sustained surface wind speed (peak 1-minute wind at 33 feet above ground level) is the determining factor in the scale.

H1: Sustained winds 74-95 mph. ***Damaging winds are expected.*** Some damage to building structures is expected, primarily to unanchored mobile homes (mainly pre-1994 construction). Some damage is likely to poorly constructed signs as well.

H2: Sustained winds 96-110 mph. ***Very strong winds will produce widespread damage.*** Some roofing material, door, and window damage of buildings will occur. There will be considerable damage to mobile homes (mainly pre-1994 construction) and poorly constructed signs. There will be power outages that could last for several days.

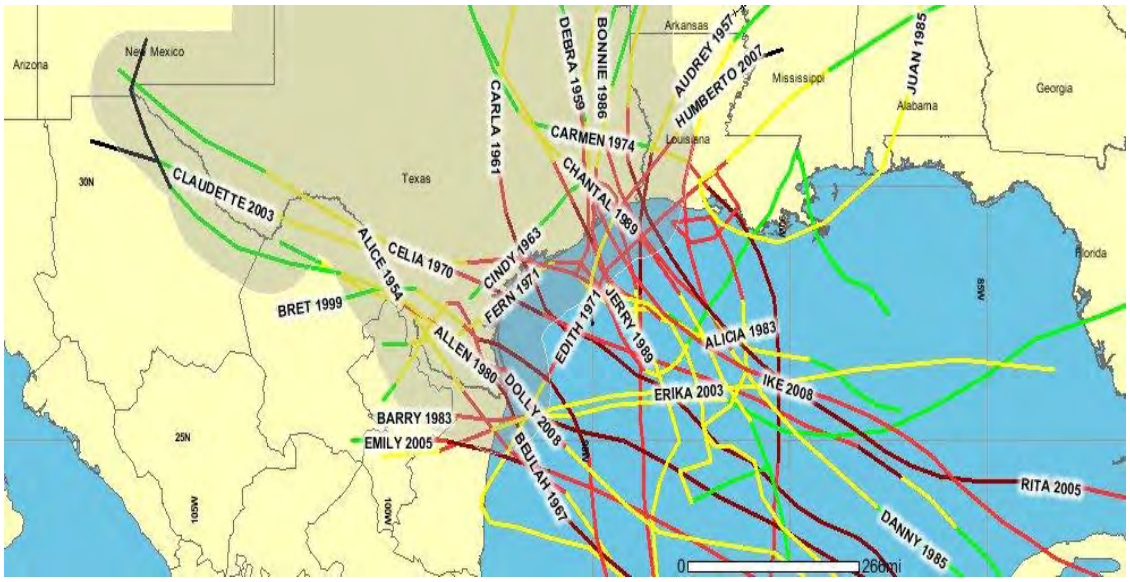
H3: Sustained winds 111-130 mph. ***Dangerous winds will cause extensive damage.*** Some structural damage to houses and buildings will occur with some wall failures. Mobile homes (mainly pre-1994 construction) and poorly constructed signs will be destroyed. Many windows in high rise buildings will be dislodged and become airborne. Many trees will be snapped or uprooted and block numerous roads. Near total power loss is expected with outages that could last from several days to weeks.

H4: Sustained winds 131-155 mph. ***Extremely dangerous winds causing devastating damage expected.*** Some wall failures with some complete roof structure failures on houses. All signs will be blown down. There will be complete destruction of mobile homes (primarily pre-1994 construction). Expect extensive damage to doors and windows. Numerous windows in high rise buildings will be dislodged and become airborne. Wind-borne debris will cause extensive damage; most trees will be snapped or uprooted and electricity may be unavailable for weeks after the hurricane passes.

H5: Sustained winds greater than 155 mph. ***Catastrophic damage is expected.*** Complete roof failure on many residences and industrial buildings will occur. Some complete building failures are expected with nearly all small buildings being blown away. Severe and extensive window and door damage will occur and nearly all windows in high rise buildings will be dislodged and become airborne. Nearly all trees will be snapped or uprooted and power poles downed. Power outages will last for weeks and possibly months.

Figure 2-3 1950-2009 Map of hurricane storm tracks

Figure 2.3



Source: http://csc-s-maps-q.csc.noaa.gov.libproxy.txstate.edu/hurricanes

Table 2-2 Tropical storms within 65 nautical miles of the Texas Coast 1950-2009

Table 2.2

YEAR	MONTH	DAY	STORM NAME	WIND SPEED
1954	6	25	ALICE	50
1954	7	29	BARBARA	35
1955	8	2	BRENDA	35
1955	8	27	NOTNAMED	40
1957	8	9	BERTHA	60
1958	6	15	ALMA	35
1958	9	6	ELLA	55
1960	6	24	NOTNAMED	40
1964	8	8	ABBY	55
1968	6	24	CANDY	60
1968	9	13	NAOMI	45
1970	9	16	FELICE	60
1973	9	4	DELIA	60
1975	8	31	CAROLINE	55
1978	7	31	AMELIA	45
1979	9	1	ELENA	35
1980	9	5	DANIELLE	50
1982	9	11	CHRIS	55
1987	8	10	NOTNAMED	40
1989	10	16	JERRY	35
1993	6	19	ARLENE	35
1993	9	13	LIDIA	35
1995	7	31	DEAN	40
1998	8	22	CHARLEY	60
1998	9	11	FRANCES	55
2001	6	6	ALLISON	45
2002	9	7	FAY	50
2003	8	31	GRACE	35
2004	9	23	IVAN	40
2007	8	16	ERIN	35
2008	8	5	EDOUARD	55
2008	9	2	GUSTAV	60

Source: http://csc-s-maps-q.csc.noaa.gov.libproxy.txstate.edu/hurricanes

The data demonstrate that hurricanes and tropical storms are a relatively common occurrence along the Texas Gulf Coast. Individual communities, however, may view this differently. Several cities have been fortunate to have many years pass without experiencing a direct hit from a major hurricane. For example, Galveston did not have a hurricane (Category 1-

5) pass within 50 nautical miles of the city for a 20-year period from September 18th, 1963 (Cindy) to August 18, 1983 (Alicia).[28] Likewise, Corpus Christi experienced a similar 25-year break from August 26, 1945 (not named) to August 3, 1970 (Celia).[29] Still all coastal communities should resist the temptation to downplay the risk and take steps to mitigate the risk for potential damage to their communities.

The Galveston Hurricane of 1900

It seems unavoidable to engage in a discussion about the history of hurricanes along the Gulf Coast without mentioning the Galveston Hurricane of 1900, viewed as one of the major turning points in the early history of the Gulf Coast region. The Galveston Hurricane remains the worst national disaster experienced in this country in terms of the loss of life (Rappaport and Fernandez-Partagas 1995, 11; Blake et al. 2007, 7). Galveston was the largest city in Texas until 1890 and was once known as the "Queen of the Gulf," the "Wall Street of the Southwest," and even the "Oleander City".[30]

In the nineteenth century, everything in Texas was done first in Galveston. Incorporated in 1839, Galveston quickly became the most active port west of New Orleans. This all changed on September 8, 1900, as Galveston was battered by the Great Storm of 1900. The hurricane had estimated winds of 135 miles per hour (a category four storm on today's scale). At the time Galveston had a population of 37,000 and was the fourth largest city in Texas following Houston, Dallas, and San Antonio.[31] The hurricane destroyed nearly two-thirds of the city's structures; all four bridges to the mainland were destroyed along with

28. See NOAA website: http://csc-s-maps-q.csc.noaa.gov/hurricanes/viewer.html
29. See NOAA website: http://csc-s-maps-q.csc.noaa.gov/hurricanes/viewer.html
30. See Fornell (1961), Barnstone (1966), Cartwright (1991), and Young (1997) as referenced by Hardwick (2001, 336).
31. See City of Galveston web site: http://www.galveston.com/history/

all telephone, telegraph, and electric lines (Bixel and Turner 2008, 43). **Figures 2.4 and 2.5** display photos of some of the catastrophic damage cased by the 1900 Hurricane. As many as 8,000 people were killed, so many in fact, that conventional burials were not possible (Rappaport and Fernandez-Partagas 1995, 11; Blake et al. 2007, 7). Many corpses were burned in mass graves as bodies washed on shore for weeks after initial efforts were made to bury people at sea (Bixel and Turner 2000, 48). (**Figure 2.6** displays a makeshift morgue used to attempt to deal with the mass causalities.) Galveston was never able to return to it pre-storm prominence.

Figure 2-4 Galveston after the 1900 hurricane

Figure 2.4

Source: http://blogs.chron.com/txpotomac/2009/09/post_123.html

Figure 2-5 Galveston after the 1900 hurricane

Figure 2.5

Source: http://www.farmersalmanac.com/weather/a/memorable_weather_events_of_the_past_200_years

Figure 2-6 Makeshift morgue after the 1900 hurricane

Figure 2.6

Source: http://www.ghosttoursofgalvestonisland.com/GALVESTON.html

The hurricane of 1900 clearly exposed the vulnerability of the Texas Gulf Coast to major storms. According to Frank (2003), before 1900, there was the belief by the Galveston Weather Bureau, headed by Isaac Monroe Cline, that the city was not vulnerable to hurricanes from the West Indies. This belief was based on the assumption that waters of the Gulf of Mexico off the Galveston shore were too shallow and would protect the island from hurricane waves. Also, hurricanes from the West Indies were not seen as a problem for Texas: It was assumed they would curve northward before reaching the Texas Coast. Sadly, these early assumptions were completely wrong, since the shallow waters off Galveston actually

made Galveston more vulnerable to a hurricane storm surge (Frank, 2003).

In the aftermath of the storm, Galveston took drastic steps to mitigate the risk for future hurricane damage. First, the city acted quickly to institute a new form of government with five commissioners each of whom was responsible for single departments (finance, water and sewage, police and fire, streets, and public improvement). The idea was that the commission would provide stability necessary to obtain funding for rebuilding, refinancing debt, and constructing protective measures against future hurricanes. The commission then assembled a board of engineers to develop a plan to protect the city from future overflows from the sea. The board developed a proposal that called for the building of a sea wall, the raising of the city grade, and creating an embankment on top of the fill adjacent to the sea wall. Construction of the 17- foot sea wall began in 1902, and by 1904, the wall was over 22,000 feet long.[32] Several extensions to the sea wall followed in 1921, 1927, and 1962. Today the sea wall extends nearly 10 miles along the Gulf of Mexico side of Galveston Island protecting nearly one-third of the beach front.[33] Raising the grade of the city involved elevating 2,156 city structures[34] and digging a large temporary canal along the sea wall to produce the fill needed to raise the grade. The digging of the canal began in 1904 and the project was completed in 1911. In total, 500 blocks of the city were raised, and filled with approximately 16.3 million cubic yards of sand.[35] Today, the sea wall serves as Galveston's first line of defense against hurricanes. Interestingly, according to FEMA (2009, 1-4), the Galveston sea wall protected much of the city from the direct impact of the storm surge from Hurricane Ike. FEMA Mitigation Assessment Teams assessing damage following Ike

32 See Bixel and Turner (2008, 97).
33 See Bixel and Turner (2008, 102).
34 See Bixel and Turner (2008, 121).
35 See Bixel and Turner (2008, 121).

reported significantly less damage due to storm surge for structures protected by the sea wall.

Hurricane Ike (2008)

Just as one feels compelled to mention the Galveston Hurricane of 1900 when discussing hurricane activity along the Texas coast, Hurricane Ike warrants similar attention. Hurricane Ike made landfall over Galveston, on September 13, 2008, at 2:10 a.m. as a large Category 2 hurricane (FEMA 2009, 1-2). Hurricane Ike was the ninth named storm during the 2008 hurricane season and the seventh to hit the United States mainland. It was the most significant of the storms that hit Texas in 2008. Hurricane Ike is likely to be one of the costliest and most destructive hurricanes in U.S. history; the total damage is estimated to be $21.3 billion, making it the fourth costliest hurricane in history behind Hurricanes Katrina (2005), Andrew (1992), and Wilma (2005).[36]

The combinations of surge and high waves with Ike were particularly destructive in areas along the Galveston Bay shoreline, particularly Bolivar Peninsula. Preliminary numbers show that of the 5,900 buildings standing on Bolivar Peninsula before Ike, approximately 3,600 were destroyed, 400 sustained major damage (likely substantially damaged), 1,800 sustained some damage but were not substantially damaged, and only 100 were undamaged or sustained only minimal damage.[37] Eastern areas of Trinity and Galveston Bays were inundated with flood waters. In Bridge City, 3,380 of the 3,400 residences in the city were inundated (FEMA 2009, 1-5). Flooding also damaged many homes and businesses

36. See Blake et al. (2007) as referenced by FEMA (2009, 1-2). See the following YouTube video link from Chapter One [http://www.youtube.com/watch?v=ofvDTeN807I] for U.S. Coast Guard aerial footage of the Bolivar Peninsula in the aftermath of IKE
37. See Halff Associates (2008) as referenced by FEMA (2009, 1-5).

in the city of Galveston, on west Galveston Island, and Follet's Island, and in communities surrounding Galveston Bay (FEMA 2009, 1-5).

According to FEMA (2009, 1-5), ports from Corpus Christi, Texas to Lake Charles, Louisiana were closed in advance of Ike. Damage to the Ports of Galveston and Houston, as well as debris in Galveston Bay and the Houston Ship Channel, kept those ports closed after the storm for several days, leaving almost 150 tankers, cargo vessels, and container ships waiting offshore. The U.S. Department of Energy estimated that 14 oil refineries were closed by the storm, as well as two Texas strategic petroleum reserve sites, causing rising gas prices and gas shortages across parts of the United States (FEMA 2009, 1-5). The storm destroyed at least 10 offshore oil rigs and damaged several large pipelines (FEMA 2009, 1-5). In addition, the U.S. Department of Energy estimated that 2.6 million customers lost power in Texas and Louisiana as a result of the storm (FEMA 2009, 1-6). **Figure 2.7** displays the path of Hurricane Ike and the massive area that was affected by the storm.

Figure 2-7 Map of Areas Affected by Ike

Figure 2.7

Source: FEMA (2009, 1-5)

Chapter Summary

This chapter provided synopsis of disaster management policy in the United States, an overview of the Texas Gulf Coast, and a history of hurricane and tropical storm activity along the Texas coast. The next chapter discusses key policy actions that can be implemented by local communities to mitigate the risk of hurricane damage.

Chapter 3 : Hurricane Damage Mitigation Policy

Chapter Purpose

A careful examination of the scholarly literature on hurricane damage mitigation policy allows one to identify key policy actions a community can implement to reduce the risk for hurricane damage. This chapter describes those policy actions. After reviewing the literature, the following categories were identified to organize the many possible hurricane damage mitigation policy actions:

1) Building codes
    1.1 Require strong codes for construction/renovation
    1.2 Retrofit existing structures
    1.3 Improve code enforcement

2) The planning process
    2.1 Identify the need for long-term planning
    2.2 Make mitigation a priority
    2.3 Participate in FEMA Hazard Mitigation Assistance Programs

3) Incentives for mitigation
    3.1 Offer tax breaks for mitigation
    3.2 Allow transfer of development rights
    3.3 Recognize and end perverse subsidies

4) Assess vulnerability and resilience
    4.1 Assess structural vulnerability
    4.2 Use total cost accounting
    4.3 Use computer modeling

5) Mitigation through zoning
    5.1 Limit development of vulnerable areas through zoning
    5.2 Regulate repeat-loss properties/Relocation

The categories were then used to develop the survey instrument. The survey is designed to determine whether city officials believe Texas coastal communities are utilizing the fourteen policy actions outlined above (the methodology is detailed in Chapter 4).

This chapter also highlights how each category is used to develop hurricane damage mitigation policy.

Building Codes

It stands to reason that building structures to withstand most of the extreme forces of nature adds resiliency to the built environment. Advances in construction can aid in building structures that are less vulnerable to high winds and water. Therefore, many experts recommend strong building codes to promote development with greater resilience.[38] Specifically, building codes play a critical role in minimizing storm damage when they require new construction and/or newly renovated structures to meet higher standards for wind resistance and higher base elevations to minimize flood damage. In addition, when structures can withstand these forces, casualties and recovery costs associated with a hurricane will be reduced.

Require Strong Codes for Construction/Renovation

Inadequate building codes were one of the major contributors to property losses during Hurricane Katrina. Damage assessment teams discovered that many structures could not withstand strong winds. As Federal Emergency Management Agency (FEMA) Mitigation Assessment Teams (MATs) assessed the damage in the Gulf Coast area following Katrina, several observations were made regarding the performance of structures to withstand hurricane forces. Specifically, the MATs observed that many buildings they inspected (both residential and commercial) constructed before the mid-1980s had building envelopes with significant wind vulnerabilities (FEMA 2006, 10-11). The building envelope typically refers

38. See Godschalk and Brower (1985, 66) Board on Natural Disasters (1999, 1945), Prater and Lindell (2000, 74), Mileti and Peek-Gottschlich (2001, 66), Simmons et al. (2002), FEMA (2006), Kates et al. (2006, 14657), FEMA (2008, 56) and FEMA (2009).

to the separation of the internal and external environment of a building. It basically serves as an outer shell to protect the interior of the building from the exterior elements. MATs also found that many of the buildings constructed before the mid-1990s had both significant wind and structural vulnerabilities (FEMA 2006, 10-14).

Surprisingly, in contrast to expectations, MATs discovered recently constructed buildings in Louisiana and Mississippi were vulnerable to wind damage as well (FEMA 2006, 10-14). A similar study by MATs conducted in Galveston following Hurricane Ike demonstrated similar findings regarding wind vulnerability. The Galveston MATs concluded that the wind load provisions of the building code in Galveston at the time of their investigation failed to meet the then current provisions of ASCE 7-88[39] (FEMA 2009, 2-25). FEMA (2006, 11-11), recommends the adoption and enforcement of the most recent editions of the International Building Code, International Residential Code, and National Fire Protection Association 5000; adoption of these codes plays a key role in improved wind performance for structures in areas that are vulnerable to hurricanes. Furthermore, after assessing the damage in Louisiana and Mississippi following Hurricane Katrina, FEMA (2006, 10-10) concluded that inadequate building codes were a major factor in the magnitude of the damage.

Action at the state level can force reluctant local coastal jurisdictions to adopt appropriate building codes. Florida developed a state-wide code in the aftermath of Hurricane Andrew (1992), and made a concerted effort to enforce it. Building code-related measures were often augmented by contractor licensing regulations and increased awareness of wind-resistant design and construction by designers and contractors (FEMA, 2006). One

39. ASCE (American Society of Civil Engineers) 7-88 prescribes the standard minimum design loads for buildings and other structures. It gives requirements for soil, wind, snow, rain and earthquake loads, and their combinations, that are suitable for inclusion in building codes.

of the results of Florida's state-wide code was MATs inspecting newly constructed residences after Hurricanes Charley and Ivan (2004) found significantly less damage when they compared those inspections to the inspections of newly constructed residences in Louisiana and Mississippi following Hurricane Katrina (FEMA 2006, 10-9). Increased attention to wind-resistant construction in Florida likely greatly improved the wind performance in Florida (FEMA, 2006). State involvement with the building industry spurs and supports the adoption of appropriate building codes.

While strengthening the code to reduce vulnerability to wind is critical, elevating structures to protect against flooding is also important. Requiring minimum elevations in flood-prone areas can play a major role in mitigating flood damage.[40] For example, many problems observed by MATs in Mississippi and Louisiana after Katrina involved elevation. Assessors noted many damaged buildings were pre-FIRM construction[41] and built on slab foundations that did not satisfy current National Flood Insurance Program (NFIP) requirements. Structures that were next to each other in neighborhoods that sustained damage had varied elevations; buildings constructed to the Basic Flood Elevation (BFE) or below experienced greater impacts from flood levels, damaging waves, and flood borne debris than did structures situated well above the BFE (see Figures 3.1 and 3.2 for examples of structures elevated well above the BFE) (FEMA 2006, 10-5, 10-4). According to FEMA (2006, 10-2), two circumstances account for the fact the high flood levels exceeded the BFE:

1. The region's storm history, although prepared in the 1980s, had been the basis for the BFEs at the time of Katrina. The BFE was outdated. A new evaluation conducted

40. See FEMA (2006), Kates et al. (2006), and Bagstad et al. (2007).
41. Construction or substantial improvement that started on or before December 31, 1974, or before the effective date of the initial Flood Insurance Rate Map (FIRM) of the community, whichever is later.

likely would significantly increase the BFE.

2. BFEs in the levee-protected areas of New Orleans were based on the assumption the levees and flood walls would protect the surrounded buildings. When developing BFEs, current NFIP standards require a levee be certified as adequately designed and constructed to provide protection against the base flood. But, since the levees protecting New Orleans are United States Army Corps of Engineers certified, the BFEs for the levee-protected areas of the city only reflected projections for flooding from precipitation that accumulates inside these areas. The BFEs did not include flooding effects from water bodies on the non-protected side of the levee, such as Lake Pontchartrain. Therefore, when levees and flood walls were overtopped or failed in Katrina's storm surge, deep flooding was widespread behind the levees.

As a result, MATs concluded that the use of the minimum BFE is not necessarily the best practice, and for best results recommended that minimum BFEs should be exceeded. This practice is known as "adding freeboard." MATs had similar findings after assessing the flood damage in Texas following Hurricane Ike (FEMA 2009, 2-6). In fact, FEMA (2009, 2-6) recommended elevating buildings in Texas above the BFE shown on the FIRM[42] at the time of construction because it serves to reduce future flood damage and significantly lower flood insurance premiums.[43]

It is clear that adopting a strong building code reduces the vulnerability of structures to wind and flooding. Thus, enacting a building code that mandates structures withstand at least average hurricane forces is a policy action communities can take to mitigate the risk of hurricane damage.

---

42. Flood Insurance Rate Map see: http://www.fema.gov/hazard/map/firm.shtm)
43. See Powell (2009) for additional discussion regarding local flood plain management.

Figure 3-1 Example 1 of a Structure Elevation that Exceeds BFE

Figure 3.1

Source: FEMA, 2006 (p. 10-5, Figure 10-3)

Figure 3-2 Example 2 of a Structure Elevation that Exceeds BFE

Figure 3.2

FEMA, 2006 (p. 10-4, Figure 10-2)

Retrofit Existing Structures

Strengthening building codes for new construction is just the first step in strengthening the built environment. Consider that in the average coastal community, only 2 percent of new building stock is added each year (Prater and Lindell 2000, 74). Therefore, even if the current building codes are strong, those codes will offer no protection for structures that are already built. As a result, several experts express the importance of retrofitting existing structures to enhance their resiliency.[44] While several steps can be taken to retrofit an existing structure, one of the least complicated measures a property owner can

44. See Prater and Lindell (2000), Simmons et al. (2002), FEMA (2006), and FEMA (2008, 56).

take is to add storm blinds. Storms blinds (a.k.a., storm shutters) protect areas of the structure, such as windows and doors that are vulnerable to wind (see **Figures 3.3**, **3.4**, and **3.5** below). Storm blinds help protect the structure from high winds and flying debris. Once a window breaks during a storm, there is an increase in the pressure on the roof and walls of the structure that often leads to further structural damage (Simmons et al. 2002, 664). Additionally, once the building envelope fails, the contents of the building are exposed to the forces of wind and water (see **Figure 3.6** below) (FEMA 2006, 10-12). Aside from the obvious benefits to installing storm blinds, Simmons et al. (2002) found that homeowners who made visible efforts to mitigate storm damage to their home in areas vulnerable to hurricanes enjoyed increases in the resale value of the home. In addition, they recommend that policymakers consider providing incentives to homeowners for voluntary mitigation efforts, as it minimizes potential damage from hurricanes while increasing property value.

As noted above, retrofit of existing structures is critical because such a small percentage of structures in coastal areas is subject to new building codes and storm blinds can serve as a simple retrofit for existing building stock. Communities that encourage the retrofitting of existing structures to increase the resiliency of the built environment to hurricane forces are taking action to mitigate the risk of hurricane damage

Figure 3-3 Storm Blind Example 1

Figure 3-4 Storm Blind Example 2

Figure 3.3	**Figure 3.4**
	
Source: http://www.flshutters.com/Hurricane.htm	

Figure 3.5

Source: http://www.flshutters.com/Hurricane.htm

Figure 3-5 Storm Blind Example 3

Figure 3-6 Example of a Failed Building Envelope

Figure 3.6

Source: FEMA, 2006 (p. 10-12, Figure 10-5)

Improve Code Enforcement

As we have seen, evidence suggests that strong building codes improve a community's resilience to hurricanes; however building codes are not effective unless they are enforced appropriately.[45] Kunreuther (1974, 300) was one of the first to recommend better code enforcement. Enforcement requires an ongoing inspection program, and many communities lack a sufficient number of inspectors. For example, according to the Board of Natural Disasters (1999, 1946) more than 25 percent of the damage from Hurricane Andrew

45. Kunreuther (1974), Board on Natural Disasters (1999), and FEMA (2006).

(1992) could have been prevented if existing building codes had been enforced. According to FEMA (2006), MATs that assessed the damage in Louisiana and Mississippi after Hurricane Katrina recommended that routine assessments should be performed regularly by qualified professionals (FEMA 2006, 15-11) to avoid future damage to buildings with vulnerable structural systems and/or building envelopes.

Local coastal communities with strong building codes for new construction and that encourage retrofitting of existing structures should also consider the importance of strictly enforcing code to ensure contractors' compliance. Communities that appropriately enforce codes are taking action to mitigate the risk of hurricane damage.

The Planning Process

The planning process is the next category identified for mitigation policy actions. Most decisions that affect development are made at the local level through the planning process. Unfortunately, these decisions often are made with minimal consideration for the vulnerability of the project to hurricane damage. The planning process can serve as the forum where local communities can dictate how development will be regulated in their city to mitigate risk.

Robert Constanza, an ecological economist and the Director of the Gund Institute for Ecological Economics at the University of Vermont, has developed three levels of engagement of people in the local planning and development process (Costanza, 2001a).“Homo economicus” is the model of human behavior and involvement where humans act in their own economic self-interest. In this case, he suggests the level of discussion required is low and decisions regarding development are made with minimal debate. “Homo economicus” reflects a market-driven paradigm. “Homo communicus” the second

characterization, involves the community in discussions regarding planning and development choices using the fairness-value paradigm. “Homo communicus” strives for an inclusive consensus that also considers future generations. “Homo naturalis,” on the other hand, makes decisions in the context of the entire ecosystem, where individual decisions are assessed by their contribution to ecological sustainability.

Currently, the vast majority of development decisions are made in the “Homo economicus” mode. However, to maintain sustainability in the coastal zone, there likely needs to be a shift in the decision-making style to one that incorporates Costanza’s “Homo communicus” and “Homo naturalis” characterizations (Duxbury and Dickenson, 2007). This implies the need for a paradigm shift in local planning and development process.

Coastal communities can implement the following three policy actions to mitigate the risk for hurricane damage: First, they can make planning decisions with a long-term outlook and resist the temptation to defer to the market-driven paradigm. Second, communities can make mitigation a priority and incorporate mitigation actions into their master plan. Third, they can offer incentives for businesses and landowners to engage in mitigation activities.

Identify the Need for Long-Term Planning

Because the market paradigm drives most development decisions, incorporating mitigation actions in the local planning process presents a major challenge. As a result, several scholars call for local government to adopt long-term planning and planning for sustainability to address this problem in advance of any disaster.[46] In Duxbury and Dickenson (2007, 322), David C. Kyler, Executive Director for the Center for a Sustainable Coast, explained that local governments often make planning decisions on a case-by case

46. See Clary (1985), Board of Natural Disasters (1999), Boswell et al. (1999), Mileti and Peek-Gottschlich (2001), Puszkin-Chevlin (2007), Bagstad et al. (2007), and Duxbury and Dickenson (2007).

basis with no long-term policy framework, and these decisions are often driven by the demands of private development without community consensus. Concepts such as "sustainability" and long-term planning are often viewed by the construction industry and local officials as inhibiting of economic development. Costanza and Farley (2007, 249) recognize this problem and suggest that seeking to increase human well-being solely by maximizing the monetary value of market goods (built capital) may be doing more to undermine our sustainable well-being than to improve it. Duxbury and Dickenson (2007, 322) recognize this push for continued development and suggest that a desirable scale for development occurs when the diminishing marginal benefits of growth in built capital are equal to the rising costs of the natural capital sacrificed to achieve that growth. In other words, the scale of growth becomes sustainable when the economic benefits of the development are equal to the cost of the damage to the environment resulting from the development. Duxbury and Dickenson (2007, 322) also note that growth beyond this point diminishes the quality of life that can be sustained across generations.

Bagstad et al. (2007) offer the concept of ecological economics as a tool to assist policymakers in making development solutions that are friendly to the ecosystem. In their discussion of ecological economics, they incorporate Costanza's (2001a) "Homo communicus" and "Homo naturalis" concepts (outlined earlier) and call for policy solutions that lead toward a fair allocation of goods and services by both market and non-market systems. In other words, the ecological economics concept incorporates a just distribution of resources in today's society on a sustainable macroeconomic scale that does not undermine the resources of future generations or critical ecosystem services[47].

47. See Bagstad et al. (2007), Farley et al. (2007).

Mileti and Peek-Gottschlich (2001, 64), assert that the practice of short-term thinking is a major problem with planning: Generally, people have a cultural and economic predisposition to think primarily in the short term. Yet effective mitigation strategies require a longer term view that takes into account the overall effect of mitigation efforts on current and future generations. This presents obvious challenges for the planning body because a good deal of disaster planning is event driven, with policy created in a reactive manner rather than a proactively. Mileti and Peek-Gottschlich (2001, 66) discuss the importance of maintaining and enhancing local environmental quality. They contend that for communities to become sustainable, human activities to mitigate hazards should not reduce the carrying capacity of the ecosystem because doing so increases losses from hazards over the long term. It is not uncommon for the carrying capacity of the environment to be compromised in over-developed areas. Over development leads to a decay of the natural barriers in place that protect coastal areas. Costanza and Farley (2007, 249) point to the over-development of wetland areas in Louisiana which likely compromised the natural barriers in the region and reduced the carrying capacity of the environment, ultimately contributing to the damage caused by Hurricane Katrina.

Developing a long-term sustainable plan may be difficult. Mileti and Peek-Gottschlich (2001, 66) suggest that long-term planning is more likely to be successful if a participatory approach is utilized that involves local citizens, business, government agencies, and non-profits. The participatory process itself may be as important as the outcome (Mileti and Peek-Gottschlich 2001, 66) and when there is local government support for a long-term plan that includes disaster mitigation policy with input from the stakeholders, there is a better chance the plan will be supported.

Planning policy fragmentation also undermines long-term planning objectives. According to Clary (1985, 27), in 1977 several natural hazard experts observed that there was no one national policy. As identified by McLean (2004, 8), a 1988 review of federal policies that address development in hazardous areas showed there was no overarching federal policy governing land use and development in vulnerable areas (May and Deyle, 1998). According to Bagstad et al. (2007, 292), a survey of federal programs influencing coastal development and disaster relief revealed a generally piecemeal approach. The programs surveyed did not have the explicit goals of limiting risky development, protecting natural resources, or reducing government and taxpayer liability to pay for repeated reconstruction (Office of Technology Assessment, 1993).

The Board of Natural Disasters (1999, 1945) observed few local governments are willing to adopt land-use measures to protect against natural hazards unless they receive strong mandates from higher level governments. Land-use approaches often require accurate identification of areas affected by hazards, but hazard-zone mapping can be too expensive for some municipalities. Also, hazards often span jurisdictional boundaries, necessitating cooperation between jurisdictions, and further complicating the process. Boswell et al. (1999, 360) explains that the response to federal and state programs to foster mitigation initiatives by local governments has been largely disappointing. They note that while most local governments have taken the minimum steps necessary to be eligible for the National Flood Insurance Program, few have responded to the incentives offered under the Community Rating System[48] to develop more effective, integrated strategies for reducing flood hazards

48. The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements (http://www.fema.gov/business/nfip/crs.shtm).

(see also Olshansky and Kartez, 1998). While state planning mandates have shown an increase in the numbers of localities addressing natural hazards in their comprehensive plans (Burby, 1996), local plans often do not consistently comply with the detailed requirements of the mandates (Deyle and Smith, 1998).

Duxbury and Dickenson (2007, 321) contend that there is fragmented responsibility among various government agencies that make decisions regarding development, land use, the environment and hazard mitigation; this has resulted in a lack of management integration, which has led to needlessly reactive management. Fragmented responsibility has lead to agencies' responding after the fact to coastal resource management problems that could have been anticipated and avoided (Duxbury and Dickenson 2007, 321). Fragmentation is perpetuated when many minor decisions are made at different levels of government. These decisions eventually add up to major coastal management problems and often the reassignment of these issues from one area to another. In other words, decision-makers typically make short-term decisions regarding land use, the environment, and hazard mitigation, and then pass on the problems to another agency or even the next administration. Puszkin-Chevlin (2007, 342) recognizes land use development policy fragmentation as a major issue as well, asserting that the incremental coastal development policy utilized in the United States is a poor approach. Puszkin-Chevlin (2007) explains the incremental approach to land use decisions is too gradual to significantly improve vulnerability or change planning goals and objectives. It appears that some local government officials use fragmentation as justification for inaction by either allowing market forces to have too much influence on development decisions or deferring to short-term thinking with little regard for long-term planning. As a result, their actions typically stray from the community's long-term master

plan goal.

Short-term thinking, policy fragmentation, fragmented responsibility, and market-driven planning all detract from the long-term planning process. Therefore, a community that can identify the need for long-term planning and plan accordingly is taking action to mitigate the risk of hurricane damage.

Make Mitigation a Priority

Godschalk and Brower (1985, 70) found natural hazards are often a low concern for policy makers. Through 2,000 interviews with policy makers, Rossi et al., (1982) discovered natural hazards problems were of very low importance and political salience, rating even lower than concern over pornography. According to the Board of Natural Disasters (1999, 1944), mitigation can be difficult to implement, both politically and economically. Progress involves creating incentives that are both appealing and feasible, ensuring long-term commitments by the supporters, and investing significant financial resources. To complicate matters further, this must all be accomplished in the face of a highly uncertain threat. Smith and Deyle (1997) noted that local plans containing policies to address hazard mitigation are often ignored in daily decision making. Or, policies are watered down in favor of politically expedient or low in local cost policies. Therefore, many local hazard mitigation plans have had little impact on reducing the national costs of hurricane disasters (Olshansky and Kartez, 1998). Also, elected officials often give mitigation little attention because their attention is diverted by the immediate problems of education, poverty and crime in their community (Prater and Lindell, 2000).[49] Clary (1985, p. 24) explains, "It is more politically acceptable to gamble a hazard event will not happen than to incur the long-term costs of emergency

49. As cited by McLean (2004, 13).

preparedness, even if that means that when a disaster strikes, the community may have to absorb greater costs….” Sadly, decision-makers are eager to put off the problem and they have a strong tendency to discount the future costs of natural disasters.

Participate in FEMA Hazard Mitigation Assistance Programs

FEMA, aware of the difficulties local governments encounter in making mitigation a priority, offers several mitigation assistance programs[50] to combat this problem. It is important for local governments to take advantage of these programs during the planning process because creating a local mitigation plan can lead to grant money assistance (Daniels and Daniels, 2003; FEMA, 2006). Development of a local mitigation plan is required for all local jurisdictions that choose to participate in FEMA hazard mitigation assistance programs, and the plan must be approved by FEMA. In addition, the Stafford Act (1988) authorizes up to seven percent of available Hazard Mitigation Grant Program funds for state or local mitigation planning purposes following a disaster to reduce future losses. The local mitigation plan requirements encourage agencies at all levels, in conjunction with local residents, businesses, and the non-profit sector to participate in planning and the implementation process. Broad participation is encouraged since mitigation actions supported by the stakeholders often reflect the needs of the community (FEMA, 2008). In addition, to be eligible for Hazard Mitigation Grant Program funding, the local government must formally adopt the Local Hazard Mitigation Plan and submit documentation to FEMA. FEMA views the formal adoption of the plan by local governments as a demonstration of the localities’ commitment to fulfilling the mission and goals of the plan.

50. See FEMA website (http://www.fema.gov/government/grant/hma/index.shtm) Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, Pre-Disaster Mitigation Grant, Repetitive Flood Claims Program, and the Severe Repeat Loss Program.

Another major mitigation assistance program offered by FEMA is the National Flood Insurance Program (NFIP). Nearly 20,000 communities across the United States and its territories participate in NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage (FEMA, 2002, 2). In exchange, NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in NFIP is voluntary. Flood insurance through the NFIP is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing flood damage to buildings and their contents. FEMA (2002, 15) estimates flood damage is reduced by nearly $1 billion a year when communities implement sound floodplain management requirements and property owners purchase flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately eighty percent less damage annually than those not built in compliance (FEMA 2002, 15). In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the nation's floodplains. Mapping flood hazards creates broad-based awareness of flood hazards and provides the data needed for floodplain management programs, while providing the necessary information to rate new construction for flood insurance (FEMA, 2002).

Local coastal communities choosing not to make mitigation a priority and failing to participate in FEMA mitigation programs are ignoring valuable measures that can reduce their community’s vulnerability of their community to a major storm. Furthermore, increasing resilience through mitigation serves as an economic benefit to a coastal community, as the cost of recovery from a major storm can be greatly reduced and the impact to the local economy can be minimized. Thus, local communities that make mitigation a

priority are taking action to mitigate the risk of hurricane damage and ensure long-term economic viability.

Incentives to Mitigate

The planning process is one way a local government can influence development, the use of incentives is another. It is critical for policy makers to understand how subsidies can help to regulate development. Government intervention in the market, particularly through taxes, subsidies, and insurance, plays a major role in influencing development patterns in the United States (Bagstad, et al. 2007, 285). When used inappropriately, incentives can distort true costs, encourage overproduction, or even damage the environment. But subsidies can also be designed to enhance economic, social, and environmental quality (Bagstad et al. 2007, 285). Therefore, policy makers must be aware of the consequences of the subsidies they create.

Offer Tax Incentives to Mitigate

One approach local government can use to promote mitigation is to offer tax incentives for property owners to take mitigation measures.[51] According to the Board of Natural Disasters (1999, 1946), property taxes could be lowered for homeowners who opt to take voluntary mitigation measures to protect their homes from hurricane damage. As mentioned earlier, homeowners who make visible efforts to mitigate storm damage to their home in areas vulnerable to hurricanes enjoy increased resale values (Simmons et al. 2002, 668). Unfortunately, property owners who choose to improve their homes to make it more resistant to hurricane forces are likely to have the property reassessed at a higher value the following year, resulting in a higher tax bill, which becomes a disincentive to voluntary

51. See Godshalk and Brower (1985), Board of Natural Disasters (1999), and Bagstad et al. (2007).

mitigation efforts. The state of California has been cognizant of this problem: Many homeowners in the state have taken voluntary steps to protect their homes from earthquakes and subsequently suffered a higher property tax bill. In response, in 1990, California voters passed Proposition 127, which exempts rehabilitation improvements to buildings from being reassessed to increase property taxes (Board of Natural Disasters 1999, 1946). Communities that offer landowners in coastal areas tax incentives to increase the stability of their home are taking action to mitigate the risk for hurricane damage.

While tax policy can serve to encourage certain actions, Godschalk and Brower (1985) explain that local tax policy can serve to discourage development of certain vulnerable areas as well. They suggest that local governments utilize preferential use-value assessment taxation policies for land solely on the basis of its income-producing capacity, rather than its market value. Godschalk and Brower (1985, 66), point out that nearly all states have enacted laws permitting preferential tax assessment of farmland and there is no reason why similar preferential assessments could not be used for land vulnerable to disasters. Local government should carefully consider its power to influence development through tax policy.

Allow Transfer of Development Rights

The use of direct subsidies is another action communities can use to steer development and encourage mitigation. Godschalk and Brower (1985, 66) and Egan (2007, 19) recommend that local governments can discourage development by allowing the transfer of development rights (TDR). TDRs are special provisions that financially compensate landowners in exchange for use restrictions on their land. TDRs essentially allow a land owner in a restricted area to sell the development rights to a landowner in a different area, which permits the receiving owner to build at a higher density than normally permitted.

Under a TDR scheme, hazard area landowners could be allowed to profit from their land by selling its development rights to a developer while still holding the land in an undeveloped state rather than building on it. Communities that offer landowners in coastal areas preferential property tax assessment and/or the ability to transfer development rights to discourage development in vulnerable areas are taking action to mitigate the risk of hurricane damage.

Recognize and End Perverse Subsidies

Many experts agree that there are several subsidies offered by government pose major obstacles to regulating development in coastal areas[52]; Costanza (2001b), refers to these as "perverse subsidies." Costanza (2001b) defines a perverse subsidy as a payment by a government to an individual or firm that increases the separation between private and social costs and benefits. Examples of some common perverse subsidies include: federal funding for infrastructure in vulnerable coastal areas; the casualty loss deduction that allows property owners to deduct the cost of uninsured damages from coastal disasters; interest and property tax deductions provided for second homes; and accelerated depreciation schedules for seasonal rental properties (Bagstad et al. 2007, 291).

Kunreuther (1974, 291) and Bagstad et al. (2007, 294) suggest that decisions about the type of structure to be erected and its location are greatly influenced by who bears the cost after a disaster. Bagstad et al. (2007, 294) advocate for requiring developers to pay the full costs of infrastructure in high-risk areas as an appropriate market-based solution to address the problem of the infrastructure subsidy. Keeping this concept in mind, communities should give detailed consideration to where and how they fund infrastructure because it

52. See Kunreuther (1974), Wamsley and Schroeder (1996, 238), Costanza, Robert (2001b), Burby (2006), Bagstad et al. (2007), Birkland and Waterman (2008).

typically encourages development. For example, if a coastal community chooses to fund a bridge and/or provide infrastructure on a vulnerable undeveloped barrier island, they are in effect encouraging development of that island without requiring the developer to assume any of the risk of developing the land. Therefore, the community essentially creates an incentive for high-risk development while failing to transfer any of that risk to the developer.

Even though perverse subsidies can occur at the local level, most scholarly research examines perverse subsidies at the federal level. There is consensus in the literature that the government practice of increasing federal funding to states and localities for disaster relief has essentially been a perverse subsidy.[53] According to Clary (1985, 24), by the mid-1970s the federal government was bearing nearly seventy percent of the cost of disaster relief (from one percent in 1953), while the state or locality was paying only thirty percent. The net effect was to lessen significantly the likelihood of large property loss from a natural disaster. Unfortunately, this policy promoted poor local planning decisions, because the federal government subsidized much of the risk.

In addition to problems created by increased government funding for disaster relief, many experts suggest that government programs created to encourage disaster mitigation are actually perverse subsidies that discourage mitigation.[54] According to Bagstad et al. (2007, 286), the NFIP is one such policy. As described above, the NFIP was originally intended to reduce flood zone development and risk with government-subsidized insurance. Instead the program has encouraged risky development by providing a subsidy to coastal and floodplain developers, repetitive-loss property owners, and the private insurance industry. As a result,

53. See Clary (1985), Boswell et al. (1999, 360), Wamsley and Schreoder (1996, 238), Pilkey and Young (2005, 7), and Birkland and Waterman (2008).
54. See Costanza (2001b), Bagstad et al. (2007), and Birkland and Waterman (2008).

development occurred in places that would otherwise be economically unsuitable for construction (Bagstad et al., 2007). Birkland and Waterman (2008, 707) caution one must consider the federal role in facilitating development in hazardous areas, and the intergovernmental role in persuading people that they were safer than they really were. Burby (2006) treats the notions of “safe development” and “local government” in these situations as inaccurate, noting that development encouraged by federal subsidies is often neither safe nor congruent with local interests. Burby (2006) argues that through flood insurance, levees, tax deductions for casualty losses, and generous disaster relief, the federal government encourages development in areas that would not otherwise be developed if the risk profile of the area were not distorted by these incentives. People whose risk perceptions are altered in this way are said to be susceptible to "moral hazard," which encourages risks they would not ordinarily assume because the additional risk is attenuated by the protection (Burby, 2006).[55]

As a result, it is critical for local officials to recognize that many incentives created through government subsidies can deter mitigation activities. Local governments should carefully examine their decisions to fund infrastructure to ascertain whether construction would discourage mitigation actions. Communities that recognize and discontinue perverse subsidies can mitigate their risk of hurricane damage.

Assess Vulnerability and Resilience

“Assess vulnerability and resilience” is another important category of hurricane damage mitigation policy action. Communities that understand which areas are most

55. As referenced by Birkland and Waterman (2008, 707), in the discussion of the federal role in facilitating development in hazardous areas.

vulnerable to hurricane damage are in the best position to develop a beneficial mitigation plan: Assessing vulnerability and resilience is the starting point in creating a local mitigation plan. Assessing vulnerability normally begins with evaluating structural vulnerability, which encompasses estimating the level of damage a category 1-5 hurricane would cause to the local electricity grid, telecommunications systems, roads, bridges, and buildings.[56] A community that does not understand the vulnerability of its infrastructure is ill equipped to appropriately mitigate disaster effects. A popular solution recommended to mitigate structural vulnerability is to implement redundancy for critical infrastructure such as electricity, telecommunications, sewer, and water.[57] All citizens in the community rely on electricity, water, and telecommunications services to conduct their day-to-day activities, so keeping these services intact during a hurricane (or having the capacity to quickly restore service after a storm), expedites the response-and-recovery phases of disaster management. A community that can minimize the disruption to these essential services is clearly less vulnerable to the effects of a hurricane.

While creating redundancy for infrastructure is useful, the location of critical infrastructure is also important (Godschalk and Brower 1985, and Cutter et al. 2000, 717). Godschalk and Brower (1985, 66) recommend requiring disclosure of hazard zones during the permit-issuance process to increase the regulatory power of public officials to assist in selection of critical water, sewer, and waste disposal facility locations. Cutter et al. (2000, 727) recommend naming certain areas “high-risk” hazard zones where structural and social vulnerability (discussed later) overlap while accounting for the frequency of hazards in those areas. Theoretically, once hazard areas are identified, a community can guide concentrated

56. See Cutter et al. (2000), Weichselgartner (2001), and Klein et al. (2003).
57. See Godschalk and Brower (1985) and Board of Natural Disasters (1999).

development away from these areas by designating them for open space or low-density uses, such as parking or recreation (Godschalk and Brower 1985, 65). This practice should minimize the structural vulnerability of these areas and result in less damage following a major storm.

According to McEntire (2004), examining vulnerability begins with understanding the relationship between development and disasters along with recognizing social considerations that affect vulnerability. The concept of social vulnerability refers to the susceptibility of particular social groups to potential losses from disastrous events.[58] Many scholars agree that understanding and measuring a population's social vulnerability must be a significant factor in assessing the overall vulnerability of a community.[59] For example, homes located in flood-prone areas sell for lower prices when compared to similar homes located outside the flood prone area.[60] As a result, it is foreseeable that lower income homeowners would be more likely to purchase these less expensive homes, and thus more vulnerable to flood damage, although they will probably have few available resources to deal with the losses and overcome disaster. This concept of social vulnerability was brought to life in the aftermath of Hurricane Katrina. Many New Orleans residents did not have the means to evacuate the city and were forced to remain during the storm. Residents in the "working class" Lower 9th Ward of New Orleans were hit particularly hard as sections of the levees along the industrial canal failed and flood waters devastated their neighborhood; other "upper-class" districts on higher ground did not flood.

While assessing structural and social vulnerability in a community is essential to

58. See Cutter et al. (2000), Weichselgartner (2001), and Klein et al. (2003).
59. See Cutter et al. (2000), Weichselgartner (2001), and Klein et al. (2003).
60. See Shilling et al. (1985) as referenced by Simmons et al. (2002, 663) in a study of real estate values in coastal areas susceptible to hurricanes.

assessing overall vulnerability, it is also important to identify resilient areas in a community. Weichselgartner (2001, 87) defines resilience as the "interaction of society with biophysical conditions that affect the ability of the environment to respond to the hazard or disaster as well as influencing the adaptation of society to such changing conditions." Mileti and Peek-Gottschlich (2001, 66) define community resilience as the extent to which a locality can withstand an extreme natural event with tolerable losses and taking into account the level of losses that were minimized through mitigation efforts that provided a certain level of protection. Klein et al. (2003, 43) discuss resiliency in terms of a community's adaptive capacity. They propose the use of adaptive capacity as the umbrella concept that includes a community's ability to prepare and plan for hazards, as well as to implement technical measures before, during, and after a hazard event. They also talk about resilience as it relates to social vulnerability, but stress the importance of identifying less vulnerable populations and illustrate how economic standing is an important factor in determining whether resilience reduces the vulnerability of very large cities to weather-related hazards.

Colten et al. (2008, 2), suggest there are four key elements of resilience: anticipation, response, recovery, and reduced vulnerability. In an effort to reduce vulnerabilities and improve resilience, Colten et al. (2008, 3) recommend communities become involved with the Community and Regional Resilience Initiative (CARRI), a federally funded program that seeks to help communities put in place policies, practices, and processes that enable them to become more resilient in the face of hazard events. The program can also help communities develop a FEMA-approved Local Mitigation Plan (outlined earlier). CARRI defines resilience as "a community or region's capability to prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to public safety and health, the

economy, and national security"(Colten et al., 2008, p. 3). Local coastal communities are encouraged to become involved with CARRI because it can provide valuable assistance in assessing vulnerability and measuring resilience.

Assessing vulnerability and resilience is a first step local government should take in developing a local mitigation plan. Once the most vulnerable areas are identified, planners can focus specific mitigation efforts in areas with the greatest need. Assessing vulnerability and resilience may also help in developing a plan for the response-and-recovery phases of disaster management. If a community has clearly identified vulnerable areas, then first responders can target those areas first during the response phase because there would be a greater likelihood the citizens in those areas will need assistance. Assessing vulnerability and resilience is a policy action communities can take to mitigate their risk for hurricane damage.

Use Total Cost Accounting

One popular measure used to evaluate vulnerability and resilience is the cost of recovery. Understanding vulnerability in the context of costs associated with response and recovery is critical, as demonstrated by the monumental damage caused by Hurricane Katrina. The process of estimating cost begins with calculating numerical values for vulnerability by approximating the number of people and structures in each hazard zone and forecasting potential losses (Cutter et al. 2000, 729). Several experts suggest that total cost accounting should be used to measure vulnerability.[61] Specifically, total cost accounting examines four types of capital lost in a coastal disaster: built capital, human capital, natural capital, and social capital (Costanza and Farley 2007, 251, and Gaddis et al. 2007, 311). Loss of built capital represents the loss of agricultural infrastructure and property, residential

61. See Costanza and Farley (2007), Gaddis et al. (2007), and Duxbury and Dickenson (2007).

property, commercial property, public infrastructure, along with industrial property and its associated infrastructure. Loss of human capital represents deaths, injuries, loss of school time, reduced school performance, resettlement, loss of public health services, and reduced individual ability (mental and physical health). Loss of natural capital encompass the loss of wetlands, barrier islands, forests, actual land loss (erosion), along with losses to fisheries, wildlife, crops, livestock, and toxic contamination. Loss of social capital involves the loss of social support, and the displacement of social networks. According to Duxbury and Dickenson (2007, 325), full-cost accounting is an attempt to ensure that the costs and benefits associated with the use of ecosystem resources are borne by the appropriate parties.

Local officials can use total cost accounting to understand the true direct and indirect recovery costs from a major hurricane along with the long-term economic impact associated with those costs. Total cost accounting estimates not only consider expenses associated with rebuilding and repairing structures, but as illustrated above, also measure the costs to the environment, public health, and local industry. Communities that use total cost accounting to measure vulnerability and resilience are taking action to mitigate the risk of hurricane damage.

Use Computer Modeling

Total cost accounting is one approach to measuring vulnerability and resilience. Several experts also recommend the use of computer modeling and data analysis to quantify overall vulnerability.[62] FEMA has developed the HAZUS-MH software to measure vulnerability of the locality. HAZUS-MH is a powerful risk-assessment software program that can estimate and analyze the potential losses from floods, hurricane winds, and

62. See Cutter et al. (2000, 725), Mileti and Peek-Gottschlich (2001, 67), and FEMA (2006).

earthquakes. HAZUS-MH uses current scientific and engineering knowledge coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard-related damage before or after a disaster occurs. The National Hurricane Center also provides a computer model to assess risk: the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) program. SLOSH is used to estimate storm surge heights and winds through data from historical, hypothetical, or predicted hurricanes in the region.[63] The calculations are then applied to the specific community's shoreline by incorporating unique bay and river configurations, water depths, and the locations of bridges and roads.

FEMA (2006) suggests that many localities may have already assessed their vulnerability through modeling, but, unfortunately, a good deal of existing flood plain data may be inaccurate or out of date. Mitigation Assessment Teams that evaluated damage after Hurricane Katrina observed that existing storm surge modeling was inaccurate and suggested conducting a review of the storm surge data and modeling procedures because many structures built to acceptable Base Flood Elevation (BFE) levels still flooded (FEMA 2006, 10-2). The reasons for the inaccurate modeling were outlined earlier in the discussion regarding building codes.

The latest computer modeling software can predict storm surge along with areas at the greatest risk for flooding during a hurricane. This will allow a coastal city to understand the various hurricane aftermath scenarios before storm strikes. Communities that use this assessment mechanism are taking action to mitigate the risk of hurricane damage.

63. See National Hurricane Center web site http://www.nhc.noaa.gov/HAW2/english/surge/slosh.shtml

Mitigation through Zoning

Another category of community policy action to mitigate the risk for hurricane damage involves zoning and land use codes. As outlined earlier in the section on the planning process, several obstacles challenge local officials' ability to regulate growth in coastal areas. It is clear there is no “magic bullet” to solve this complicated problem, but several experts suggest that incorporating proper zoning and land use codes can aid in mitigating damage from natural hazards.[64] Even though a strong building code enhances the resiliency of structures, certain areas are so vulnerable that structures simply cannot be built strong enough to endure the forces that can impact them.

Limit Development of Vulnerable Areas through Zoning

According to Mileti and Peek-Gottschlich (2001, 61), White and Haas (1975) were some of the first to call for better land use and planning measures to reduce damage caused by natural disasters. Mileti and Peek-Gottschich (2001, 66) advise limiting expansion into sensitive areas through zoning as essential to hazard mitigation. Zoning and planning can work hand-in-hand to ensure people and property are kept out of the way of hazards, by assuring that the mitigating qualities of the natural environment are maintained and that development is resilient in the face of natural forces. Godschalk and Brower (1985, 65), discuss zoning in terms of: setting standards for structure setbacks from the shore, building height and bulk; lot size; and density. They suggest hazard areas should be zoned as "over-lay" districts requiring special performance standards for all uses, no matter what their type. Examples of such special performance standards include: minimum elevations above the

64. See White and Haas (1975), Godschalk and Brower (1985), Mileti and Peek-Gottschlich (2001), McLean (2004), and Salvesen (2005).

100-year flood height for the first inhabited floor of structures in flood hazard zones and minimum beach-front setbacks to protect structures from coastal erosion. Once special performance standards are instituted in "over-lay" districts, any time structures are repaired or rebuilt following significant damage, the new codes would regulate construction. Special performance standards could also require buildings to be strengthened or flood-proofed in the zone, or even limit the number of buildings that could be rebuilt within hazard zones. In any event, special performance standards can increase the resiliency of structures located in the hazard zone.

Salvesen (2005, 189) maintains that development is driven by demand; it is unlikely to occur when demand is weak. On the other hand, when the demand is strong, developers will work to overcome obstacles. This often creates difficultly for officials in charge of zoning regulations because hazard prone areas are often considered prime real estate with desirable amenities (Prater and Lindell, 2000)[65]. Salvesen (2005) examined this issue in his study of the Coastal Barrier Resources Act (CBRA) of 1982. The CBRA was designed to prevent high-risk development while protecting ecologically valuable coastal areas with the goal of reducing tax dollars spent for disaster relief. The act removed federal subsidies (infrastructure and insurance) that encouraged development in designated areas of coastal barriers, thus making development in such areas more expensive. Salveson's study revealed that despite the removal of federal subsidies, in places where local government actions and policies facilitated development, development was still likely to occur. However, the opposite was also true: Local governments that limited development through local zoning policies helped prevent development from occurring. Therefore, it is critical for local

65. As referenced by McLean (2004, 4).

governments to understand that the policies they implement influence development and that they have the power to limit development in vulnerable areas.

Regulate Repeat-Loss Properties

The problem of repeat-loss properties is another issue that can be addressed through local zoning regulations. Several experts recommend ending the practice of rebuilding repeat loss properties.[66] Smart Growth America (2005, 6) suggests that areas deemed too dangerous for habitation should be set aside from future redevelopment, and local leaders should identify other areas suitable for higher density development to make up for the land loss. Bagstad et al. (2007, 288), identify the problems with the NFIP regarding repeat-loss properties. Unlike private insurance, the NFIP will pay claims multiple times for the same property, and the program does not raise rates with additional claims. Therefore, the practice encourages rebuilding in the most flood-prone areas. According to Pilkey and Young (2005, 6), because highly vulnerable shoreline communities (such as North Topsail Island in North Carolina; Santa Rosa Island in Florida; Waveland, Mississippi; and Dauphin Island, Alabama) have already been destroyed twice in 35 years, they should never again receive federal tax dollars to rebuild buildings or infrastructure. In all, repetitive-loss properties account for approximately two percent of NFIP policyholders (approximately 82,000 of 4.1 million participating households), but almost thirty percent of all claims, totaling over $200 million per year (Bagstad et al., 2007, 288).

Local communities can end the cycle of rebuilding repeat-loss structures in the most vulnerable coastal areas after a hurricane strike by simply re-zoning the areas for less

66. See Pilkey and Young (2005), Smart Growth America (2005, 6), and Bagstad et al. (2007).

vulnerable development. Communities that regulate repeat-loss properties through zoning are taking action to mitigate the risk of hurricane damage.

Relocation

Relocation is one controversial solution to the repetitive losses problem.[67]. Godschalk and Brower (1985, 65) cite the examples of the small community of Allenville, Arizona, and the business district of Soldiers Grove, Wisconsin, that were relocated from flood-prone areas along rivers, but they acknowledge that relocation is a last resort after other mitigation measures fail. Bagstad et al. (2007, 289) cite the example of St. Charles County, Missouri, where over 900 families were relocated to higher ground following the 1993 flood. In other cases, entire towns, such as Valmeyer, Illinois, were moved from the floodplain to higher ground, breaking an ongoing cycle of flood damage and government relief spending. When evaluated from a long-term cost perspective, a one-time relocation is clearly less expensive than an ongoing cycle of damage and rebuilding (Bagstad et al. 2007, 289). Nevertheless, relocation is typically unpopular, especially when the land where the repeat loss occurs has other desirable amenities.

Many residents in these repeat-loss areas feel a sense of entitlement to rebuild. This mindset is well illustrated by the comments from a resident from Grand Isle (Louisiana) after half of the buildings were swept away by Hurricanes Katrina and Rita. The resident said, "We're not about to leave…" while sweeping up the cement pad below his dwelling with nothing left above but the pilings. He added, "If we have another hurricane that does the same thing, we're not leaving" (Houck 2006, 12). In addition, following Hurricane Katrina, Gulfport, Mississippi's, mayor enthusiastically told the *L.A. Times* that he had just gotten off

67. See Godschalk & Brower (1985), Bagstad et al. (2007).

the phone with a condominium investor who was "…just very, very excited, very anxious to get going right there on that beach front - actually in one of the lower elevations" (Houck 2006, 12). While the executive director of the Biloxi Chamber of Commerce assured the *L.A. Times* that they would be rebuilding businesses right on the beaches, but "…they'll just be built smarter (Houck 2006, 12)." These comments sadly demonstrate some of the serious challenges planners and zoning officials face in implementing mitigation policies.

Nevertheless, it is critical that local zoning officials understand the importance zoning can play in a community's master plan to limit development in the areas most vulnerable to hurricane damage. A community's decision to set aside vulnerable coastal land for low-risk development such as parks and recreation, instead of allowing high-risk high-density commercial or residential development likely depends on the local economy, but also may turn on the community's commitment to mitigating the possible effects of a hurricane. Communities that limit development of vulnerable areas and/or relocate vulnerable structures are taking action to mitigate the risk for hurricane damage.

Conceptual Framework

The purpose of this research is descriptive, and the conceptual framework[68] used is that of descriptive categories. The use of descriptive categories organizes the inquiry by describing the important policy actions that comprise hurricane damage mitigation policy. As mentioned above, a review of the scholarly literature yielded the key policy actions of hurricane damage mitigation policy and provided a framework for developing a questionnaire to describe city officials' perceptions of their local hurricane damage mitigation policy.

68. See Shields (1998) and Shields and Tajalli (2006) for a discussion regarding conceptual frameworks.

The five major categories outlined above—building codes, the planning process, incentives to mitigate, assessing vulnerability and resilience, and mitigation through zoning— are organized as headings for descriptive categories in **Table 3.1**.

Table 3-1 Conceptual Framework Linked to the Literature

Table 3.1	
Policy Action	**Sources**
Building Codes	
1. Require strong codes for construction/renovation	1. Godschalk and Brower, 1985; Board on Natural Disasters, 1999; Prater and Lindell, 2000; Mileti and Peek-Gottschlich, 2001; Simmons et al., 2002; FEMA, 2006; Kates et al., 2006; Bagstad et al., 2007; FEMA, 2008; FEMA, 2009
2. Retrofit existing structures	2. Prater and Lindell, 2000; Simmons et al., 2002; FEMA, 2006; FEMA, 2008
3. Improve code enforcement	3. Kunreuther, 1974; Board of Natural Disasters, 1999; FEMA, 2006
The Planning Process	
1. Identify the Need for Long-Term Planning	1. Clary, 1985; Board of Natural Disasters, 1999; Boswell et al., 1999; Mileti and Peek-Gottschlich, 2001; McLean, 2004; Puszkin-Chevlin, 2007; Bagstad et al., 2007; Duxbury and Dickenson, 2007
2. Make Mitigation a Priority	2. Rossi et al., 1982; Goldschalk and Brower, 1985; Smith and Deyle, 1997; Olshansky and Kartez, 1998; Board of Natural Disasters, 1999; Prater and Lindell, 2000; McLean, 2004
3. Participate in FEMA Hazard Mitigation Assistance Programs: (NFIP)	3. Daniels and Daniels, 2003; FEMA, 2002; FEMA, 2008
Incentives to Mitigate	

1. Offer Tax Breaks for Mitigation	1. Godschalk and Brower, 1985; Board of Natural Disasters, 1999; Bagstad et al., 2007
2. Allow Transfer of Development Rights	2. Godschalk and Brower, 1985, Egan, 2007
3. Recognize and end Perverse Subsidies	3. Kunreuther, 1974; Clary, 1985; Wamsley and Schroeder, 1996; Boswell et al., 1999; Constanza, 2001b; Burby, 2006; Bagstad et al., 2007; Birkland and Waterman, 2008
Assess Vulnerability and Resilience	
1. Assess Structural Vulnerability and Resilience	1. Godschalk and Brower, 1985; Cutter et al., 2000; Weichselgartner, 2001; Mileti and Peek-Gottschlich, 2001 Klein et al., 2003; Colten et al., 2008
2. Use Total Cost Accounting	2. Constanza and Farley, 2007; Gaddis et al., 2007; Duxbury and Dickenson, 2007
3. Use Computer Modeling	3. Cutter et. al., 2000; Mileti and Peek-Gottschlich, 2001; FEMA, 2006
Mitigation through Zoning	
1. Limit Development of Vulnerable Areas through Zoning	1. White and Haas, 1975; Godschalk and Brower, 1985; Mileti and Peek-Gottschlich, 2001; McLean, 2004; Salvesen, 2005
2. Regulate Repeat-Loss Properties/ Relocation	2. Godschalk & Brower, 1985; Pilkey and Young, 2005; Smart Growth America, 2005; Bagstad et al., 2007

Chapter Summary

In this chapter, the benefits and difficulties of key policy actions of hurricane damage mitigation policy were discussed. The five descriptive categories for policy actions are: building codes, the planning process, incentives to mitigate, assess vulnerability and resilience, and mitigation through zoning. The next chapter discusses the methodology used for this research.

Chapter 4 : Methodology

Chapter Purpose

In this chapter, the policy actions developed in Chapter Three are operationalized (See **Table 4.1**) into questionnaire items. The strengths and weaknesses of survey research as it relates to this study are explored. In addition, the chapter also covers the population surveyed, statistics, and human subject issues.

Operationalization of the Conceptual Framework

Table 4.1 illustrates how each policy action identified in the literature is operationalized into a survey instrument. The column on the left of **Table 4.1** displays the policy actions that were developed from a comprehensive review of the literature on hurricane damage mitigation policy actions. The column on the right of **Table 4.1** displays the survey questions presented to respondents designed to address the policy actions. The survey is designed to gauge the respondent's assessment of the categories and policy actions discussed in Chapter Three and are addressed through a variety of questions. For example, the first policy action calls for requiring strong building codes for construction and renovation. Therefore, the questions developed to assess this policy action began by gauging the respondent's estimation of the strength of building codes in his or her community. Then respondents were asked whether the building code had been strengthened in the last 10 years. This was designed to allow respondents to offer additional details about the strength of the building code. An assortment of question formats were used. Some of the questions were closed questions of the matrix variety and utilize a Likert style scale (*strongly agree, agree, neither agree nor disagree, disagree or strongly disagree*; these are marked with an * on

Table 4.1. Others questions are of the contingency variety. In addition, the survey contained open ended questions that allowed respondents to provide a short answer with specific details.

Table 4-1 Conceptual Framework Operationalization Table

Table 4.1	
Category	**Survey Question**
1. Building Codes	
1.1 Require Strong Codes for Construction/Renovation	7a.The current building codes in the community are strong enough to ensure that new structures can withstand average hurricane forces.*
	8. Has the community strengthened the building code in the last ten years? ***Yes/No*** (If Yes, approximately how many times? _____)
1.2 Retrofit Existing Structures	9. Approximately what percentage of local homeowners have retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces (1%-100%)? _____%
	10. Approximately what percentage of local business structures have been retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces (1%-100%)? _____%
	11. Approximately what percentage of government-owned structures have been retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces (1%-100%)? _____%
1.3 Improve Code Enforcement	7b. The current building code is enforced effectively.*
	7c.The community has adequate resources to enforce the current building code.*
2. The Planning Process	
2.1 Identify the Need for Long-Term Planning	1c. The community considers the impact new development projects have on the community's long-term plan for development.*
	1d. New development projects are evaluated in terms of how they fit in the community's master plan.*
2.2 Make Mitigation a Priority	1a. Mitigating the risk for hurricane damage is a major priority in this community. *
	1b. Mitigating the risk for hurricane damage plays a major role in the planning process in this community.*

	2. Are hurricane damage mitigation measures a part of the community's master plan? ***Yes/No*** (Please describe why not.)
2.3 Participate in FEMA Hazard Mitigation Assistance Programs	3. Does the community participate in the National Flood Insurance Program? ***Yes/No*** (Please describe why not.)
	4. Has your community developed a FEMA-approved Local Hazard Mitigation Plan? ***Yes/No*** (If no, describe why not.)
	5. Has your community received Hazard Mitigation Grant Program Funding from FEMA to assist in the mitigation planning process? ***Yes/No*** 6. If your community received Hazard Mitigation Grant Program Funding from FEMA, approximately what percentage of your mitigation planning costs were paid by FEMA grants in the last three years? ____ 0 – 20% ____ 20 – 40% ____ 40 – 60% ____ 60 – 80% ____ 80 – 100%
3. Incentives to Mitigate	
3.1 Offer Tax Breaks for Mitigation	14. Does your community offer property tax breaks to encourage voluntary mitigation efforts? ***Yes/No***
	15. Does your community offer preferential property tax assessment to discourage the development of vulnerable land? ***Yes/No***
3.2 Allow Transfer of Development Rights	17. Does your community allow landowners in vulnerable areas to sell development rights to their land to landowners in less vulnerable areas? ***Yes/No***
3.3 Recognize and end Perverse Subsidies	13. Has the community funded infrastructure in vulnerable areas not eligible for federal infrastructure funding? ***Yes/No*** 16. Does your community have a provision in the property tax code that protects property owners from rate increases if they make voluntary efforts to improve their property to reduce the potential risk for hurricane damage (i.e., installing storm shutters)? ***Yes/No***
4. Assess Vulnerability and Resilience	

4.1 Assess Structural Vulnerability	20. Please indicate which of the following infrastructure items the community has taken steps to protect from hurricane damage: ___Water ___Sewer ___Power generation ___Telecommunications ___None of the above
4.2 Use Computer Modeling	12. The community uses the following assessment tools to identify areas that are most vulnerable to hurricane damage. _____Computer Modeling Software (i.e., FEMA's HAZUS-MH)
4.3 Use Total Cost Accounting	12 (con't) ___ Total Cost Accounting ___ No assessment tool is used ___ Other, please describe:
5. Mitigation through Zoning	
5.1 Limit Development of Vulnerable Areas through Zoning	18a. The community limits development in certain vulnerable coastal areas to very low-density development (i.e., parking lots, parks, recreation areas).*
	19. Approximately what percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time have been re-zoned for less vulnerable development? _____%
5.2 Regulate Repeat-Loss Properties/Relocation	18b. The community prefers to rebuild structures destroyed by a hurricane in the same location rather than restricting the rebuild to a less vulnerable location.* 21. Has the community arranged to permanently relocate structures that are located in a vulnerable area and have been damaged by a hurricane to mitigate the risk of future hurricane damage. ***Yes/No*** (briefly describe the relocation efforts.)

<u>*Response Scale</u>
Strongly Agree
Agree
Neither Agree nor Disagree
Disagree
Strongly Disagree

Research Technique

The conceptual framework served as a guide for the construction of the survey

This study used research directed at city officials in the Texas Coastal Zone to assess their perceptions of hurricane damage mitigation practices in their community. The questionnaire was sent to all but two of the potential respondents (69) using Survey Monkey (www.surveymonkey.com). A fax version of the questionnaire was forwarded to two potential respondents who preferred use a paper version.

Survey Research Strengths

Survey research was selected for this study because it is flexible and allows many detailed questions on a specific topic (Babbie 2004, 275). As outlined above in **Table 4.1**, respondents were presented with twenty-one questions regarding hurricane damage mitigation policy actions. Detailed questions were necessary to cover the various categories of hurricane damage mitigation policy. According to Babbie (2004, 243), survey research is considered an excellent method for describing attitudes and orientations of a population; describing perceptions of city officials (in the Texas Coastal Zone) was a key component of completing this study. In addition, survey research allowed for the collection of a large amount of data with manageable analysis requirements.

Survey Research Weaknesses

While the survey research method was selected as the best fit for this study, consideration was given to the weaknesses of the method. A common problem with survey research is that it can be plagued by a poor response rate, also known as non-response bias, which may result in data that fail to represent the population (Babbie, 2004). Unfortunately,

this researcher did not have the resources to offer an incentive to respondents to combat a poor response rate, so a second survey was sent to all respondents who failed to respond to the first to improve the response rate. The second request yielded three additional respondents who did not respond to the first request.

Respondent bias is another concern. In this study, respondents are asked to report on policy action or non-action, but some may be reluctant to report non-action. Therefore, one would anticipate that if respondents identify problems or non-action, it is understated ,just as policy action likely is overstated. Nonetheless, even if the response rate is low, if the respondent identifies problems, there is reason to believe the problems are real. Another method to obtain this information to combat response bias would have been to travel to these cities and examine their policies and practices through a multi-method system (e.g., document analysis, visual inspection, archival records, and interviews). But due to the time constraints of this project a multi-method system was not an option.

Babbie (2004) warns that poorly worded or biased questions can influence a respondent's answers. To combat wording problems and to reduce question biases, the survey was pre-tested by three emergency management specialists (an Emergency Management Coordinator, an Assistant Emergency Management Coordinator, and Emergency Planner/Homeland Security Coordinator, all employed by a county in Texas with a population over one million). All testers had experience with the four aspects of disaster management (mitigation, preparedness, response, and recovery) as it relates to hurricanes.

Another concern was that the mayor or city manager could pass on the survey to an assistant to complete. It appear that the use of Survey Monkey reduced this risk because the on-line version of the survey was targeted to respondents directly through their email, it is

user friendly, and it takes less than 15 minutes to complete.

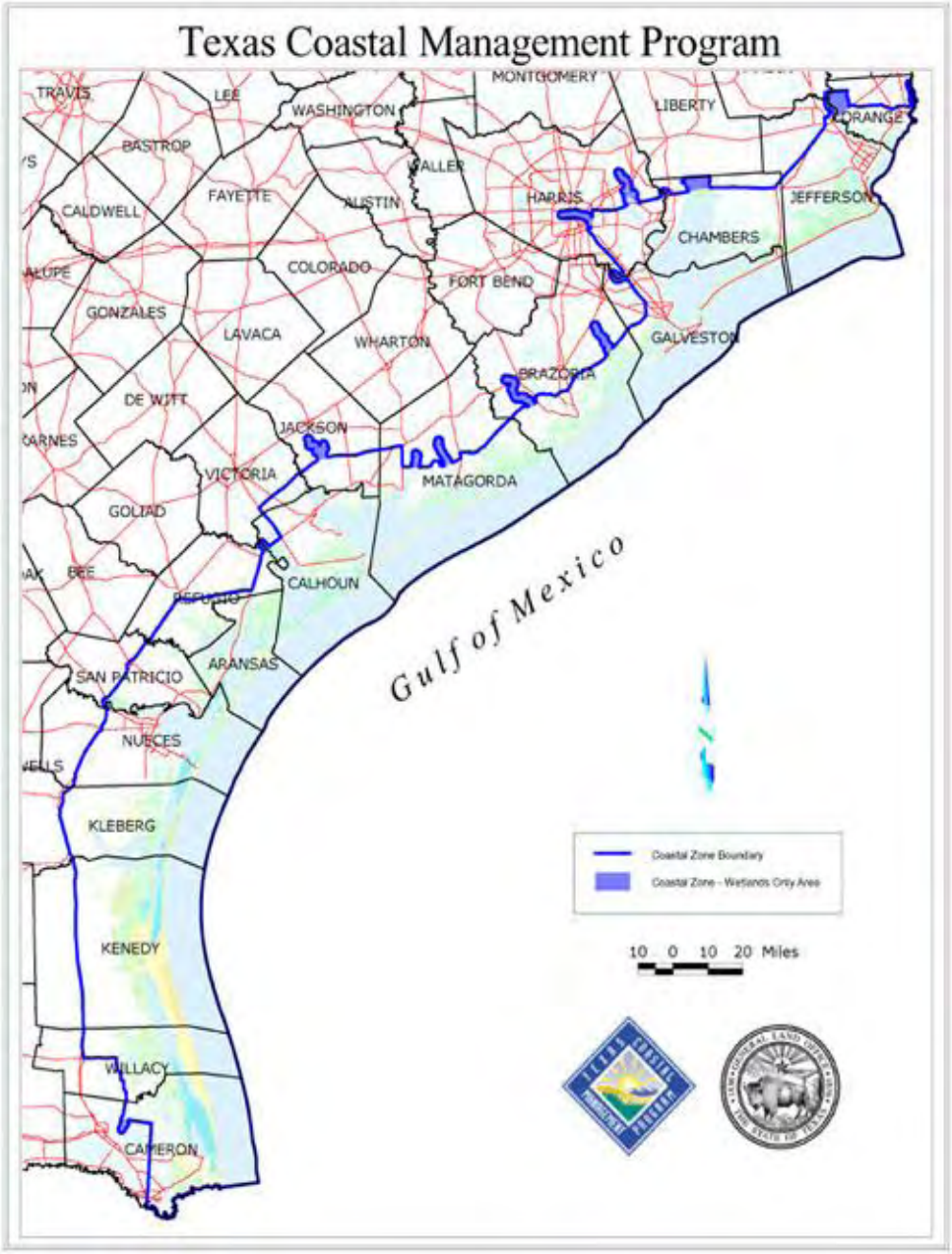
Population

Respondents sought were Texas city officials who manage cities within the Texas Coastal Zone as defined by the General Land Office (GLO) for the State of Texas[69]. **Figure 4.1** displays a map of the Texas Coastal Zone. In the majority of cases (56%) the city manager was selected because most Texas cities use the council-manager form of government and the city manger serves as the single administrative authority for the city. According to Svara (1999), most city managers are leaders in policy, offering more than just technical advice to the city council and elected officials, and the city manager usually is in a unique position to understand and interpret policy decisions. Some of the communities located in the Texas Coastal Zone however, are small towns that do not employ a city manager; in these cases (44%), either the mayor or city administrator was surveyed (See **Table 4.2**). After sorting through the potential respondents located within the Texas Coastal Zone, this researcher discovered 71 cities with some form of local government are located within the zone. Therefore, the entire population was sent the survey, so, this study did not involve sampling. **Table 4.2** contains the list of coastal cities' officials to whom the survey was sent. The names and contact information of respondents was excluded to protect anonymity.

69. See GLO web site for information about the Texas Coastal Zone (http://www.glo.state.tx.us/coastal.html)

Figure 4-1 Map of the Texas Coastal Zone

Figure 4.1



Source: http://www.glo.state.tx.us/coastal/cmpdoc/jpegs/guidance-czb-sm.jpg

Table 4-2 Survey Respondents Sought in the Texas Coastal Zone*[70]

Table 4.2			
1.City Manager	Anahuac	37. City Manager	League City
2.City Manager	Aransas Pass	38. Mayor	Los Fresnos
3.Mayor	Austwell	39. City Manager	McAllen
4. Mayor	Bayside	40. City Manager	Nassau Bay
5. City Manager	Baytown	41. City Manager	Nederland
6. Mayor	Bayview	42. City Manager	Orange
7. Mayor	Beach City	43. City Administrator	Orange Grove
8. City Manager	Beaumont	44. Mayor	Oyster Creek
9. City Manager	Bridge City	45. City Manager	Palacios
10. City Manager	Brownsville	46. Mayor	Pasadena
11. City Administrator	Clear Lake Shores	47. Mayor	Petronilla
12. City Manager	Clute	48. City Administrator	Pinehurst
13. City Manager	Corpus Christi	49. City Manager	Port Aransas
14. City Manager	Deer Park	50. City Manager	Port Arthur
15. City Administrator	Dickinson	51. City Manager	Port Isabel
16. City Administrator	Driscoll	52. City Manager	Port Lavaca
17. City Manager	Edinburg	53. City Manager	Port Neches
18. City Manager	Freeport	54. City Manager	Portland
19. City Manager	Friendswood	55. Mayor	Quintana
20. Mayor	Fulton	56. City Administrator	Rio Hondo
21. Mayor	Galena Park	57. Mayor	Robstown
22. City Manager	Galveston	58. City Manager	Rockport
23. Mayor	Gregory	59. Mayor	Rose City
24. City Manager	Groves	60. Mayor	San Leon
25. City Manager	Harlingen	61. City Manager	Santa Fe
26. Mayor	Hitchcock	62. City Manager	Seabrook
27. Mayor	Houston	63. Mayor	Seadrift
28. City Manager	Ingleside	64. City Manager	Sinton
29. City Manager	Jacinto City	65. Mayor	South Houston
30. City Administrator	Jamaica Beach	66. City Manager	South Padre Island
31. Mayor	Jones Creek	67. Mayor	Surfside Beach
32. City Administrator	Kemah	68. City Manager	Taft
33. City Manager	La Marque	69. Mayor	Texas City
34. City Manager	La Porte	70. City Manager	Webster
35. City Manager	Laguna Vista	71. Mayor	West Orange
36. City Manager	Lake Jackson		

*Not all responded; see Chapter Five.

70. See the GLO website for a detailed map that displays the location of the cities surveyed in **Table 4.2:** http://www.glo.state.tx.us/coastal/jpegs/vert5x13cmp.jpg

Statistics

As this is a descriptive study, descriptive statistics were used to analyze the collected data collected. This included the mean, median, and mode. Frequency distribution tables are provided to display data for particular questions, as well. The use of descriptive statistics was selected as the best technique for the descriptive analysis called for in this study. These data may prove to be valuable in future research.

Human Subjects Protection

Every effort was made to keep the identity of respondents confidential. The identity of respondents and their individual responses will remain anonymous; neither respondents nor cities are identified in connection with the survey results. In addition, all respondent contact information has been stored on this researchers' password-protected laptop computer as a precaution. Also, respondent cities were not identified by name in connection with the data collected. Even though basic steps were taken to keep the identity of respondents confidential, this applied research project was submitted for exemption from a full review from the Texas State Institutional Review Board and the exemption request was approved.[71] In addition, all respondents were presented with a disclaimer before completing the survey. The disclaimer explained that survey results will remain confidential and participation was voluntary (see Appendix A)

71. IRB#: EXP2009N2572 (see Appendix B)

Chapter Summary

This chapter presented an operationalization of the conceptual framework and the survey questions presented to respondents. They survey questions were developed after conducting a study of the scholarly literature on hurricane damage mitigation policy that allowed this researcher to identify policy actions local communities could implement. This chapter also addressed the strengths and weaknesses of survey research, the survey population, statistics, and the human subject issues.

Chapter 5 : Results

Chapter Purpose

The purpose is to address and discuss the hurricane damage mitigation policy survey sent to city officials in the Texas Coastal Zone. This data addresses the research purpose: describing the policy actions of Texas Gulf Coast Cities to mitigate the risk for hurricane damage from the perspective of city officials.

Description of Returned Surveys

The survey was sent to 71 city officials who manage communities located in the Texas Coastal Zone (see **Table 4.2**); 19 surveys were returned. Thus, the response rate for returned surveys was approximately 27 percent. However, only 12 respondents answered every question on the survey. Babbie (2004, 261) suggests a response rate of at least 50 percent is required for accuracy, and the response rate for this survey was well below that rate. This raises concern the results could be influenced by bias. However, as discussed in the previous chapter, one would anticipate that if respondents are willing to disclose non-action, regarding hurricane damage mitigation policy in their community, that non-action likely is understated. Even with a low response rate, if a respondent identified problems, there is reason to believe the problems are real. However the opposite is also expected. One would anticipate respondents will overstate policy action creating a bias that misrepresents such action.

The tables in this chapter outline the response rates, frequency distributions, along with the mean, median and mode for the survey questionnaire items. Because only 19

surveys were returned, data for individual responses will be presented rather than response rate percentages.

As outlined in Chapter Three, policy actions local communities can implement to mitigate the risk for hurricane damage were placed in five categories: building codes, the planning process, incentives to mitigate, assessing vulnerability and resilience, and mitigation through zoning. The findings are summarized by category in the next section.

Building Codes

The building code category contains three policy actions: require strong codes for construction/renovation, retrofit existing structures, and improve code enforcement. **Table 5.1** shows responses to building codes.

Table 5-1 Building Codes Results

Table 5.1			
Survey Question	N	# Strongly Agree and Agree	# Other Responses
The current building codes in the community are strong enough to ensure new structures can withstand average hurricane forces.	15	(4) Strongly Agree (10) Agree	(1) Neither Agree nor Disagree
The current building code is enforced effectively.	15	(6) Strongly Agree (8) Agree	(1) Neither Agree nor Disagree
The community has adequate resources to enforce the current building code.	15	(3) Strongly Agree (10) Agree	(1) Neither Agree nor Disagree (1) Disagree

Although these responses data suggest that city officials in this data set perceive current building codes and code enforcement as sufficient in their communities, these results may be influenced by bias (the reluctance to report non-action and to overstate action). Nearly all respondents (14) indicated building codes in their community are strong enough to

ensure new structures can withstand average hurricane forces. In addition, nearly all respondents (14) concur the current building code is enforced effectively and the vast majority (13) agreed their community has adequate resources to enforce the current building code. Only one respondent indicated the community lacks the resources to enforce the current building code.

Table 5.2 displays the responses for a follow-up survey question pertaining to the policy action of requiring strong codes for new construction/renovation; **Table 5.3** displays the frequency distribution for the follow-up to this question. Unfortunately, only thirteen respondents entered a value indicating how many times the building code was strengthened. **Figure 5.1** displays a graph of the frequency distribution for the data in **Table 5.3**.

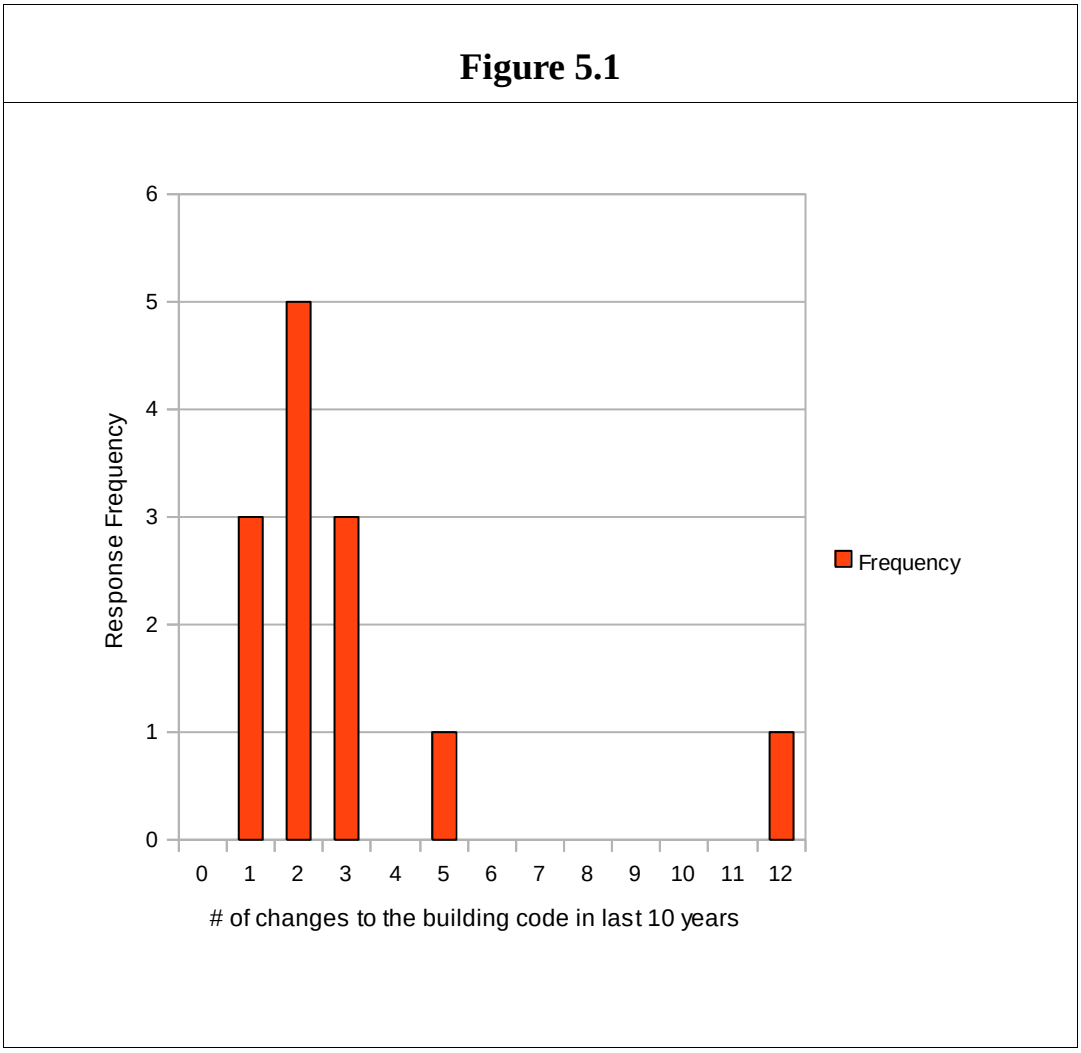
Table 5-2 Building Codes Results

Table 5.2 – Building Codes		
Survey Question	N	Response
Has the community strengthened the building code in the last 10 years?	15	(13) Yes (2) No

Table 5-3 Building Codes Results

Table 5.3 – Building Codes				
Survey Question	N	Mean	Median	Mode
If Yes, approximately how many times?	13	3	2	2

Figure 5-1 (Building Codes) Graph of Frequency Distribution



The data suggest over the last 10 years many respondents have strengthened the building code, but two respondents indicated the codes in their community have not changed during that time. Thirteen respondents reported their community had strengthened the building code in the past 10 years, and all thirteen approximated the number of times the code was strengthened; the values ranged from 1-12 and the mode was 2. The vast majority

of respondents (10) changed the building code more than one time in their community during that time.

Table 5.4 provides a frequency table for three survey questions addressing the policy action of retrofitting existing structures.

Table 5-4 Building Codes Results

Table 5.4			
Estimated percentage of group that **retrofitted** to reduce vulnerability to hurricanes.			
	Mean	Median	Mode
Homeowners N=12	19%	10%	10%
Local Businesses N=12	11%	4%	0%
Government-Owned N=13	26%	1%	0%

Based on the data, it appears that retrofitting existing structures is not a common practice among this set of Texas coastal communities

Approximately 19 percent of homeowners had retrofitted; the median was 10 percent and the mode was 10 percent. The percentage of retrofitted local business structures was similarly low: an average of 11 percent, with a median less than 4 percent and a mode of 0 percent. The percentage of retrofitted government-owned structures was low as well: an average of approximately 26 percent, with a median less than 1 percent and a mode of 0 percent (see Appendix D for a table with all responses).

The Planning Process

The second category of hurricane mitigation policy action addressed in Chapter Three was the planning process, which contains three policy actions: identify the need for long-term planning, make mitigation a priority, and participate in FEMA hazard mitigation

assistance programs. **Table 5.5** shows responses to survey items pertaining to the planning process.

Table 5-5 The Planning Process Results

Table 5.5			
Survey Question	N	# Strongly Agree and Agree	Other Responses
Mitigating the risk for hurricane damage is a major priority in this community.	19	(10) Strongly Agree (7) Agree	(2) Neither Agree nor Disagree
Mitigating the risk for hurricane damage plays a major role in the planning process in this community.	19	(8) Strongly Agree (8) Agree	(2) Neither Agree nor Disagree (1) Disagree
The community considers the impact new development projects have on the community's long-term plan for development.	19	(7) Strongly Agree (8) Agree	(4) Neither Agree nor Disagree
New development projects are evaluated in terms of how they fit in the community's master plan.	19	(7) Strongly Agree (9) Agree	(3) Neither Agree nor Disagree

Mitigation is a priority among communities that responded to the survey. Respondents also indicated they tend to consider long-term plans when making decisions regarding development. Again, however, there is a question about the role of bias. As outlined earlier (Chapter Four), respondents may be reluctant to reveal non-action or overstate policy action. In any event, nearly all respondents (17) indicated that mitigating the risk for hurricane damage is a priority. No one surveyed disagreed that mitigation was a priority, but two elected not to offer an opinion. Sixteen perceived that mitigation plays a major role in the planning process, and the majority of respondents (15) indicated decisions about development are made in terms of how it fits into the long-term plan for development.

In addition, the vast majority (16) indicated that new development projects are evaluated in terms of how the projects fit into the community's master plan.

Table 5.6 displays the response frequency for another survey question pertaining to the policy action of making mitigation a priority.

Table 5-6 The Planning Process Results

Table 5.6		
Survey Question	N	Response
Are hurricane mitigation measures part of the community's master plan? If No, please describe why not.	19	(15) Yes (4) No

Hurricane damage mitigation measures are normally part of the responding communities' master plan: more than three-quarters of respondents answered "yes" to this question. Three of the respondents who answered "no" to this question and provided some added explanations. Respondent A indicated that the city's emergency management coordinator had developed a separate hazard mitigation plan that was not a part of the community's master plan. Respondent B explained that their community had only 3 to 5 homes located in the storm surge area (possibly implying hurricane mitigation measures are not a major concern). Respondent C indicated that hurricane damage mitigation was part of the building permit process in the community and they had a separate hurricane response plan.

Among this set of communities mitigation action is a priority, and most communities incorporated hurricane damage mitigation measures in their master plan. Also, the majority

of respondents indicated that their community considers long-term planning procedures when making decisions regarding new development.

Table 5.7 addresses the third policy action outlined under the planning process category: participate in FEMA hazard mitigation assistance programs. The table provides responses for each question.

Table 5-7 The Planning Process Results

Table 5.7		
Survey Question	N	Response
Community participates in the National Flood Insurance Program?	18	(18) Yes (0) No
Community developed a FEMA-approved hazard mitigation plan?	18	(17) Yes (1) No
Community received hazard mitigation program grant funding from FEMA?	19	(6) Yes (13) No
Approximately what percentage of mitigation planning costs were paid by FEMA in the last 3 years?	6	(3) 0%-20% (0) 20%-40% (0) 40%-60% (3) 60%-80% (0) 80%-100%

Communities surveyed are involved in hazard mitigation assistance programs, and in the National Flood Insurance Program. All but one reported their community has developed a FEMA-approved hazard mitigation plan; the one respondent (Respondent D) who answered "no" to this question explained the community was included in a local hazard mitigation plan being developed by a nearby Texas coastal city. The response rate was simply too low to draw conclusions about mitigation planning costs paid by FEMA.

Incentives to Mitigate

The third policy category was incentives to mitigate, which contains three policy actions: offer tax breaks for mitigation, allow transfer of development rights, and recognize

and end perverse subsidies. The survey questions in **Table 5.8** address these actions and the table displays the responses for each question in this category.

Table 5-8 Incentives to Mitigate Results

Table 5.8		
Survey Question	N	Response
Community has funded infrastructure in vulnerable areas not eligible for federal infrastructure funding?	15	(4) Yes (11) No
Community offers tax breaks to encourage voluntary mitigation efforts?	15	(0) Yes (15) No
Community offers preferential tax assessment to discourage the development of vulnerable land?	15	(0) Yes (15) No
Community has a provision in the tax code that protects property owners from rate increases if they make voluntary efforts to improve their property to reduce the risk for hurricane damage?	15	(0) Yes (15) No
Community allows landowners in vulnerable areas to sell development rights to landowners in less vulnerable areas?	15	(2) Yes (13) No

These 15 Texas communities rarely offer landowners financial incentives to mitigate the risk for hurricane damage. However, the vast majority (11) indicated they did not fund infrastructure in areas ineligible for federal funding. No respondents reported offering tax breaks to encourage voluntary mitigation efforts, nor did they offer preferential tax assessment to discourage the development of vulnerable land. None of the communities surveyed reported having any provision in the local tax code to protect homeowners from property tax increases when they made voluntary efforts to protect their property from hurricane damage. Also, the vast majority of respondents (13) did not allow landowners to sell development rights. Surprisingly, permitting transfer of development rights was the only policy action in the incentive category that received any favorable responses (2).

The findings may be the result of political preference, since typically the state of Texas is a reluctant to allow government intervention in the economy.

Assess Vulnerability and Resilience

The fourth policy category was assessing vulnerability and resilience, with three policy actions: assess structural vulnerability and resilience, use computer modeling, and use total cost accounting. The survey questions in **Table 5.9** address these actions, and the table provides the responses for each question in this category.

Table 5-9 Assess Vulnerability and Resilience Results

Table 5.9		
Survey Question	N	Response
The community uses the following assessment tool(s) to identify areas that are most vulnerable to hurricane damage. ___*Computer modeling software* ___*Total cost accounting* ___*No assessment tool is used* ___*Other*	15	(6) Computer modeling software (7) No assessment tool is used (2) Other (0) Total cost accounting
Please indicate which of the following infrastructure items the community has taken steps to protect from hurricane damage: ___*Water* ___*Sewer* ___*Power generation* ___*Telecommunications* ___*None of the above*	15	(12) Water (11) Sewer (7) Power Generation (2) Telecommunications (2) None of the above

The results were mixed with just over one-half of respondents reporting use of a mechanism to assess vulnerability and resilience. Nonetheless, the data show that the majority of responding communities have taken steps to protect water and sewer facilities, yet neglected to protect telecommunications facilities and to a lesser degree power-

generation facilities. Nearly half of survey respondents (7) indicated that no assessment tool was used to assess vulnerability and resilience, but nearly as many (6) reported using computer modeling software. Two respondents indicated that a different assessment tool was used and provided details regarding those tools. Respondent E indicated the community uses visual analysis, FIRM maps, and historical data to assess vulnerability and resilience. Respondent F indicated the community uses NFIP flood maps, prior hurricane flood impact maps, and Texas General Land Office Bureau of Economic Geology erosion rates run data as assessment tools.

Although the results were mixed with regard to the use of a tool to assess vulnerability, a preliminary inquiry into the vulnerability of critical infrastructure was encouraging with regard to water and sewer facilities. However, some improvement is likely needed for the added protection of power generation, telecommunications facilities, and critical infrastructure items; when they are offline for long periods of time, recovery efforts following a hurricane event are hampered. The reinstatement of power service is crucial before activity in the disaster zone can begin to return to pre-disaster levels.

Mitigation through Zoning

The final policy category of policy was mitigation through zoning, which contains two policy actions: limit development of vulnerable areas through zoning and regulate repeat-loss properties. The survey questions in **Table 5.10** address these actions and the table displays the responses for the questions.

Table 5-10 Mitigation through Zoning Results

Table 5.10			
Survey Question	N	# Strongly Agree and Agree	Other Responses
The community limits development in certain vulnerable coastal areas to very low density development.	15	(3) Strongly Agree (4) Agree	(7) Neither Agree nor Disagree (1) Disagree
The community prefers to rebuild structures destroyed by a hurricane in the same location rather than restricting the rebuild to a less vulnerable location.	15	(0) Strongly Agree (4) Agree	(8) Neither Agree nor Disagree (2) Disagree (1) Strongly Disagree

The results were mixed with regard to limiting development in vulnerable coastal areas; no clear majority opinion emerged. Results also were mixed regarding relocation. Less than half of respondents (7) indicated the community limits development in vulnerable areas to very low-density development. Interestingly, the same number of respondents (7) did not offer an opinion about limiting development in vulnerable areas. Four respondents admitted their community prefers to rebuild structures that have been destroyed by a hurricane in the same location rather than relocating structures to a less vulnerable location. But over half of respondents did not offer an opinion regarding the rebuild of structures in the same location if the structure had been destroyed once.

Table 5.11 contains the frequency distribution and responses for questions that address the issue of regulating repeat-loss properties through zoning.

Table 5-11 Mitigation through Zoning Results

Table 5.11					
Survey Question	N	Responses	Mean	Median	Mode
Approximately what percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time have been re-zoned for less vulnerable development?	13	(10) 0% (3) 1%	0.23%	0%	0%
Has the community arranged to permanently relocate structures that are located in a vulnerable area and have been severely damaged by a hurricane, to mitigate the risk of future hurricane damage?	15	(2) Yes (13) No	N/A	N/A	No

These communities were not using methods to mitigate the risk for hurricane damage through zoning. In addition, the overwhelming majority of respondents (13) indicated that their community had not relocated structures that had been severely damaged by a hurricane to mitigate the risk of future damage.

Some surveyed communities are making an effort to limit development in vulnerable areas to low-density development, but many are not. It was particularly interesting to observe that the majority of city officials surveyed did not offer an opinion on limiting development in vulnerable areas or rebuilding in the same location following destruction. However, follow-up questions regarding relocation showed that these Texas coastal cities were resistant to relocating structures and had taken little to no action to reduce repeat-loss properties.

Chapter Summary

The purpose of this chapter was to discuss survey results for hurricane damage mitigation policy along the Texas coast. The response rate was so low that the results cannot be generalized; they apply only to the communities that responded. In addition, the results that overwhelmingly support a policy action must be evaluated in terms of the suspected bias to overstate policy action. Keeping this bias in mind, the data suggest that responding city officials in the Texas Coastal Zone perceive the current building code and current building code enforcement as sufficient in their communities. Nearly all respondents (14/15) indicated that the building codes in their community are strong enough to ensure that new structures can withstand average hurricane forces. The data also suggest that among those surveyed mitigation is a priority and long-term plans are considered when making decisions regarding development. Nearly all respondents (17/19) indicated that mitigating the risk for hurricane damage was a major priority for their community.

Respondents participate in FEMA-approved hazard mitigation assistance programs and virtually all respondents (17/18) had a FEMA-approved hazard mitigation plan. However, nearly half of those surveyed (7/15) did not have a mechanism in place to assess vulnerability and resilience. Typically, assessing vulnerability is a first step in developing a FEMA-approved hazard mitigation plan.

Interestingly, the results showed that communities surveyed rarely offered incentives to mitigate the risk for hurricane damage. The majority of respondents reported taking steps to protect critical infrastructure such as water (12/15) and sewer (11/15) facilities, but the survey results were mixed with regard to respondents' limiting development in vulnerable

coastal areas to low-density development; less than half of respondents supporting the idea (7/15). Finally, the results indicted the vast majority of respondents (13/15) were resistant to permanently relocating rather than rebuilding structures in vulnerable areas to avoid future losses.

Chapter 6 : Conclusion

Chapter Purpose

The final chapter provides a summary of the research findings as they relate to the research purpose. Recommendations for future research are also included. The recommendations are based on a reflection of the research, the scholarly literature, and survey results.

Summary of Research

The purpose of the research was to survey and describe the policy actions of Texas coastal cities to mitigate the risk for hurricane damage from the perspective of city officials. To provide a prospective on hazard mitigation policy, the history of disaster management policy was discussed along with a brief history of damages caused by hurricanes and tropical storms along the Texas Gulf coast.

The review of the scholarly literature on hurricane damage mitigation policy allowed this researcher to divide the policy actions local communities can implement into five categories: building codes, the planning process, incentives to mitigate, assess vulnerability and resilience, and mitigation through zoning.

The survey was submitted to 71 city officials who manage communities located in the Texas Coastal Zone. Out of a population of 71, 19 surveys were returned, or approximately 26 percent. However, several respondents did not complete the entire survey. Some survey questions were completed by only 12 respondents. Babbie (2004, 261) suggests that a response rate of at least 50 percent is required for accuracy; and the response rate for this survey was well below that rate. This raises concern the results could be influenced by non-

response bias. **Table 6.1** displays a summary of the survey results with policy actions listed in the left column.

Table 6-1 Summary of Results

Table 6.1		
Category	**Survey Question**	**Evidence**
Building Codes		
Require Strong Codes for Construction/Ren-ovation	The current building codes in the community are strong.	(14/15) Strongly Agree or Agree
	Community strengthened the building code in the last ten years?	(13) Yes (N = 15)
	How many times?	μ[72] = 3 (N = 13)
Retrofit Existing Structures	Percentage of local homeowners who have retrofitted.	μ = 19% (N = 12)
	Percentage of local business structures that have been retrofitted.	μ = 11% (N = 12)
	Percentage of government-owned structures that have been retrofitted.	μ = 26% (N = 13)
Improve Code Enforcement	Building code is enforced effectively.	(14/15) Strongly Agree or Agree
	Adequate resources to enforce the current building code.	(13/15) Strongly Agree or Agree
The Planning Process		
Identify the need for long-term planning	Community considers impact of new development projects on long-term plan.	(15/19) Strongly Agree or Agree
	Development projects are evaluated in terms of how they fit in the community's plan.	(16/19) Strongly Agree or Agree
Make Mitigation a Priority	Mitigating the risk for hurricane damage is a major priority in this community.	(17/19) Strongly Agree or Agree
	Mitigating the risk for hurricane damage plays a major role in the planning process in this community.	(16/19) Strongly Agree or Agree
	Are hurricane damage mitigation measures a part of the community's master plan?	(15) Yes (N = 19)
Participate in FEMA Hazard Mitigation	Participate in the National Flood Insurance Program?	(18) Yes (N = 18)

72. "μ" represents the mean for the population.

Assistance Programs	Community developed a FEMA approved Local Hazard Mitigation Plan? ***Yes/No***	(17) Yes (N = 18)
	Community received Hazard Mitigation Grant Program Funding from FEMA to assist in the mitigation planning process? ***Yes/No*** If your community received Hazard Mitigation Grant Program Funding from FEMA, approximately what percentage of your mitigation planning costs were paid by FEMA grants in the last three years? ____ 0 – 20% ____ 20 – 40% ____ 40 – 60% ____ 60 – 80% ____ 80 – 100%	(13) No (N = 19) (3) 0%-20% (0) 20%-40% (0) 40%-60% (3) 60%-80% (0) 80%-100%
Incentives to Mitigate		
Offer Tax Breaks for Mitigation	Community offers tax breaks to encourage voluntary mitigation efforts?	(15) No (N = 15)
	Community offers preferential property tax assessment to discourage the development of vulnerable land?	(15) No (N = 15)
Allow Transfer of Development Rights	Community allow landowners in vulnerable areas to sell development rights to their land?	(13) No (N = 15)
Recognize and End Perverse Subsidies	Community has funded infrastructure in vulnerable areas not eligible for federal infrastructure funding?	(11) No (N = 15)
	Community has a provision in the property tax code that protects property owners from rate increases if they make voluntary efforts to improve their property.	(15) No (N = 15)
Assess Vulnerability and Resilience		
Assess Structural Vulnerability	The community has taken steps to protect critical infrastructure from hurricane damage: Water Sewer Power generation Telecommunications None of the above	N = 15 (12) Water (11) Sewer (7) Power Generation (2) Telecommunications (2) None of the above
Use Computer Modeling	The community uses the following assessment tools to identify areas that are most vulnerable to hurricane damage. _____Computer modeling software (i.e., FEMA's HAZUS-MH)	N = 15 (6) Computer Modeling

Use Total Cost Accounting	(con't) ___ Total cost accounting ___ No assessment tool is used ___ Other, please describe:	N = 15 (0) Total cost accounting (7) No assessment tool (2) Other
Mitigation through Zoning		
Limit Development of Vulnerable Areas through Zoning	The community limits development in certain vulnerable coastal areas to very low-density development.	N = 15 (3) Strongly Agree (4) Agree (7) Neither Agree nor Disagree (1) Disagree
	Percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time that have been re-zoned for less vulnerable development?	N = 13 μ = .23%
Regulate Repeat Loss Properties Relocation	Community prefers to rebuild structures destroyed by a hurricane in the same location rather than restricting the rebuild to a less vulnerable location.	N = 15 (0) Strongly Agree (4) Agree (8) Neither Agree nor Disagree (2) Disagree (1) Strongly Disagree
	Community has arranged to permanently relocate structures that are located in a vulnerable area and have been damaged by a hurricane to mitigate the risk of future hurricane damage.	N = 15 (13) No

The survey suggested that nearly all respondents (17/19) view hurricane damage mitigation policy as a priority in their community, and all but one respondent (17/18) reported having a FEMA-approved local hazard mitigation plan. The data also suggests that communities surveyed engage in long-term planning at least in some degree. These findings tend disagree with the scholarly literature[73]. Prater and Lindell (2000) suggest elected officials often give mitigation little attention because their attention is diverted by the immediate problems of education, poverty and crime in their community.[74] Godschalk and

73. See Rossi et al. (1982), Godschalk and Brower (1985, 70), Clary (1985, 24), Smith and Deyle (1997), and Prater and Lindell (2000) regarding the discussion of the relative low importance of hazard mitigation policy.
74. As cited by McLean (2004, 13)

Brower (1985, 70) found natural hazards are often a low concern for policy makers. Through 2,000 interviews with policy makers, Rossi et al. (1982), discovered natural hazards problems were of very low importance and political salience, rating even lower than concern over pornography. Mileti and Peek-Gottschlich (2001, 64) assert that the problem of short-term thinking is a major problem with planning; Generally people have a cultural economic predisposition to think primarily in the short term. Finally, in Duxbury and Dickenson (2007, 322), David C. Kyler, Executive Director for the Center for a Sustainable Coast, explained that local governments often make planning decisions on a case-by case basis with no long-term policy framework, and these decisions are often driven by the demands of private development without community consensus.

Results also showed the majority of respondents had confidence in the current building code and code enforcement in their community. Again, these findings disagree with FEMA's findings following Hurricane Katrina and Hurricane Ike for the need to improve building codes. The data signaled that the majority of community's surveyed (11/15) did not fund infrastructure in areas not eligible for federal funding. As noted in Chapter Three, the literature identified the practice of funding infrastructure in an area ineligible for federal funding as a policy that subsidizes development of vulnerable land.[75] In addition, the results showed that almost half of respondents (7/15) perceive that they are limiting development in vulnerable areas to low-density development. One possible explanation for the strong findings in favor of these policy actions could be response bias. Consider the earlier discussion regarding the reluctance of respondents to report non-action and exaggerate policy action. The aforementioned mitigation policy actions may be a result of respondents' simply

75. See Bagstad et al. (2007, 294).

exaggerating the action taken in their community.

On the other hand, given the direction of the possible response bias, there is a higher level of confidence in the findings that point in the opposite direction of the expected response bias. Communities surveyed reported making almost no effort to offer incentives to landowners to encourage efforts to mitigate potential hurricane damage. None of the respondents had elected to use their property tax policy to encourage such efforts, and only a few permitted landowners to transfer development rights. The data also demonstrated that respondents were resistant to relocating structures rather than rebuilding in the same location to avoid future losses. In fact, respondents admitted to taking very little action to reduce repeat-loss properties in their communities. Only two (of 15) communities surveyed reported taking action to relocate structures and only 3 (of 13) reported re-zoning a miniscule 1 percent of the land where repeat losses had occurred. The issue of repeat loss properties was highlighted in Chapter Three as a major problem in vulnerable coastal areas.[76] In any event, suspected bias suggests respondents would attempt to minimize this non-action, therefore these findings of non-action are likely accurate.

Assessment of Results

Table 6.2 displays an assessment of the survey results. An analysis of the responses to key questions was conducted and assigned one of three ratings: exceeds expectations, meets expectations, or below expectations. This assessment reflects this researcher's evaluation of the overall efforts in the Texas Coastal Zone to implement the 14 policy actions in the left column in **Table 6.2**.

76. See Pilkey and Young (2005), Smart Growth America (2005), and Bagstad et al. (2007) for discussions calling for the end of repeat-loss properties in Chapter Three.

Table 6-2 Assessment of Results

Table 6.2		
Category	**Survey Question**	**Tentative Assessment**
Building Codes - Overall		**Mixed**
Require Strong Codes for Construction/Renovation	The current building codes in the community are strong.	Exceeds Expectations
	Community strengthened the building code in the last ten years?	Exceeds Expectations
	How many times?	Exceeds Expectations
Retrofit Existing Structures	Percentage of local homeowners who have retrofitted.	**Below Expectations**
	Percentage of local business structures that have been retrofitted.	**Below Expectations**
	Percentage of government-owned structures that have been retrofitted.	**Below Expectations**
Improve Code Enforcement	Building code is enforced effectively.	Exceeds Expectations
	Adequate resources to enforce the current building code.	Exceeds Expectations
The Planning Process - Overall		**Exceeds Expectations**
Identify the need for long-term planning	Community considers impact of new development projects on long-term plan.	Exceeds Expectations
	Development projects are evaluated in terms of how they fit in the community's plan.	Exceeds Expectations
Make Mitigation a Priority	Mitigating the risk for hurricane damage is a major priority in this community.	Exceeds Expectations
	Mitigating the risk for hurricane damage plays a major role in the planning process in this community.	Exceeds Expectations
	Are hurricane damage mitigation measures a part of the community's master plan?	Exceeds Expectations
Participate in FEMA Hazard Mitigation Assistance Programs	Participate in the National Flood Insurance Program?	Exceeds Expectations
	Community developed a FEMA-approved Local Hazard Mitigation Plan?	Exceeds Expectations
Incentives to Mitigate - Overall		**Below Expectations**
Offer Tax Breaks for Mitigation	Community offers tax breaks to encourage voluntary mitigation efforts?	**Below Expectations**
	Community offers preferential property tax assessment to discourage the development of vulnerable land?	**Below Expectations**
Allow Transfer of Development Rights	Community allow landowners in vulnerable areas to sell development rights to their land?	**Below Expectations**

Recognize and end Perverse Subsidies	Community has funded infrastructure in vulnerable areas not eligible for federal infrastructure funding?	Meets Expectations
	Community has a provision in the property tax code that protects property owners from rate increases if they make voluntary efforts to improve their property.	**Below Expectations**
Assess Vulnerability and Resilience - Overall		**Meets Expectations**
Assess Structural Vulnerability	The community has taken steps to protect critical infrastructure from hurricane damage:	
	Water	Exceeds Expectations
	Sewer	Exceeds Expectations
	Power Generation	Meets Expectations
	Telecommunications	**Below Expectations**
Use Computer Modeling	The community uses the following assessment tools to identify areas that are most vulnerable to hurricane damage. _____Computer Modeling Software (i.e., FEMA's HAZUS-MH)	Meets Expectations
Use Total Cost Accounting	(con't) ___ Total Cost Accounting ___ No assessment tool is used ___ Other, please describe:	
Mitigation through Zoning - Overall		**Below Expectations**
Limit Development of Vulnerable Areas through Zoning	Percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time that have been re-zoned for less vulnerable development?	**Below Expectations**
	Percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time that have been re-zoned for less vulnerable development?	**Below Expectations**
Regulate Repeat Loss Properties/ Relocation	Community prefers to rebuild structures destroyed by a hurricane in the same location rather than restricting the rebuild to a less vulnerable location.	**Below Expectations**
	Community has arranged to permanently relocate structures that are located in a vulnerable area and have been damaged by a hurricane to mitigate the risk of future hurricane damage.	**Below Expectations**

Table 6.2 shows that many policy actions received a "below expectations" rating. The planning process was the only category where every policy action in the category exceeded expectations overall. The building codes category finished a close second with two of the three policy actions (require strong codes for new construction/renovation and improve code enforcement) receiving "exceeds-expectations" ratings. In contrast, the ratings for policy actions in the incentives to mitigate category were disappointing. Based on the survey, local property tax policies of respondents failed to offer any incentives to landowners to mitigate the risk for hurricane damage. The ratings in the vulnerability and resilience category were more encouraging: Over half of respondents reported using a mechanism to assess vulnerability; the only policy action in this area that failed to meet expectations was protection of telecommunications facilities. Finally, all of the policy actions in the mitigation through zoning category received a "below-expectations" rating. In the end, only 6 of the 14 policy actions were assessed with a rating of "meets expectations" or above with 2 policy actions receiving a split rating.

Future Research

Discussed in Chapter One, disaster management policy tends to be event driven (Prater and Lindell, 2000, Birkland and Waterman, 2008). This study focused on hurricane damage mitigation policy along the Texas Coastal Zone, a relatively small part of the United States coastline at risk for hurricane activity. The Texas coast has recently experienced catastrophic damage from Hurricane Ike, while the Louisiana, Mississippi, and Alabama coasts are still recovering from the devastation of Hurricane Katrina. The Gulf Coast has encountered a relatively active hurricane pattern for the past several years. Future hurricane damage mitigation policy research that targets coastal areas experiencing relatively low

hurricane activity may offer different results.

This study could be expanded to include the entire Gulf Coast region of the United States or even the entire portion of the coastal zone of the United States at risk for hurricane activity. Such a study may shed light on the variation in mitigation policy from state to state or region to region. In addition, expanding the study could provide an assessment of the overall state of hurricane mitigation policy along the areas of the United States coast at risk for hurricanes.

Similar research of the fourteen policy actions (see Chapter Five) identified in this study could be conducted using a multi-method approach to combat response bias. A researcher could travel to cities in the Texas Coastal Zone and examine their mitigation policies and practices through document analysis, visual inspection, archival records, and interviews. The multi-method approach could provide a richness of data that could not be achieved by this study, which employed a single method.

Furthermore, policymakers could adopt the framework developed in this study as a model that could then be used to conduct an internal assessment of local hurricane damage mitigation policy. This assessment could aid a coastal community in measuring its risk for potential hurricane damage. In addition, the assessment may help a community improve its local hazard mitigation plan. In any event, policymakers would greatly benefit from additional research examining hurricane damage mitigation policy in the United States. Such information could influence future decisions regarding development, the environment, and federal assistance following a hurricane event.

Bibliography

Babbie, Earl. 2004. *The practice of social research*. 10th ed. Belmont, CA: Wadsworth.

Bagstad, Kenneth J., Kevin Stapleton, and John R. D'Agostino. 2007. Taxes, subsidies, and insurance as drivers of United States coastal development. *Ecological Economics* 63 (2-3) (8/1): 285-98.

Barnstone, H. 1966. *The Galveston that was*. New York, NY: McMillian.

Birkland, Thomas, and Sarah Waterman. 2008. Is federalism the reason for policy failure in Hurricane Katrina? *Publius* 38 (4) (Fall): 692.

Bixel, Patricia, and Elizabeth Turner. 2000. *Galveston and the 1900 storm*. Austin, TX: University of Texas Press.

Blake, Eric, Edward Rappaport, and Christopher Landsea. 2007. *The deadliest, costliest, and most intense United States tropical cyclones from 1851 to 2006 (and other frequently requested hurricane facts).* Miami, FL: National Weather Service, National Hurricane Center.

Board on Natural Disasters. 1999. Mitigation emerges as major strategy for reducing losses caused by natural disasters. *Science* 284 (5422) (Jun. 18): 1943-7.

Bogard, William C. 1988. Bringing social theory to hazards research: Conditions and consequences of the mitigation of environmental hazards. *Sociological Perspectives* 31, (2) (Apr.): 147-68.

Boswell, Michael R., Robert E. Deyle, Richard A. Smith, and E. Jay Baker. 1999. A quantitative method for estimating probable public costs of hurricanes. *Environmental Management* 23, (3): 359.

Burby, Raymond. 2006. Hurricane Katrina and the paradoxes of government disaster policy: Bringing about wise government decisions for hazardous areas. *Annals of the American Academy of Political and Social Science* 601 (1): 171-191.

———. 1996. *Making governments plan: State experiments in managing land use.* Baltimore, MD: Johns Hopkins, University Press.

Cartwright, G. 1991. *Galveston: A history of the island*. New York, NY: Atheneum Press.

Clary, Bruce B. 1985. The evolution and structure of natural hazard policies. *Public Administration Review* 45 (Special Issue: Emergency Management: A Challenge for Public Administration) (Jan.): 20-8.

Colten, Craig E., Robert W. Kates, and Shirley B. Laska. 2008. Three years after Katrina: Lessons for community resilience. *Environment* 50, (5) (Sep/Oct): 36

Costanza, Robert. 2001a. Visions, values, valuation and the need for ecological economics. *Bioscience* 51 (6): 459-468.

_____. 2001b. Review: Government-sponsored perversity; perverse subsidies: How tax dollars can undercut the environment and the economy. *Bioscience* 51 (5) (May): 408-10.

Costanza, Robert, and Joshua Farley. 2007. Ecological economics of coastal disasters: Introduction to the special issue. *Ecological Economics* 63, (2-3) (8/1): 249-53.

Cox, Shawn. 2006. A developed ideal emergency management program setting and plan: A case study of Navarro County. *Applied Research Projects.* Paper 106. http://ecommons.txstate.edu/arp/106

Cummings, J. D. 2006. Should the government provide insurance for catastrophes? *Federal Reserve Bank of St. Louis Review* 88 (4): 337-379.

Cutter, Susan L., Jerry T. Mitchell, and Michael S. Scott. 2000. Revealing the vulnerability of people and places: A case study of Georgetown County, South Carolina. *Annals of the Association of American Geographers* 90 (4) (Dec.): 713-37.

Daniels, Tom, and Katherine Daniels. 2003. The environmental planning handbook for sustainable communities and regions. Chicago, IL: Planners Press.

Deyle, Robert E., and R. A. Smith. 1998. Local government compliance with state planning mandates: The effects of state implementation in Florida. *Journal of American Planning Association* 64 (4): 457-469.

Duxbury, Jane, and Sarah Dickinson. 2007. Principles for sustainable governance of the coastal zone: In the context of coastal disasters. *Ecological Economics* 63 (2-3) (8/1): 319-30.

Edwards, Frances L. 2007. Federal intervention in local emergency planning: Nightmare on main street. *State & Local Government Review* 39 (1, A Symposium: Emergency Preparedness of State and Local Governments): 31-43.

Egan, Kristina. 2007. Safe growth and natural disaster. Massachusetts Smart Growth Alliance. Spring 2007. Available from http://www.bos.frb.org/commdev/c&b/2007/spring/article7.pdf.

Ellis, Dee. 2001. Carcass disposal issues in recent disasters, accepted methods, and suggested plan to mitigate future events. *Applied Research Projects.* Paper 68. http://ecommons.txstate.edu/arp/68

Farley, Joshua, Daniel Baker, David Baker, Christopher Koliba, Richard Matteson, Russell Mills, and James Pittman. 2007. Opening the policy window for ecological economics: Katrina as a focusing event. *Ecological Economics* 63 (2-3) (8/1): 344-54.

Federal Emergency Management Agency. 2009. *Hurricane Ike in Texas and Louisiana building performance observations, recommendations and technical guidance.* FEMA P-757. http://www.fema.gov/library/viewRecord.do?id=3577.

———. 2008. *Local multi-hazard mitigation guidance.* http://www.fema.gov/library/viewRecord.do?id=3336 .

———. 2006. *Hurricane Katrina in the Gulf Coast: Mitigation assessment team report, building performance observations, recommendations, and technical guidance*. http://www.fema.gov/library/viewRecord.do?id=1857.

———. 2002. *National flood insurance program, program description.* http://www.fema.gov/library/viewRecord.do?id=1480.

Fornell, E. W. 1961. *The Galveston era: The Texas crescent on the eve of secession*. Austin, TX: University of Texas Press.

Frank, Neil. 2003. The great Galveston hurricane of 1900. In *Hurricane! coping with disaster: Progress and challenges since Galveston, 1900.*, eds. Robert Simpson, Richard Anthes, Michael Garstang, and Joanne Simpson, Washington, DC: American Geophysical Union 129-140.

Gaddis, Erica Brown, Brian Miles, Stephanie Morse, and Debby Lewis. 2007. Full-cost accounting of coastal disasters in the United States: Implications for planning and preparedness. *Ecological Economics* 63 (2-3) (8/1): 307-18.

Godschalk, David R., and David J. Brower. 1985. Mitigation strategies and integrated emergency management. *Public Administration Review* 45 (Special Issue: Emergency Management: A Challenge for Public Administration) (Jan.): 64-71.

Gatlin, Heather. 2006. The search for a theoretical framework for long-term disaster recovery efforts: A normative application of Jane Addams' social democratic theory and ethics. *Applied Research Projects.* Paper 125. http://ecommons.txstate.edu/arp/125

Haddow, George, and Jane Bullock. 2006. *Introduction to emergency management*. 2nd ed. Boston, MA: Elsevier Butterworth-Heinemann.

Haddow, George, Jane Bullock, and Damon Coppola. 2007. *Introduction to emergency management*. 3rd ed. Boston, MA: Elsevier. Elsevier Butterworth-Heinemann

Halff Associates. 2008. *Hurricane Ike damage assessment letter report.* Galveston County, TX.

Hardwick, Susan W. 2001. Identity, place, and locale in Galveston. *Geographical Review* 91, (1/2, Doing Fieldwork) (Jan. - Apr.): 335-41.

Houck, Oliver. 2006. Can we save New Orleans? *Tulane Environmental Law Journal* (Spring).

Kates, R. W., C. E. Colten, S. Laska, and S. P. Leatherman. 2006. Reconstruction of New Orleans after Hurricane Katrina: A research perspective. *Proceedings of the National Academy of Sciences of the United States of America* 103 (40) (Oct. 3): 14653-60.

Klein, Richard J. T., Robert J. Nicholls, and Frank Thomalla. 2003. Resilience to natural hazards: How useful is this concept? *Global Environmental Change Part B: Environmental Hazards* 5 (1-2): 35-45.

Kreps, Gary. 1990. The federal emergency management system in the United States: Past and present. *International Journal of Mass Emergencies and Disasters* 8 (3): 275-300.

Kunreuther, Howard. 1974. Disaster insurance: A tool for hazard mitigation. *The Journal of Risk and Insurance* 41 (2) (Jun.): 287-303.

May, Peter J., and Robert E. Deyle. 1998. *Governing land use in hazardous areas with a patchwork system. In R.J Burby* (ed). *Cooperating with nature: Confronting natural hazards and land use planning for sustainable communities*. Washington DC: Joseph Henry Press.

McEntire, David A. 2004. Development, disasters and vulnerability: A discussion of divergent theories and the need for their integration. *Disaster Prevention and Management* 13 (3).

McLean, Katherine M. 2004. Determining the effectiveness of local mitigation strategies for local governments in Florida: A preliminary review of the local mitigation strategy through the capital improvements program. Master of Public Administration and Master of Science in Planning, Ruben O'D Askew School of Public Administration. Florida State University.

McLoughlin, David. 1985. A framework for integrated emergency management. *Public Administration Review* 45 (Special Issue: Emergency Management: A Challenge for Public Administration) (Jan.): 165-72.

Mileti, Dennis S., and Lori Peek-Gottschlich. 2001. Hazards and sustainable development in the United States. *Risk Management* 3 (1): 61-70.

Office of Technology Assessment, U.S. Congress. 1993. *Preparing for an uncertain climate.* Washington DC: U.S. Government Printing Office, Volume 1.

Olshansky, R., and J. D. Kartez. 1998. Managing land use to build resilience. In R. J. Burby (ed.), *Cooperating with nature: Confronting natural hazards with land-use planning for*

sustainable communities. Washington DC: Joseph Henry Press.

Petersen, Katherine M. 2006. Disaster preparedness and recovery for museums: A business recovery model. *Applied Research Projects.* Paper 118. http://ecommons.txstate.edu/arp/118

Phillips, Jeffrey. 1998. Pre-disaster emergency management in Comal County Texas: An analysis of awareness, concern, and attitudes. *Applied Research Projects.* Paper 102. http://ecommons.txstate.edu/arp/102

Pilkey, Orrin H., and Robert S. Young. 2005. Editorial: Will Hurricane Katrina impact shoreline management? Here's why it should. *Journal of Coastal Research* 21 (6) (Nov.): iii-ix.

Powell, William. 2009. Identifying land use/land cover (LULC) using national agriculture imagery program (NAIP) data as a hydrologic model input for local flood plain management (2009). *Applied Research Projects.* Paper 296. http://ecommons.txstate.edu/arp/296

Prater, Carla S., and Michael K. Lindell. 2000. Politics of hazard mitigation. *Natural Hazards Review* 1 (2) (05): 73.

Puszkin-Chevlin, Ana C. 2007. Determinants of local hazard mitigation policy and built environment vulnerability: Three case studies from Florida's treasure coast. Ph.D., Dissertation. NY: Columbia University.

Rappaport, Edward, and Jose Fernandez-Partagas. 1995. T*he deadliest Atlantic tropical cyclones, 1492-1994.* Coral Gables, FL: National Hurricane Center. http://www.nhc.noaa.gov/pastdeadly.shtml

Rossi, P., J. Wright, and E. Weber-Burdin. 1982. *Natural hazards and public choice: The state and local politics of hazard mitigation study*. London, England: Academic Press.

Salvesen, David. 2005. The coastal barrier resources act: Has it discouraged coastal development? *Coastal Management* 33 (2): 181-95.

Schneider, Saundra. 2008. (Mis) perceptions of the intergovernmental response to disasters. *Publius: The Journal of Federalism* 38 (4).

Shields, Patricia M. 1998. Pragmatism as philosophy of science: A tool for public administration. *Research in Public Administration* 4; 195-225. http://ecommons.txstate.edu/polsfacp/33/

Shields, Patricia M. and Hassan Tajalli. 2006. Intermediate theory: The missing link in successful student scholarship. *Journal of Public Affairs Education* (3): 313-334. http://ecommons.txstate.edu/polsfacp/39/

Shilling, James D., John D. Benjamin, and C. F. Sirmans. 1985. Adjusting comparable sales for floodplain location. *Appraisal Journal* 53 (3) (07): 429.

Simmons, Kevin M., Jamie Brown Kruse, and Douglas A. Smith. 2002. Valuing mitigation: Real estate market response to hurricane loss reduction measures. *Southern Economic Journal* 68 (3) (Jan.): 660-71.

Smart Growth America. 2005. *The hurricane's [Katrina] legacy redevelopment in the Gulf Coast and the nation.*(Accessed 2/11/09) http://www.breakthroughcommunities.info/katrina/SGA_Gulf_Coast_Recommendations_Final.pdf

Smith, R. A., and R. E. Deyle. 1997. Blue-sky or morning-after planning for hurricane recovery: A case study of the Florida panhandle following hurricane Opal, in J. Schwab (ed.), *Planning for post-disaster recovery and reconstruction,* Planning Advisory Report. American Planning Association Chicago, IL. 238-285.

Sylves, Richard. 2007. Federal emergency management comes of age: 1979-2001. In *Emergency management: The American experience, 1900-2005.*, ed. C. B. Rubin. Arlington, VA: Public Entity Risk Institute.

Wamsley, Gary L., and Aaron D. Schroeder. 1996. Escalating in a quagmire: The changing dynamics of the emergency management policy subsystem. *Public Administration Review* 56 (3) (May - Jun.): 235-44.

Waugh, William Jr. 1994. Regionalizing emergency management: Counties as state and local government. *Public Administration Review* 54 (3) (May - Jun.): 253-8.

_____.2000. *Living with hazards, dealing with disasters*. Armonk, NY: M.E. Sharpe.

Weichselgartner, Juergen. 2001. Disaster mitigation: The concept of vulnerability revisited. *Disaster Prevention and Management* 10 (2): 85.

White, G. F., and J. E. Haas. 1975. *Assessment of research on natural hazards*. Cambridge, MA: Massachusetts Institute of Technology Press.

Young, E. B. 1997. *Galveston and the great west*. College Station, TX: Texas A&M University Press.

Appendix A

Disclaimer

This survey contains 21 questions and takes no more than 15 minutes to complete. At the top of the page, there is a bar that displays your progress. Participation in this survey is voluntary and participants may withdraw from the study at any time without prejudice or jeopardy to their standing with any relevant organization with which they are associated. Participants may choose to not answer any question for any reason. Results of the survey will remain confidential. Responses provided by participants will not be published in a manner where participants are identified by name nor will the results be published in a manner that connects results to a particular city. This study has been exempted from a full review by the Texas State University Institutional Review Board (IRB # EXP2009N2572).

Appendix B

Exemption Request EXP2009N2572 - Approval

From: OSP IRB <ospirb@txstate.edu>
To: jpwilso@yahoo.com

DO NOT REPLY TO THIS MESSAGE. This email message is generated by the IRB online application program.
Based on the information in IRB Exemption Request EXP2009N2572 which you submitted on 09/20/09 19:02:44, your project is exempt from full or expedited review by the Texas State Institutional Review Board.
If you have questions, please submit an IRB Inquiry form:
http://www.txstate.edu/research/irb/irb_inquiry.htmlComments:No comments.
==========

Institutional Review Board
Office of Research Compliance
Texas State University-San Marcos
(ph) 512/245-2314 / (fax) 512/245-3847 / ospirb@txstate.edu / JCK 489
601 University Drive, San Marcos, TX 78666

Texas State University-San Marcos is a member of the Texas State University System
NOTE: This email, including attachments, may include confidential and/or proprietary information and may be used only by the person or entity to which it is addressed. If the reader of this email is not the intended recipient or his or her agent, the reader is hereby notified that any dissemination, distribution or copying of this email is prohibited. If you have received this email in error, please notify the sender by replying to this message and deleting this email immediately. Unless otherwise indicated, all information included within this document and any documents attached should be considered working papers of this office, subject to the laws of the State of Texas.

Appendix C

1. Overview

This survey contains 21 questions and takes no more than 15 minutes to complete. At the top of the page there is a bar that displays your progress.

Participation in this survey is voluntary and participants may withdraw from the study at any time without prejudice or jeopardy to their standing with any relevant organization with which they are associated. Participants may choose to not answer any question for any reason.

Results of the survey will remain confidential. Responses provided by participants will not be published in a manner where participants are identified by name nor will the results be published in a manner that connects results to a particular city.

This study has been exempted from a full review by the Texas State University Institutional Review Board (IRB # EXP2009N2572).

2. The Planning Process

The questions in this section will reference local planning policy.

1. Please indicate whether you strongly agree, agree, neither agree or disagree, disagree or strongly disagree with the following statements.

	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Mitigating the risk for hurricane damage is a major priority in this community.	○	○	○	○	○
Mitigating the risk for hurricane damage plays a major role in the planning process in this community.	○	○	○	○	○
This community considers the impact new development projects have on the community's long-term plan for development.	○	○	○	○	○
New development projects are evaluated in terms of how they fit in the community's master plan.	○	○	○	○	○

2. Are hurricane damage mitigation measures a part of the community's master plan?

- ◯ Yes
- ◯ No

Please describe why not.

3. Does the community participate in the National Flood Insurance Program?

- ◯ Yes
- ◯ No

Please describe why not.

4. Has your community developed a Federal Emergency Management Agency (FEMA) approved Local Hazard Mitigation Plan?

- ◯ Yes
- ◯ No

Please describe why the community has not.

5. Has your community received Hazard Mitigation Grant Program Funding from FEMA to assist in the mitigation planning process?

- ◯ Yes
- ◯ No

6. If your community received Hazard Mitigation Grant Program Funding from FEMA, approximately what percentage of your mitigation planning costs were paid by FEMA grants in the last three years?

- ◯ 0%-20%
- ◯ 20%-40%
- ◯ 40%-60%
- ◯ 60%-80%
- ◯ 80%-100%

3. Building Codes

The questions in this section will reference the local building codes.

7. Please indicate whether you strongly agree, agree, neither agree or disagree, disagree or strongly disagree with the following statements.

	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
The current building codes in the community are strong enough to ensure that new structures can withstand average hurricane forces.	○	○	○	○	○
The current building code is enforced effectively.	○	○	○	○	○
The community has adequate resources to enforce the current building code.	○	○	○	○	○

8. Has the community strengthened the building code in the last ten years?

○ Yes

○ No

If "Yes" approximately how many times?

9. Approximately what percentage of local homeowners have retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces (1-100%)?

10. Approximately what percentage of local business structures have been retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces (1-100%)?

11. Approximately what percentage of government-owned structures have been retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces (1-100%)?

4. Assessing Vulnerability and Resilience

The questions in this section will reference tools used to assess vulnerability and resilience.

12. The community uses the following assessment tool(s) to identify areas that are most vulnerable to hurricane damage (check all that apply).

- [ ] Computer modeling software (i.e., FEMA's HAZUS-MH)
- [ ] Total Cost Accounting
- [ ] No assessment tool is used
- [ ] Other, please explain

5. Incentives to Mitigate

The questions in this section will reference the offering incentives to encourage mitigation.

13. Has the community funded infrastructure in vulnerable areas that are not eligible for federal infrastructure funding?

- ◯ Yes
- ◯ No

14. Does your community offer property tax breaks to encourage voluntary mitigation efforts?

- ◯ Yes
- ◯ No

15. Does your community offer preferential property tax assessment to discourage the development of vulnerable land?

- ◯ Yes
- ◯ No

16. Does your community have a provision in the property tax code that protects property owners from rate increases if they make voluntary efforts to improve their property (i.e., installing storm shutters) to reduce the potential risk for hurricane damage?

- ◯ Yes
- ◯ No

17. Does your community allow landowners in vulnerable areas to sell development rights to their land to landowners in less vulnerable areas?

- ◯ Yes
- ◯ No

6. Zoning

The questions in this section will reference local zoning practices.

18. Please indicate whether you strongly agree, agree, neither agree or disagree, disagree or strongly disagree with the following statements.

	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
The community limits development in certain vulnerable coastal areas to very low-density development (i.e., parking lots, parks, recreation areas, etc...).	◯	◯	◯	◯	◯
The community prefers to rebuild structures destroyed by a hurricane in the same location rather than restricting the rebuild to a less vulnerable location.	◯	◯	◯	◯	◯

19. Approximately what percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time have been re-zoned for less vulnerable development (1-100%)?

[ ]

20. Please indicate which of the following infrastructure items the community has taken steps to protect from hurricane damage.

- [ ] Water
- [ ] Sewer
- [ ] Power generation
- [ ] Telecommunications
- [ ] None of the above

21. Has the community arranged to permanently relocate structures that are located in a vulnerable area and have been severely damaged by a hurricane to mitigate the risk of future hurricane damage?

- ◯ Yes
- ◯ No

Briefly describe the relocation efforts.

Appendix D

Survey Results		
Category	**Survey Question**	**Results**
Building Codes		
Require Strong Codes for Construction/ Renovation	The current building codes in the community are strong enough to ensure new structures can withstand average hurricane forces.*	(4) Strongly Agree or Agree (10) Agree (1) Neither Agree nor Disagree
	Has the community strengthened the building code in the last ten years? ***Yes/No***	(13) Yes (2) No
	If yes, how many times?	(3) 1 time (5) 2 times (3) 3 times (1) 5 times (1) 12 times
Retrofit Existing Structures	Approximately what percentage of local homeowners have retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces? _____%	(1) 1% (2) 2% (2) 5% (3) 10% (1) 20% (1) 35% (1) 50% (1) 75%
	Approximately what percentage of local business structures have been retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces? _____%	(3) 0% (1) 1% (2) 2% (2) 5% (2) 10% (1) 15% (1) 80%
	Approximately what percentage of government-owned structures have been retrofitted (e.g., installation of storm shutters) to reduce their vulnerability to hurricane forces? _____%	(6) 0% (1) 1% (1) 10% (2) 20%
Improve Code Enforcement	The current building code is enforced effectively.*	(6) Strongly Agree or Agree (8) Agree (1) Neither Agree nor Disagree
	The community has adequate resources to enforce the current building code.*	(3) Strongly Agree (10) Agree (1) Neither Agree nor Disagree (1) Disagree

The Planning Process		
Identify the need for long-term planning	The community considers the impact new development projects have on the community's long-term plan for development.*	(7) Strongly Agree (8) Agree (4) Neither Agree nor Disagree
	New development projects are evaluated in terms of how they fit in the community's master plan.*	(7) Strongly Agree (9) Agree (3) Neither Agree nor Disagree
Make Mitigation a Priority	Mitigating the risk for hurricane damage is a major priority in this community. *	(10) Strongly Agree (7) Agree (2) Neither Agree nor Disagree
	Mitigating the risk for hurricane damage plays a major role in the planning process in this community.*	(8) Strongly Agree (8) Agree (2) Neither Agree nor Disagree (1) Disagree
	Are hurricane damage mitigation measures a part of the community's master plan? ***Yes/No*** (Please describe why not.)	(15) Yes (4) No
Participate in FEMA Hazard Mitigation Assistance Programs	Does the community participate in the National Flood Insurance Program? ***Yes/No***	(18) Yes (0) No
	Has your community developed a FEMA approved Local Hazard Mitigation Plan? ***Yes/No***	(17) Yes (1) No
	Has your community received Hazard Mitigation Grant Program Funding from FEMA to assist in the mitigation planning process? ***Yes/No*** 6. If your community received Hazard Mitigation Grant Program Funding from FEMA, approximately what percentage of your mitigation planning costs were paid by FEMA grants in the last three years? ____ 0 – 20% ____ 20 – 40% ____ 40 – 60% ____ 60 – 80% ____ 80 – 100%	(6) Yes (13) No (3) 0%-20% (0) 20%-40% (0) 40%-60% (3) 60%-80% (0) 80%-100%
Incentives to Mitigate		
Offer Tax Breaks for Mitigation	Does your community offer property tax breaks to encourage voluntary mitigation efforts? ***Yes/No***	(0) Yes (15) No
	Does your community offer preferential property tax assessment to discourage the development of vulnerable land? ***Yes/No***	(0) Yes (15) No

Allow Transfer of Development Rights	Does your community allow landowners in vulnerable areas to sell development rights to their land to landowners in less vulnerable areas? ***Yes/No***	(2) Yes (13) No
Recognize and End Perverse Subsidies	Has the community funded infrastructure in vulnerable areas not eligible for federal infrastructure funding? ***Yes/No***	(4) Yes (11) No
	Does your community have a provision in the property tax code that protects property owners from rate increases if they make voluntary efforts to improve their property to reduce the potential risk for hurricane damage (i.e., installing storm shutters)? ***Yes/No***	(0) Yes (15) No
Assess Vulnerability and Resilience		
Assess Structural Vulnerability	Has the community taken steps to protect critical infrastructure from hurricane damage: Water Sewer Power generation Telecommunications None of the above	 (12) Water (11) Sewer (7) Power generation (2) Telecommunications (2) None of the above
Use Computer Modeling	The community uses the following assessment tools to identify areas that are most vulnerable to hurricane damage. _____Computer modeling software (i.e., FEMA's HAZUS-MH)	 (6) Computer modeling
Use Total Cost Accounting	(con't) ___ Total cost accounting ___ No assessment tool is used ___ Other, please describe:	 (0) Total cost accounting (7) No assessment tool (2) Other
Mitigation through Zoning		
Limit Development of Vulnerable Areas through Zoning	The community limits development in certain vulnerable coastal areas to very low density development (i.e., parking lots, parks, recreation areas).*	(3) Strongly Agree (4) Agree (7) Neither Agree nor Disagree (1) Disagree
	Approximately what percentage of the areas where community structures have been destroyed by a hurricane and rebuilt more than one time have been re-zoned for less vulnerable development? ____%	(10) 0% (3) 1%

Regulate Repeat Loss Properties/ Relocation	The community prefers to rebuild structures destroyed by a hurricane in the same location rather than restricting the rebuild to a less vulnerable location.*	(0) Strongly Agree (4) Agree (8) Neither Agree nor Disagree (2) Disagree (1) Strongly Disagree
	Has the community has arranged to permanently relocate structures that are located in a vulnerable area and have been damaged by a hurricane, to mitigate the risk of future hurricane damage. ***Yes/No***	(2) Yes (13) No

<u>*Response Scale</u>
Strongly Agree
Agree
Neither Agree nor Disagree
Disagree
Strongly Disagree