City of Waveland
Local Hazard Mitigation Plan

March 2013

amec

EXECUTIVE SUMMARY

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. The City of Waveland developed this Local Hazard Mitigation Plan (LHMP) update to make the City and its residents less vulnerable to future hazard events. This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 so that Waveland would be eligible for the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation and Hazard Mitigation Grant programs.

The City followed a planning process prescribed by FEMA, which began with the formation of a hazard mitigation planning committee (HMPC) comprised of key City representatives, and other regional stakeholders. The HMPC conducted a risk assessment that identified and profiled hazards that pose a risk to the City, assessed the City's vulnerability to these hazards, and examined the capabilities in place to mitigate them. The City is vulnerable to several hazards that are identified, profiled, and analyzed in this plan. Floods, hurricanes, and sea level rise are among the hazards that can have a significant impact on the City.

Based on the risk assessment, the HMPC identified goals and objectives for reducing the City's vulnerability to hazards. The goals and objectives of this multi-hazard mitigation plan are:

Goal 1 – Minimize risk and vulnerability of the community to hazards and reduce damages and protect lives, properties, and public health and safety in the City of Waveland

- Prevent and reduce flood damage and related losses
- Minimize impact to both existing and future development
- Minimize economic and resource impact

Goal 2 – Provide protection for critical facilities, infrastructure, and services from hazard impacts.

Goal 3 – Increase public awareness of the risk and vulnerability of the community to hazards

- Enhance public outreach, education and preparedness program to include all hazards of concern
  - Educate residents on how to best protect themselves and their property during hazard events (include people new to the area)
  - Create targeted public outreach campaigns utilizing diverse and comprehensive outreach mechanisms (meetings, newspaper, radio, television, social media, schools)
- Increase public communications to keep the public well informed prior to, during and after a disaster event

- Improve alert and warning capabilities informing public of hazard events, evacuation routes and sheltering options
- Increase public's awareness and involvement in communities' mitigation projects
  - Assist residents in utilizing grant funds to mitigate property damage

Goal 4 – Increase communities' ability to be prepared for a disaster event and capabilities to mitigate losses

- Enhance emergency services capabilities
- Enhance communication capabilities and interagency coordination
- Increase knowledge and use of technologies and data
- Enhance use of shared resources

Goal 5 – Enhance and improve floodplain management program to maximize CRS credits

Goal 6 – Maintain FEMA Eligibility/Position the communities for Grant funding

To meet this identified goal, the plan recommends 53 mitigation actions, which are summarized in the table that follows. This plan has been formally adopted by the City and will be updated every five years at a minimum.

Table ES.1. City of Long Beach Mitigation Actions

Action Item	Priority	New Action/ 2007 Action
Protect external A/C equipment in the Central Fire Station and Install Underground Storage Tanks	High	New
Warning Sirens	High	New
Residential Elevation	High	New
Sarah Lane to Adams Lane Evacuation Route	High	New
Culvert under Highway 603	High	New
Culvert under Railroad Track at South Street	High	New
Coordinate with and support the US Army Corps of Engineers on Projects in the MsCIP Relating to the City of Waveland	High	New
Public Outreach	High	New
Education of Residential Retrofitting	Medium	New
Evacuation Planning	High	New
Protection of Public Records	High	New
Public Warning Boards (Signs)	High	New
Enhance City of Waveland Website	Medium	New
Beach Front Erosion Protection	High	New
Protection of Marshes and Natural Barriers	High	New

Action Item	Priority	New Action/ 2007 Action
Extension of Stormwater Drainage Facilities into Gulf	Medium	New
Property Acquisition Project	Medium	New
Drainage Projects	Medium	New
Green Space Development	Medium	New
Flood Insurance Promotion	High	New
Elevation Certificate Program	Medium	New
Dredge Jackson Marsh	High	New
Canal Cleanout	High	New
Mitigation Reconstruction/ Flood Proofing	Medium	New
Retrofitting	Medium	New
Sewage Lift Station Bypass Project	High	New
Continue to control construction site runoff through requirement of clearing and grading permits erosion and sediment control regulations.	High	2007
Continue to control post-construction site runoff so it does not exceed pre-development site runoff through enforcement of best management practices.	High	2007
Continue to strengthen floodplain regulations, as appropriate.	High	2007
Update list of City's repetitive flood loss properties to include properties in area annexed in 2006, encourage owners of repetitive and severe repetitive loss properties citywide to participate in mitigation activities such as flood proofing, elevation, or buyout programs, and prepare a floodplain management plan for the repetitive loss areas.	High	2007
Acquire or otherwise remove repetitive and severe repetitive loss properties from the floodplain.	High	2007
Encourage business owners to protect vulnerable structures through flood proofing, elevation, shutters, and other mitigation activities.	Medium	2007
Work with flood insurance agents and lending institutions to ensure that mandatory flood insurance requirements are being met in area annexed in 2006 and throughout Waveland when new maps are adopted.	High	2007
Continue to publicize evacuation routes and approximate travel times to evacuate the area.	High	2007
Continue to mail flood safety information, including evacuation zones and routes, to every address in Waveland every year.	High	2007
Continue to publicize how families can prepare and plan for disaster.	High	2007
Consider establishing a program to train and certify neighborhoods in first response actions after hazards.	Medium	2007
Promote business continuity planning for small businesses and government.	Medium	2007
Publicize information about the special needs registry maintained by the Hancock County Emergency Management Agency and how residents with special needs can register themselves.	Medium	2007
Provide information on model construction techniques, such as storm shutters, in public places so people can learn about these mitigation techniques and adopt them for their own homes.	Medium	2007
Encourage residents to acquire and monitor NOAA weather radios.	Medium	2007

Action Item	Priority	New Action/ 2007 Action
Establish a facility north of Interstate 10 that can be used as a command center in the event of a major hurricane that can also serve as a shelter for essential city personnel and equipment and house a critical records vault.	Medium	2007
Develop a generator plan for all critical facilities.	Medium	2007
Use the Reverse 911 system to issue evacuation warning and advisories, especially for special needs residents.	Medium	2007
Use existing data from the monitoring and warning gauges on waterways to predict hazardous situations. Use Hurrevac and other existing computer programs and data to predict hazardous situations.	Medium	2007
Maintain NOAA StormReady Designation.	Low	2007
Provide an annual pre-hurricane season workshop and exercise for elected officials and emergency operations staff.	High	2007
Enhance the communications system in a coordinated fashion between appropriate departments in the county, city, and the state.	Medium	2007
The City of Waveland will continue to train its personnel in weapons of mass destruction and hazardous materials response through the following education programs:	Low	2007
Continue to update CAMEO, MARPLOT, and ALOHA software where available and install in all response vehicles.	Medium	2007
Continue to update information about hazardous materials facilities in Waveland upon receiving Tier II Forms from the facilities.	Medium	2007
Continue to update the Pre-Plan Emergency Response Books for hazardous materials locations within Waveland.	Medium	2007
Continue to seek grant funding through FEMA Fire Act Grants and Homeland Security Grants for terrorist and HAZMAT equipment to enable its emergency response personnel to prepare and respond to acts of terrorism and hazardous materials incidents.	Medium	2007

TABLE OF CONTENTS

Chapters

1 INTRODUCTION 1.1
1.1 Purpose 1.1
1.2 Background and Scope 1.1
1.3 Community Profile 1.2
1.3.1 Overview of the Community 1.3
1.3.2 Topography and Climate 1.5
1.3.3 History 1.7
1.3.4 Economy 1.8
1.3.5 Population 1.9
1.4 Plan Organization 1.10

2 WHAT'S NEW 2.1
2.1 What's New in the Plan Update 2.1
2.2 2007 LHMP Mitigation Strategy Status and Successes 2.2

3 PLANNING PROCESS 3.1
3.1 Local Government Participation 3.1
3.2 The 10-Step Planning Process 3.2
3.2.1 Phase 1: Organize Resources 3.3
3.2.2 Phase 2: Assess Risks 3.11
3.2.3 Phase 3: Develop the Mitigation Plan 3.11
3.2.4 Phase 4: Implement the Plan and Monitor Progress 3.2

4 RISK ASSESSMENT
4.1 Hazard Identification: Natural Hazards 4.2
4.1.1 Results and Methodology 4.2
4.1.2 Disaster Declaration History 4.6
4.2 Hazard Profiles 4.8
4.2.1 Climate Change and Sea Level Rise 4.11
4.2.2 Coastal/Canal Bank Erosion 4.29
4.2.3 Dam/Levee Failure 4.33
4.2.4 Drought 4.39
4.2.5 Earthquake 4.42
4.2.6 Extreme Heat 4.48
4.2.7 Extreme Winter Weather 4.51
4.2.8 Flood 100/500-Year and Localized Flooding 4.53
4.2.9 Hurricane and Tropical Storm (including Coastal Storm Surge) 4.65
4.2.10 Thunderstorm (includes hail, lightning, high wind) 4.87

4.2.11 Tornado 4.100
4.2.12 Wildfire 4.104
4.2.13 Railroad: Hazardous Materials Release 4.107
4.2.14 Natural Hazards Summary 4.110
4.3 Vulnerability Assessment Summary 4.111
4.3.1 Vulnerability of Waveland to Specific Hazards 4.132
4.3.2 Climate Change 4.134
4.3.3 Coastal/Canal Bank Erosion 4.152
4.3.4 Flood: 100-/500-year 4.153
4.3.5 Flood: Stormwater/Localized Flooding 4.186
4.3.6 Hurricane and Tropical Storms 4.186
4.3.7 Thunderstorm (includes hail, lightning, high wind) 4.209
4.3.8 Railroad Hazardous Materials Release 4.209
4.4 Capability Assessment 4.214
4.4.1 Administrative/Technical Mitigation Capabilities 4.226
4.4.2 Fiscal Mitigation Capabilities 4.227
4.4.3 Mitigation Outreach and Partnerships 4.227
4.4.4 Other Mitigation Capabilities 4.230

5 MITIGATION STRATEGY 5.1
5.1 Mitigation Strategy: Overview 5.1
5.1.1 Continued Compliance with NFIP 5.2
5.2 Goals and Objectives 5.4
5.3 Identification and Analysis of Mitigation Actions 5.7
5.31 Prioritization Process 5.8
5.4 Mitigation Action Plan 5.10

6 PLAN ADOPTION 6.1

7 PLAN IMPLEMENTATION AND MAINTENANCE 7.1
7.1 Implementation 7.1
7.1.1 Role of Hazard Mitigation Planning Committee in Implementation and Maintenance 7.2
7.2 Maintenance 7.2
7.2.1 Maintenance Schedule 7.2
7.2.2 Maintenance Evaluation Process 7.3
7.2.3 Incorporation into Existing Planning Mechanisms 7.4
7.2.4 Continued Public Involvement 7.5

Appendices

Appendix A – Adoption Resolution

Appendix B – Planning Process

Appendix C – Mitigation Strategy

Appendix D - References

1 INTRODUCTION

1.1 Purpose

The City of Waveland prepared this Local Hazard Mitigation Plan (LHMP) update to the 2007 Federal Emergency Management Agency (FEMA) approved City of Waveland Hazard Mitigation and Flood Protection Plan. The purpose of this plan update is to guide hazard mitigation planning to better protect the people and property of the City from the effects of hazard events. This plan demonstrates the community's commitment to reducing risks from hazards and serves as a tool to help decision-makers direct mitigation activities and resources. This plan was also developed, among other reasons, to ensure Waveland's continued eligibility for certain federal disaster assistance: specifically, the FEMA Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Program (PDM), and the Flood Mitigation Assistance Program (FMA). Completion also earns credits for the National Flood Insurance Program's Community Rating System (CRS) which can lower flood insurance premiums for home and business owners in participating CRS communities.

1.2 Background and Scope

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters, because additional expenses incurred by insurance companies and non-governmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be reduced or even eliminated.

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society an average of $4 in avoided future losses in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council 2005).

Hazard mitigation planning is the process through which hazards are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies determined, prioritized, and implemented. This plan documents Waveland's hazard mitigation planning process and identifies relevant hazards and vulnerabilities and strategies the City will use to decrease vulnerability and increase resiliency and sustainability.

The Waveland LHMP update is a single-jurisdiction plan that geographically covers the entire area within the City's jurisdictional boundaries (hereinafter referred to as the planning area).

This plan update was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. (Hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act (DMA or DMA 2000.) While the act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the planning area is subject to hazards related to its waterfront location, access to these funding streams is vital.

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions. The planning area has been affected by hazards in the past and is thus committed to reducing future impacts from hazard events and maintaining eligibility for mitigation-related federal funding.

1.3 Community Profile

1.3.1 Overview of the Community

Waveland is the westernmost of the two incorporated cities located in Hancock County on the Mississippi Gulf Coast. It shares boundaries with the City of Bay St. Louis on the east, with the Mississippi Sound of the Gulf of Mexico on the south, and unincorporated Hancock County on the west and north. Waveland is located approximately 145 miles south of Jackson, Mississippi, about 58 miles east of New Orleans, Louisiana, and 93 miles west of Mobile, Alabama. State Highway 603 runs north and south from Waveland and U.S. Highway 90 runs east and west through Waveland. Both intersect with Interstate Highway 10 allowing easy commuting to New Orleans and other communities to the east and west and access to other major north-south highways. The City of Waveland is shown in Figures 1.1 and 1.2.

Figure 1.1. City of Waveland Base Map

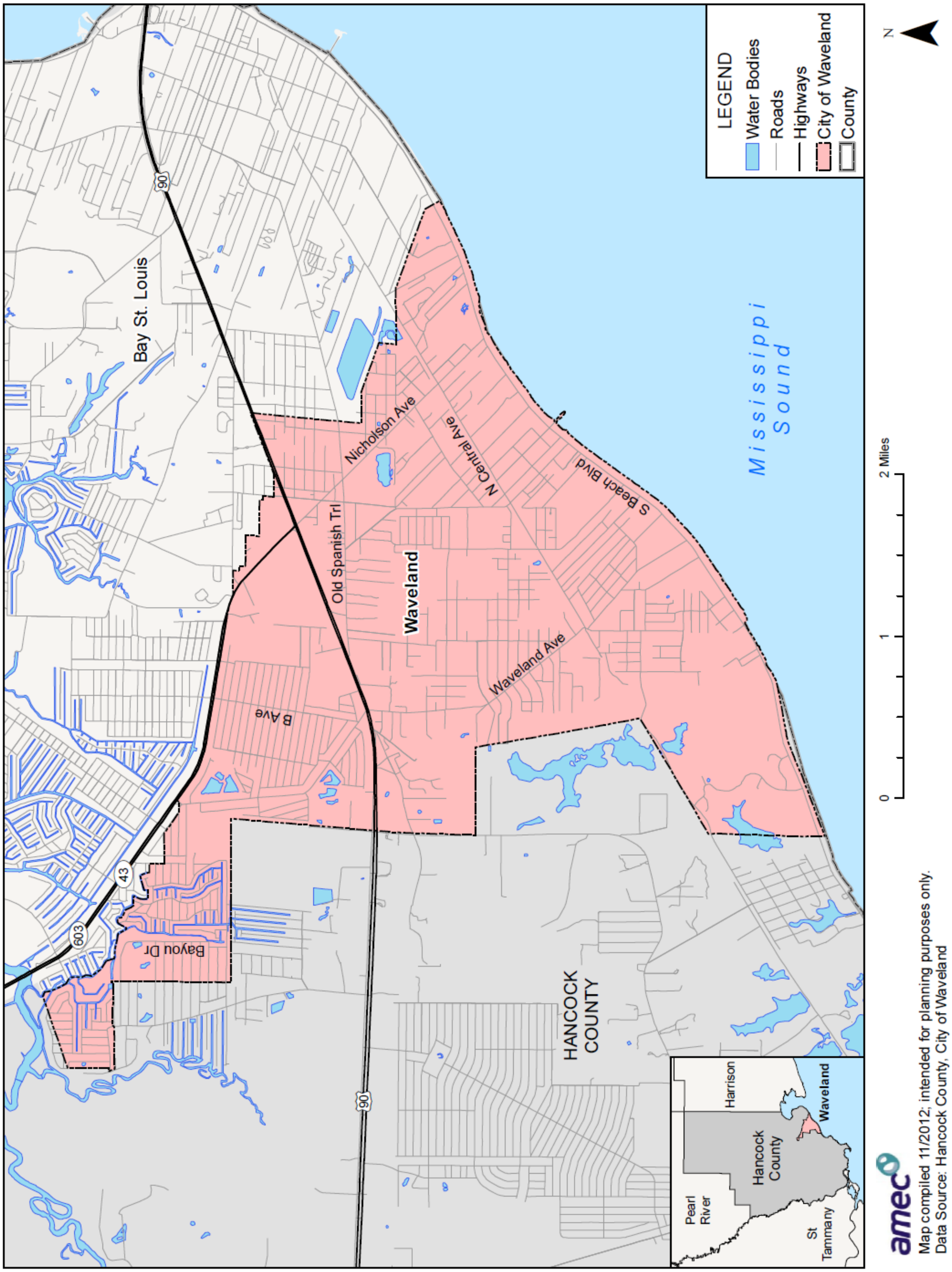
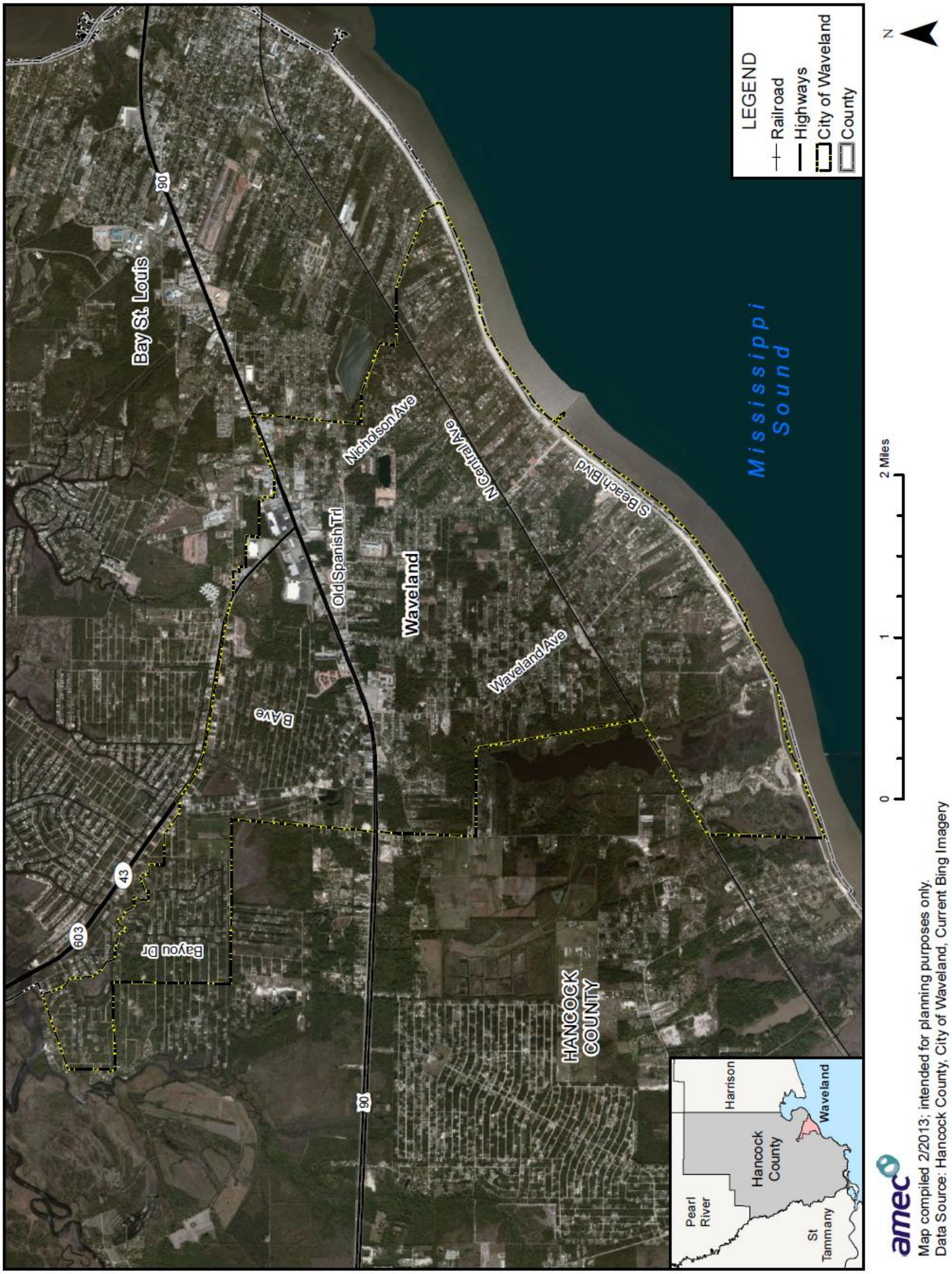


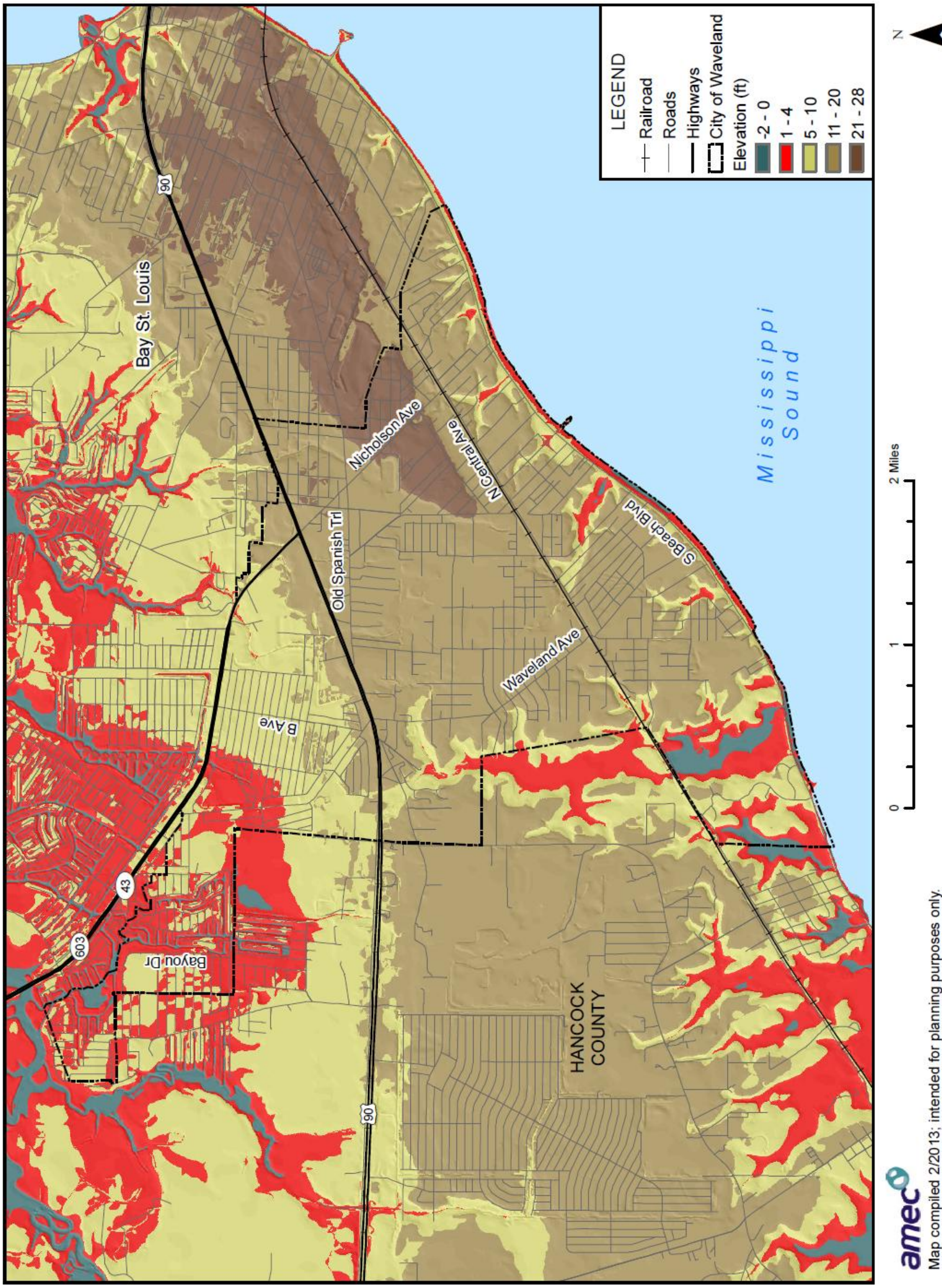
Figure 1.2. Base Map with Imagery



1.3.2 Topography and Climate

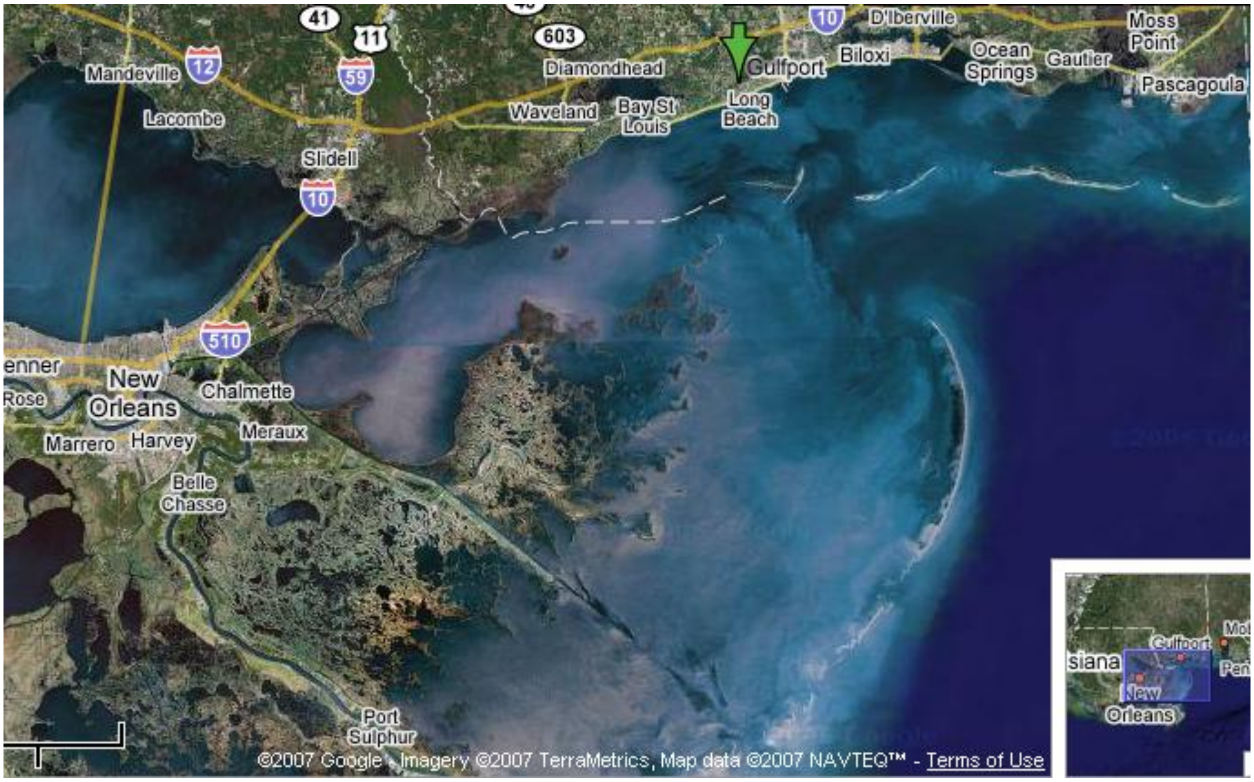
Waveland sits atop a coastal ridge with elevations averaging between 10 and 15 feet National Geodetic Vertical Datum (NGVD). Elevations drop to below 10 feet NGVD north of the city and average about 5 feet NGVD along South Beach Boulevard. Specific topography of the City of Waveland can be seen in Figure 1.3.

Figure 1.3. Waveland Topography



Waveland's southern boundary is found in the waters of the Mississippi Sound. The Mississippi Sound is a relatively shallow body of water with the average depth of 2.97 meters and is separated from the Gulf of Mexico by a series of barrier islands. South of Waveland lie the low, marshy islands of the Louisiana Marshes. Lake Bourgne, a wide saltwater bay, is situated to the southwest and the mouth of the Mississippi River and is almost due south of Waveland. These features can be seen in Figure 1.4.

Figure 1.4. Topography of the Gulf of Mexico



Source: Mitigation Assessment Team Report, Hurricane Katrina in the Gulf Coast (FEMA 549/July 2006)

The climate is mild with mean annual temperatures in the upper sixties. Average winter temperatures range from 50 to 60 degrees Fahrenheit, with mean summer temperatures ranging from 75 to 82 degrees Fahrenheit. Rainfall averages approximately 61 to 65 inches annually with the majority of the accumulation between July and September. Winds in the area are generally southeasterly or southwesterly with speeds usually remaining under 10 miles per hour. Wind speeds increase during periodic coastal storms. Thunderstorms occur between 70 and 80 days a year; many of these storms are accompanied by strong to severe winds.

1.3.3 History

Hancock County was established in 1812 in the Mississippi Territory and formally chartered by the state in 1817. The first people of European descent in the area settled land around the waterfront near present day Bay St. Louis, Waveland, and Pearlington. Bay St. Louis and

Waveland were originally part of one community known as Shieldsboro, named for Thomas Shields who obtained the area through a Spanish Land Grant in 1789.

Shieldsboro was established as a summer retreat for wealthy planters and business people from New Orleans area who were seeking to escape the disease and heat of the summers in the city and delta farmland. By 1825, Shieldsboro was a thriving community and became the County seat of government. The completion of the New Orleans, Mobile and Chattanooga Railroad in 1869 did much for the development of the town as a summer resort. The coming of a post office in 1819 put Shieldsboro on the map. On April 27, 1875, the name of the community was changed to Bay St. Louis.

Waveland was a part of old Shieldsboro and Bay St. Louis until 1888 when it was granted a charter that created the second municipality in Hancock County. The first Town Hall was constructed in 1893 on land donated by Jessie P. Coleman. There are many traditions and legends surrounding Waveland, many of which originated in the early 1800s. One legend relates that an organizer and overlord of a band of local pirates that included such infamous characters as Pierre and Jean Lafitte occupied a home in Waveland. The Lafitte brothers and their band of pirates gave aid to Andrew Jackson in the Battle of New Orleans, forever etching their names in history as loyal Americans.

Early in 1970, under the administration of then Mayor Garfield Ladner, Waveland became a city due to the increase in its population. Initially, its creation was largely due to the presence of the L & N Railroad and its proximity to New Orleans. From its beginning, it was a resort town to many New Orleans residents who had summer homes here.

1.3.4 Economy

Waveland and surrounding Hancock County and coastal Mississippi has a healthy and diverse economy ranging from tourism (focused mainly along the coastal communities), to technology and scientific endeavors that are centered at NASA's John C. Stennis Space Center that covers approximately one half of the land area of Hancock County. Stennis Space Center is the premier national site for testing rocket engines and world class research center that has been an economic magnet for more than 40 years. Approximately 35 commercial interests have set up operations in and around the center and range from such technology giants as Boeing, Digital Media, and Lockheed Martin. The center is known as a world-wide leader in the geospatial remote sensing technology field. The site is located in northwestern Hancock County on the Pearl River.

Table 1.1 shows the employment and unemployment rates along with industry employment by major classification for Hancock County, including Waveland.

Table 1.1. 2011 Employment Occupations Classifications

Occupation Classification	Percent Employed
Management, Professional, and Related Occupations	35.2%
Service Occupations	18.1%
Sales and Office Occupations	20.6%
Natural Resources, Construction, and Maintenance Occupations	15.3%
Production, Transportation, and Material Moving Occupations	10.8%

Source: U. S. Census Bureau, 2007-2011 American Community Survey – 5 Year Estimates

According to 2011 Census American Community Survey data, household income in Waveland was derived primarily from private wages and salaries (73.9 percent); the next highest category for wages was government at 18.5 percent. The 2011 median household income for the area was $33,164, and the per capita income was $21,015. Annual median family income was reported to be $50.417.

1.3.5 Population

The City of Waveland has an estimated 6,435 residents, according to the U.S. Census Bureau 2010 estimates. Table 1.2 breaks down Waveland's demographics.

Table 1.2. The City of Waveland's Demographic and Social Characteristics, 2010

Characteristic	City of Waveland
Gender/Age	
Male	48.6%
Female	51.4%
Median Age	37.1
Under 5 Years	7.4%
65 Years and Over	11.2%
Race/Ethnicity**	
White	80.5%
Some Other Race	1.1%
Asian	1.5%
Black or African American	13.3%
American Indian/Alaska Native	0.6%
Hispanic or Latino (Any Race)	3.8%
Education	
High School Graduate or Higher	84.2%

Source: U.S. Census Bureau American Community Survey, 2010, www.census.gov/
**Of the 97.1% reporting one race

More demographic information and information on growth can be found in Section 4.3 under the heading Growth and Development Trends.

1.4 Plan Organization

The Waveland Local Hazard Mitigation Plan update is organized as follows:

- Chapter 2: What's New
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption
- Chapter 7: Plan Implementation and Maintenance
- Appendix A: Adoption Resolution
- Appendix B: Planning Process
- Appendix C: Mitigation Strategy
- Appendix D: References

2 WHAT'S NEW

Requirements §201.6(d)(3): A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

The 2007 City of Waveland Hazard Mitigation and Flood Protection Plan contained a risk assessment of identified hazards for the City of Waveland and a mitigation strategy to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA, much progress has been made by the City and all participating communities on implementation of the mitigation strategy. This section of the plan provides information specific to the City of Waveland. This chapter includes an overview of the approach to updating the plan, identifies new analyses and information included in this plan update, and highlights key mitigation successes.

2.1 What's New in the Plan Update

This LHMP update involved a comprehensive review and update of each section of the 2007 plan and includes an assessment of the success of the City of Waveland in evaluating, monitoring and implementing the mitigation strategy outlined in the initial plan. In fact, based in part on the issuance of the new 2008 FEMA Plan Preparation Guidance, the 2007 plan has been reorganized, updated, and rewritten in its entirety. Only the information and data still valid from the 2007 plan was carried forward as applicable into this LHMP update.

Also to be noted, Section 7.0 Implementation and Maintenance of this plan update identifies key requirements for updating future plans:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to inventories; and
- Incorporate new action recommendations or changes in action prioritization.

These requirements and others as detailed throughout this plan were also addressed during this plan update process. New information and analyses contained in this plan update includes the following:

- 9 new hazards were addressed in this plan that were not addressed in the 2007 plan:

- Climate Change (storm surge, sea level rise)
- Coastal/Canal Bank Erosion
- Dam/Levee Failure
- Drought
- Earthquake
- Extreme Heat
- Extreme Winter Weather
- Flood: Stormwater/Localized Flooding
- Wildfire

- In addition to these new hazards, the tornado hazard was separated from the thunderstorm hazard.
- Increased flood risk analysis based on the new DFIRM and the most recent Harrison County Assessor's Data. Also developed a history of the flood maps and flood ordinances in order to develop a more refined loss estimate for flood and storm surge.
- Increased discussion of hurricane, including a greater discussion of storm surge and its effects on the City.
- The Climate Change hazard, with a focus on sea level rise and storm surge, was included as a separate hazard. An in-depth literature search was completed and the SLR and storm surge impacts to the City were analyzed using GIS and County assessor data.
- GIS was used, to the extent data allowed, to analyze all priority hazards as part of the vulnerability assessment. This involved utilizing mapped hazard data, combined with the County parcel data.
- Conducted a HAZUS run for the hurricane hazard specific to the City of Waveland
- New research and discussion on cultural, historic, and natural resources of the City.
- Populations at risk to identified hazards were identified utilizing GIS and 2010 Census data. Assets at risk were identified by property type, and values of properties included based on data from the Hancock County Assessor's Database. The discussion on growth and development trends was enhanced utilizing 2010 Census data.
- Hazard impacts to future development were analyzed through the development of future development maps and tables by property type based on the County assessor's data.
- A new critical facility definition was developed, facilities identified by the City, and then geocoded and analyzed for all mapped priority hazards. Maps of critical facilities at risk to identified hazards were included in the Update.
- Enhanced public outreach and agency coordination efforts were conducted throughout the plan update process in order to meet the more rigorous requirements of CRS in addition to DMA requirements.

2.2 2007 LHMP Mitigation Strategy Status and Successes

In the 2007 mitigation strategy for the City of Waveland, the HMPC put forward the following goals:

- Goal 1: Coordinate and incorporate hazard mitigation into community recovery and redevelopment from Hurricane Katrina.
- Goal 2: Improve drainage, stormwater, and flood management.
- Goal 3: Reduce the damage to life and property caused by non-flood/hurricane hazards.
- Goal 4: Provide public education about hazards and how to minimize or avoid related impacts.
- Goal 5: Enhance emergency operations capabilities.
- Goal 6: Provide public education regarding terrorism situations and ways to reduce the impacts of terrorism and other accidental hazardous situations.

Success Stories

Waveland has been successful in implementing actions identified in the 2007 LHMP Strategy as follows:

- City Hall and City Hall Annex is completed. The placement of the new building is now on Coleman Ave. with rear parking which will make it easier to enter and exit the building. The building is elevated to 1 foot above base flood elevation of 19 feet, which includes the City's 1 foot freeboard.
- Fire Station # 1 is completed. The placement of the new building is now on Coleman Ave. which will make it easier to enter and exit with the fire apparatus. The building is elevated to 6 feet above base flood elevation of 19 feet, which includes the City's 1 foot freeboard. The living quarters are now located above the apparatus bay.
- The new Central Fire Station is completed and operational. The building is located in an X Zone and is built to the 500-year Flood elevation, but was still constructed at an elevation of 20 feet.
- The construction of the Waveland Library is complete and is built to 1 foot above the base flood elevation or 19 or 20 feet.

Past Mitigation Actions Update

The 2007 mitigation strategy contained 46 separate mitigation actions benefiting one or more communities within the City. Of these 46 actions, 9 have been completed, and 33 are ongoing. 4 have not yet been started due to a variety of reasons such as changes in priorities, lack of funding, or changes to the projects themselves. 30 of these projects are still considered viable, and will be carried forward in this plan. More detail on these projects can be found in Chapter 5. The status of these mitigation actions are shown in Table 2.1 and the descriptions that follow.

Table 2.1. 2007 Waveland Actions and Status Summary

Actions	Complete	Ongoing	Not yet Started	Project in 2013 LHMP Update
Goal 1 Coordinate and incorporate hazard mitigation into community recovery and redevelopment from Hurricane Katrina.				
Elevate and harden new City Hall and Annex Building to withstand surge, wave action, and hurricane force winds	X			N
Elevate and harden new Fire Station No. 1 to withstand surge, wave action, and hurricane force winds.	X			N
Elevate and harden new Police Department to withstand shallow, still water flooding, and high winds.		X		N
Relocate Fire Station #2 so that it is closer to the area annexed in 2006 and elevate and harden it to withstand surge, wave action, and hurricane force winds.	X			N
Elevate and harden the new library to withstand surge, wave action, and hurricane force winds.	X			N
Relocate the elevated water tank near the City Hall out to a site north of the CSX Railroad.		X		N
Develop a housing reconstruction and repopulation plan and program and incorporate mitigation.		X		N
Develop codes and ordinances to address redevelopment.	X			N
Revise flood ordinance to require that structures in existing B-Zones that are adjacent to existing A-Zones be elevated four feet above the applicable base-flood elevation.	X			N
Revise flood ordinance to adopt elevation standards derived from new FEMA maps	X			N
Consider mitigation opportunities in reconstruction of historic Civic Center.	X			N
Continue to identify and pursue mitigation components of the Mississippi Renewal Forum and subsequent design charrettes and coordination with the new Comprehensive Plan under development.		X		N
Elevate the motor control centers and two of the four generators at the Hancock County Utility Authority Wastewater Treatment Plant in Waveland.		X		N
Goal 2: Improve drainage, stormwater, and flood management.				
Update the City's Master Drainage Plan and develop and implement solutions to persistent drainage problems.		X		N
Continue to control construction site runoff through requirement of clearing and grading permits erosion and sediment control regulations.		X		Y
Continue to control post-construction site runoff so it does not exceed pre-development site runoff through enforcement of best management practices.		X		Y
Continue to strengthen floodplain regulations, as appropriate.		X		Y

Actions	Complete	Ongoing	Not yet Started	Project in 2013 LHMP Update
Update list of City's repetitive flood loss properties to include properties in area annexed in 2006, encourage owners of repetitive and severe repetitive loss properties citywide to participate in mitigation activities such as flood proofing, elevation, or buyout programs, and prepare a floodplain management plan for the repetitive loss areas.		X		Y
Acquire or otherwise remove repetitive and severe repetitive loss properties from the floodplain.		X		Y
Encourage business owners to protect vulnerable structures through flood proofing, elevation, shutters, and other mitigation activities.		X		Y
Establish a plan to conserve green spaces (areas that serve as buffers) and conservation and riparian areas.			X	N
Work with flood insurance agents and lending institutions to ensure that mandatory flood insurance requirements are being met in area annexed in 2006 and throughout Waveland when new maps are adopted.		X		Y
Enforce building regulations in area annexed in 2006.	X			N
Goal 3: Reduce the damage to life and property caused by non-flood/hurricane hazards.				
Consider including safe rooms in all newly constructed public buildings.			X	N
Require that all new public buildings be constructed to resist up to category 5 hurricane force winds and straight-line winds from thunderstorms.		X		N
Goal 4: Provide public education about hazards and how to minimize or avoid related impacts.				
Continue to publicize evacuation routes and approximate travel times to evacuate the area.		X		Y
Continue to mail flood safety information, including evacuation zones and routes, to every address in Waveland every year.		X		Y
Continue to publicize how families can prepare and plan for disaster.		X		Y
Consider establishing a program to train and certify neighborhoods in first response actions after hazards.		X		Y
Promote business continuity planning for small businesses and government.		X		Y
Publicize information about the special needs registry maintained by the Hancock County Emergency Management Agency and how residents with special needs can register themselves.		X		Y
Provide information on model construction techniques, such as storm shutters, in public places so people can learn about these mitigation techniques and adopt them for their own homes.		X		Y
Encourage residents to acquire and monitor NOAA weather radios.		X		Y

Actions	Complete	Ongoing	Not yet Started	Project in 2013 LHMP Update
Goal 5: Enhance emergency operations capabilities.				
Establish a facility north of Interstate 10 that can be used as a command center in the event of a major hurricane that can also serve as a shelter for essential city personnel and equipment and house a critical records vault.			X	Y
Develop a generator plan for all critical facilities.		X		Y
Use the Reverse 911 system to issue evacuation warning and advisories, especially for special needs residents.		X		Y
Use existing data from the monitoring and warning gauges on waterways to predict hazardous situations. Use Hurrevac and other existing computer programs and data to predict hazardous situations.		X		Y
Maintain NOAA StormReady Designation.		X		Y
Provide an annual pre-hurricane season workshop and exercise for elected officials and emergency operations staff.		X		Y
Enhance the communications system in a coordinated fashion between appropriate departments in the county, city, and the state.		X		Y
Participate in the Mississippi Automated Systems Project.			X	N
Goal 6: Provide training, outreach, and data concerning acts of terrorism and hazardous materials in Waveland and the surrounding area.				
The City of Waveland will continue to train its personnel in weapons of mass destruction and hazardous materials response through the following education programs:		X		Y
Continue to update CAMEO, MARPLOT, and ALOHA software where available and install in all response vehicles.		X		Y
Continue to update information about hazardous materials facilities in Waveland upon receiving Tier II Forms from the facilities.		X		Y
Continue to update the Pre-Plan Emergency Response Books for hazardous materials locations within Waveland.		X		Y
Continue to seek grant funding through FEMA Fire Act Grants and Homeland Security Grants for terrorist and HAZMAT equipment to enable its emergency response personnel to prepare and respond to acts of terrorism and hazardous materials incidents.		X		Y

Goal 1 Coordinate and incorporate hazard mitigation into community recovery and redevelopment from Hurricane Katrina.

Elevate and harden new City Hall and Annex Building to withstand surge, wave action, and hurricane force winds

Progress to Date: 2012 City Hall and City Hall Annex is completed. The placement of the new building is now on Coleman Ave. with rear parking which will make it easier to enter and exit the building. The building is elevated to 17 feet above base flood elevation including the City's 1 foot freeboard.

Elevate and harden new Fire Station No. 1 to withstand surge, wave action, and hurricane force winds.

Progress to Date: 2012 Fire Station # 1 is completed. The placement of the new building is now on Coleman Ave. which will make it easier to enter and exit with the fire apparatus. The building is elevated to 17 feet above base flood elevation including the city's 1 foot freeboard. The living quarters are now located above the apparatus bay.

Elevate and harden new Police Department to withstand shallow, still water flooding, and high winds.

Progress to Date: Ongoing. City is having issues with the Contractor. The Waveland Police Department is now operating out of the previous fire department double wide trailer on Coleman Ave.

Relocate Fire Station #2 so that it is closer to the area annexed in 2006 and elevate and harden it to withstand surge, wave action, and hurricane force winds.

Progress to Date: Completed in 2012. The new Central Fire Station is completed and operational. The building is located in an X Zone, but was constructed at an elevation of 20 feet.

Elevate and harden the new library to withstand surge, wave action, and hurricane force winds.

Progress to Date: Completed in 2012. The construction of the Waveland Library is complete and is built to 1 foot above the Base Flood Elevation of 19 feet.

Relocate the elevated water tank near the City Hall out to a site north of the CSX Railroad.

Progress to Date: Ongoing. The FEMA Project Worksheet that was written for the Tank was not enough to repair the tank and the City of Waveland is looking into project with FEMA to determine the issue with the funding.

Develop a housing reconstruction and repopulation plan and program and incorporate mitigation.

Progress to Date: Ongoing. The city of Waveland and its planning consultants (AMEC) have selected 8 properties for phase 1 of the acquisition program with a total projected cost of $1,107,153.00. That application is being submitted to MEMA for approval. Additional Acquisition projects are being applied for through AMEC.

Develop codes and ordinances to address redevelopment.

Progress to Date: In 2010, the City of Waveland did not adopt the Smart Code because Waveland did a new comprehensive plan

Revise flood ordinance to require that structures in existing B-Zones that are adjacent to existing A-Zones be elevated four feet above the applicable base-flood elevation.

Progress to Date: Completed. The City feels it is in the best interest of residents in B-Zones bordering A-Zones to also adhere to the City's new Flood Damage Prevention Ordinance elevation requirement, which is four feet above the current Base-Flood Elevation, Post Hurricane Katrina

Revise flood ordinance to adopt elevation standards derived from new FEMA maps

Progress to Date: Completed. The current Floodplain Management Ordinance is #342 which requires a one foot freeboard above the 2009 DFIRMs.

Consider mitigation opportunities in reconstruction of historic Civic Center.

Progress to Date: Completed. A grant has been received from the Mississippi Department of Archives and History to repair and restore the building. As a historic structure, it is not required that the structure be elevated. It is not intended that any HMGP funds will be used on this project. Waveland Civic Center repairs have been completed and reopened for public use

Continue to identify and pursue mitigation components of the Mississippi Renewal Forum and subsequent design charrettes and coordination with the new Comprehensive Plan under development.

Progress to Date: Ongoing. The ideas for Coleman Avenue are being seriously considered for incorporation into the reconstructed Coleman Avenue business district. The City will continue to consider the ideas generated at this Charrette and a second Waveland-specific Charrette.

Elevate the motor control centers and two of the four generators at the Hancock County Utility Authority Wastewater Treatment Plant in Waveland.

Progress to Date: Ongoing. The motor control centers have been replaced in their original location because of the need to get service back on line, but HMGP funding has been approved to elevate the motor control centers as well as two of the four generators. Funding to elevate the other two generators was denied because of the associated costs. Two generators can operate one-third of the facility. It is still important to protect the two generators that are not currently scheduled to be elevated. This is considered a County project, and will not be carried forward.

Goal 2: Improve drainage, stormwater, and flood management.

Update the city's Master Drainage Plan and develop and implement solutions to persistent drainage problems.

Progress to Date: Ongoing. MEMA has approved the $6.9 million drainage grant for water sheds 29b, 45, 45b, 23, 36a, 36b, 31 and 36d

Continue to control construction site runoff through requirement of clearing and grading permits erosion and sediment control regulations.

Progress to Date: Ongoing. The City has adopted an Erosion and Sediment Control Ordinance to safeguard people, protect property, prevent damage to the environment, and promote the public welfare by guiding, regulating, and controlling the design, construction, use, and maintenance of any development or other activity that disturbs or breaks the topsoil or results in movement of earth on land in the City of Waveland. The city continues to enforce its erosion and sediment control ordinance.

Continue to control post-construction site runoff so it does not exceed pre-development site runoff through enforcement of best management practices.

Progress to Date: Ongoing. The City of Waveland is implementing the Stormwater Management Phase II Plan for 2009 through 2013, and has submitted the annual report to Mississippi Department of Environmental Quality for their approval.

Continue to strengthen floodplain regulations, as appropriate.

Progress to Date: Ongoing. Waveland is a NFIP member in good standing and has a Community Rating System (CRS) Class Rating of 5, which indicates that it adopts regulations more stringent than the NFIPs

Update list of city's repetitive flood loss properties to include properties in area annexed in 2006, encourage owners of repetitive and severe repetitive loss properties citywide to participate in mitigation activities such as flood proofing, elevation, or buyout programs, and prepare a floodplain management plan for the repetitive loss areas.

Progress to Date: Ongoing. Waveland has already commenced enforcing its more stringent flood insurance and building regulations in the annexed area and at every opportunity will take steps to help owners mitigate flooding to their properties (e.g., elevation, acquisition, relocation, etc.) by applying for HMGP, FMA, RFC, SRL, and other grants as applicable.

Acquire or otherwise remove repetitive and severe repetitive loss properties from the floodplain.

Progress to Date: Ongoing. The original 18 properties that were submitted to MEMA for approval are still going through the process of being acquired. And has been reduced to 8 properties because of funding. The Voluntary Statements of participation have been completed by the homeowners for the second time.

Encourage business owners to protect vulnerable structures through flood proofing, elevation, shutters, and other mitigation activities.

Progress to Date: Ongoing. Small business owners in Waveland should be encouraged to participate in this loan program and undertake retrofitting measures that will minimize damage to their structures during a hurricane or flood.

Establish a plan to conserve green spaces (areas that serve as buffers) and conservation and riparian areas.

Progress to Date: Not yet started. 18 properties were submitted to MEMA but due to funding issues that number has been reduced to 8 properties, when acquired. This will remain Green Space.

Work with flood insurance agents and lending institutions to ensure that mandatory flood insurance requirements are being met in area annexed in 2006 and throughout Waveland when new maps are adopted.

Progress to Date: Ongoing. This is an ongoing activity for the City.

Enforce building regulations in area annexed in 2006.

Progress to Date: Completed. IBC-IRC Flood damage prevention Ordinance # 342 has been adopted by the City and continues to be enforced.

Goal 3: Reduce the damage to life and property caused by non-flood/hurricane hazards.

Consider including safe rooms in all newly constructed public buildings.

Progress to Date: Ongoing. Continue to use Annex 7 of the Outreach Project Strategies (OPS) Technical Resource Manual includes information on residential and small business safe room designs.

Require that all new public buildings be constructed to resist up to category 5 hurricane force winds and straight-line winds from thunderstorms.

Progress to Date: Ongoing. The Waveland Police Department is still in the process of being built using 361 funding.

Goal 4: Provide public education about hazards and how to minimize or avoid related impacts.

Continue to publicize evacuation routes and approximate travel times to evacuate the area.

Progress to Date: Ongoing. The Corps of Engineers is still in the process of updating the new Mississippi Hurricane Evacuation Study.

Continue to mail flood safety information, including evacuation zones and routes, to every address in Waveland every year.

Progress to Date: Ongoing. The annual mail-out of the Flood Safety Information brochure is completed each year prior to the start of Hurricane Season.

Continue to publicize how families can prepare and plan for disaster.

Progress to Date: Ongoing. It is recommended that the Waveland Civil Defense Coordinator and Bay-Waveland-Hancock County Civil Defense continue to work in partnership with the American Red Cross to provide this information to the community. Joint press releases will detail the proper steps to develop this plan. These will be submitted to the local newspapers. Civil Defense and Red Cross representatives will work together at the County's Hurricane Fair and the Business and Industry Expo each year to provide brochures on developing Family Disaster Plans. Brochures will also be made available to Waveland's major employers that can be given to staff with paychecks.

Consider establishing a program to train and certify neighborhoods in first response actions after hazards.

Progress to Date: Ongoing. In August 2009, the Hancock County Board of Supervisors has approved the County Emergency Management Agency to organize a new- search and rescue team which may be called upon for numerous types of situations.

Promote business continuity planning for small businesses and government.

Progress to Date: Ongoing. The City continues to use materials from ready.gov for business continuity after a disaster.

Publicize information about the special needs registry maintained by the Hancock County Emergency Management Agency and how residents with special needs can register themselves.

Progress to Date: Ongoing. - At all community Outreach Programs, people that may need assistance in the event of any emergency are encouraged to call the Hancock County Emergency Operations Center and be placed on the Special Needs List.

Provide information on model construction techniques, such as storm shutters, in public places so people can learn about these mitigation techniques and adopt them for their own homes.

Progress to Date: Ongoing. Copies of Protecting Your Property from High Winds Reinforce or Replace Garage Doors and FEMAs Technical Fact Sheet No. 26 on Shutter Alternatives are made available at all Public Outreach Program as well as the following brochures and guides;

- Brace Gable End Roof Framing
- Secure Composition Shingle Roofs
- Secure Built-up and Single-Ply Roofs
- Secure Metal Siding and Metal Roofs
- Remove Trees and Potential Windborne Missiles
- Reinforce or Replace Garage Doors
- Reinforce Double Entry Doors
- Protect Windows and Doors with Covers
- Maintain EIFS Walls

Encourage residents to acquire and monitor NOAA weather radios.

Progress to Date: Ongoing. The City of Waveland Fire Department and NFIP/CRS annually participates in several Public Outreach venues to advise people about NOAA All Hazard Radios.

Goal 5: Enhance emergency operations capabilities.

Establish a facility north of Interstate 10 that can be used as a command center in the event of a major hurricane that can also serve as a shelter for essential city personnel and equipment and house a critical records vault.

Progress to Date: Not yet started. Local officials are continuing to seek funding and a suitable location for this project

Develop a generator plan for all critical facilities.

Progress to Date: Ongoing. Fire Chief / CRS Coordinator working with consultants have an application for generators approved by Mississippi Emergency Management Agency for generators with quick connections and have been bid or are in the process of being built to bid specs.

Use the Reverse 911 system to issue evacuation warning and advisories, especially for special needs residents.

Progress to Date: Not yet started. The Hancock County Emergency Operations Center has relocated to a temporary facility. As of July 2012, the system was still down.

Use existing data from the monitoring and warning gauges on waterways to predict hazardous situations. Use Hurrevac and other existing computer programs and data to predict hazardous situations.

Progress to Date: Ongoing. It is recommended that the City of Waveland Fire Department and Waveland Police Department continue to receive training in the use and interpretation of this information and remain updated to the most current version of the Hurrevac Software. This will greatly assist them in making decisions related to evacuations. It is recommended that training continue to be obtained through the U.S. Geological Survey and the National Weather Service.

Maintain NOAA StormReady Designation.

Progress to Date: Ongoing. The Fire Chief and Assistant Fire Chief, in March 2012 met with the National Weather Service Forecast Office in New Orleans on the continuance of a Storm Ready Community for the City of Waveland Fire Department. The meeting was held at the New Waveland Fire Department located at 427 Hwy 90 in Waveland. At that meeting it was decided that since the fire department was located in a suitable building, the City could reapply for Storm Ready Status. That application has been submitted and is currently awaiting approval.

Provide an annual pre-hurricane season workshop and exercise for elected officials and emergency operations staff.

Progress to Date: Ongoing. The Bay/Waveland/Hancock County Civil Defense Office continues to provide training and updates to everyone.

Enhance the communications system in a coordinated fashion between appropriate departments in the county, city, and the state.

Progress to Date: Ongoing. Waveland Fire Department has replaced all of its radio communication equipment and now has a completed Fire Department to store and house its own communications for Fire Service, Law Enforcement, and Public Works. The Hancock County 911 continues in an agreement with Bay St. Louis, Waveland and Hancock County in providing dispatch services to all City and County Departments as of May 2012.

Participate in the Mississippi Automated Systems Project.

Progress to Date: This project has been discontinued and will not be carried forward.

Goal 6: Provide training, outreach, and data concerning acts of terrorism and hazardous materials in Waveland and the surrounding area.

The City of Waveland will continue to train its personnel in weapons of mass destruction and hazardous materials response through the following education programs:

Progress to Date: Ongoing. Advanced Haz-Mat Technician, this course provides emergency responders operational level instruction on responding to and operating during a weapon of mass destruction incident. The course covers chemical, ordinance/explosive, biological and radiological/nuclear threats.

Incident Response to Terrorist Bombings—This course is designed to provide basic instruction on weapons of mass destruction and terrorist incidents with a focus on explosives and incendiary devices.

Hazardous Materials Technician Levels I and II—These courses provide emergency response personnel training and information in biological terms, monitoring equipment, personal protective equipment, plugging and patching, containment and confinement and chlorine kit training.

Continue to update CAMEO, MARPLOT, and ALOHA software where available and install in all response vehicles.

Progress to Date: Ongoing. CAMEO and MARPLOT updates are downloaded annually, and each of the City's water wells that house chlorine gas are placed in a series of events printed and put into the Fire Department Pre-Plan Manuals for response and training.

Continue to update information about hazardous materials facilities in Waveland upon receiving Tier II Forms from the facilities.

Progress to Date: Ongoing. Each year all hazardous storage locations within Waveland report their hazardous storage inventory to the Fire Department and Civil Defense Coordinator on Tier II forms. The Tier II forms are placed in the Pre-Plan Books for that location. Information on the Tier II forms include the owners name, address, emergency contact telephone numbers, a list of chemicals in their inventory, type of storage containers for each chemical, quantities stored, location of each stored chemical and length of time the chemical is stored on site.

Continue to update the Pre-Plan Emergency Response Books for hazardous materials locations within Waveland.

Progress to Date: Ongoing. The Waveland Fire Department maintains and annually updates the Pre-Plan Emergency Response books on all hazardous materials locations within the City Limits of Waveland. The Preplan books are used in scenario-based training as well in emergency and hazardous chemical inventory; Tier II code descriptions; response procedures; hazmat summary sheet; CAMEO facility and chemical reports; facility contact information; site plans;

material safety data sheets; and evacuation radius maps of ¼, ½, ¾, and one mile evacuation zones.

Continue to seek grant funding through FEMA Fire Act Grants and Homeland Security Grants for terrorist and HAZMAT equipment to enable its emergency response personnel to prepare and respond to acts of terrorism and hazardous materials incidents.

Progress to Date: Ongoing. Waveland continues to seek funding to equip its public safety personnel (firefighters) for these situations. Also in Feb 2012 Waveland applied for the Safer Grant. but as of the date of this update, There has been no approval of this grant.

3 PLANNING PROCESS

Requirements §201.6(b) and §201.6(c)(1): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

1) **An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;**
2) **An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and**
3) **Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.**

[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Waveland recognized the need and importance of the update process for their local hazard mitigation plan and initiated its development. After receiving a grant from the Federal Emergency Management Agency (FEMA), which served as the primary funding source for this plan, the County contracted with AMEC Environment and Infrastructure (AMEC) to facilitate and develop the plan. AMEC's role was to:

- Assist in establishing the Hazard Mitigation Planning Committee (HMPC) as defined by the Disaster Mitigation Act (DMA);
- Meet the DMA requirements as established by federal regulations and follow FEMA's planning guidance;
- Support objectives under the National Flood Insurance Program's Community Rating System and the Flood Mitigation Assistance program;
- Facilitate the entire planning process;
- Identify the data requirements that HMPC participants could provide and conduct the research and documentation necessary to augment that data,
- Assist in facilitating the public input process;
- Produce the draft and final plan documents; and
- Coordinate with the Mississippi Emergency Management Agency (MEMA) and FEMA Region IV plan reviews.

3.1 Local Government Participation

The DMA planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC;
- Detail where within the planning area the risk differs from that facing the entire area;
- Identify potential mitigation actions; and
- Formally adopt the plan.

For the Waveland Planning Area's HMPC, "participation" meant the following:

- Providing facilities for meetings;
- Attending and participating in the HMPC meetings;
- Completing and returning the AMEC Data Collection Guide;
- Collecting and providing other requested data (as available);
- Managing administrative details;
- Making decisions on plan process and content;
- Identifying mitigation actions for the plan;
- Reviewing and providing comments on plan drafts;
- Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan;
- Coordinating, and participating in the public input process; and
- Coordinating the formal adoption of the plan by the governing board of the City.

The City met all of these participation requirements. Representatives from the City of Waveland included the Fire Department, Mayor's Office, Police Department, Parks and Recreation, Planning Department, City Engineering consultant, and Public Works assisted as did the Hancock County GIS Department and the Development Commission. ADD TO THIS AFTER OTHER MEETINGS. Appendix B provides additional information and documentation of the planning process.

3.2 The 10-Step Planning Process

AMEC established the planning process for updating the Waveland Local Hazard Mitigation Plan (LHMP) using the DMA planning requirements and FEMA's associated guidance. This guidance is structured around a four-phase process:

1) Organize Resources;
2) Assess Risks;
3) Develop the Mitigation Plan; and
4) Implement the Plan and Monitor Progress.

Into this process, AMEC integrated a more detailed 10-step planning process used for FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. Thus, the modified 10-step process used for this plan meets the requirements of six major programs: FEMA's Hazard Mitigation Grant Program; Pre-Disaster Mitigation program; Community

Rating System; Flood Mitigation Assistance Program; Severe Repetitive Loss program; and new flood control projects authorized by the U.S. Army Corps of Engineers.

Table 3.1 shows how the modified 10-step process fits into FEMA's four-phase process. The sections that follow describe each planning step in more detail.

Table 3.1. Mitigation Planning Processes Used to Develop the Waveland LHMP

DMA Process	Modified CRS Process
1) Organize Resources	
201.6(c)(1)	1) Organize the Planning Effort
201.6(b)(1)	2) Involve the Public
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies
2) Assess Risks	
201.6(c)(2)(i)	4) Identify the Hazards
201.6(c)(2)(ii)	5) Assess the Risks
3) Develop the Mitigation Plan	
201.6(c)(3)(i)	6) Set Goals
201.6(c)(3)(ii)	7) Review Possible Activities
201.6(c)(3)(iii)	8) Draft an Action Plan
4) Implement the Plan and Monitor Progress	
201.6(c)(5)	9) Adopt the Plan
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan

This LHMP update involved a comprehensive review and update of each section of the 2007 plan and includes an assessment of monitoring and implementing the mitigation strategy outlined in the initial plan. The process followed to update the plan is detailed in the above table and the sections that follow and is the same process that was used to prepare the 2007 plan. As part of this plan update, all sections of the plan were reviewed and updated to reflect new data, processes, participating jurisdictions, and resulting mitigation strategies.

3.2.1 Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

With Waveland's commitment to participate in the DMA planning process and the Community Rating System (CRS), AMEC worked with the City's Fire Department and other City officials to establish the framework and organization for development of the plan. An initial meeting was held with key community representatives to discuss the organizational aspects of this plan update process. At the beginning of the planning process, the City of Waveland passed a resolution establishing the planning process and the hazard mitigation planning committee. This resolution is included in Appendix B.

The initial kick-off meeting was held on November 7, 2012. A notice was posted in the local newspaper inviting members of the public to attend. Invitations to this kickoff meeting were extended to City officials, citizens, and federal, state, and local stakeholders that might have an interest in participating in the planning process. The list of initial invitees is included in Appendix B. The HMPC was established as a result of the kickoff meeting and meeting participants suggested additional persons who would be of value as members.

Waveland

- Mayor's Office
- Fire Department
- Police Department
- City Clerk
- City Attorney
- Planning and Zoning
- Public Works
- Parks and recreation
- Board of Alderman

Neighboring Communities

- City of Bay St. Louis
- City of Diamondhead
- Hancock County

Other Government and Stakeholder Representatives

- American Red Cross – Waveland
- Bay Waveland School District
- Hancock County School District
- Hancock County Office of Emergency Management
- Hancock Development Commission
- Pearl River Basin Development Commission
- Mississippi Emergency Management Agency
- National Weather Service
- FEMA Region IV
- Department of Marine Resources
- U.S. Army Corps of Engineers
- Mississippi Department of Environmental Quality
- Gulf Regional Planning Commission
- Grand Bay National Estuarine Reserve
- National Oceanic and Atmospheric Agency Coastal Management

- National Oceanic and Atmospheric Agency GIS

A list of participating HMPC representatives is included in Appendix B. This list details all HMPC members that attended one or more HMPC meetings detailed in Table 3.2. Planners also utilized the support of many other support staff in order to collect and provide requested data and to conduct timely reviews of the draft documents. Note that the above list of HMPC members also includes several other government and stakeholder representatives that contributed to the planning process. Specific participants from these other agencies are also identified in Appendix B.

The planning process officially began with kick-off meeting held November 7, 2012 held in Waveland. The meeting covered the scope of work and an introduction to the DMA requirements. Participants were provided with a Data Collection Guide, which included worksheets to facilitate the collection of information necessary to support development of the plan. Using FEMA guidance, AMEC designed these worksheets to capture information on past hazard events, identify hazards of concern to the City, quantify values at risk to identified hazards, inventory existing capabilities, and record possible mitigation actions. A copy of AMEC's Data Collection Guide for this project is included in Appendix B. Because this is a plan update, another worksheet was developed, the Mitigation Action Status Summary Worksheet, to capture information on the current status of mitigation action items included in the 2006 plan. This worksheet is also included in Appendix B.

During the planning process, the HMPC communicated through face-to-face meetings, email, telephone conversations, and a file transfer protocol (ftp) website. Draft documents were posted on this website so that the HMPC members could easily access and review them. Agendas and sign in sheets for HMPC meetings are included in Appendix B.

Table 3.2. HMPC Meetings

Meeting Type	Meeting Topic	Meeting Date(s)
HMPC #1 Kick-off Meeting	1) Introduction to DMA and the planning process 2) Overview of current LHMP; 3) Organize Resources: the role of the HMPC, planning for public involvement, coordinating with other agencies/stakeholders 4) Introduction to Hazard Identification	November 7, 2012
HMPC #2	Present the Risk Analysis to the LHMP Update Plan Goals and Objectives Review of Mitigation Alternatives	March 5, 2013
HMPC #3	Identify Updated List of Mitigation Actions Review of Mitigation Actions and Mitigation Selection Criteria Update and Prioritize Mitigation Actions	March 6, 2013

Planning Step 2: Involve the Public

Early discussions with Waveland personnel established the initial plan for public involvement. Public outreach for this plan update began during the plan development process with an informational press release, shown in **Error! Reference source not found.**, to inform the public of the purpose of the DMA and the hazard mitigation planning process for Waveland. As part of this effort, the public was invited to attend the kickoff meeting. At the kick-off meeting, the HMPC discussed additional options for public involvement and agreed to an approach using established public information mechanisms and resources within the community.

Public involvement activities for this plan update included press releases, stakeholder and public meetings, and the collection of public and stakeholder comments on the draft plan. Information provided to the public included an overview of the mitigation status and successes resulting from implementation of the 2007 plan as well as information on the processes, new risk assessment data, and proposed mitigation strategies for the plan update.

The complete draft of the plan was provided to the LHMP in March of 2013. It was also presented to the City Council at a public meeting held in March of 2013. A public hearing was conducted on March 13, 2013. The public hearings were advertised in the local newspaper. Additionally hard copies of the draft of the plan were made available to interested parties at the Library and City Hall and a copy of the draft plan was posted on the City of Waveland web site. Public hearing notices included where the hard copies of the draft of the plan would be available for review and the City's web site address. More information about public outreach is shown in Appendix C.

In addition to advertisement for public participation, notices of meetings were sent directly to all persons on the Hazard Mitigation Planning Committee Contact List. The majority of these people reside in Waveland or in surrounding communities.

Figure 3.1. Notice to the Public of Plan Update

WAVELAND Help Reduce Disaster Losses in Your Community by Participating in the City of Waveland Local Hazard Mitigation Plan Update

The City of Waveland is developing a Local Hazard Mitigation Plan (LHMP) Update to their 2007 plan. The purpose of this LHMP Update is to assess risk to natural and significant manmade hazards, implement actions to reduce future losses, and maintain eligibility for federal mitigation funds in accordance with the Disaster Mitigation Act of 2000.

What is Hazard Mitigation?

Hazard mitigation means any action taken to reduce or eliminate the long-term risk to human life and property from natural or manmade hazards.

Why is Natural Hazard Mitigation Important?

Most people who live or work in the City of Waveland have been affected by natural hazards in one way or another. The City of Waveland and its residents are vulnerable to a variety of hazards including hurricanes, floods, severe weather, and even the effects of climate change.

The rising costs associated with disaster response and recovery have focused the attention of federal, state, and local governments on addressing natural hazards before they occur. Obviously, torrential rains, hurricanes, and floods cannot be prevented from occurring. Planning for natural hazards and implementing mitigation measures, however, can reduce the impact of such events when they do occur. Emergency response and recovery costs; property damage and monetary losses; personal injury and loss of life; and the overall economic and social impact on the community can all be reduced, and in some instances eliminated through natural hazard mitigation.

Hazard Mitigation Plan and Plan Update Process

After securing Federal Emergency Management Agency (FEMA) mitigation grant funding in 2012, the City of Waveland is using the funds to support an update of their LHMP. This LHMP Update is being developed by a Hazard Mitigation Planning Committee comprised of representatives from various City departments; neighboring jurisdictions such as Hancock County and Bay St. Louis, key federal state and local agency stakeholders and the public. The plan is addressing an updated list of hazards, including, hurricane, flood, dam and levee failure to earthquake, severe weather, and even the effects of climate change. The plan will assess the likely impacts of these hazards to the people and assets of the City of Waveland and will also establish updated goals and prioritize projects to reduce the impacts of future disasters on people and property as well as to critical facilities and infrastructure.

Another benefit of mitigation planning is that it can also help lessen the cost of flood insurance in the City of Waveland through FEMA's National Flood Insurance Program's (NFIP) Community Rating System. Most recently, FEMA has provided and continues to provide significant funding for recovery and mitigation in the City of Waveland following the devastation created by Hurricane Katrina.

National Flood Insurance Program's Community Rating System

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.

As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the goals of the CRS Program. The objective of the CRS is to reward communities for what they are doing, as well as to provide an incentive for implementing additional flood protection activities. The reduction in flood insurance premium rates is provided according to a community's CRS classification. The City of Waveland joined the CRS in 1993 and is currently a CRS Class 5, which provides a 25 percent discount on flood insurance for those located within the special flood hazard area (SFHA) and a 10 percent discount for those located in non-SFHA areas.

Opportunities for Input

Members of the community have a very important role in this process. A draft of the LHMP Update is available beginning March 13th 2013 for review and comment by the public and all interested stakeholders on this website and also the at the following locations:

- Public Library, 345 Coleman Ave., Waveland
- City Hall, 301 Coleman Ave., Waveland

A public meeting on the draft plan will also be held:

Date/Time: Monday, March 18, 2013 @ 6:00 pm
Location: Central Fire Station, 427 Highway 90, Waveland

Public and local stakeholder attendance is invited and encouraged at this upcoming public meeting.

For more information on this project, contact:

Mike Smith	Jeanine Foster	Patrick Moore
Fire Department City of Waveland	AMEC Environment & Infrastructure	AMEC Environment & Infrastructure
Phone: (228) 467-2042	Phone: (303) 717-7171	(228) 327-5166
Email: fireman39576@att.net	Email: jeanine.Foster@amec.com	Email: patrick.moore@amec.com

Figure 3.2. Public Outreach Table at Wal-Mart

Source: AMEC

Planning Step 3: Coordinate with Other Departments and Agencies

Early in the planning process, the HMPC determined that the updated risk assessment, mitigation strategy development, and plan approval would be greatly enhanced by inviting other local, state and federal agencies and organizations to participate in the process. Based on their involvement in hazard mitigation planning, their landowner status in City, and/or their interest as a neighboring jurisdiction, representatives from the following agencies were invited to participate on the HMPC:

- Federal Emergency Management Agency
- Mississippi Emergency Management Agency
- Department of Marine Resources
- Mississippi Development Authority
- Mississippi Flood Plain Management
- U.S. Forest Service
- National Weather Service

- Southern Mississippi Planning and Development District
- Gulf Regional Planning Commission
- American Red Cross
- Public Works (City and County)
- Hancock County Board of Supervisors
- Hancock County Emergency Management
- Hancock County Development Commission
- Historic Preservation
- Grand Bay National Estuarine Reserve
- National Oceanic and Atmospheric Agency Coastal Management
- National Oceanic and Atmospheric Agency GIS

Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community planning efforts is also paramount to the success of this plan. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. Waveland uses a variety of comprehensive planning mechanisms, such as general plans and ordinances, to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. The development of this plan incorporated information from the following existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions.

- City of Waveland Hazard Mitigation and Flood Protection Plan, 2007
- City of Waveland Comprehensive Plan, 2009
- Waveland and Hancock County Flood Insurance Studies, 2009
- Hancock County Comprehensive Plan, 2010
- Hancock County Hazard Mitigation Plan, 2006
- Hancock County Emergency Operation Center Standard Operating Guidelines
- City of Bay St. Louis Hazard Mitigation Plan, 2011
- State of Mississippi Standard Mitigation Plan, 2010
- Mississippi Coastal Improvements Program Plan

Other documents were reviewed and considered, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, vulnerability assessment, and capability assessment.

Each chapter and section of the 2007 Hazard Mitigation Plan was reviewed and changes made to update data. Population and economic data were updated to reflect current conditions. Significant changes to the community as result of Hurricane Katrina in 2005 were discussed and were noted as appropriate.

3.2.2 Phase 2: Assess Risks

Planning Steps 4 and 5: Identify the Hazards and Assess the Risks

AMEC led the HMPC in an effort to identify, document, and profile all the hazards that have, or could have, an impact the planning area. Data collection worksheets were developed and used in this effort to aid in determining hazards and vulnerabilities and where the risk varies across the planning area. Geographic information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities.

The HMPC also conducted a capability assessment to review and document the planning area's current capabilities to mitigate risk from and vulnerability to hazards. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the HMPC could assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. A more detailed description of the risk assessment process and the results are included in Chapter 4 Risk Assessment.

3.2.3 Phase 3: Develop the Mitigation Plan

Planning Steps 6 and 7: Set Goals and Review Possible Activities

AMEC facilitated brainstorming and discussion sessions with the HMPC that described the purpose and process of developing planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in Chapter 5 Mitigation Strategy. Additional documentation on the process the HMPC used to develop the goals and strategy is in Appendix C.

Planning Step 8: Draft an Action Plan

Based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, AMEC produced a complete first draft of the plan. This complete draft was posted for HMPC review and comment on the project file transfer protocol (ftp) website. Other agencies were invited to comment on this draft as well. HMPC and agency comments were integrated into the second public review draft, which was advertised and distributed to collect public input and comments. AMEC integrated comments and issues from the public, as appropriate, along with additional internal review comments and produced a final draft for the MEMA and FEMA Region IV to review and approve, contingent upon final adoption by the governing boards of each participating jurisdiction.

3.2.4 Phase 4: Implement the Plan and Monitor Progress

Planning Step 9: Adopt the Plan

In order to secure buy-in and officially implement the plan, the plan was reviewed and adopted by the Board of Aldermen of the City of Waveland on the dates included in the corresponding resolution in Appendix A: Adoption Resolution.

Planning Step 10: Implement, Evaluate, and Revise the Plan

The true worth of any mitigation plan is in the effectiveness of its implementation. Up to this point in the planning process, all of the HMPC's efforts have been directed at researching data, coordinating input from participating entities, and developing appropriate mitigation actions. Each recommended action includes key descriptors, such as a lead manager and possible funding sources, to help initiate implementation. An overall implementation strategy is described in Chapter 7 Plan Implementation and Maintenance.

Implementation and Maintenance Process: 2007

The 2007 City of Waveland Hazard Mitigation and Flood Protection Plan included a process for plan maintenance. This process as set forth in the 2007 plan was generally followed, with some variation.

Responsibility for Plan Review and Maintenance/Schedule for Annual Plan Review

As explained, the original Hazard Mitigation and Flood Protection Plan was only days old prior to the devastation created by Hurricane Katrina. The 2007 plan update wass the first actual review of the 2005 FEMA approved plan, and it followed the process the HMPC described in that plan, which follows below. The major difference is that instead of its first annual review, Katrina had forced the community to use this plan update process to carefully scrutinize earlier efforts and truly focus on incorporating as many hazard mitigation techniques, actions, and activities into community redevelopment as possible.

The 2005 plan review process called for the city's Fire Chief/Civil Defense Coordinator/ Community Rating System Coordinator, on behalf of the Board of Aldermen, to be responsible for facilitating, coordinating, and scheduling reviews and maintenance of the plan. The review of the Hazard Mitigation Plan normally occured in August or September each year concurrently with review of the plan for Community Rating System recertification.

- The City's Fire Chief/Civil Defense Coordinator/Community Rating System Coordinator placed an advertisement in the local newspaper advising the public of the date, time, and place for the annual review of the plan and be responsible for leading the meeting to review the plan.

- Notices were mailed to the members of the Hazard Mitigation Planning Council, federal state, and local agencies, non-profit groups, local planning agencies, representatives of business interests, neighboring communities, public utilities, academia, the medical community, and others advising them of the date, time, and place for the review.
- City officials were noticed by telephone or personal visit and urged to participate.
- Members of the city's Planning Commission and other appointed commissions and groups were noticed either by telephone or personal visit and asked to participate in the review.
- Prior to the review, department heads and others tasked with implementation of the various activities were queried concerning progress on each activity in their area of responsibility and asked to present a report at the review meeting.
- After the review meeting, a report was prepared by the Fire Chief/Civil Defense Coordinator/Community Rating System Coordinator and presented to the Board of Aldermen for review, and a request was made that the Board take action to recognize and adopt any changes resulting from the review.
- A request was made that a copy of the report be spread upon the minutes of the meeting of the Board, and appropriate agencies, including MEMA and FEMA will be noticed that copies of the report are available upon request. A copy of the report was furnished to the Insurance Services Office with the CRS recertification in September each year.

Criteria for Annual Review and Monitoring of This Plan

The criteria recommended in 44 CFR 201 and 206 will be utilized in reviewing and updating the plan. More specifically, the review and subsequent annual report included the following information:

- Community growth or change in the past year.
  - The number of newly constructed residential structures, the valuation of the permits, and the location of the new structures by recognized flood zones (This will also include discussion of applicable annexations.)
  - The number of newly constructed commercial structures, the valuation of permits, and the location of the new commercial structures by recognized flood zones
- The number of substantially damaged or substantially improved structures within the report year by flood zone
- The renovations to public infrastructure including water, sewer, drainage, roads, bridges, gas lines, and buildings
- Natural hazard occurrences that required activation of the Emergency Operations Center (EOC) and whether or not the event resulted in a presidential disaster declaration.
- Natural hazard occurrences that were not of a magnitude to warrant activation of the EOC or a federal disaster declaration but were severe enough to cause damage in the community or closure of businesses, schools, or public services
- The dates of hazard events descriptions
- Documented damages due to the event

- Closures of places of employment or schools and the number of days closed
- Road or bridge closures due to the hazard and the length of time closed
- Assessment of the number of private and public buildings damaged and whether the damage was minor, substantial, major, or if buildings were destroyed. The assessment will include residences, mobile homes, commercial structures, industrial structures, and public buildings, such as schools and public safety buildings
- Review of any changes in federal, state, and local policies to determine the impact of these policies on the community and how and if the policy changes can or should be incorporated into the Hazard Mitigation Plan

Public Involvement and Others Involved in Annual Plan Reviews

The public was noticed by placing an advertisement in the newspaper specifying the date and time for the review and inviting public participation. Local, state, and regional agencies were notified and invited to attend and participate. The Hazard Mitigation Planning Council was notified and requested to participate in the review.

Responsibility for Implementation of Goals and Activities

The elected officials and officials appointed to head each department within the community were charged with implementation of various activities in the plan. During the review, an assessment of progress on each of the goals and activities in the plan was determined and noted. At that time, recommendations were not made to modify timeframes for completion of activities, funding resources, and responsible entities. The priority standing of various activities were not changed. Some activities that are found not to be doable were deleted from the plan entirely.

Schedule for Plan Updates

When the 2005 plan was completed and approved, it was expected that a complete update and revision of the plan would not be undertaken for about five years with the first complete update scheduled to occur in 2010. It was also anticipated that the plan would be updated at any other time that conditions and circumstances warranted an update. Examples of conditions and circumstances that could trigger the need for updating the plan include a major annexation or major disaster, or any other actions that result in a major change to the community.

The City of Waveland experienced both a major disaster and a major annexation within the first six months of the 2005 plan's approval. The disaster was Hurricane Katrina. The annexation regards an area north of the community that was being contested while the 2005 plan was being developed. The catastrophic damage from Hurricane Katrina, the 2006 expanded planning and project scoping regulations developed by FEMA post-Katrina, and the annexation of the area north and west of Waveland made the update of the plan necessary. This plan was completed and adopted by the City of Waveland on July 1, 2008. It is anticipated that in compliance with the five-year update requirement, the next complete update of the plan would be in 2012. The process was begun in later 2012, and finished in March of 2013.

4 RISK ASSESSMENT

Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

As defined by the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction's potential risk to natural hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This risk assessment followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses* (FEMA 386-2, 2002), which breaks the assessment down to a four-step process:

1) Identify Hazards;
2) Profile Hazard Events;
3) Inventory Assets; and
4) Estimate Losses.

Data collected through this process has been incorporated into the following sections of this chapter:

- **Section 4.1**: **Hazard Identification**: **Natural Hazards** identifies the natural hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.
- **Section 4.2**: **Hazard Profiles** discusses the threat to the planning area and describes previous occurrences of hazard events and the likelihood of future occurrences.
- **Section 4.3: Vulnerability Assessment** assesses the planning areas' exposure to natural hazards; considering assets at risk, critical facilities, and future development trends.
- **Section 4.4: Capability Assessment** inventories existing mitigation activities and policies, regulations, and plans that pertain to mitigation and can affect net vulnerability.

This risk assessment covers the entire geographical extent of the City of Waveland.

This Local Hazard Mitigation Plan (LHMP) update involved a comprehensive review and update of each section of the risk assessment. As part of the risk assessment update, new data was used, where available, and new analyses were conducted. Refinements, changes, and new methodologies used in the development of this risk assessment update are summarized in Chapter 2.0 What's New and detailed in this Risk Assessment portion of the plan.

4.1 Hazard Identification: Natural Hazards

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

The City of Waveland's HMPC conducted a hazard identification study to determine the hazards that threaten the planning area.

4.1.1 Results and Methodology

Using existing natural hazards data and input gained through planning meetings, the HMPC agreed upon a list of natural hazards that could affect Waveland. Hazards data from the Mississippi Emergency Management Agency (MEMA) State of Mississippi Standard Mitigation Plan, FEMA, the National Oceanic and Atmospheric Administration (NOAA), the National Hurricane Center (NHC), National Climatic Data Center (NCDC), the Spatial Hazards Events and Losses Database for the United States (SHELDUS) and many other sources were examined to assess the significance of these hazards to the planning area. Significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries, as well as property and economic damage. The natural hazards evaluated as part of this plan include those that have occurred historically or have the potential to cause significant human and/or monetary losses in the future.

The following hazards in Table 4.1 were identified and investigated for this plan update. As a starting point, the updated 2010 Mississippi State Hazard Mitigation Plan was consulted to evaluate the applicability of new hazards of concern to the State to the planning area. Building upon this effort, hazards from the past plan were also identified, and comments explain how hazards were updated from the previous plan. All hazards from the 2007 plan except terrorism were profiled in this plan update.

Table 4.1. Hazard Identification and Comparison to 2007 Plan

2013 Hazards	2007 Hazards	Comment
Climate Change (storm surge, sea level rise)	-	New hazard
Coastal/Canal Bank Erosion	–	New hazard
Dam/Levee Failure	–	New hazard
Drought	–*	New hazard
Earthquake	–*	New hazard
Extreme Heat	–*	New hazard
Extreme Winter Weather	–*	New hazard
Flood: 100/500 year	Floods	Increased level of analysis using DFIRM and Hancock County Assessor's Data
Flood: Stormwater/Localized Flooding	–	New hazard
Hurricane and Tropical Storms (includes ocean surf events)	Hurricane Ocean Surf Events	Increased level of discussion, adding language on storm surge
Thunderstorm (includes hail, lightning, high wind)	Severe Thunderstorms	Similar analysis was performed
Tornado	Included in Thunderstorm	Similar analysis was performed
Wildfire	–*	New hazard
Railroad: Hazardous Materials Release	CSX Railroad/Hazardous Materials	Greater analysis was performed
–	Terrorism	This was dropped from plan consideration

* In the previous plan, certain hazard were mentioned but not profiled. For purposes of this plan, these will be considered new hazards.

During the evaluation the HMPC determined that a number of hazards would not be included in the plan. This decision was based upon the understanding that they were not prevalent hazards within Waveland or the local area. Following is a brief description of those hazards and the reason for their exclusion:

- **Avalanche** – Avalanche is a mass of snow moving down a slope. Two basic elements are necessary to create a slide, a steep, snow covered slope and a trigger, neither of which is present in the City of Waveland. Further, there is no avalanche history in the State of Mississippi.
- **Expansive Soils** – Expansive soils shrink when dry and swell when wet and can exert enough pressure to crack sidewalks, driveways, basement floors, pipelines and foundations. According to the U.S. Geological Survey (USGS), there are no expansive soils located in the Waveland area.
- **Land Subsidence** – Land subsidence occurs when large amounts of ground water have been withdrawn from certain types of rocks such as find grained sediments causing the rock to

compact. The soils in Waveland are predominately sandy ranging from a graying to black sandy silt with running veins of coarser sand that are not subject to land subsidence.

- **Landslide** – An abrupt movement of soil and bedrock downhill in response to gravity, landslides can be triggered by an earthquake or other natural cause. Due to a relatively flat topography in the City of Waveland, landslide risk in the City is negligible.
- **Tsunamis** – Defined as a long-term (generally 15 to 60 minutes) wave caused by a large scale movement of the sea floor due to volcanic eruption, marine earthquake or landslide. Barely noticeable at sea, the wave velocity may be as high as 400 knots so that it travels great distances and in shoal water reaches heights up to 15 meters. The National Oceanic and Atmospheric Association (NOAA) indicates that the risk of a tsunami in the area is low due to the relatively shallow depth of the Gulf of Mexico and the absence of geologic formation and activity on the sea floor.
- **Volcano** – A volcano is a mountain that is built by accumulation of lava, ash flows and air born ash and dust. When pressure from gases and the molten rock within the volcano become strong enough to cause an explosion, eruption occurs. There are no active volcanoes in Waveland or the State of Mississippi and no historical record of this hazard.

Table 4.2 was completed by the HMPC, based in part on the risk assessment, to identify, profile, and rate the significance of identified hazards. Only the more significant hazards (high or medium) have a more detailed hazard profile and are analyzed further in Section 4.3 Vulnerability Assessment (to the extent possible).

Table 4.2. Hazard Summary for Waveland

Hazard	Frequency of Occurrence	Spatial Extent	Potential Magnitude	Significance
Climate Change (storm surge, sea level rise)	Highly Likely	Extensive	Catastrophic	Medium
Coastal/Canal Bank Erosion	Highly Likely	Limited	Negligible	Medium
Dam/Levee Failure	Unlikely	Limited	Negligible	Low
Drought	Occasional	Significant	Negligible	Low
Earthquake	Occasional	Extensive	Critical	Low
Extreme Heat	Highly Likely	Extensive	Limited	Low
Extreme Winter Weather	Likely	Negligible	Limited	Low
Flood: 100/500 year	Occasional	Significant	Critical	High
Flood: Stormwater/ Localized Flooding	Highly Likely	Significant	Critical	High
Hurricane and Tropical Storms (includes ocean surf events)	Likely	Extensive	Catastrophic	High
Thunderstorm (includes hail, lightning, high wind)	Highly Likely	Significant	Limited	High
Tornado	Likely	Limited	Negligible	Low
Wildfire	Likely	Limited	Negligible	Low
Railroad: Hazardous Materials Release	Occasional	Limited	Negligible	Medium

Guidelines:
Frequency of Occurrence:
Highly Likely: Nearly 100% probability in the next year.
Likely: Between 10 and 100% probability in the next year
Occasional: Between 1 and 10% probability in the next year
Unlikely: Less than 1% probability in the next year

Potential Magnitude:
Catastrophic: More than 50% of the area affected
Critical: 25 to 50% of the area affected
Limited: 10 to 25% of the area affected
Negligible: Less than 10% of the area affected

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning Area

Significance:
Low
Medium
High

Source: AMEC Data Collection Guide

4.1.2 Disaster Declaration History

One method the HMPC used to identify hazards was the researching of past events that triggered federal and/or state emergency or disaster declarations in the planning area. Federal and/or state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

Based on the disaster declaration history provided in Table 4.3, Waveland and Hancock County are among the many areas in Mississippi susceptible to disaster. Details on federal and state disaster declarations were obtained by the HMPC from FEMA and MEMA, and compiled in chronological order in Table 4.3. A review of state and federal declared disasters indicates that Hancock County and Waveland received 13 federal disaster declarations between 1965 and 2012. 11 of the declarations were associated with hurricanes and tropical storm occurring during hurricane season (June 1 – November 30). The remaining two were associated with spring storms that caused flooding and tornado activity in the month of May prior to the onset of hurricane season.

This disaster history (combined FEMA and State declared) suggests that Waveland and Hancock County are major event worthy of a disaster declaration every 3.7 years. Every declaration resulted directly or indirectly from severe weather. Similarly, most disaster-related injuries to people and damage to property resulted from severe weather conditions. Wind and flood damage from storm surge associated with hurricanes accounts for the majority of damage followed by heavy rainfall associated with hurricanes and tropical storms.

Table 4.3. Hancock County State and Federal Disasters Declaration, 1965-2012

Hazard Type	Disaster #	Year	Federal Declaration	Location	Damage*
Hurricane Betsy	DR-210	1965	09/24/1065	MS/LA Coasts	
Hurricane Camille	DR-271	1969	08/18/1969	State of MS/TN/VA	
Hurricane Frederic	DR-599	1979	09/13/1979	MS/AL Coasts	$19,471,559
Hurricane Elena	DR-741	1985	09/04/1985	MS/AL/FL Coasts	

Hazard Type	Disaster #	Year	Federal Declaration	Location	Damage*
Severe Storm, tornado, flooding	DR-1051	1995	05/12/1995	Hancock Co. and 6 other counties	$996,257
Hurricane Georges	DR-1251	1998	10/01/1998	Hancock County and 6 other counties	$32,124,060
Tropical Storm Allison	DR-1382	2001	06/21/2001	Hancock County and 4 other counties	$2,356,352
Tropical Storm Isidore	DR-1436	2002	10/01/2002	Hancock County and 10 other counties	$9,700,101
Hurricane Ivan	DR-1550	2004	09/2004	MS/AL/FL Coasts	$15,559,059
Hurricane Dennis	DR-1594	2005	09/10/2005	Hancock and 2 other counties	$1,691,481
Hurricane Katrina	DR-1604	2005	08/29/2005	Hancock County and 40 other MS counties	$2,032,150,345
Hurricane Gustav	DR-1794	2008	09/29/2008	Hancock County and 4 other counties	$50,862,196
Severe storms, flooding, tornadoes	DR-1837	2009	05/12/2009	Hancock and 3 other counties	$5,689,097
Hurricane Isaac	DR-4081	2012	8/29/2012	Hancock County and 47 other MS counties	Undetermined

Source: FEMA, MEMA

* In 2012 dollars. Dollar damage values are for all Counties in the disaster declaration.

4.2 Hazard Profiles

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The hazards identified in Section 4.1 Hazard Identification Natural Hazards, are profiled individually in this section. In general, information provided by planning team members is integrated into this section with information from other data sources. These profiles set the stage for Section 4.3 Vulnerability Assessment, where the vulnerability is quantified for each of the priority hazards.

Each hazard is profiled in the following format:

Hazard/Problem Description

This section gives a description of the hazard and associated issues followed by details on the hazard specific to the Waveland Planning Area. Where known, this includes information on the hazard extent, seasonal patterns, speed of onset/duration, and magnitude and/or any secondary effects.

Past Occurrences

This section contains information on historical incidents, including impacts where known. The extent or location of the hazard within or near the Waveland Planning Area is also included here. Historical incident worksheets were used to capture information from the City on past occurrences.

Frequency/Likelihood of Future Occurrence

The frequency of past events is used in this section to gauge the likelihood of future occurrences. Where possible, frequency was calculated based on existing data. It was determined by dividing the number of events observed by the number of years on record and multiplying by 100. This gives the percent chance of the event happening in any given year (e.g., three hurricanes or tropical storms over a 30-year period equates to a 10 percent chance of a experiencing a hurricane or tropical storm in any given year). The likelihood of future occurrences is categorized into one of the following classifications:

- **Highly Likely**—Near 100 percent chance of occurrence in next year or happens every year
- **Likely**—Between 10 and 100 percent chance of occurrence in next year or has a recurrence interval of 10 years or less

- **Occasional**—Between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years
- **Unlikely**—Less than 1 percent chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.

Section 4.2.13 Natural Hazards Summary provides an initial assessment of the profiles and assigns a level of significance or priority to each hazard. Those hazards determined to be of high or medium significance were characterized as priority hazards that required further evaluation in Section 4.3 Vulnerability Assessment. Those hazards that occur infrequently or have little or no impact on the planning area were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency and resulting damage, including deaths/injuries and property, crop, and economic damage. This assessment was used by the HMPC to prioritize those hazards of greatest significance to the planning area, enabling the County to focus resources where they are most needed.

The following sections provide profiles of the natural hazards that the HMPC identified in Section 4.1 Hazard Identification. Natural hazards (as identified in Table 4.2 are profiled first in alphabetical order; followed by profiles of man-made hazards. A discussion of general severe weather for the City is profiled below.

Severe Weather: General

Severe weather is generally any destructive weather event, but usually occurs in the Waveland Area as localized storms that bring heavy rain, hail, lightning, and strong winds.

The National Oceanic and Atmospheric Administration's National Climatic Data Center (NCDC) has been tracking severe weather since 1950. Their Storm Events Database contains data on the following: all weather events from 1993 to current (except from 6/1993-7/1993); and additional data from the National Hurricane Center. This database contains 229[1] severe weather events that occurred in the Waveland area between January 1, 1950 and September 30, 2012. Table 4.4 summarizes these events.

Table 4.4. NCDC Severe Weather Reports for Hancock County and Waveland 1950-2012*

Type	# of Events	Property Loss	Deaths	Injuries
Flash Flood	16	$610,000	0	0
Funnel Cloud	6	$0	0	0
Hail	49	$0	0	0

[1] The NCDC database currently is under re-development. Winter storm, hurricane, and other hazards are not currently tracked in the NCDC database.

Type	# of Events	Property Loss	Deaths	Injuries
Heavy Rain	2	$0	0	0
Lightning	8	$280,000	0	2
Storm Surge	2	$500,000	0	0
Thunderstorm Winds	96	$202,893	4	4
Tornado	43	$2,082,250	0	14
Urban/Small Stream Flood	2	$0	0	0
Waterspout	5	$0	0	0
Total	**229**	**$3,675,143**	**4**	**20**

Source: National Climatic Data Center Storm Events Database
*Note: Losses reflect totals for all impacted areas of Hancock County.

The HMPC supplemented NCDC data with data from SHELDUS (Spatial Hazard Events and Losses Database for the United States). SHELDUS is a county-level data set for the United States that tracks 18 types of natural hazard events along with associated property and crop losses, injuries, and fatalities for the period 1960-2010. Produced by the Hazards Research Lab at the University of South Carolina, this database combines information from several sources (including the NCDC). From 1960 to 1995, only those events that generated more than $50,000 in damage were included in the database. For events that covered multiple counties, the dollar losses, deaths, and injuries were equally divided among the affected counties (e.g., if four counties were affected, then a quarter of the dollar losses, injuries, and deaths were attributed to each county). From 1995 to 2010 all events that were reported by the NCDC with a specific dollar amount are included in SHELDUS.

SHELDUS contains information on 216 severe weather events that occurred in Hancock County between 1960 and 2010. Table 4.5 summarizes these events.

Table 4.5. SHELDUS Severe Weather Reports for Hancock County and Waveland, 1960-2010*

Type	# of Events	Property Loss	Crop Loss	Deaths	Injuries
Coastal	6	$3,769,014,999.99	$0	0	0
Coastal Flooding	2	$26,666.67	$0	0	0
Coastal Wind	2	$18,333.34	$0	0	0
Flooding	16	$34,018,886.52	$6,983,881.22	0.14	0.14
Flooding - Severe Storm/Thunder Storm	9	$2,200,215.89	$138.51	0	0
Hail	1	$208.33	$20.83	0	0
Hail - Severe Storm/Thunder Storm	1	$2,380.95	$0.00	0	0
Hail - Severe Storm/Thunder Storm – Wind	3	$22,829.46	$1,782.95	0	1.69
Hail – Wind	1	$60.98	$60.98	0	0
Heat	2	$0	$23,823.03	0	0.13

Type	# of Events	Property Loss	Crop Loss	Deaths	Injuries
Hurricane/Tropical Storm	28	$1,123,099,982.16	$1,001,122.15	44.87	68.47
Hurricane/Tropical Storm - Severe Storm/Thunder Storm – Wind	1	$1,388.89	$1,388.89	0	0.03
Lightning	14	$385,800.00	$0	4	6
Lightning - Severe Storm/Thunder Storm	1	$5,000	$0	0	0
Lightning – Tornado	1	$5,000	$500	0	0
Severe Storm/Thunder Storm	9	$28,663.13	$1,746,119.74	0	0.06
Severe Storm/Thunder Storm - Tornado – Wind	1	$2,500	$0	0	0.5
Severe Storm/Thunder Storm - Wind	58	$323,068.30	$1,170.74	0.02	0.08
Tornado	28	$5,598,416.67	$500.00	0	12
Tornado – Wind	2	$3,000	$250	0	0
Wind	14	$37,595.79	$0	0	8.03
Winter Weather	16	$152,647.96	$139,249.87	0.2	0.08
Total	**216**	**$4,934,947,645.03**	**$9,900,008.91**	**49.23**	**97.21**

Source: SHELDUS, Hazards Research Lab, University of South Carolina, www.sheldus.org/

*Events may have occurred over multiple counties, so damage may represent only a fraction of the total event damage and may be not specific to Hancock County

The NCDC and SHELDUS tables above summarize severe weather events that occurred in Hancock County. Only a few of the events actually resulted in state and federal disaster declarations. It is interesting to note that different data sources capture different events during the same time period, and often display different information specific to the same events. While the HMPC recognizes these inconsistencies, they see the value this data provides in depicting the City's overall hazard environment. As previously mentioned, most all of Waveland and South Mississippi's state and federal disaster declarations have been a result of severe weather.

4.2.1 Climate Change and Sea Level Rise

Hazard/Problem Description

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e., more or fewer extreme weather events). Climate change is caused by factors that include oceanic processes (such as oceanic circulation), variations in solar radiation, plate tectonics, volcanic eruptions, and human-induced alterations of the natural world. Climate change is a natural occurrence in which the earth has warmed and cooled periodically over geologic time. The recent and rapid warming of the earth over the past century has been cause for concern, as this warming is very likely due to the accumulation of human-caused green house gases, such as CO_2, in the atmosphere (IPCC, 2007). This warming has taken place almost everywhere over the continents (Compo and Sardeshmukh, 2009), which strongly suggests that there is a global cause, rather than a mere coincidence of weather patterns that would result in patches of warming and cooling.

Climate change can have direct implications on almost every hazard addressed in this plan, with earthquake and hazardous materials being possible exceptions. Climate change has the potential to alter the nature and frequency of most hazards. The potential for climate change influences on hazards are summarized in this section and noted in each of the hazard's hazard/problem description and "Likelihood of Future Occurrences" discussion.

Due to Waveland's location on the Gulf Coast much of this section focuses on the consequences of sea level rise as a direct result of climate change, and exacerbation of hazards such as storm surge flooding. This section is based on a review of relevant literature and summarizes the state of the science on climate change and likely impacts for the Mississippi Gulf Coast, with a focus on the City of Waveland.

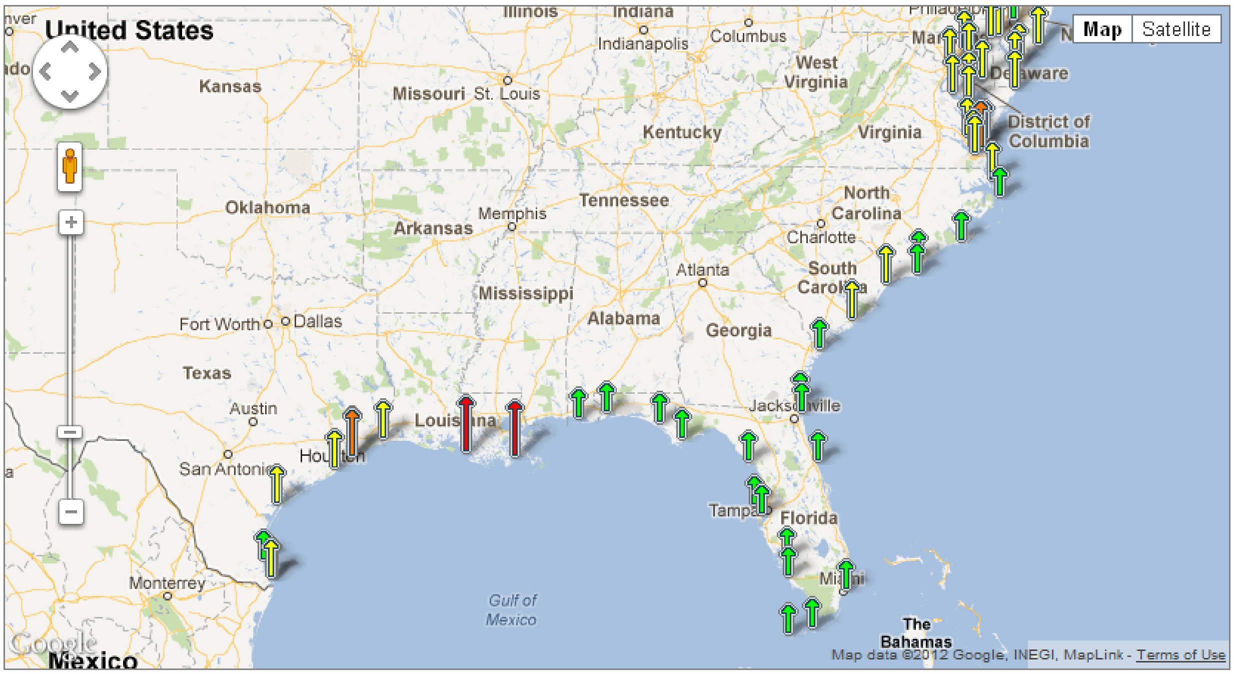
Past Occurrences

In 2011 the MS Dept of Marine Resources released a report on the Assessment of Sea Level Rise in Coastal MS (7/2011). This report includes a summary of climate change and sea level rise implications along the MS Gulf Coast. A general overview of the research and publications indicates that the prediction of sea level rise is not a perfectly exact science. As technologies and knowledge of the subject increase and improve, the predictive methodologies improve. One method of predicting future events is to consider the past. Evidence indicates global sea levels have risen at a consistent rate of approximately 0.04 to 0.5 inches per year since 1900. Since 1992 new methods of satellite altimetry using the TOPEX/Poseidon satellite indicate a rate of rise of 3 millimeters (0.11 inches) per year (NOAA Science on a Sphere). There are generally two separate mechanics involved in global sea level rise. The first is directly attributed to global temperature increases, which warm the oceans waters and cause them to expand. The second is attributed to the melting of ice over land which simply adds water to the oceans. Global sea level rise is likely caused by a combination of these two mechanics and can be exasperated on the local level by factors such as erosion and subsidence. Figure 4.1 illustrates regional trends in sea level available from a NOAA website: Sea Levels Online. The relative Mean Sea Level trend dramatically increases west of Mississippi, largely due to a combination of sea level rise and subsidence of land due to sediment loading in the Mississippi Delta region.

Figure 4.1. Regional Sea Level Trends

Sea Levels Online

East Coast | West Coast | Gulf Coast | Alaska | Hawaii | Global



The map above illustrates regional trends in sea level, with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that station.

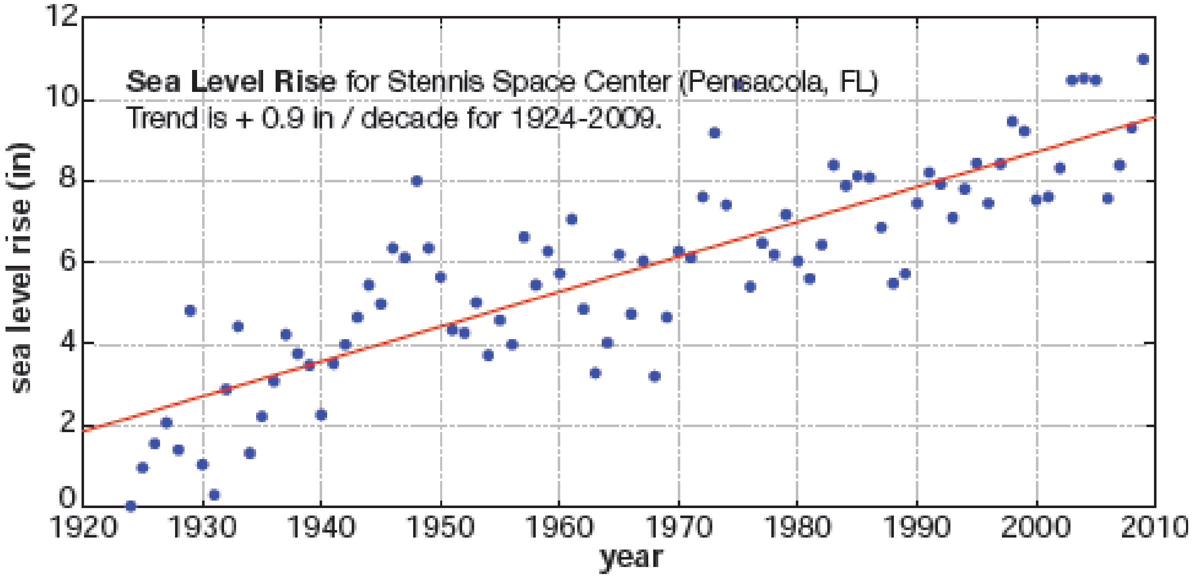
Sea Level Trends
mm/yr (feet/century)

9 to 12 (3 to 4)	3 to 6 (1 to 2)	-3 to 0 (-1 to 0)	-9 to -6 (-3 to -2)	-15 to -12 (-5 to -4)
6 to 9 (2 to 3)	0 to 3 (0 to 1)	-6 to -3 (-2 to -1)	-12 to -9 (-4 to -3)	-18 to -15 (-6 to -5)

Source: http://tidesandcurrents.noaa.gov/sltrends/sltrends.html

The NASA Stennis Space Center has been studying potential impacts of climate change on its operations and facilities. The Center occupies a nearly circular area of approximately 32.5 square miles (about 21,000 acres) in western Hancock County approximately 10 miles northwest of Waveland. The Center has compiled local data for the Waveland area that looks nearly a century into the past as well as the future. The temperature and sea level trends over that past century indicate that the climate is changing in the Waveland area. Figure 4.2 shows that sea level has risen over decades, though individual years vary somewhat, based on the closest long-term records kept in Pensacola Florida, another area of the Gulf of Mexico comparable to Waveland. This data indicates that sea level has risen over seven inches in the past 75 years.

Figure 4.2. Sea Level Trends in Pensacola, FL

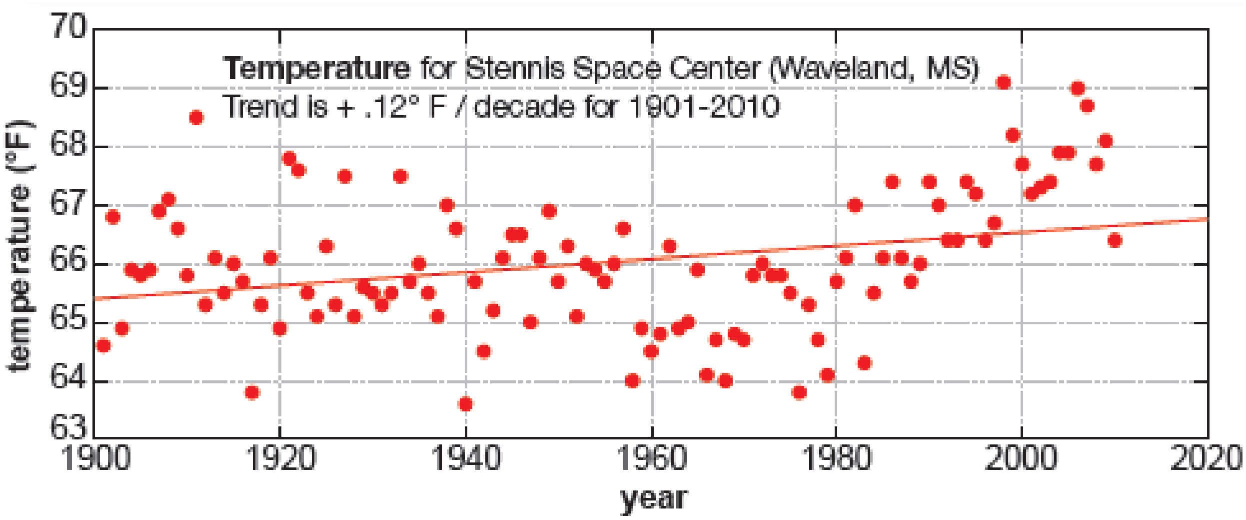


Source: Stennis Space Center

Continued rise in mean sea level could eventually affect the level of threat from hazards that Waveland already experiences such as hurricane storm surge, coastal erosion, land subsidence, stormwater drainage, and saltwater intrusions of aquifers (What is their water supply?). Over time, the condition of a rising sea level may magnify these impacts. Sea level rise may also place unanticipated stress on the gravity flow stormwater systems within the City. Infrastructure systems, facilities, homes, businesses and coastal structures may also eventually feel the effects of the rising sea. Storm surge augmented by future sea level rise could produce a cascade of consequences affecting things such as land use, infrastructure, facilities, waterway navigation, the local economy, public health and safety, drinking water supplies, and ecosystems.

Temperature data from Waveland indicate the average annual temperatures have risen approximiately 1.3 degrees F over the past century. The data plotted in Figure 4.3 indicates that the trend varies substantially from year to year, but the overall trend is increasing, particularly over the past 20 years.

Figure 4.3. Waveland Average Temperature Trends



Source: Stennis Space Center

Likelihood of Future Occurrence

A report on Global Climate Change Impacts in the United States was released by the U.S. Global Change Research Program (USGCRP) in 2009 and summarizes the science of climate change and the impacts of climate change on the United States, now and in the future. The report discusses climate-related impacts for various societal and environmental sectors and regions across the nation. (Karl et al 2009). A summary of climate impacts in the Southeast United States reveals that the region's climate is generally warm and wet, with mild and humid winters. Since 1970, average annual temperatures in the region have increased by about 2°F. Winters, in particular, are getting warmer. The average number of freezing days has declined by four to seven days per year since the mid-1970s. Most areas, with the exception of southern Florida, are getting wetter. Autumn precipitation has increased by 30% since 1901. The number of heavy downpours has increased in many parts of the region. Despite increases in fall precipitation, the area affected by moderate and severe drought, especially in the spring and summer, has increased since the mid-1970s.

It is important to discuss projected temperature changes, as heat is a major driver of climate and climate related-phenomena. Average annual temperatures in the region are projected to increase by 4 to 9°F by 2080. It is unclear how precipitation will change in Mississippi. Climate models are currently inconclusive as to whether the net change will be an increase or decrease. Models do suggest that rainfall will arrive in heavier downpours with increased dry periods between storms. These changes would increase the risk of both flooding and drought. The coasts will likely experience stronger hurricanes and sea level rise and storm surge could present problems for coastal communities and ecosystems (USGCRP 2009). These topics are explored in more detail in the following section.

Climate Scenarios

The United Nations Intergovernmental Panel on Climate Change (IPCC) developed several greenhouse gas (GHG) emissions scenarios based on differing sets of assumptions about future economic growth, population growth, fossil fuel use, and other factors. The emissions scenarios range from "business-as-usual" (i.e., minimal change in the current emissions trends) to more progressive (i.e., international leaders implement aggressive emissions reductions policies). Each of these scenarios leads to a corresponding GHG concentration, which is then used in climate models to examine how the climate may react to varying levels of GHGs. Climate researchers use many global climate models to assess the potential changes in climate due to increased GHGs.

Key Uncertainties Associated with Climate Projections

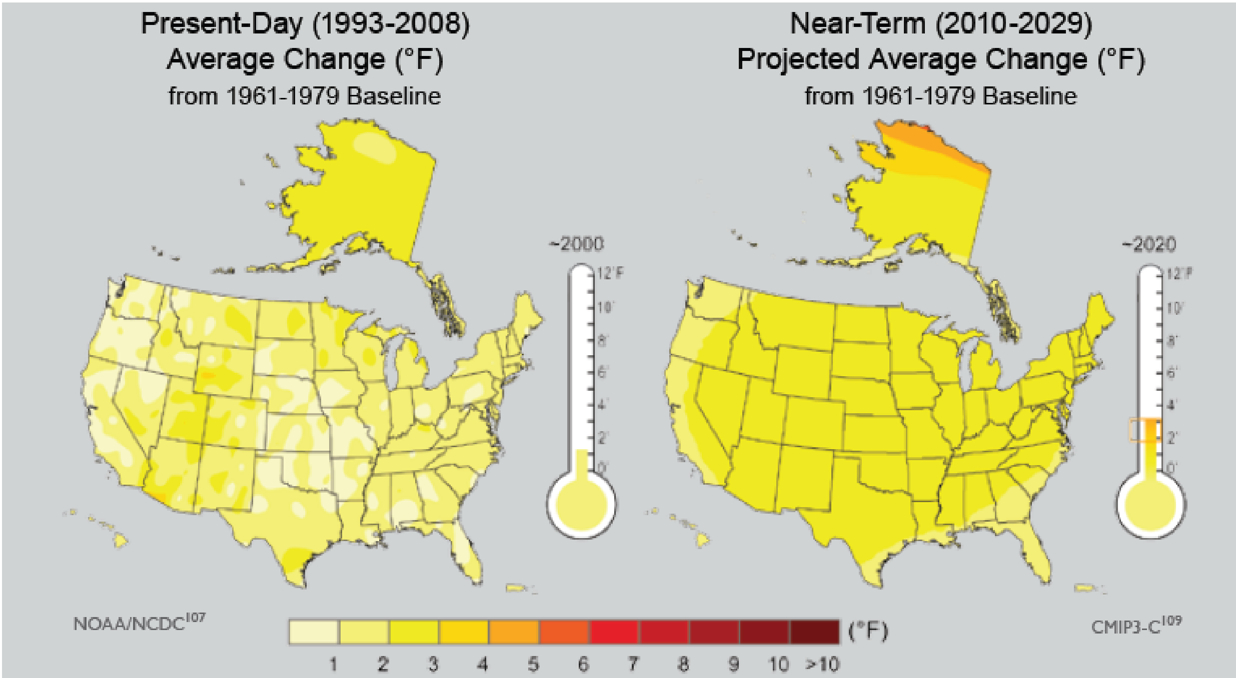
Climate projections and impacts, like other types of research about future conditions, are characterized by uncertainty. Climate projection uncertainties include but are not limited to:

- Levels of future greenhouse gas concentrations and other radiatively important gases and aerosols,
- Sensitivity of the climate system to greenhouse gas concentrations and other radiatively important gases and aerosols,
- Inherent climate variability, and
- Changes in local physical processes (such as afternoon sea breezes) that are not captured by global climate models.

Even though precise quantitative climate projections at the local scale are characterized by uncertainties, the information provided can help identify the potential risks associated with climate variability/climate change and support long term mitigation and adaptation planning.

Figures 4.4 and 4.5 are excerpts from the Global Climate Change Impacts report that show the magnitude of the observed and projected changes in annual average temperature. The map for the period around 2000 shows that most areas of the United States have warmed 1 to 2°F compared to the 1960s and 1970s. Although not reflected in these maps of annual average temperature, this warming has generally resulted in longer warm seasons and shorter, less intense cold seasons. The average warming for the country as a whole is shown on the thermometers adjacent to each map. By the end of the century, the average U.S. temperature is projected to increase by approximately 7 to 11°F under the higher emissions scenario and by approximately 4 to 6.5°F under the lower emissions scenario.

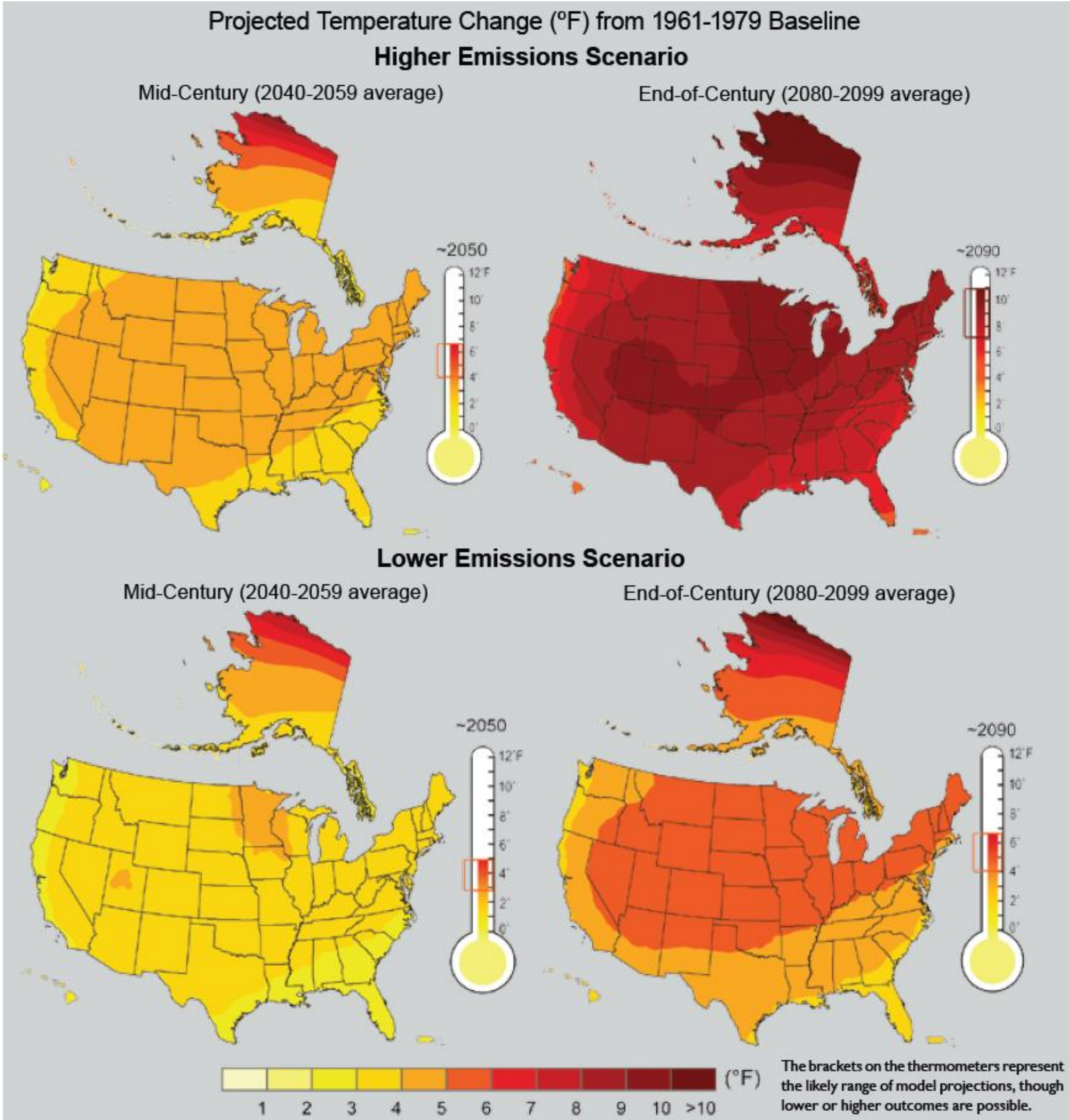
Figure 4.4. Present and Near Term Average Temperature Changes



The maps and thermometers on this page and the next page show temperature differences (either measured or projected) from conditions as they existed during the period from 1961-1979. Comparisons to this period are made because the influence on climate from increasing greenhouse gas emissions has been greatest during the past five decades. The present-day map is based on the average observed temperatures from 1993-2008 minus the average from 1961-1979. Projected temperatures are based on results from 16 climate models for the periods 2010-2029, 2040-2059, and 2080-2099. The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible. The mid-century and end-of-century maps show projections for both the higher and lower emission scenarios.[91] The projection for the near-term is the average of the higher and lower emission scenarios[91] because there is little difference in that timeframe.

Source: USGCRP (2009). Global Climate Change Impacts in the United States

Figure 4.5. Projected Average Temperature Changes



Source: (USGCRP (2009). Global Climate Change Impacts in the United States

The report concludes that in addition to temperature increases projected sea level rise, increased hurricane intensity, and associated storm surge may lead to further erosion, flooding, and property damage in the Southeast. Specific concerns for the Southeast include:

- Sea level rise along the Southeast coast will likely erode wetlands and coastal shorelines. Low-lying areas would be flooded more frequently. Some ecosystems and communities could be permanently lost.

- Sea level rise and increased storms will likely increase the salinity of estuaries, coastal wetlands, and tidal rivers. Rapid sea level rise could even eliminate some barrier islands that currently protect inland habitats. (*JB note: Barrier Island protection - possibly a regional adaptation strategy*)
- Hurricanes gain strength over warm ocean waters. The destructive energy of Atlantic hurricanes has increased in recent decades. As the ocean surface continues to warm, hurricane intensity will likely continue to increase.
- More frequent storm surge flooding of low-lying areas would cause more frequent flooding of transportation infrastructure. This can disrupt travel and damage roads, highways, bridges, oil and gas operations, and other structures in coastal areas. The transportation network is particularly vulnerable since many roads in the Gulf Coast region of the Southeast are at an elevation of four feet or less.
- Higher temperatures increase evaporation and water loss from plants. Projected increases in temperature will likely increase the frequency, duration, and intensity of droughts in the area.
- Projected changes in surface water runoff to the coast and groundwater recharge will likely allow saltwater to intrude and mix with shallow aquifers in some coastal areas of the Southeast, particularly in Florida and Louisiana.
- Warmer temperatures could increase the number of wildfires and pest outbreaks, such as the southern pine beetle.

Another study prepared in 2008 by the U.S. Climate Change Science Program, *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I*, came to the following conclusions about the outlook for climate change for the Gulf Coast region:

- Warming Temperatures - An ensemble of GCMs indicate that the average annual temperature is likely to increase by 1-2 °C (2-4 °F) in the region by 2050. Extreme high temperatures also are expected to increase, and within 50 years the probability of experiencing 21 days a year with temperatures of 37.8 °C (100 °F) is greater than 50 percent.
- Changes in Precipitation Patterns - While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events.
- Rising Sea Levels - Relative sea level is likely to rise between 1 and 6 ft by the end of the 21st century, depending upon model assumption and geographic location. The highest rate of relative sea level rise will very likely be in the central and western parts of the Gulf Coast (Louisiana and East Texas) where subsidence rates are highest.
- Storm Activity - Hurricanes are more likely to form and increase in their destructive potential as the sea surface temperature of the Atlantic and Gulf of Mexico continue to increase. Rising relative sea level will exacerbate exposure to storm surge and flooding. Depending on the trajectory and scale of individual storms, facilities at or below 9 m (30 ft) could be subject to direct storm surge impacts.

Local Climate Change Projections

Scientists from NASA's Goddard Institute for Space Studies adjusted regional climate models, based on local temperature and sea level records, to make projections more specific and useful for the Stennis Space Center area. This "downscaling" process can provide a more precise projection for a specific location (in this case, the Stennis Space Center area) than modeling for an entire region, such as the southern US. The findings were summarized in "Adapting Now to a Changing Climate, Stennis Space Center; NASA Climate Risks" handout, in the Fall of 2012 (Members of NASA's Climate Adaptation Science Investigator (CASI) Work Group contributed to this document.). The handout has a synopsis of IPCC Climate scenarios, climate science context, and qualitative changes in extreme events, and temperature for the Waveland area.

Using the downscaled models, scientists project higher average annual temperatures and rising average sea levels for the Stennis area. Three emissions scenarios were used in 16 different global climate models, to provide a range of possible outcomes and provide a sound basis for policy decisions and adaptation planning. Table 4.6 summarizes the downscaled climate projections. While little change is expected in average annual precipitation, storms may be more intense, leading to increased risks of flooding.

Table 4.6. Summary of Potential Changes in Precipitation, Sea Level, and Temperature

	2020's	2020's avg	2050's	2050'savg	2080's	2080's avg
Average Annual Precipitation	-5% to +5%		-10% to +5%		-10% to +5%	
Sea Level (inches)	+2 to +4	3	+6 to +10	8	+11 to +19	15
Sea Level-Rapid Ice Melt Possibility (inches)	+4 to +8	6	+18 to +27	22.5	+41 to +55	48
Average Annual Temperature (F°)	+1.5° to +2.0°		+2.5° to +4.5°		+3.5° to +7.0°	

Source: Adapting Now to a Changing Climate, Stennis Space Center; NASA Climate Risks" handout

Summary of Global Sea Level Rise Data

The specific time horizon for sea level rise remains uncertain and is difficult to predict with precision. A report on Global Sea Level Rise Scenarios for the US National Climate Assessment prepared by NOAA in December 2012 suggests that a wide range of estimates for future global mean SLR are scattered throughout the scientific literature and other high profile assessments, such as previous reports of the National Climate Assessment and the Intergovernmental Panel on Climate Change (IPCC). Until the 2012 NOAA report was developed there was no coordinated, interagency effort in the US to identify agreed upon global mean SLR estimates for the purpose of coastal planning, policy, and management. At present, coastal managers are left to identify global SLR estimates through their own interpretation of the scientific literature or the advice of experts on an ad-hoc basis.

The report indicates that there is a high level of confidence (>9 in 10 chance) that global mean sea level will rise at least 0.2 meters (8 inches) and no more than 2.0 meters (6.6 feet) by 2100 based on a large body of science. Given the range of possibilities planning for sea level rise can be a challenge at the local level. The report recommends scenario planning vs. probabilistic projections of future conditions. No widely accepted method is currently available for producing probabilistic projections of sea level rise at actionable scales (i.e. regional and local). Scenarios do not predict future changes, but describe future potential conditions in a manner that supports decision-making under conditions of uncertainty. Scenarios are used to develop and test decisions under a variety of plausible futures. This approach strengthens an organization's ability to recognize, adapt to, and take advantage of changes over time.

Summary of Local Sea Level Rise Data

The local sea level rise potential in the Mississippi Gulf Coast and Waveland area is based on a summary of available science and data in the MS Department of Marine Resources report on SLR. The methodology used to determine linear projections of sea level rise for the Mississippi coast included an analysis of both short and long-term data for the Dauphin Island and Pensacola Tide Stations and a comparison of data from those stations to the short-term data available for Mississippi Tide Stations including stations located at the Pascagoula NOAA Lab, the Gulfport Harbor, and the Bay-Waveland Yacht Club. The lack of long-term data from Mississippi stations necessitated comparison of short-term data from all stations to determine the presence of statistical consistencies. It was determined that statistical consistencies existed. As a result, the mean projected linear sea level rise trend for Mississippi was determined to be an average of 0.10 inches per year, yielding projections of 0.5 inches in five years; 1 inch in ten years, 2 inches in twenty years; 5 inches in fifty years, and 10 inches in 100 years. This trend represents a best-case scenario for the Mississippi Gulf Coast.

Actual sea level rise levels potentially experienced in the future are dependent on a number of factors that are potentially difficult to predict. These factors include erosion, accretion, and subsidence as local contributing factors. Other factors such as glacial melt and climate change are more global in nature but still have potential to impact future sea levels on the Mississippi coast. Thus the range of predictions for future sea levels on the Mississippi coast range from 0.10 inch per year (best case) to approximately 0.83 inches per year (worst case). The potential worst case scenario equals approximately 6.25 feet (74.7 inches) of sea level rise by the year 2100. This worst case includes a rapid ice melt scenario of land-based ice such as the Western Antarctic Ice Sheet or Greenland. Data collected over the past several years reveal that this ice is melting faster than most Global Climate Models project.

During the update of this plan sea level rise (SLR) inundation data for 1, 2, 3, 4, 5, and 6 foot rise scenarios was available from NOAA. These same data sets can be viewed online with the NOAA Sea Level Rise Viewer (http://www.csc.noaa.gov/slr/viewer/#). NOAA provided this data in GIS format as well as low lying, non-hydrologically connected polygons (i.e. low areas not connected to the sea but influenced by rising groundwater tables) for the same 6 scenarios.

Based on the literature review of SLR projections and discussions with City mitigation planners three scenarios were chosen for planning purposes that best approximated the SLR potential in 2100 and the available NOAA inundation data:

- Best case: 1ft SLR
- Average Case: 3ft SLR
- Worst Case: 6ft SLR

These scenarios were used for further mapping and vulnerability analysis in this LHMP. The following maps in Figures 4.6 through 4.8 represent the SLR scenarios for Waveland. Figure shows an overview of the three scenarios in the regional context and combined into one figure for ease of comparison. Further discussion on the impacts of SLR on the built environment can be found in section 4.3 Vulnerability Assessment Summary.

Figure 4.6. Sea Level Rise 1 ft Scenario in Waveland

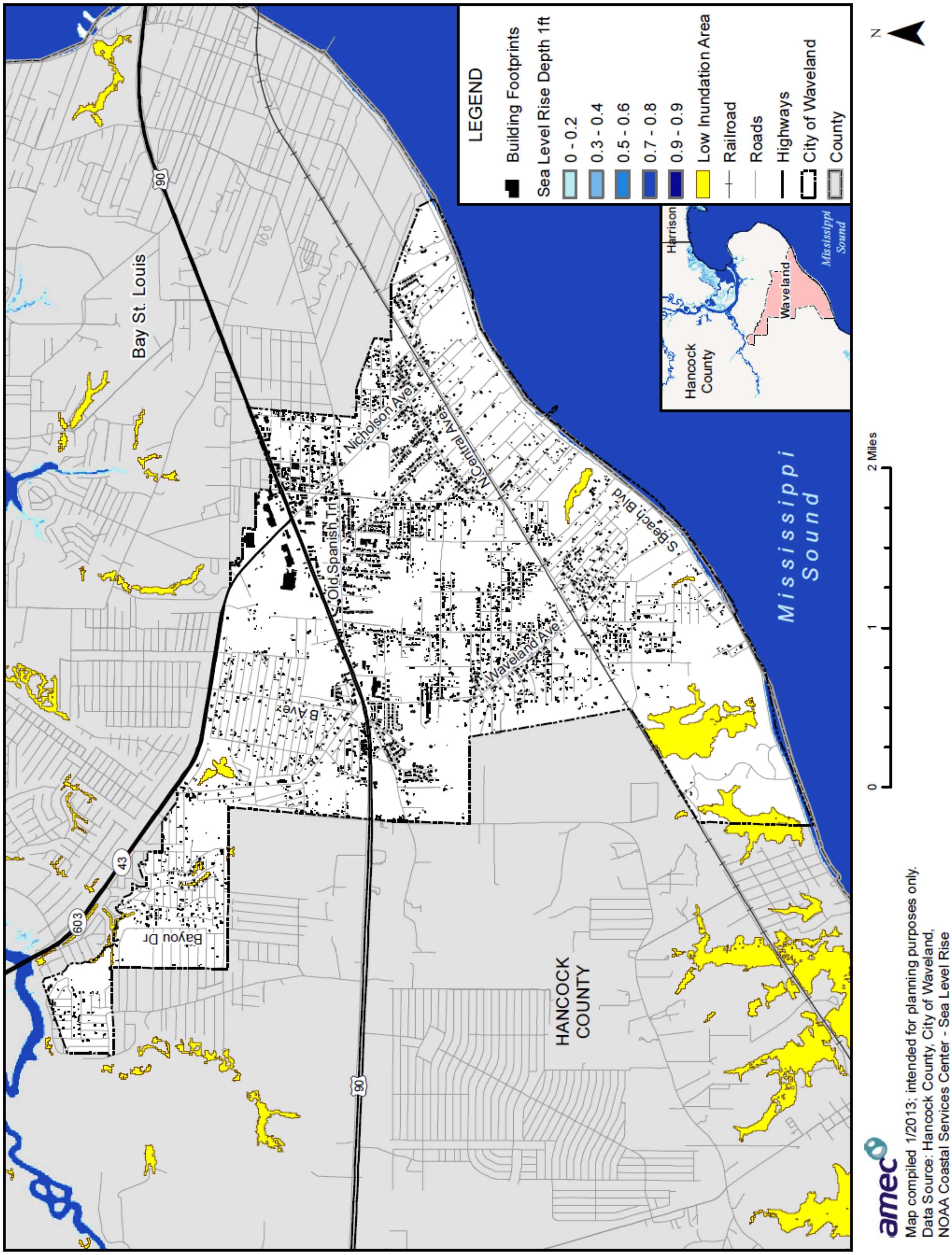


Figure 4.7. Sea Level Rise 3 ft Scenario in Waveland

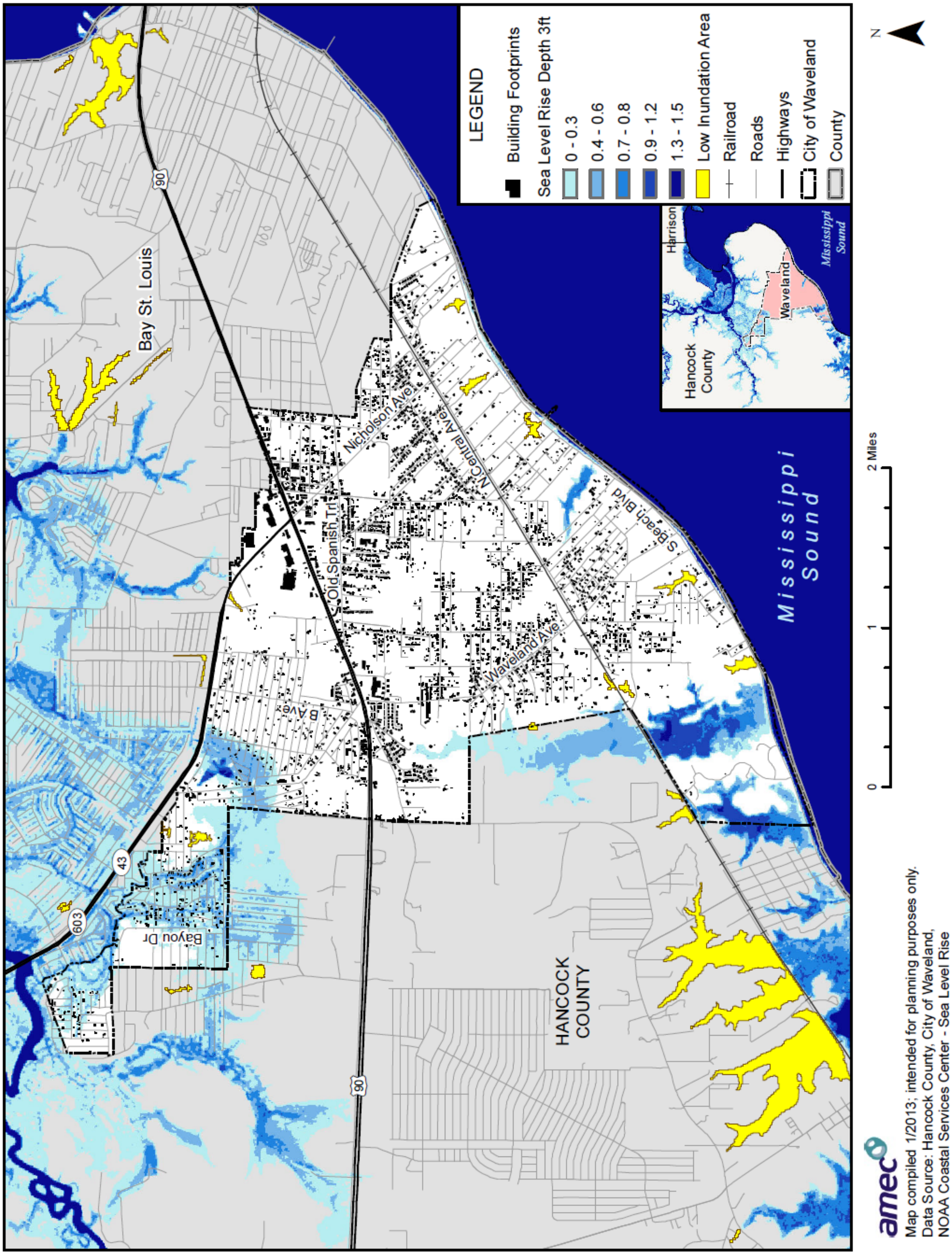
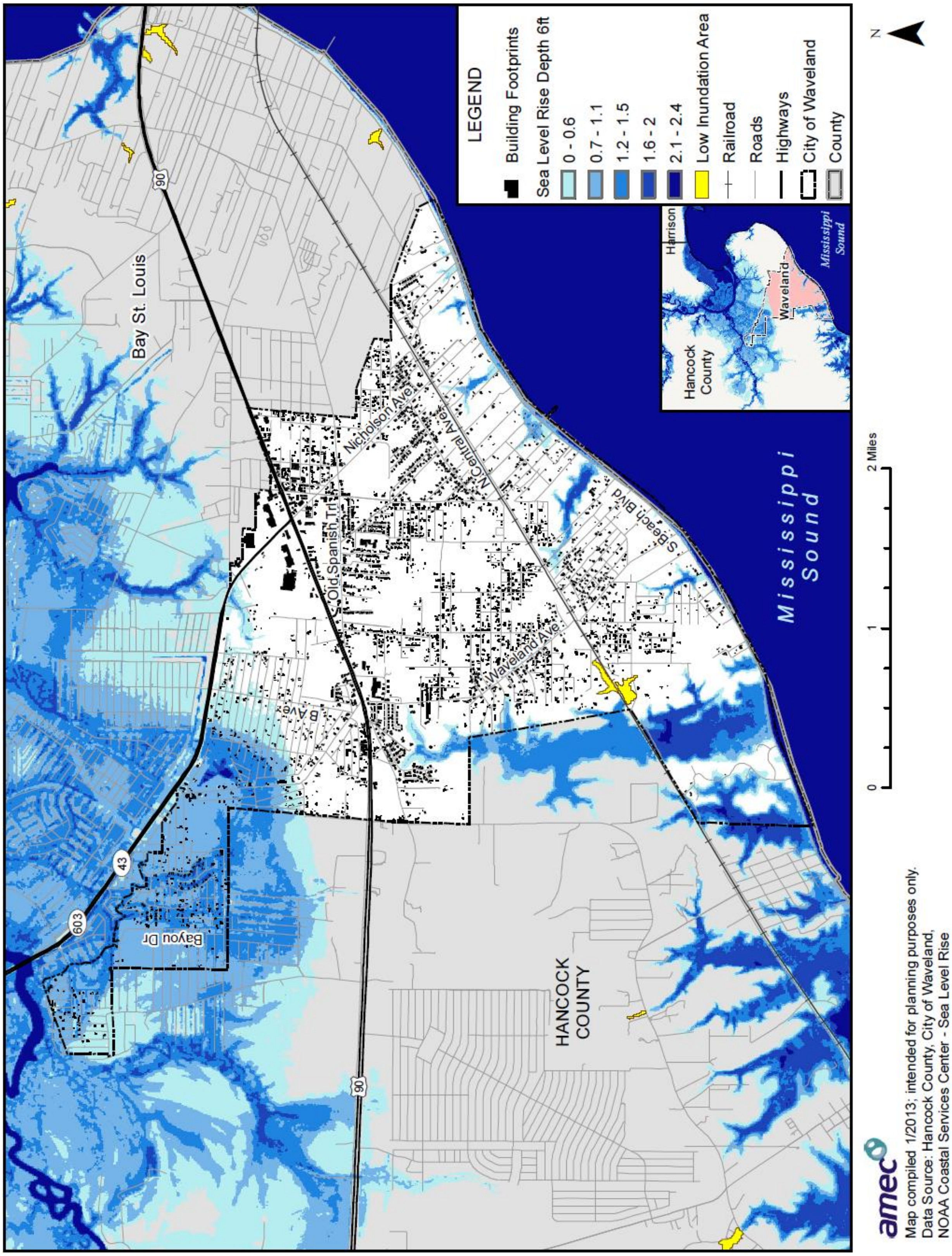


Figure 4.8. Sea Level Rise 6 ft Scenario in Waveland



Climate Change and Sea Level Rise Effects on Extreme Events

A significant consideration for Waveland and the Mississippi Gulf Coast is the potential for climate change and sea level rise to affect the frequency, duration, and intensity of tropical weather activity, storm frequency, flooding, and drought. Even small amounts of sea level rise make rare floods more common by adding to tides and storm surge. Table 4.7 summarizes the general direction of changes in intensity and frequency of extreme events based on climate change projections.

Table 4.7. Qualitative Changes in Extreme Events During This Century

Event	Direction of Change	Likelihood
Hot Days	▲	Very Likely
Intense Precipitation	▲	Likely
Flooding	▲	Likely
Drought	▲	More likely than not
Intense Winds	▲	More likely than not

Source: Stennis Space Center

A report developed by Climate Central titled Surging Seas investigated the potential for climate change to alter the frequency of flood events. For a representative station (Pensacola FL or Grand Isle- East Point LA):

- Odds of a 100-year flood or worse by 2030, with sea level rise from global warming: 20%
- Odds without global warming: 17%
- Bottom line: global warming multiplies the odds by 1.2X

Storm Surge Height

Sea level change will be particularly important in influencing storm surge flooding in the Waveland area, since the area is already is subject to flooding from above normal tides, surge and rainfall events from hurricanes and less powerful tropical storms. The previously referenced 2008 study on the impacts of climate change on transportation systems and infrastructure included modeling of storm surge impacts with and without sea level rise. Simulated storm surge from NOAA SLOSH model runs across the central Gulf Coast region demonstrate a 22to 24 foot potential surge with major hurricanes of Category 3 or greater without considering a future sea level rise effect. After Hurricane Katrina in 2005, high watermark surveys in New Orleans and east along the Gulf Coast in Mississippi revealed storm surge heights approaching 28 ft above MSL. A storm approaching from the east on a northwesterly track can elevate storm surge 1-3 ft in comparison to a storm of equal strength approaching on a northeasterly track. The combined conditions of a slow churning Category 5 hurricane making landfall on a westerly track along the central Gulf Coast under climate change and elevated sea levels indicate that transportation assets and facilities at or below 30 ft MSL are subject to direct impacts of projected storm surge. This conclusion is cause for concern as the entire community of Waveland is within 0-28 ft above current MSL.

Also, it is expected that storm surges superimposed on higher mean sea levels will tend to exacerbate coastal erosion and land loss. In the CCSP *Impacts of Climate Change and Variability* report, it was noted that during Hurricanes Rita and Katrina, for example, 217 mi^2 of land in coastal Louisiana was converted to open water, and the Chandeleur Island chain was reduced in size by roughly 85 percent. The implications of the loss of these natural storm buffers on coastal infrastructure have yet to be quantified.

Hurricane Activity

One of the primary factors contributing to the origin and growth of tropical storm and hurricanes systems is water temperature. The CCSP report also noted that sea surface temperature has increased significantly in the main hurricane development region of the North Atlantic during the past century as well as in the Gulf of Mexico.

Significant theoretical and research data supports the position that temperature increases in the world's oceans and rising sea levels may potentially increase the frequency, duration, and intensity of hurricanes originating in the Atlantic Basin. Much of this same data supports the idea that increases in sea level will also equate to increased storm surges driven by hurricanes affecting the gulf coast region. Evidence of these factors is seen in an analysis of Accumulated Cyclone Energy (ACE) data from 1950 to 2009. While the data shows no clear trend in hurricane intensity, it does indicate a noticeable increase in intensity over the previous 20 years with six of the ten most active hurricane seasons occurring since the mid-1990s. Some studies conclude that the increase in hurricane activity in recent decades is due to the combination of natural cyclical events (such as the North Atlantic Oscillation) and human-induced increases in sea surface temperature.

Temperature Extremes

Temperature trends across the Gulf States region are not as pronounced as they are nationally due to the moderating effect of the proximate Gulf of Mexico waters. The GCM results run with the A1B, A2, and B1 emissions scenarios suggest a warmer Gulf Coast region, with the greatest increase in temperature occurring in summer and lowest increases in winter. This is consistent with another analysis of historical data (in the CCSP report) that shows a significant increase in summer minimum temperature across the Gulf Coast study area between 1950 and 2002. Despite the absence of a detectible trend in the number of days exceeding a high threshold temperature, it is very likely that in the future the number of very hot days will substantially increase. The number of days per year exceeding 90°F is projected to rise dramatically in the coming century, and the number of days with temperatures below 40°F is projected to decrease, as shown in Table 4.8.

Table 4.8. Hot and Cold Day Projections

Daily Temperatures	Baseline	2020s	2050s	2080s
Days/year at or above 100°F	2	3 to 6	6 to 20	10 to 50
Days/year at or above 90°F	82	93 to 106	106 to 131	120 to 155
Days/year at or below 40°F	62	49 to 54	40 to 50	31 to 45
Days/year at or below 32°F	25	16 to 20	12 to 17	8 to 14

Source: Stennis Space Center; Baseline is from Poplarville, MS

Increasing Daily Precipitation Extremes

Current generation climate models are limited in their ability to simulate individual storms by a lack of horizontal resolution. Based on a simple theoretical argument (from the Climate Center report) it is expected that extreme precipitation events should become more intense as the climate warms. The IPCC (2007) concluded that the frequency of heavy precipitation events had increased over most areas during the past century and that a continued increase in heavy precipitation events is very likely during the 21st century.

Summary of Climate Change Impacts

Climate change has the potential to magnify the impacts of many of the hazards profiled in this plan. Table 4.9 below is reproduced from the Stennis Space Center study and brochure and synthesizes the qualitative changes in extreme events based on global climate model simulations, published literature, and expert judgment. The vulnerability assessment in Section 4.3.2 further quantifies the risk Waveland faces from floods, hurricanes, sea level rise and other hazards affected by climate change.

Table 4.9. Summary of Climate Trends and Potential Impacts in the Waveland Area

Climate Trends	Potential Impacts
Rising Sea Level	Exacerbated flooding from storm surges; reduced emergency response capabilities. Increased salinity impacts to drinking water resources and habitats
Increased Coastal Flooding	Impacts to wastewater treatment plants on the coast; damage to infrastructure; changes in shoreline habitats; overloading of stormwater management system
Overall Increased Temperature	Increased cooling costs in the summer; decreased heating costs in the winter. Changes in plant and animal cycles, including pest and disease vector species
Increased Number of High Temperature Days	Potential for damage to infrastructure materials; potential for limiting work and recreation outdoors; increased health problems related to heat stress

Climate Trends	Potential Impacts
Precipitation Changes	Increased flooding from extreme precipitation events; increased risk of drought as temperatures rise; habitats affected by fluctuating groundwater levels

Source: Stennis Space Center - based on global climate model simulations, published literature, and expert judgment

4.2.2 Coastal/Canal Bank Erosion

Hazard/Problem Description

Coastal Erosion

Coastal erosion is a hydrologic hazard defined as the wearing away of land and loss of beach, shoreline or dune material and is measured as the rate of change in the position or horizontal (landward) displacement of a shoreline over a period of time. Short-term erosion typically results from episodic natural events such as hurricanes and storm surge, windstorms and flooding hazards, but may be exacerbated by human activities such as boat wakes, removal of dune and vegetative buffers, shoreline hardening and dredging. Long-term erosion is a function of multi-year impacts such as wave action, sea level rise, sediment loss, subsidence and climate change. Climatic trends can change a beach from naturally accreting to eroding due to increased episodic erosion events caused by waves from an above-average number of storms and high tides, or the long-term effects of fluctuations in sea level.

Natural recovery from erosion can take years to decades. If a beach and dune system does not recover quickly enough naturally, coastal and upland property may be exposed to further damage in subsequent coastal erosion and flooding events. Human actions to supplement natural coastal recovery, such as beach nourishment, dune stabilization and shoreline protection structures (e.g., sea walls, groins, jetties, etc.) can mitigate the hazard of coastal erosion, but may also exacerbate it under some circumstances.

Hancock County Sand Beach was built to protect the seawall in Hancock County and to protect Beach Boulevard from high tides. After the Hurricane of 1947, the County secured funding to build a beach in front of the seawall to protect the seawall and Beach Boulevard which runs along the seawall. The Hurricane of 1947 breached the seawall in Hancock County in several locations. Erosion of the sand beach is a constant threat to the seawall. Erosion of the sand beach occurs from two sources, water borne erosion and wind borne erosion. The County has established beach profiles and maintains these profiles daily to insure the longevity of the beach and its protective nature. Additionally, a pathway was added, which has functioned to anchor the seawall along a three mile area in Bay St. Louis and Waveland. The County plans for renourishment of the Sand Beach in the Bay St. Louis and Waveland area, approximately every six years. Natural hazards can shorten the renourishment time frame. Historically, coastal storms have significantly eroded the sand beach.

Hurricane Katrina's high tides and tidal surges caused damage to the profile of the beach, spurring erosion in some locations of the man-made beach. The Hancock County Board of Supervisors is restoring the seawall, IS THIS DONE? Beach Boulevard, and the sand beach, by pumping in additional sand and profiling the contours of the sand beach to reduce wind borne and water borne erosion. The Hancock County Sand Beach is maintained by the Hancock County Board of Supervisors.

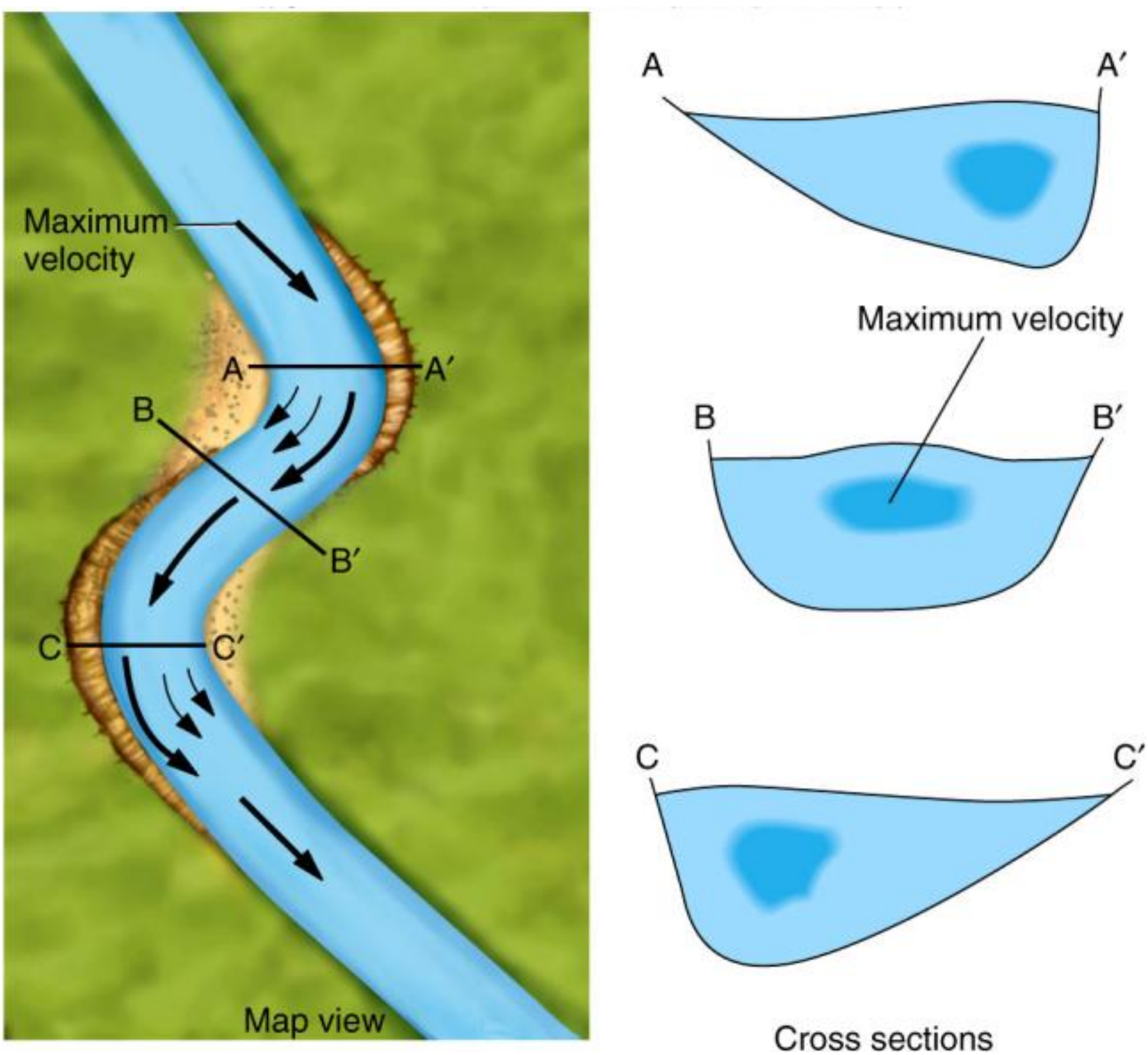
Beaches and areas within the City that border marshlands can also be susceptible to erosion. These areas are located around lakes and rivers or canals in the City. Death and injury are not associated with coastal erosion; however, it can cause the destruction of buildings and infrastructure and represents a major threat to the local economies of coastal communities that rely on the financial benefits of recreational beaches. According to the State of Mississippi Hazard Mitigation Plan, coastal erosion is primarily caused by coastal flooding and hurricanes, which are addressed in Sections 4.2.8 and 4.2.9.

Canal Bank Erosion

Any flowing body of water (brook, creek, stream, river) is a stream (often referred to locally as a canal). Stream flow is expressed as volume per unit time, usually cubic meters per second, cubic feet per second, sometimes cubic kilometers per second, or acre-feet per second or day. Stream flow varies tremendously with time. Short term controls include rainfall and evaporation conditions. Long term controls include land use, soil, groundwater state, and rock type.

Streams/canals erode by a combination of direct stream processes, like down cutting and lateral erosion, and indirect processes, like mass-wasting accompanied by transportation. Water tends to move downstream in slugs that extend all the way across a channel as shown in Figure 4.9. When the channel bends, water on the outside of the bend (the cut-bank) flows faster and water on the inside of the bend (the point) flows slower. This distribution of velocity results in erosion occurring on the outside of the bend (cut) and deposition occurring on the inside of the bend.

Figure 4.9. Meanders and Stream flows



Stream bank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects. Stream bank erosion processes, although complex, are driven by two major components: stream bank characteristics (erodibility) and hydraulic/gravitational forces. Many land use activities can affect both of these components and lead to accelerated bank erosion. The vegetation rooting characteristics can protect banks from fluvial entrainment and collapse, and also provide internal bank strength. When riparian vegetation is changed from woody species to annual grasses and/or forbs, the internal strength is weakened, causing acceleration of mass wasting processes. Stream bank aggradation or degradation is often a response to stream channel instability. Since bank erosion is often a symptom of a larger, more complex problem, the long-term solutions often involve much more than just bank stabilization. Numerous studies have demonstrated that stream bank erosion contributes a large portion of the annual sediment yield.

Determining the cause of accelerated streambank erosion is the first step in solving the problem. When a stream is straightened or widened, streambank erosion increases. Accelerated streambank erosion is part of the process as the stream seeks to re-establish a stable size and pattern. Damaging or removing streamside vegetation to the point where it no longer provides for bank stability can cause a dramatic increase in bank erosion. A degrading streambed results in higher and often unstable, eroding banks. When land use changes occur in a watershed, such as clearing land for agriculture or development, runoff increases. With this increase in runoff the stream channel will adjust to accommodate the additional flow, increasing streambank erosion. Addressing the problem of streambank erosion requires an understanding of both stream dynamics and the management of streamside vegetation.

Erosion and deposition are occurring continually at varying rates over the planning area. Swiftly moving floodwaters cause rapid local erosion as the water carries away earth materials. Severe erosion removes the earth from beneath bridges, roads and foundations of structures adjacent to streams. By undercutting it can lead to increased bridge failure and landslide hazard. The deposition of material can block culverts, aggravate flooding, destroy vegetation and lawns by burying them, and reduce the capacity of water reservoirs as the deposited materials displace water.

Unique to the planning area's canal bank problem is a species know as the nutria. The biology of the nutria species allows it to reproduce at rapid speed, making it an unwieldy animal to control if released into the wild. A female nutria averages about five young per litter, but can birth as many as 13 at a time. A female can breed again within two days after giving birth, meaning one nutria can have up to three litters per year. Nutria are herbivores and feed on wetland plants. They have caused extensive damages to both coastal and canal banks. Due to the lack of vegetation on the shores, bank erosion increases.

Past Occurrences

A search of the NCDC database and SHELDUS database resulted in no past occurrences of coastal erosion or canal bank erosion. This is most likely due to the fact that coastal erosion is often a secondary hazard to hurricane, storm surge, and severe storms. Coastal and canal bank erosion continues to happen on smaller scales in the City of Waveland.

September 26th, 2002 – Tropical Storm Isidore made landfall near Grand Isle, Louisiana during the early morning of September 26th. Significant beach erosion occurred along the coast and on the barrier islands. WERE THERE DAMAGES IN THE CITY?

HMPC – WHAT AREAS ARE SUBJECT TO EROSION? IS THERE A BEACH MASTER PLAN? IS THE BEACH MAINTAINED BY THE COUNTY? HOW ABOUT THE MAN

MADE RIVERS IN THE BAYOU DRIVE AREA? ARE THEY RIP-RAPPED TO PROTECT AGAINST EROSION?

Likelihood of Future Occurrences

Highly Likely—Coastal/canal bank erosion remains a natural, dynamic and continuous process for Waveland's coastal areas and canals. The man-made sand beach is subject to minimal coastal erosion from normal tidal activities, and is subject to moderate to severe erosion from coastal storms and southeastern winds. The Hancock County Board of Supervisors established a policy for daily maintenance of the sand beach to protect the beach protective barrier, and established policies for replenishment as part of long-term maintenance and emergency repair. The probability of future occurrence is highly likely. The damaging impacts of coastal and canal bank erosion are lessened through structural protection measures; however, it is likely that the impacts of coastal and canal bank erosion will increase in severity due to future episodic storm events as well as the anticipated slow onset, long-term effects of climate change and sea level rise.

Climate Change and Coastal/Canal Bank Erosion

Climate change and sea level rise may increase the impacts to coastal and canal bank erosion. As sea level rise occurs, the existing beach will be at greater risk to coastal erosion. Sea level rise will also create coastal areas where existing land is developed today. These areas will be subject to tidal erosion and will need to be mitigated. Sea level rise along the coast of Waveland will likely erode wetlands. Some ecosystems and communities could be permanently lost.

4.2.3 Dam/Levee Failure

Hazard/Problem Description

Dam Failure

A dam is a barrier constructed across a watercourse that stores, controls, or diverts water. Dams are usually constructed of earth, rock, or concrete. The water impounded behind a dam is referred to as the reservoir and is measured in acre-feet. One acre-foot is the volume of water that covers one acre of land to a depth of one foot. Dams can benefit farm land, provide recreation areas, generate electrical power, and help control erosion and flooding issues.

A dam failure is the collapse or breach of a dam that causes downstream flooding. Dam failures may be caused by natural events, human-caused events, or a combination. Due to the lack of advance warning, failures resulting from natural events, such as hurricanes, earthquakes, or landslides, may be particularly severe. Prolonged rainfall and subsequent flooding is the most common cause of dam failure.

Dam failures usually occur when the spillway capacity is inadequate and water overtops the dam or when internal erosion in dam foundation occurs (also known as piping). If internal erosion or overtopping cause a full structural breach, a high-velocity, debris-laden wall of water is released and rushes downstream, damaging or destroying anything in its path. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can result from any one or a combination of the following:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross-section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway;
- High winds, which can cause significant wave action and result in substantial erosion;

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major casualties and loss of life could result, as well as water quality and health issues. Potentially catastrophic effects to roads, bridges, and homes are also of major concern. Associated water quality and health concerns could also be issues. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

The Surface Water and Dam Safety Divisions of the Office of Land and Water Resources, Mississippi Department of Environmental Quality (MDEQ) develop regulations on Dam Safety for the state. Dams are categorized according to what lies downstream, as well as the expected impact of dam failure. The following is taken from regulations for dams in Mississippi that will describe the statutory dam categories:

High Hazard (Category I, or Class C) – Dam failure may cause loss of life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads. Dams constructed in residential, commercial, or industrial areas are classified as high hazard dams unless otherwise classified on a case-by-case business. For example, dams constructed where there is potential for development receive a high hazard classification. The term "High Hazard" does not speak to the quality of the structure, but rather the potential for a resultant death or exposure to property damage downstream in case of a failure. A dam can be as small as six feet in height, but if a homeowner lives within a reasonable distance of the structure, he may be considered vulnerable.

Significant Hazard (Category II, or Class B) – A class of dam in which failure poses no threat to life, but which may cause significant damage to main roads, minor roads, or cause interruption of service of public utilities.

Low Hazard (Category III, or Class A) – A class of dam in which failure would at the most, result in damage to agricultural land, farm buildings (excluding residences), or minor roads. Without exception, all low hazard dams in Mississippi are earthen dams; some are considered to be properly engineered structures.

According to data from the National Performance of Dams Program (NPDP), there are no high or significant hazard dams that would affect the City of Waveland. Dams in Hancock County are shown in Table 4.10.

Table 4.10. Dams in Hancock County

Dam Name	Hazard Class	EAP	Owner	Dam Type	Dam Height	Storage (acre-feet)*	Stream	Nearest Community
Rondalee Ranch Lake	Low	Not required	Private	Earth	15	139	–	–
Seabron Shaw Lake	Low	Not required	Private	Earth	13	70	Tributary of Crane Creek	Bay St. Louis 36 miles
Rufus Shaw Lake	Low	Not required	Private	Earth	13	92	Tributary of Wolf River	Bay St. Louis 37 miles
Bobby Sides Lake	Low	Not required	Private	Earth	17	256	Tributary of Hickory Creek	Kiln 32 miles
Necaise Lake	Low	Not required	Private	Earth	17	167	–	–
Smith Lake	Low	Not required	Private	Earth	13	84	–	–
Cuevas Lake	Low	Not required	Private	Earth	13	112	–	–
Lee Lakems00170	Low	Not required	Private	Earth	12	56	–	–
Lee Lake	Low	Not required	Private	Earth	12	56	–	–
Lee Lakems00172	Low	Not required	Private	Earth	13	306	–	–
Bounds Lake	Low	Not required	Private	Earth	13	111	–	–

Dam Name	Hazard Class	EAP	Owner	Dam Type	Dam Height	Storage (acre-feet)*	Stream	Nearest Community
St Regis Paper Co Lake	Low	Not required	Private	Earth	13	139	–	–
Crosby Lake	Low	Not required	Private	Earth	11	56	–	–
Ms No Name 053	Low	Not required	Private	Earth	13	139	–	–
A Hoda Lake	Low	Not required	Private	Earth	13	84	–	–
Catfish Ponds Lake	Low	Not required	Private	Earth	8	919	–	–
Chester Lee Lake	Low	Not required	Private	Earth	10	60	–	–
Fletcher Lake	Low	Not required	Private	Earth	8	160	–	–
B M Brignse Lake	Low	Not required	Private	Earth	13	180	Tributary of Jordan River	Kiln 20 miles
Ms Nasa Test Faclty Lock	Low	Not required	Private	Earth	68	2690	–	–
Salem Scout Lake	Low	Not required	Private	Earth	20	480	Tributary of Wolf River	Cuevas 21 miles
Tranquility Trails Dam#1	Low	Not required	Private	Earth	31	346	–	–

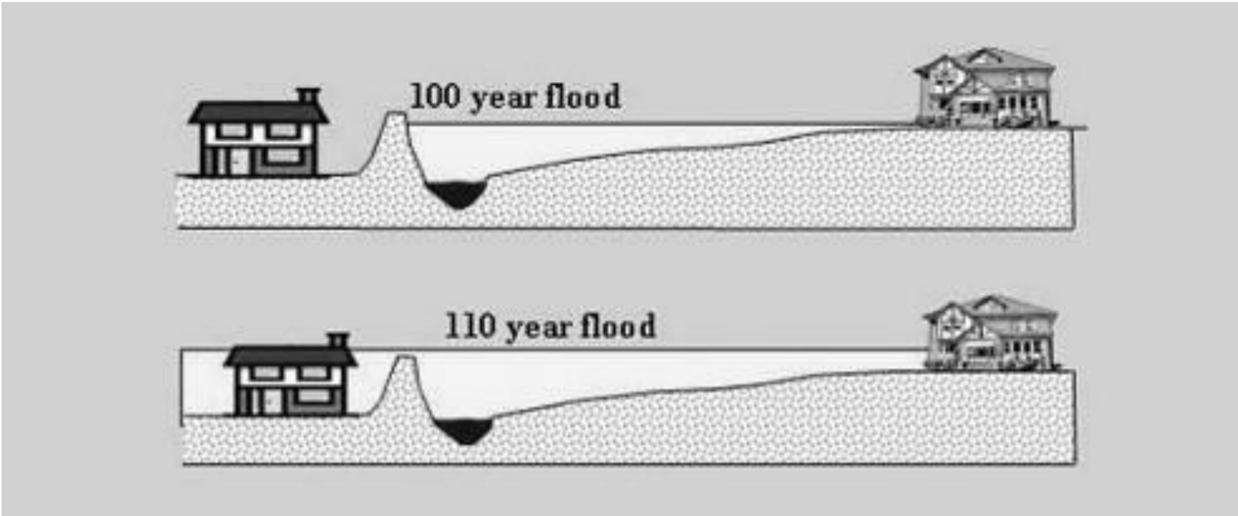
Source: National Performance of Dams Program
* One acre foot equals 325,000 gallons of water

Levee Failure

A levee is a type of dam that runs along the banks of a river or canal. Levees reinforce the banks and help prevent flooding. By confining the flow, levees can also increase the speed of the water. Levees can be natural or man-made. A natural levee is formed when sediment settles on the river bank, raising the level of the land around the river. To construct a man-made levee, workers pile dirt or concrete along the river banks, creating an embankment. This embankment is flat at the top, and slopes at an angle down to the water. For added strength, sandbags are sometimes placed over dirt embankments.

Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events. Levees reduce, not eliminate, the risk to individuals and structures behind them.

Figure 4.10. Flooding from Levee Overtopping

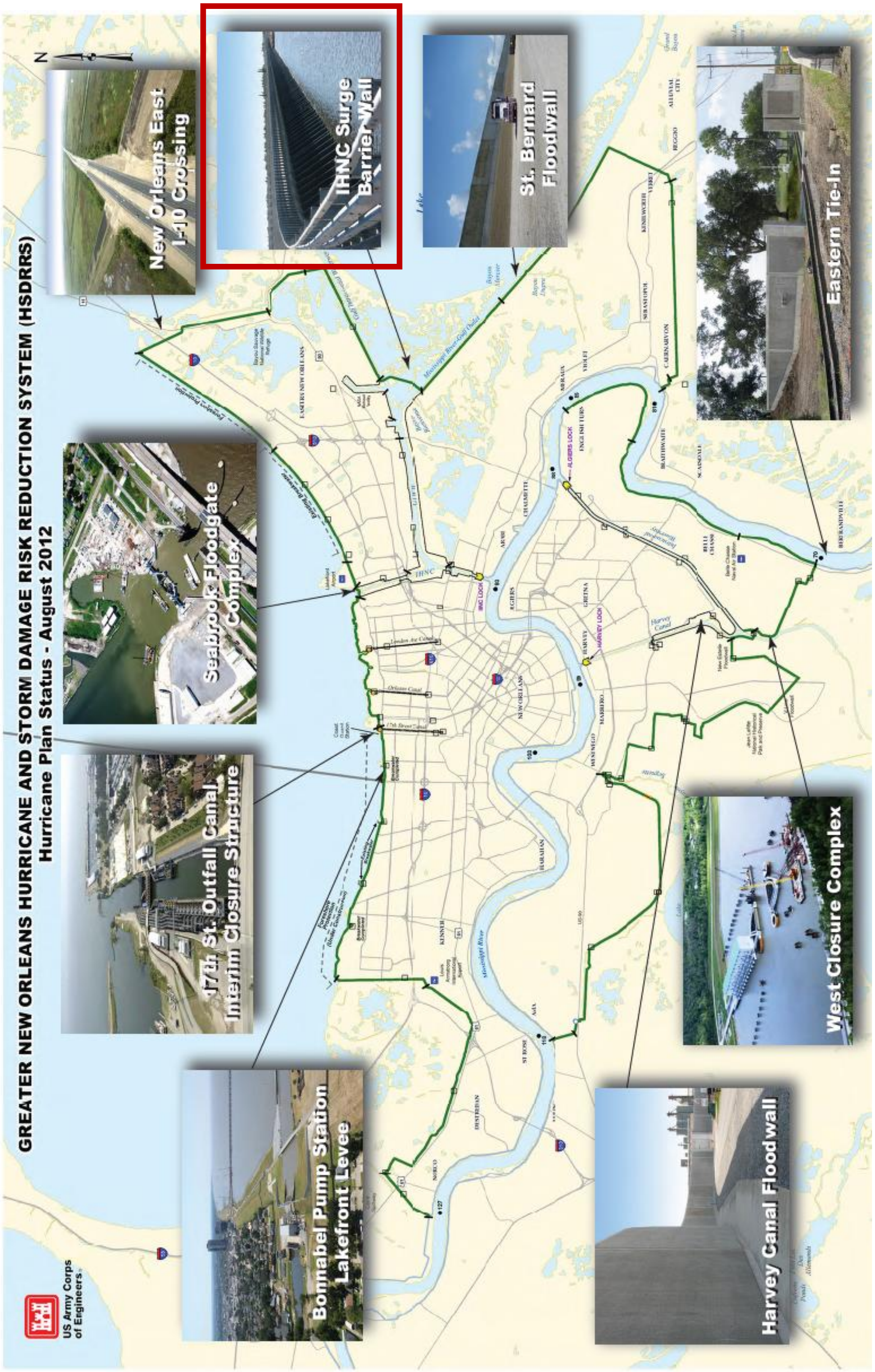


Source: Levees In History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR. http://www.floods.org/ace-files/leveesafety/lss_levee_history_galloway.ppt

A levee system failure or overtopping can create severe flooding (see Figure 4.10) and high water velocities. It is important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

Members of the HMPC noted a project by the US Army Corps of Engineers that may increase flooding in the City. The Inner Harbor Navigation Canal Surge Barrier (IHNC) project is intended to protect New Orleans from future flooding. An unintended byproduct of the project may be increased flood waters routed around the City of New Orleans coming downstream to affect coastal Mississippi communities. A map of that project, with the project highlighted in a red box, is shown in Figure 4.11.

Figure 4.11. Inner Harbor Canal Surge Barrier



Source: US Army Corp of Engineers

Past Occurrences

There was only one dams breached in Hancock County. The Boy Scout Camp Dam located at the Salmon Reservation breached in April, 1983. There were no damages in the City of Waveland. No levee failures have been reported in the City.

Likelihood of Future Occurrences

Unlikely–There are no high or significant hazard dams that could impact the City. Since no occurrences of levee failure have happened and there are no certified levees in the City, future levee failure is unlikely.

Climate Change and Dam and Levee Failure

Given the fact that there are no high or significant hazard dams that would affect the City of Waveland, climate change is unlikely to change the risk of the City to dam failure. Given the fact that there are no levees in the City, climate change is unlikely to change the current risk of the City to levee failure. However, future levees may need to be built to combat the effects of sea level rise. Climate change may affect future levees in the City.

4.2.4 Drought

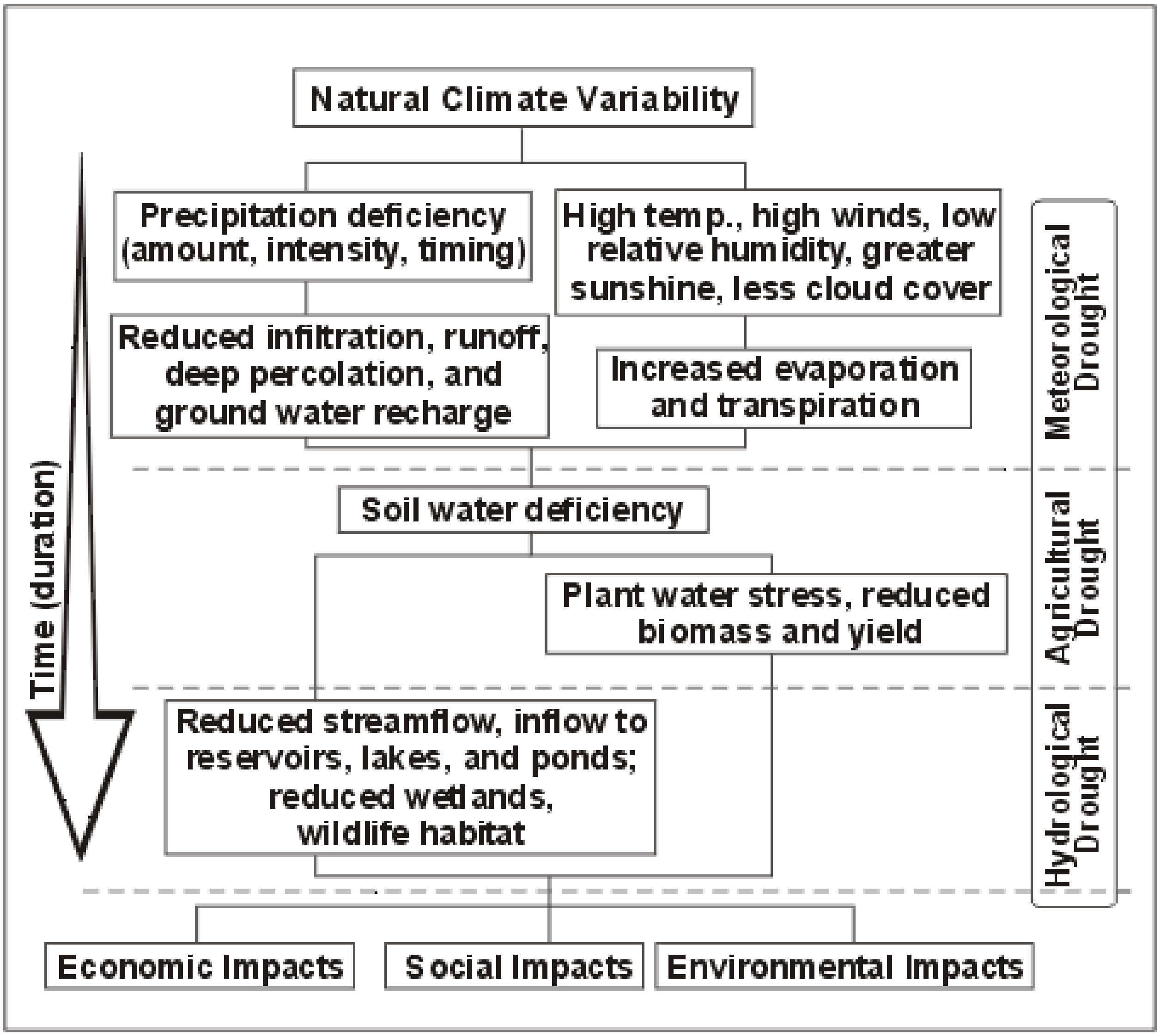
Hazard/Problem Description

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Drought is a complex issue involving (see Figure 4.12) many factors—it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects:

- Meteorological drought is usually defined by a period of below average water supply.
- Agricultural drought occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- Hydrological drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- Socioeconomic drought occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

Figure 4.12. Causes and Impacts of Drought



Source: National Drought Mitigation Center

Drought in the United States is monitored by the National Integrated Drought Information System (NIDIS). A major component of this portal is the U.S. Drought Monitor. The Drought Monitor concept was developed jointly by the NOAA's Climate Prediction Center, the NDMC, and the USDA's Joint Agricultural Weather Facility in the late 1990s as a process that synthesizes multiple indices, outlooks and local impacts, into an assessment that best represents current drought conditions. The final outcome of each Drought Monitor is a consensus of federal, state, and academic scientists who are intimately familiar with the conditions in their respective regions. A snapshot of the drought conditions in Waveland and the State of Mississippi can be found in Figure 4.13.

Figure 4.13. Waveland Drought Status

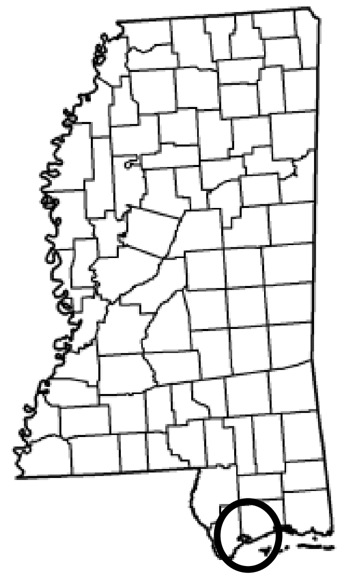
U.S. Drought Monitor

March 5, 2013
Valid 7 a.m. EST

Mississippi

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	100.00	0.00	0.00	0.00	0.00	0.00
Last Week (02/26/2013 map)	99.98	0.02	0.00	0.00	0.00	0.00
3 Months Ago (12/04/2012 map)	60.66	39.34	1.15	0.00	0.00	0.00
Start of Calendar Year (01/01/2013 map)	73.38	26.62	0.00	0.00	0.00	0.00
Start of Water Year (09/25/2012 map)	82.25	17.75	12.65	7.08	2.55	0.00
One Year Ago (02/28/2012 map)	90.20	9.80	2.44	0.06	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

Released Thursday, March 7, 2013
Matthew Rosencrans, NOAA/NWS/NCEP/Climate Prediction Center

Source: US Drought Monitor

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in the planning area are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Voluntary conservation measures are typically implemented during extended droughts. Water quality deterioration is also a potential problem. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Past Occurrences

The NCDC and SHELDUS databases report no incidents of extended drought for the City of Waveland or Hancock County. Given the fact that Waveland is located in sub-tropical South Mississippi and receives an annual average rainfall of 64 inches, extended periods of drought are extremely rare. Short term droughts are possible, but there is limited record keeping of minor droughts.

Likelihood of Future Occurrences

Occasional–Limited historical data make precise estimating of probability unrealistic within the context of this planning process. However, the probability of future drought conditions is considered to be occasional, with the entire state being vulnerable. Future water supply is a concern with continued growth.

Climate Change and Drought

According to the IPCC, the nature and frequency of drought could be altered from climate change. A future of reduced overall precipitation, warmer summers, and greater demand in the City will cause much more stress to water supplies. Higher temperatures increase evaporation and water loss from plants. Projected increases in temperature will likely increase the frequency, duration, and intensity of droughts in the area.

4.2.5 Earthquake

Hazard/Problem Description

The State of Mississippi Standard Mitigation Plan defines an earthquake as a sudden ground motion or vibration of the Earth produced by the rapid release of stored up energy along an active fault. The released energy is transferred to the surrounding materials as vibratory motion known as seismic waves. As the seismic waves pass from one type of geological material to another, they may be amplified or dampened based on the composition of the new material and the energy will decrease with distance. Once the vibrations reach the ground surface they are transferred to man-made buildings, infrastructure or critical facilities. If the waves are strong enough and the structures are not designed or built to accommodate the shaking, the vibration can cause damage to or failure of the building, infrastructure or critical facility.

Magnitude and intensity are two ways earthquakes are measured. Magnitude measures the energy released at the source of the earthquake and is measured by a seismograph. Intensity is a measure of the shaking produced by an earthquake at a certain location. A comparison of magnitude and intensity is shown in Table 4.11.

Table 4.11. Richter and Modified Mercalli Scales for Measuring Earthquakes

Magnitude (Richter Scale)	Modified Mercalli Intensity
1.0 – 3.0	I
3.0 – 3.9	II, III
4.0 – 4.9	IV – V
5.0 – 5.9	VI – VII
6.0 – 6.0	VII – IX
7.0 and higher	VIII or higher

Source: USGS Earthquake Hazards Program

Intensity is gauged by how an earthquake affects people, structures and the natural environment. The Modified Mercalli Intensity Scale is the standard scale used in the United States to measure intensity. Table 4.12 provides the abbreviated descriptions for each intensity level.

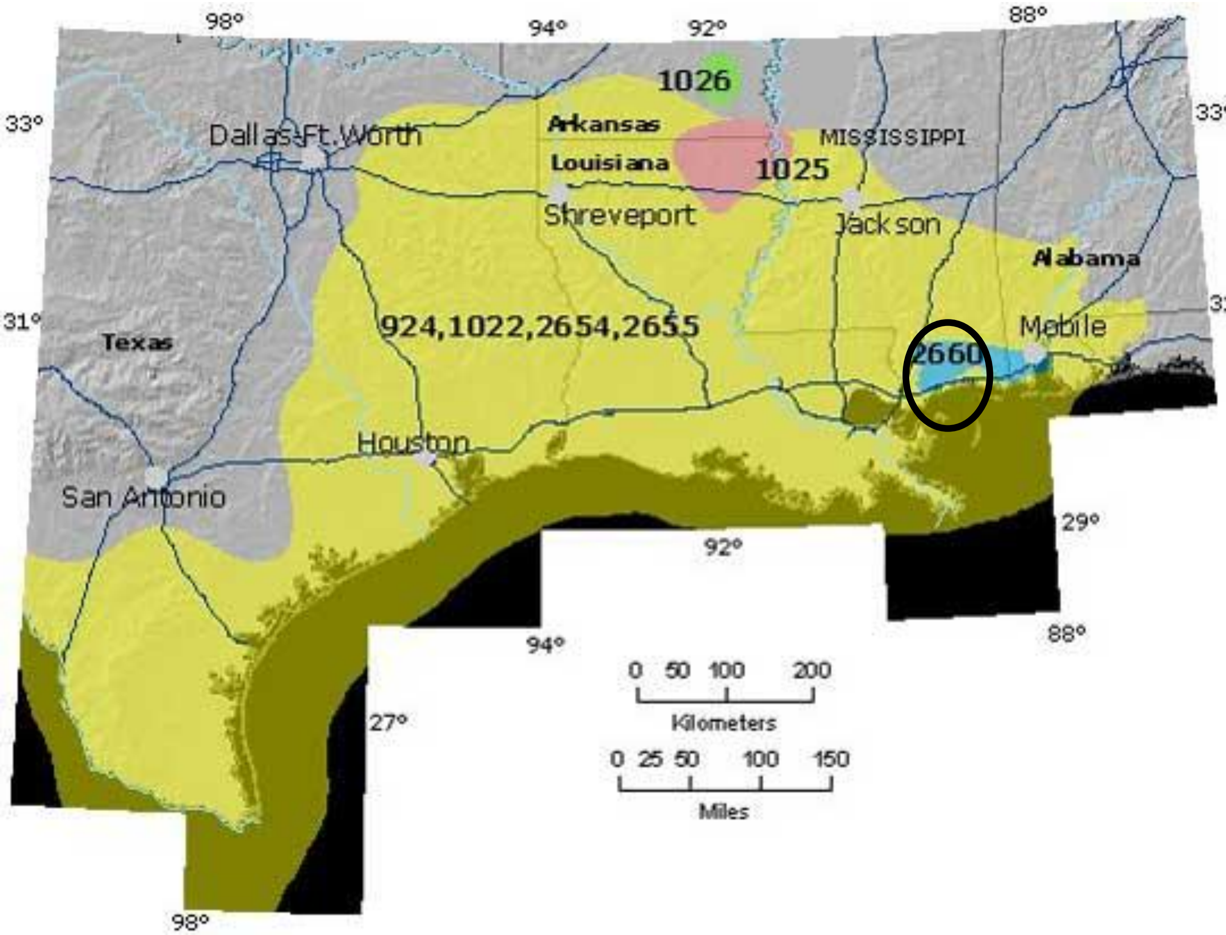
Table 4.12. Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors; by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, and great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: Mississippi Standard Hazard Mitigation Plan 2010

There are a series of seaward facing normal fault lines along the northern Gulf of Mexico from western Florida to Texas, including Mississippi. The Gulf Margin faults along the Mississippi Coast are classified by the USGS as Class B since they have indicated low seismic activity and existing geologic information is unclear on the threat from damaging ground motion. The fault closest to the planning area is the Wiggins uplift (shown on Figure 4.14 as 2660 in blue). Unlike flood and other hazards, there is no specific area in Waveland that would be affected any more or less from the impacts of an earthquake within the region.

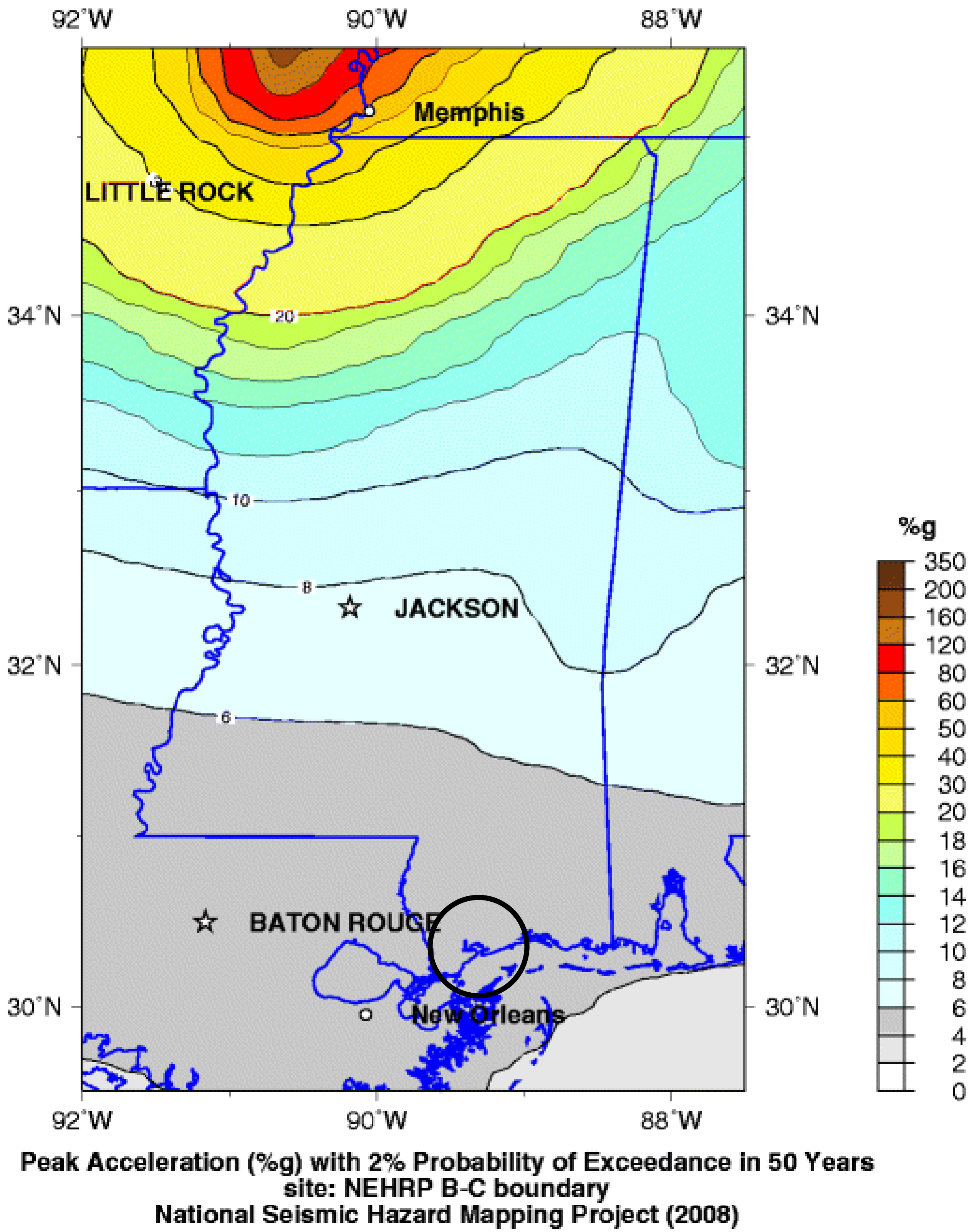
Figure 4.14. Fault Lines in the Waveland Area



Source: USGS

The U.S. Geological Survey (USGS) issues National Seismic Hazard Maps as reports every few years. These maps provide various acceleration and probabilities for time periods. Figure 4.15 depicts the peak horizontal acceleration (%g) with 2% probability of exceedance in 50 years for the planning region. The figure demonstrates that almost all the City falls in the 4%g area (represented by the darker gray shade). This data indicates that the expected severity of earthquakes in the region is fairly limited, as damage from earthquakes typically occurs at peak accelerations of 30%g or greater. However, the potential, though remote, does exist for damaging earthquakes.

Figure 4.15. Seismic Hazard Map of Waveland, 2% Probability of Exceedance in 50 Years



The State of Mississippi Standard Mitigation Plan lists earthquakes as a hazard to the State of Mississippi but focuses their analysis mainly toward the northwestern part of the state due to the juxtaposition of that area to the New Madrid Fault line. Additional geologic research has been conducted by the University of Mississippi to determine location, activity and history of other possible fault lines and their threat to the State.

Past Occurrences

Historically, not many earthquakes are centered within Mississippi and most earthquakes that do originate in Mississippi have a magnitude of 3.5 or less. The State's inventory of earthquakes beginning in 1923 lists only two as originating along the Gulf Coast, see Table 4.13. The USGS lists another earthquake in 2005 that occurred 75 miles to the north and west of the City, and another in 2011 that occurred 95 miles to the west of the City. The 2005 earthquake occurred in Louisiana, so it is not shown in the State of Mississippi Standard Mitigation Plan. The 2011 earthquake occurred after the writing of the State Plan.

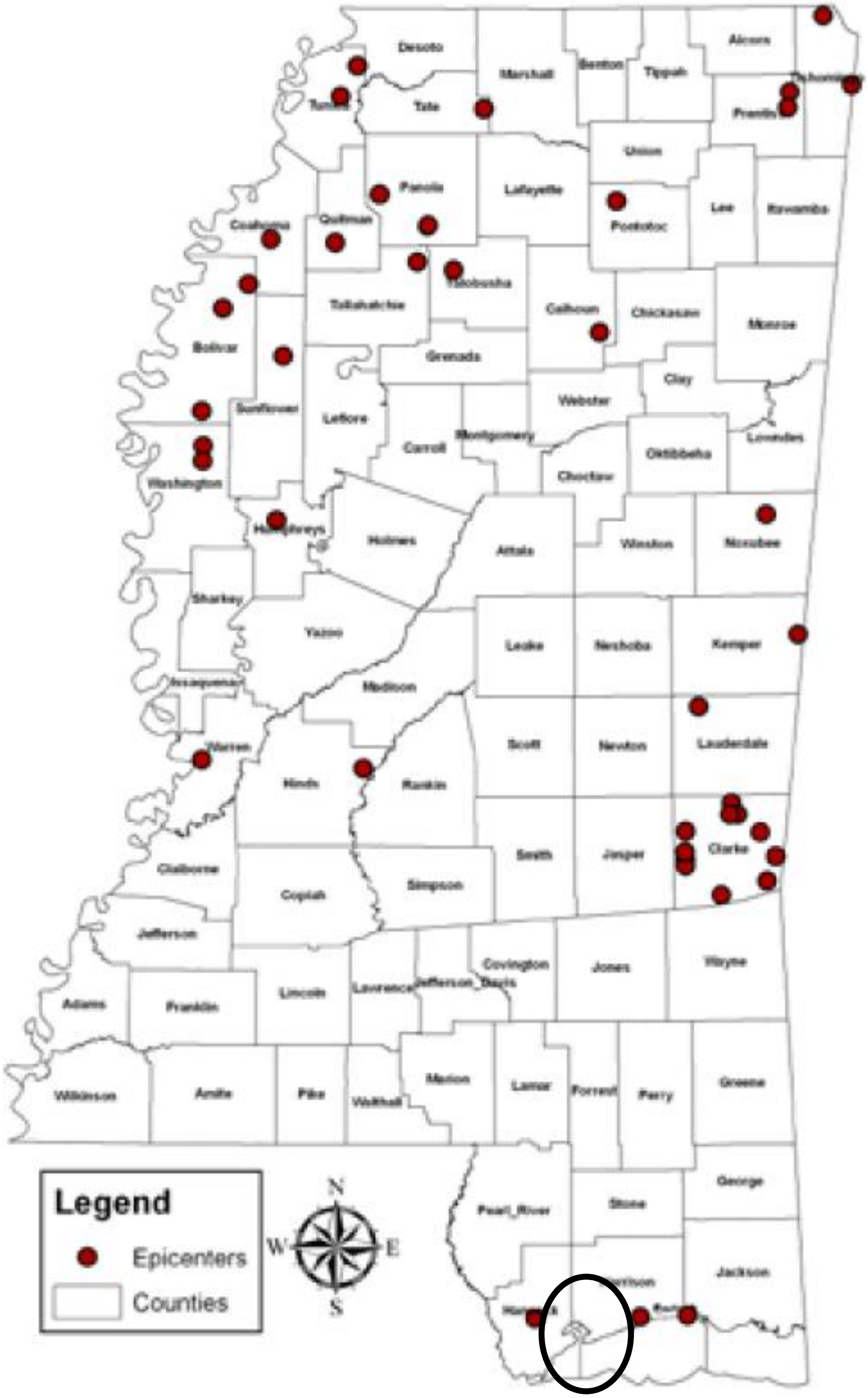
Table 4.13. Earthquakes in the Waveland Area

Date	Origin/Distance	Magnitude	Maximum Intensity
February 1, 1955	30 miles off the coastline	not available	VII
September 9, 1975	Along the Gulf Coast/24 miles from Waveland	2.9	IV
December 20, 2005	Near Hammond, LA/78 miles from Waveland	3.0	III
February 18, 2011	Near Dauphin Island/81 miles from Waveland	3.5	III

Source: State of Mississippi Standard Hazard Mitigation Plan Sec. 3: 248; USGS and MDEQ Office of Geology

Figure 4.16, from the 2010 State Plan, depicts past earthquake occurrences in the Waveland vicinity.

Figure 4.16. Historic Earthquakes near Waveland



Source: 2010 State of Mississippi Hazard Mitigation Plan

No verifiable damage is reported to have occurred with any of the three earthquakes originating along the Gulf Coast. Only reports of dishes rattling and minor shaking has ever been reported in an earthquake affecting the Mississippi Gulf Coast.

Likelihood of Future Occurrence

Occasional—There have been 4 minor earthquakes that have affected Waveland since 1911. There are known faults located on the Gulf Coast and the possibility of future earthquakes is there. The State of Mississippi Standard Mitigation Plan maps three earthquake epicenters along coastal Mississippi, one in central Hancock County (near the City), one on the central Jackson County coastline and one on the coastline at the boundary between Jackson and Harrison Counties. It is possible and probable that an earthquake could occur at any of these three locations. Any earthquake, though rare, should be considered potentially dangerous. The State Plan finds that Hancock County where Waveland is located has a low vulnerability to earthquake activity. The likelihood of future occurrence of a major/damaging earthquake is unlikely.

Climate Change and Earthquake

It is unlikely that climate change will have an effect on earthquakes in the City of Waveland.

4.2.6 Extreme Heat

Hazard/Problem Description

Extreme heat can have severe impacts on human health and mortality and natural ecosystems, as well as agriculture and other economic sectors. For this reason, this hazard is addressed.

Extreme heat is described in the State of Mississippi Standard Mitigation Plan as follows:

> "Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks."

Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. According to the National Weather Service (NWS), among natural hazards, only the cold of winter—not lightning, hurricanes, tornados, floods, or earthquakes—takes a greater toll. In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died.

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop. Elderly persons, small children, chronic invalids, those on certain medications or drugs, and persons with weight and alcohol problems are particularly susceptible to heat reactions, especially during heat waves in areas where moderate climate usually prevails. Figure 4.18 illustrates the relationship of temperature and humidity to heat disorders.

Figure 4.17. National Weather Service's Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	118	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution Extreme Caution Danger Extreme Danger

Source: NOAA National Weather Service Heat Index information

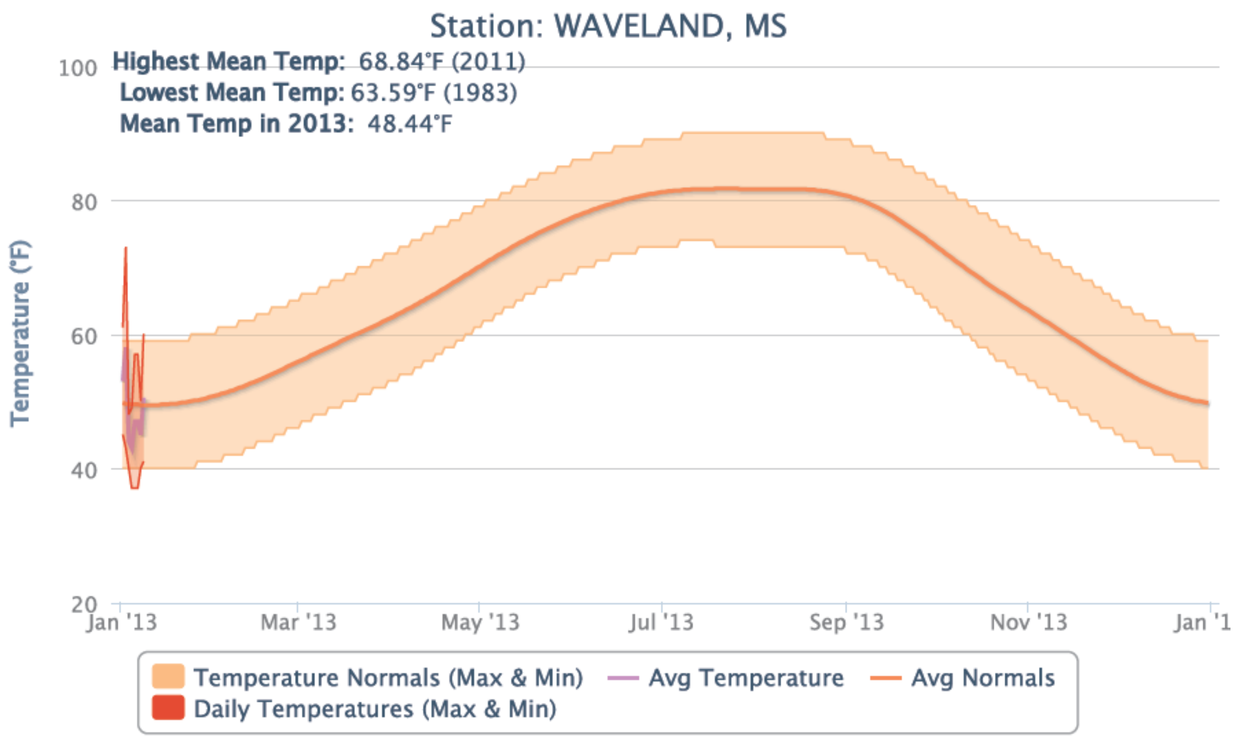
Figure 4.18. National Weather Service's Heat Index

Heat Index	Category	Possible heat disorders for people in high risk groups
130°F or higher	Extreme Danger	Heatstroke risk extremely high with continued exposure.
105° - 129°F	Danger	Sunstroke, Heat Cramps and Heat Exhaustion likely, Heatstroke possible with prolonged exposure and/or physical activity.
90° - 105°F	*Extreme Caution*	*Sunstroke, Heat Cramps and Heat Exhaustion possible with prolonged exposure and/or physical activity.*
80° - 90 °F	Caution	Fatigue possible with prolonged exposure and/or physical activity.

Source: NOAA National Weather Service Heat Index information

Along the Mississippi Coast where Waveland is located, it is not unusual for temperatures to reach and exceed 90° Fahrenheit during June, July, August, and into September (see Figure 4.19). On occasion, the temperature may approach or exceed 100° Fahrenheit. The waterfront location and sub-tropical climate introduces humidity into the air and combined with the temperature, can result in dangerous conditions for strenuous outdoor activity. In weather terms, the combination of heat and humidity is referred to as heat index.

Figure 4.19. Waveland, MS Daily Normal and Extreme Temperatures



Source: Southern Regional Climate Center, Waveland Station

The NOAA National Weather Service has developed a guide for prediction of heat index or the "as felt" temperature that reveals the following:

- A temperature of 90° Fahrenheit with 50% humidity results in heat index or "as felt" temperature of 95° F triggering High Caution for heat related disorders with prolonged outdoor activity.
- A temperature of 90° Fahrenheit with 70% relative humidity results in heat index of 105° F, in the Danger level for heat disorders with prolonged exposure or strenuous activity.
- A temperature of 90° Fahrenheit and relative humidity of 95% results in heat index of 127° F, a temperature considered Extremely Dangerous for likelihood of heat disorders with prolonged exposure or strenuous activity.

Past Occurrences

Neither the NCDC nor SHELDUS reports any extreme temperature events in Waveland. However, temperatures of more than 90° F with relative humidity approaching 70% are not unusual for the Gulf Coast area and Waveland. Most homes and businesses are equipped with air equipment to cool the air to a safer level. These conditions are normal and should be expected every summer.

Likelihood of Future Occurrence

Highly Likely—High heat and relative humidity are normal weather features of the area and will continue to occur every summer of every year. Individual mitigation measures are necessary and used by a majority of the population.

Climate Change and Extreme Heat

Figures 4.4 and 4.5 in Section 4.2.1 are excerpts from the Global Climate Change Impacts report that show the magnitude of the observed and projected changes in annual average temperature. The map for the period around 2000 shows that most areas of the United States have warmed 1 to 2°F compared to the 1960s and 1970s. Although not reflected in these maps of annual average temperature, this warming has generally resulted in longer warm seasons and shorter, less intense cold seasons. The average warming for the country as a whole is shown on the thermometers adjacent to each map. By the end of the century, the average U.S. temperature is projected to increase by approximately 7 to 11°F under the higher emissions scenario and by approximately 4 to 6.5°F under the lower emissions scenario.

4.2.7 Extreme Winter Weather

Hazard/Problem Description

The National Weather Service defines a winter storm as having three factors, cold air, moisture and lift. In terms of weather, these terms can be described in the following manner:

- **Cold Air** – Results from subfreezing temperatures near the ground and in the clouds creating a suitable environment for snow and ice.
- **Moisture** – Necessary in the formation of clouds and precipitation. Air blowing across a body of water is an excellent source of moisture.
- **Lift** – Necessary to raise the moist air to form clouds and cause precipitation. An example of lift is warm air colliding with cold air and rising.

These three factors acting together create conditions suitable for a winter storm. The NWS defined three categories of winter storm events as follows:

- **Heavy Snow**: Two inches or more in a 12 hour period for the southern two thirds of the State and two to four inches or more for 12 hours for the northern one-third of the state.
- **Ice Storm**: Any accumulation of ice ¼ inch or more within a 12- to 24-hour period.
- **Winter Storm**: Any combination of ice or snow above. A mixture of snow and freezing rain would trigger a winter storm warning issued by the NWS.

Severe winter storms can cause immense economic losses to the State of Mississippi. Hampered transportation routes caused by closed or blocked roads, airports, and waterways can prevent the movement of essential economic goods. Other secondary problems included flooding from melting ice and snow, and rainfall on heavily glazed and saturated surfaces. Icy, snow-covered areas can create a hazard to drivers and to walkers with increased accidents. Downed power lines can create a risk of electrocution to residents and to electric power workers. Finally, frozen and broken water lines in homes are not only costly to repair, but create additional hazards from electrocution.

Nearly every winter, hard freeze warnings are issued advising residents to protect exposed pipes, plants and outdoor pets. Additionally, shelter locations are given and those who do not live in heated homes can go to shelters overnight. Temperatures rarely remain below freezing for more than 24 hours.

Past Occurrences

SHELDUS has a longer period of record for tracking winter storms in the City of Waveland than the NCDC. The SHELDUS database identified 16 instances occurring between 1960 and 2010. These are shown in Table 4.14. The table shows winter storms for the entire County. Since extreme winter weather is a regional phenomenon, it can be assumed that affects felt in the County were also felt in the City of Waveland.

Table 4.14. SHELDUS Winter Storms in Hancock County 1960-2010

Hazard Begin Date	Hazard End Date	Hazard Type Combo	Property Damage	Remarks
1/9/1962	1/11/1962	Winter Weather	$60,975.61	Severe Freeze
12/11/1962	12/14/1962	Winter Weather	$0.00	Unusual Cold
1/12/1963	1/29/1963	Winter Weather	$0.00	Ice Storms, Unusually Cold
12/24/1963	12/24/1963	Winter Weather	$60.98	Cold Spell
12/31/1963	12/31/1963	Winter Weather	$909.09	Heavy Snow
12/17/1964	12/19/1964	Winter Weather	$609.76	Sleet, Freezing Rain
3/20/1965	3/21/1965	Winter Weather	$0	Cold
1/29/1966	1/30/1966	Winter Weather	$609.76	Snow And Cold Wave
1/5/1973	1/12/1973	Winter Weather	$6,097.56	Ice Storm
12/24/1983	12/25/1983	Winter Weather	$0	Extreme Cold
2/1/1985	2/2/1985	Winter Weather	$64,102.60	Winter Storm
3/22/1986	3/22/1986	Winter Weather	$0	Late Season Cold
4/3/1987	4/5/1987	Winter Weather	$0	Unusual Cold
4/10/1989	4/10/1989	Winter Weather	$609.76	Late Season Freeze

Hazard Begin Date	Hazard End Date	Hazard Type Combo	Property Damage	Remarks
12/21/1989	12/21/1989	Winter Weather	$6,172.84	Extreme Cold
2/2/1996	2/5/1996	Winter Weather	$12,500.00	Extended Cold

Source: SHELDUS

The HMPC identified one winter storm occurring in Waveland since 1969. Residents remember significant snowfalls in 1964 and the 1940's. The most recent winter storm to affect the City of Waveland was Christmas Day, 2004. Approximately one quarter to one half inch of frozen participation fell across the City. The frozen precipitation stayed on the ground for less than 24 hours. A number of single vehicle accidents were reported, however there were no power outages reported.

The **February 2, 1996** winter weather event was an arctic airmass that affected much of southern Mississippi bringing the longest extended period of cold weather since 1989. Considerable property damage resulted from broken pipes due to the extended period of subfreezing temperatures. ANY CITY PROPERTY AFFECTED?

A low pressure system in the Gulf of Mexico produced snow accumulations of 1 to 2 inches on **December 18, 1996**, however heat from the from the ground and roadways melted the frozen precipitation nearly as quickly as it fell.

Likelihood of Future Occurrences

Likely–Between 1960 and 2010, there were 16 recorded extreme winter weather events for the City. This equates to 26.2% chance of a winter storm event occurring in the City, or a chance of a winter storm event every 3.8 years. The area can expect hard freeze warnings to be issued at least once each winter. No significant damage has been reported due to winter storms in Waveland.

Climate Change and Extreme Winter Weather

Although heat waves will likely become more frequent, there is also the potential for continued cold outbreaks in winter, even in an overall warmer climate. This could possibly increase the risk of the City to extreme winter weather.

4.2.8 Flood 100/500-Year and Localized Flooding

Hazard/Problem Description

Flooding in Waveland can be attributed to four sources: tidal flooding resulting from hurricanes, tropical storms, and other low-pressure systems that originate in the Gulf of Mexico and freshwater flooding from heavy rainfall that overburdens drainage structures in the community.

100-/500-year Flooding

According to the *State of Mississippi Standard Mitigation Plan*, flooding causes 90% of all natural disaster damages in the State. Most of the 288 deaths in Hurricane Katrina were flood related. Flooding can also cause extensive property damage, contributing to significant structural damage and in some cases structural failure from velocity associated with moving water and from saturation from flood waters. In nearly all cases of structural flooding unless personal property is relocated above the anticipated flood stage, it is also at risk.

Flooding is the rising and overflowing of a body of water onto normally dry land. History clearly highlights floods as the most frequent natural hazard impacting the City. Floods are among the most costly natural disasters in terms of human hardship and economic loss nationwide. Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. Floods can be extremely dangerous, and even six inches of moving water can knock over a person given a strong current. A car will float in less than two feet of moving water and can be swept downstream into deeper waters. This is one reason floods kill more people trapped in vehicles than anywhere else. During a flood, people can also suffer heart attacks or electrocution due to electrical equipment short outs. Floodwaters can transport large objects downstream which can damage or remove stationary structures, such as dam spillways. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utilities lines and interrupt services. Standing water can cause damage to crops, road, foundations, and electrical circuits. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts from any type of flooding. Additional information on evacuation and post-disaster mitigation policies and procedures can be found in Section 4.4 of this Risk Assessment.

Certain health hazards are also common to flood events. While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where cattle and hogs are kept or their wastes are stored can contribute polluted waters to the receiving streams.

Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as e. coli and other disease causing agents.

The second type of health problem arises after most of the water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet areas of a building that have not been properly cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

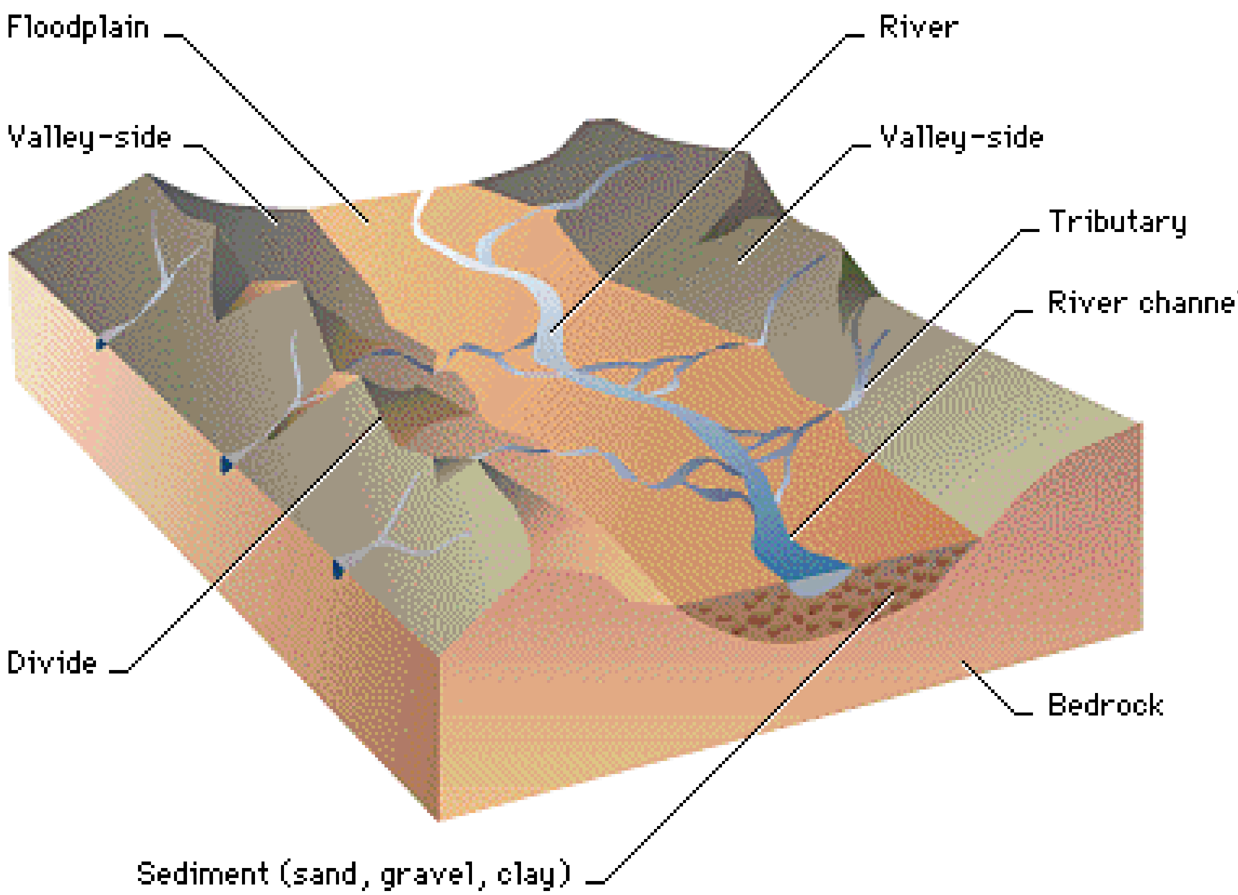
Another health hazard occurs when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If a city or county water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Flooding and Floodplains

The area adjacent to a channel is the floodplain, as shown in Figure 4.20. A floodplain is flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. Floodplains are made when floodwaters exceed the capacity of the main channel or escape the channel by eroding its banks. When this occurs, sediments (including rocks and debris) are deposited that gradually build up over time to create the floor of the floodplain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream.

Figure 4.20. Floodplain Topography



Source: FEMA

In its common usage, the floodplain most often refers to that area that is inundated by the 100-year flood, the flood that has a 1% chance in any given year of being equaled or exceeded. The 100-year flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program (NFIP). The 500-year flood is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity.

The 100-year flood, which is the minimum standard used by most federal and state agencies, is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance. Most of the flood prone counties and incorporated communities on the Gulf Coast participate in the NFIP, including the City of Waveland. Participation in the NFIP requires adoption of a local floodplain management ordinance and its enforcement within a mapped

Special Flood Hazard Area. A jurisdiction's eligibility to participate is premised on their adoption and enforcement of state and community floodplain management regulations intended to prevent unsafe development in the floodplain, thereby reducing future flood damages. Thus, participation in the NFIP is based on an agreement between communities and the federal government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal government will make flood insurance available within the community as a financial protection against flood losses. Since floods have an annual probability of occurrence, have a known magnitude, depth and velocity for each event, and in most cases, have a map indicating where they will occur, they are in many ways often the most predictable and manageable hazard.

Regulated floodplains are illustrated on inundation maps called Digital Flood Insurance Rate Maps (DFIRM) or Flood Insurance Rate Maps (FIRM). It is the official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community. Private citizens and insurance agents use DFIRM's to determine whether or not specific properties are located within flood hazard areas. Community officials use DFIRM's to administer floodplain management regulations and to mitigate flood damage. Lending institutions and federal agencies use DFIRM's to locate properties and buildings in relation to mapped flood hazards, and to determine whether flood insurance is required when making loans or providing grants following a disaster for the purchase or construction of a building.

In Waveland, all flooding can be defined as coastal, drainage or flash flooding. There can also risk to dam and levee failures, discussed separately in Section 4.2.3. Most drainage related flooding results from intrusion of tide water into drainage outlets that prevent drainage structures from operating as efficiently as they are designed to do during heavy rainfall.

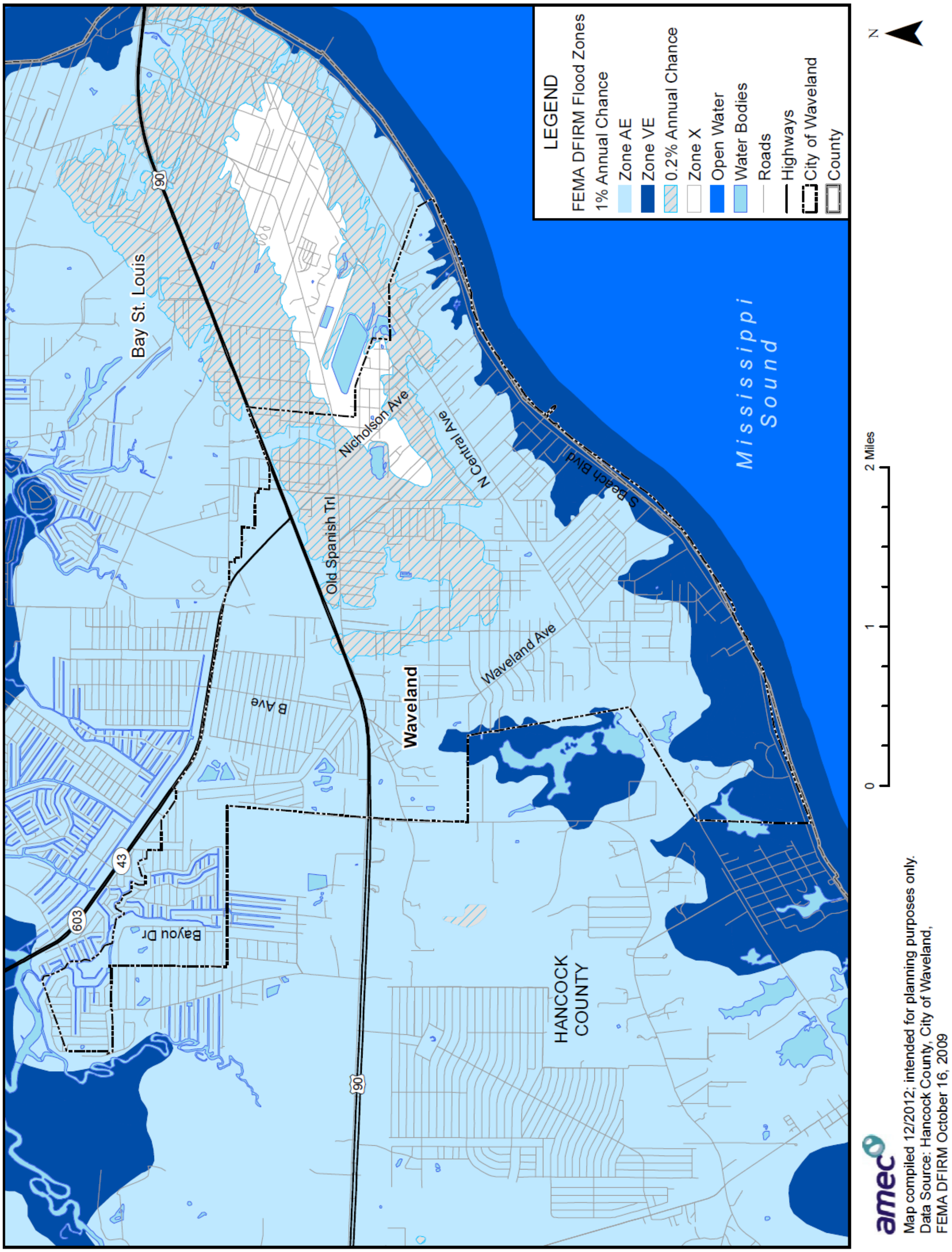
- ***Coastal (Tidal) Flooding***: All lands bordering the Mississippi Sound, bays, estuaries or lakes are prone to tidal affects/flooding. Coastal land such as sand bars, barrier islands and deltas provide a buffer zone to help protect human life and real property relative to the sea much as flood plains provide a buffer zone along rivers and other bodies of water. Coastal floods usually occur as a result of abnormally high tides or tidal waves, storm surge and heavy rains in combination with high tides, tropical storms and hurricanes. (see Section 4.2.9 for more details)
- ***Flash or Rapid Flooding***: Flash flooding is the result of heavy, localized rainfall, possibly from slow-moving intense thunderstorms that cause small streams to overflow. In Waveland, flash floods are most common when rain fall on built-up areas where impervious surfaces, gutters and storm sewers speed up the flow of run-off. These floods can become raging torrents of water that rip through streambeds, streets, and coastal section, sweeping everything in their path.
- ***Drainage***: Drainage flooding occurs primarily in urban or developed areas when the volume of runoff exceeds the capacity of the drainage system. Flooding of this nature can be the

result of increased development, inadequate drainage structures, riverine flooding, coastal flooding or a combination of these causes.

Flooding can occur in coastal Waveland year-around but is most frequent in late spring, summer, and winter. The summer months often bring persistent thunderstorms and late summer the heavy rains associated with tropical storms and hurricanes moving ashore from the Gulf of Mexico are more prevalent. Winter storms originating in the Gulf also account for flooding events. Mean annual rainfall is 61 inches along the Mississippi Coast.

Waveland has sustained flood events severe enough to warrant federal disaster declarations. Table 4.3 in Section 4.1.2 shows the date, cause, designation, and damages as result of the declaration. Flood prone areas are identified within the City of Waveland from the the most current Flood Insurance Study (FIS) and associated DFIRM Maps developed by the FEMA and the NFIP and adopted by ordinance on October 16, 2009. The DFIRM assists the City to manage activity within the floodplain and reduce loss of life and property damage from flooding. The DFIRM for the City is shown on Figure 4.21.

Figure 4.21. Waveland DFIRM Flood Zones



The following Flood Insurance zones are identified by the DFIRM:

- **VE Zone:** also known as the coastal high hazard areas. They are areas subject to high velocity water including waves; they are defined by the 1% annual chance (base) flood limits (also known as the 100-year flood) and wave effects 3 feet or greater. The hazard zone is mapped with base flood elevations (BFEs) that reflect the combined influence of stillwater flood elevations, primary frontal dunes, and wave effects 3 feet or greater.
- **AE Zone:** AE Zones, also within the 100-year flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 100-year flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects.
- **1% Annual Chance (Zone A)**: A Special Flood Hazard Area that corresponds to the 1-percent annual chance floodplains determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations or base flood depths are shown within this zone.
- **0.2% Annual Chance (Zone X)**: Areas of 500 year or 0.2% annual chance of flooding with contributing drainage area of less than one square mile and areas protected by certified levees from the base flood.
- **Zone X (unshaded)**: representing the areas on the FIRM that are located outside the limits of the 500-year flooding. They were formerly mapped and depicted as Zone C

The NFIP utilizes the 100-year flood as a basis for floodplain management. The FIS defines the probability of flooding as flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 100 year period (recurrence intervals). Or considered another way, properties within a 100-year flood zone have a one percent probability of being equaled or exceeded during any given year. Mortgage lenders require that owners of properties with federally-backed mortgages located in Special Flood Hazard Areas (SFHA) purchase and maintain flood insurance policies on their properties. Consequently, newer and recently purchased properties in the community are insured against flooding. Due to the risk of flooding from hurricanes, the City of Waveland has encouraged all owners of property located in the City, even if the property is not located in a SFHA, to purchase and maintain flood insurance policies.

Waveland joined the NFIP on September 11, 1970. Waveland has achieved a Class 5 flood insurance rating through participation in the NFIP's Community Rating System. The present Class 5 rating rewards all National Flood Insurance Program policyholders in the City with a 25 percent reduction in their flood insurance premiums. As of December 1, 2012, there were 1,876 flood insurance policies in force in the City.

Localized Flooding

Localized, stormwater flooding also occurs throughout the City. Urban storm drainpipes and pump stations have a finite capacity. When rainfall exceeds this capacity, or the system is clogged, water accumulates in the street until it reaches a level of overland release. This type of flooding may occur when intense storms occur over the City. In addition to flooding, damage to these areas during heavy storms includes pavement deterioration, washouts, debris areas, and downed trees. The frequency and type of damage or flooding that occurs varies from year to year, depending on the quantity of runoff.

According to the HMPC, numerous parcels and roads throughout the City both included and not included in the FEMA 100- and 500-year floodplains are subject to flooding in heavy rains. Most of the land within the City limits of Waveland has a gentle slope as the City sits atop a coastal ridge with elevations averaging between 10 and 15 feet National Geodetic Vertical Datum (NGVD). There are very few areas that have a slope greater than 5% and these areas occur adjacent to the railroad tracks and the canals. Due to the gentle slope of the land, water drains slowly and has a tendency to pond during heavy rains. Many residents have expressed concern regarding thoroughfares ponding after rainfall

Grand Bayou and its tributaries are two primary sources of flooding during periods of heavy rainfall. Other flat, poorly drained areas of the community experience ponding during heavy rainfall include:

- Nicholoson Avenue - Exxon & 90 - 100 Block on Beach
- Waveland Avenue - 100 Beach - Highway 90
- South Central Avenue - 100 Colman Avenue -Waveland Avenue & Central
- North Central Avenue - City line past Lakewood Drive - Colman Avenue
- Old Spanish Trail Highway 90 - Nicholson Avenue
- Waveland Beach Boulevard from Bay Oak Drive to Clermont Boulevard
- South Street to Clermont Boulevard
- Highway 603 at the Log Cabins between Avenue B and Kiln-Waveland Cutoff Road

THESE ARE FROM A FEMA HURRICANE ANALYSIS. ARE THERE OTHER AREAS?

Past Occurrences

Flooding can occur in Waveland year-around but is most frequent in late spring, summer, and winter. The summer months often bring persistent thunderstorms and late summer the heavy rains associated with tropical storms and hurricanes moving ashore from the Gulf of Mexico are more prevalent. Winter storms originating in the Gulf also account for flooding events. Mean annual rainfall is 61 inches along the Mississippi Coast. Past occurrences for tropical storm and hurricane can be found in Section 4.2.9.

Table 4.15 shows the flood events from causes other than hurricanes reported by the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) since 1995 for the City of Waveland. Table 4.16 shows SHELDUS events related to flooding. This database covers from 1960 to 2010, but records only County level events.

Table 4.15. NCDC Flooding in Hancock County and Waveland –1995 to September 30, 2012

Location	Date	Cause	Type	Injuries/ Deaths	Damages
Citywide*	5/8-5/9/95	Spring Storm	Flash Flood	0/0	$0
Coastal Area*	7/29/95	Tropical Storm	Coastal Flood	0/0	$0
Countywide	4/11/1995	Spring Storm	Urban/Small Stream Flood	0/0	$0
Citywide	5/19/97	Spring Storm	Flash Flood	0/0	$100,000
Citywide	1/7/98	Winter Storm	Flash Flood	0/0	$10,000
Citywide	3/7/98	Winter Storm	Flash Flood	0/0	$0
Countywide	6/11/01	Heavy Rainfall	Urban/Small Stream Flood	0/0	$0
Citywide	9/26/02	Heavy Rainfall	Flash Flood	0/0	$0
Citywide	6/30/03	Tropical Storm	Flash Flood	0/0	500,000
Citywide*	7/1/03	Tropical Storm	Flood	0/0	$1,000,000
Coastal Area	5/29/05	Heavy Rainfall	Flash Flood	0/0	$0
Citywide	12/12/2009	Heavy Rainfall	Flash Flood	0/0	$0
Citywide	3/9/2011	Heavy Rainfall	Flash Flood	0/0	$0

Source: NCDC

*These events were listed in the NCDC database search in the last plan. They are included here as well.

Table 4.16. SHELDUS Flooding in Waveland –1960 to 2010

Date	Hazard Type	Injuries	Fatalities	Property Damage	Remarks
12/24/1973	Flooding - Severe Storm/Thunder Storm	0	0	$9,090.91	Heavy Rain, Flooding
4/11/1974	Flooding	0.14	0.14	$0.00	Flood
10/15/1975	Flooding - Severe Storm/Thunder Storm	0	0	$847.46	Heavy Rains, Flooding
11/21/1977	Flooding - Severe Storm/Thunder Storm	0	0	$6,097.56	Heavy Rain, Flood
5/2/1978	Flooding - Severe Storm/Thunder Storm	0	0	$71,428.57	Heavy Rains, Flooding
5/7/1978	Flooding - Severe Storm/Thunder Storm	0	0	$60,975.61	Heavy Rains, Flooding
1/18/1979	Flooding - Severe Storm/Thunder Storm	0	0	$60,975.61	Heavy Rain Flooding
3/2/1979	Flooding - Severe Storm/Thunder Storm	0	0	$263,157.89	Heavy Rain, Flooding

Date	Hazard Type	Injuries	Fatalities	Property Damage	Remarks
4/12/1979	Flooding	0	0	$21,739,130.43	River Flooding
4/1/1980	Flooding - Severe Storm/Thunder Storm	0	0	$60,975.61	Rain, Flood
4/11/1980	Flooding - Severe Storm/Thunder Storm	0	0	$1,666,666.67	Rain, Flood
12/1/1982	Flooding	0	0	$60,975.60	Flooding
1/20/1983	Flooding	0	0	$1,666,666.67	Coastal Flood
4/6/1983	Flooding	0	0	$2,083,333.33	Flood
4/6/1983	Flooding	0	0	$50,000.00	Flood
5/18/1983	Flooding	0	0	$6,250,000.00	Flood
2/2/1990	Flooding	0	0	$182,926.83	Flooding
4/1/1991	Flooding	0	0	$6,097.56	Flood
5/1/1991	Flooding	0	0	$609,756.10	Flood
5/19/1997	Flooding	0	0	$100,000.00	Floods
1/7/1998	Flooding	0	0	$10,000.00	Flash Flood
6/30/2003	Flooding	0	0	$500,000.00	
6/30/2003	Flooding	0	0	$500,000.00	Flash Flood
7/1/2003	Flooding	0	0	$250,000.00	Flood
9/2/2011	Flooding	0	0	$10,000.00	

Source: SHELDUS

The following provides details on the flood events detailed in the NCDC database and from members of the HMPC.

May 8th and 9th, 1995 - Eight to eleven inches of rain fell across the south and central sections of the county. The Waveland/Bay St. Louis area recorded 11.81 inches of rain overnight. Extensive flooding in poorly drained areas was reported with some structures reporting flooding. Flooding was also reported along the Jordan River.

May 19th, 1997 - Thunderstorm persisted over the same region of coastal Mississippi producing torrential rainfall. A National Weather Service cooperative observer in Waveland recorded 7.75 inches of rain during the afternoon and evening hours. Hancock County civil defense reported up to 12 inches of rain in some areas. Civil Defense officials reported approximately 60 houses had some type of flooding along with 12 businesses.

January 7th, 1998 - Widespread rains of 3 to 5 inches occurred across the region during the morning hours. Considerable runoff occurred due to saturated soil from heavy rain during the previous two days resulted in widespread flooding of streets and secondary roadways.

March 7th, 1998 - Heavy rainfall of 4 to 6 inches occurred during the late morning and afternoon of March 7 along the Mississippi Coast. The soil was already saturated from 1.5 to 3 inches of rain that had occurred the previous day, therefore there was extensive runoff. Widespread street flooding was reported in many communities, especially near the the coast. Strong southerly winds resulted in above normal tides along the coast which restricted runoff from drainage canals and small streams into the Gulf. A number of houses in each county were flooded with Harrison County reporting 75 to 80 houses flooded along with some residents evacuated.

September 26th, 2002 - Tropical Storm Isidore made landfall near Grand Isle, Louisiana during the early morning of September 26th. Rainfall amounts associated with Isidore were generally 5 to 8 inches and resulted in some river flooding and flash flooding. Approximately 2,500 homes in Hancock County were flooded, primarily as the result of storm surge, with river flooding and flash flooding causing some of the flood damage. In addition, around 300 businesses in Harrison County received flood damage. Evacuation of approximately 40 people in Hancock County occurred early on September 26, 2002 to rescue people in areas flooded by storm surge.

May 29th, 2005 – Heavy rainfall of 3 to 5 inches within several hours caused significant flooding of a number of roadways in southern Hancock County.

October 22nd, 2007 – Widespread heavy rain fell across across south Mississippi in advance of a deep upper level low pressure system and a strong cold front. Rainfall amounts ranging from three to eight inches were common across Hancock County. Street flooding was widespread and a number of vehicles, homes, and businesses were flooded.

March 28th, 2009 – Several episodes of widespread severe weather and heavy rainfall occurred from March 26th through the 28th as a series of strong upper air disturbances impacted the central gulf region as a meandering and nearly stationary frontal boundary drifted back and forth across the area. Portions of U.S. Highway 90 around Waveland were flooded due to heavy rainfall.

December 12th, 2009 – Moderate to locally heavy rainfall occurred across sections of the Mississippi coast as an upper air disturbance acted on deep moisture in place across the Gulf Coast. The rain fell on nearly saturated ground resulting in some flash flooding. Heavy rainfall resulted in widespread and significant street flooding in the Waveland and Bay St. Louis areas.

March 9th, 2011 – Thunderstorms in advance of a strong cold front produced numerous reports of flooding and severe weather on the afternoon of the 8th through the morning of the 9th. Some street flooding was reported on Chapman Road and along Harrison Avenue.

June 30th, 2010 - The large scale wind circulation associated with Hurricane Alex caused tides 1 to 2 feet above normal along the Mississippi coastline, resulting in minor flooding in a few locations. Heavy rainfall also produced isolated flooding near the coast. Water on Kiln-Delisle Road with water reported up to window level on vehicles.

Frequency/Likelihood of Future Occurrence

100-/500-year Flood

Occasional—By definition, the City of Waveland has a 1 percent chance of a 100-year or significant flood being equaled or exceeded in any given year.

Localized Flooding

Highly Likely—Based on historical data and input from the HMPC, flooding events less severe than a 100-year flood and those outside of the 100-year floodplain occur on an annual basis in the City during periods of heavy rains. Tidal flooding from tropical storms and depressions can be expected to occur every other year. Due to the low elevations, flat terrain and tidal influence on drainage unusually heavy rainstorms and any tropical storm, hurricane or other storm-tide producing event will flood unmitigated properties in Waveland. Due to its location on the shores of the Mississippi Sound, the area's susceptibility to hurricanes and other tropical disturbances originating in the Gulf of Mexico, and the high rate of annual rainfall, there is a 100 percent chance that flooding will continue to occur from time to time. Therefore, the likelihood of future occurrence of localized flooding is highly likely.

Climate Change and Flooding/Localized Flooding

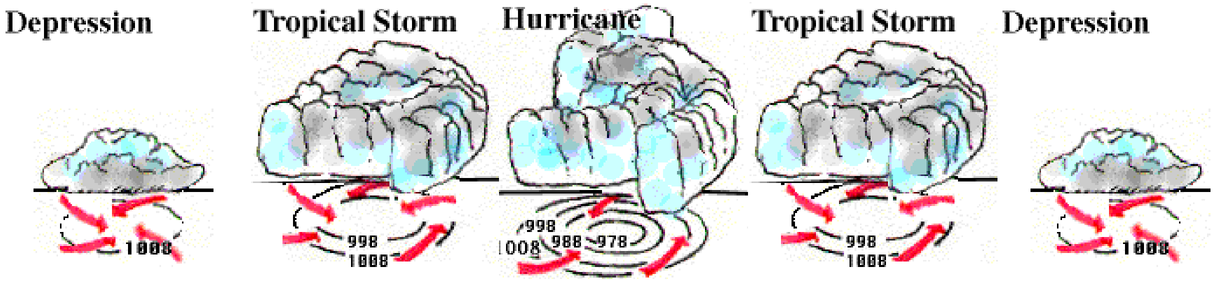
Climate change and sea level rise may affect flooding in the City of Waveland. While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events. Projected changes in surface water runoff to the coast and groundwater recharge will likely allow saltwater to intrude and mix with shallow aquifers in some coastal areas of the Southeast, particularly in Florida and Louisiana.

4.2.9 Hurricane and Tropical Storm (including Coastal Storm Surge)

Hazard/Problem Description

Hurricanes evolve through a life cycle of stages from birth to death. A hurricane begins as a tropical depression. A tropical depression in time can grow to a tropical storm by attaining sustained 34 mph wind speeds. At this point, the tropical storm is named. Tropical storms, in turn, organize and intensify and can continue to grow to become hurricanes. Once a hurricane matures and begins to dissipate (either over the ocean or after the hurricane has made landfall), it is downgraded to a tropical storm, and finally to a tropical depression before dying out completely. The progression of tropical disturbances can be seen in Figure 4.22.

Figure 4.22. Life Cycle of a Hurricane



Source: Department of Atmospheric Sciences at the University of Illinois at Urbana-Champaign

This section of the plan profiles tropical storms, hurricanes, and coastal storm surge.

Tropical Storm

Tropical depressions and tropical storms affect the City of Waveland. Both are categorized by the National Weather Service as a tropical cyclone. The differentiation between these two is wind speed and organization:

- **Tropical Depression** - a tropical cyclone in which the maximum 1-minute sustained surface wind is 33 knots (38 mph) or less. When viewed from a satellite, tropical depressions appear to have little organization. However, the slightest amount of rotation can usually be perceived when looking at a series of satellite images. Instead of a round appearance similar to hurricanes, tropical depressions look like individual thunderstorms that are grouped together.
- **Tropical Storm** - a tropical cyclone in which the maximum 1-minute sustained surface wind ranges from 34 to 63 knots (39 to 73 mph) inclusive. As the storm transitions from tropical depression to tropical storm, the storm itself becomes more organized and begins to become more circular in shape - resembling a hurricane.

Each are warm-core, non-frontal, synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation above a well-defined center. Once formed, a tropical cyclone is maintained by the extraction of heat energy from the ocean at high temperature and heat export at the low temperatures of the upper troposphere. Tropical storms can cause problems even without becoming a hurricane. However, most of the problems a tropical storm cause stem from heavy rainfall. Table 4.18 shows the tropical storms that have made landfall in Waveland and their affects on the City. Tropical storms, while a hazard on their own, often bookend hurricanes, as seen in Figure 4.22.

Hurricane

A hurricane is a warm-air tropical cyclone with pronounced rotary circulation around the "eye" or "core" in which maximum sustained surface wind is at least 74 mph (64 knots). Hurricanes are classified by intensity into one of five categories on the Saffir/Simpson Scale. The

Saffir/Simpson Scale, shown in Table 4.17, is used to give an estimate of the potential property damage and flooding expected along the coast from hurricane landfall.

Table 4.17. Saffir/Simpson Hurricane Wind Scale 2010*

Scale Number (Category)	Wind Speed (mph)	Potential Damage
1	74-95	Moderate
2	96-110	Extensive
3	111-130	Devastating
4	131-155	Catastrophic
5	>155	Catastrophic

Source: National Hurricane Center
*Unlike earlier versions, the most recent Saffir/Simpson Scale does not address the potential for other hurricane-related impacts such as storm surge, rainfall-induced floods and tornadoes. It should also be noted that to some degree the general damage descriptions are dependent upon the local building codes in effect and how well they have been enforced.

Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline in the landfall region. The following describes the characteristics of each category storm:

Category 1 Hurricane - Winds 74 – 95 mph. Very dangerous winds will produce some damage.

People, livestock, and pets struck by flying or falling debris could be injured or killed. Older (mainly pre-1994 construction) mobile homes could be destroyed, especially if they are not anchored properly as they tend to shift or roll off their foundations. Newer mobile homes that are anchored properly can sustain damage involving the removal of shingle or metal roof coverings, and loss of vinyl siding, as well as damage to carports, sunrooms, or lanais. Some poorly constructed frame homes can experience major damage, involving loss of the roof covering and damage to gable ends as well as the removal of porch coverings and awnings. Unprotected windows may break if struck by flying debris. Masonry chimneys can be toppled. Well-constructed frame homes could have damage to roof shingles, vinyl siding, soffit panels, and gutters. Failure of aluminum, screened-in, swimming pool enclosures can occur. Some apartment building and shopping center roof coverings could be partially removed. Industrial buildings can lose roofing and siding especially from windward corners, rakes, and eaves. Failures to overhead doors and unprotected windows will be common. Windows in high-rise buildings can be broken by flying debris. Falling and broken glass will pose a significant danger even after the storm. There will be occasional damage to commercial signage, fences, and canopies. Large branches of trees will snap and shallow rooted trees can be toppled. Extensive damage to power lines and poles will likely result in power outages that could last a few to several days. Hurricane Dolly (2008) is an example of a hurricane that brought Category 1 winds and impacts to South Padre Island, Texas.

Category 2 Hurricane - Winds 96-110 mph. Extremely dangerous winds will cause extensive damage.

There is a substantial risk of injury or death to people, livestock, and pets due to flying and falling debris. Older (mainly pre-1994 construction) mobile homes have a very high chance of being destroyed and the flying debris generated can shred nearby mobile homes. Newer mobile homes can also be destroyed. Poorly constructed frame homes have a high chance of having their roof structures removed especially if they are not anchored properly. Unprotected windows will have a high probability of being broken by flying debris. Well-constructed frame homes could sustain major roof and siding damage. Failure of aluminum, screened-in, swimming pool enclosures will be common. There will be a substantial percentage of roof and siding damage to apartment buildings and industrial buildings. Unreinforced masonry walls can collapse. Windows in high-rise buildings can be broken by flying debris. Falling and broken glass will pose a significant danger even after the storm. Commercial signage, fences, and canopies will be damaged and often destroyed. Many shallowly rooted 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. Potable water could become scarce as filtration systems begin to fail. Hurricane Frances (2004) is an example of a hurricane that brought Category 2 winds and impacts to coastal portions of Port St. Lucie, Florida with Category 1 conditions experienced elsewhere in the city.

Category 3 Hurricane - Winds 111-130 mph. Devastating damage will occur.

There is a high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) mobile homes will be destroyed. Most newer mobile homes will sustain severe damage with potential for complete roof failure and wall collapse. Poorly constructed frame homes can be destroyed by the removal of the roof and exterior walls. Unprotected windows will be broken by flying debris. Well-built frame homes can experience major damage involving the removal of roof decking and gable ends. There will be a high percentage of roof covering and siding damage to apartment buildings and industrial buildings. Isolated structural damage to wood or steel framing can occur. Complete failure of older metal buildings is possible, and older unreinforced masonry buildings can collapse. Numerous windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Most commercial signage, fences, and canopies will be destroyed. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to a few weeks after the storm passes. Hurricane Ivan (2004) is an example of a hurricane that brought Category 3 winds and impacts to coastal portions of Gulf Shores, Alabama with Category 2 conditions experienced elsewhere in this city.

Category 4 Hurricane - Winds 131 to 155 mph. Catastrophic damage will occur.

There is a very high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) mobile homes will be destroyed. A high percentage of newer mobile homes also will be destroyed. Poorly constructed homes can sustain complete collapse of all walls as well as the loss of the roof structure. Well-built homes also can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Extensive damage to roof coverings, windows, and doors will occur. Large amounts of windborne debris will be lofted into the air. Windborne debris damage will break most unprotected windows and penetrate some protected windows. There will be a high percentage of structural damage to the top floors of apartment buildings. Steel frames in older industrial buildings can collapse. There will be a high percentage of collapse to older unreinforced masonry buildings. Most windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Nearly all commercial signage, fences, and canopies will be destroyed. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Long-term water shortages will increase human suffering. Most of the area will be uninhabitable for weeks or months. Hurricane Charley (2004) is an example of a hurricane that brought Category 4 winds and impacts to coastal portions of Punta Gorda, Florida with Category 3 conditions experienced elsewhere in the city.

Category 5 Hurricane - Winds greater than 155 mph. Catastrophic damage will occur.

People, livestock, and pets are at very high risk of injury or death from flying or falling debris, even if indoors in mobile homes or framed homes. Almost complete destruction of all mobile homes will occur, regardless of age or construction. A high percentage of frame homes will be destroyed, with total roof failure and wall collapse. Extensive damage to roof covers, windows, and doors will occur. Large amounts of windborne debris will be lofted into the air. Windborne debris damage will occur to nearly all unprotected windows and many protected windows. Significant damage to wood roof commercial buildings will occur due to loss of roof sheathing. Complete collapse of many older metal buildings can occur. Most unreinforced masonry walls will fail which can lead to the collapse of the buildings. A high percentage of industrial buildings and low-rise apartment buildings will be destroyed. Nearly all windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Nearly all commercial signage, fences, and canopies will be destroyed. Nearly all trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Long-term water shortages will increase human suffering. Most of the area will be uninhabitable for weeks or months. Hurricane Andrew (1992) is an example of a hurricane that brought Category 5 winds and impacts to coastal portions of Cutler Ridge, Florida with Category 4 conditions experienced elsewhere in south Miami-Dade County.

All categories of storms feature property damaging high winds, storm surge flooding, and pounding surf that results in land subsidence and infrastructure damage. They produce torrential rainfall that can cause fresh water flooding many miles inland from the point of landfall. Depending upon the size of the storm, communities located within 100 or more miles inland from of the point of landfall may sustain measurable damage from the wind, tide, or rainfall associated with a hurricane. Since the impact of hurricanes is so widespread, and damage can result from any or all of the aforementioned, an attempt is made to identify the impacts of each of the hazards within the hazard identified as hurricanes and tropical storms.

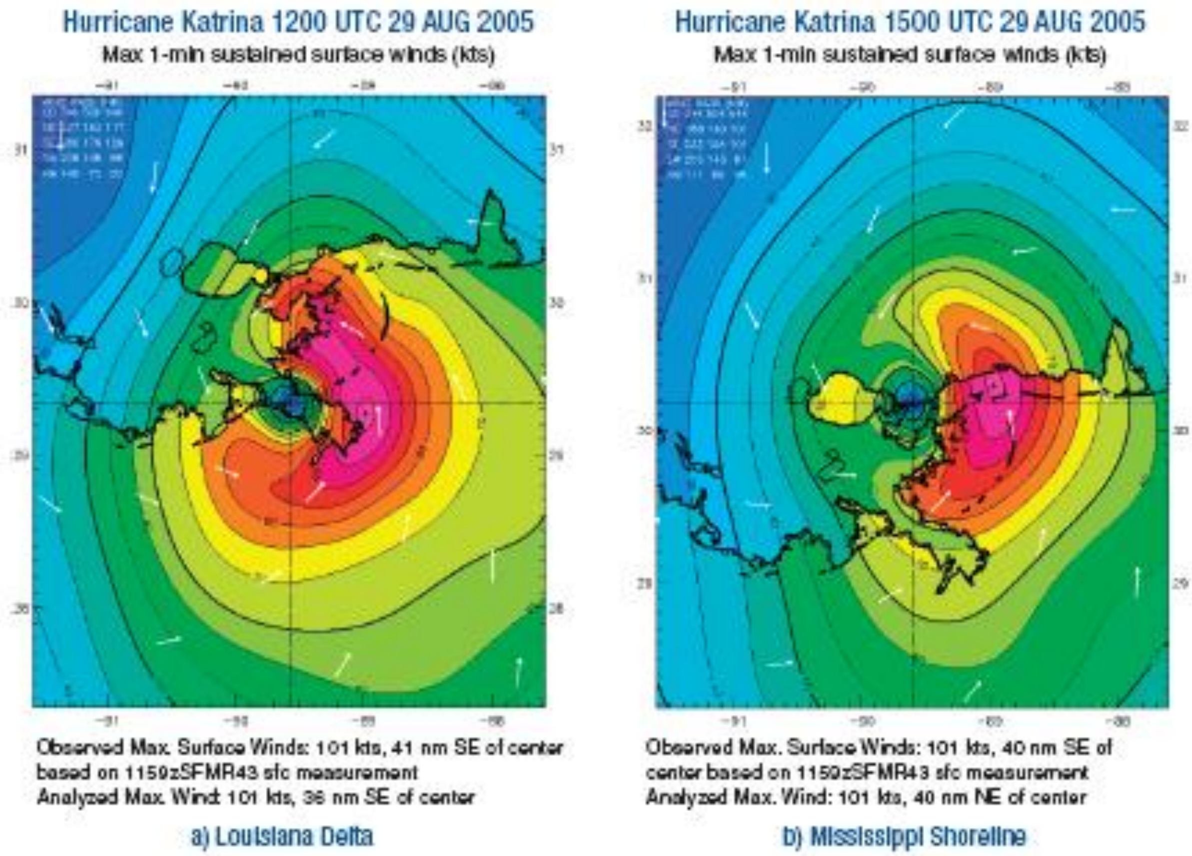
The greatest threat to life and property in Waveland would occur if a Category 5 hurricane directly struck the City. The potential damages to public and private property was modeled by the State of Mississippi in its Hazard Mitigation Plan using HAZUS-MH and revealed that the greatest loss would occur across the Mississippi Gulf Coast and adjoining northern counties if the point of impact were Harrison County, immediately to the east of Hancock County. The greatest loss to the City would occur if Hancock County was struck by a Category 5 hurrricane.

Hurricane Katrina was the most damaging storm to strike Waveland and Hancock County in the past century. According to the Mitigation Assessment Team Report, Hurricane Katrina in the Gulf Coast, Building Performance Observations, Recommendations, and Technical Guidance (FEMA 549/July 2006), Hurricane Katrina was very large storm with hurricane force wind speeds covering approximately 200 miles in diameter as it neared shore and landfall. Within one hour of landfall and within 100 miles of the coastline, Katrina's wind speeds and central pressure were that of a Category 5 hurricane.

According to the National Weather Service (NWS) post-Katrina report issued on December 20, 2005, when the hurricane made its second landfall at Buras, Louisiana, it packed an estimated one-minute sustained wind speed of 110 knots (127 mph) with approximately 150 mph three-second gusts. After landfall in Louisiana, Katrina traveled over the Mississippi River Delta and Breton Sound before reaching the Mississippi coast, its third landfall (one in Florida, one in Louisiana, and one in Mississippi). The NWS estimated one-minute sustained surface winds of 105 knots (120 mph) or approximately 145 mph three-second gusts at landfall in Mississippi.

The NWS estimates were higher than any recorded by land-based instruments. The highest land-based wind speed was recorded at 117 mph by a Texas Tech University tower located at Stennis International Airport approximately 8 miles inland, north of Waveland, and more than 10 miles east of the actual landfall. Most other land-based anemometers either failed before they recorded maximum winds or were located great distances from the storm's path. As a result, no wind speed instruments likely recorded the maximum winds produced by Katrina. Figure 4.23 depicts maximum sustained winds in Waveland and the surrounding area.

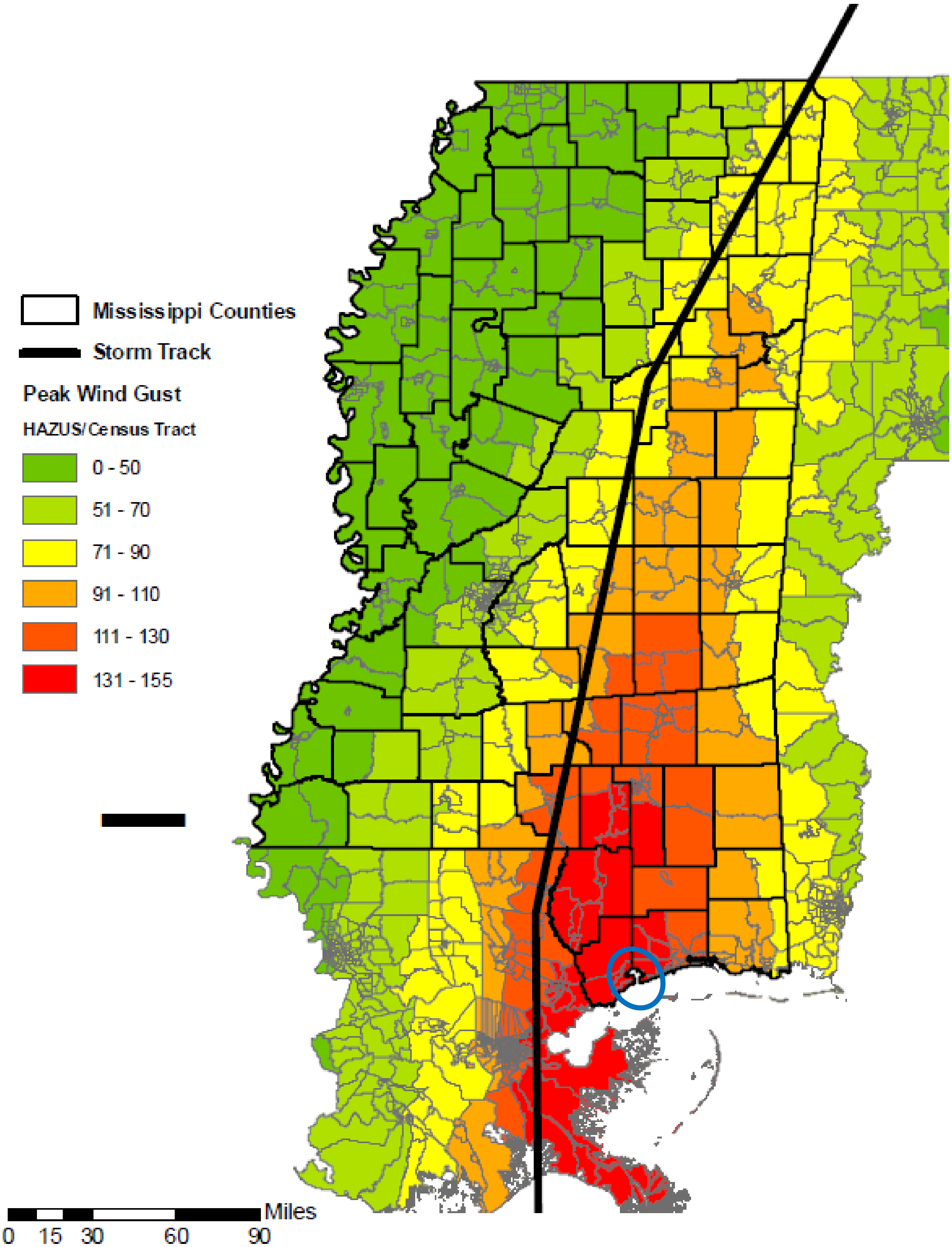
Figure 4.23. High Winds in the Waveland Area during Hurricane Katrina



Source: FEMA, Mitigation Assessment Team Report: Hurricane Katrina in the Gulf Coast

Winds of up to 100 mph were experienced in Hattiesburg, Jackson, and Laurel, Mississippi with hurricane force winds as far north as Amory, MS (see Figure 4.24). When the storm exited the northeast corner of Mississippi into Tennessee, wind speeds were recorded between 60 and 70 mph. Hundreds of thousands of acres of forest was damaged, and downed trees caused power outages lasting for up to several weeks in some areas. Property damaging F1 and F2 tornadoes spawned by Katrina were confirmed in Forrest County in the Hattiesburg area and in Newton, Lauderdale, Kemper, and Leake Counties as Katrina blew through the east-central area of the state. According to the assessment report, the anemometer was blown down at Laurel-Jones County Airport, and wind speed recording ceased in Jackson and Hattiesburg when power was lost, disabling wind measuring instruments at the height of the storm.

Figure 4.24. Peak Gusts of Hurricane Katrina



Source: State of Mississippi Hazard Mitigation Plan

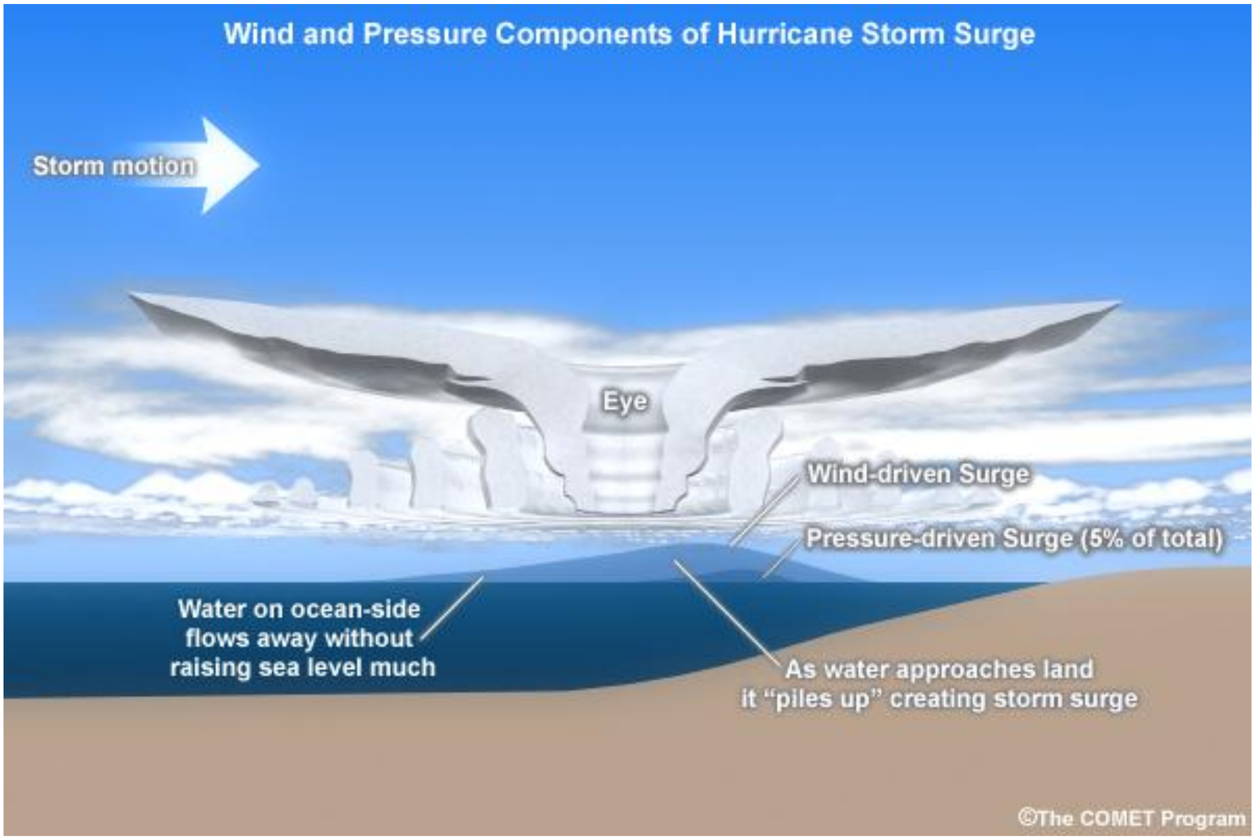
Coastal Storm Surge

According to the NOAA National Hurricane Center, along the coast, storm surge is often the greatest threat to life and property from a hurricane. In the past, large death tolls have resulted from the rise of the ocean associated with many of the major hurricanes that have made landfall. Hurricane Katrina (2005) is a prime example of the damage and devastation that can be caused by surge. At least 1,500 persons lost their lives during Katrina and many of those deaths occurred directly, or indirectly, as a result of storm surge.

Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides. This rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides reaching up to 20 feet or more in some cases.

Storm surge is produced by water being pushed toward the shore by the force of the winds moving cyclonically around the storm (see Figure 4.25). The impact on surge of the low pressure associated with intense storms is minimal in comparison to the water being forced toward the shore by the wind. The maximum potential storm surge for a particular location depends on a number of different factors. Storm surge is a very complex phenomenon because it is sensitive to the slightest changes in storm intensity, forward speed, size, angle of approach to the coast, central pressure, and the shape and characteristics of coastal features such as bays and estuaries. Other factors which can impact storm surge are the width and slope of the continental shelf. A shallow slope will potentially produce a greater storm surge than a steep shelf.

Figure 4.25. How Storm Surge is Created



Source: NOAA

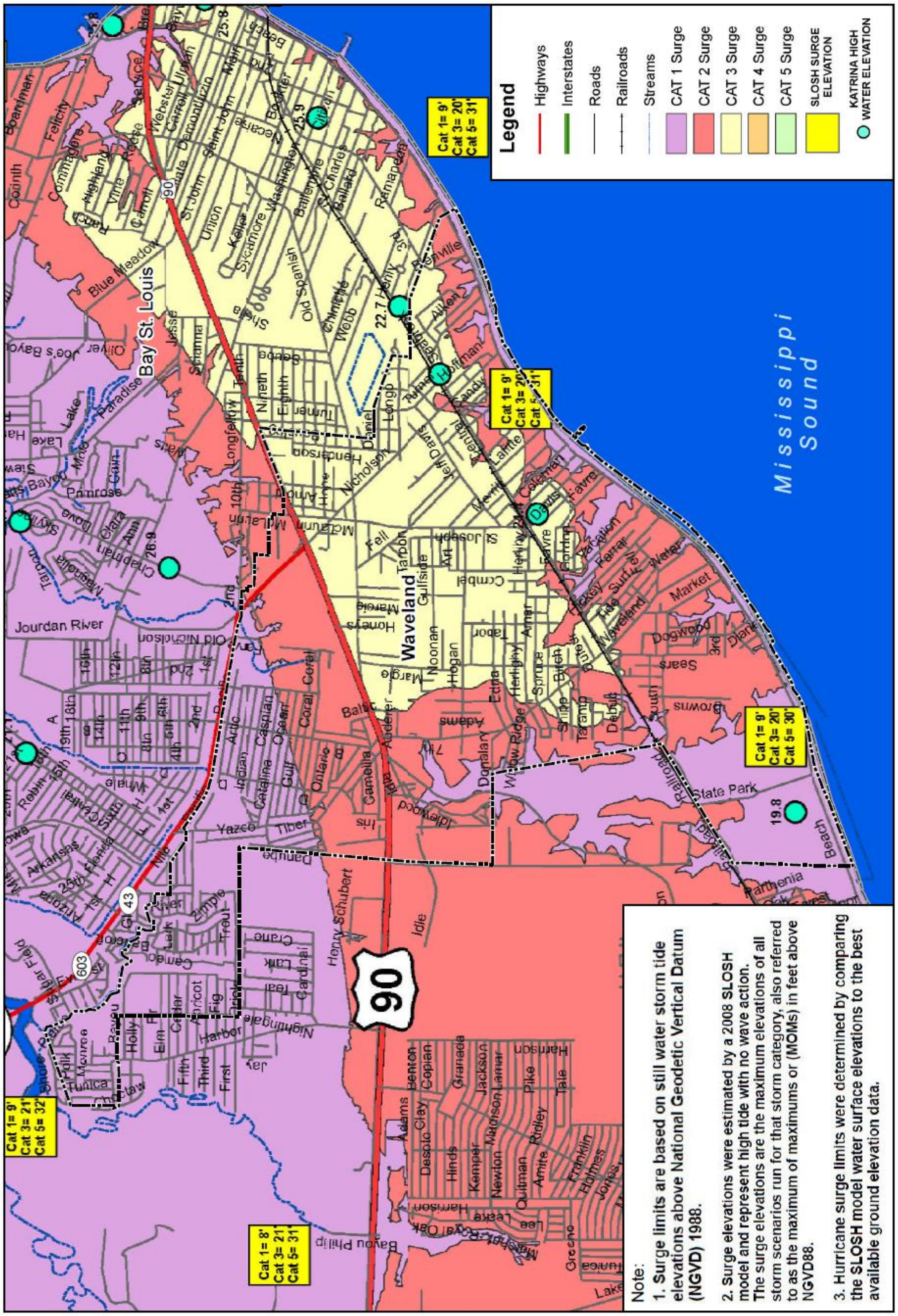
Adding to the destructive power of surge, battering waves may increase damage to buildings directly along the coast. Extended pounding by frequent waves can demolish any structure not specifically designed to withstand such forces. Additionally, currents created by tides combine with the waves to severely erode beaches and coastal highways. Buildings that survive hurricane winds can be damaged if their foundations are undermined and weakened by erosion.

In confined harbors, the combination of storm tides, waves, and currents can also severely damage marinas and boats. In estuaries and bayous, salt water intrusion endangers the public health, kills vegetation, and can send animals, such as snakes and alligators, fleeing from flooded areas.

Storm Surge Mapping

In May 2010, MEMA published anticipated storm surge maps indicating expected storm surge from Category 1 though Category 5 hurricanes. In addition, the high water marks (HWM) and the depth of flooding at those locations established using Hurricane Katrina surge data are indicated. Anticipated Sea, Lake, and Overland Surges from Hurricane (SLOSH) surge elevations for Category 1, 3 and 5 hurricanes are also shown Figure 4.26 on the map at various locations across the City.

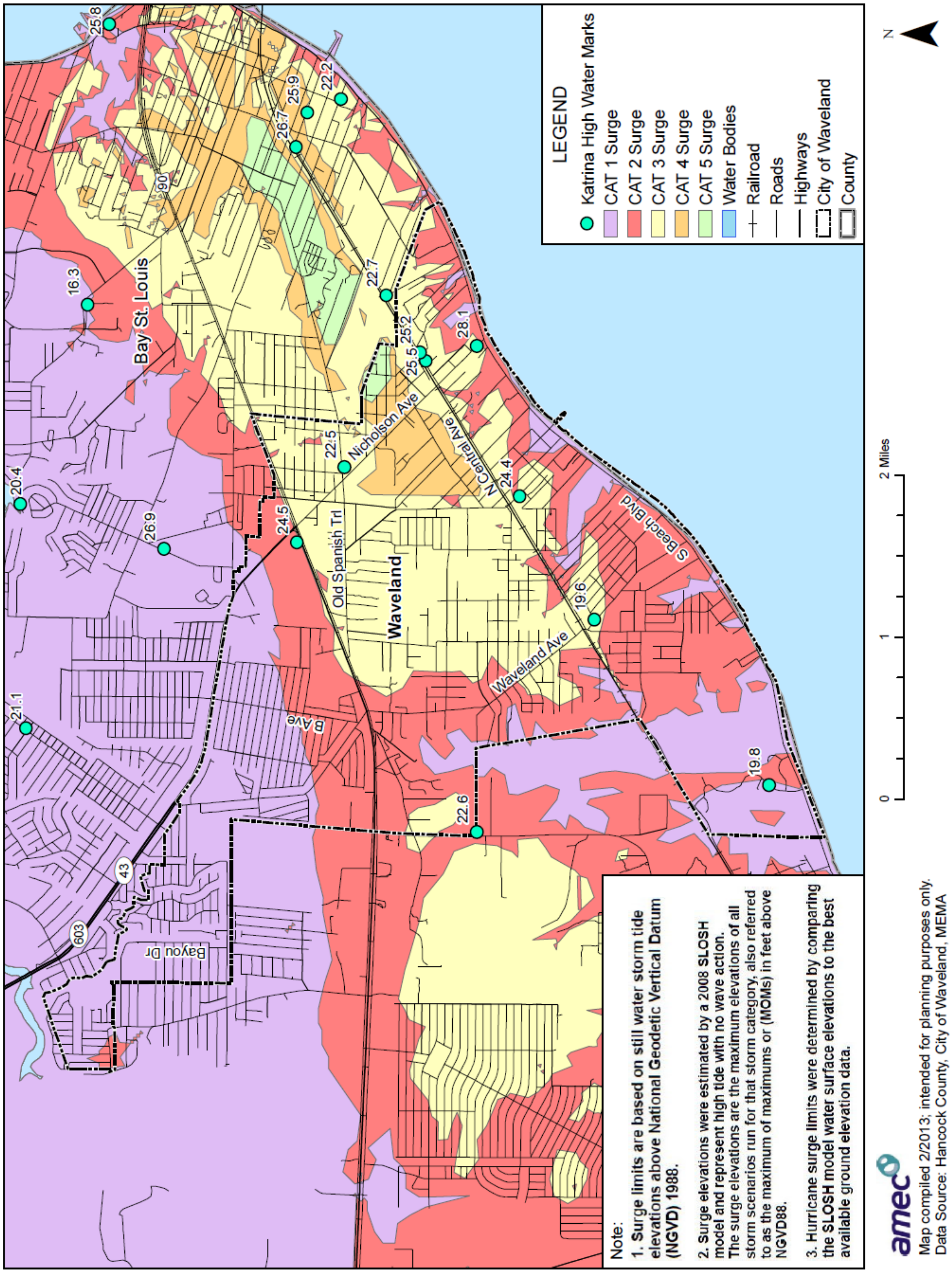
Figure 4.26. SLOSH Model for Waveland



Storm surge from Katrina caused severe damage to residential, commercial, and public buildings and infrastructure in Waveland. To assist in the long-term recovery and mitigation effort, FEMA performed a coastal high water marks (HWMs) study to investigate the high water conditions throughout the areas impacted by Katrina. The HWMs were surveyed by FEMA and the U.S. Geological Survey and results were classified as one of three basic types: surge only, surge and waves, or wave run up.

The HWM data demonstrates that Hurricane Katrina's coastal storm surge and wave-related high water conditions reached historical proportions and covered significant portions of the Mississippi study area. According to the HWM for the Waveland area, the high water mark resulting from surge and waves height at the south end of Nicholson Avenue was 28.1 feet. Surge levels ranging from 19 to 28 feet were experienced all across the community, placing still water flood elevations from 4 to 18 feet above the actual ground elevation in most areas of the City. High water marks from Hurricane Katrina are shown on Figure 4.27.

Figure 4.27. Hurricane Katrina High Water Marks



The HWM data was used by FEMA in calculating the flood hazard area boundaries and base flood elevations for the new DFIRMs. As such, the updated risk is reflected in the DFIRM that Waveland adopted October 16, 2009. Figure 4.26 illustrates worst-case storm surges for Category 1, 3, 5 storms along the Gulf Coast and the estimated maximum storm surge limits along the coast resulting from Hurricane Katrina storm surge and wave action. It is worthy to note that projected storm surges for Category 1, 3, and 5 hurricanes in Waveland are among the largest in the Gulf of Mexico.

Figure 4.28. SLOSH Data for Storm Surge in the Gulf of Mexico

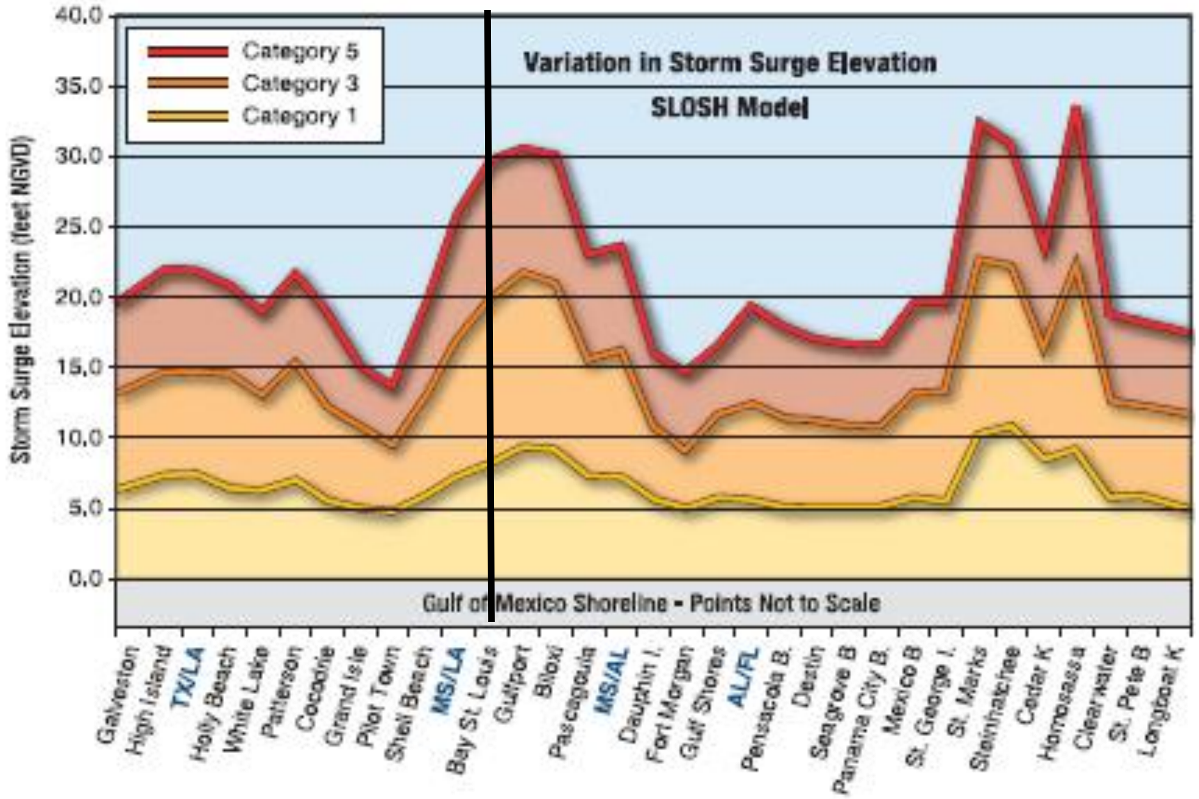


Figure 1-9. Maximum SLOSH storm surge predictions for open coast, developed shorelines

SOURCE: SLOSH DISPLAY CD-ROM/JANUARY 5, 2006/NOAA

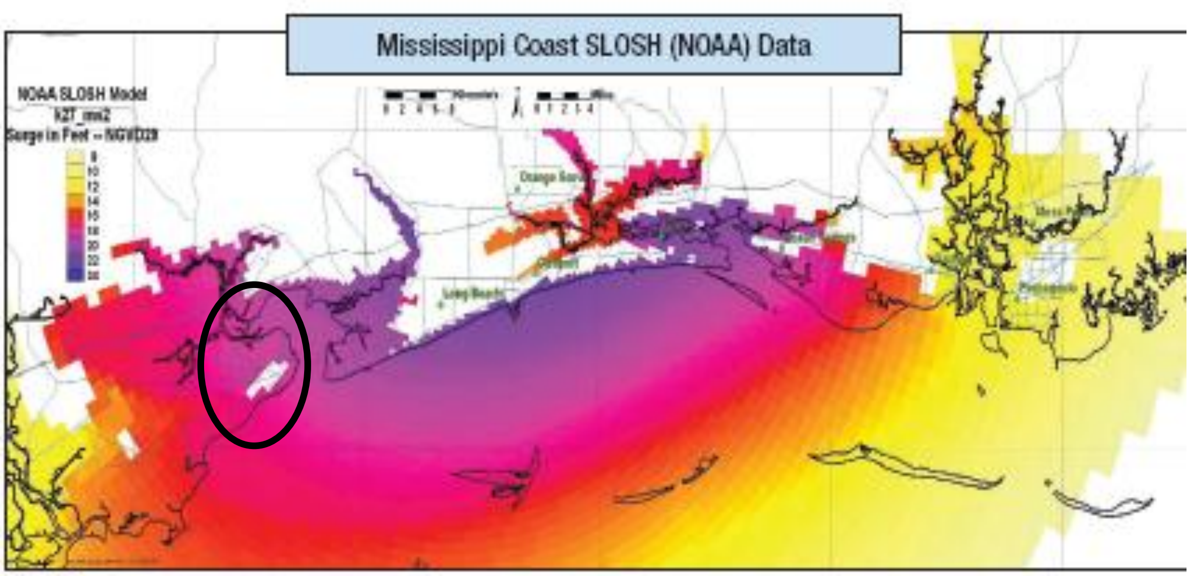


Figure 1-10. The SLOSH model of high water elevations for Hurricane Katrina

SOURCE: NOAA

Source: FEMA, Mitigation Assessment Team Report: Hurricane Katrina in the Gulf Coast

Past Occurrences

Hurricane

Hurricane season is defined as June 1 through November 30 each year, but hurricanes have been observed earlier and later. The earliest Atlantic hurricane was on March 7, 1908, and the latest on December 31, 1954, a storm that persisted as a hurricane until January 5, 1955 (2005's Zeta formed six hours earlier than the 1955 storm). Approximately half of the hurricanes that struck the middle Gulf Coast where Waveland is located were major hurricanes. Historically, September has about as many major hurricane landfalls as October and August combined. However, five of the most devastating hurricanes did not occur in September: Andrew (August 1992), Audrey (June 1957), Hazel (October 1954), Camille (August 1969), and Katrina (August 2005).

Since 1900, the Mississippi Coast, Hancock County, and the City of Waveland has felt the effects of 20 hurricanes and 13 tropical storms. Table 4.18 reflects the history of hurricanes and tropical storms from 1900 to 2012. This table originates from information from the National Hurricane Center.

Table 4.18. Hurricane & Tropical Storm History from 1900 to 2012

Name	Date	Category	Affected Area	Death	Injuries	Damage*
1909 Hurricane	9/20-9/21/1909	4	Hancock County & no other details available	350	Unknown	No details available
1915 Hurricane	9/29/1915	4	Hancock County & no other details available	275	Unknown	No details available
1947 Hurricane	9/19/1947	3	Hancock County & no other details available	51	Unknown	$100,000,000
Hurricane Betsy	9/25/1965	3	Hancock & no details available	N/A	N/A	No details available
Hurricane Camille	8/18/1969	5	Hancock & 18 other counties	12 (in Hancock County)	143	No details available
Hurricane Bob	7/10/1979	1	Hancock & no other details available	1	3	$20,000,000
Hurricane Frederic	9/13/1979	3	Hancock & 13 other counties	5	N/A	No details available
Hurricane Elena	9/4/1985	3	Hancock & 3 other counties			No details available
Hurricane Juan	10/29/1985	1	Hancock & no other details available	24	N/A	$1,750,000
Hurricane Florence	9/9/1988	1	Hancock & no other details available	1	N/A	$2,900,000
TS Dean	7/31/1995	N/A	Hancock & no other details available	1	N/A	$500,000
Hurricane Opal	10/4/1995	3	Hancock & 2 other counties	0	0	$75,000

Name	Date	Category	Affected Area	Death	Injuries	Damage*
Hurricane Danny	7/18/1997	1	Hancock & 2 other counties	4	N/S	$100,000,000
TS Hermine	9/19/1998	n/a	Hancock & 3 other counties	0	0	$85,000
Hurricane Georges	10/1/1998	2	Hancock & 15 other counties	0	0	$674,000,000
TS Allison	6/21/2001	n/a	Hancock & 4 other counties	0	0	$50,000
TS Bertha	8/5/2002	N/A	Hancock & no other details available	1	N/A	$200,000
TS Hanna	9/14/2002	N/A	Hancock & no other details available	3	N/A	$20,000,000
TS Isidore	9/25/2002	n/a	Hancock & 23 other counties	1	0	$25,500,000
Hurricane Lili	10/3/2002	1	Hancock & 22 other counties	0	0	$13,900,000
TS Bill	6/30/2003	n/a	Hancock & 16 other counties	0	0	$1,200,000
Hurricane Ivan	9/15/2004	4	Hancock & 43 other counties	1	0	$200,000,000
TS Matthew	10/9/2004	n/a	Hancock & 2 other counties	0	0	$50,000
TS Arlene	6/10/2005	n/a	Hancock & 9 other counties	0	0	$445,000
Hurricane Cindy	7/5/2005	1	Hancock & 3 other counties	0	0	$9,000,000
Hurricane Dennis	7/10/2005	2	Hancock & 40 other counties	0	0	$26,000,000
Hurricane Katrina	8/29/2005	3	Hancock & 48 other counties	231	N/A	$80,000,000,000
Tropical Dep.	8/24/2008	n/a	Hancock County & coastal MS	0	0	$0
Hurricane Ike	9/01/2008	3	Hancock, Coastal MS, LA, TX	0	0	$10,700,000
Tropical Storm	9/11/2008	n/a	Hancock & Coastal MS	0	0	$0
TS Ida	11/9/2009	n/a	Hancock &Coastal MS	1	0	$0
TS Lee	9/2/2011	n/a	Hancock &Coastal MS	0	0	$10,000
Hurricane Isaac	8/21/2012	1	Hancock &Coastal MS, LA	5		$970,000,000

Source: National Hurricane Center/Hurricane History; NCDC, SHELDUS
*Damages are not specific to the City, but to all areas affected by the hurricane.

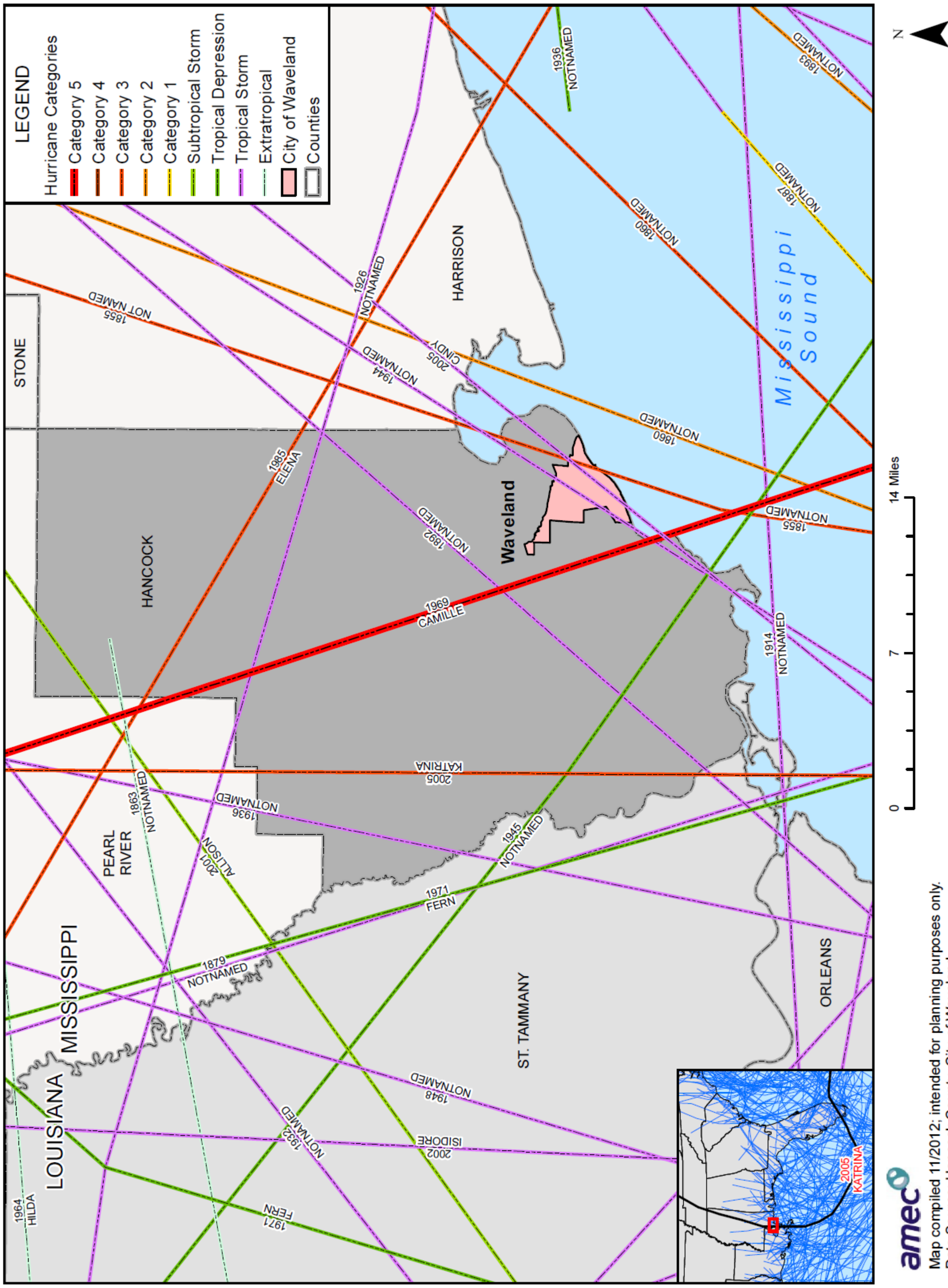
In addition to these hurricanes, the Flood Insurance Study for the City of Waveland indicated that there were several significant storms during the 1800s which caused loss of life and damage to properties along the Mississippi Gulf Coast. These include hurricanes in 1819, 1821, 1852, 1855, 1860, and 1893. These hurricanes, although not in Table 4.18, are shown on Figure 4.29.

Coastal Mississippi, including Waveland, has felt the effects of direct strikes from many hurricanes during the last century, six of which were considered major (Category 3 or higher) with wind speeds exceeding 130 mph. Hancock County and Waveland sustained a direct hit from Hurricane Camille in 1969, one of only a few Category 5 storms to ever make landfall in the U.S. Hurricane Katrina was a Category 5 storm until only a few hours prior to landfall when its winds dropped to Category 3. The tide and storm surge experienced along the coastline actually exceeded that to be expected from a Category 5 storm.

The NOAA National Hurricane Center described Katrina as an extraordinarily powerful and deadly hurricane that carved a wide swath of catastrophic damage and inflicted a large loss of life. Hurricane force winds extended 90 miles from the eye of the hurricane with tropical storm force winds extending 200 miles, making Katrina not only extremely intense but also exceptionally large. The impact of Katrina was felt from the Texas-Louisiana line to the Florida Panhandle. Hurricane force winds were felt as far north as Jackson and Meridian in Mississippi with major wind damage, including widespread power failure, structural damage, and tree damage. For the first time in its history, the entire grid of the Mississippi Power Company was out of service, leaving more than 250,000 customers throughout South Mississippi without electricity, some for nearly two weeks.

Figure 4.29 indicates the historic paths of hurricanes over the past 150 years using Homeland Security Infrastructure Program (HSIP) Freedom data. Table 4.19 that follows gives an additional analysis on hurricanes, tropical storms, tropical depressions, and extratropical storms that have affect the City of Waveland and Hancock County since 1850.

Figure 4.29. Hurricanes in Waveland



Map compiled 11/2012; intended for planning purposes only.
Data Source: Hancock County, City of Waveland,
HSIP Freedom 2012 Hurricane Tracks

Table 4.19. Hurricanes Affecting Waveland and Hancock County

Name	Category	Date	Wind Speed (knots)	Pressure (Millibars)
Not Named	Tropical Depression	07/09/1896	30	0
Not Named	Tropical Storm	08/27/1852	40	0
Not Named	Tropical Storm	09/12/1892	45	0
Not Named	Extratropical	09/13/1892	45	0
Not Named	Category 3	09/16/1855	100	0
Not Named	Tropical Storm	09/24/1889	45	0
Not Named	Tropical Storm	09/24/1897	35	0
Not Named	Tropical Storm	09/28/1861	50	0
Not Named	Extratropical	10/01/1863	40	0
Not Named	Extratropical	10/23/1880	60	991
Not Named	Extratropical	6/17/1902	35	0
Not Named	Extratropical	6/17/1902	35	0
Not Named	Extratropical	6/29/1902	35	0
Not Named	Extratropical	6/30/1907	35	0
Not Named	Extratropical	8/21/1915	35	0
Not Named	Extratropical	8/21/1915	35	0
Not Named	Tropical Storm	7/21/1916	45	1,001
Not Named	Tropical Storm	7/22/1916	40	0
Not Named	Extratropical	8/1/1926	25	0
Not Named	Tropical Storm	9/21/1926	60	983
Not Named	Tropical Depression	8/10/1928	30	0
Not Named	Tropical Depression	8/16/1928	30	0
Not Named	Tropical Depression	10/18/1932	20	0
Not Named	Tropical Storm	7/27/1936	40	0
Not Named	Tropical Storm	9/10/1944	35	0
Not Named	Extratropical	9/15/1944	35	0
Not Named	Tropical Depression	9/6/1945	30	0
Not Named	Tropical Depression	9/6/1945	25	0
Not Named	Extratropical	9/19/1945	25	0
Not Named	Extratropical	2/4/1952	50	0
Not Named	Extratropical	2/5/1952	45	0
Edna	Category 1	9/11/1954	80	0
Not Named	Tropical Storm	9/15/1961	35	0
Betsy	Tropical Depression	9/12/1965	20	0
Camille	Category 5	8/18/1969	165	909
Heidi	Tropical Storm	9/14/1971	40	998
Eloise	Extratropical	9/24/1975	20	1,004

Name	Category	Date	Wind Speed (knots)	Pressure (Millibars)
Elena	Category 3	9/2/1985	100	959
Bob	Tropical Storm	8/20/1991	60	977
Bertha	Tropical Storm	7/14/1996	55	995
Floyd	Extratropical	9/17/1999	45	985
Helene	Tropical Depression	9/23/2000	25	1,011
Allison	Subtropical Storm	6/11/2001	35	1,003
Frances	Tropical Depression	9/8/2004	25	1,001
Jeanne	Tropical Depression	9/27/2004	30	993
Jeanne	Tropical Depression	9/28/2004	25	998
Cindy	Tropical Storm	7/6/2005	50	994
Katrina	Category 3	8/29/2005	110	923

Source: HSIP 2012 Freedom – Hurricane Tracks

Coastal Storm Surge

Since 1995 (the date the NCDC began collecting data), the NCDC reports that the Mississippi Coast and Hancock County has felt the effects of 17 coastal storm surges. Table 4.20 reflects the history of hurricanes and tropical storms from 1995 to 2010.

Table 4.20. Coastal Storm Surge Events in Hancock County and Waveland 1995-2010*

Type	Date	Affected Area	Death	Injuries	Damage
Coastal Flood	7/29/1995	Hancock, Harrison, and Jackson Counties	0	0	$0
Storm Surge	2/15/1998	Hancock County	0	0	$500,000
Storm Surge (TS Bill)	6/3/2003	Hancock, Harrison, and Jackson Counties	0	0	$1,000,000
Storm Surge (TS Ivan)	9/16/2004	Hancock, Harrison, and Jackson Counties	0	0	$2,000,000
Storm Surge (TS Matthew)	10/10/2004	Hancock and Harrison Counties	0	0	$30,000
Storm Surge (TS Cindy)	7/5/2005	Hancock, Harrison, and Jackson Counties	0	0	$1,000,000
Storm Surge (Hurricane Katrina)	8/29/2005	Hancock, Harrison, and Jackson Counties	0	0	$11,300,000,000
Coastal Flood	101/16/2006	Hancock County	0	0	$0
Coastal Flood	4/10/2008	Hancock County	0	0	$0
Storm Surge (Hurricane Gustav)	9/1/2008	Amite, Hancock, Pearl River, Pike, Walthall, Wilkinson Counties	0	0	$1,300,000
Storm Surge (Hurricane Ike)	9/11/2008	Hancock, Harrison, and Jackson Counties	0	0	$0
Coastal Flood	3/27/2009	Hancock County	0	0	$0

Type	Date	Affected Area	Death	Injuries	Damage
Coastal Flood	12/1/2009	Hancock County	0	0	$0
Coastal Flood	2/4/2010	Hancock County	0	0	$0
Coastal Flood	5/1/2010	Hancock County	0	0	$0
Coastal Flood	5/2/2010	Hancock County	0	0	$0
Coastal Flood	6/30/2010	Hancock County	0	0	$0

Source: NCDC

Note: The NCDC database was undergoing renovation during the writing of this plan. Storm surge since 2010 was not tracked by the NCDC as a standalone hazard.

Frequency/Likelihood of Future Occurrence

Hurricane and Tropical Storm

Likely—According to the *State of Mississippi Standard Mitigation Plan*, the three coastal and three first tier counties in the state are in high risk areas with an almost certain probability they will be impacted by hurricanes in the future. The plan places the probability of future occurrence within 75 miles of the Gulf Coast including Hancock County as follows:

Table 4.21. Probability of Future Hurricane Occurrence in Hancock County and Waveland in the Next 50 years

Type and Number of Hurricanes	Probability in Hancock County
Probability of 1 or More Named Storms Making Landfall	82.7%
Probability of 1 or more named Hurricanes Making Landfall	57.3%
Probability of 1 or more intense Hurricanes Making Landfall	31.8%
Probability of Tropical Storm Force (>= 40 mph) Wind Gusts	99.9%
Probability of Tropical Storm Force (>= 75 mph) Wind Gusts	99.6%
Probability of Tropical Storm Force (>= 115 mph) Wind Gusts	82.3%

Source: State of Mississippi Hazard Mitigation Plan, 2010

Coastal Storm Surge

Highly Likely—Given the 17 storm surge occurrences over a period of 16 years (1995-2010), 1.06 coastal storm surge events affect Waveland each year.

Climate Change and Hurricane/Storm Surge

One of the primary factors contributing to the origin and growth of tropical storm and hurricanes systems is water temperature. Sea surface temperature may increased significantly in the main hurricane development region of the North Atlantic during the past century as well as in the Gulf of Mexico.

Sea level change will be particularly important in influencing storm surge flooding in the Waveland area, since the area is already is subject to flooding from above normal tides, surge and rainfall events from hurricanes and less powerful tropical storms. The previously referenced 2008 study on the impacts of climate change on transportation systems and infrastructure included modeling of storm surge impacts with and without sea level rise. Simulated storm surge from NOAA SLOSH model runs across the central Gulf Coast region demonstrate a 22-24-ft potential surge with major hurricanes of Category 3 or greater without considering a future sea level rise effect. After Hurricane Katrina in 2005, high watermark surveys in New Orleans and east along the Gulf Coast in Mississippi revealed storm surge heights approaching 28 ft above MSL. A storm approaching from the east on a northwesterly track can elevate storm surge 1-3 ft in comparison to a storm of equal strength approaching on a northeasterly track. The combined conditions of a slow churning Category 5 hurricane making landfall on a westerly track along the central Gulf Coast under climate change and elevated sea levels indicate that transportation assets and facilities at or below 30 ft MSL are subject to direct impacts of projected storm surge. This conclusion is cause for concern as the entire community of Waveland is within 0- 28 ft above current MSL. The transportation network is particularly vulnerable since many roads in the Gulf Coast region of the Southeast are at an elevation of four feet or less.

4.2.10 Thunderstorm (includes hail, lightning, high wind)

Hazard Profile

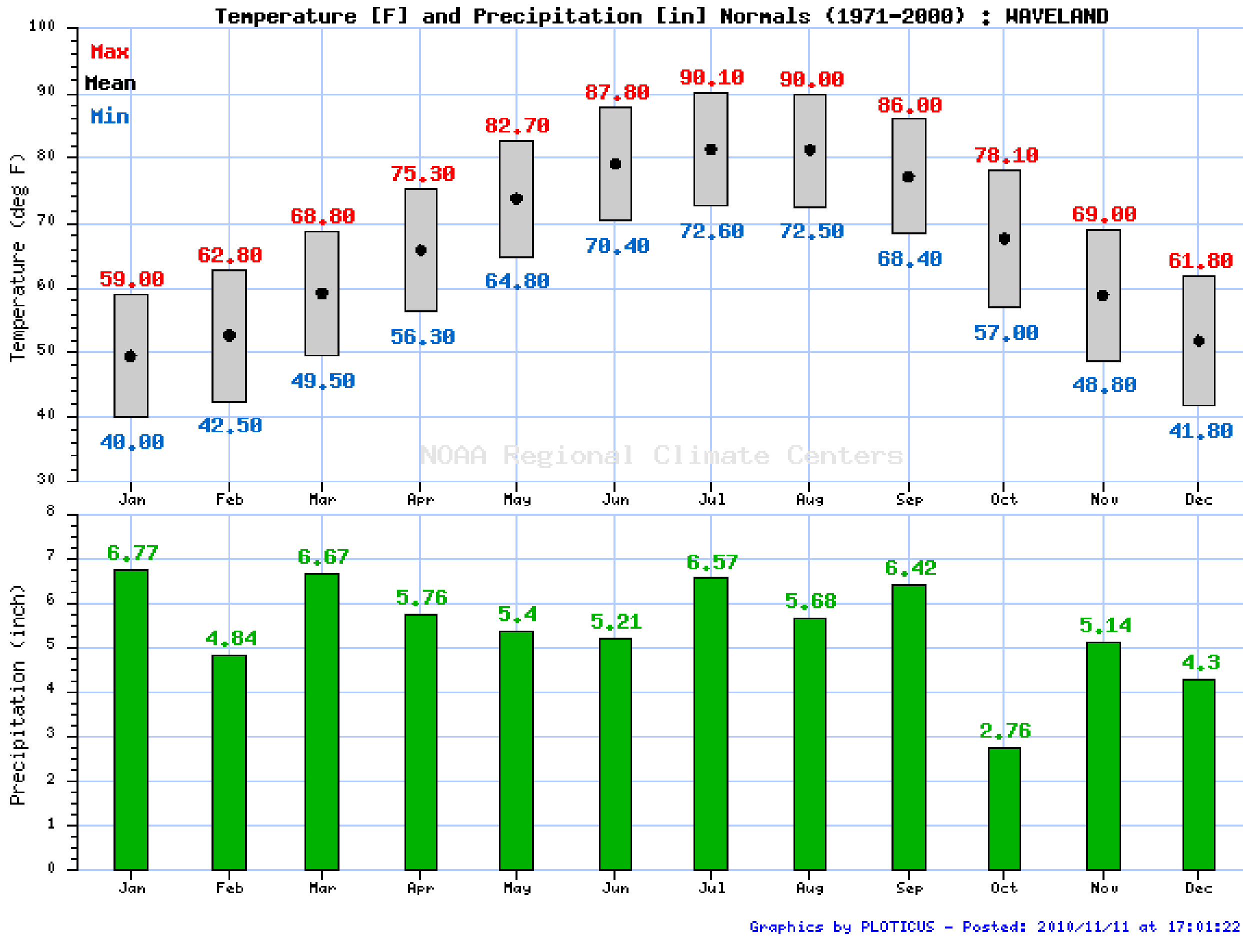
On the Mississippi Gulf Coast severe thunderstorms can occur at almost any time of the year. According to the National Weather Service, thunderstorms occur in this area 70 to 80 days each year. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is 1 inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado (profiled in Section 4.2.11).

Information from the National Weather Service Observation Site at Waveland is summarized in the discussion below and in Figure 4.30.

Waveland Weather Station (Period of Record 1971 to 2010)

Information from the closest weather station with the most comprehensive data, the Waveland weather station (30° 29′ by -89° 38′, 8 ft above mean sea level (MSL)), is summarized below in Figure 4.30. Average annual precipitation in Waveland is 65.1 inches per year. Precipitation averages are relatively consistent month to month, with the exception of October, which sees less rain.

Figure 4.30. Waveland Average Monthly Temperatures and Precipitation

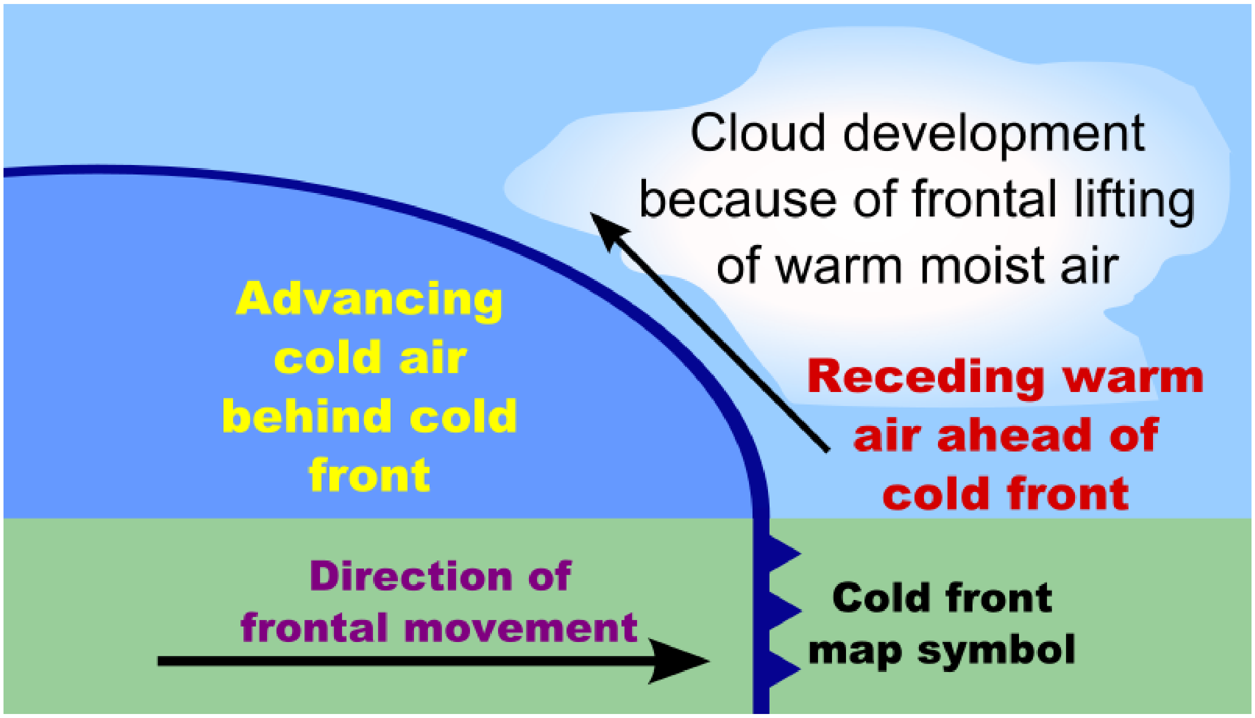


Source; Southern Regional Climate Center, Waveland Station

Severe Thunderstorms

Thunderstorms result from the rapid upward movement of warm, moist air (see Figure 4.31). They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of greater than 35,000 ft. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth's surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of air that spreads out at Earth's surface and causes strong winds associated with thunderstorms.

Figure 4.31. Formation of a Thunderstorm



Source: NASA. http://rst.gsfc.nasa.gov/Sect14/Sect14_1c.html

There are four ways in which thunderstorms can organize: single cell, multicell cluster, multicell lines (squall lines), and supercells. Even though supercell thunderstorms are most frequently associated with severe weather phenomena, thunderstorms most frequently organize into clusters or lines. Warm, humid conditions are favorable for the development of thunderstorms. The average single cell thunderstorm is approximately 15 miles in diameter and lasts less than 30 minutes at a single location. However, thunderstorms, especially when organized into clusters or lines, can travel intact for distances exceeding 600 miles.

Thunderstorms are responsible for the development and formation of many severe weather phenomena, posing great hazards to the population and landscape. Damage that results from thunderstorms is mainly inflicted by downburst winds, large hailstones, and flash flooding caused by heavy precipitation. Stronger thunderstorms are capable of producing tornadoes and waterspouts.

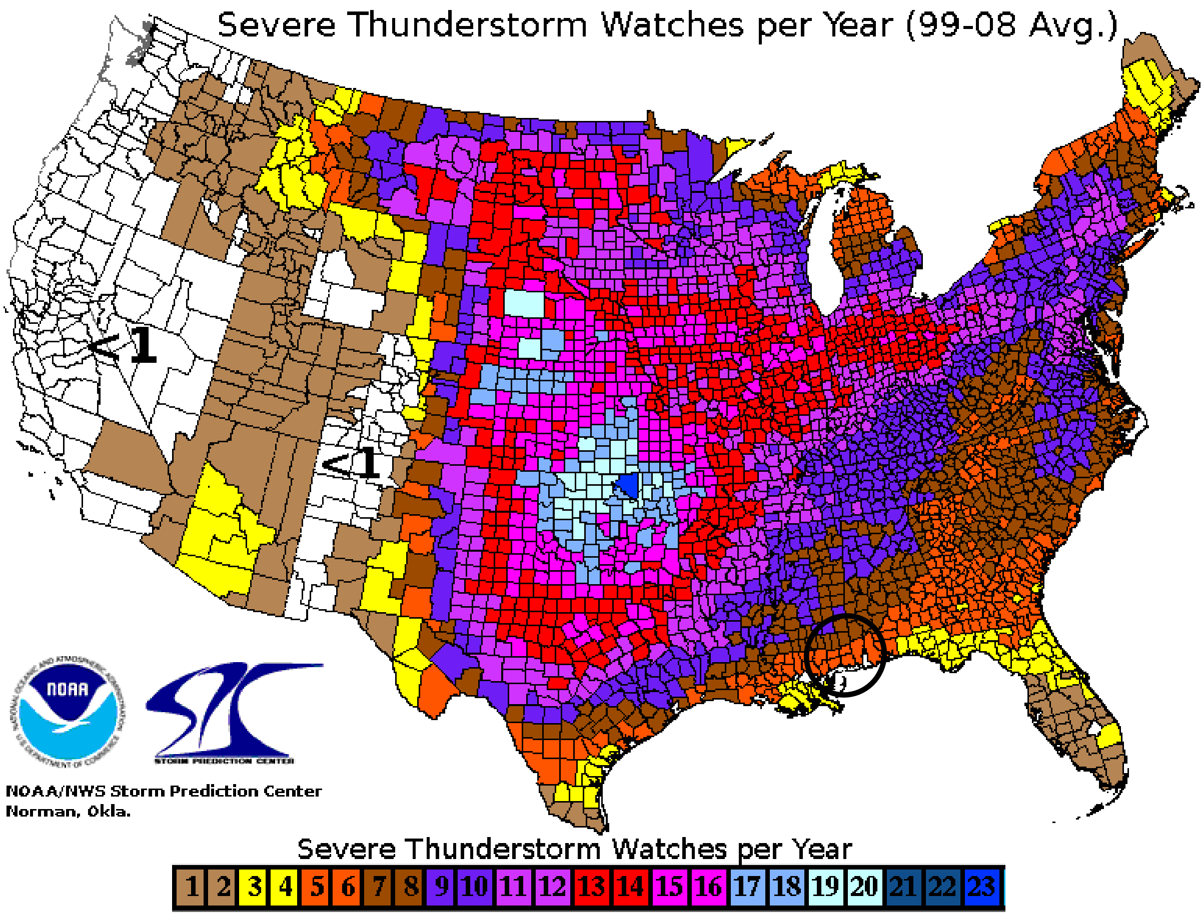
The National Weather Service issues two types of alerts for severe thunderstorms:

- A **Severe Thunderstorm Watch** indicates when and where severe thunderstorms are likely to occur. Citizens are urged to watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information. Severe Thunderstorm Watches are issued by the Storm Prediction Center in Norman, OK.
- A **Severe Thunderstorm Warning** is issued when severe weather has been reported by spotters or indicated by radar. Warnings indicate imminent danger to life and property to

those in the path of the storm. Severe Thunderstorm Warnings are issued by the National Weather Service in Jackson.

The City sees 5-6 severe thunderstorm watches per year. This can be seen in Figure 4.32.

Figure 4.32. Severe Thunderstorm Watches per Year in the Planning Area



Source: NOAA/NWS Storm Prediction Center

Flash floods often result from the heavy rainfall of thunderstorm systems and nationally are considered the number one thunderstorm-related killer because they often occur at night and people in affected areas may not be able to see the extent of the rapidly rising water before it is too late to escape. Drivers attempting to cross flood-covered sections of roadways can be swept into deeper water and perish. During daylight hours, children playing in flooded drainage canals and ditches are particularly vulnerable to drowning in flash floods. Flash flooding and flooding from accumulations of rainwater from thunderstorms are addressed in depth in Section 4.2.8.

Lightning

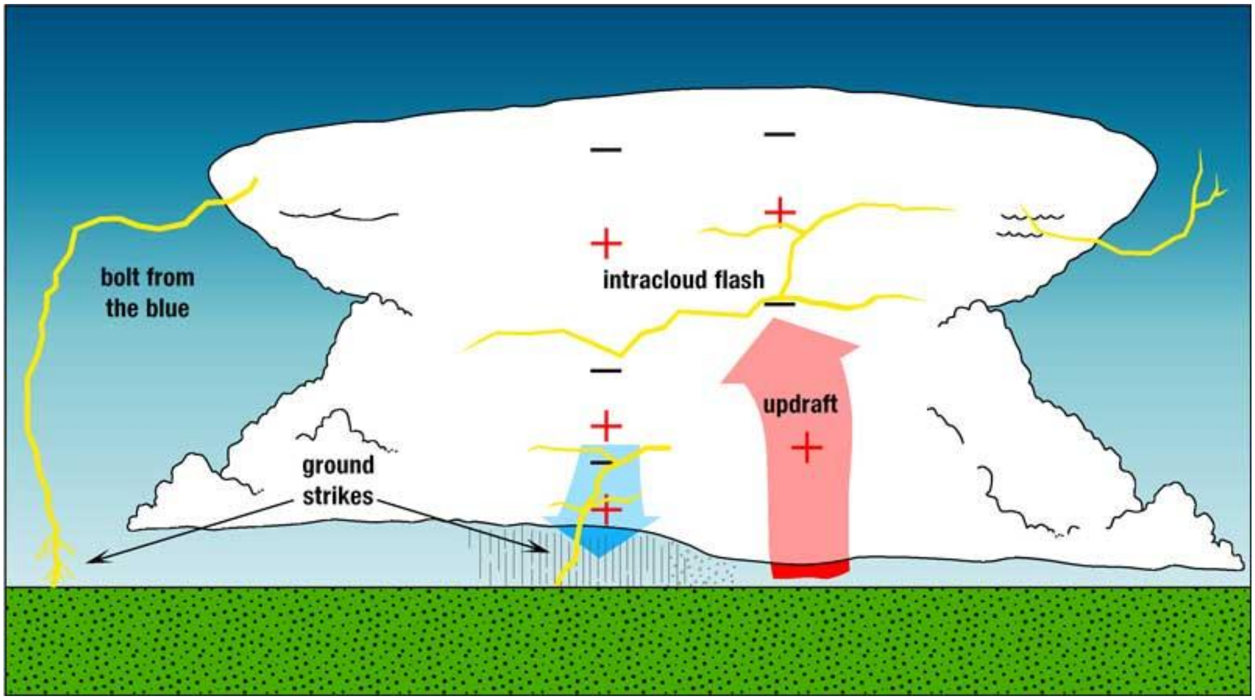
Lightning is an electrical discharge between positive and negative regions of a thunderstorm. A lightning flash is composed of a series of strokes with an average of about four. The length and duration of each lightning stroke vary, but typically average about 30 microseconds.

Lightning is one of the more dangerous weather hazards in the United States and in Mississippi. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines, and electrical systems. Lightning also causes forest and brush fires, and deaths and injuries to livestock and other animals. According to the National Lightning Safety Institute, lightning causes more than 26,000 fires in the United States each year. The institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be in excess of $6 billion per year. Impacts can be direct or indirect. People or objects can be directly struck, or damage can occur indirectly when the current passes through or near it.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat (see Figure 4.33). Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

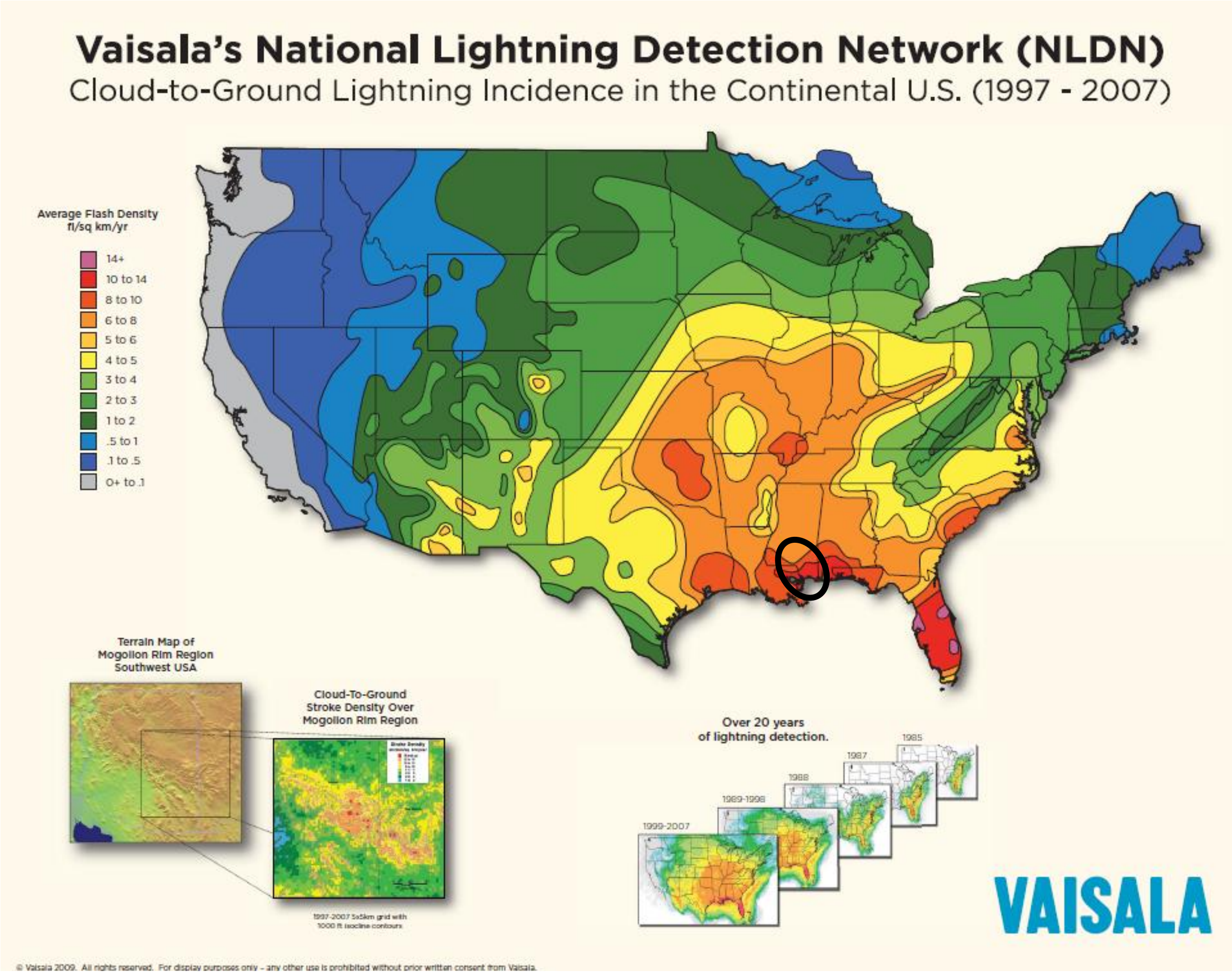
Figure 4.33. Cloud to Ground and Intracloud Lightning



Source: National Weather Service

The ratio of cloud-to-ground and intra-cloud lightning can vary significantly from storm to storm. Depending upon cloud height above ground and changes in electric field strength between cloud and earth, the discharge stays within the cloud or makes direct contact with the earth. If the field strength is highest in the lower regions of the cloud, a downward flash may occur from cloud to earth. Using a network of lightning detection systems, the United States monitors an average of 25 million strokes of lightning from the cloud-to-ground every year. Figure 4.34 depicts cloud-to-ground lightning strikes in the United States and the planning area (circled in black).

Figure 4.34. Lightning Flash Density Map



No deaths have been attributed to lightning in Waveland.

High Winds

High winds, often accompanying severe thunderstorms, can cause significant property damage threaten public safety, and have adverse economic impacts from business closures and power loss. Windstorms in Waveland can be straight-line winds, but most often are tornadic or hurricane related in the City. Straight-line winds are generally any thunderstorm wind that is not associated with rotation (i.e., not tornadic). These winds can overturn mobile homes, tear roofs off of houses, topple trees, snap power lines, shatter windows, and sandblast paint from cars. Other associated hazards include utility outages, arcing power lines, debris blocking streets, dust storms, and an occasional structure fire. Strong winds, when combined with saturated ground conditions, can down very mature trees. Figure 4.35 illustrates the wind zones in the United States. The City is in a hurricane susceptible wind zone.

Figure 4.35. United States Wind Zones

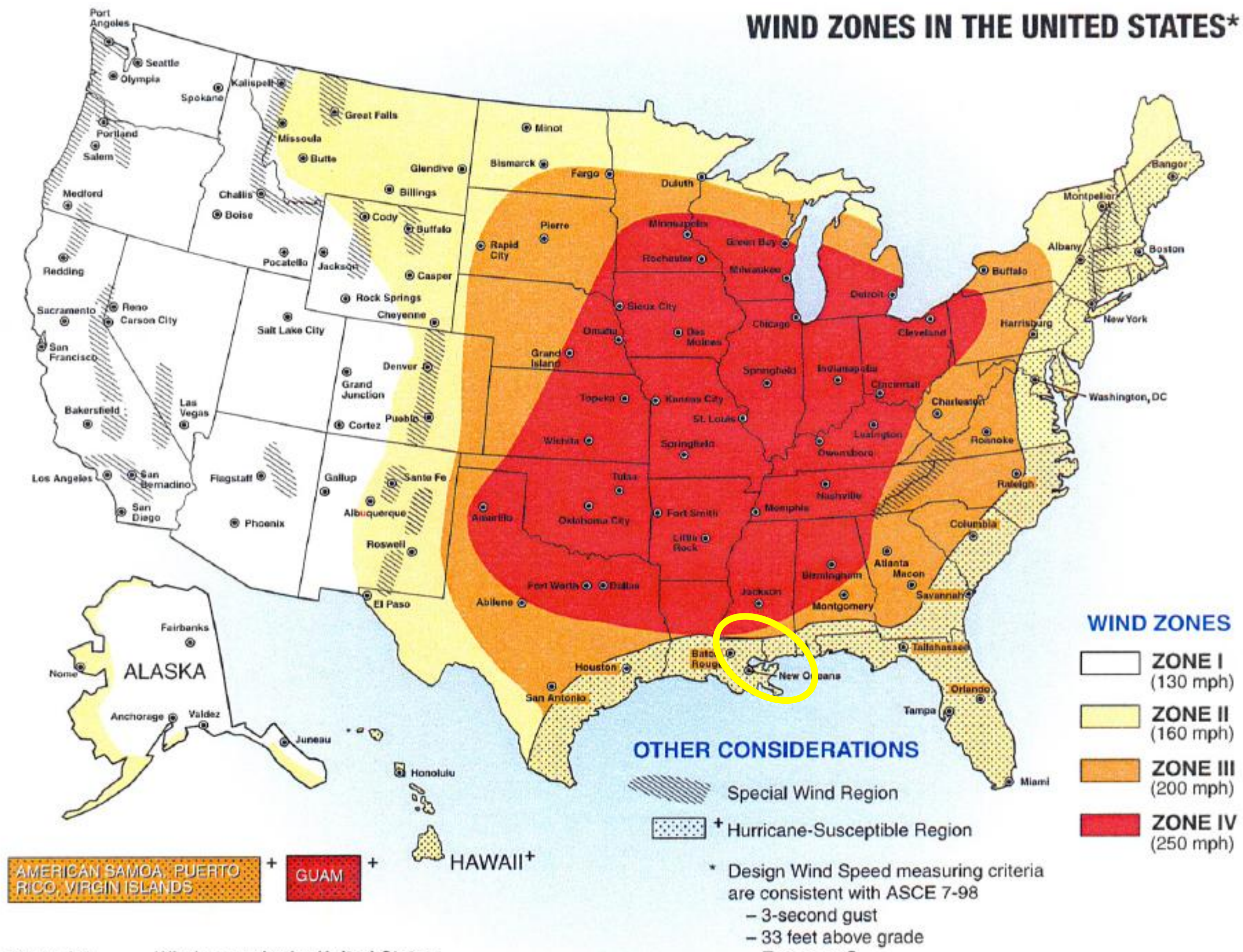


Figure I.2 Wind zones in the United States

Source: FEMA

Hail

Hail is associated with thunderstorms that can also bring high winds and tornados. It forms when updrafts carry raindrops into extremely cold areas of the atmosphere where they freeze into ice. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is pulled by gravity towards the earth. Hailstorms occur throughout the spring, summer, and fall in the region, but are more frequent in late spring and early summer. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 mph. Hail causes nearly $1 billion in damage to crops and property each year in the United States. Hail is also one of the requirements which the National Weather Service uses to classify thunderstorms as 'severe.' If hail more than ¾ of an inch is produced in a thunderstorm, it qualifies as severe.

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4.22 indicates the hailstone measurements utilized by the National Weather Service.

Table 4.22. Hailstone Measurements

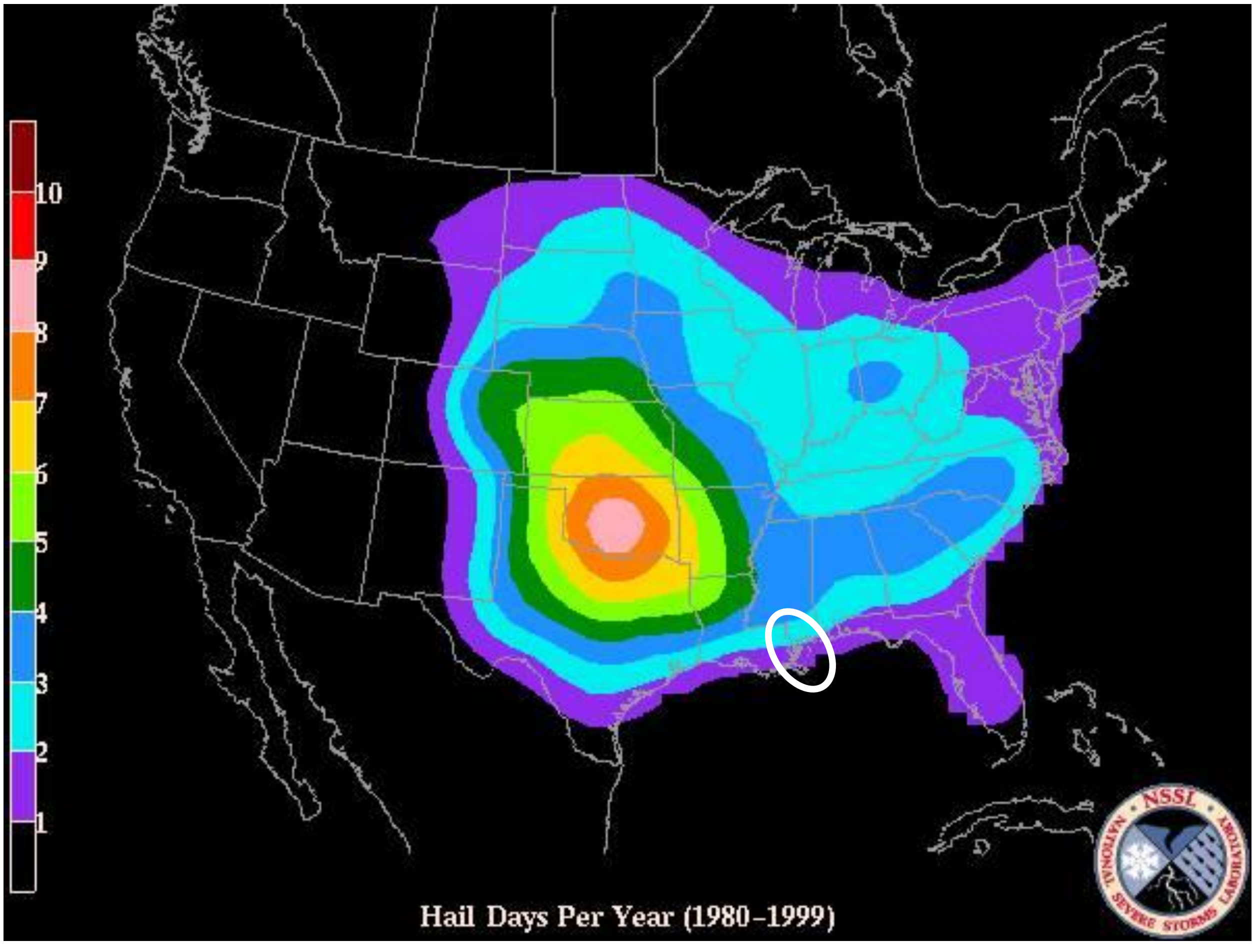
Average Diameter	Corresponding Household Object
.25 inch	Pea
.5 inch	Marble/Mothball
.75 inch	Dime/Penny
.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball
1.75 inch	Golf-Ball
2.0 inch	Hen Egg
2.5 inch	Tennis Ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

There is no clear distinction between storms that do and do not produce hailstones. Nearly all severe thunderstorms probably produce hail aloft, though it may melt before reaching the ground. Multi-cell thunderstorms produce many hailstones, but not usually the largest hailstones. In the life cycle of the multi-cell thunderstorm, the mature stage is relatively short so there is not much time for growth of the hailstone. Supercell thunderstorms have sustained updrafts that support large hail formation by repeatedly lifting the hailstones into the very cold air at the top of the thunderstorm cloud. In general, hail 2 inches (5 cm) or larger in diameter is associated with supercells (a little larger than golf ball size which the NWS considers to be 1.75 inch.). Non-supercell storms are also capable of producing golf ball size hail.

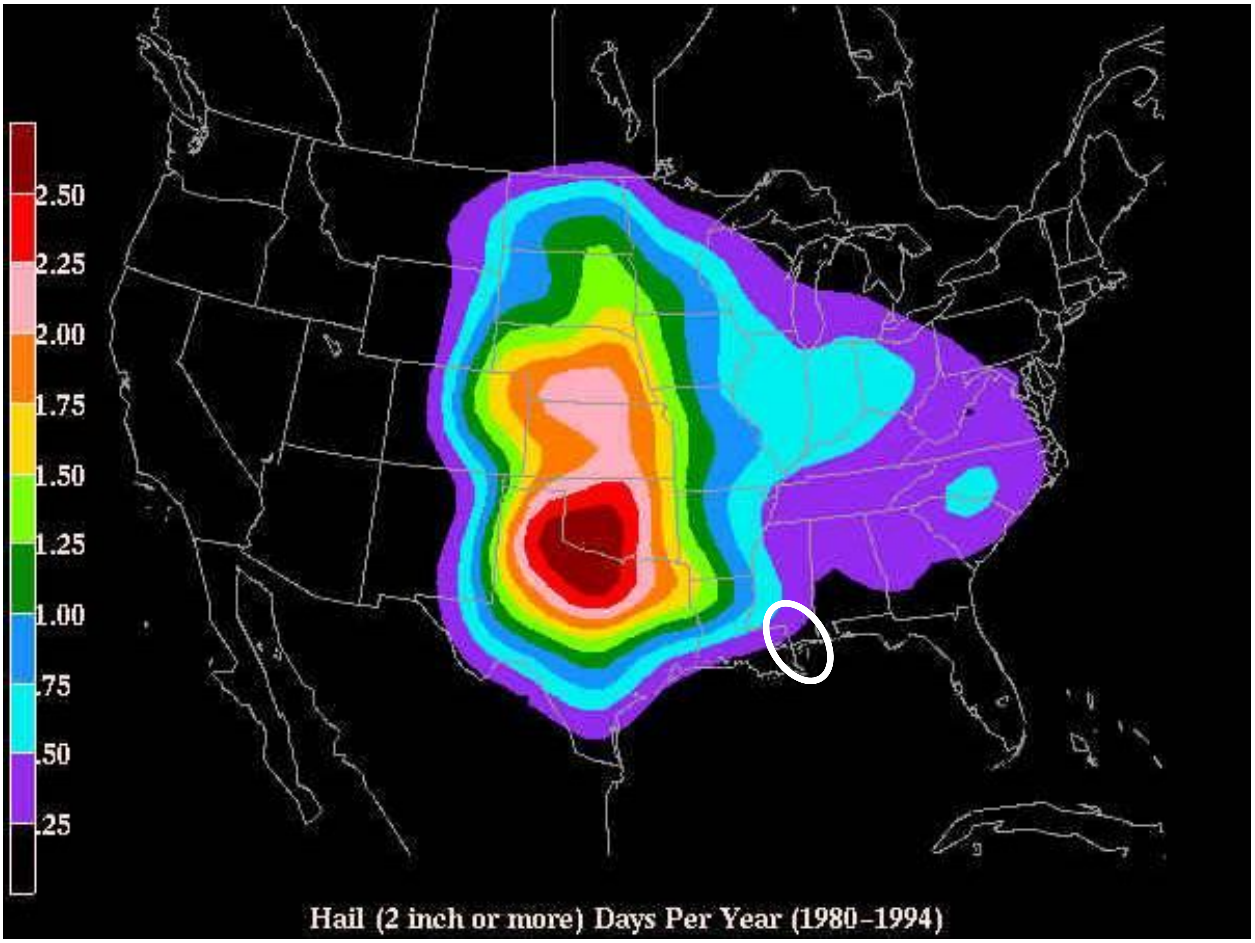
In all cases, the hail falls when the thunderstorm's updraft can no longer support the weight of the ice. The stronger the updraft the larger the hailstone can grow. When viewed from the air, it is evident that hail falls in paths known as hail swaths. They can range in size from a few acres to an area 10 miles wide and 100 miles long. Figure 4.36 shows the average number of days of hail per year in the United States, with the planning area outlined in a white oval. Figure 4.37 shows the average number of days of severe hail (over two inches in diameter) per year in the United States, with the planning area outlined in a white oval.

Figure 4.36. Average Number of Days of Hail per Year



Source: NOAA National Severe Weather Laboratory

Figure 4.37. Average Days of Large Hail in the Planning Area



Source: NOAA National Severe Weather Laboratory

Past Occurrences

Thunderstorm

According to the National Weather Service, winds with speeds of 58 miles per hour (50 knots) or higher is one of the defining indicators of a severe thunderstorm. The most significant thunderstorm wind damage is caused by straight-line winds that can exceed 100 miles per hour in severe thunderstorms. Straight-line winds known as downbursts can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation. Table 4.23 shows the dates, wind speeds (if available), and the cost of damages for the 14 thunderstorms with high winds between 1993 and September 30, 2012 in Hancock County and the City of Waveland.

Table 4.23. Thunderstorms with High Wind in Hancock County and Waveland between 1993 and 9/30/2012

Date	Wind Speed	Damages*	Remarks
09/09/94	Unknown	$5,000	Several trees and limbs were blown across power lines along Lower Bay road.
07/26/99	Unknown	$500	The Hancock County Sheriff's Office reported trees blown down.
09/29/99	Unknown	$100	One tree and numerous limbs were blown down.
08/10/00	Unknown	$1,000	Several trees and power lines were knocked down.
03/14/01	Unknown	$500	A tree was blown down.
06/11/01	Unknown	$15,000	Several trees were blown down and a mobile home overturned.
08/02/02	Unknown	$1,000	Trees and power lines were knocked down.
7/17/03	55 mph	$10,000	The roof of a house was blown off.
11/18/03	55 mph	$5,000	Thunderstorm winds damaged the roof of a building.
6/24/04	55 mph	$500	A tree was blown down along Jordan River Drive near Washington Street
04/11/05	55 mph	$2,000	Trees and power lines were knocked down.
03/26/09	55 mph	$1,000	A few trees were blown down along Lower Bay Road just to the west southwest of Waveland.
7/2/2009	55 mph	$1,500	Thunderstorm winds damaged a fence and destroyed metal lawn buildings
4/4/2011	61 mph	$1,000	A tree fell on a power line on South Street near Clemont Harbor.

Source: NCDC
*Countywide totals

Hail

Table 4.24 reflects the number of reported hail occurrences for Waveland, as recorded in the NCDC database.

Table 4.24. Hail Events in Hancock County and Waveland between 1993 and 9/30/2012

Date	Hail Size (inches)	Cost of Damages	Remarks
2/17/1995	0.75	$0	Dime-size hail and smaller was reported in and around Waveland in southeast Hancock County.
7/9/1995	0.75	$0	Hail, up to the size of golf balls was reported in several locations in southern Hancock County.
3/2/1999	0.75	$0	Dime size hail was reported by Emergency Management.

Source: NCDC

Table 4.25 reflects the number of reported hail occurrences for Waveland, as recorded in the SHELDUS database.

Table 4.25. Hail Events in Hancock County and Waveland between 1960 and 2011

Date	Hazard Type Combo	Injuries	Fatalities	Property Damage	Crop Damage	Remarks
3/27/1961	Hail - Severe Storm/Thunder Storm - Wind	0.02	0	$1,162.79	$116.28	Winds, Hail And Rain
4/10/1962	Hail - Wind	0	0	$60.98	$60.98	Hail And Wind
4/28/1964	Hail	0	0	$208.33	$20.83	Hail
4/25/1964	Hail - Severe Storm/Thunder Storm - Wind	1.67	0	$16,666.67	$1,666.67	Heavy Rains, Wind, Hail
5/4/1972	Hail - Severe Storm/Thunder Storm	0	0	$2,380.95	$0.00	Heavy Rain, Hailstorm
5/27/1978	Hail - Severe Storm/Thunder Storm - Wind	0	0	$5,000.00	$0.00	Thunderstorm, High Winds, Hail

Source: SHELDUS

Lightning

Table 4.26 reflects the number of lightning occurrences in Waveland, as recorded in the NCDC database. It should be noted that lightning happens with great frequency in the City. Only reported lightning events with reported damages are included in the table.

Table 4.26. Lightning Events in Hancock County and Waveland between 1993 and 2010

Date	Damages	Comments
01/18/96	$1,000	Lightning struck a transformer and interrupted electric service to several customers.
09/16/96	$150,000	Lightning caused a fire that damaged a restaurant and several motel suites.

Source: NCDC

Frequency/Likelihood of Future Occurrence

Highly Likely—Waveland is reported to average 70 to 80 days per year when thunderstorms occur. Severe thunderstorms with high wind are likely to occur in Waveland at least once every year. It should be assumed that every area of the community is vulnerable to severe thunderstorms with high winds, hail, and lightning and that in any given year, several of these storms will occur.

Climate Change and Thunderstorm

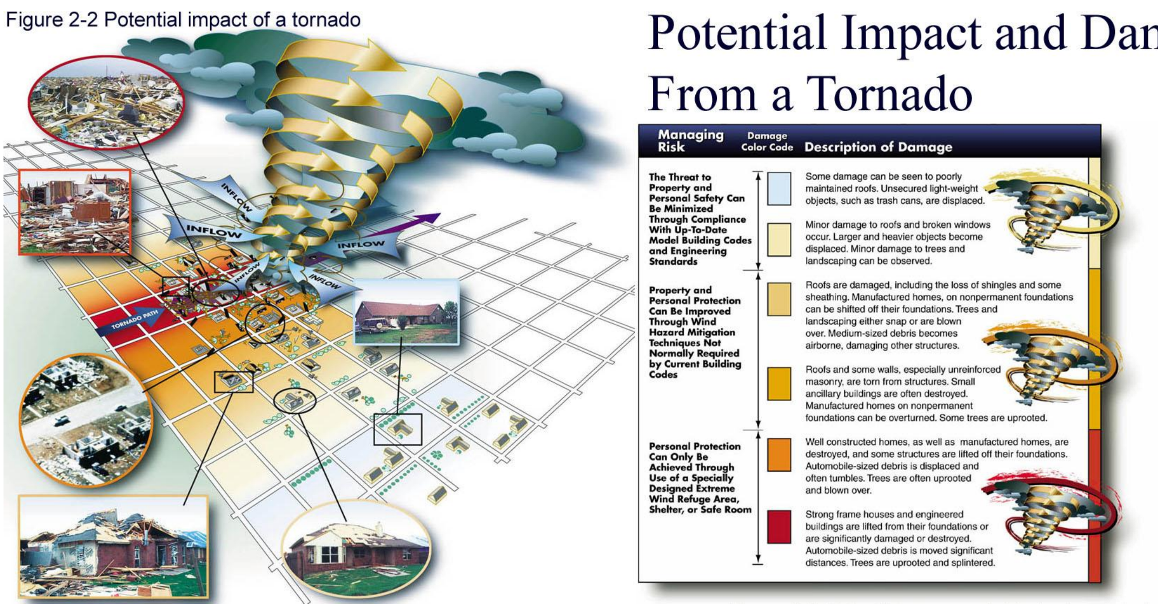
While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. Hail may become more common in the City. The amount of lightning is not projected to change.

4.2.11 Tornado

Hazard/Problem Description

A tornado is defined by FEMA as "a violently rotating column of air, pendant from a cumulonimbus, with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena." Tornadoes are nature's most violent storm. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long. Figure 4.38 illustrates the potential impact and damage from a tornado.

Figure 4.38. Potential Impact and Damage from a Tornado



Source: FEMA

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis, better correlation between damage and wind speed. It is also more precise because it takes into account the materials affected and the construction of structures damaged by a tornado. Table 4.27 shows the wind speeds associated with the original Fujita scale ratings and the damage that could result at different levels of intensity. Table 4.28 shows the wind speeds associated with the Enhanced Fujita Scale ratings.

Table 4.27. Traditional Fujita (F) Scale

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Administration Storm Prediction Center

Table 4.28. Enhanced Fujita (EF) Scale

Enhanced Fujita (EF) Scale	Enhanced Fujita Scale Wind Estimate (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

Source: National Oceanic and Atmospheric Administration Storm Prediction Center

Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible. Before a tornado hits, the wind may die down and the air become very still. A cloud of debris can mark the location of a tornado even if a funnel is not evident. Tornadoes generally occur near the trailing edge of a thunderstorm. It is not uncommon to see clear, sunlit skies behind a tornado.

A waterspout is a tornado that forms over a body of water and siphons large amounts of water aloft that is dumped when the waterspout dissipates. Waterspouts sometimes come ashore with extremely heavy rainfall when they dissipate. A funnel cloud is a cloud formation that demonstrates the characteristics of a tornado but does not actually reach the ground.

Tornadoes are not limited by location; every home in Waveland has a probability of being impacted by a tornado. Due to the City's waterfront location adjacent to the Mississippi Sound, Waveland has a higher probability of a waterspout making landfall and causing damage to properties near the waterfront, than a direct hit by a tornado.

Past Occurrences

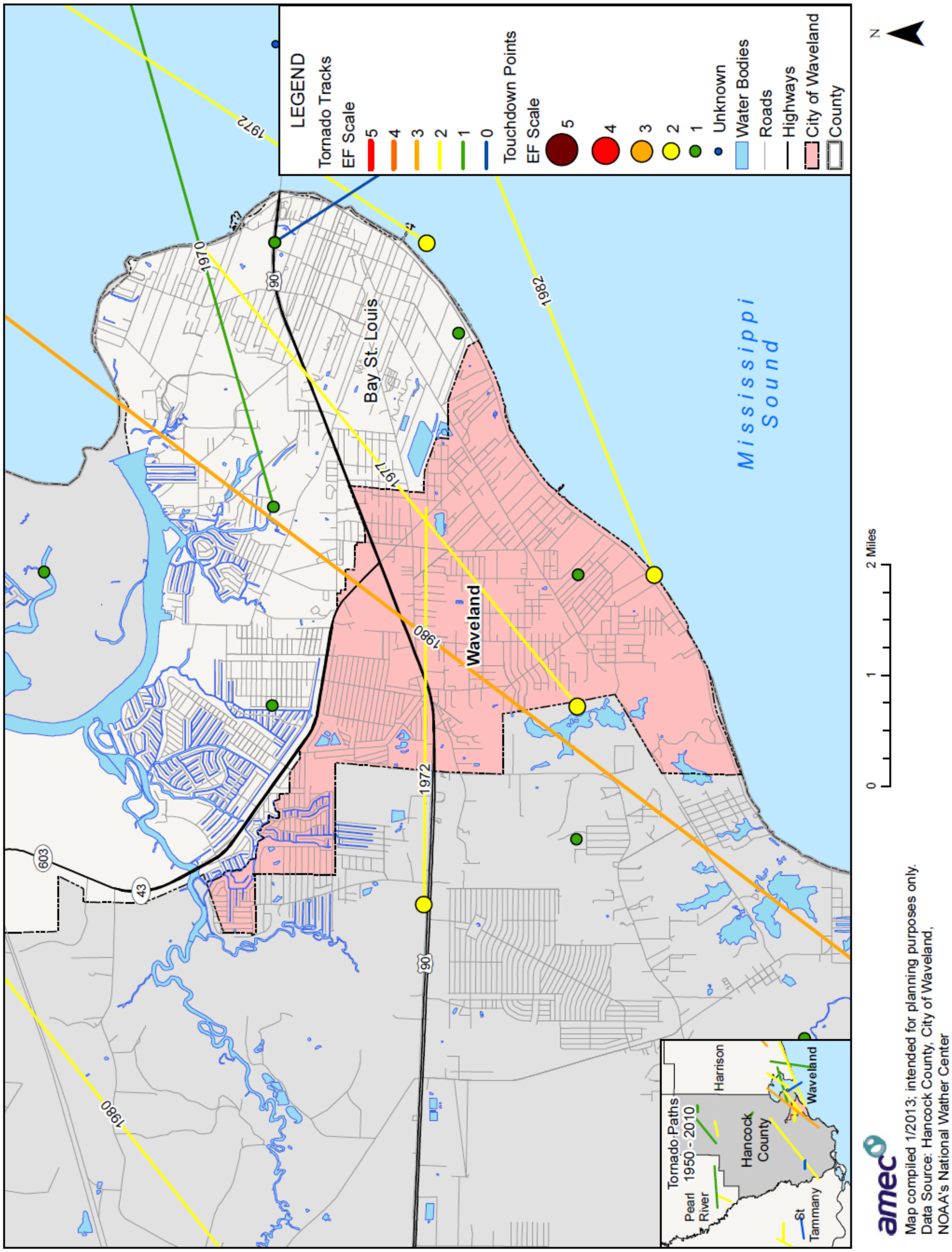
Table 4.29 lists historic tornado activity in Waveland. Figure 4.39 shows the location of tornado touchdowns and paths in the Waveland area.

Table 4.29. Tornadoes and Waterspouts Sighted in Hancock County and Waveland 1955 – 9/30/2012

Date	Type	Magnitude	Deaths	Injuries	Damage
3/2/1972	Tornado	F2	0	2	$250,000
5/2/1977	Tornado	F2	0	0	$25,000
5/19/1980	Tornado	F3	0	8	$25,000
4/20/1982	Tornado	F2	0	0	$250,000
8/13/1998	Tornado	F0	0	0	$0
8/27/2001	Waterspout		0	0	$0
6/30/2003	Tornado	F1	0	0	$1,000
4/6/2005	Tornado	F1	0	0	$50,000

Source: NOAA National Climatic Data Center

Figure 4.39. Waveland Tornado Paths and Touchdowns



Frequency/Likelihood of Future Occurrence

Likely—In the past 60 years 7 tornadoes have been sighted within the City Limits or about one every 8.5 years, with 43 reported in Hancock County. MEMA Planners in the *State of Mississippi Standard Mitigation Plan* quote the National Weather Service, indicating that projection of tornado events is not possible with accuracy, stating:

> "Tornado occurrence is too random to scientifically establish the probability of future events in any one county. Tornados have occurred and could reoccur in any of the Mississippi 82 counties. The recorded period shows an average of 32 tornado events per year throughout the State of Mississippi."

According to the *State of Mississippi Standard Mitigation Plan,* based upon past activity, Hancock County has an annual probability of occurrence of 20, ranking it 11th among Mississippi Counties. To develop this probability, the total number of events occurring in the County was divided by the number of years in the period of record.

Climate Change and Tornadoes

Climate change may increase the number of tornadoes in the City. This is especially true of tornadoes spawned during periods of hurricane. For a greater discussion of climate change and hurricanes, refer to Sections 4.2.1 and 4.2.9

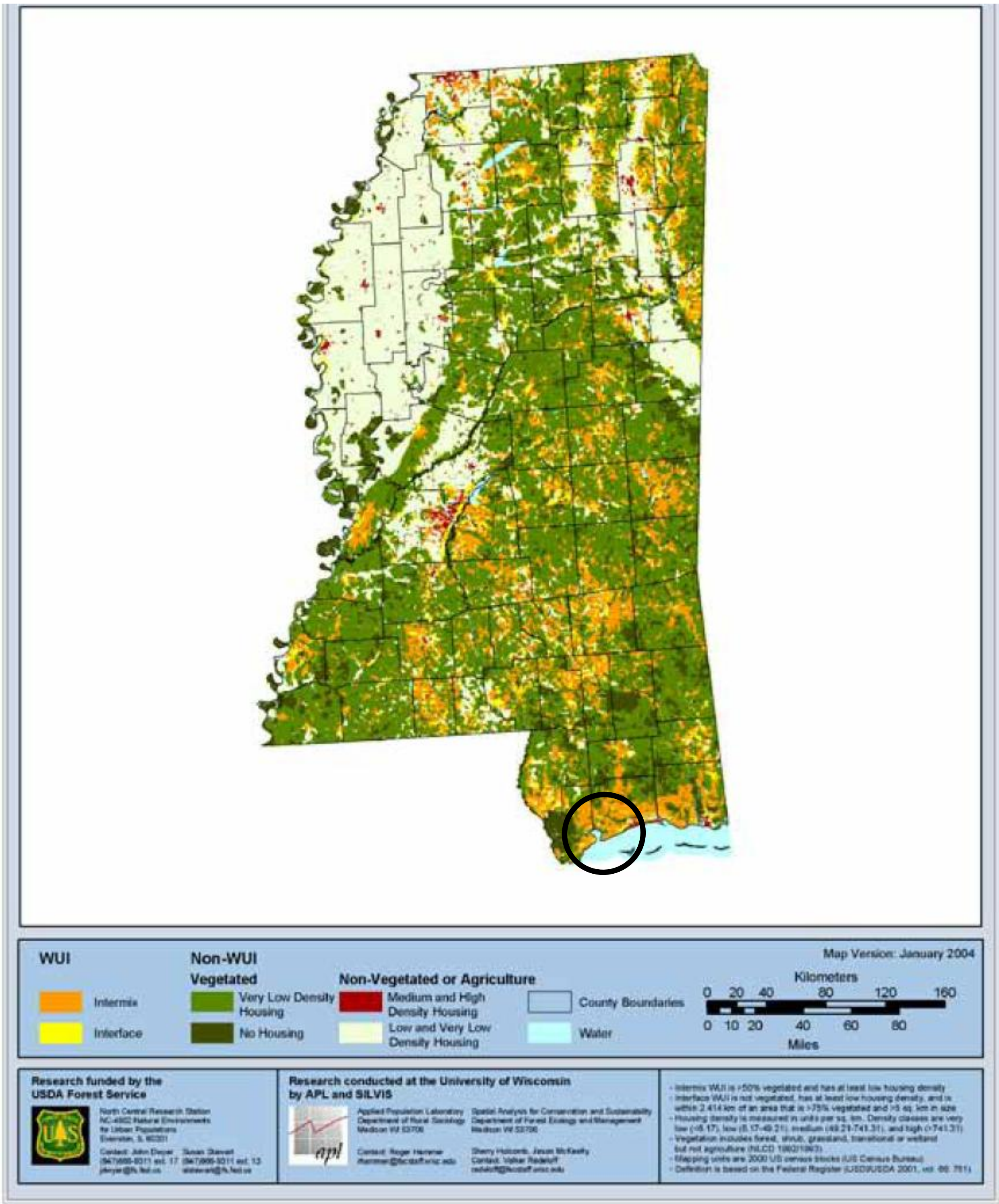
4.2.12 Wildfire

Hazard Profile

The *State of Mississippi Standard Mitigation Plan* defines a wildfire as any fire that burns uncontrollably in a natural setting such as grasslands, forest and brush land. Prescribed burnings are the only exception to a wildfire. Wildfires can be either man-made or natural. The typical cause of a natural wildfire is lightning. Prescribed burning, also known as controlled burning is the deliberate use of fire under specified and controlled conditions. Prescribed burns are used by forest management professionals and individual landowners to accomplish specific tasks such as fuel reduction, site preparation, wildlife habitat improvement, and disease control.

As population in rural areas increase, so do the issues facing Wildland/Urban Interface (WUI) areas. Wildland/Urban Interface is the development of residential and commercial areas adjacent to or comingled with vegetative areas. This trend in development increases wildfires in urban areas and threatens human life, structures and wildland resources. WUI is broken into two categories, intermix and interface. Intermix defines housing and commercial development that is mixed with wildland vegetation. Interface describes housing and commercial development in proximity to wildland vegetation. Much of the land area of Waveland is located in an Intermix area, as shown in Figure 4.40.

Figure 4.40. State of Mississippi WUI in 2000



Source: *State of Mississippi Hazard Mitigation Plan*

Mississippi traditionally has two wildland fire seasons each year. The first season usually begins in late October with the first frost and hardwood leaf drop and runs through December. The second season usually begins in February and runs to mid-April or until spring green-up. These seasons vary from year to year, depending on rainfall, wind, and other weather factors. The southern one-third of the State generally tends to have the most wildland fire activity. The five-year average for wildland fires in Mississippi is 3,613 wildland fires and 45,728 acres. Average wildland fire size is close to 10 acres.

Although Mississippi has its share of WUI areas, relatively few homes and structures are lost to wildland fires. An average of 12 homes and eight other structures are lost each year to wildland fires. Another four homes and two structures are damaged each year. There are usually 15 vehicles damaged or destroyed by wildland fire each year.

The area most concerning to the City are the areas made vacant by Hurricane Katrina, and the newly annexed area to the northwest of the City. With a driving wind, a fire in those areas could spread quickly and become dangerous.

Past Occurrences

The National Climatic Data Center lists no severe wildfires in Waveland. Waveland is a densely populated community with few tracts of vacant land in wooded acreage. The Waveland Fire Department takes all fires seriously and is equipped to quickly bring any fire under control.

INSERT NFIRS

Frequency/Likelihood of Future Occurrence

Unlikely—There have been no past occurrences of wildland/urban interface wildfires in the City. The State of Mississippi Standard Hazard Mitigation Plan states that debris accumulation from Hurricane Katrina will pose a threat toward future wildfires in the next few years. Since Katrina communities have worked with local agencies to remove debris and dead standing trees but five years later, many lots are now overgrown, adding to the potential fuel for fires. Some properties where damaged structures still remain vacant can be an attractive target for arsonists, setting up the possibility of a fire being set and burning out of control for some time prior to be discovered.

Climate Change and Wildfire

Warmer temperature can exacerbate drought conditions. Drought often kills plants, which serve as fuel for wildfires. Warmer temperatures could increase the number of wildfires and pest outbreaks, such as the southern pine beetle.

4.2.13 Railroad: Hazardous Materials Release

Hazard/Problem Description

A hazardous material is any item or agent (biological, chemical, physical) which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Hazardous materials can be present in any form: gas, solid, or liquid. Environmental or atmospheric conditions can influence hazardous materials if they are uncontained.

The U.S. Occupational Safety and Health Administration's (OSHA) definition of hazardous material includes any substance or chemical which is a "health hazard" or "physical hazard," including: chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents which act on the hematopoietic system; agents which damage the lungs, skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists or smoke which may have any of the previously mentioned characteristics.

The Environmental Protection Agency (EPA) incorporates the OSHA definition, and adds any item or chemical which can cause harm to people, plants, or animals when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment. The EPA maintains a list of 366 chemicals that are considered extremely hazardous substances (EHS). This list was developed under the Superfund Amendments and Reauthorization Act. The presence of EHSs in amounts in excess of a threshold planning quantity requires that certain emergency planning activities be conducted.

A release or spill of bulk hazardous materials could result in fire, explosion, toxic cloud or direct contamination of people and property. The effects may involve a local site or many square miles. Health problems may be immediate, such as corrosive effects on skin and lungs, or be gradual, such as the development of cancer from a carcinogen. Damage to property could range from immediate destruction by explosion to permanent contamination by a persistent hazardous material.

Accidents involving the transportation of hazardous materials could be just as catastrophic as accidents involving stored chemicals, possibly more so, since the location of a transportation accident is not predictable. The U.S. Department of Transportation divides hazardous materials into nine major hazard classes. A hazard class is a group of materials that share a common major hazardous property, i.e., radioactivity, flammability, etc. These hazard classes include:

- Class 1—Explosives
- Class 2—Compressed Gases
- Class 3—Flammable Liquids

- Class 4—Flammable Solids; Spontaneously Combustible Materials; Dangers When Wet Materials/Water-Reactive Substances
- Class 5—Oxidizing Substances and Organic Peroxides
- Class 6—Toxic Substances and Infectious Substances
- Class 7—Radioactive Materials
- Class 8—Corrosives
- Class 9—Miscellaneous Hazardous Materials/Products, Substances, or Organisms

The City of Waveland is bisected by the CSX Railroad that runs from east to west about four blocks north of the beachfront. This railroad is the primary route for freight trains carrying a variety of chemicals and toxic materials from the "chemical corridor" of Texas and Louisiana to the eastern United States. A high number of freight trains cross the area daily. Products carried include petroleum products, pulp board, plastics and agricultural products.

There is currently no passenger rail serving the Waveland area. Amtrak service via the Sunset Limited (New Orleans to Jacksonville) was discontinued after Hurricane Katrina. Passengers traveling to Atlanta or the northeast can board the Amtrak Crescent at Hattiesburg or Picayune and proceed along the Norfolk Southern line. The locations of lines relative to the City of Waveland are shown in Figure 1.1 in Chapter 1.

Past Occurrences

The United States Department of Transportation Pipeline and Hazardous Materials Safety Administration's (PHMSA) Office of Hazardous Materials Safety performs a range of functions to support the safe transport of hazardous material. One of these functions is the tracking of hazardous materials incidents in the United States. Rail incidents in the City of Waveland are shown in Table 4.30. One reported event has occurred in the City.

Table 4.30. Railroad Hazardous Materials Releases in Waveland 1970-2012

Date of Incident	Quantity Released	Unit of Measure	Commodity Long Name	Total Amount of Damages	Failure Cause Description	Description of Events
10/6/2002	0	–	Environmentally Hazardous Substances Liquid N.O.S.	$0	Derailment	On 10/06/2002, at approximately 1700 hours, CSX Transportation Train X60905 derailed at milepost 756 near Waveland MS. There were 105 cars in the train 24 derailed, 8 of which contained residue from hazardous material shipments. No product was released; there were no injuries or exposures. Local response agencies closed nearby roads and evacuated 200 persons as a precaution.

Source: PHMSA Incident Search

Likelihood of Future Occurrences

Occasional–There has been 1 rail related hazardous materials spill reported to the PHMSA since 1970. This equates to a hazardous materials spill occurring in Waveland every 43 years, or a 2.3% chance of a rail related hazardous materials spill every year.

Climate Change and Railroad: Hazardous Materials Release

Climate change is unlikely to have an effect on hazardous materials releases in or near the City of Waveland.

4.2.14 Natural Hazards Summary

Table 4.31 summarizes the results of the hazard identification and hazard profile for Waveland based on the hazard identification data and input from the HMPC. For each hazard profiled in Section 4.2, this table includes the likelihood of future occurrence and whether the hazard is considered a priority hazard for the City.

Table 4.31. Overall Summary and Impact of Probably Hazards City of Waveland

Hazard	Likelihood of Future Occurrence	Priority Hazard
Climate Change (storm surge, sea level rise)	Highly Likely	Y
Coastal/Canal Bank Erosion	Highly Likely	Y
Dam/Levee Failure	Unlikely	N
Drought	Occasional	N
Earthquake	Occasional	N
Extreme Heat	Highly Likely	N
Extreme Winter Weather	Likely	N
Flood: 100/500 year	Occasional	Y
Flood: Stormwater/ Localized Flooding	Highly Likely	Y
Hurricane and Tropical Storms (includes ocean surf events)	Likely	Y
Thunderstorm (includes hail, lightning, high wind)	Highly Likely	Y
Tornado	Likely	N
Wildfire	Likely	N
Railroad Hazardous Materials Release	Occasional	Y

4.3 Vulnerability Assessment Summary

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.
Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.
Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.
Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

With Waveland's hazards identified and profiled, the HMPC conducted a vulnerability assessment to describe the impact that each hazard would have on the City. The vulnerability assessment quantifies, to the extent feasible using best available data, assets at risk to natural hazards and estimates potential losses.

Vulnerability assessments followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses*. The vulnerability assessment first describes the total vulnerability and values at risk and then discusses vulnerability by hazard.

Data used to support this assessment included the following:

- County GIS data (hazards, base layers, and assessor's data);
- GIS Datasets shared by Gulf Regional Planning Commission (GRPC)
- Written descriptions of inventory and risks provided by the earlier City Hazard Mitigation Plans
- Existing plans and studies

Waveland Assets at Risk

Hancock County's parcel layer was used as the basis for the inventory of developed parcels. The property type categories were developed by GRPC from a recent land use survey and applied to the parcel dataset. Table 4.32 shows the count, land value, improved value, content value, and total value of parcels in Waveland.

Table 4.32. Waveland Total Property Assets at Risk by Property Type

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value*	Total Value with Land
Camp and Resort	1	0	$0	$0	$0	$0	$0
Commercial	101	89	$18,129,342	$40,759,811	$40,759,811	$81,519,622	$99,648,964
Cultural and Parks	6	3	$281,120	$988,634	$988,634	$1,977,268	$2,258,388
Education	2	0	$100,000	$0	$0	$0	$100,000
Government	7	2	$280,000	$3,136,185	$3,136,185	$6,272,370	$6,552,370
Land and Forest	5,545	105	$78,361,563	$3,930,075	$3,930,075	$7,860,150	$86,221,713
Medical	3	3	$217,625	$353,361	$530,042	$883,403	$1,101,028
Recreation and Entertainment	4	1	$319,996	$1,665,068	$1,665,068	$3,330,136	$3,650,132
Religion	31	6	$57,034	$700,468	$700,468	$1,400,936	$1,457,970
Residential	2,640	2,439	$57,929,545	$217,148,823	$108,574,412	$325,723,235	$383,652,780
Services	53	40	$3,953,828	$7,268,598	$7,268,598	$14,537,196	$18,491,024
Transportation	15	2	$1,783,010	$955,752	$1,433,628	$2,389,380	$4,172,390
Utilities and Communication	7	2	$119,864	$82,118	$123,177	$205,295	$325,159
Total	**8,415**	**2,692**	**$161,532,927**	**$276,988,893**	**$169,110,097**	**$446,098,990**	**$607,631,917**

Source: Hancock County Assessor's Data 2012, CRPC property type data
* Total value represents the improved value plus the content value for all Waveland parcels.

Critical Facility Inventory

Of significant concern with respect to any disaster event is the location of critical facilities in the planning area. Critical facilities are often defined as those essential services and facilities in a major emergency which, if damaged, would result in severe consequences to public health and safety or a facility which, if unusable or unreachable because of a major emergency, would seriously and adversely affect the health, safety, and welfare of the public.

The City of Waveland defined critical facilities in its 2007 Hazard Mitigation Plan as:

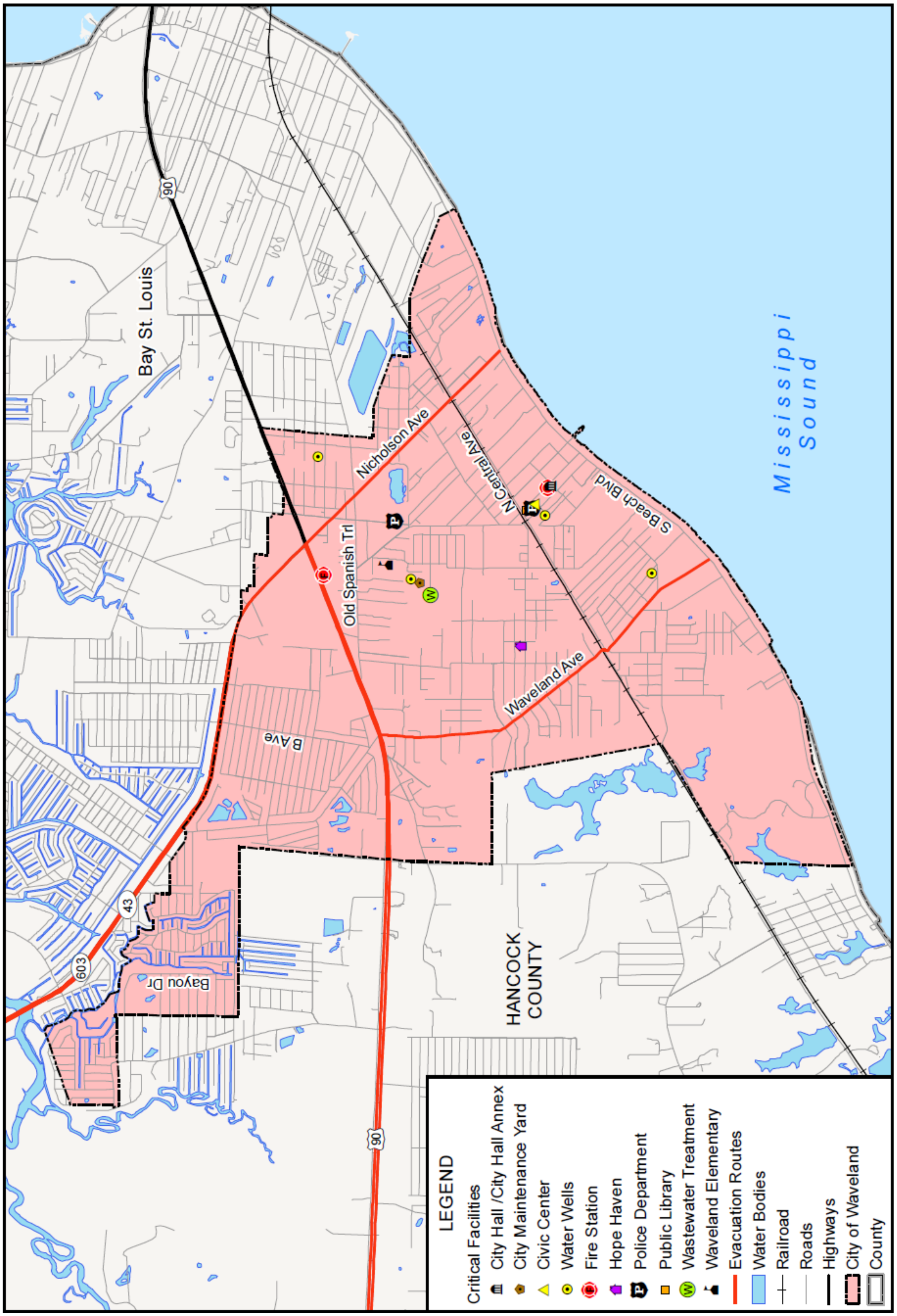
> "Facilities are considered critical because they are used for operation of government, public safety, or concentrations of populations such as children, elderly, or lower-income persons/families."

For the 2010 update to the plan, the City of Waveland has inventoried its critical facilities and classified them in the same way as the State of Mississippi in their 2010 State Hazard Mitigation Plan Update. The State of Mississippi developed the following definitions for Critical Facilities and Critical Infrastructure, with guidance from FEMA publication 386-2 and 42 U.S.C. 5195c. The intention of these definitions was to aid in the assessment of the vulnerability and operational necessity of facilities and systems within the state during the occurrence of a hazard event.

- A **Critical Facility** is defined as any structure that provides or houses critical services necessary to ensure the health and welfare of the population following a natural or man-made hazard event, including any facilities designated by local governments in their Hazard Mitigation Plan.
- **Critical Infrastructure** is defined as systems so vital to the State of Mississippi that the incapacity of those systems would have a debilitating impact on security, economics, public health, safety, or any combination of those factors, including any infrastructure designated by local governments in their Hazard Mitigation Plan.

Critical facilities in Waveland meeting this definition are shown in Figure 4.41 and Table 4.33.

Figure 4.41. Waveland Critical Facilities



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Map compiled 2/2013; intended for planning purposes only.
Data Source: Hancock County, City of Waveland

Table 4.33. Waveland Inventory of Critical Facilities

Facility	Type	Address/Coordinates	Replacement Value
City Hall	Public	301 Coleman Ave	$3,200,000
City Hall Annex	Public	301 Coleman Ave	$0
Fire Station #1	Fire Public	307 Coleman Ave	$1,800,000
Police Department	Public	335 Coleman Ave	$0
Public Library	Public	345 Coleman Ave	$1,639,377
Civic Center	Public	335 Coleman Ave	$3,209,313
Faith Street Water Well	Well	89 22' 10.891" W, 30 18' 18.234"N	$600,000
Tide Street Water Well	Well	89 22' 52.095"W, 30 16' 33.753"N	$600,000
Davis Ave Water Well	Well	89 22' 31.445"W, 30 17' 7.157"N	$600,000
Hope Haven	Public	716 Herlihy St	$200,000
Central Fire Station	Fire Public	427 Hwy 90	$3,287,000
Wastewater Treatment	Public	322 Gulfside	$15,000,000
City Maintenance Yard	Public	322 Gulfside	$1,000,000
Police Department (construction)	Public	1602 McLaurn	$4,415,979
Gulfside Street Water Well	Well	89 23' 0.253"W, 30 17' 47.799"N	$600,000
Waveland Elementary	Elementary Public	1101 St Joseph St	$3,500,000

Source: City of Waveland

Cultural, Historic, and Natural Resources

Assessing Waveland's vulnerability to disaster also involves inventorying the cultural, historical, and natural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- In the event of a disaster, an accurate inventory of natural, historical and cultural resources allows for more prudent care in the disaster's immediate aftermath when the potential for additional impacts is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, for example, wetlands and riparian habitat which help absorb and attenuate floodwaters and thus support overall mitigation objectives.

Cultural and Historic Resources

Waveland has a stock of historically significant homes, public buildings, and landmarks. To inventory these resources, the HMPC collected information from the following of sources.

- The **National Register of Historic Places** is the nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.
- The **Historic American Buildings Survey** and the **Historic American Engineering Record** collections document achievements in architecture, engineering, and landscape design in the United States and its territories through a comprehensive range of building types, engineering technologies, and landscapes.
- The **Historic Preservation Division of the Mississippi Department of Archives and History** works with individuals and local governments across the state and provides grants, tax incentives, and technical assistance from on-staff architectural historians and archaeologists for preservation projects. It oversees, among others, the State Historical Marker, Mississippi Landmark, and National Register of Historic Places programs.

According to the National Register of Historic Places, there are no properties on the National Register in the City of Waveland.

According to the Historic American Buildings Survey (HABS) and Historic American Engineering Record (HAER), there are no HABS and HAER structure in Waveland.

The Historic Preservation Division of the Mississippi Department of Archives and History does contain records of historic properties in the City. These are shown on Table 4.34.

Table 4.34. Mississippi Department of Archives and History Properties in Waveland

Name	Location	Date Designated	Date Recorded
Waveland Civic Center [Waveland Elementary School]	Coleman Avenue, Waveland, Hancock County	May 19, 2000	March 17, 2005

Source; Mississippi Department of Archives and History

The Waveland Civic Center represents the last remaining historical property in the City. All previous properties of cultural and historical significance within the City were destroyed during Hurricane Katrina.

Natural Resources

Natural resources are important to include in cost/benefit analyses for future projects and may be used to leverage additional funding for mitigation projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetlands areas protects sensitive habitat as well as reducing the force of and storing floodwaters.

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (i.e., endangered species) in the planning area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Information from the U.S. Fish and Wildlife Service was accessed to create an inventory of special status species in Waveland. Table 4.35 lists national and state endangered or threatened species in Waveland by species type.

Table 4.35. Threatened and Endangered Species in the Waveland Area

Group	Name	Scientific Name	Status
Birds	Arctic peregrine Falcon	*Falco peregrinus tundrius*	Recovery
Clams	Stirrupshell	*Quadrula stapes*	Endangered
Ferns and Allies	Louisiana quillwort	*Isoetes louisianensis*	Endangered
Fishes	Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Fishes	Pearl darter	*Percina aurora*	Candidate
Mammals	West Indian manatee	*Trichechus manatus*	Endangered
Mammals	American black bear	*Ursus americanus*	Similarity of Appearance (Threatened)
Reptiles	Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Reptiles	Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Reptiles	Green sea turtle	*Chelonia mydas*	Threatened
Reptiles	Loggerhead sea turtle	*Caretta caretta*	Threatened
Reptiles	Ringed map turtle	*Graptemys oculifera*	Threatened
Reptiles	Gopher tortoise	*Gopherus polyphemus*	Threatened

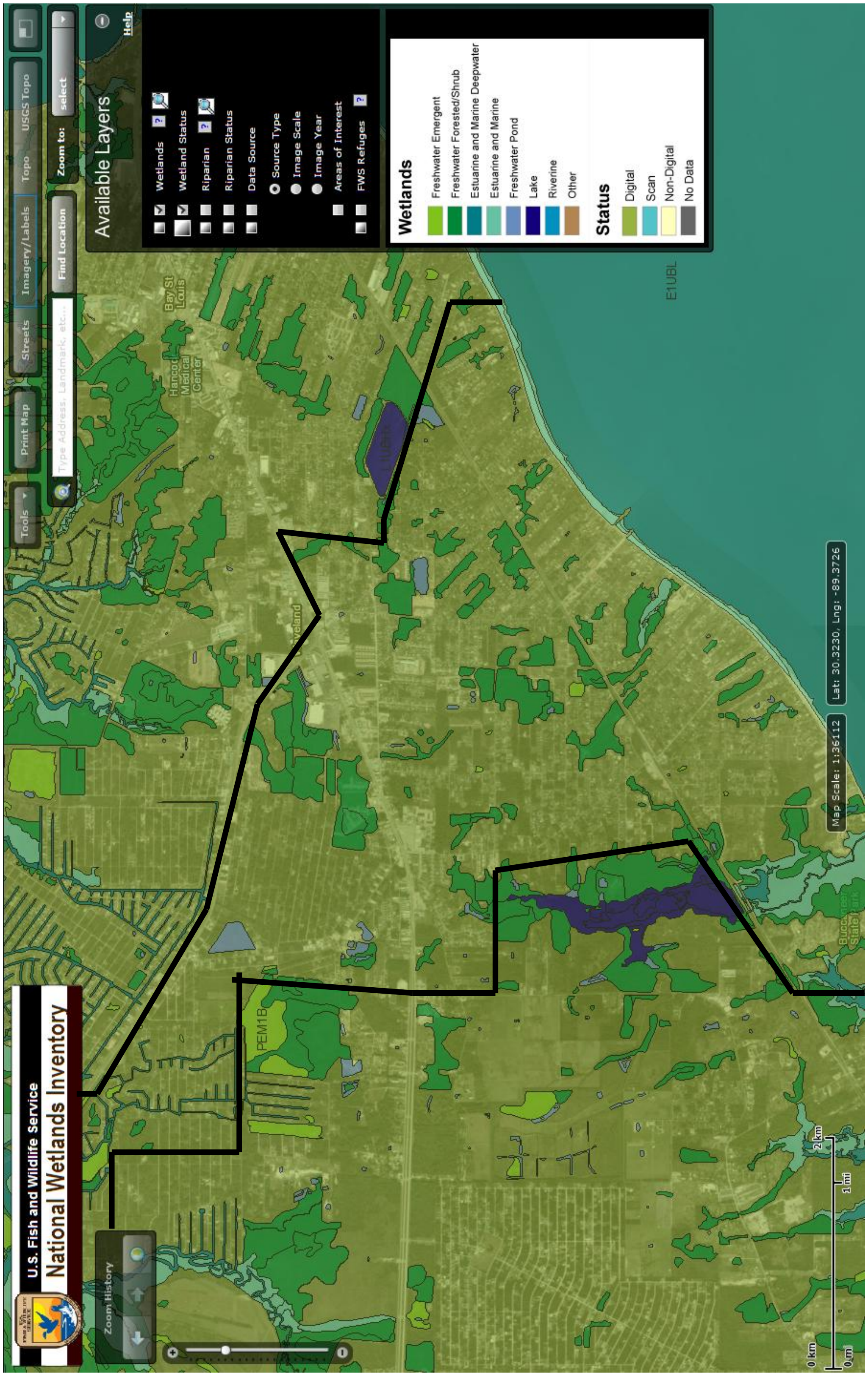
Source: US Fish and Wildlife Service

In addition to endangered species, the City of Waveland is also home to a variety of wetlands. The U.S. Fish and Wildlife Service defines wetlands as:

> "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (plants specifically adapted to live in wetlands); (2) the substrate is predominantly undrained hydric (wetland) soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year."

In the 2009 Waveland Comprehensive plan, an analysis was done on the area of the City that was considered wetlands. This analysis determined that only 1% (148 acres) of the total land area is covered with wetlands that are not otherwise within special flood hazard zones as described in Section 4.2.8. Figure 4.42, from the US Fish and Wildlife Service National Wetland Inventory, indicates the potential location of wetlands within the City of Waveland. Black lines approximate City limits.

Figure 4.42. Waveland Wetlands Map



Source: US Fish and Wildlife National Wetland Inventory

Other Natural Assets

Wetlands, marshes, and nearshore marine and estuarine habitat are the nursery grounds for the entire marine food chain in the Gulf of Mexico. These habitats have been identified by the U.S. Fish and Wildlife Service as habitats of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. Pollution, development, and other factors are destroying such habitat throughout the Gulf region. As this habitat is destroyed, it further depletes the species that form the base of the food chain throughout the Gulf of Mexico. Numerous species of marine flora and fauna begin their life cycles in marshes and wetlands. Ultimately, the entire Gulf of Mexico ecosystem is threatened by the accelerated destruction of this habitat. Failure to address the loss of this habitat in the Gulf of Mexico region threatens the long-term health of the entire ecosystem and human culture, with the attendant loss of billions of dollars of marine-related resources.

Growth and Development Trends

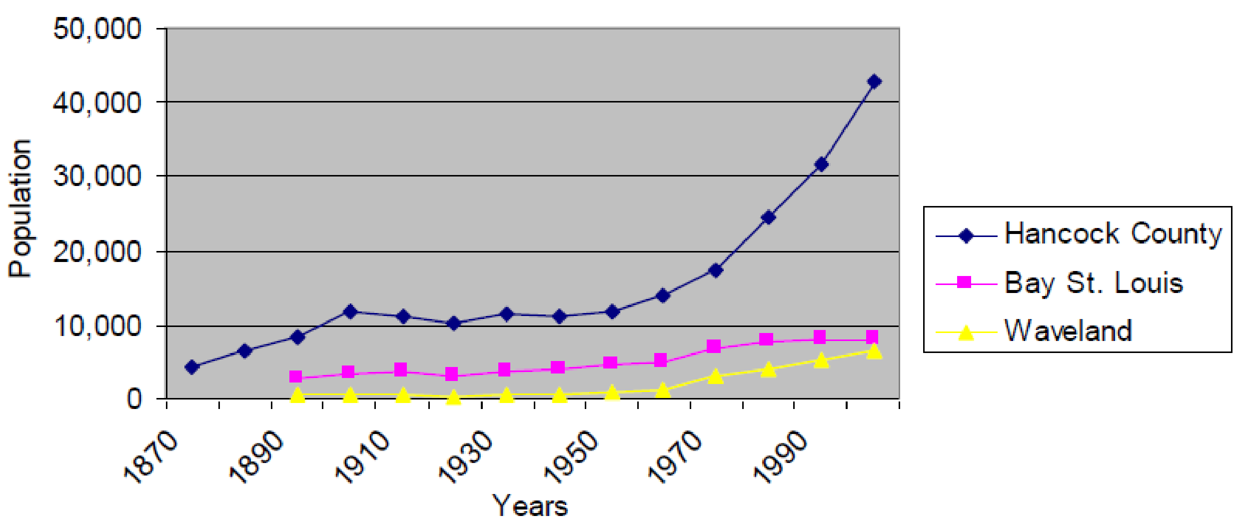
As part of the planning process, the HMPC looked at changes in growth and development, both past and future, and examined these changes in the context of hazard-prone areas, and how the changes in growth and development affect loss estimates and vulnerability. New development is occurring throughout the City of Waveland.

Population

Historic and Current Population

Historically, population growth in Waveland has been positive growth (see Figure 4.43 and Table 4.36). There have been periods of history where population change has seen a reduction, but positive population growth has been a historical norm for the City.

Figure 4.43. Population of Waveland Between 1870 and 2000



Source: Hancock County Comprehensive Plan Demographic Overview, January 18, 2007

Table 4.36. Population in Waveland From 1890-2000

Year	Population	Change from Previous Decade
1890	528	N/A
1900	520	-1.5%
1910	554	6.5%
1920	431	-22.3%
1930	663	53.8%
1940	768	15.9%
1950	793	3.2%
1960	1,106	39.4%
1970	3,108	181.0%
1980	4,168	34.1%
1990	5,369	28.8%
2000	6,674	24.36%
2010*	6,435	-3.6%

Source: City of Waveland Comprehensive Plan 2009
* US Census Bureau 2010 Population number

In each decade since 1970, population within the City of Waveland continued to grow, with double-digit growth figures each decade. But with the opening of the Diamondhead community, population in the unincorporated areas of Hancock County began to grow at a rate faster rate than that of the Cities in Hancock County.

During 2004 through 2006, two incidences occurred which would once again alter the population of the City of Waveland. In 2004, the Cities of Waveland and Bay St. Louis initiated an annexation of some of the same land area located north of both cities. The presentations by the cities concluded and were under consideration by a Chancery Court Judge, when on August 29, 2005, Hurricane Katrina made landfall along the Hancock County coastline. Nearly one year after Hurricane Katrina made landfall, on July 1, 2006, the Chancery Court Judge awarded additional land area to the City of Waveland as part of an annexation decree. With the annexation in 2006, the City added over 1,600 people to the population of the City. Futher, as a result of Katrina, the City saw a decline in population.

The population in the City of Waveland is projected to be 7,875 people by 2030, and the population in Hancock County is projected to be 53,696 people. This projection indicates that the population of the City of Waveland will account for about 14% of the County's total population (see Table 4.37).

Table 4.37. Future Population Growth in Waveland

2010*	2015**	2020**	2025**	2030**
6,435	6,122	6,673	7,224	7,875

Source: *US Census Bureau
**City of Waveland Comprehensive Plan, 2009

Land Use

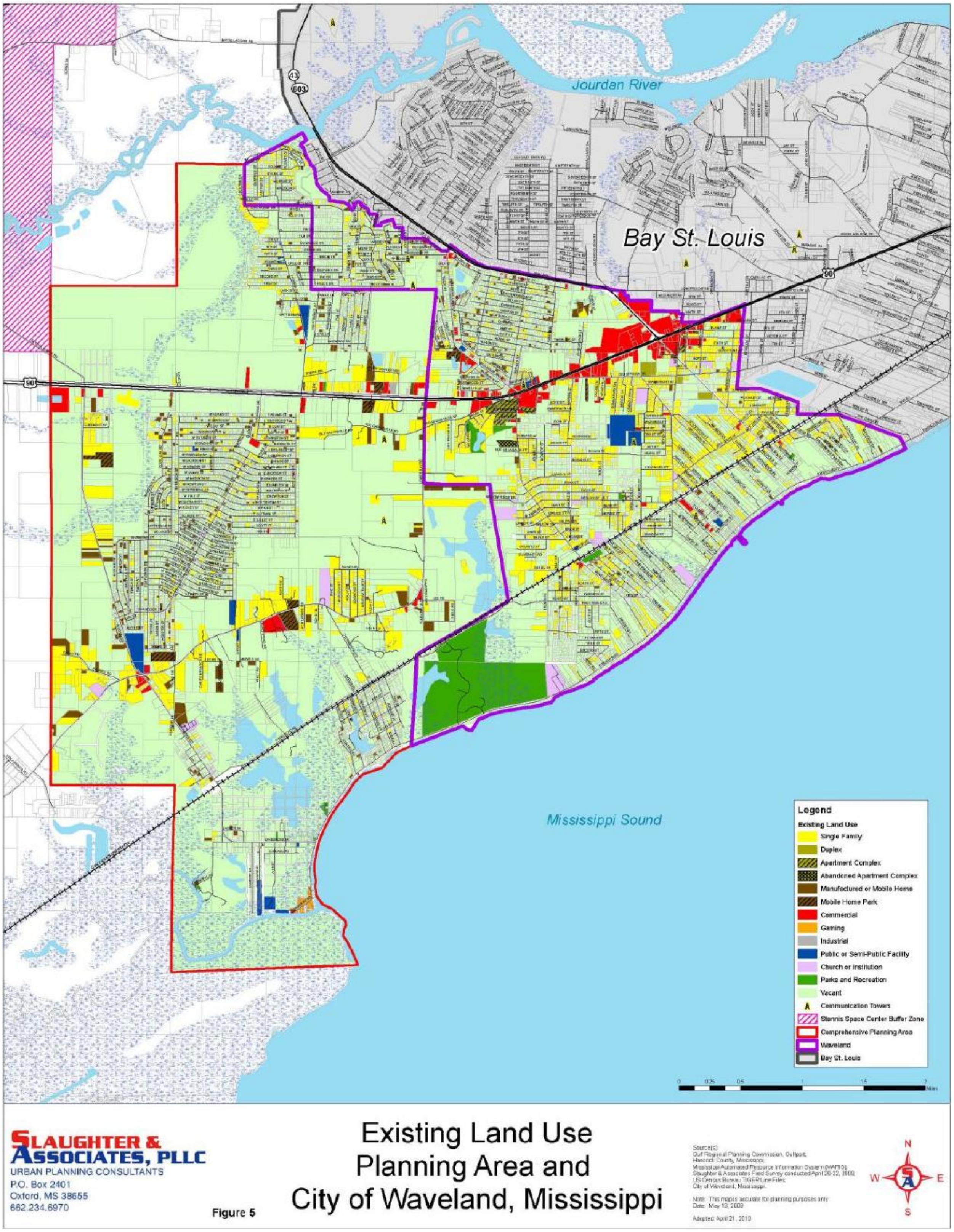
During the creation of the most recent Waveland Comprehensive plan, the City performed an Existing Land Use Study for the City's incorporated area. Existing land use data for the City of Waveland and their Planning Area was determined by a windshield survey update of an existing land use study that was conducted by the Gulf Regional Planning Commission (GRPC) during the winter of 2006 – spring of 2007. After the damage of Hurricane Katrina in 2005, the GRPC began a field study mapping the entire Hancock County land use, including incorporated cities and unincorporated areas. This study assigned codes to each individual parcel in the county. Land use categories used for this Comprehensive Plan analysis were a simplified and slightly modified version of the GRPC land use codes described above. The following standard classification of land uses was used:

- **Single-Family Residential** – This category identifies lots or parcels of any size that have one (1) detached residential unit on site.
- **Manufactured or Mobile Home** – This category consists of residential units that are factory built including mobile homes ("trailers"), travel trailers (used for Katrina relief housing), and Katrina Cottages. There is also a similar category that distinguishes between a single manufactured unit or a parcel developed as a mobile home park or subdivision.
- **Multi-Family Residential** – Multi-family residential is defined as a structure containing two (2) or more residential units, including but not limited to duplexes, townhomes, condominiums, apartments, etc. Duplexes and apartments are kept as separate categories for this land use plan.
- **Commercial** – Commercial uses consist of retail establishments of all types and sizes, gas stations, restaurants, mini-storages, car washes, etc. Office uses and professional services are also included within the commercial category.
- **Gaming** – Gaming land uses include casinos and any related activity on casino grounds.
- **Industrial** – This category includes uses and facilities involved with the processing, manufacturing, or distribution of materials.
- **Public or Semi-Public** – This category consists of uses that may relate to local, state, or federal governmental functions such as governmental office or service buildings, city halls, schools, libraries, etc. Utility substations, cell towers, and treatment facilities are also included within this classification.
- **Church or Institution** – This category includes any religious type facility including churches, cemeteries, and church affiliated disaster relief efforts from Hurricane Katrina.

- **Parks and Recreation** – Recreational uses include the passive or active use of the following facilities: city ballparks, playgrounds, public or private golf courses, neighborhood open space and Buccaneer State Park.
- **Vacant** – All other land free of the above uses or structures was classified as vacant. Vacant land also includes agricultural land uses that have to do with the cultivation of crops or raising of animals. Vacant beachfront property is also included in this category. Vacant land will be discussed and broken down in more detail within the latter part of this chapter. Please refer to the specific notes regarding the vacant land analysis to determine exactly which land types were included or not included for analysis purposes.

For the 2009 Comprehensive Plan, planners used the GRPC survey as a base but also conducted a windshield survey to verify any major changes within the past two years. Any changes such as new construction or rebuilding after Katrina were noted, updated, and included in the existing land use map. That map is included here as Figure 4.44.

Figure 4.44. Waveland Land Use



Source: City of Waveland Comprehensive Plan, 2009

Future Land Use

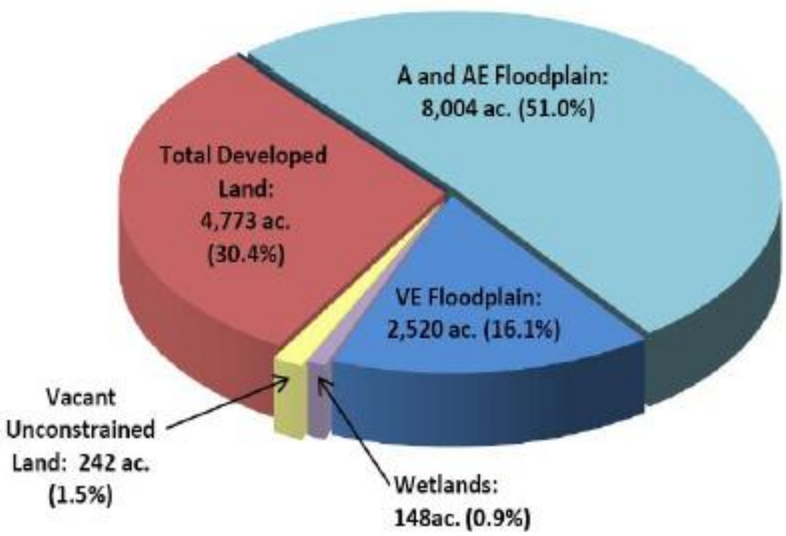
The Comprehensive Planning Area, which includes the City of Waveland has a total land area of 15,687 acres. Of this acreage, 4,733 acres are currently developed and 10,913 acres are vacant land. To analyze the development potential of this vacant land, it is necessary to identify the constraints on future development and understand the applicability of such limits. Most constraints or limits on development are not absolute. Indeed, most constraints are regulatory in nature and do not restrict development outright. Rather they impose construction and elevation requirements in addition to existing building and zoning codes. Further, in considering the constraints or limits upon vacant land use in the Comprehensive Planning Area, it is important to note that most of the area’s developmental limits derive from the area’s positive attributes - its coastal location, bayous and wetlands, not the more negative attributes associated with potential hazard risks inherent to the region.

This analysis from the Comprehensive Plan considers six land types or conditions that could constrain land use in the City. They are: Floodplains and floodways, wetlands, existing lakes/water bodies, severe slops and utility right-of-ways or easements.

The analysis is shown in Figure 4.45. The figure shows that of the 10,913 acres of vacant land in the City, only 242 acres of that is unconstrained for future development.

Figure 4.45. Vacant Land Analysis in Waveland

	Acres	Sq. Mi.	% of Total Land Area
City Limits Area:	5,669	8.86	-
Planning Area:	10,018	15.65	-
Total Comprehensive Planning Area:	15,687	24.51	-
Total Vacant Land:	10,913	17.05	69.6%
Vacant Constrained Land [1]:	10,672	16.67	68.0%
A, AE, VE Floodway Areas	0	0.00	0.0%
A and AE Floodplain Areas	8,004	12.51	51.0%
VE Floodplain Areas	2,520	3.94	16.1%
Wetlands(Outside FP/FW)	148	0.23	0.9%
Water Surface (Outside FP/FW/Wetlands)[2]	0	0.00	0.0%
Severe Slopes (Outside FP/FW/Wetlands)[3]	0	0.00	0.0%
Utility Easements (Outside FP/FW/Wetlands/Slopes)	0	0.00	0.0%
Vacant Unconstrained Land:	242	0.38	1.5%
Total Developed Land:	4,773	7.46	30.4%



Source: City of Waveland Comprehensive Plan, 2009

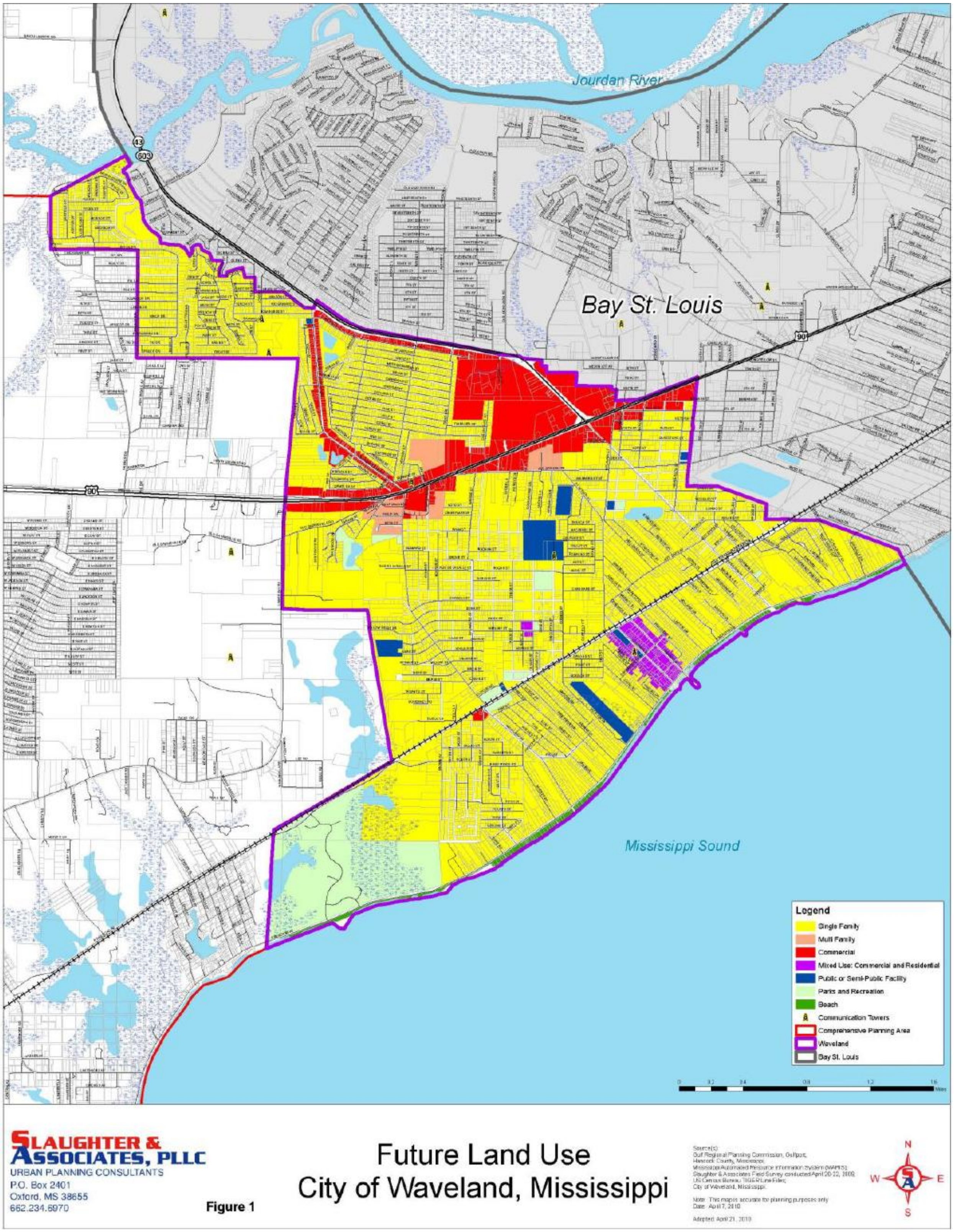
The future land use plan and the future thoroughfare map are important tools that will guide individual land use decisions. The future land use plan is based upon several elements, including the existing land use patterns, guidance provided by the citizens advisory committee, projections of growth within the community, and identified land use needs. Prior to Hurricane Katrina, the existing land use pattern within the City of Waveland was stable. Census information indicated that the median value of a home located within the City of Waveland grew at a rate faster than the median value of a home located within the State of Mississippi, and the median value of a home in Waveland grew at a rate consistent with other communities in Hancock County. Additionally, the City maintained its same high rate of home ownership.

Hurricane Katrina devastated the City of Waveland, but the pattern of land use within the City has not been significantly altered. Recommended land uses, while possibly different from uses permitted by current zoning, follow existing land use or preserve existing development densities. The majority of the City remains low to medium density residential, US Highway 90, MS Highway 603 and the Kiln Waveland Cutoff Road will continue to serve as regional primary shopping areas. The Coleman District will be rebuilt to serve as the City's Downtown, providing retail, entertainment and governmental functions for visitors and for residents of the City of Waveland. The future land use map is shown in Figure 4.46.

Additionally, in conjunction with the future land use plan, the following recommendations for future land use were included in the 2009 Waveland Comprehensive Plan.

- Develop and implement design guidelines which govern development along the City's gateway commercial corridors.
- Encourage the development of residential apartments and condominiums on the upper floors of commercial structures located within the Coleman Avenue District.
- Establish green spaces throughout the City of Waveland, in cooperation with schools, churches and developers. Through cooperation, costs for the purchase and maintenance of green spaces may be shared. Additionally, the City should consider that these green spaces may serve multiple functions.
- Create incentives to encourage additional residential development in the area bounded by Avenue C and Superior Street and the Kiln Waveland Cutoff Road and Chestnut Street. Incentives may include the development of open spaces, neighborhood parks and green spaces to enhance property values within this area. Other improvements may include enhanced infrastructure including additional drainage work.
- Constantly monitor redevelopment activities to ensure that actions taken do not adversely affect residents from rebuilding in the City of Waveland.
- Site Plan Review should be codified to ensure compliance with the Zoning and Subdivision Regulations and other City ordinances as they apply to large-scale and special projects. Site Plan Review should provide the developer with an understandable process for project review and approval which should conserve the time and efforts of City employees in various departments.
- Establish conservation based land trust or work with the Land Trust from the Coastal Mississippi Plain to conserve and maintain low-lying areas of Waveland, natural drainage areas of Waveland and to conserve green spaces and forested areas. The land trust should be able to provide guidance to people donating property for conservation and preservation purposes as to the tax benefits of their donations.
- Reevaluate the neighborhood commercial districts included within the City's zoning ordinance to determine if there is still a need for both neighborhood commercial districts after the development of the Coleman Zoning Districts.
- Rezone the Kiln Waveland Cutoff Road to allow continued commercial development along this collector roadway.

Figure 4.46. Waveland Future Land Use Map



Future Land Use Analysis

In order to determine where future development can occur in the City, AMEC performed an analysis on the location of possible future infill development areas. This was done using the following methodology. Using GIS, the 2012 Hancock County's parcel layer was used as the basis for the inventory of undeveloped parcels to help identify areas of future development. It is not to be assumed that all of the areas currently vacant will be developed. However, the maps do show where possible development may occur in the City. The northern portion of the City is shown in Figure 4.47. The southern portion of the City is shown in Figure 4.48. Any parcel that is colored in these maps is vacant or unimproved. Future development could happen in any of these parcels.

Figure 4.47. North Waveland Future Development Areas

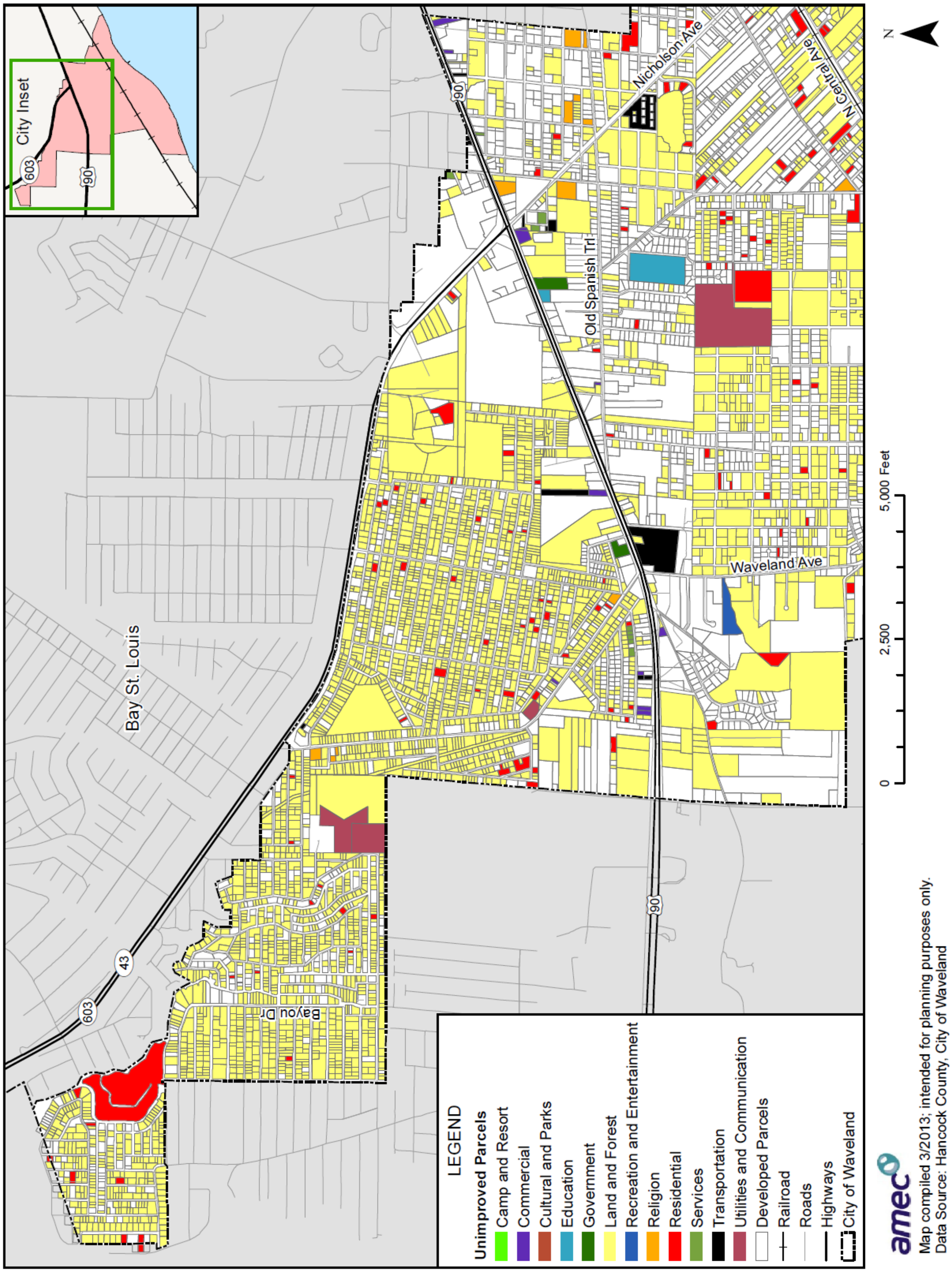
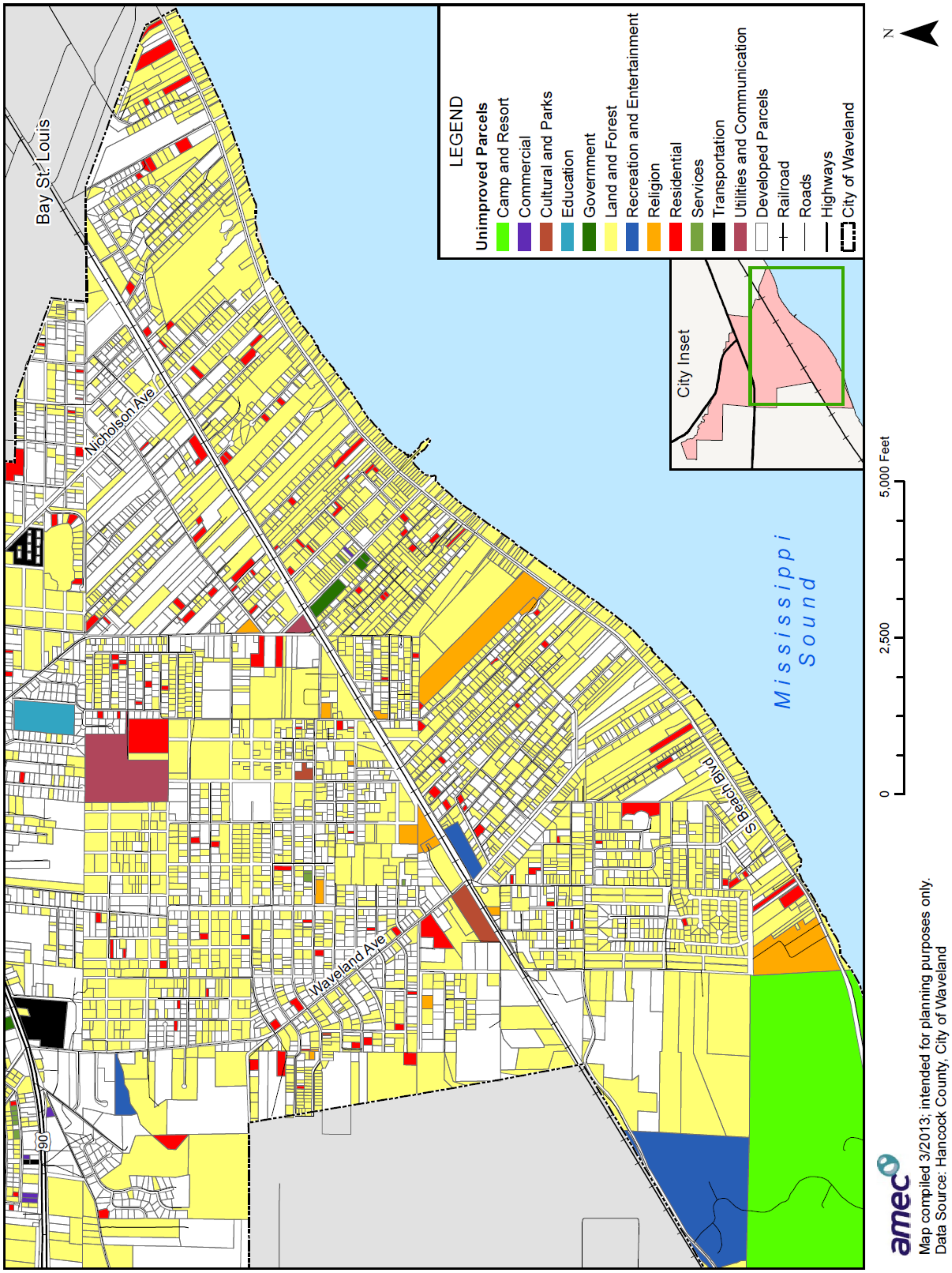


Figure 4.48. South Waveland Future Development Areas



A simple analysis was performed to quantify parcels within these development areas that are also in sea level rise, flood and hurricane storm surge hazard areas. Results can serve as a vulnerability analysis guide for future development.

Methodology and analysis of vulnerability of new growth areas to flood, storm surge, and sea level rise can be found in their respective hazard vulnerability assessments:

- Sea Level Rise (Section 4.3.2)
- Flood (Section 4.3.4)
- Hurricane Storm Surge (Section 4.3.6)

4.3.1 Vulnerability of Waveland to Specific Hazards

The Disaster Mitigation Act regulations require that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. This section summarizes the possible impacts and quantifies, where data permits, the City's vulnerability to each of the hazards identified as a priority hazard in Table 4.31 in Section 4.2.13 Natural Hazards Summary. The hazards evaluated, in order of risk to the City, further as part of this vulnerability assessment include:

- Climate Change (storm surge, sea level rise)
- Coastal/Canal Bank Erosion
- Flood: 100-/500-year
- Flood: Stormwater/Localized Flooding (including storm surge)
- Hurricane and Tropical Storms
- Thunderstorm (includes hail, lightning, high wind)
- Railroad Hazardous Materials Release

An estimate of the vulnerability of the City to each identified hazard, in addition to the estimate of risk of future occurrence, is provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**–The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **Low**–Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**–Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.

- **High**–Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High**–Very widespread with catastrophic impact.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical community facilities (e.g., a fire station), historic structures, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the impact, or vulnerability, of that area to that hazard.

The HMPC identified three hazards in the planning area for which specific geographical hazard areas have been defined and for which sufficient data exists to support a quantifiable vulnerability analysis. These hazards are flood and hurricane (both wind and storm surge), and railroad hazardous materials release. Potential sea level rise impacts associated with the climate change hazard are also quantified utilizing various potential scenarios based on available literature.. Because these hazards have discrete hazard risk areas, their risk varies by location. For flood, in addition to the findings in the State plan, the HMPC inventoried the following for the City, to the extent possible, to quantify vulnerability in identified floodplains:

- General hazard-related impacts, including impacts to life, safety, and health
- Values at risk (i.e., types, numbers, and value of land and improvements)
- Populations at risk (i.e, those residing in the hazard area base on land use and residential occupancy)
- Identification of critical facilities at risk
- Identification of cultural and natural resources at risk
- Development trends within the identified hazard area

For hurricane wind damage, the HMPC relied primarily on State plan findings for damage estimates; although a HAZUS run was conducted for this plan specific to the City. A more quantifiable assessment was done on the storm surge component of hurricane as described above. The City did quantify, to the extent possible, vulnerability to hurricane winds in the following categories:

- Flood damages from hurricanes
- Population at risk to hurricanes
- Loss of life from hurricanes
- Natural resources vulnerable to hurricane
- Private improvements at risk to hurricane
- Critical facilities at risk to hurricane

The vulnerability and potential impacts from the other priority hazards that do not have specific mapped areas nor the data to support additional vulnerability analysis are discussed in more general terms.

4.3.2 Climate Change and Sea Level Rise Vulnerability Assessment

Likelihood of Future Occurrence—Highly Likely
Vulnerability—High

The Waveland area, due to its location on the Gulf Coast, is vulnerable to the potential impacts of climate change and sea level rise. The climate change hazard profile in Section 4.2.1 discusses how climate-driven hazards such as hurricanes and flooding are likely to increase in frequency, and possibly intensity, in the future. Thus the 25-year flood of today may become the 10 year event in the future. The reader should refer to the vulnerability assessment discussions on flood (Section 4.3.4), erosion (Section 4.3.3), hurricane (Section 4.3.6), etc. for the current exposure and risk to these hazards with the perspective that climate change has the potential to exacerbate the existing risk and vulnerabilities. This section will focus on an assessment of direct impacts from sea level rise, using best available data. The potential impacts of climate change and sea level rise include increased flooding frequency, potential damage to critical infrastructure, and increasing public costs associated with flood insurance claims, infrastructure repair and maintenance, environmental impacts and increased costs associated with emergency management efforts.

Sea Level Rise

Sea level rise impacts on building and infrastructure are assessed with an exposure analysis as opposed to a loss estimate. This approach attempts to quantify the assets exposed to three different SLR scenarios (Best case: 1ft, Average case: 3ft, and worst case: 6ft). Since SLR is a gradual phenomenon it is assumed that buildings, contents, and infrastructure at risk can be relocated before permanent inundation occurs. This analysis provides an estimate of the magnitude of the land, buildings, and infrastructure potentially at risk to SLR.

Sea level rise can have the following impacts on property and infrastructure in the Waveland area:

- Coastal infrastructure: Bridges, docks, piers
- Jettys/erosion control structures
- Roads and bridges
- Utility infrastructure
- Erosion hazard zones
- Built environment including residential development
- Natural resources
- Recreational facilities and amenities such as beaches, public access points, and parks

- Loss of property and property tax revenue due to inundation

Assets at Risk

Based on the NOAA SLR inundation scenarios the loss of land due to inundation will be greatest on the northwestern portion of Waveland (See Figures 4.6 through 4.8 in Section 4.2.1). Areas adjacent to the Four Dollar Bayou are the most vulnerable. Southwestern areas of the City adjacent to the coast in the vicinity of Buccaneer State Park/Jackson Marsh are also at risk to permanent inundation, but these areas mostly undeveloped at present. The greatest risk to existing infrastructure is associated with residential properties and City streets in the Bayou Drive area in northwestern Waveland.

Tables 4.38 and 4.39 shows the results of an exposure analysis done with GIS using the three scenarios. Table 4.38 shows the sea level rise type and associated land use areas to give greater detail. Minimal impacts occur at the 1 ft level, but significant inundation of developed areas occurs in the 3 ft and 6 ft levels. With sea level rise, the loss estimate includes the total land value and improved value of the properties, as it is assumed the entire property (both land and structures) is unusable and at loss once it is inundated. Contents values are not included in these tables, as sea level rise is a gradual process, which allows people to move the contents of the property out prior to inundation. Table 4.39 is a summary table by sea level rise type and details the loss ratio. The loss ratio looks at the total loss estimate for each SLR scenario relative to the total potential exposure of the City to that hazard. For SLR, the total exposure of the City to SLR is the total land value plus improved value for all parcels within the City limits.

Table 4.38. Waveland Sea Level Rise Detail by Land Use Type

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Total Value*	Loss Estimate
1ft Sea Level Rise						
Sea Level Rise Area						
Land and Forest	143	0	$227,177	$0	$227,177	$227,177
Total Sea Level	**143**	**0**	**$227,177**	**$0**	**$227,177**	**$227,177**
Low Inundation Area						
Land and Forest	7	0	$26,223	$0	$26,223	$26,223
Residential	2	1	$8,000	$49,442	$57,442	$57,442
Total Low Inundation	**9**	**1**	**$34,223**	**$49,442**	**$83,665**	**$83,665**
Total at Risk	**152**	**1**	**$261,400**	**$49,442**	**$310,842**	**$310,842**

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Total Value*	Loss Estimate
3ft Sea Level Rise						
Sea Level Rise Area						
Land and Forest	1,091	10	$5,379,859	$19,500	$5,399,359	$5,399,359
Residential	132	118	$1,122,034	$6,116,314	$7,238,348	$7,238,348
Utilities and Communication	1	0	$15,730	$0	$15,730	$15,730
Total Sea Level	**1,224**	**128**	**$6,517,623**	**$6,135,814**	**$12,653,437**	**$12,653,437**
Low Inundation Area						
Land and Forest	16	0	$723,487	$0	$723,487	$723,487
Residential	4	2	$52,980	$207,075	$260,055	$260,055
Utilities and Communication	1	0	$17,328	$0	$17,328	$17,328
Total Low Inundation	**21**	**2**	**$793,795**	**$207,075**	**$1,000,870**	**$1,000,870**
Total at Risk	**1,245**	**130**	**$7,311,418**	**$6,342,889**	**$13,654,307**	**$13,654,307**
6ft Sea Level Rise						
Sea Level Rise Area						
Camp and Resort	1	0	$0	$0	$0	$0
Commercial	2	2	$128,587	$463,565	$592,152	$592,152
Land and Forest	2,157	23	$14,500,966	$98,191	$14,599,157	$14,599,157
Recreation and Entertainment	1	0	$0	$0	$0	$0
Religion	5	2	$0	$307,364	$307,364	$307,364
Residential	254	224	$2,982,428	$13,649,077	$16,631,505	$16,631,505
Services	4	4	$80,680	$412,911	$493,591	$493,591
Transportation	1	0	$0	$0	$0	$0
Utilities and Communication	2	0	$33,058	$0	$33,058	$33,058
Low Inundation Area						
-	0	0	$0	$0	$0	$0
Total Low Inundation	**0**	**0**	**$0**	**$0**	**$0**	**$0**
Total at Risk	**2,427**	**255**	**$17,725,719**	**$14,931,108**	**$32,656,827**	**$32,656,827**

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012
*Total Value includes the sum of land and improved values

Table 4.39. Waveland Sea Level Rise Summary

Sea Level Rise Type	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Total Value*	Loss Estimate	Loss Ratio
1ft Rise	152	1	$261,400	$49,442	$310,842	$310,842	0.05%
3ft Rise	1,245	130	$7,311,418	$6,342,889	$13,654,307	$13,654,307	2.25%
6ft Rise	2,426	255	$17,725,719	$14,931,108	$32,656,827	$32,656,827	5.37%

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012
*Total Value includes the sum of land and improved values

In analyzing the SLR loss estimates, it is also interesting to note the actual percentages of total and improved parcels by SLR scenarios. For example, of the total parcel count of 8,415 in the City of Waveland, 152 parcels or 2% of the parcel inventory is affected by the 1 ft SLR scenario. For the 6 ft. SLR scenario, this increases to 2,426 affected parcels or 29% of the total parcel inventory affected by SLR inundation. This analysis is also done on just the improved parcel inventory of 2,692 in the City. Again, looking at the 1 ft and 6 ft scenarios, the affected percentage of improved parcels goes from 0.04% to 9%. Thus the most significant SLR impacts to the City for any of the scenarios are to unimproved parcels. See Table 4.40 for details.

Table 4.40. Property Percentages

Sea Level Rise Type	Total Parcel Count	Total Parcel %	Improved Parcel Count	Improved Parcel %
1ft Sea Level Rise	152	2%	1	0.04%
3ft Sea Level Rise	1,245	15%	130	5%
6ft Sea Level Rise	2,426	29%	255	9%

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012
Total Parcel Count – 8,145; Total Improved Parcel Count – 2,692

Also of interest in evaluating potential SLR impacts to the City, is looking at the affected building footprints and area (by acre) inundated by each SLR scenario. Similar to the above analysis looking at percentages of improved parcels affected, the building footprint analysis looks at the actual buildings affected by each SLR scenario and the percentage of total buildings affected in the City (see Table 4.41).

Table 4.41. Building Footprints* in Sea Level Rise

Sea Level Rise Type	Building Count	% of Buildings
1ft Sea Level Rise	11	0.2%
3ft Sea Level Rise	356	6%
6ft Sea Level Rise	666	12%

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012
*Total Buildings within Waveland City Limits - 5,724

Another way to evaluate potential impacts to the City is looking at total land area affected by the various SLR scenarios. Based on the total land area (in acres) in the City, 4%, 15%, and 26% of the total land area is affected by the 1 ft, 3ft, and 6 ft SLR scenarios, respectively (see Table 4.42).

Table 4.42. Area of Sea Level Rise in Acres

Sea Level Rise Type	Area	% of Land Inundated
1ft Sea Level Rise	214	4%
3ft Sea Level Rise	819	15%
6ft Sea Level Rise	1,424	26%

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012
Total Area of Waveland 5,523

In addition to looking at the lateral extent of what is affected under the various SLR scenarios, it helps to understand the actual depth of SLR impacts. Figure 4.49provides an overview of the depths of the SLR impact for each scenario. Figure 4.50 shows a more detailed look of the depth for the worst case, 6 ft scenario with imagery.

Figure 4.49. Waveland Sea Level Rise Overview Map

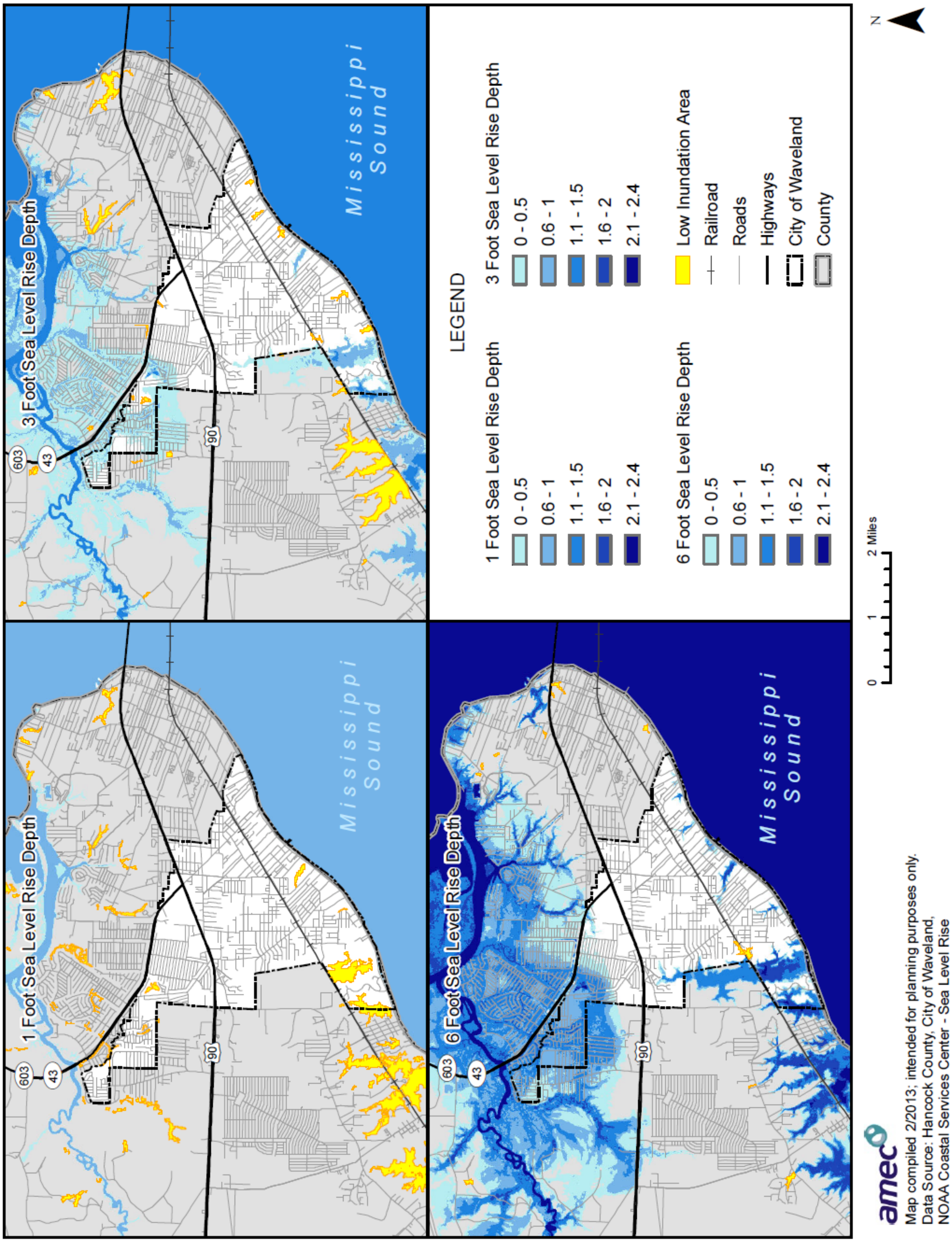
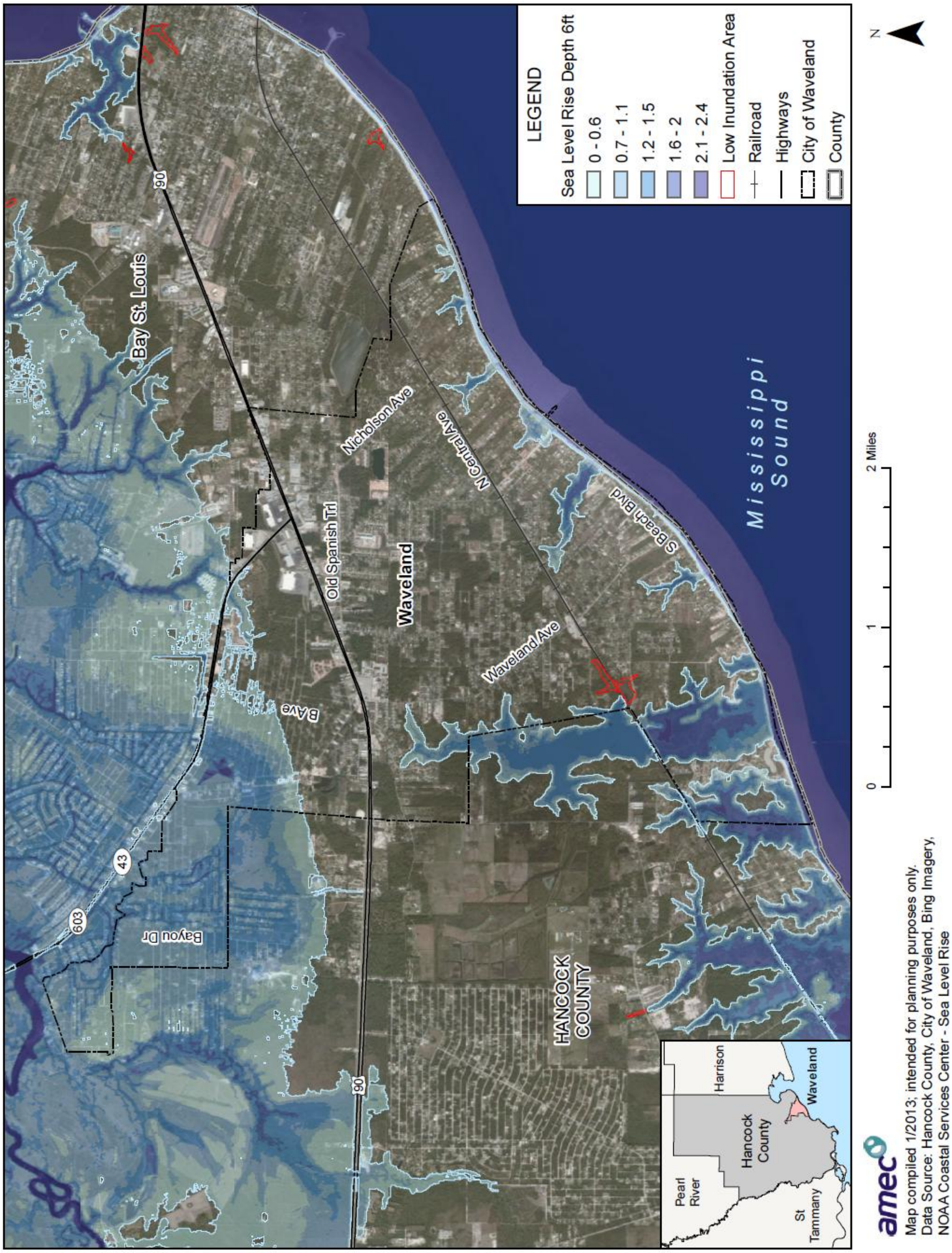


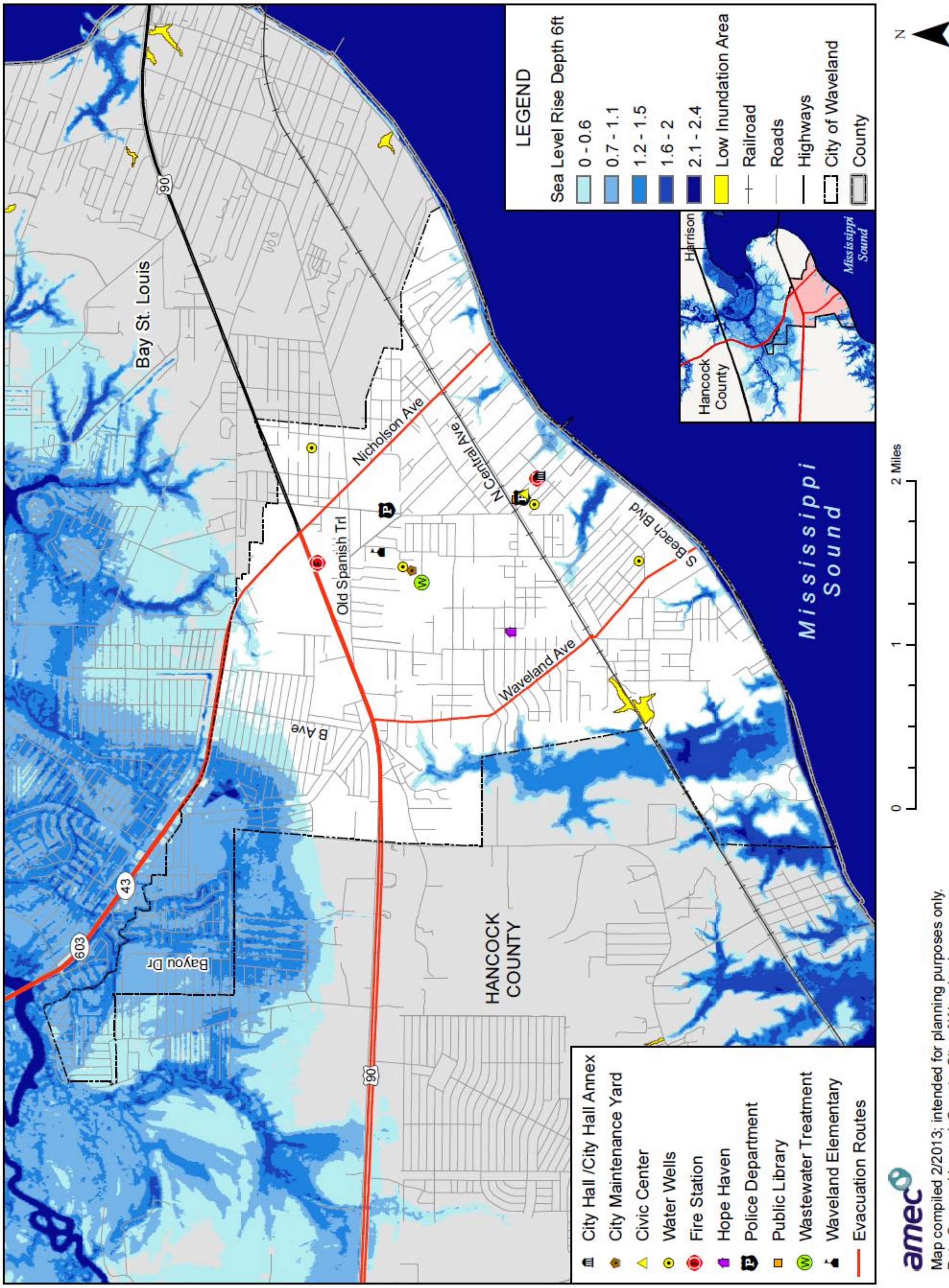
Figure 4.50. Waveland Sea Level Rise 6 foot Scenario with Imagery



Critical Facilities at Risk

A GIS analysis of SLR direct impacts to critical facilities indicated that the City's facilities are not at risk to direct inundation, even for the 6 ft worst case scenario (see Figure 4.51).

Figure 4.51. Waveland 6 Foot Sea Level Rise – Critical Facilities



Population at Risk

Based on a visual interpretation of the SLR scenario maps the impacts of SLR to neighboring Bay St Louis are likely to be even more severe. This could result in more development pressures and population shifts into Waveland in the future. Table 4.43 represents an estimate of the population presently residing in areas prone to SLR based on applying an average household size factor of 2.50 for the City of Waveland from the U.S. Census Bureau to the amount of residential parcels in the SLR inundation zones from the three scenarios. Note that 10% of the present day population is at risk from the worst case scenario.

Table 4.43. Population At Risk to Sea Level Rise

SLR Scenario	Developed Residential Parcels*	Population Estimate**
1 foot	1	3
3 foot	120	300
6 foot	224	560

Source: AMEC analysis,
*In both sea level rise and low inundation areas
**based on U.S. Census Bureau Average Household Size of 2.50

Future Development

Population and infrastructure on the Mississippi coast continues to increase as the Gulf Coast continues to recover from Hurricane Katrina. With this development there is potential for additional properties to become at risk to sea level rise and climate change impacts. Floodplain management, future land use planning, and careful site selection for critical facilities and infrastructure will be important considerations in reducing the potential vulnerabilities and impacts of sea level rise on man-made systems in Waveland.

Methodology

A simple analysis was performed to quantify parcels within these development areas that are also in sea level rise areas. Sea level rise and low inundation area GIS layers were provided by the NOAA Coastal Services Center. Analysis was performed on sea level rise and low inundation areas for 1, 3 and 6 foot intervals. Unimproved parcel centroids were intersected with each of these scenarios. Figures 4.73 through 4.54 were created to show were undeveloped land could be impacted by sea level rise. Table 4.70 details the unimproved parcels at risk to the three sea level rise scenarios.

Figure 4.52. Future Development in the 1 foot Sea Level Rise

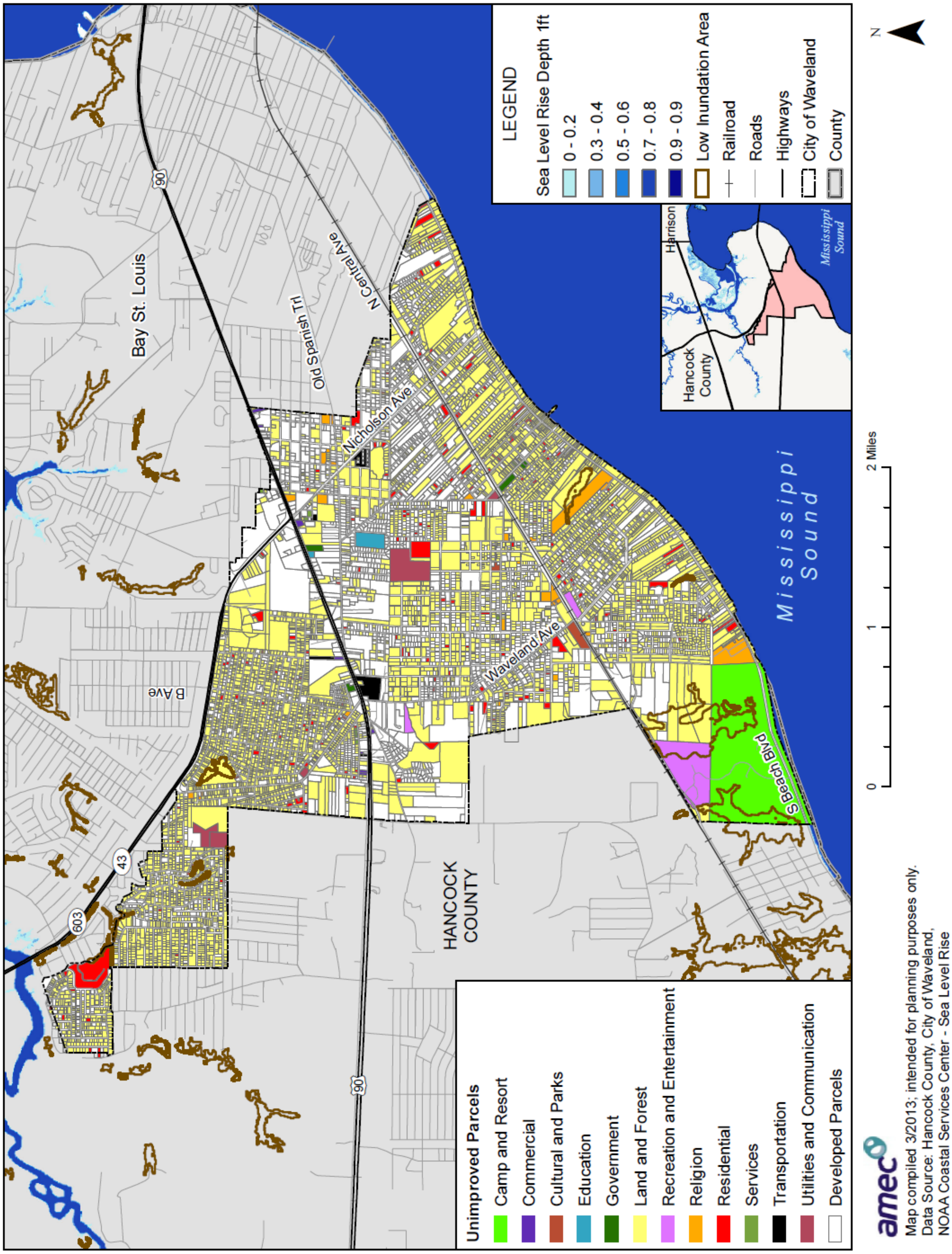


Figure 4.53.   Future Development in the 3 foot Sea Level Rise

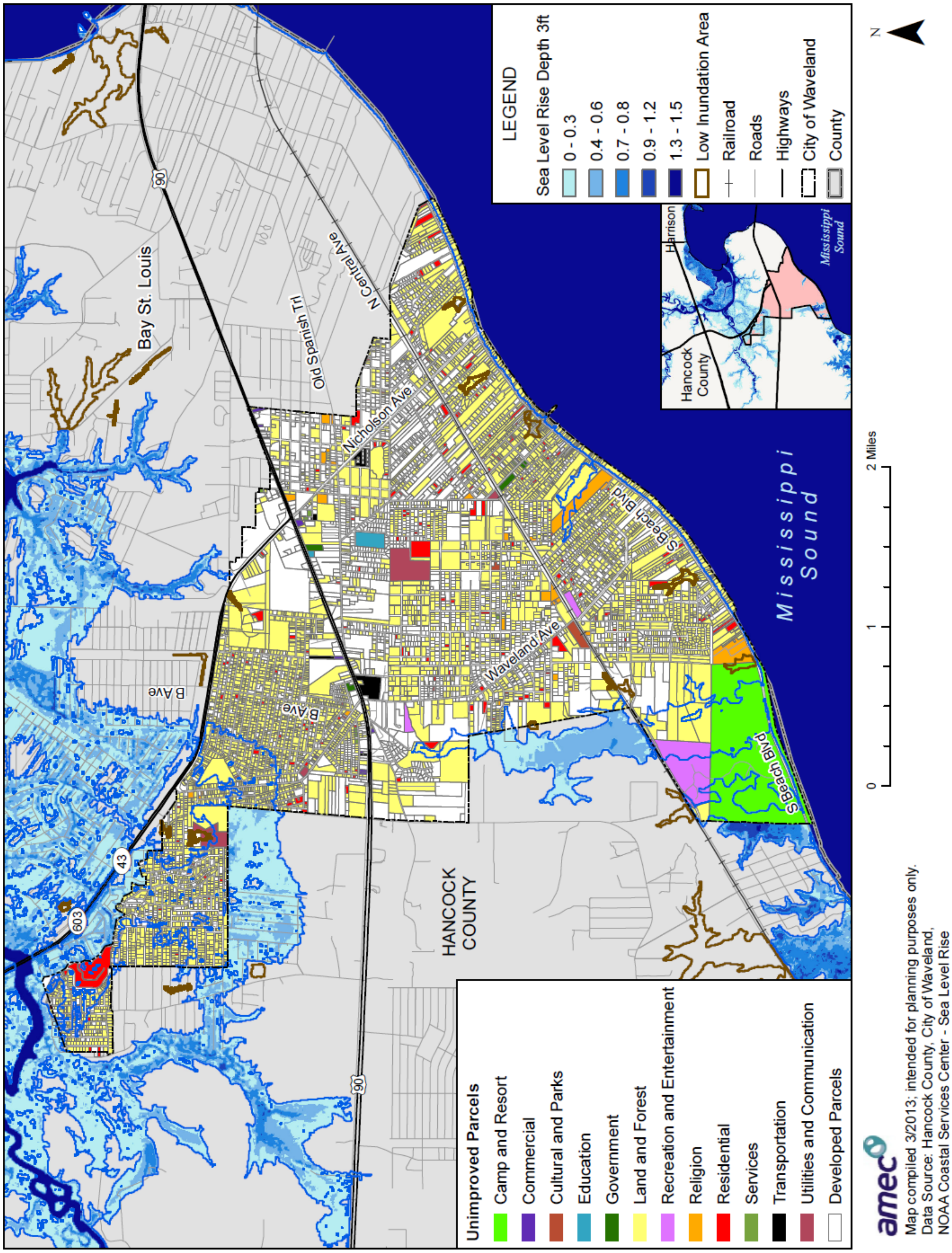


Figure 4.54. Future Development in the 6 foot Sea Level Rise

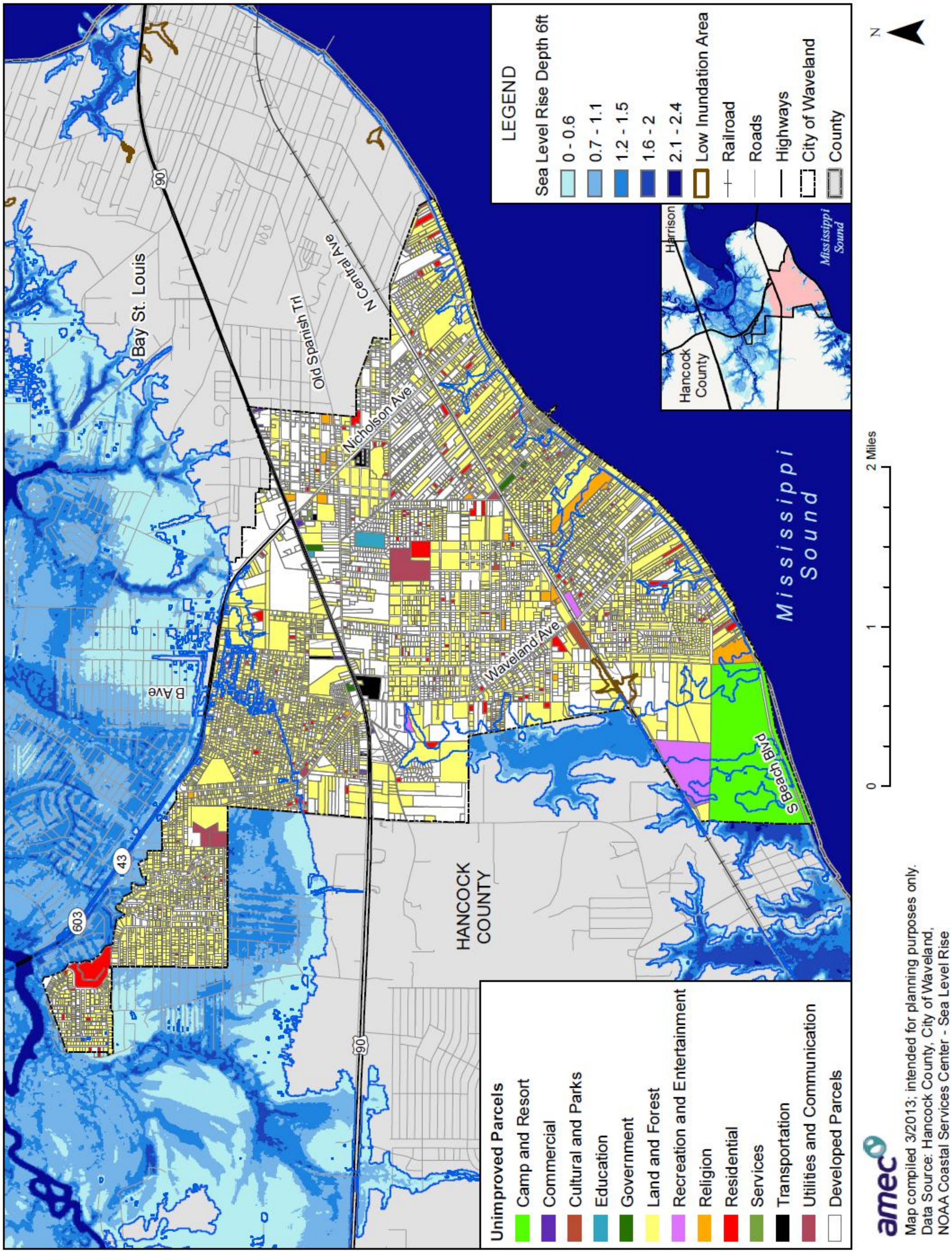


Table 4.44. Waveland – Future Development Parcels and Sea Level Rise

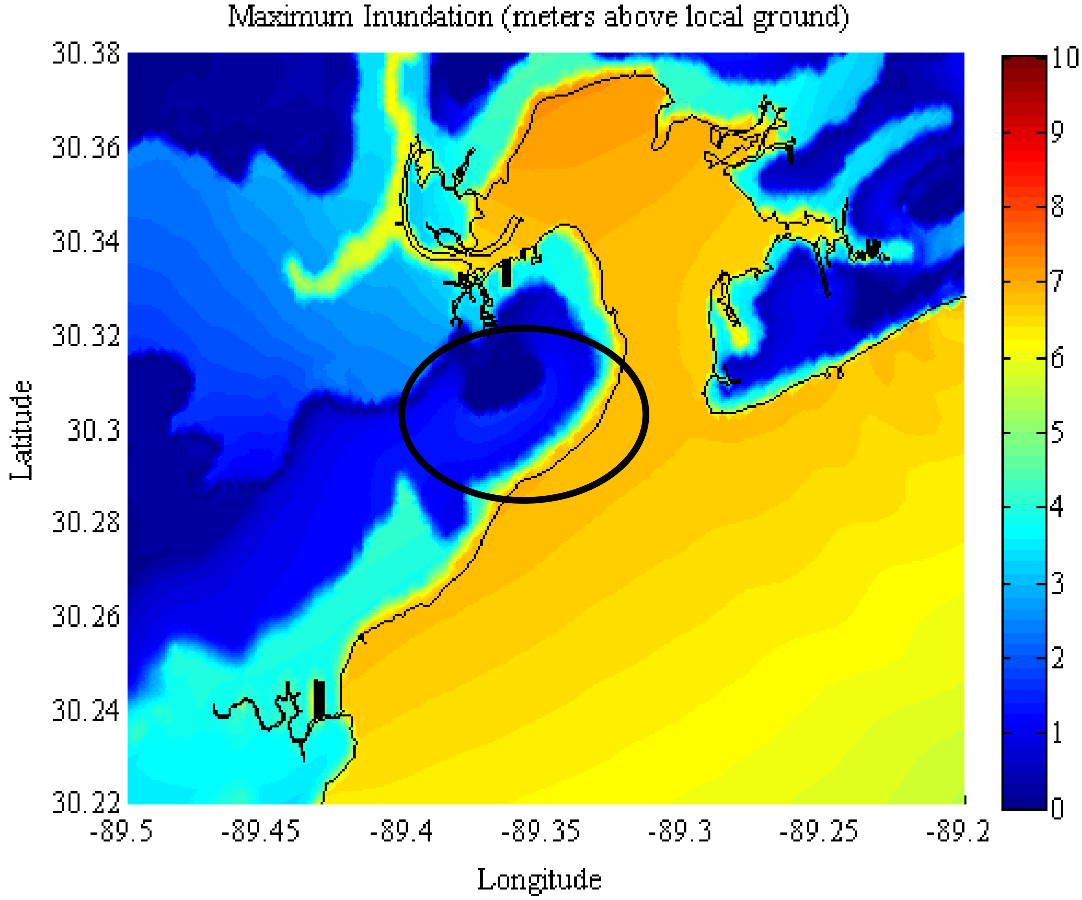
Land Use	Unimproved Parcel Count	Land Value
1 foot Sea Level Rise and Low Inundation Area Parcels		
Cultural and Parks	150	$253,400
Residential	1	$4,000
Total 1 foot	**151**	**$257,400**
3 foot Sea Level Rise and Low Inundation Area Parcels		
Land and Forest	1,097	$6,030,736
Residential	16	$110,073
Utilities and Communication	2	$33,058
Total 3 foot	**1,115**	**$6,173,867**
6 foot Sea Level Rise and Low Inundation Area Parcels		
Camp and Resort	1	$0
Land and Forest	2,134	$14,357,126
Recreation and Entertainment	1	$0
Religion	3	$0
Residential	30	$182,593
Transportation	1	$0
Utilities and Communication	2	$33,058
Total 6 foot	**2,172**	**$14,572,777**

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012

Storm Surge Flooding

During the planning process an effort was made to collection information regarding existing modeling of hurricane storm surge incorporating sea level rise. The NASA Stennis Space Center had completed modeling using ADCIRC to assess the flood and inundation risk to the Center, utilizing the 2005 Hurricane Katrina as the baseline storm scenario. One scenario considered a historical hurricane Katrina storm with an additional 10 inches of global sea level rise. The results indicate that the surge is increased and overland surge penetrates further inland (see Figure 4.55) and all of Waveland is inundated by water at its shallowest at least a half meter deep. Note that a 30 M resolution DEM was used as the basis for the simulation. Higher resolution NOAA LiDAR data for the region recently became available and could be used to refine these simulations and would allow high resolution depth grids to be generated in and around Waveland. See the discussion on hurricane storm surge flood vulnerability for an estimate of losses based on existing conditions associated with various category storms. Sea level rise and climate change magnify those impacts by affecting the frequency and intensity of surge events.

Figure 4.55. Storm Surge Inundation Map based on a Hurricane Katrina Repeat and 10 inches of SLR



Source: Stennis Space Center. Black oval represents approximate location of Waveland

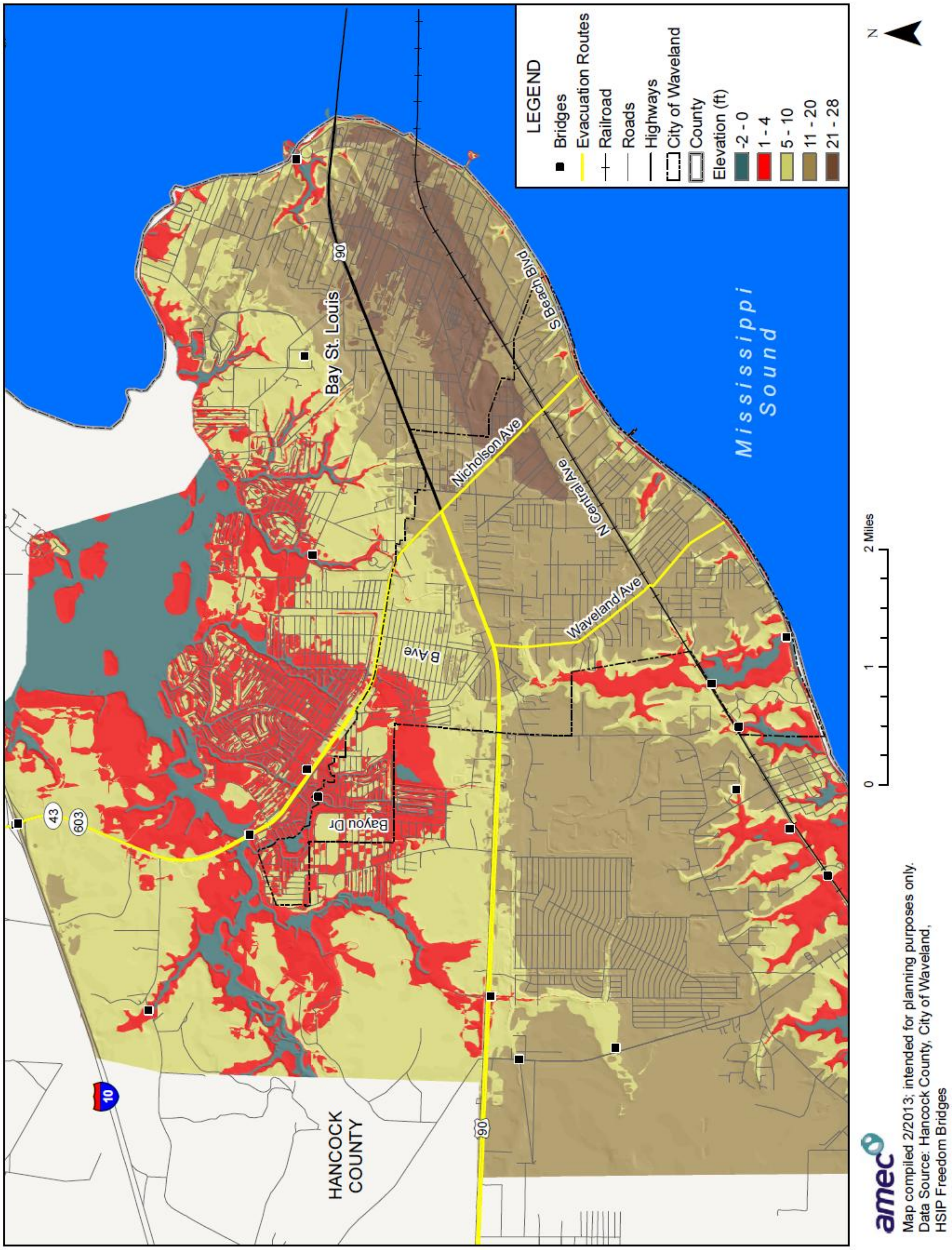
With more detailed topography data becoming available the City of Waveland may want to consider further analyses. Modeling can be an extensive and expensive undertaking, however, thus the relative merit of more this should be balanced against what is already known, namely that the community is already very at risk to coastal flooding and storm surge.

Shallow Coastal Flooding

Many coastal areas experience periodic minor-to-moderate shallow coastal flooding events typically as a result of meteorological factors that include high tides, winds, and rain. These events often affect roadways, buildings, and other infrastructure. Properties located in low lying areas and VE flood zones are most at risk, not just to long term inundation of the sea but more frequent flooding. Already the City of Waveland is mostly within an existing FEMA designated flood zone that has a significant history of flooding during "normal" rain events. This includes many repetitive and severe repetitive loss properties, as defined by the NFIP. The saying "Today's flood is tomorrow's high tide" is particularly applicable to areas that are frequently inundated due to seasonal rain events.

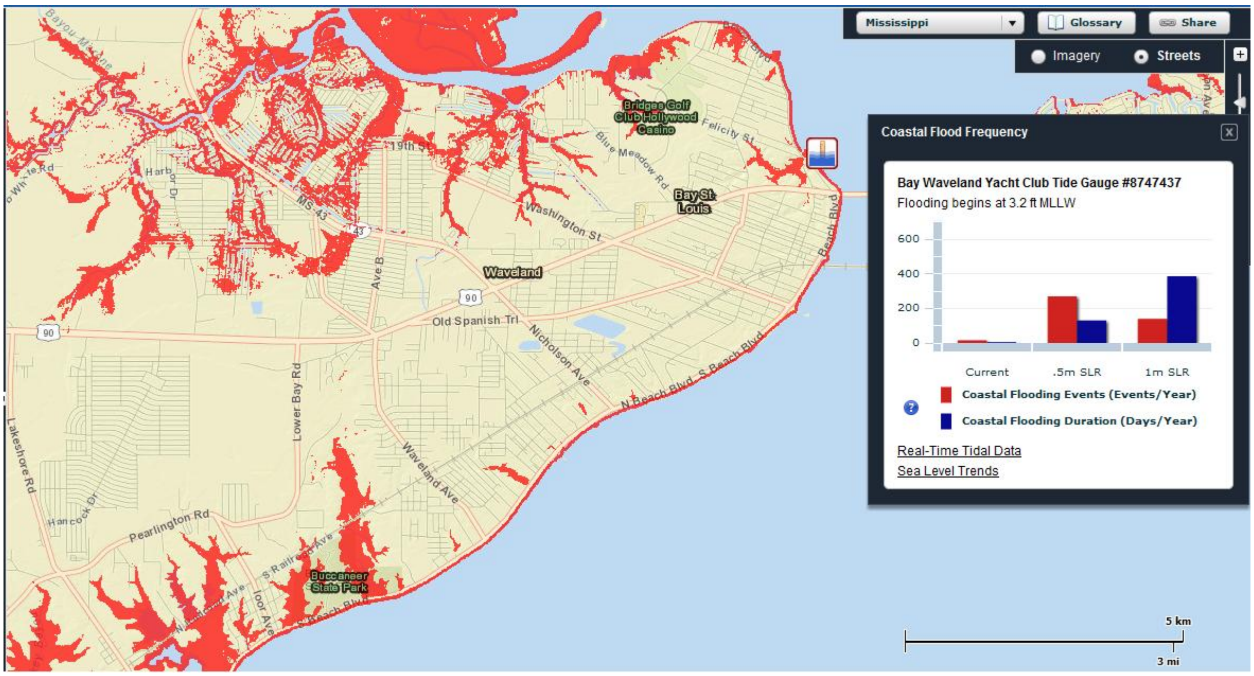
More frequent tidal, rain event, and storm surge flooding of low-lying areas would cause more frequent flooding of transportation infrastructure. This can disrupt travel and damage roads, highways, bridges, oil and gas operations, and other structures in coastal areas. The greater Gulf Coast transportation network is particularly vulnerable since many roads in the region of the Southeast are at an elevation of four feet or less (Gulf Coast Transportation vulnerability study 2008). Figure 4.56 illustrates the location of key evacuation routes for the City of Waveland relative to the local topography of the area. The red on the figure show those areas within the City that are at an elevation of four feet or less. With key evacuation routes intersecting many of these low lying areas, further evaluation of road elevations for key routes are warranted.

Figure 4.56. Waveland Topography with Evacuation Routes and Bridges



The NOAA Sea Level Rise Viewer (http://www.csc.noaa.gov/slr/viewer/#) allows a user to click on a NOAA tide station in an on-line map to see information on the current frequency of coastal flood events and durations as compared to hypothetical half-meter and one-meter sea level rise scenarios. This map illustrates the extent of flood-prone coastal areas based on predicted water levels exceeding specific tidal heights as issued by local National Weather Service offices. The coastal flood event frequencies and durations for tide gauges were calculated using observed tidal data over a three year period (2007-2009). The future frequency and duration predictions are based on the addition of half-meter and one-meter sea level rise scenarios to the observed water levels over the three-year period. As can be seen in Figure 4.57 with the map the coastal flood frequency (events/year) and duration (days/year) increases considerably with only a half-meter rise in sea level.

Figure 4.57.   Areas Near Waveland Subject to Shallow Coastal Flooding



Source: NOAA Sea Level Rise Viewer (http://www.csc.noaa.gov/slr/viewer/#)

Natural Resources at Risk

Natural ecosystems within the Mississippi Sound are vulnerable to direct and indirect impacts of sea level rise. Direct impacts include impacts to wetlands and other estuarine environments. SLR has the potential to affect these systems' ability to migrate as sea levels increase or decrease, as well as reducing the natural and beneficial functions they provide for absorbing floodwaters and storm surge. Indirect impacts include changes in salinity, impacts to emergent vegetation, and the ability of sediments to migrate and settle in areas of potential land loss. Area potentially at risk near Waveland include Bucaneer State Park, Gulf Ecological Management site (GEMS) coastal preserves, National Wildlife Reserves, and the Mississippi Barrier Islands. Impacts to these systems have already been realized and are evidenced by changes and shifts in the shape and location of the barrier islands, and loss of wetlands over time (MS Dept of Marine Resources report 2011). Continued increases in sea levels will continue to place these systems at risk and will serve to increase the vulnerability of Mississippi's coastal ecosystem, as well as the built environment.

Future Development

Population and infrastructure on the Mississippi coast continues to increase as the Gulf Coast continues to recover from Hurricane Katrina. With this development there is potential for additional properties to become at risk to storm surge and climate change impacts. Floodplain management, future land use planning, and careful site selection for critical facilities and infrastructure will be important considerations in reducing the potential vulnerabilities and impacts of storm surge on man-made systems in Waveland.

4.3.3 Coastal/Canal Bank Erosion

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Canal Bank Erosion

Waveland has had events of canal bank erosion in the past. Canal bank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects. Local interests have, with limited finances, sought for many years to provide protection from reoccurring floods on the canals that traverse the City. Areas of specific risk include

- Shoreline Park
- Bayou Phillips
- Jackson Marsh Area
- Bayou Drive

Erosion is occurring as a matter of course on a limited basis to all canal bank areas. There is no one place that has significant issues that need to be addressed through a project at this time.

Coastal Erosion

The severity of coastal erosion is typically measured through a quantitative assessment of annual shoreline change for a given beach cross-section of profile (feet or meters per year) over a long period of time. Erosion rates vary as a function of shoreline type and are influenced primarily by episodic events, but can be used in land use and hazard management to define areas of critical concern. Unfortunately, there is no uniform erosion rate database or GIS data layer that defines erosion rates or such areas of critical concern for Hancock County's shoreline. However, according to a study prepared by the Heinz Center, much of the Gulf Coast experiences an average of three feet of erosion per year.

Erosion of the sand beach is a constant threat to the seawall. Erosion of the sand beach occurs from two sources, water borne erosion and wind borne erosion. The County has established beach profiles and maintains these profiles daily to insure the longevity of the beach and its protective nature. Additionally, a pathway was added, which has functioned to anchor the seawall along a three mile area in Bay St. Louis and Waveland. The County plans for renourishment of the Sand Beach in the Waveland area, approximately every six years.

The sand beach, the seawall and Beach Boulevard are critical infrastructure to protect the coastal areas in the City and Hancock County. The sand beach and the seawall protect the safety and welfare of residents. Beach Boulevard provides a transportation lifeline through the Cities and the southern unincorporated county. The sand beach also provides recreation for residents and tourists and contributes to the economic development of Hancock County.

Historic shoreline data indicate erratic shifts between coastal erosion and accretion resulting in dynamic shoreline changes. Hurricane Katrina damaged many of the beaches as well as the beach protection facilities. The United States Army Corps of Engineers completed an investigative report that identified major needed restoration and mitigation projects. Work on the projects in the USACE Coastal Improvements Program continues, and is noted in the capability assessment of this plan in Section 4.4.

Waveland city services including lift stations have not been impacted by the wind born sand erosion. VERIFY Wind-borne sand has been deposited in the storm drains located near the beach of the City. Only maintenance activities are anticipated in this area in the near future.

Future Development

Since future development can happen at many locations within the City (see Figures 4.47 and 4.48 in Section 4.3), it is likely that future development may happen in these zones. The City has development ordinances in effect to mitigate increased erosion in developing areas.

4.3.4 Flood: 100-/500-year

Likelihood of Future Occurrence—Occasional
Vulnerability—Extremely High

Flood damage is directly related to the depth of flooding and a two foot deep flood usually results in about 20 percent damage to the structure which translates to 20 percent of the structure's replacement value. According to the DFIRM, a large portion of the City is located in areas vulnerable to 100-year flooding under normal flood circumstances. When compared to the vulnerability of predicted flood level models (SLOSH) resulting from hurricane storm surge, the entire City becomes vulnerable to property damaging flooding from a Category 3 or stronger hurricane.

According to the HAZUS technical manual several recent studies point to the need for distinguishing between coastal A-zones and riverine A-zones. While the dominant form of damage to buildings in the latter is inundation, buildings in coastal A-zones are often subject to more severe flood forces. Recent post-disaster building damage assessments in coastal areas have shown buildings in coastal A-zones are often damaged by waves, high velocity flows, scour and erosion, and floating debris. Conditions in coastal A-zones are probably closer to those in V-zones than non-coastal A-zones. Thus damage could be potentially be worse than modeled. Accordingly, FIA V-Zone damage functions have been selected as the default damage function for single-family residential structures in coastal A- zones as well as coastal V-zones.

Methodology

2012 Hancock County's parcel layer was used as the basis for the inventory of developed parcels and the 2009 DFIRM was used to identify affected parcels by floodzone. In some cases, there are parcels in multiple flood zones, such as Zone AE, VE and X500 or 1% and 0.2% annual chance floodplains. GIS was used to create a centroid, or point, representing the center of each parcel polygon, which was overlaid on the floodplain layer. For the purposes of this analysis, the flood zone that intersected the centroid was assigned as the flood zone for the entire parcel. The parcels were segregated and analyzed for the entire City of Waveland. The results are summarized in the tables and maps provided within the vulnerability section.

The property type categories were developed by GRPC from a recent land use survey. These categories were joined back into the Hancock County Assessor database through GIS so land use categories could be included to develop content value and show potential loss from hazards. Content values estimations are based on Hazus methodologies of estimating value as a percent of improved structure values by property type. Table 4.45 shows the breakdown of the different property types in Waveland and their estimated content replacement value percentages.

Table 4.45. Content Replacement Factors

Property Type	Content Replacement Values
Residential	50%
Camp and Resort	100%
Commercial	100%
Cultural and Parks	100%
Education	100%
Government	100%
Land and Forest	100%
Recreation and Entertainment	100%
Religion	100%

Property Type	Content Replacement Values
Services	100%
Medical	150%
Transportation	150%
Utilities and Communication	150%

Source: Hazus 2.1

The loss estimate for flood is based on the total of improved and contents value. The value of land is not included in the loss estimates as generally the land is not at loss to floods, just the value of improvements and structure contents.. The land value is represented in in the flood tables, but these values are only present to show the value of the land and are not included in any of the flood analysis. It is important to note, that information on those properties mitigated (e.g., floodproofed or elevated) in the SFHA was not available for analysis, thus the resulting flood damage loss estimates could be higher than actual figures. Once the potential value of affected parcels was calculated, damage factors were applied to obtain loss estimates by floodzone. Table 4.47 provides the damage factors that were used in calculating flood damage losses for the City. These damage factors were developed based on utilizing FEMA loss estimate methodologies for floods and the BFEs associated with each of the flood maps and flood ordinances for the City starting back when the City of Waveland joined the NFIP on September 11, 1970. BFEs for each of the City flood maps are summarized as follows:

- 1970 FIRM: Average BFE of 13.1 ft
- 1983 FIRM : BFE range of 13- 17 ft
- 2009 DFIRM: BFE range of 17 - 27 ft

For the 2009 DFIRM, Table 4.46 (which is used for the actual flood loss estimates) shows the correlation between BFEs and flood depth.

Table 4.46. Effective DFIRM

BFE (ft)	Average Depth (ft)
17	7.84
18	10.29
19	9.91
20	13.15
21	15.52
22	19.47
23	20.86
24	21.80
25	22.74
26	24.53
27	25.23

Source: FEMA DFIRM October 16, 2009

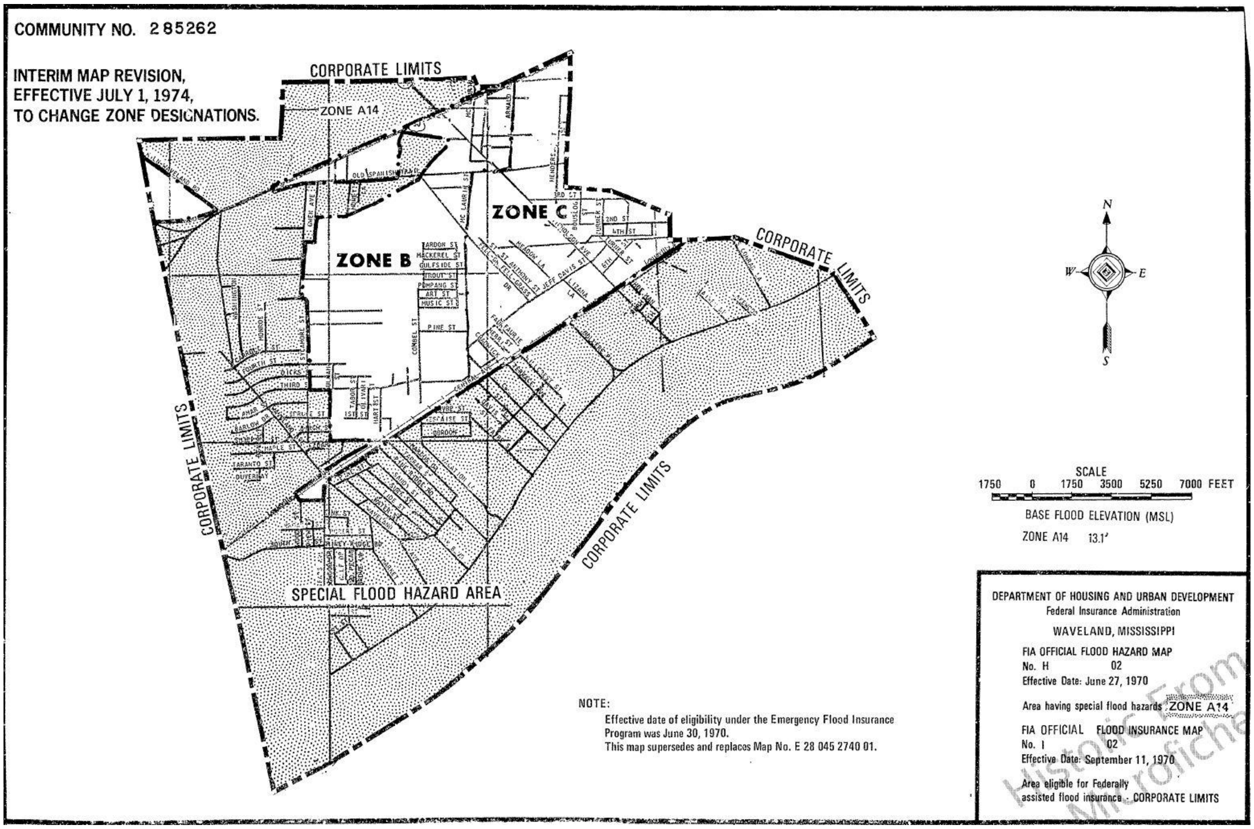
Table 4.47. Waveland Flood Loss Damage Factors

NFIP Periods	Damage Factors
No Date	
1% Chance	45%
0.2% Chance	25%
< 1970 (Pre-Firm)	
1% Chance	45%
0.2% Chance	25%
1971 – 2005 (Katrina)	
1% Chance	40%
0.2% Chance	25%
2006 – Present (Post-Katrina)	
1% Chance	0%
0.2% Chance	25%

Source: City of Waveland

Figures 4.58 - 4.60 show the three effective maps for the City that were used to develop this methodology as well as a map that overlays and compares the Q3 floodzones with the current DFIRM floodzones. Figure 4.58 is the Effective FIRM for Waveland dated September 11, 1970. Figure 4.59 shows the Q3 floodzones from 1983. Figure 4.60 shows the current 2009 DFIRMs for the City. Figure 4.61 shows the 1983 FIRM floodzones compared to the current 2009 DFIRM floodzones.

Figure 4.58. 1970 Waveland FIRM



Source: FEMA

Figure 4.59. Waveland FEMA Q3 Map

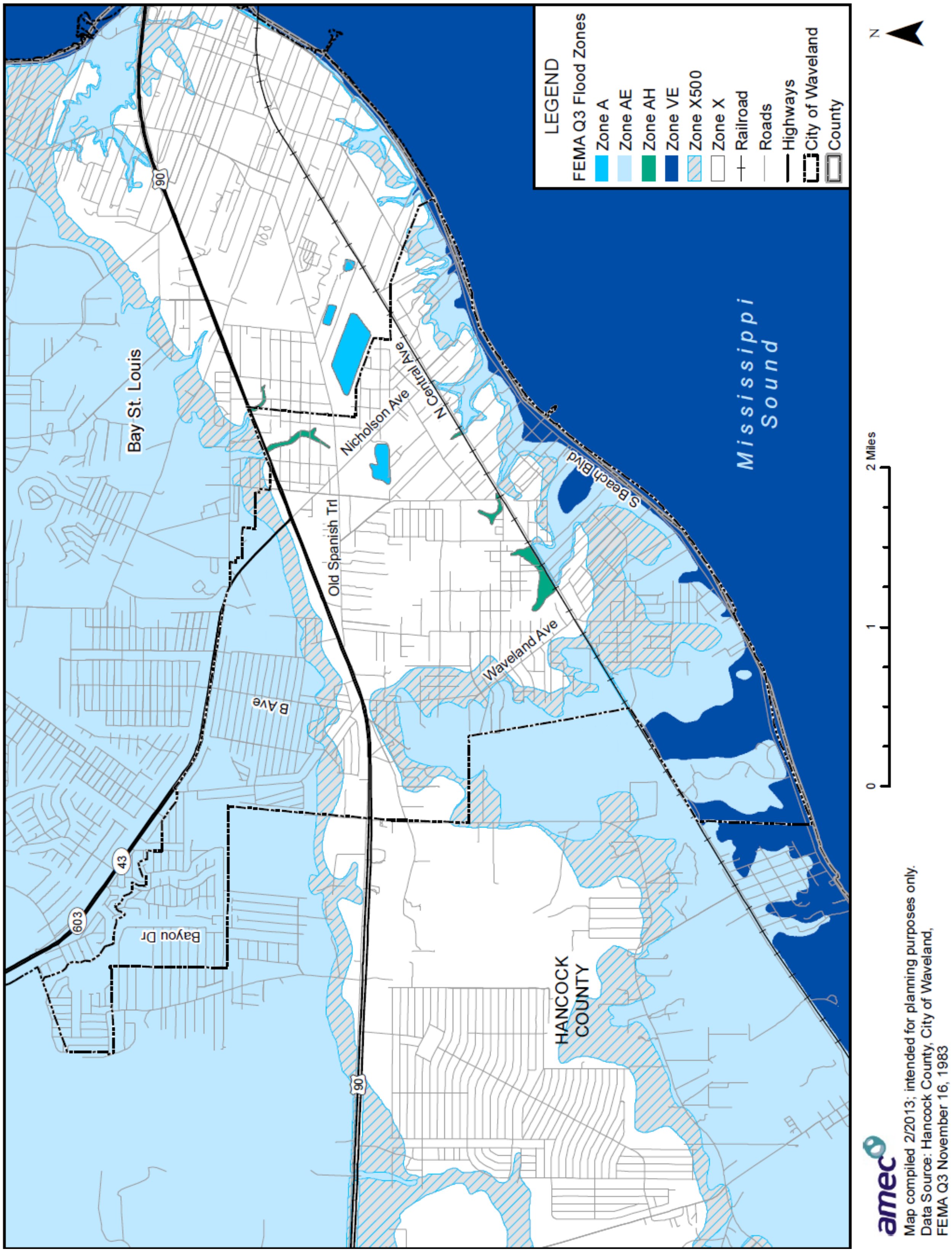


Figure 4.60. Waveland DFIRM

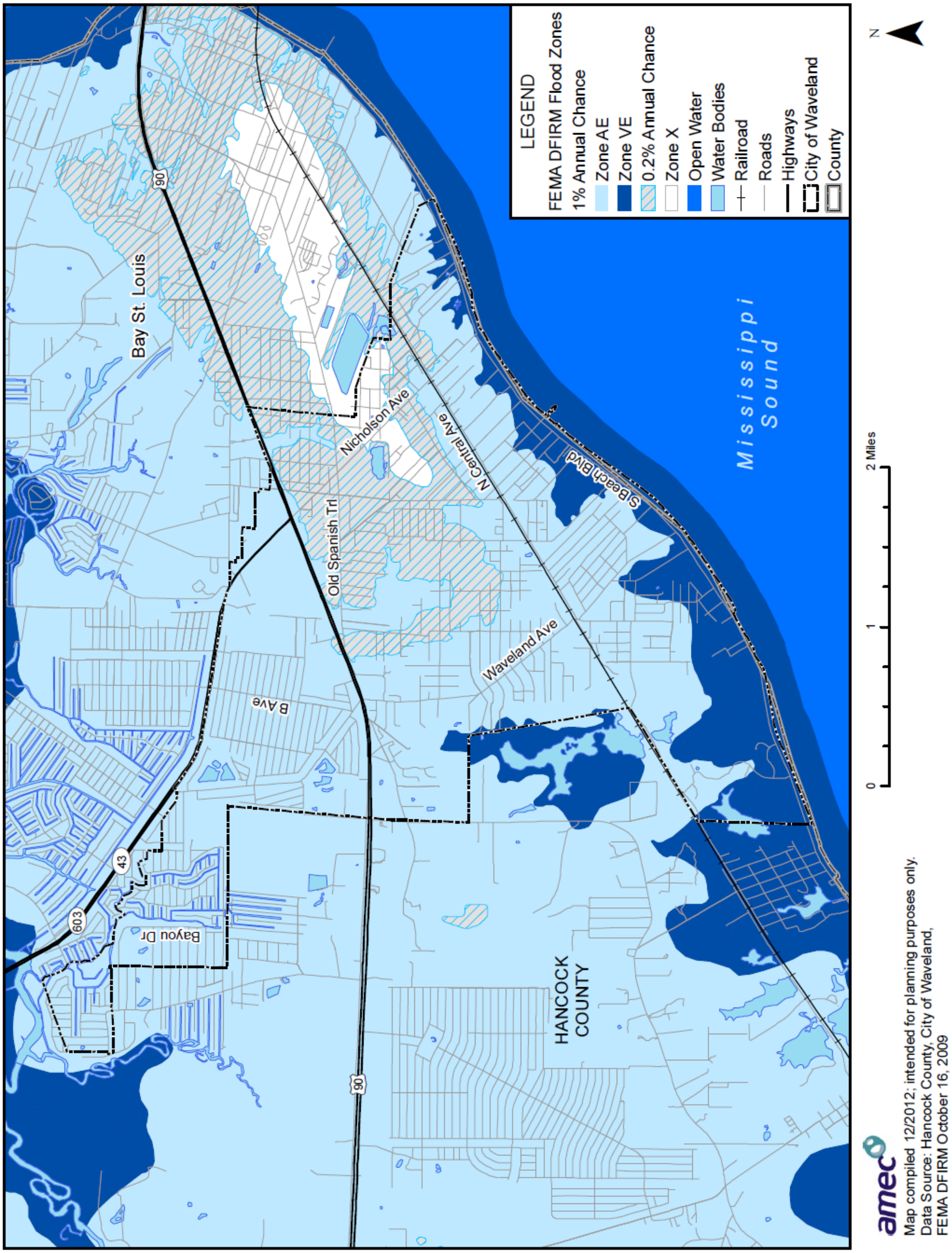
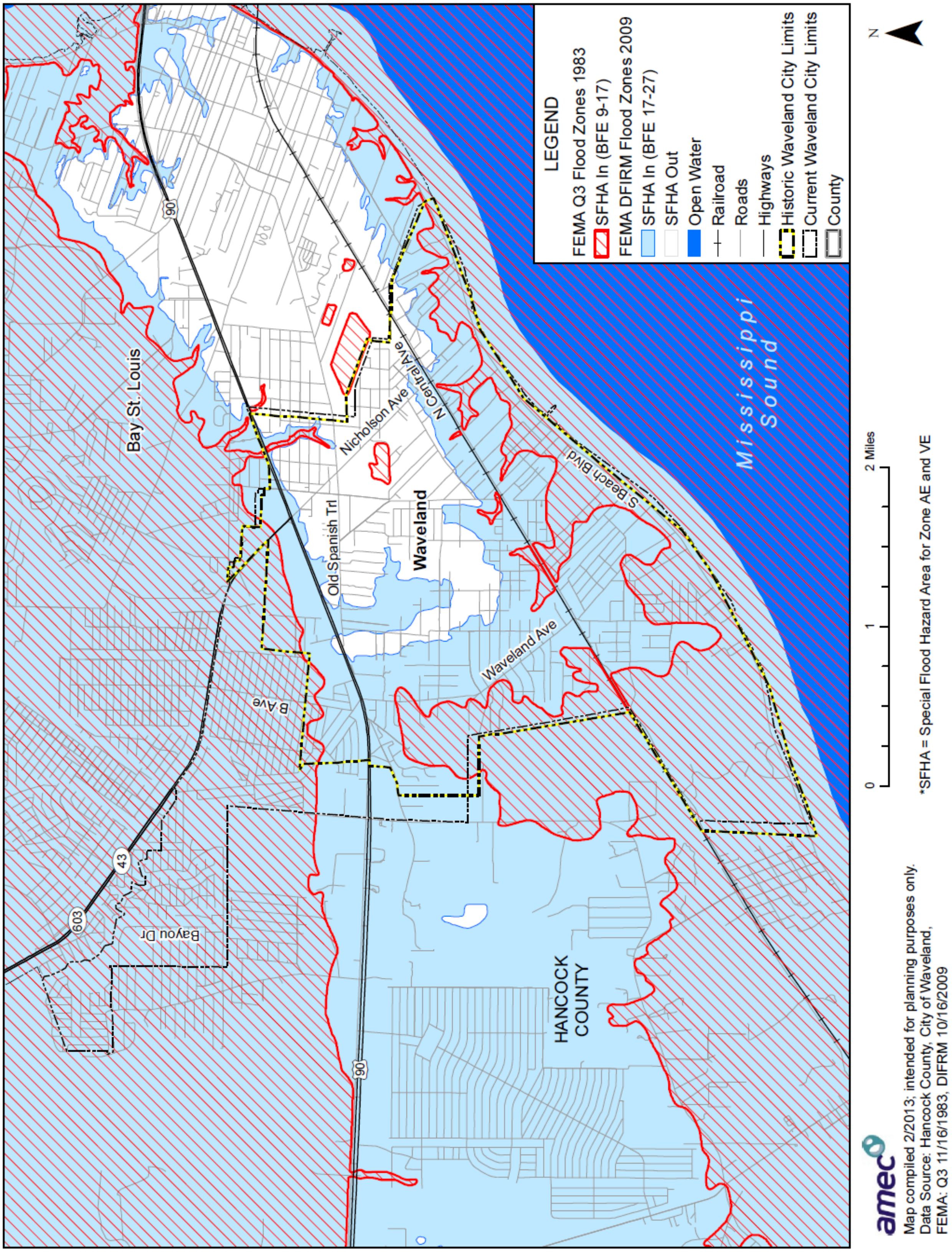


Figure 4.61. Waveland DFRIM Q3 Comparison Map



In comparing the difference between the 1983 FIRM, using the FEMA Q3 data, and the current 2009 DFIRMs, Tables 4.48 and 4.49 show the area in acres inundated by both flood maps. Table 4.48 includes the old Waveland city limits, before the annexation of the area to the north. Table 4.49 shows the comparison utilizing the new City limits. The SFHA (Special Flood Hazard Area) refers to the area within the 100-year flood zone (those areas with a one percent probability of being equaled or exceeded during any given year).

Table 4.48. Old Waveland City Limits

City Area	DFIRM SFHA In (acres)/ % Flooded	Waveland Q3 SFHA In (acres)/ % Flooded
4,371	3,384/77%	1,585/36%

Source: FEMA

Table 4.49. New Waveland City Limits

City Area	DFIRM SFHA In (acres) /% Flooded	Q3 SFHA In (acres) /% Flooded
5,523	4,533/82%	2,574/47%

Source: FEMA

Values at Risk

Table 4.50 is a summary table that shows the count and improved value of parcels that fall in a floodplain by land use type. Parcels outside the floodplain are also shown (Zone X).

Table 4.50. Waveland – Detailed Flood Loss Estimates by Flood Zone and Property Type

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Estimated Content Value	Total Value
Zone AE						
Commercial	82	74	$15,782,630	$37,250,854	$37,250,854	$74,501,708
Cultural and Parks	5	2	$140,000	$935,854	$935,854	$1,871,708
Government	5	1	$190,000	$1,845,271	$1,845,271	$3,690,542
Land and Forest	4,402	87	$53,002,632	$2,657,920	$2,657,920	$5,315,840
Medical	2	2	$217,625	$290,470	$435,705	$726,175
Recreation and Entertainment	4	1	$319,996	$1,665,068	$1,665,068	$3,330,136
Religion	22	6	$57,034	$700,468	$700,468	$1,400,936
Residential	1,632	1,489	$31,356,540	$132,245,272	$66,122,636	$198,367,908
Services	33	23	$2,624,258	$3,797,506	$3,797,506	$7,595,012
Transportation	12	2	$1,729,490	$955,752	$1,433,628	$2,389,380
Utilities and Communication	5	1	$99,308	$2,165	$3,248	$5,413
Total	**6,204**	**1,688**	**$105,519,513**	**$182,346,600**	**$116,848,158**	**$299,194,758**

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Estimated Content Value	Total Value
Zone VE						
Camp and Resort	1	0	$0	$0	$0	$0
Land and Forest	614	3	$16,105,801	$261,335	$261,335	$522,670
Religion	3	0	$0	$0	$0	$0
Residential	101	82	$5,641,956	$14,239,157	$7,119,579	$21,358,736
Total	**719**	**85**	**$21,747,757**	**$14,500,492**	**$7,380,914**	**$21,881,406**
0.2% Annual Chance						
Commercial	19	15	$2,346,712	$3,508,957	$3,508,957	$7,017,914
Cultural and Parks	1	1	$141,120	$52,780	$52,780	$105,560
Education	2	0	$100,000	$0	$0	$0
Government	2	1	$90,000	$1,290,914	$1,290,914	$2,581,828
Land and Forest	467	11	$8,287,950	$926,666	$926,666	$1,853,332
Medical	1	1	$0	$62,891	$94,337	$157,228
Religion	6	0	$0	$0	$0	$0
Residential	756	722	$17,514,260	$60,623,503	$30,311,752	$90,935,255
Services	20	17	$1,329,570	$3,471,092	$3,471,092	$6,942,184
Transportation	3	0	$53,520	$0	$0	$0
Utilities and Communication	2	1	$20,556	$79,953	$119,930	$199,883
Total	**1,279**	**769**	**$29,883,688**	**$70,016,756**	**$39,776,427**	**$109,793,183**
Zone X (unshaded)						
Land and Forest	62	4	$965,180	$84,154	$84,154	$168,308
Residential	151	146	$3,416,789	$10,040,891	$5,020,446	$15,061,337
Total	**213**	**150**	**$4,381,969**	**$10,125,045**	**$5,104,600**	**$15,229,645**

Source: Hancock County Assessor's 2012 Data, FEMA DFIRM October 16, 2009

Table 4.51 shows calculation of loss estimate values discussed in the methodology above. This table is also broken up by 1%, VE zone, and 0.2% annual chance flood, and total flood (1%, VE, and 0.2% annual chance floods combined).

Table 4.51. Waveland – Flood Loss Estimates by Flood Zone Summary

Flood Zone	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Estimated Content Value	Total Value	Loss Estimate
Zone AE	6,204	1,688	$105,519,513	$182,346,600	$116,848,158	$299,194,758	$71,879,868
Zone VE	719	85	$21,747,757	$14,500,492	$7,380,914	$21,881,406	$187,061

Flood Zone	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Estimated Content Value	Total Value	Loss Estimate
0.2% Annual Chance	1,279	769	$29,883,688	$70,016,756	$39,776,427	$109,793,183	$27,448,296
Total	**8,202**	**2,542**	**$157,150,958**	**$266,863,848**	**$164,005,498**	**$430,869,346**	**$99,515,225**

Source: Hancock County Assessor's 2012 Data, FEMA DFIRM October 16, 2009

Table 4.52 that follows shows the loss ratio for the flood damage assessment. The loss ratio is the loss estimate divided by the total potential exposure (i.e., total of improved and contents value for all parcels located in the City) and displayed as a percentage of loss by 1% Annual Chance and 0.2% annual chance floods. For the 1% chance flood, the loss ratio of improved parcels to unimproved parcels is 16%. Although this loss ratio is relatively low, the City should keep in mind that this could go up with additional development in the 1% annual chance floodplain, with over 5,000 undeveloped parcels in the 1% chance floodplain.

Table 4.52. Waveland Loss Ratio by Flood Zone

Flood Zone	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Estimated Content Value	Total Value	Loss Estimate	Loss Ratio
1% Annual Chance	6,923	1,773	$127,267,270	$196,847,092	$124,229,071	$321,076,163	$70,475,341	16%
0.2% Annual Chance	1,279	769	$29,883,688	$70,016,756	$39,776,427	$109,793,183	$27,448,296	6%
Total	8,202	2,542	$157,150,958	$266,863,848	$164,005,498	$430,869,346	$97,923,637	22%

Flooded acres

Also of interest is the land area affected by the various flood zones. The following is an analysis of flooded acres in the City in comparison to total area within the City limits.

Methodology

GIS was used to calculate acres flooded by FEMA flood zones and land use categories. The Hancock County parcel layer and effective DFIRM were intersected and parcels were calculated by acres. Once this was done the parcel centroid layer was intersected into the previously intersected layer so that the flooded acre where the centroid is located would populate the correct flooded acre attribute. Since Waveland has coastal flooding rather than riverine flooding, parcels can be in multiple flood zones. Since all the flood analysis was based on centroid location for counts and values this method was used to maintain these counts for consistency and accuracy. In the below tables each flood zone is represented and then split out by land use and their total acres and flooded acres and parcel counts for each category.

Limitation

One limitation to be made from this analysis is that the parcel layer does not have right of way. Due to this, there are voids of land that are not calculated; therefore, this analysis only represents total parcel acres. The other limitation created by this type of analysis is the portion of the flooded parcel that does not intersect with the centroid is omitted and is not counted in this analysis. An example of this is where a parcel boundary is split during the GIS intersection process into Zone AE and VE. The parcel's total acreage is 1 but it was split into Zone AE by 0.3 acres and Zone VE by 0.7 acres. The centroid intersects with the Zone VE portion and is attributed 0.7 acres of flooding for the parcel however the 0.3 acre in Zone AE is not calculated and is omitted.

Tables 4.53 and 4.54 represent a detailed and summary analysis of total acres for each FEMA DFIRM flood zone.

Table 4.53. Waveland Detail of Total Acres to Flooded Acres by Land Use

Land Use	Total Acres	Improved Flooded Acres
Zone AE		
Commercial	149	145
Cultural and Parks	9	2
Government	7	1
Land and Forest	1,892	55
Medical	1	1
Recreation and Entertainment	74	3
Religion	17	3
Residential	917	803
Services	27	25
Transportation	16	1
Utilities and Communication	18	1
Total AE Zone	**3,127**	**1,039**
Zone VE		
Camp and Resort	287	0
Land and Forest	330	1
Religion	44	0
Residential	75	55
Total VE Zone	**736**	**56**
0.2% Annual Chance		
Commercial	21	18
Cultural and Parks	0	0
Education	12	0
Government	4	1

Land Use	Total Acres	Improved Flooded Acres
Land and Forest	252	8
Medical	0	0
Religion	8	0
Residential	360	323
Services	16	14
Transportation	6	0
Utilities and Communication	28	1
Total 0.2% Annual Chance	**708**	**366**
Zone X		
Land and Forest	32	9
Residential	78	61
Total Zone X	**110**	**70**

Source: Hancock County Assessor's Data 2012, FEMA DFIRM October 16, 2009

Table 4.54. Waveland Summary of Total Acres to Flooded Acres

Zone	Total Acres	Improved Flooded Acres
Zone AE	3,127	1,039
Zone VE	736	56
0.2% Annual Chance	708	366
Zone X	110	70
Total	**4,681**	**1,532**

Source: Hancock County Assessor's Data 2012, FEMA DFIRM October 16, 2009

Population at Risk

A separate analysis was performed to determine population in the 1%, VE, and 0.2 annual chance floodplains. Using GIS, the DFIRM flood zones were overlayed on the improved residential parcel data. Those parcel centroids that intersect the flood zones were counted and multiplied by the Census Bureau Waveland household factor (2.50) (see Table 4.55). According to this analysis, there is a total population of 5,655 in the 1%, VE, or 0.2% annual chance floodplain.

Table 4.55. Waveland Population at Risk to Flood

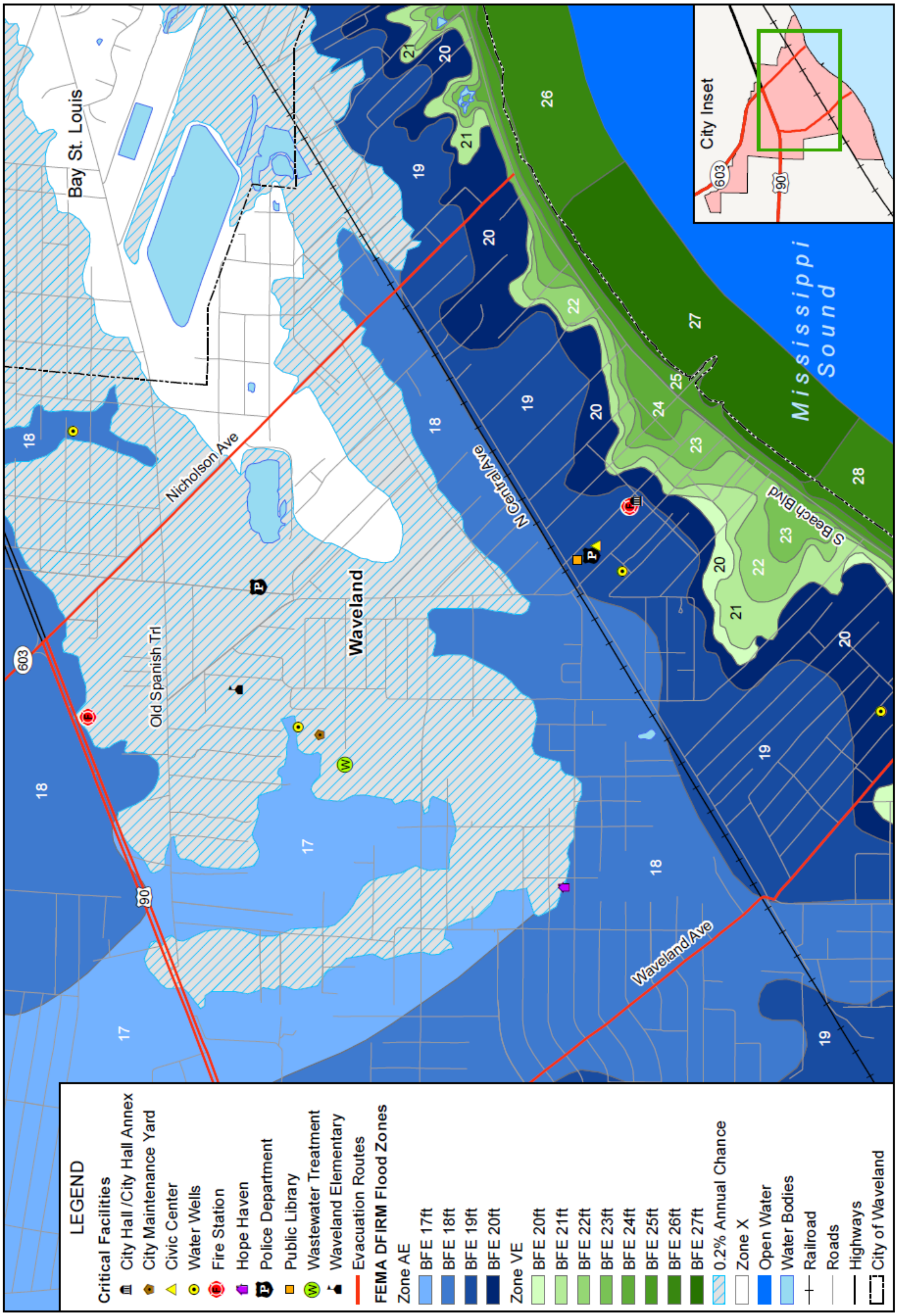
DFIRM	Improved Residential Property Count	Population
Total 1% Annual Chance	1,458	3,645
Total VE Zone	82	205
Total 0.2% Annual Chance	722	1,805
Total	**2,262**	**5,655**

Source: Hancock County Assessor's Data 2012, FEMA DFIRM October 16, 2009, US Census Bureau

Critical Facilities at Risk

A separate analysis was performed to determine critical facilities in the 1% and 0.2 annual chance floodplains. Using GIS, the DFIRM flood zones were overlayed on the critical facility location data. Figure 4.62 shows critical facilities, DFIRM flood zones, and flood elevations. Table 4.56 details critical facilities by facility type, flood zone, replacement value, and base flood elevation.

Figure 4.62. Waveland Critical Facilities in Flood Zones with Elevation



amec

Table 4.56. Waveland Critical Facilities by Flood Zone

Facility	Facility Type	Address/ Coordinates	Flood Zone	Replacement Values	Base Flood Elevation	Elevation Certificate Records
City Hall	Public	301 Coleman Ave	Zone AE	$3,200,000	19ft	20ft
City Hall Annex	Public	301 Coleman Ave	Zone AE	$0	19ft	20ft
Fire Station #1	Fire Public	307 Coleman Ave	Zone AE	$1,800,000	19ft	25ft
Police Department	Public	335 Coleman Ave	Zone AE	$0	19ft	unavailable
Public Library	Public	345 Coleman Ave	Zone AE	$1,639,377	19ft	19.85ft
Civic Center	Public	335 Coleman Ave	Zone AE	$3,209,313	19ft	unavailable
Faith Street Water Well	Well	89 22' 10.891" W, 30 18' 18.234"N	Zone AE	$0	18ft	18ft
Tide Street Water Well	Well	89 22' 52.095"W, 30 16' 33.753"N	Zone AE	$0	20ft	16.2ft
Davis Ave Water Well	Well	89 22' 31.445"W, 30 17' 7.157"N	Zone AE	$0	19ft	unavailable
Hope Haven	Public	716 Herlihy St	Zone AE	$200,000	18ft	unavailable
Central Fire Station	Fire Public	427 Hwy 90	0.2% Annual Chance	$3,287,000	0	20ft
Wastewater Treatment	Public	322 Gulfside	0.2% Annual Chance	$15,000,000	0	unavailable
City Maintenance Yard	Public	322 Gulfside	0.2% Annual Chance	$1,000,000	0	unavailable
Police Department (construction)	Public	1602 McLaurn	0.2% Annual Chance	$4,415,979	0	unavailable
Gulfside Street Water Well	Well	89 23' 0.253"W, 30 17' 47.799"N	0.2% Annual Chance	$0	0	24ft
Waveland Elementary	Elementary Public	1101 St Joseph St	0.2% Annual Chance	$3,500,000	0	unavailable

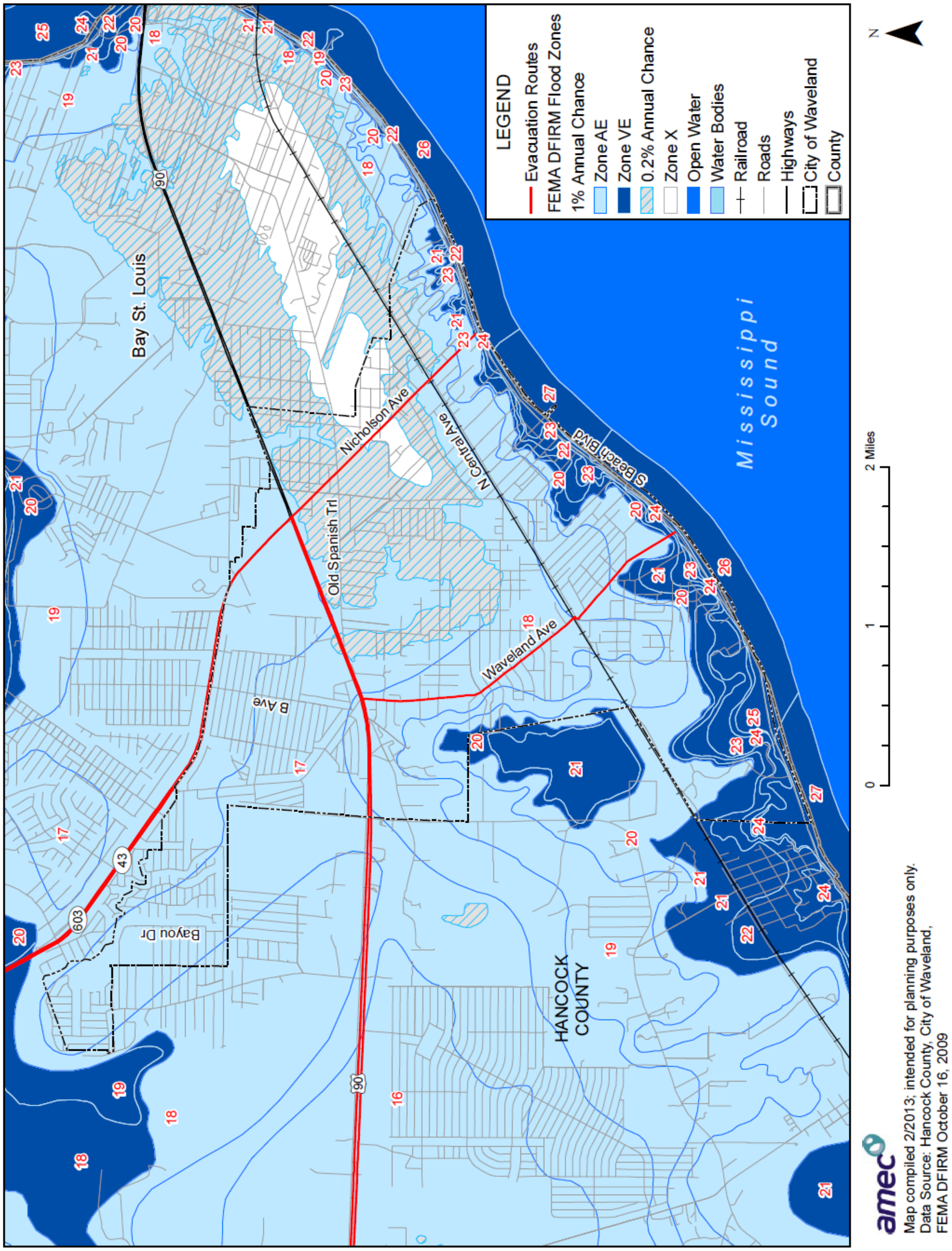
Source: City of Waveland, FEMA DFIRM October 16, 2009

During times of flood in Waveland, evacuation routes are sometime inundated. This happened recently during Hurricane Isaac and Katrina. While not mapped critical facilities like those in Table 4.56, evacuation routes are critical to the City. During times of flooding, Highway 603 has been overtopped and has not allowed evacuees to use that route. Figure 4.63 shows an example of this flooding. Figure 4.64 details locations of evacuation routes overlayed on the FEMA DFIRM floodplains.

Figure 4.63. Highway 603 Flooding During Isaac

Source: http://www.wlox.com/story/19406606/hwy-603-under-water-in-hancock-county

Figure 4.64. Waveland Base Flood Elevation and Evacuation Routes



Future Development

A simple analysis was performed to quantify parcels within these development areas that are also in flood hazard areas.

Methodology

The 2012 Hancock County's parcel layer was used as the basis for the inventory of undeveloped parcels to help identify areas of future development. In some cases, there are parcels in multiple flood zones. GIS was used to create a centroid, or point, representing the center of each parcel polygon, which was overlaid on the floodplain layer. For the purposes of this analysis, the flood zone that intersected the centroid was assigned as the flood zone for the entire parcel. The parcels were segregated and analyzed for the entire City of Waveland. Figure 4.65 shows the future development areas in the FEMA floodplains. Table 4.57 delineates the future development areas by floodplain. In addition, the table shows future development outside the FEMA floodplains (Zone X). The analysis shows a total of 63 parcels in the City that are currently unimproved and located outside of the floodplain.

Figure 4.65. Waveland Future Development Areas and FEMA DFIRM Flood Zones

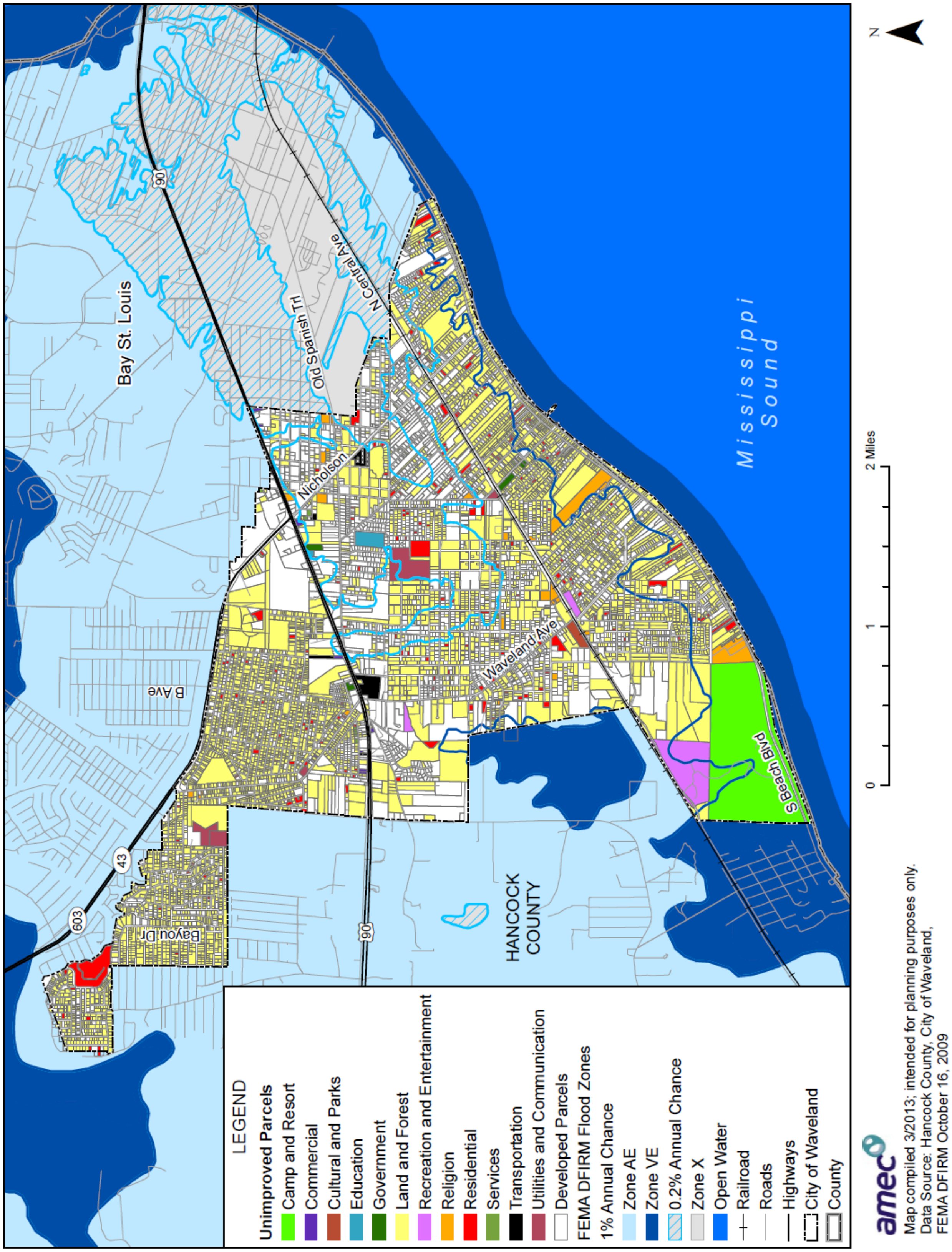


Table 4.57. Waveland Future Development and FEMA DFIRM Flood Zones

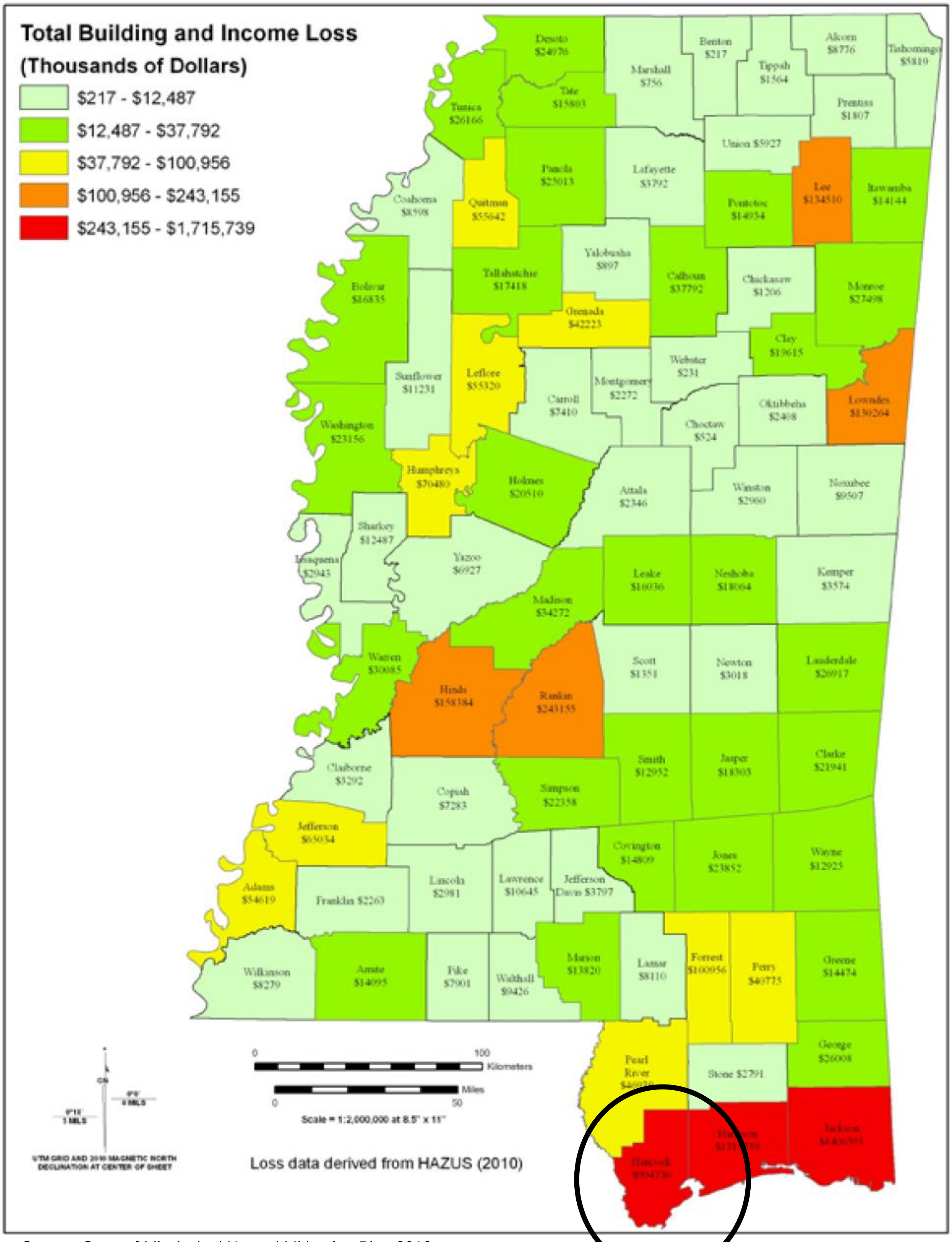
Land Use	Unimproved Parcel Count	Land Value
Zone AE		
Commercial	8	$718,270
Cultural and Parks	3	$0
Government	4	$190,000
Land and Forest	4,315	$50,968,838
Recreation and Entertainment	3	$0
Religion	16	$32,219
Residential	143	$2,110,000
Services	10	$70,490
Transportation	10	$986,415
Utilities and Communication	4	$79,058
Total Zone AE	**4,516**	**$55,155,290**
Zone VE		
Camp and Resort	1	$0
Land and Forest	611	$15,969,063
Religion	3	$0
Residential	19	$891,567
Total Zone VE	**634**	**$16,860,630**
0.2% Annual Chance		
Commercial	4	$275,090
Education	2	$100,000
Government	1	$0
Land and Forest	456	$7,824,168
Religion	6	$0
Residential	34	$701,539
Services	3	$67,100
Transportation	3	$53,520
Utilities and Communication	1	$0
Total 0.2 % Annual Chance	**510**	**$9,021,417**
Zone X		
Land and Forest	58	$781,742
Residential	5	$78,840
Total	**63**	**$860,582**

Source: Hancock County Assessor's 2012 Data, FEMA October 16, 2009 DFIRM

Mississippi State Plan Findings

Using HAZUS-MH runs, the planners preparing the 2010 State of Mississippi Standard Mitigation Plan were able to analyze the impacts of flooding by county jurisdictions and assess flood losses. The results show potential losses and loss ratios as highest in the three coastal counties, including Hancock County where coastal and riverine flood hazards are extensive. The countywide 100-year flood scenario losses for Hancock County indicates losses of from $994,736,000 including property damage and business interruption losses. Figure 4.66 shows total building loss from flooding by county in Mississippi.

Figure 4.66. Total Building Loss from Flooding in Mississippi by County

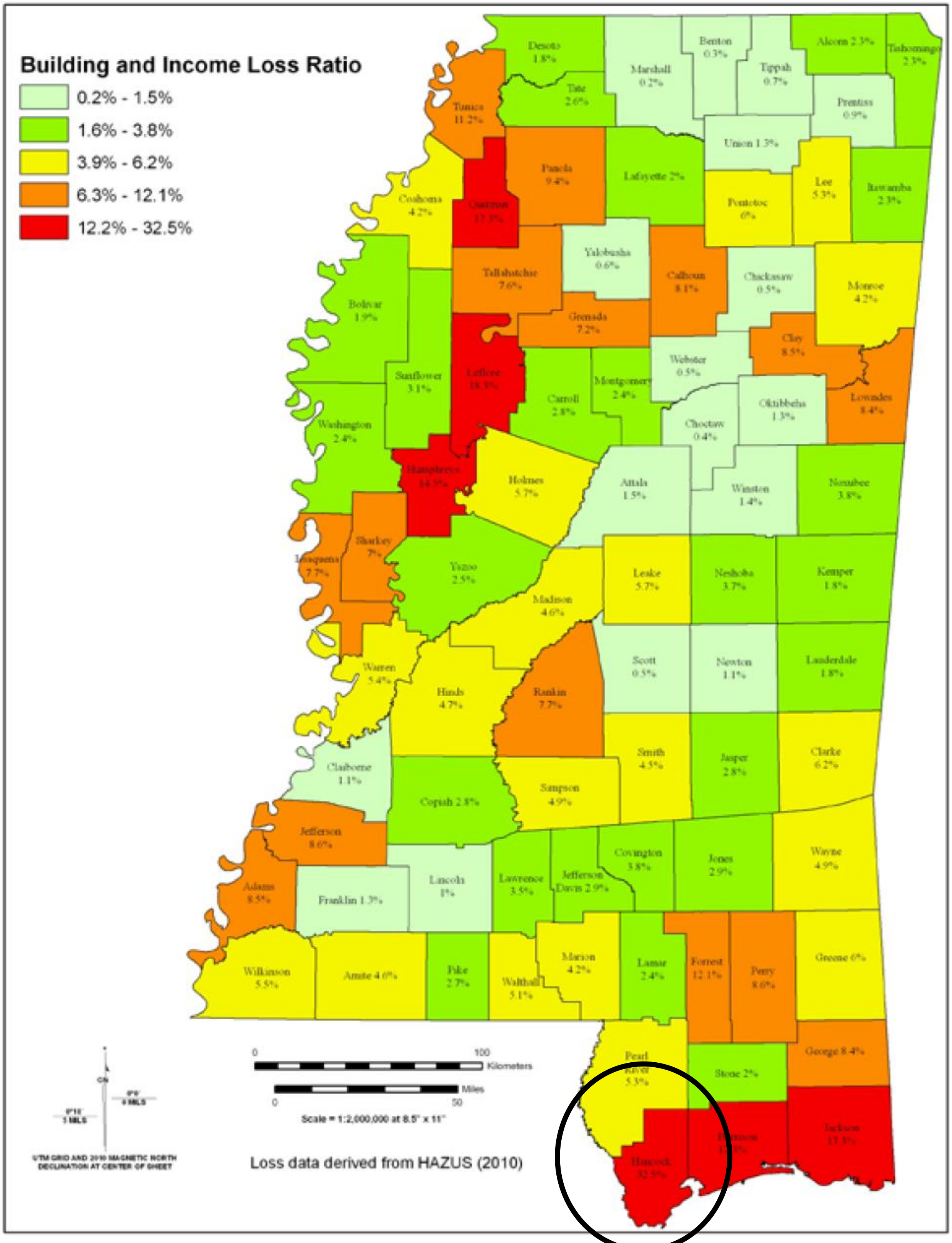


Source: State of Mississippi Hazard Mitigation Plan 2010

The Loss Ratio for the percentage of the total value of structures in the County that could be damaged by a 100-year flood is 32.5% and Hancock County ranked first in the HAZUS-MH 100-year flood loss estimation. Figure 4.67 shows the loss ratio from flooding by county in Mississippi.

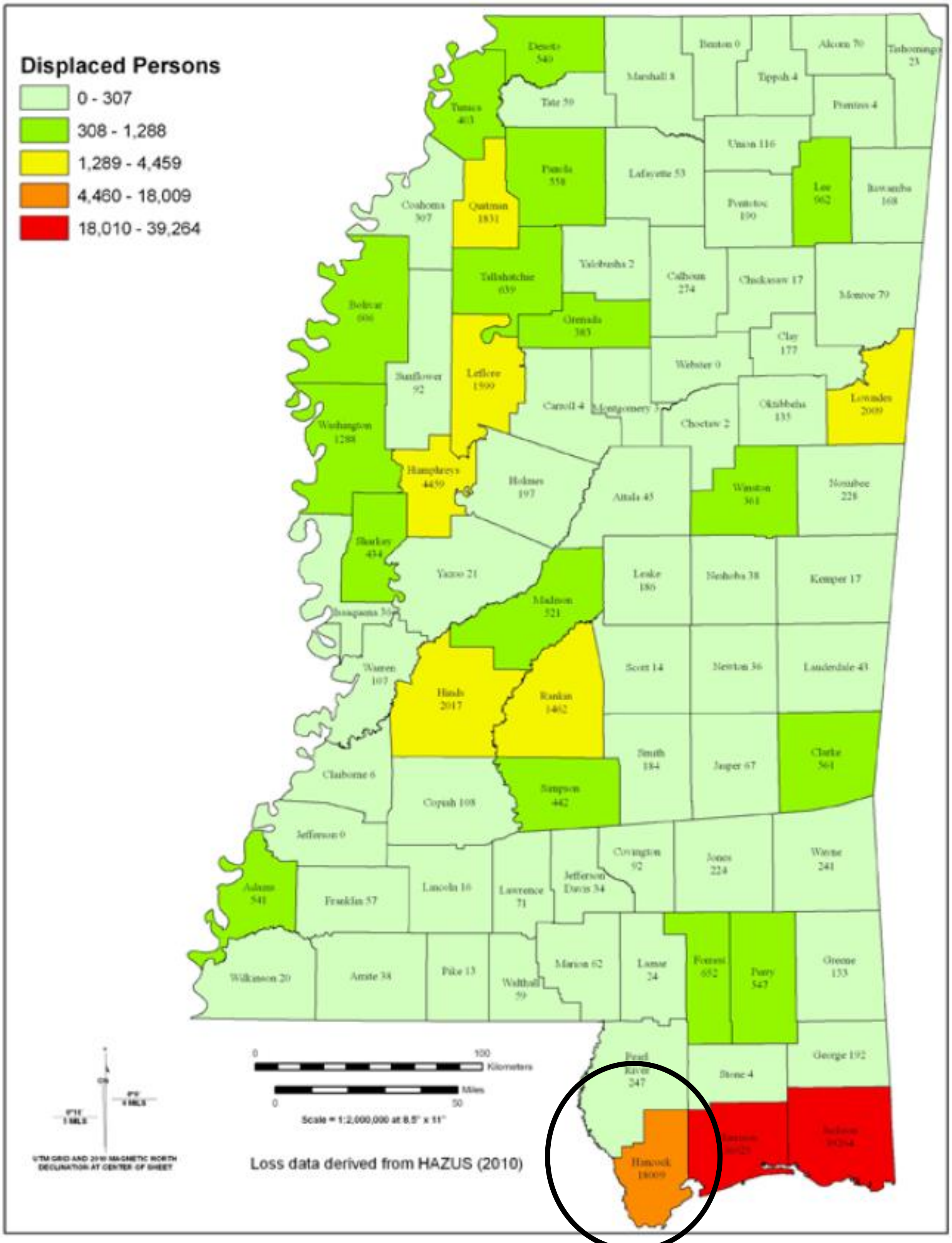
Hancock County also ranked third in the “Flooding Impacts on Populations” ranked by projected numbers of displaced households (7,991) and people needing shelter (18,009). Figure 4.68 shows Hancock County’s displaced population in relation to other counties in Mississippi.

Figure 4.67. Building and Income Loss Ratio from Flooding by County



Source: State of Mississippi Hazard Mitigation Plan 2010

Figure 4.68. Displaced Persons from Flooding in Mississippi by County



Source: State of Mississippi Hazard Mitigation Plan 2010

Flood Insurance Analysis

The City of Waveland joined the NFIP on September 11, 1970, and the CRS on October 1, 1993. According to the CRS listing of eligible communities dated October 1, 2012, the City is currently a Class 5, which provides a 25 percent discount on flood insurance for those located within the special flood hazard area (SFHA) and a 10 percent discount for those located in non-SFHA areas.

NFIP insurance data provided by FEMA indicates that as of April 13, 2012 there were 1,876 policies in force in the City, resulting in $472,183,400 of insurance in force. Of these, 1,727 are for residential properties; 149 are nonresidential. 277 of these are in A zones; 27 are in V or VE zones, and 1,569 policies are for parcels in the B, C, and X zone.

There have been 1,371 closed paid losses totaling $177,213,692; 1,332 of these were for residential properties and 39 were nonresidential. Of these losses, 612 were parcels in A zones, 61 were in the V or VE zones, and 697 parcels were in the B, C, or X zones. Information was not provided on one claim. Of the 1,371 claims, 749 claims were associated with pre-FIRM structures and 616 with post-FIRM structures, while information was not provided for 6 parcels.

Based on this analysis of insurance coverage, Long Beach has significant assets at risk to the 100-year and greater floods. Of the 1,688 improved residential parcels within the 100-year floodplain, only 277 (16.1 percent) of those parcels maintain flood insurance.

Repetitive Loss Analysis

Two analyses were done of repetitive loss in the City. Two separate data sources were used. While they do not contain the same data, it is worthwhile to include both the FEMA and ISO data in the following analysis.

MEMA Analysis

In addition, Waveland's vulnerability to flooding is highlighted by its number of Repetitive Loss (RL) properties. According to the April 13, 2012 data from FEMA, there are 23 RL buildings in the City with 34 paid losses totaling $2,326,017.30. Of these RL buildings, 16 are in the A zones, 0 are in the V or VE zones, and 7 are in the B, C, X zone. There are also Severe Repetitive Loss (SRL) properties in the City. 2 of these structures have incurred four or more losses; while 2 more have had 2-3 losses.

ISO Analysis

A separate analysis from information from ISO (the agency that administers the NFIP CRS program) was performed for the City of Waveland. According to the 2011 NFIP records detailed in Table 4.58, there are a total of 69 RL properties in Waveland for which losses totaling more than $7 million dollars have been paid. Of the 69 RL properties, 65 are residential properties and

4 are used for non-residential purposes. 8 of the 65 residential properties and 1 non-residential property have received damage and total payments qualifying them as SRL properties.

Table 4.58. Repetitive Loss and Severe Repetitive Loss Properties Summary Table

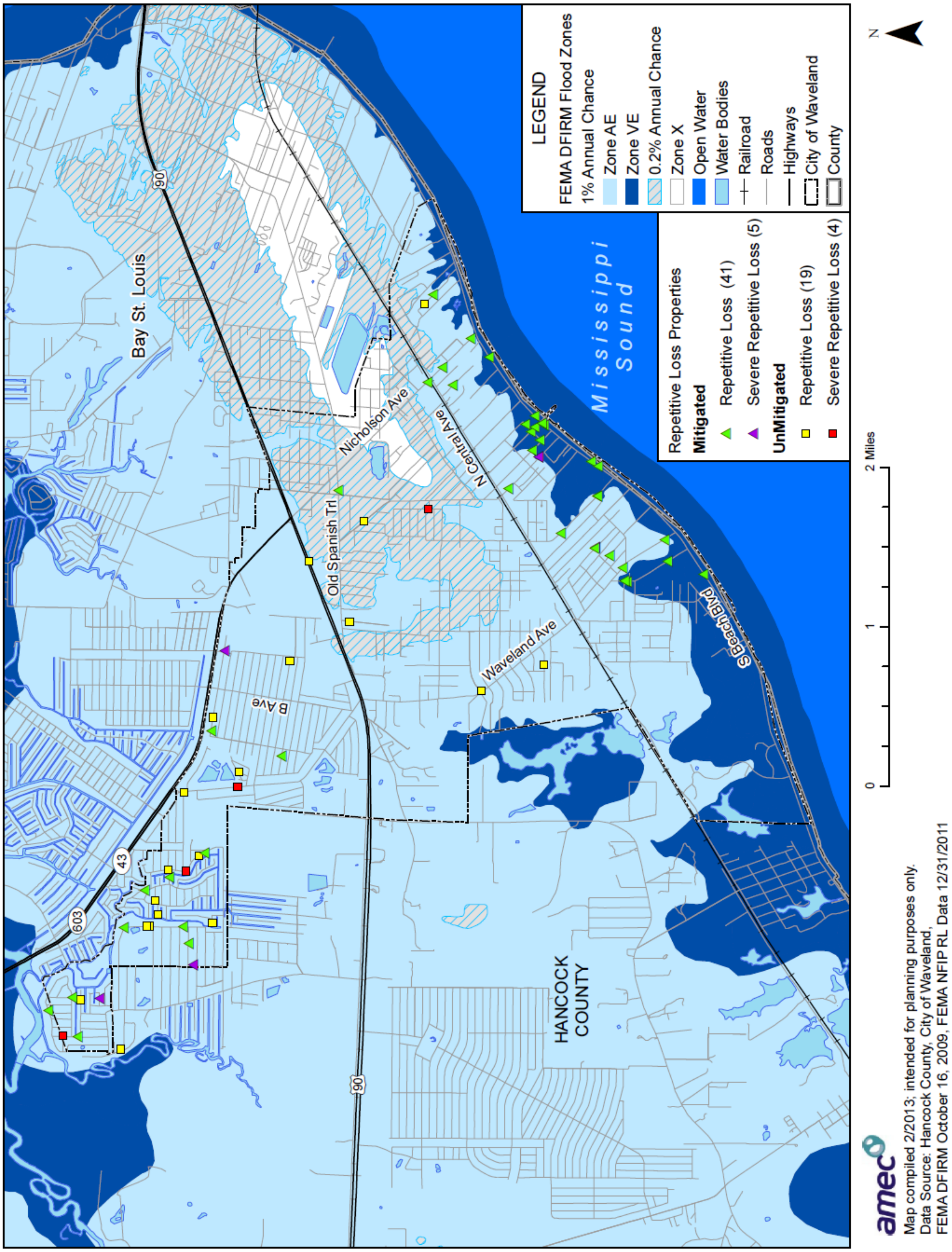
Repetitive Severity	Flood Zone	Building Count	Content Payments	Building Payments	Total Payments
Repetitive Loss	AE	36	$2,730,383	$917,440	$3,647,823
	VE	8	$971,737	$295,151	$1,266,888
	0.2% Annual Chance	5	$402,719	$93,981	$496,700
	X	11	$574,917	$146,984	$721,901
	Total	**60**	**$4,679,756**	**$1,453,556**	**$6,133,313**
Severe Repetitive Loss	AE	6	$515,943	$138,047	$653,991
	VE	1	$89,671	$30,000	$119,671
	0.2% Annual Chance	1	$60,601	$17,590	$78,191
	X	1	$101,850	$37,063	$138,913
	Total	**9**	**$768,065**	**$222,700**	**$990,765**
	Grand Total	**69**	**$5,447,822**	**$1,676,256**	**$7,124,078**

Source: NFIP Repetitive Loss Data 2011

A digital copy of the FEMA, October 16, 2009 NFIP DFIRM for Hancock County, including Waveland, was used to develop a base for mapping the RL and SRL properties.

Using the effective DFIRM, the RL properties and SRL properties from the list furnished by MEMA and the NFIP dated December 31, 2011 were geo-coded and mapped. The resulting map in Figure 4.69 illustrates the location of these properties separated out by the classification of mitigated or unmitigated in relation to the known flood hazard areas within Waveland. There are 46 mitigated properties with total payments of $4.7 million and 23 unmitigated properties with total payments of $2.3 million.

Figure 4.69. Repetitive Loss Properties in Waveland



ISO Mitigated Repetitive Loss Properties

Table 4.59 was created by sorting the RL addresses into whether they were mitigated or not and then into how severe their repetitive loss is by occupancy. This table also shows the number of RL and SRL properties located in each mapped flood zone, by occupancy; the amount of payments for flood losses to structures, and contents; and a total amount of claim payments in each zone, again by property type and repetitive severity. Of the 90 RL and 9 SRL properties, 41 RL and 5 SRL properties are have been mitigated; however, there are 19 RL properties and 4 SRL on the RL list that are unmitigated.

Table 4.59. Mitigated Repetitive Loss and Severe Repetitive Loss Properties

Mitigated	Repetitive Severity	Occupancy	Building Count	Current Flood Zone	Content Payments	Building Payments	Total Payments
Yes	Repetitive Loss	Single Family	21	AE	$568,487	$1,610,487	$2,178,974
		Single Family	7	VE	$234,869	$770,531	$1,005,400
		Single Family	3	0.2% Chance	$26,146	$153,121	$179,266
		Single Family	7	X	$125,744	$430,886	$556,630
		2-4 Family	1	AE	$14,539	$143,142	$157,680
		Condos	1	VE	$60,282	$201,206	$261,488
		Non Residential	1	AE	$10,500	$64,232	$74,732
		Total	41		$1,040,567	$3,373,604	$4,414,171
	Severe Repetitive Loss	Single Family	3	AE	$58,152	$127,876	$186,028
		Single Family	1	VE	$30,000	$89,671	$119,671
		Single Family	1	0.2% Chance	$17,590	$60,601	$78,191
		Total	**5**		**$105,742**	**$278,148**	**$383,890**
		Mitigated Total	**46**		**$1,146,308**	**$3,651,752**	**$4,798,061**

Mitigated	Repetitive Severity	Occupancy	Building Count	Current Flood Zone	Content Payments	Building Payments	Total Payments
No	Repetitive Loss	Single Family	12	AE	$323,915	$776,108	$1,100,022
		Single Family	2	0.2% Chance	$67,835	$249,598	$317,434
		Single Family	3	X	$21,240	$125,771	$147,011
		Non Residential	1	AE	$0	$136,415	$136,415
		Non Residential	1	X	$0	$18,260	$18,260
		Total	**19**		**$412,990**	**$1,306,152**	**$1,719,142**
	Severe Repetitive Loss	Single Family	2	AE	$20,126	$287,313	$307,439
		Single Family	1	X	$37,063	$101,850	$138,913
		Non Residential	1	AE	$59,770	$100,755	$160,524
		Total	**4**		**$116,958**	**$489,917**	**$606,876**
		Unmitigated Total	**23**		**$529,948**	**$1,796,069**	**$2,326,017**
		Grand Total	**69**		**$1,676,256**	**$5,447,822**	**$7,124,078**

Source: NFIP Repetitive Loss Data 2011

Table 4.60 was created by sorting the RL addresses into whether they were insured or not and then into how severe their repetitive loss is by occupancy. This table also shows the number of RL and SRL properties located in each mapped flood zone, by occupancy; the amount of payments for flood losses to structures, and contents; and a total amount of claim payments in each zone, again by property type and repetitive severity. Of the 90 RL and 9 SRL properties, 17 RL and 2 SRL properties are insured; however, there are 43 RL properties and 7 SRL on the RL list that are uninsured.

Table 4.60. Insured Repetitive Loss and Severe Repetitive Loss Properties

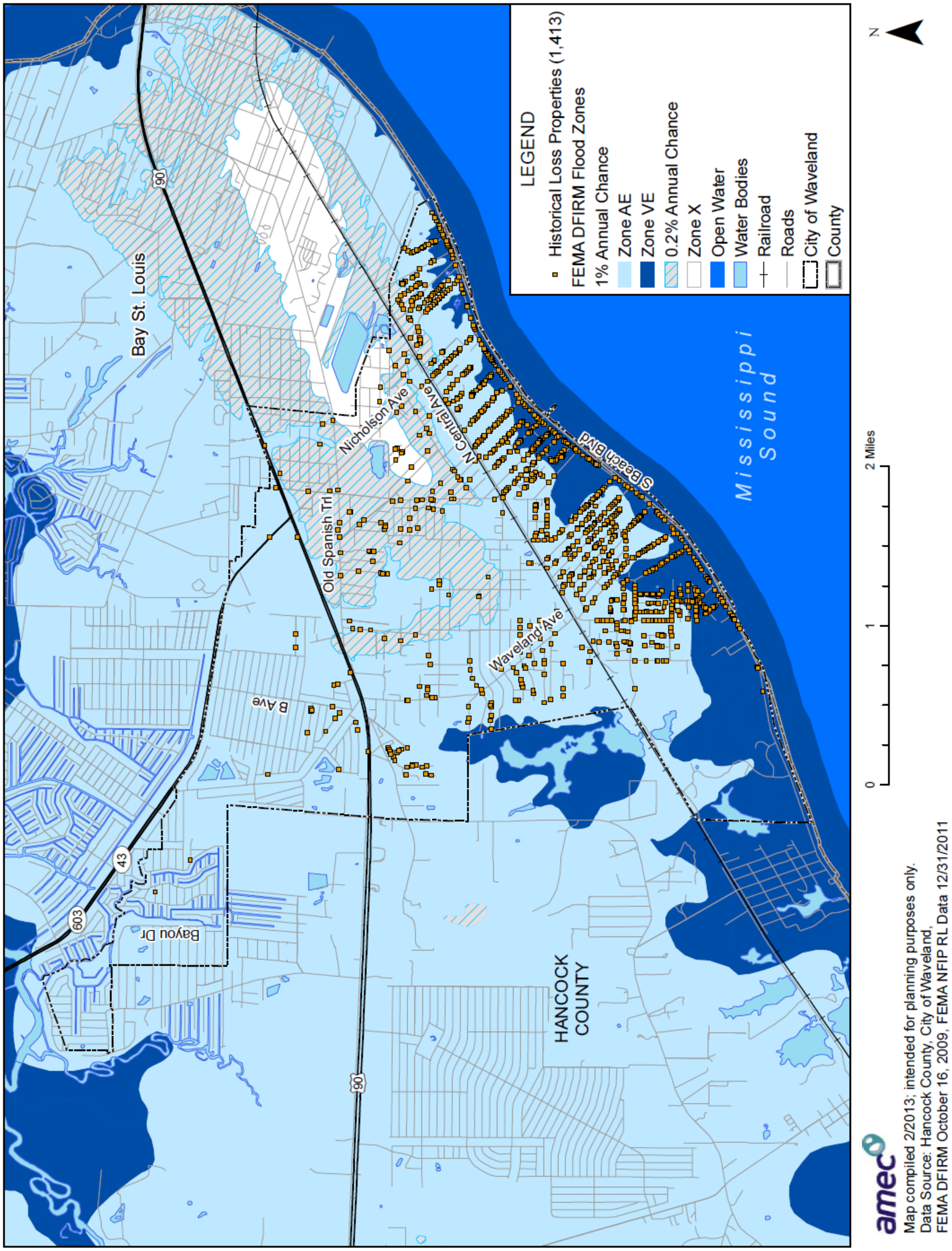
Insured	Repetitive Severity	Occupancy	Building Count	Current Flood Zone	Content Payments	Building Payments	Total Payments
Yes	Repetitive Loss	Single Family	9	AE	$263,837	$681,917	$945,754
			2	VE	$63,294	$181,358	$244,652
			3	0.2% Chance	$69,235	$311,243	$380,478
			3	X	$22,858	$110,089	$132,946
		Total	**17**		**$419,224**	**$1,284,606**	**$1,703,829**
	Severe Repetitive Loss	Single Family	1	AE	$184	$183,596	$183,779
			1	X	$37,063	$101,850	$138,913
		Total	2		$37,247	$285,446	$322,692
		Insured Total	**19**		**$456,470**	**$1,570,052**	**$2,026,522**
No	Repetitive Loss	Single Family	24	AE	$628,565	$1,704,678	$2,333,242
			5	VE	$171,575	$589,173	$760,749
			2	0.2% Chance	$24,746	$91,477	$116,222
			7	X	$124,127	$446,568	$570,695
		2-4 Family	1	AE	$14,539	$143,142	$157,680
		Condos	1	VE	$60,282	$201,206	$261,488
		Non Residential	2	AE	$10,500	$200,647	$211,147
			1	X	$0	$18,260	$18,260
		Total	**43**		**$1,034,333**	**$3,395,150**	**$4,429,483**
	Severe Repetitive Loss	Single Family	4	AE	$78,094	$231,593	$309,687
			1	VE	$30,000	$89,671	$119,671
			1	0.2% Chance	$17,590	$60,601	$78,191
		Non Residential	1	AE	$59,770	$100,755	$160,524
		Total	7		$185,453	$482,619	$668,073
		Uninsured Total	**50**		**$1,219,786**	**$3,877,770**	**$5,097,556**
		Grand Total	**69**		**$1,676,256**	**$5,447,822**	**$7,124,078**

Source: NFIP Repetitive Loss Data, 2011

ISO Historical Loss Properties

Historical loss properties for the years 1977-2011 amounts to 1,413 properties with a total paid amount of $181 million based on the NFIP repetitive loss database for 2011. This list of addresses was geocoded into GIS and mapped in Figure 4.70. During the process of geocoding these addresses many addresses were removed due to errors in the database of properties outside the city limits of Waveland.

Figure 4.70. Waveland FEMA DFIRM with Historical Loss Properties



4.3.5 Flood: Stormwater/Localized Flooding

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Historically, the City has been at risk to flooding. Localized flooding also occurs throughout the City at various times throughout the year with several areas of primary concern unique to the City. Localized flooding and ponding not only affects streets and property, but standing water can be a breeding ground for mosquitoes. Affected localized flood areas identified by the City are summarized below:

- Grand Bayou and its tributaries are also sources of flooding during periods of heavy rainfall. Other flat, poorly drained areas of the community experience ponding during heavy rainfall:
- Nicholoson Avenue - Exxon & 90 - 100 Block on Beach
- Waveland Avenue - 100 Beach - Highway 90
- South Central Avenue - 100 Colman Avenue -Waveland Avenue & Central
- North Central Avenue - City line past Lakewood Drive - Colman Avenue
- Old Spanish Trail Highway 90 - Nicholson Avenue
- Waveland Beach Boulevard from Bay Oak Drive to Clermont Boulevard
- South Street to Clermont Boulevard
- Highway 603 at the Log Cabins between Avenue B and Kiln-Waveland Cutoff Road
- OTHER TROUBLE AREAS? DOES THE HMPC HAVE ANY PICTURES WE CAN ADD HERE?

Future Development

The risk of localized flooding to future development can be minimized by accurate recordkeeping of repetitive localized storm activity and an evaluation of regional drainage issues. Mitigating the root causes of the localized flooding or choosing not to develop in areas that often are subject to localized flooding that will reduce future risks of losses due to this hazard.

4.3.6 Hurricane and Tropical Storms (including Storm Surge) Vulnerability Analysis

Likelihood of Future Occurrence—Likely
Vulnerability—Extremely High

Torrential rains from hurricanes and tropical storms can produce extensive urban and riverine flooding. Winds from these storms located offshore can drive ocean water up the mouth of a river, compounding the severity of inland overbank flooding.

In addition to the combined destructive forces of wind, rain, and lightning, hurricanes can cause a "surge" in the ocean, which can raise the sea level as high as 25 feet or more in the strongest hurricanes. This “storm surge” also can have the opposite effect, in that the sea level can be lowered to below mean sea level at the backside of a hurricane. This phenomenon causes more destruction as storm surge waters are sucked back out to sea.

Natural resources, particularly beaches, are devastated by hurricanes. The erosion of the coastline is considerable due to the impact of wind, waves, and debris in a hurricane event. Beaches need to be replenished with appropriate materials to reduce erosion. Storm surge and subsequent erosion of the shoreline often leads to the loss of property. Vulnerability of the City to coastal erosion is discussed in greater detail in Section 4.3.3.

Assets at Risk

Hurricane/Tropical Storm Wind

A Hazus hurricane probabilistic scenario for wind damages was performed specific to the City of Waveland in this hazard mitigation plan. It is important to note that this is for wind damages from hurricane only, and does not cover flooding or storm surge damages both of which are covered in other sections of this plan. A probabilistic scenario based on Hurricane Camille’s track and damages was run for the City of Waveland and presented below.

Methodology

HAZUS-MH 2.1 was utilized to model hurricane wind losses for the City of Waveland. Specifically, the probable magnitude used for Butte County utilized a 100-year event. Level 1 analyses were run, meaning that only the default data was used and not supplemented with local building inventory or hazard data. There are certain data limitations when using the default data, so the results should be interpreted accordingly; this is a planning level analysis.

Limitations

Hazus-MH 2.1 and earlier versions base their analysis on census tracts which are very large and aren’t always an accurate representation of the populations and structures within the smaller city limits of Waveland. For this probabilistic run, the census tracks cover the City of Waveland pre-annexation. Annexed lands are not included in this scenario. As such, the 2010 Mississippi State Hazard Mitigation Plan findings on hurricane winds will be used as support for the discussion of property at risk in the entirety of the City Waveland and Hancock County. This follows Table 4.69.

The methodology for running the probabilistic hurricane scenario used probabilistic wind contour maps developed by the National Weather Service that are included with Hazus. Hazus estimates hurricane winds and potential damage and loss to residential, commercial, and industrial buildings. It also estimates direct economic loss, post-storm shelter needs, and building and tree debris quantities and allows assessment of specific structural changes to buildings to strengthen them for mitigation.

The results of the probabilistic scenario are captured in Table 4.61. Key losses included the following:

- Total economic loss estimated from hurricane winds was over $156.4 million, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $128.1 million.
- Over 23 percent of the buildings in the City were at least moderately damaged. 179 buildings were completely destroyed.
- Over 86 percent of the building- and income-related losses were residential structures. 3 percent of the estimated losses were related to business interruptions.

Table 4.61. Waveland 100-year Hazus Hurricane Scenario Results

Impacts/Earthquake	100-year Hurricane Wind Damages
Residential Buildings Damaged (Based upon 10,224 buildings)	None: 3,901 Minor: 3,776 Moderate: 1,748 Severe: 375 Destruction: 179
Building Related Loss	$128,065,430
Total Economic Loss	$156,379,390
Property Damage	Residential: $113,291,560 Commercial: $10,763,910 Industrial: $1,088,880 Others: $2,921,090
Business Interruption Loss	Residential: $21,389,940 Commercial: $5,728,530 Industrial: $101,220 Others: $1,094,270
Essential Facility Damage (Based upon 134 buildings)	1 hospital with at least moderate damage 3 schools with at least moderate damage
Displaced Households	303
Shelter Requirements	79
Debris Generation	Brick/Wood: 18,992 tons Reinforced Concrete/Steel: 0 tons Eligible Tree Debris: 22,884 tons Other Tree Debris: 33,354 tons

Source: HAZUS-MH 2.0

Storm Surge

Hurricane surge analysis is similar to the flood analysis for the City in that parcels were converted into centroids and intersected with the five hurricane surge categories. This analysis was done in GIS by intersecting the parcel centroids to each hurricane surge GIS layer. Contents and damage factors utilized in the methodology are described in detail above in the flood section (see Section 4.3.4). Figure 4.71 and Tables 4.62 through 4.66 were made to represent the potential effects of each hurricane surge based on hurricane categories.

Figure 4.71. Waveland Storm Surge from Hurricane Categories 1 through 5

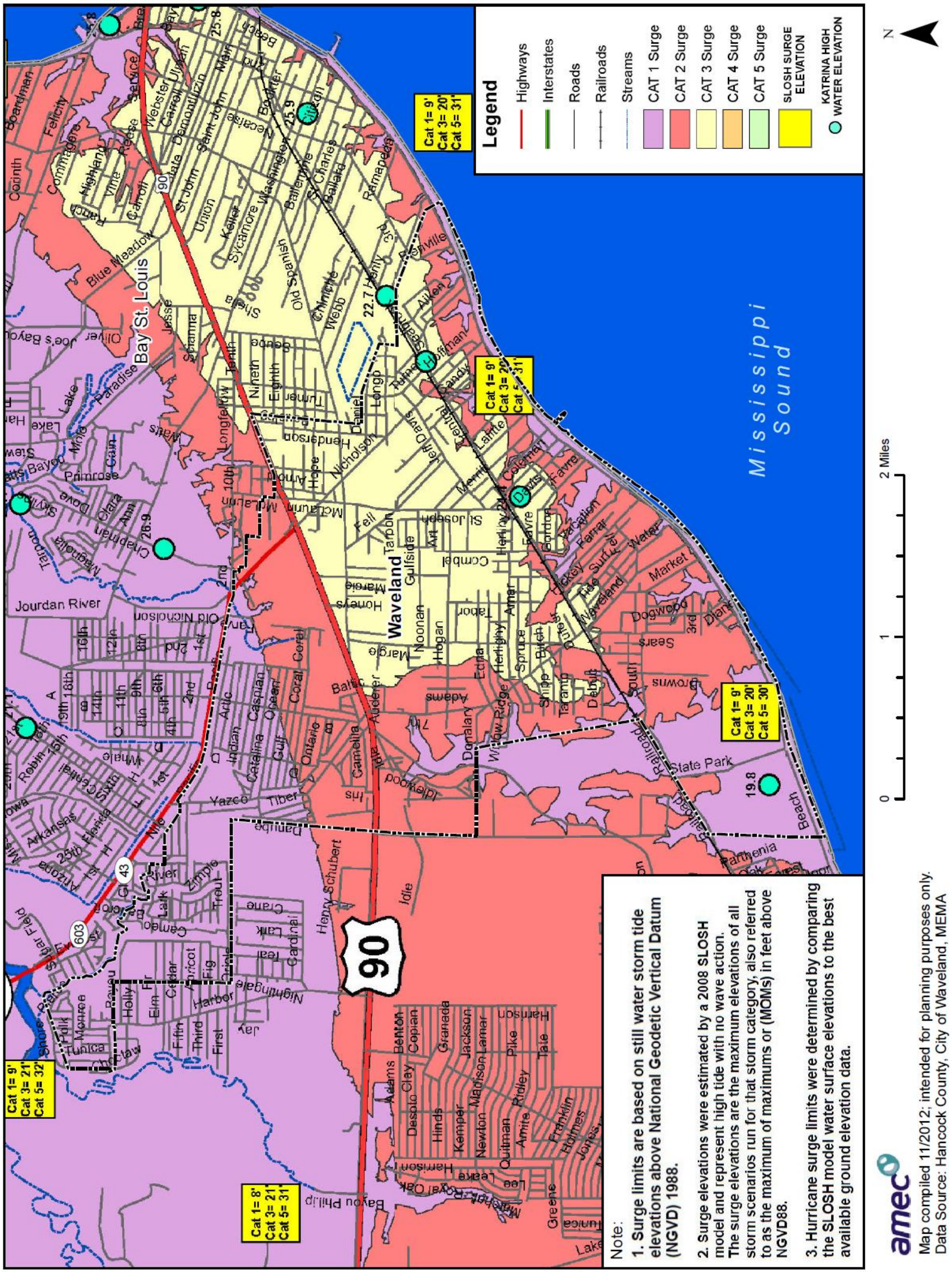


Table 4.62. Hurricane Category 1 Storm Surge Damages in the City of Waveland

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value*	Estimated Loss
Camp and Resort	1	0	$0	$0	$0	$0	$0
Commercial	7	7	$363,787	$977,993	$977,993	$1,955,986	$437,458
Cultural and Parks	2	1	$0	$23,738	$23,738	$47,476	$18,990
Land and Forest	2,408	30	$18,087,386	$522,347	$522,347	$1,044,694	$289,752
Recreation and Entertainment	1	0	$0	$0	$0	$0	$0
Religion	5	2	$0	$307,364	$307,364	$614,728	$245,891
Residential	291	254	$3,756,799	$15,901,277	$7,950,639	$23,851,916	$5,227,363
Services	5	5	$108,680	$617,379	$617,379	$1,234,758	$495,243
Transportation	1	0	$0	$0	$0	$0	$0
Utilities and Communication	2	0	$33,058	$0	$0	$0	$0
Total	**2,723**	**299**	**$22,349,710**	**$18,350,098**	**$10,399,460**	**$28,749,558**	**$6,714,698**

Source: Hancock County Assessor's Data 2012, MEMA

* Land value is shown but not included in total value or loss estimate for hurricane storm surge

Table 4.63. Hurricane Category 2 Storm Surge Damages in the City of Waveland

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value*	Estimated Loss
Camp and Resort	1	0	$0	$0	$0	$0	$0
Commercial	61	55	$13,567,475	$33,589,146	$33,589,146	$67,178,292	$18,600,770
Cultural and Parks	2	1	$0	$23,738	$23,738	$47,476	$18,990
Government	3	1	$190,000	$1,845,271	$1,845,271	$3,690,542	$0
Land and Forest	4,329	67	$56,819,075	$1,806,596	$1,806,596	$3,613,192	$814,971
Recreation and Entertainment	3	1	$319,996	$1,665,068	$1,665,068	$3,330,136	$1,332,054
Religion	15	5	$16,815	$696,967	$696,967	$1,393,934	$522,547
Residential	1,156	1,033	$24,283,982	$96,950,226	$48,475,113	$145,425,339	$26,603,294
Services	24	18	$2,015,158	$2,813,431	$2,813,431	$5,626,862	$2,145,031
Transportation	8	1	$1,043,400	$260,935	$391,403	$652,338	$0
Utilities and Communication	3	0	$39,058	$0	$0	$0	$0
Total	**5,605**	**1,182**	**$98,294,959**	**$139,651,378**	**$91,306,733**	**$230,958,111**	**$50,037,657**

Source: Hancock County Assessor's Data 2012, MEMA

** Land value is shown but not included in total value or loss estimate for hurricane storm surge

Table 4.64. Hurricane Category 3 Storm Surge Damages in the City of Waveland

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value*	Estimated Loss
Camp and Resort	1	0	$0	$0	$0	$0	$0
Commercial	101	89	$18,129,342	$40,759,811	$40,759,811	$81,519,622	$22,214,846
Cultural and Parks	6	3	$281,120	$988,634	$988,634	$1,977,268	$45,380
Education	2	0	$100,000	$0	$0	$0	$0
Government	7	2	$280,000	$3,136,185	$3,136,185	$6,272,370	$645,457
Land and Forest	5,545	105	$78,361,563	$3,930,075	$3,930,075	$7,860,150	$1,600,267
Medical	3	3	$217,625	$353,361	$530,042	$883,403	$329,777
Recreation and Entertainment	4	1	$319,996	$1,665,068	$1,665,068	$3,330,136	$1,332,054
Religion	31	6	$57,034	$700,468	$700,468	$1,400,936	$522,547
Residential	2,640	2,439	$57,929,545	$217,148,823	$108,574,412	$325,723,235	$65,817,982
Services	53	40	$3,953,828	$7,268,598	$7,268,598	$14,537,196	$4,670,539
Transportation	15	2	$1,783,010	$955,752	$1,433,628	$2,389,380	$694,817
Utilities and Communication	7	2	$119,864	$82,118	$123,177	$205,295	$49,971
Total	**8,415**	**2,692**	**$161,532,927**	**$276,988,893**	**$169,110,097**	**$446,098,990**	**$97,923,637**

Source: Hancock County Assessor's Data 2012, MEMA

* Land value is shown but not included in total value or loss estimate for hurricane storm surge

Table 4.65. Hurricane Category 4 Storm Surge Damages in the City of Waveland

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value	Estimated Loss
Camp and Resort	1	0	$0	$0	$0	$0	$0
Commercial	101	89	$18,129,342	$40,759,811	$40,759,811	$81,519,622	$22,214,846
Cultural and Parks	6	3	$281,120	$988,634	$988,634	$1,977,268	$45,380
Education	2	0	$100,000	$0	$0	$0	$0
Government	7	2	$280,000	$3,136,185	$3,136,185	$6,272,370	$645,457
Land and Forest	5,545	105	$78,361,563	$3,930,075	$3,930,075	$7,860,150	$1,600,267
Medical	3	3	$217,625	$353,361	$530,042	$883,403	$329,777
Recreation and Entertainment	4	1	$319,996	$1,665,068	$1,665,068	$3,330,136	$1,332,054
Religion	31	6	$57,034	$700,468	$700,468	$1,400,936	$522,547
Residential	2,640	2,439	$57,929,545	$217,148,823	$108,574,412	$325,723,235	$65,817,982

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value	Estimated Loss
Services	53	40	$3,953,828	$7,268,598	$7,268,598	$14,537,196	$4,670,539
Transportation	15	2	$1,783,010	$955,752	$1,433,628	$2,389,380	$694,817
Utilities and Communication	7	2	$119,864	$82,118	$123,177	$205,295	$49,971
Total	**8,415**	**2,692**	**$161,532,927**	**$276,988,893**	**$169,110,097**	**$446,098,990**	**$97,923,637**

Source: Hancock County Assessor's Data 2012, MEMA
* Land value is shown but not included in total value or loss estimate for hurricane storm surge

Table 4.66. Hurricane Category 5 Storm Surge Damages in the City of Waveland

Land Use	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Content Value	Total Value	Estimated Loss
Camp and Resort	1	0	$0	$0	$0	$0	$0
Commercial	101	89	$18,129,342	$40,759,811	$40,759,811	$81,519,622	$22,214,846
Cultural and Parks	6	3	$281,120	$988,634	$988,634	$1,977,268	$45,380
Education	2	0	$100,000	$0	$0	$0	$0
Government	7	2	$280,000	$3,136,185	$3,136,185	$6,272,370	$645,457
Land and Forest	5,545	105	$78,361,563	$3,930,075	$3,930,075	$7,860,150	$1,600,267
Medical	3	3	$217,625	$353,361	$530,042	$883,403	$329,777
Recreation and Entertainment	4	1	$319,996	$1,665,068	$1,665,068	$3,330,136	$1,332,054
Religion	31	6	$57,034	$700,468	$700,468	$1,400,936	$522,547
Residential	2,640	2,439	$57,929,545	$217,148,823	$108,574,412	$325,723,235	$65,817,982
Services	53	40	$3,953,828	$7,268,598	$7,268,598	$14,537,196	$4,670,539
Transportation	15	2	$1,783,010	$955,752	$1,433,628	$2,389,380	$694,817
Utilities and Communication	7	2	$119,864	$82,118	$123,177	$205,295	$49,971
Total	**8,415**	**2,692**	**$161,532,927**	**$276,988,893**	**$169,110,097**	**$446,098,990**	**$97,923,637**

Source: Hancock County Assessor's Data 2012, MEMA
* Land value is shown but not included in total value or loss estimate for hurricane storm surge

Table 4.67 provides a summary of parcels at risk in the City, and includes a loss estimate and loss ratio. The data illustrates that a Category 1 or 2 has less impact to the City, with over $6 million and $50 million in damages respectively, but storm surge from a Category 3 or higher hurricane potentially inundates the entire City area with total losses in excess of $97 million. Similar to the flood hazard, potential losses from a storm surge generally affect improved structures and their content, the value of land is generally not a loss. Thus the land value is shown, but the loss estimate is just based on the total value calculated for this hazard which includes improved and contents values only. The loss ratio illustrates the ratio (or %) of damages associated with each hurricane storm surge scenario relative to the overall improved values of property inventory within the City. As noted previously, the City is totally inundated from a Category 3, 4, and 5 hurricane with a loss ratio of 22%.

Table 4.67. Waveland Hurricane Storm Surge Loss Ratio

Hurricane Category	Total Parcel Count	Improved Parcel Count	Land Value	Improved Value	Estimated Content Value	Total Value	Estimated Loss	Loss Ratio
1	2,723	299	$22,349,710	$18,350,098	$10,399,460	$28,749,558	$6,714,698	2%
2	5,605	1,182	$98,294,959	$139,651,378	$91,306,733	$230,958,111	$50,037,657	11%
3	8,415	2,692	$161,532,927	$276,988,893	$169,110,097	$446,098,990	$97,923,637	22%
4	8,415	2,692	$161,532,927	$276,988,893	$169,110,097	$446,098,990	$97,923,637	22%
5	8,415	2,692	$161,532,927	$276,988,893	$169,110,097	$446,098,990	$97,923,637	22%

Source: Hancock County Assessor's Data 2012, MEMA
* Land value is shown but not included in total value or loss estimate for hurricane storm surge

Population at Risk

Hurricane Wind

In assessing Waveland's vulnerability to damage and loss of life from hurricanes and tropical storms, at the top of the list is loss of life and property due to winds. The City's citizens are vulnerable to hurricanes. In the Hazus hurricane scenario in Table 4.61, Hazus estimated that 303 families would be displaced by hurricane winds.

The very young, the elderly and the handicapped are especially vulnerable to harm from hurricanes. For those who are unable to evacuate for medical reasons, there should be provision to take care of special-needs patients and those in hospitals and nursing homes. Many of these patients are either oxygen- dependent, insulin-dependent, or in need of intensive medical care. There is a need to provide ongoing treatment for these vulnerable citizens, either on the coast or by air evacuation to upland hospitals. The stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

Disability status from the 2010 Census was unavailable. The 2010 Census population of residents under 5 years old was 474 (7.4% of the population). The 2010 Census population of residents over 65 was 720 (11.2% of the population. The total population of the City is at risk to hurricanes. 2010 US Census population data suggests that all 6,435 citizens of the City would be at risk to hurricane.

Storm Surge

Storm surge analysis for populations at risk was performed with the five hurricane surge categories. This analysis was done in GIS by intersecting the parcel centroids to each hurricane surge GIS layer. In evaluating populations at risk, only those people residing in the hurricane storm surge zones are included. Thus,those parcel centroids intersecting the flood zones were counted and multiplied by the Census Bureau Waveland household factor (2.50). Population at risk to storm surge is shown in Table 4.68.

Table 4.68. Waveland Population at Risk to Storm Surge

Hurricane Category	Improved Residential Parcels	Population
Hurricane Category 1	254	635
Hurricane Category 2	1,033	2,583
Hurricane Category 3	2,439	6,098
Hurricane Category 4	2,439	6,098
Hurricane Category 5	2,439	6,098

Source: Hancock County Assessor's Data 2012, MEMA, US Census Bureau

Critical Facilities at Risk

Hurricane Winds

The HMPC denoted that all critical facilities are at risk to damage from hurricanes. Newer buildings have been built to withstand greater structural strain from hurricane. However, a direct hit from a Category 3 or higher hurricane could damage any critical facility in the City. STILL TRUE?

Storm Surge

A separate analysis was performed to determine critical facilities in the hurricane storm surge zones. Using GIS, the storm surge flood zones were overlayed on the locations of critical facilities in the City of Waveland. Figure 4.72 shows the storm surge zones in the City and the location of the City's critical facilities. Table 4.69 shows the critical facilities in the City at risk to each hurricane surge zones.

Figure 4.72. Waveland Storm Surge and Critical Facilities

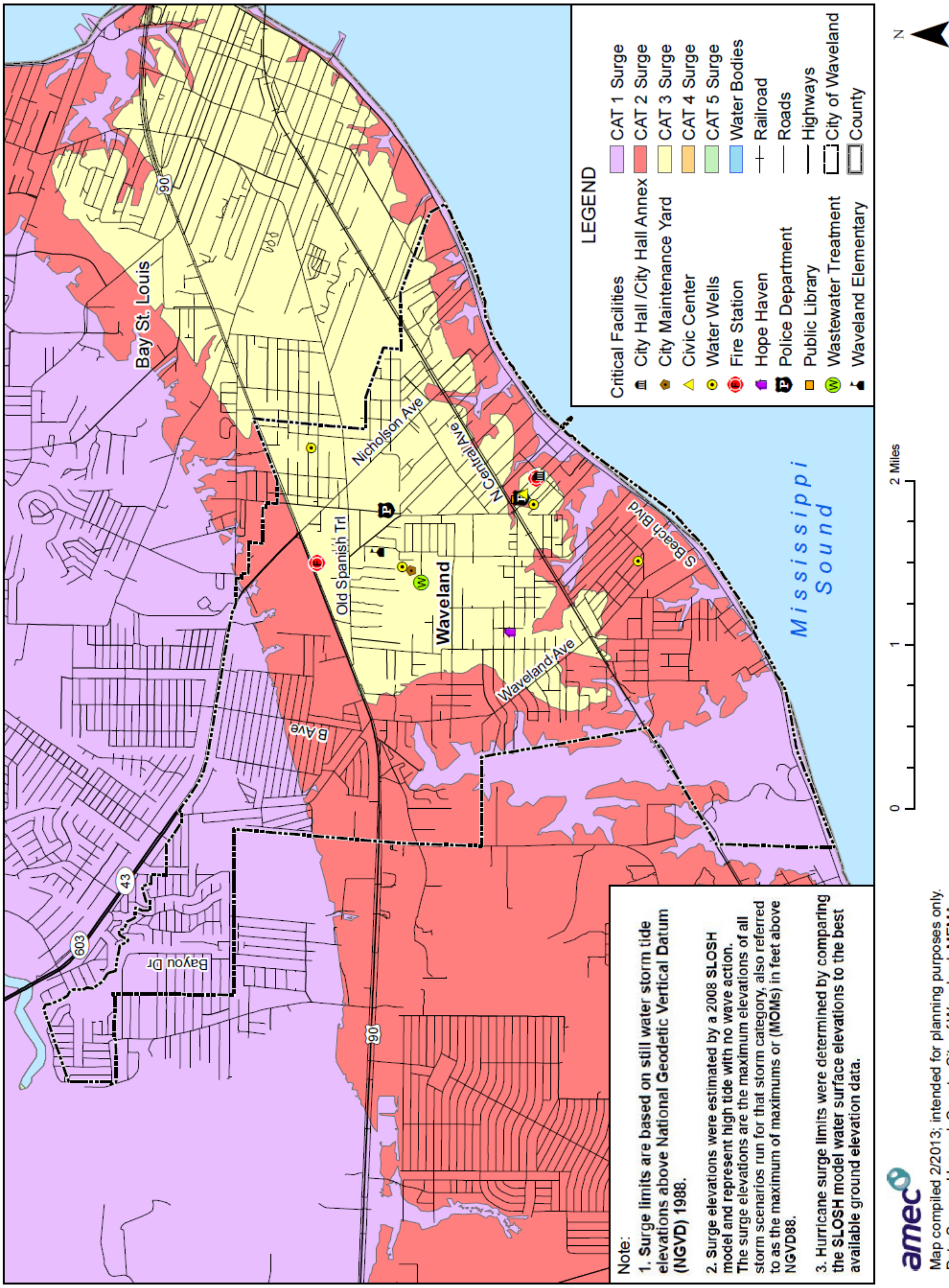


Table 4.69. Waveland Critical Facilities in Hurricane Surge Zones

Facility	Facility Type	Address	Hurricane Surge Zones	Replacement Values
City Hall	Public	301 Coleman Ave	CAT 3, 4, 5	$3,200,000
City Hall Annex	Public	301 Coleman Ave	CAT 3, 4, 5	$0
City Maintenance Yard	Public	322 Gulfside	CAT 3, 4, 5	$1,000,000
Civic Center	Public	335 Coleman Ave	CAT 3, 4, 5	$3,209,313
Davis Ave Water Well	Well	89 22' 31.445"W, 30 17' 7.157"N	CAT 3, 4, 5	$600,000
Faith Street Water Well	Well	89 22' 10.891" W, 30 18' 18.234"N	CAT 3, 4, 5	$600,000
Fire Station #1	Fire Public	307 Coleman Ave	CAT 3, 4, 5	$1,800,000
Central Fire Station	Fire Public	427 Hwy 90	CAT 3, 4, 5	$3,287,000
Gulfside Street Water Well	Well	89 23' 0.253"W, 30 17' 47.799"N	CAT 3, 4, 5	$600,000
Hope Haven	Public	716 Herlihy St	CAT 3, 4, 5	$200,000
Police Department	Public	335 Coleman Ave	CAT 2, 3, 4, 5	$0
Police Department (construction)	Public	1602 McLaurn	CAT 3, 4, 5	$4,415,979
Public Library	Public	345 Coleman Ave	CAT 2, 3, 4, 5	$1,639,377
Tide Street Water Well	Well	89 22' 52.095"W, 30 16' 33.753"N	CAT 2, 3, 4, 5	$600,000
Wastewater Treatment	Public	322 Gulfside	CAT 3, 4, 5	$15,000,000
Waveland Elementary	Elementary Public	1101 St Joseph St	CAT 3, 4, 5	$3,500,000

Source: City of Waveland, MEMA

Development Trends

A simple analysis was performed to quantify parcels within these development areas that are also in storm surge areas.

Methodology

A simple analysis was performed to quantify parcels within these development areas that are also in storm surge areas. Hurricane surge analysis is similar to flood analysis in that parcels were converted into centroids and intersected with the five hurricane surge categories. This analysis was done in GIS by intersecting the parcel centroids to each hurricane surge GIS layer. Neither Category 1 or 2 hurricane storm surges have the potential strength to inundate the whole City of Waveland. Figures 4.73 and 4.74 were created to show were undeveloped land could be impacted by storm surge from a Category 1 or 2 storm surge. Table 4.70 details the unimproved parcels at risk to Category 1 and 2 hurricane storm surge. Category 3 or above would inundate the City and are not included in Table 4.70.

Figure 4.73. Future Development in the Category 1 Storm Surge Area

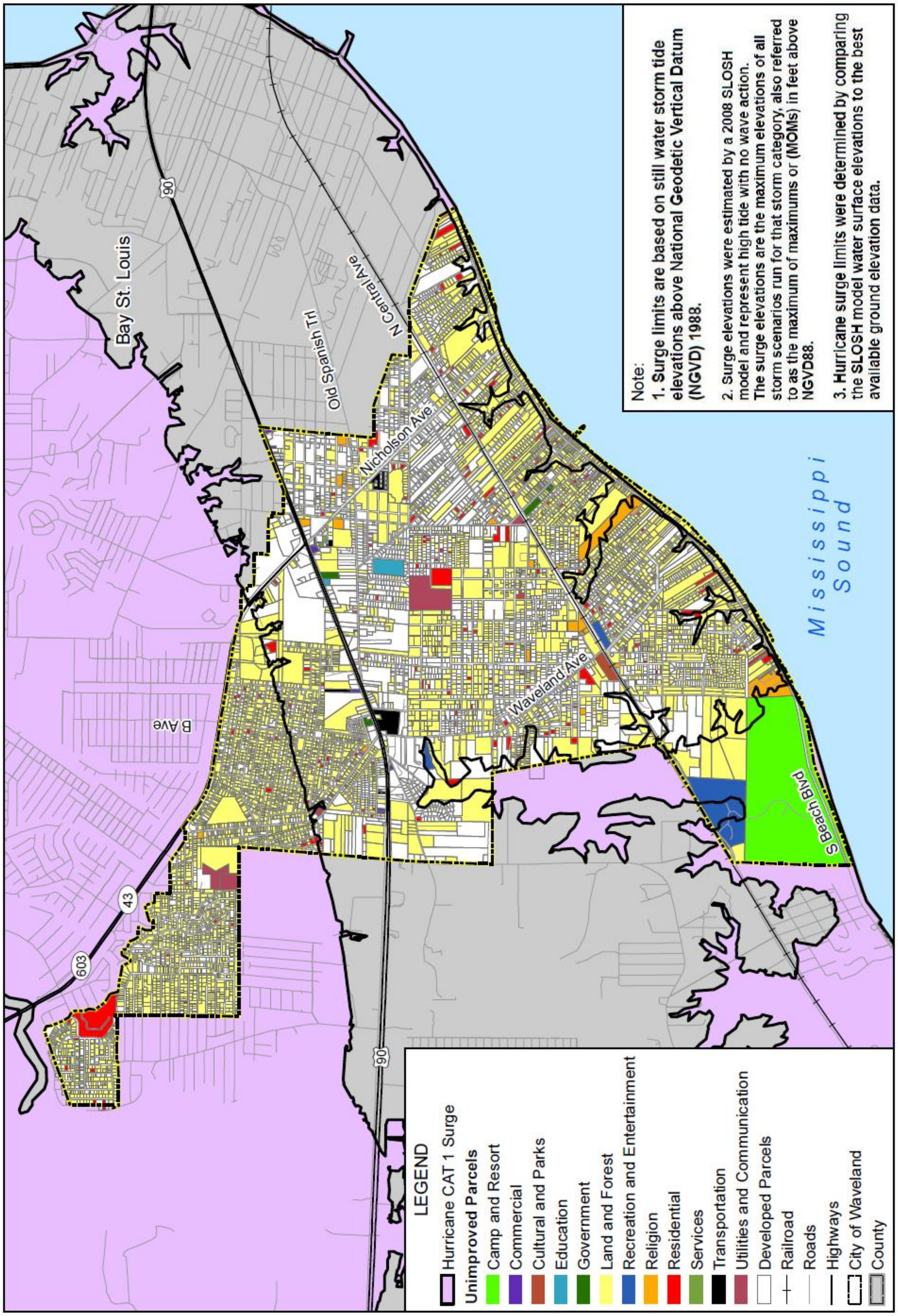


Figure 4.74. Future Development in the Category 2 Storm Surge Area

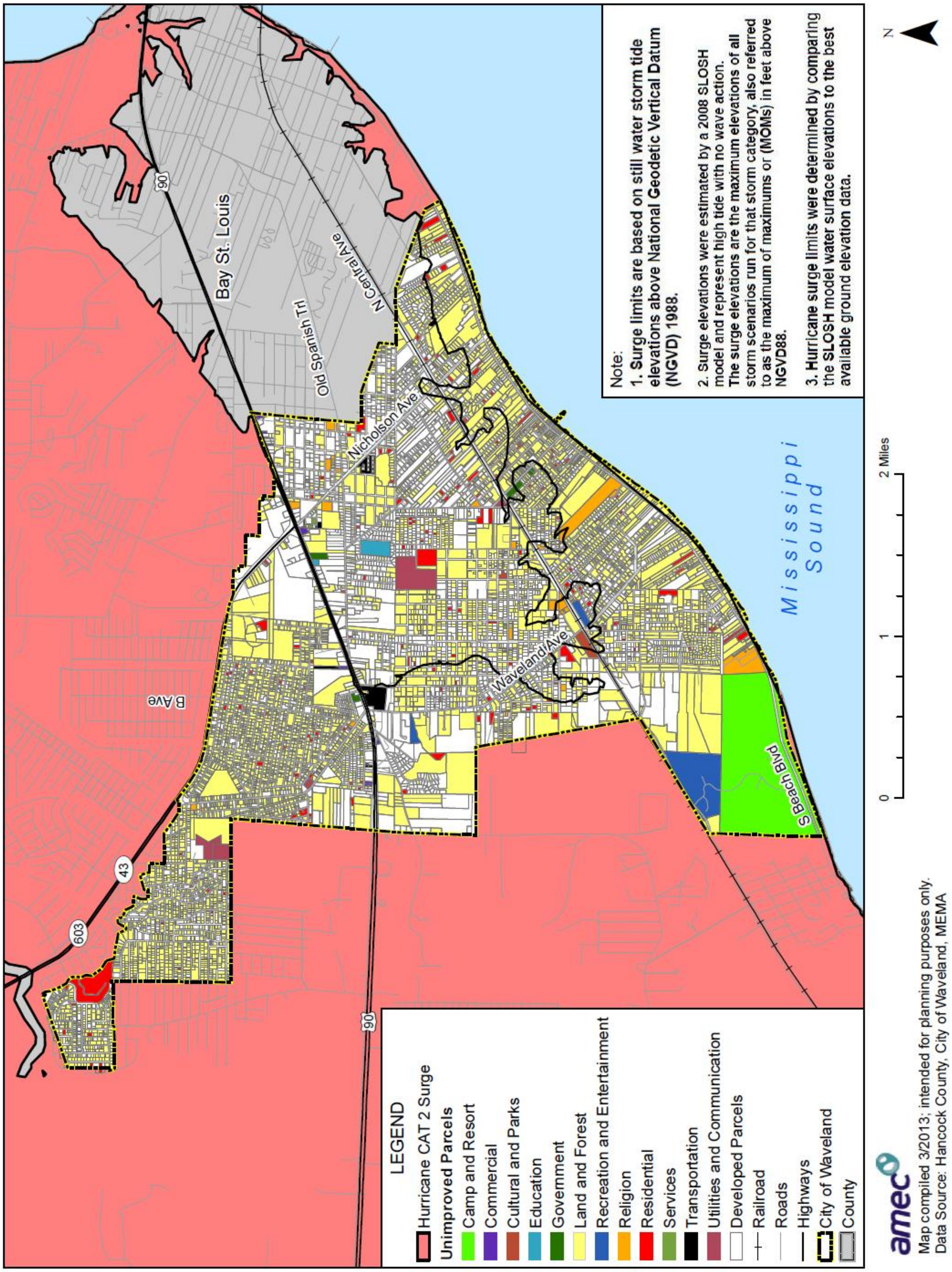


Table 4.70. Waveland – Future Development Parcels and Storm Surge Areas from Category 1 and 2 Hurricanes

Land Use	Unimproved Parcel Count	Land Value
Category 1 Surge		
Camp and Resort	1	$0
Cultural and Parks	1	$0
Land and Forest	2,378	$17,864,746
Recreation and Entertainment	1	$0
Religion	3	$0
Residential	37	$220,593
Transportation	1	$0
Utilities and Communication	2	$33,058
Total Category 1	**2,424**	**$18,118,397**
Category 2 Surge		
Camp and Resort	1	$0
Commercial	6	$267,750
Cultural and Parks	1	$0
Government	2	$190,000
Land and Forest	4,262	$55,381,604
Recreation and Entertainment	2	$0
Religion	10	$6,000
Residential	123	$2,395,893
Services	6	$54,290
Transportation	7	$831,400
Utilities and Communication	3	$39,058
Total Category 2	**4,423**	**$59,165,995**

Source: NOAA Coastal Services Center, Hancock County Assessor's Data 2012

Impacts on future development are dependent upon mitigation of existing buildings and whether or not Waveland will become more pro-active than in the past. How well structures are built or placed in the future will determine the impact of future hurricane winds in the future. Strong development codes and ordinances are the key to sustainable future development. Codes and ordinances are discusses in more detail in the Section 4.4 below.

2010 Mississippi State Plan Findings

This section is included to provide an overview of the hurricane hazard impacts to Waveland and Hancock County detailing a more regional perspective of potential of impacts. HAZUS-MR4 hurricane loss modeling capabilities were used to quantify expected losses to the state and differentiate vulnerability by county. HAZUS-MR4 can model specific hypothetical or historical scenarios and probabilistic scenarios. Scenario results represent the expected damage from a single hurricane event, while probabilistic scenario results represent the range of probable losses estimated from a 100,000-year simulation of expected hurricane activity. The direct economic loss results for a probabilistic analysis include annualized loss estimates. Annualized losses are the total losses summed over the entire simulation period divided by 100,000 years.

During the 2010 update to the State plan an annualized loss scenario was again run for the entire state. The probabilistic scenario was run to model annualized losses for each Mississippi county. This scenario was chosen over a deterministic analysis largely because the impacts from a severe hurricane are known due to Hurricane Katrina.

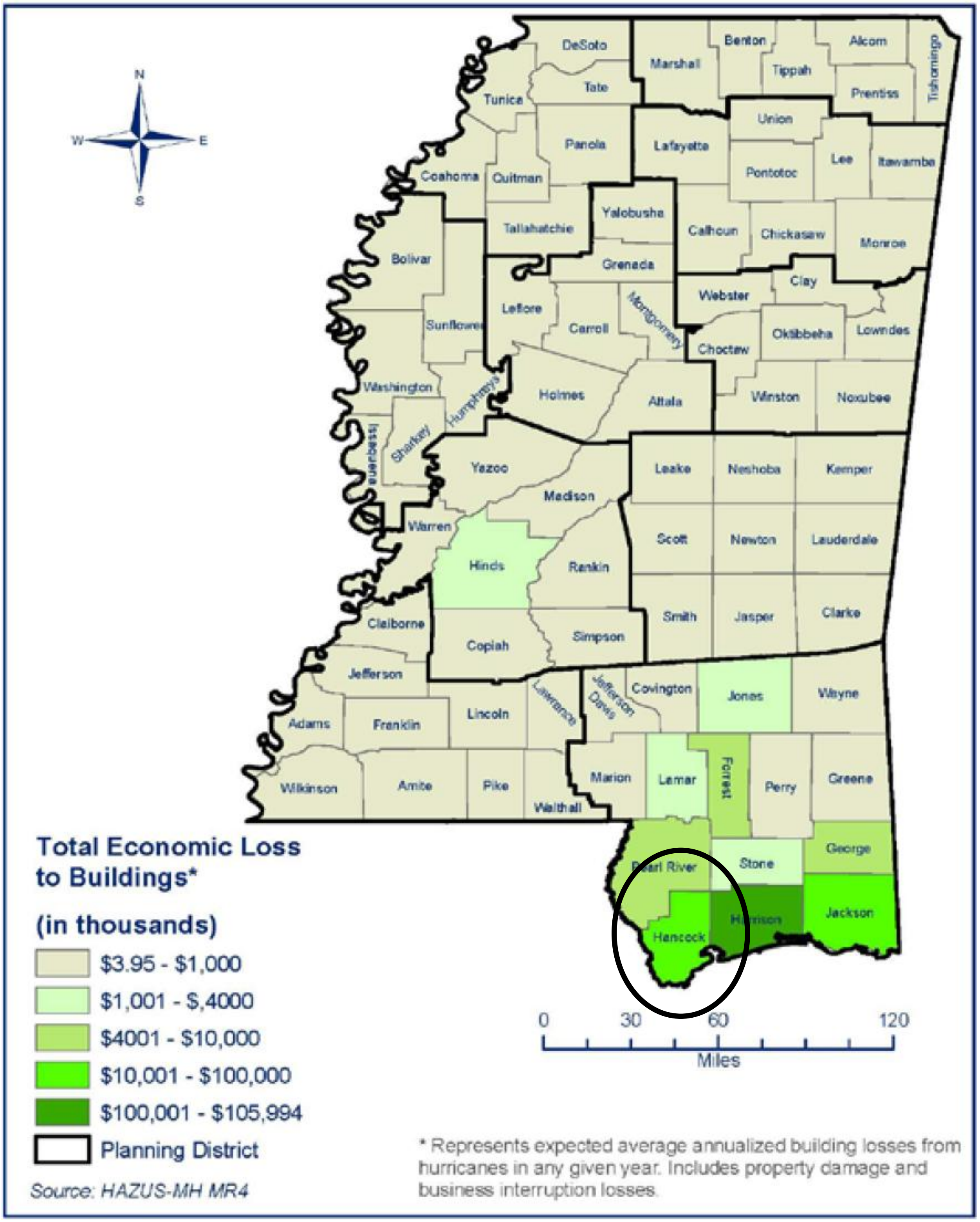
Camille's storm track served as the pattern for the 2010 deterministic scenarios but the initial point of impact was changed to strike in the center of each of the three coastal counties of Hancock, Harrison and Jackson and then track north. The impact points were chosen because the geographic locations and the record of past occurrences indicate they are the areas in the State most likely to be struck. The scenarios for each of the three impact points were run for Category 5 Camille-based storms.

HAZUS-MR4 does not include flood or storm surge damages in the estimation process, so damages from wind only were determined by these scenarios obtained from the state Hazard Mitigation Plan. Damages and losses from flooding caused by storm surge and other hurricane-related flooding was addressed in the flood component of the state's risk assessment

In the State Plan, SLOSH modeling provided depth of flooding information but did not provide damages or loss estimates. The State of Mississippi investigated correlating depth of flooding information from SLOSH models run and determined it was not possible to correlate flood data from the SLOSH modeling to the damage and loss information from the HAZUS-MR4 scenarios. Since no correlation was possible, SLOSH modeling is not included in the State plan and damages and losses from storm surge is not specifically addressed. Damages and losses from flooding caused by storm surge and other hurricane-related flooding is addressed in the flood component of the risk assessment.

The results of the annualized loss modeling are presented in Figure 4.75 and Table 4.71 that follow. Results shown are annualized total dollar losses, which include property damage and business interruption losses, and annualized loss ratio, which is the percent of the building structure value that could be damaged from hurricanes in any given year.

Figure 4.75. Hazus-MH Hurricane Loss Estimation: Annualized Loss Scenario Total Economic Loss



Source: 2010 State of Mississippi Hazard Mitigation Plan

Table 4.71. Hazus-MH Annualized Hurricane Loss Estimation

County	Building Damage	Loss Ratio*	Contents Damage and Inventory Loss ($)	Income Loss **	Total Building Loss	Loss Ratio Rank
Hancock	$9,232,000	0.34	$3,412,000	$2,608,000	$15,251,000	3

Source: 2010 State of Mississippi Hazard Mitigation Plan

*Loss ratio is the percent of the total building inventory value that could be damaged from hurricanes in any given year.

**Total income loss includes relocation loss, capital-related loss, wages loss, and rental income loss.

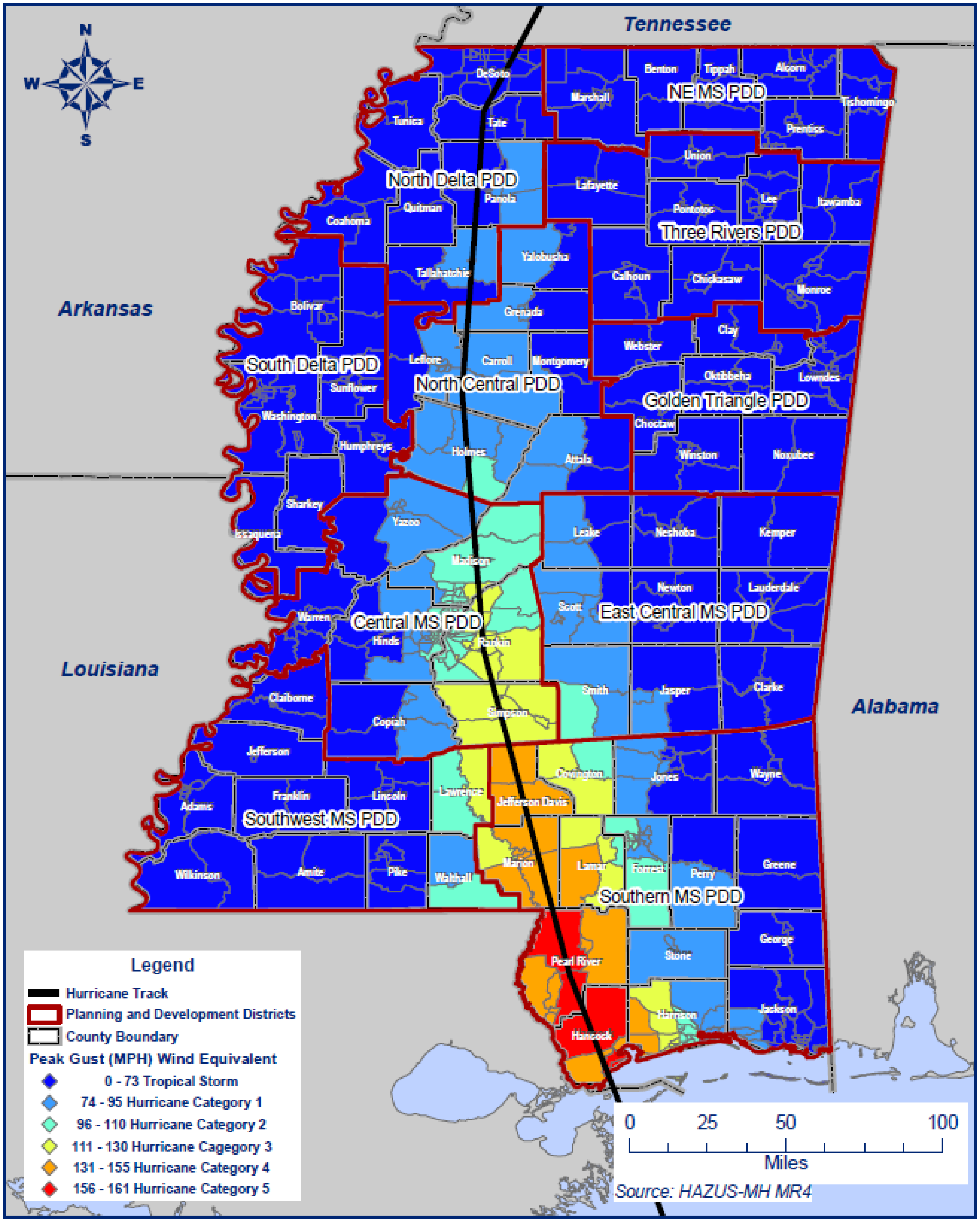
Tables 4.72 through Table 4.74 illustrate Hancock County's vulnerability to a Category 5 hurricane. The tables document numbers of buildings damaged by structure type and degree of damage for each of the three HAZUS-MR4 deterministic scenarios (Hancock County, Harrison County, and Jackson County landfalls). In addition, wind speed of Category 5 hurricanes are provided as Figures 4.76 to Figure 4.78

Table 4.72. Buildings Damaged in Hancock County with a Hancock County Landfall

County	Minor	Moderate	Severe	Destroyed	Total
Hancock					
Total Res	2,410	5,515	6,142	6,869	20,936
Total Other*	107	355	846	64	1,373
Total	**2,517**	**5,870**	**6,988**	**6,933**	**22,308**

Source: 2010 State of Mississippi Hazard Mitigation Plan

Figure 4.76. Windspeed of Category 5 Hurricane – Hancock County Landfall



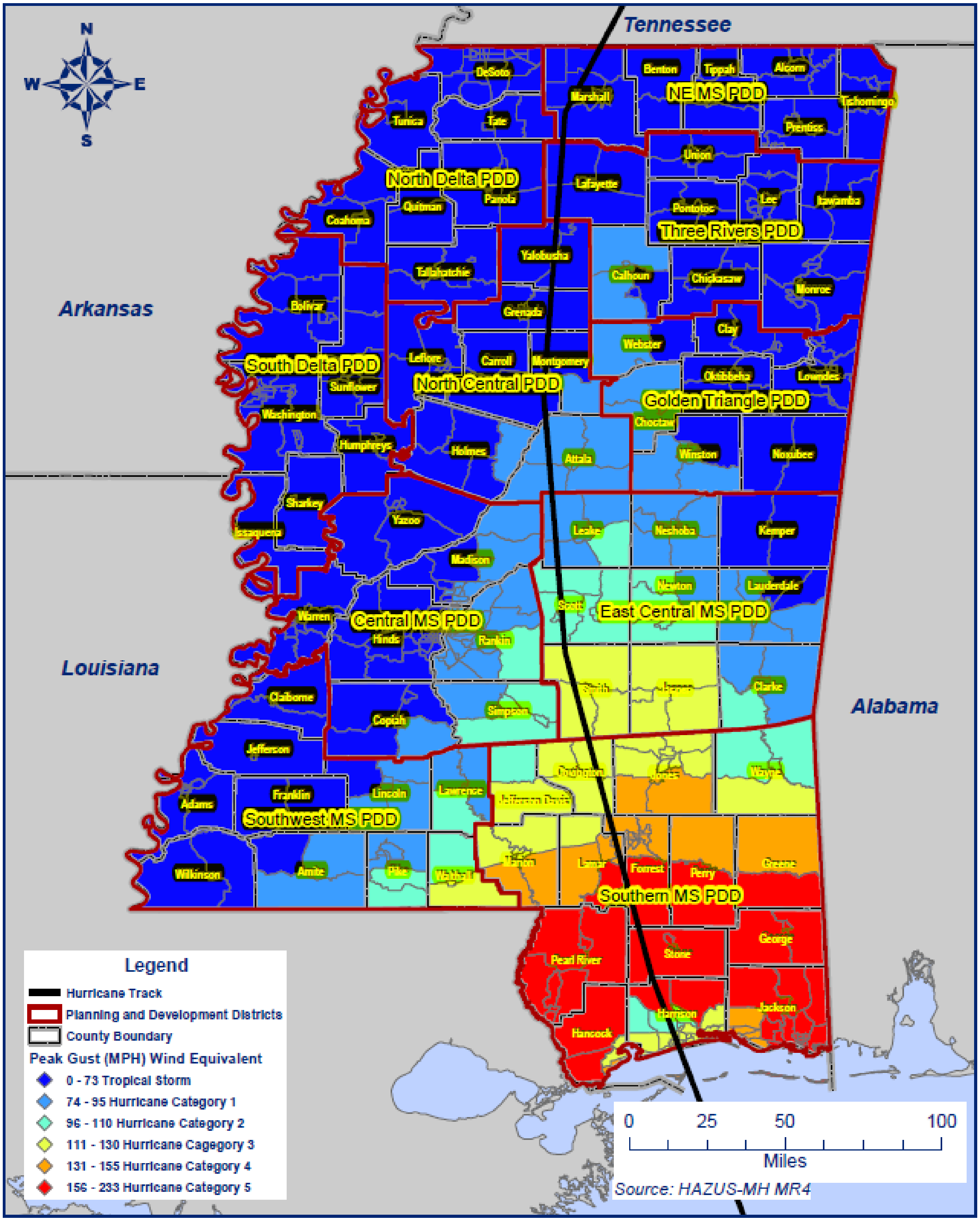
Source: 2010 State of Mississippi Hazard Mitigation Plan

Table 4.73. Buildings Damaged in Hancock County with a Harrison County Landfall

County	Minor	Moderate	Severe	Destroyed	Total
Hancock					
Total Res	5,574	3,653	1,866	6,129	17,222
Total Other*	269	307	420	133	1,129
Total	**5,844**	**3,959**	**2,286**	**6,262**	**18,351**

Source: 2010 State of Mississippi Hazard Mitigation Plan

Figure 4.77. Windspeed of Category 5 Hurricane – Harrison County Landfall



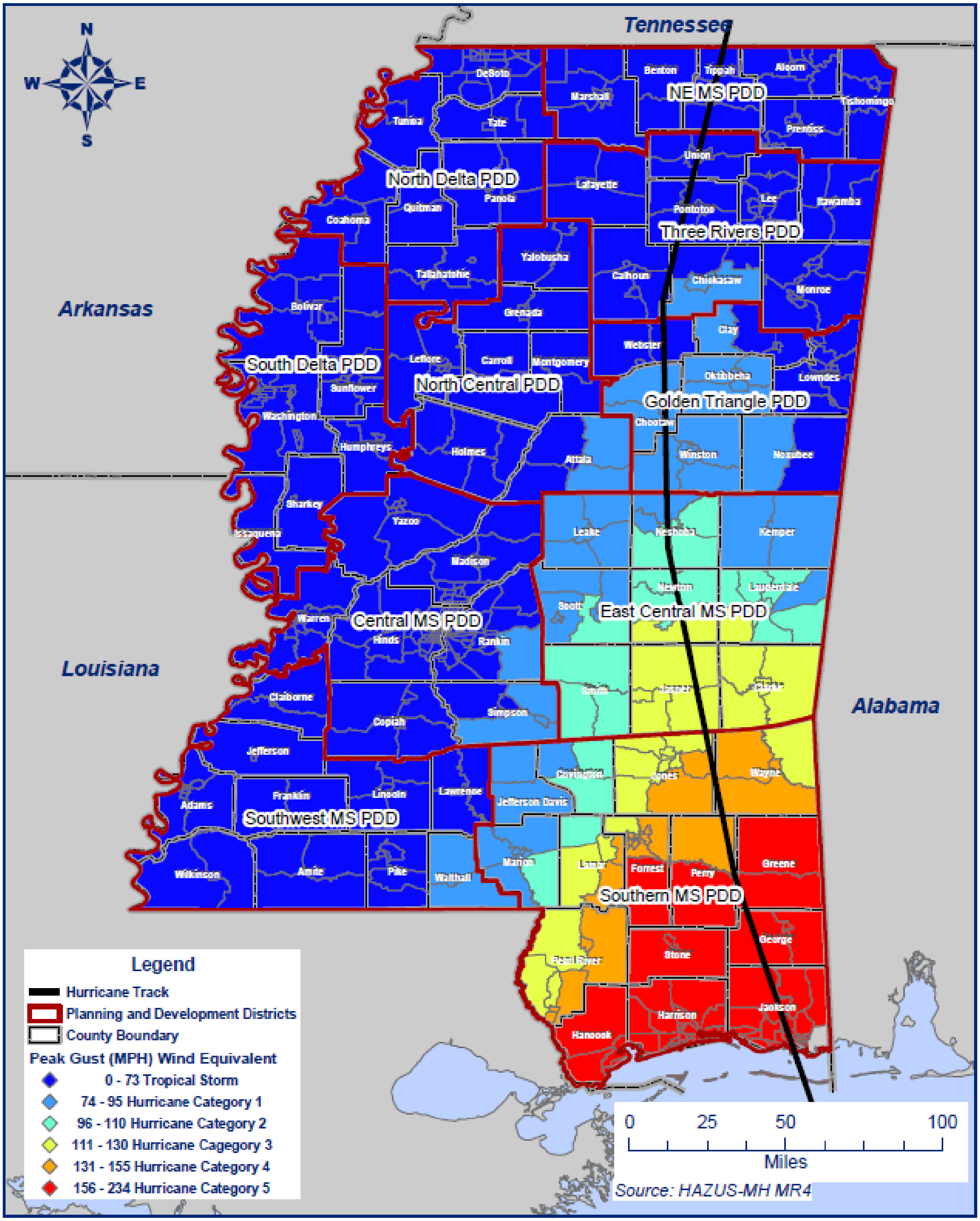
Source: 2010 State of Mississippi Hazard Mitigation Plan

Table 4.74. Buildings Damaged in Hancock County with a Jackson County Landfall

County	Minor	Moderate	Severe	Destroyed	Total
Hancock					
Total Res	844	2,736	5.556	12.120	21.256
Total Other*	41	185	989	187	1.402
Total	**886**	**2,921**	**6.545**	**12.307**	**22.658**

Source: 2010 State of Mississippi Hazard Mitigation Plan

Figure 4.78. Windspeed of Category 5 Hurricane – Jackson County Landfall



Source: 2010 State of Mississippi Hazard Mitigation Plan

Summary of State Plan Findings

Economic losses expected in Hancock County from a Category 5 hurricane will vary significantly depending upon the landfall scenario as follows, (expressed in thousands of dollars)

- Hancock County Scenario: $1,399,791,000
- Harrison County Scenario: $886,439,000
- Jackson County Scenario: $1,987,056,000

Source: 2010 State of Mississippi Hazard Mitigation Plan

The State Plan also noted that economic losses from a Category 3 or Category 1 hurricane, regardless of landfall scenario, would exceed $500,000.

4.3.7 Thunderstorm (includes hail, lightning, high wind)

Likelihood of Future Occurrence—Highly Likely
Vulnerability—Medium

Thunderstorms producing winds, hail, and lightning are a common occurrence in the City between early spring and late fall. Given the lightning statistics for the region, the City is at risk and is vulnerable to the effects of lightning. Persons recreating or working outdoors during the months of April through September will be most at risk to lightning strikes. In addition, hailstones are frequently thrown out miles in front of the storm producing them. Fortunately, there have been no incidents of death of injury associated with lightning in the City. There have been no deaths due to hail or severe storm in the City either.

Thunderstorms can produce locally heavy rain and high winds, which may result in localized flooding. Hail primarily causes crop damage. However, hailstorms in populated areas like Waveland can cause significant damage to roofs, automobiles, trees and windows. Critical facilities and infrastructure will have the greatest consequences if damaged by a lightning strike. The greatest losses from lightning could result from secondary hazards, such as wildfire.

Future Development

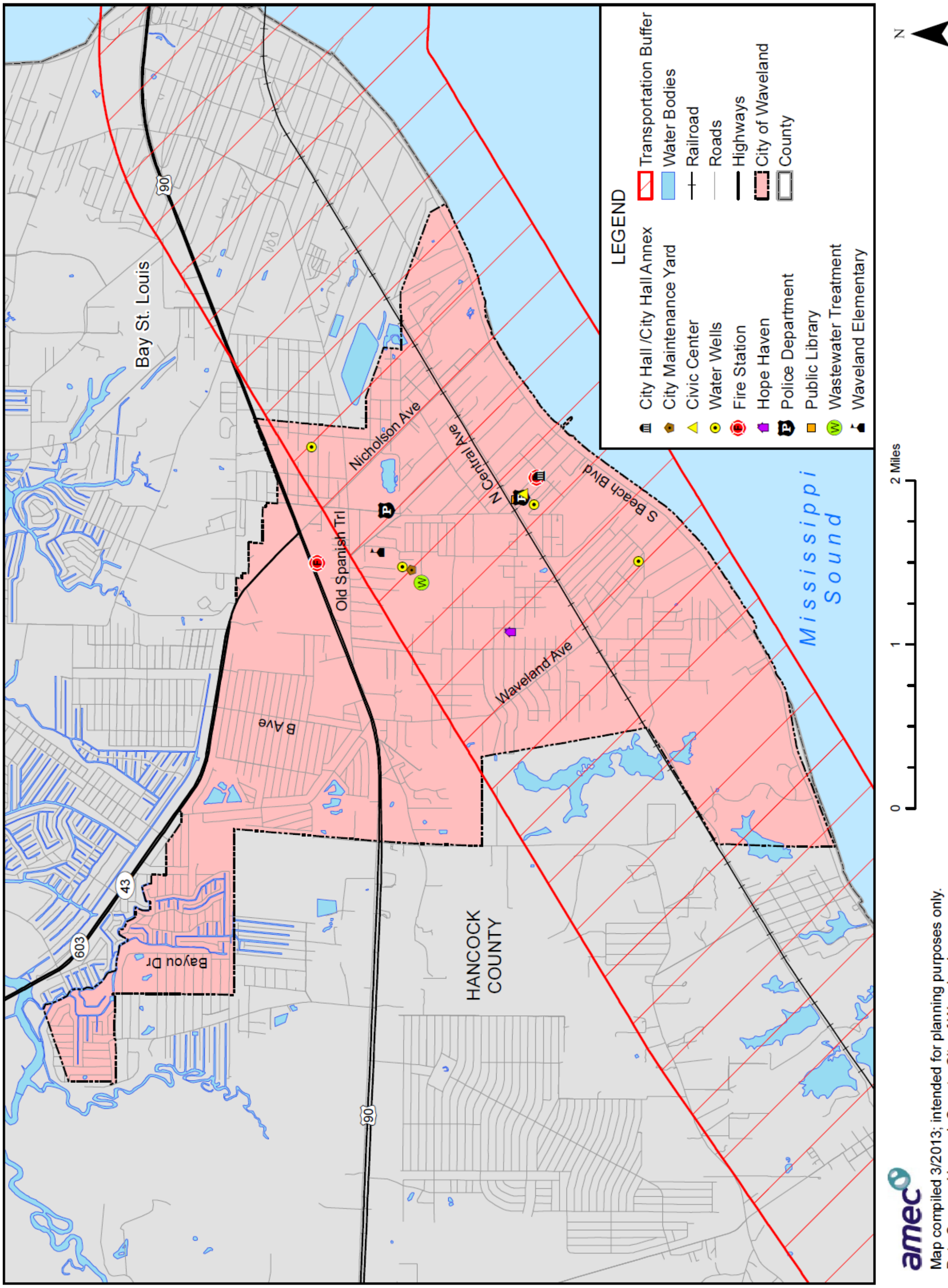
The entire City is at risk to thunderstorms. Areas of future development are at no greater risk to thunderstorm than the current built environment. Critical facilities will need to be built to withstand the effects of thunderstorm, hail, lightning, and high wind.

4.3.8 Railroad Hazardous Materials Release

Likelihood of Future Occurrence—Occasional
Vulnerability—High

It is often quite difficult to quantify the potential losses from human-caused hazards. While the facilities themselves have a tangible dollar value, loss from a human-caused hazard often inflicts an even greater toll on a community, both economically and emotionally. The impact to identified assets will vary from event to event and depend on the type, location, and nature of a specific hazardous material incident. Given the difficulty in quantifying the losses associated with technological hazards, this section focuses on analyzing key assets and populations relative to the hazardous materials sites and transportation corridors identified above. Figure 4.79 shows the railroad hazardous materials transportation corridor in the City of Waveland as well as the two mile buffer zone used in this analysis.

Figure 4.79. Waveland Railroad Hazardous Materials Route and Buffer Zone



Values at Risk

During a hazardous materials transportation spill, it is generally the people that are at risk to the effects of the spill. During a spill, buildings and property are at limited risk. Should a propane truck catch fire in a residential area, it may cause a building to burn, but will not burn all buildings inside the buffer zone. As such, no analysis on assets in the buffer zone was performed.

Population at Risk

To determine the populations at risk from a transportation-related hazardous materials release within identified transportation corridors, an analysis was performed using GIS. A one-mile buffer was applied to both sides of the CSX Railroad, creating a two-mile buffer zones around each corridor. The buffer distance was based on guidelines in the U.S. Department of Transportation's Emergency Response Guidebook that suggest distances useful to protect people from vapors resulting from spills involving dangerous goods considered toxic if inhaled. The recommended buffer distance referred to in the guide as the "protective action distance" is the area surrounding the incident in which people are potentially at risk of harmful exposure. For purposes of this plan, an average buffer distance of one mile was used on either side of the transportation corridor. Actual buffer distances will vary depending on the nature and quantity of the release, whether the release occurred during the night or daytime, and prevailing weather conditions.

In Table 4.75, the buffered transportation corridor was intersected with the residential parcels to obtain an estimate of affected population. Those parcel centroids that intersect the buffered corridor were counted and multiplied by the 2010 Census Bureau average household factor (2.50) for the City of Waveland. It is important to note that populations associated with commercial, government and other property types may also be affected by a hazardous materials release, but no census/population data is associated with these property types and are therefore excluded from this analysis. According to this residential based analysis, there is a total population of 4,885 in the buffered railroad corridor.

Table 4.75. Waveland Population at Risk in the Buffer Zone

Transportation Corridor	Corridor Length (mi)	Population at Risk
CSX Railroad	3.7	4,885

Source: Hancock County Assessor's 2012 Data, US Census Bureau

Critical Facilities at Risk

During a hazardous materials transportation spill, it is generally the people that are at risk to the effects of the spill. During a spill, buildings and property are at limited risk. However, critical facilities may be at risk to evacuation and reduction of emergency services or other capabilities.

Table 4.76 below and Figure 4.79 above show the critical facilities at risk in the buffer zone. All but the new fire station (Central Fire Station) located on Hwy 90 are within this buffer.

Table 4.76. Waveland Critical Facilities at Risk in the Buffer Zone

Facility	Facility Type	Address	City	Replacement Values
City Hall	Public	301 Coleman Ave	Waveland	$3,200,000
City Hall Annex	Public	301 Coleman Ave	Waveland	$0
Fire Station #1	Fire Public	307 Coleman Ave	Waveland	$1,800,000
Police Department	Public	335 Coleman Ave	Waveland	$0
Public Library	Public	345 Coleman Ave	Waveland	$1,639,377
Civic Center	Public	335 Coleman Ave	Waveland	$3,209,313
Faith Street Water Well	Well	89 22' 10.891" W, 30 18' 18.234"N	Waveland	$600,000
Tide Street Water Well	Well	89 22' 52.095"W, 30 16' 33.753"N	Waveland	$600,000
Davis Ave Water Well	Well	89 22' 31.445"W, 30 17' 7.157"N	Waveland	$600,000
Hope Haven	Public	716 Herlihy St	Waveland	$200,000
Wastewater Treatment	Public	322 Gulfside	Waveland	$15,000,000
City Maintenance Yard	Public	322 Gulfside	Waveland	$1,000,000
Police Department (construction)	Public	1602 McLaurn	Waveland	$4,415,979
Gulfside Street Water Well	Well	89 23' 0.253"W, 30 17' 47.799"N	Waveland	$600,000
Waveland Elementary	Elementary Public	1101 St Joseph St	Waveland	$3,500,000

Source: City of Waveland GIS

Future Development

Development will continue to happen within hazardous materials transportation zones. Those who choose to develop in these areas should be made aware of the risks associated with living within a hazardous materials transportation route.

4.4 Capability Assessment

Table 4.77 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of Waveland. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Table 4.77. Waveland Regulatory Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	Y/N	Date	Comments
General plan	Y	2006	
Zoning ordinance	Y	5/28/2010	
Subdivision ordinance	Y	5/28/2010	
Growth management ordinance	Y	2009	
Floodplain ordinance	Y		Ordinance #335
Other special purpose ordinance (stormwater, steep slope, wildfire)	Y	2009	
Building code	Y		2012 IBC
BCEGS Rating	Y		5/5
Fire department ISO rating	Y		Class 5
Erosion or sediment control program	Y	11/2004	Ordinance #322
Stormwater management program	Y	2009	
Site plan review requirements	Y	2009	
Capital improvements plan	Y		
Economic development plan	Y		
Local emergency operations plan	Y	2010	
Community Wildfire Protection Plans	Y		In process
Flood insurance study or other engineering study for streams	Y	2009	
Repetitive Loss Plan	Y	2010	
Elevation certificates	Y	N/A	Ongoing
Other			

City of Waveland Comprehensive Plan (2009)

A Comprehensive Plan, in broad terms, is a policy statement to guide the future placement and development of community facilities. It is the basis for a community’s zoning, subdivision and design regulations and a community’s official maps and amendments to the zoning, subdivision and design ordinances. The Comprehensive Plan identifies a future vision, values, principals and goals for the community, determines the projected growth for the community and identifies policies to plan, direct and accommodate anticipated growth. This document is an update to the

City of Waveland's Comprehensive Plan adopted by the Board of Mayor and Aldermen of the City of Waveland in 2005.

Goals identified in the Comprehensive Plan include:

- Residential Goals
  - Protect, maintain and strengthen the neighborhoods within the City of Waveland.
  - Offer a variety of quality subdivisions, from traditional subdivisions of single family homes on traditionally large lots, to clustered homes surrounded by open areas and green space.
  - Recapture the tranquil and nostalgic neighborhoods which existed prior to Hurricane Katrina.
  - Encourage people who had second homes in Waveland to build back.
  - Develop quality residential subdivisions and residential communities with housing for persons and families in all income ranges to make Waveland attractive to new residents.
  - Update zoning and subdivision regulations to insure that infrastructure including streets, drainage, water, sewer, street lighting and other infrastructure are properly designed and of high standards and quality construction.
  - Recognize the beauty and the serenity of Waveland's beachfront, and its ability to attract new residents.
  - Create amenities within the community that are attractive to young families. Ensure that there are good schools, available childcare and recreational opportunities within a short distance of each neighborhood.
  - Create amenities within the community that are attractive to retirees and the elderly. Ensure that there are social activities attractive for senior citizens along with quality health care and supportive services.

- Commercial Development Goals
  - The Coleman District, from Terrace Avenue to St. Joseph Street and from the beachfront to the railroad tracks, should be the cultural center of the community, providing nostalgic links to the past, while incorporating opportunities for commercial and cultural redevelopment.
  - Diversify the tourism economy to achieve optimum use of the City's waterfront area without compromising the quiet, unique and serene character of Waveland's beachfront.
  - Develop a positive image program focused on landscaping and beautification programs along major thoroughfares including US Highway 90, MS Highway 603 and Kiln Waveland Cutoff Road. The program may also include the Coleman District and other designated minor collector roadways within the City.
  - Implement land use controls such as zoning and subdivision regulations and building related codes with a pro-business, pro-development attitude while not compromising standards of high quality and design.

- Capitalize on the City's location and its attractiveness to new businesses by maintaining a business friendly environment and growth policy.
- Strengthen and maintain Waveland's strong sense of community and community pride, openness towards newcomers, and hometown atmosphere while promoting growth and development.
- Strengthen the City's economy and overall quality of life by putting amenities in place to attract new businesses to the community.
- Encourage rebuilding, and protect, maintain and enhance the amenities that attract visitors to the City of Waveland. These amenities include the Waveland beachfront, the Coleman District and the City's green spaces and parks.

- Parks, Recreation, and Open Space Goals
  - Maintain a serene beachfront in Waveland.
  - Provide adequate and readily accessible recreational facilities for all Waveland's citizens from children to senior citizens with an emphasis on family oriented facilities and programs.
  - Continue to encourage the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) to complete renovations to Buccaneer State Park and work with the MDWFP to capitalize on the wide variety and range of facilities that are available at Buccaneer State Park.
  - Create open space to assist with improving drainage, and to provide opportunities for passive recreation.

- Public Schools and Education Goals
  - Support local and regional efforts designed to enhance education and training of the City's workforce.

- Community Facilities Goals
  - Provide seamless public services.
  - Ensure that public buildings, such as City Hall and supportive buildings portray a positive image for the City of Waveland and adequately serve the growing needs of the City during the planning period.
  - Continue to support excellence in fire and police services and emergency response.
  - Establish a long term program to create adequate drainage in Waveland which reduces flooding from rain events, enhances the water quality of storm water runoff, and remains economically feasible.
  - Partner with agencies, organizations, institutions and other local governments to enhance the social, cultural and recreational opportunities available to Waveland residents.
  - Allow for regional cooperation when feasible, in the provision of public services.

- Transportation Goals
  - Create attractive gateways and commercial corridors within the City of Waveland.

- Establish “way-finding” signage and landscaping to guide people from US Highway 90 and MS Highway 603 to the Coleman District.
- Provide and maintain a circulation system that safely and efficiently meets the needs of residents, businesses and visitors.
- Provide sidewalks and bike paths to link neighborhoods to neighborhoods and neighborhoods to commercial areas, and where not possible along existing local roadways, utilize traffic calming methods to slow traffic.
- Establish parking within the Coleman District which supports the use of the Waveland beachfront.

Stormwater Management Plan (2010)

This plan has been developed to address existing water quality issues and to prevent water quality impairment due to polluted stormwater runoff within the City of Waveland MS4 permitted area. The following program represents a revision of the original plan that was permitted during the initial Phase II permitting cycle from 2003-2007 in Mississippi. The next five-year permitting cycle will extend from 2009-2013. This plan has been developed as an issue-specific Five-Year Stormwater Phase II Program, and the specific issues to be addressed through the program are as follows:

- Stormwater runoff pollution including general litter and debris, pesticides and fertilizers from lawns and runoff from streets and parking areas;
- Illegal dumping and improper disposal of household hazardous wastes and automobile wastes;
- Erosion and sedimentation associated with construction and development;
- Leaking septic tanks and sewage pollution; and
- Water quality impairments associated with city operations to include roadway and utility maintenance, recreational field's maintenance, and the operation of city owned facilities.

The program components include Public Education, Public Involvement, Illicit Discharge Detection and Elimination, Construction Site Runoff Controls, Post-Construction Runoff Controls, and Pollution Prevention/Good Housekeeping.

Comprehensive Emergency Management Plan

The Bay-Waveland-Hancock County Civil Defense Agency, Civil Defense Director, and staff are responsible for the Comprehensive Emergency Management Plan (CEMP). The City of Waveland is a participating jurisdiction in the CEMP and its Fire Chief serves as the city's Civil Defense Coordinator. The CEMP addresses the four phases of emergency management: The CEMP attempts to be all-inclusive in combining all phases of emergency management (preparedness, response, recovery, and mitigation) and recognizes hazard mitigation as one of the primary missions and responsibilities of emergency management. Mitigation actions have a direct effect on how difficult the other three components are to address, as follows:

- Preparedness-Mitigation actions undertaken prior to or in preparation for a natural hazard event such as a hurricane directly affect how well the property and population weathers the storm and the extent of damage sustained.
- Response-Sound mitigation actions undertaken prior to the occurrence of a hazardous event reduce emergency response efforts prior to, during, and after the event.
- Recovery-The primary goal of mitigation is to reduce the damages from a natural hazard, the length of time it takes to return to normal after the event, and the cost of recovery.

The Bay-Waveland-Hancock County Comprehensive Emergency Management Plan (CEMP) is the blueprint for emergency management activities in Hancock County. The CEMP creates mutual-aid agreements to perform respective emergency management functions before, during, and after natural disasters and emergencies. The CEMP also establishes standard operating procedures for staffing, activating, and de-activating the Emergency Operations Center.

Hancock County EOC Standing Operating Guide

Emergencies occur almost every day but occasionally a disaster, which may be outside the normal scope of day to day operations, occurs that can place an enormous strain on a community. Many times such a response requires multiple agencies to work together to support multiple jurisdictions. The ability of a government to adequately respond and recover from such an event is dependent upon the volume of the resources required and the time in which government and its citizens must respond. Large scale events such as major hurricanes have the potential to exceed the capacity of Hancock County, requiring extensive outside resources from the state and federal government. Regardless of the cause, the county must be prepared to respond to save lives and protect property.

An effective response and recovery from such an event requires close coordination, communication and prioritization of tasks and resources. Such coordination requires the establishment of an emergency operations center (EOC) that is equipped and staffed with the key stakeholders and decision-makers of the government or jurisdiction affected. The Hancock County EOC located at 5380 Kiln/Delisle Road, Kiln, Mississippi, is designated as the coordination point for all emergencies or disasters in Hancock County that extend beyond the normal definition of day to day emergencies that may be handled by the cities and Bay St Louis and Waveland and their law enforcement and fire departments, the county volunteer fire departments, or American Medical Response as the county's EMS provider.

Hancock County Evacuation Plan

The purpose of an Evacuation Plan is to document the agreed upon strategy for the County's response to emergencies that involve the evacuation of persons from an impacted area to a safe area. This involves coordination and support for the safe and effective evacuation of the general population, and for those who need additional support to evacuate. Focus areas within this evacuation plan include public alert and warning, transportation, care and shelter, and others.

Hurricane evacuation zones are the areas that need to be evacuated for a particular hurricane scenario to protect residents at risk from flooding or high winds. Evacuation zones include all areas having a serious risk of flooding. Evacuation zones sometimes include non-flood areas if they are cut off or completely surrounded by flooded areas.

Evacuation scenarios are developed to simplify evacuation decision-making by comparing areas of potential storm surge for each hurricane category. The development of approved evacuation zones is crucial for the completion of the Transportation Analysis portion of the hurricane evacuation study (HES). Individual zones were developed through coordination of the Mobile District USACE with the local counties and were then provided to the contractor for use in the vulnerability analysis process. The surge areas were used to determine evacuation zones. These evacuation zones were used to estimate the evacuating population and number of evacuating vehicles.

Table 4.78 identifies the evacuation scenarios that were established through coordinating with the City and Hancock County in 2010. These scenarios have been developed for each coastal county in Mississippi.

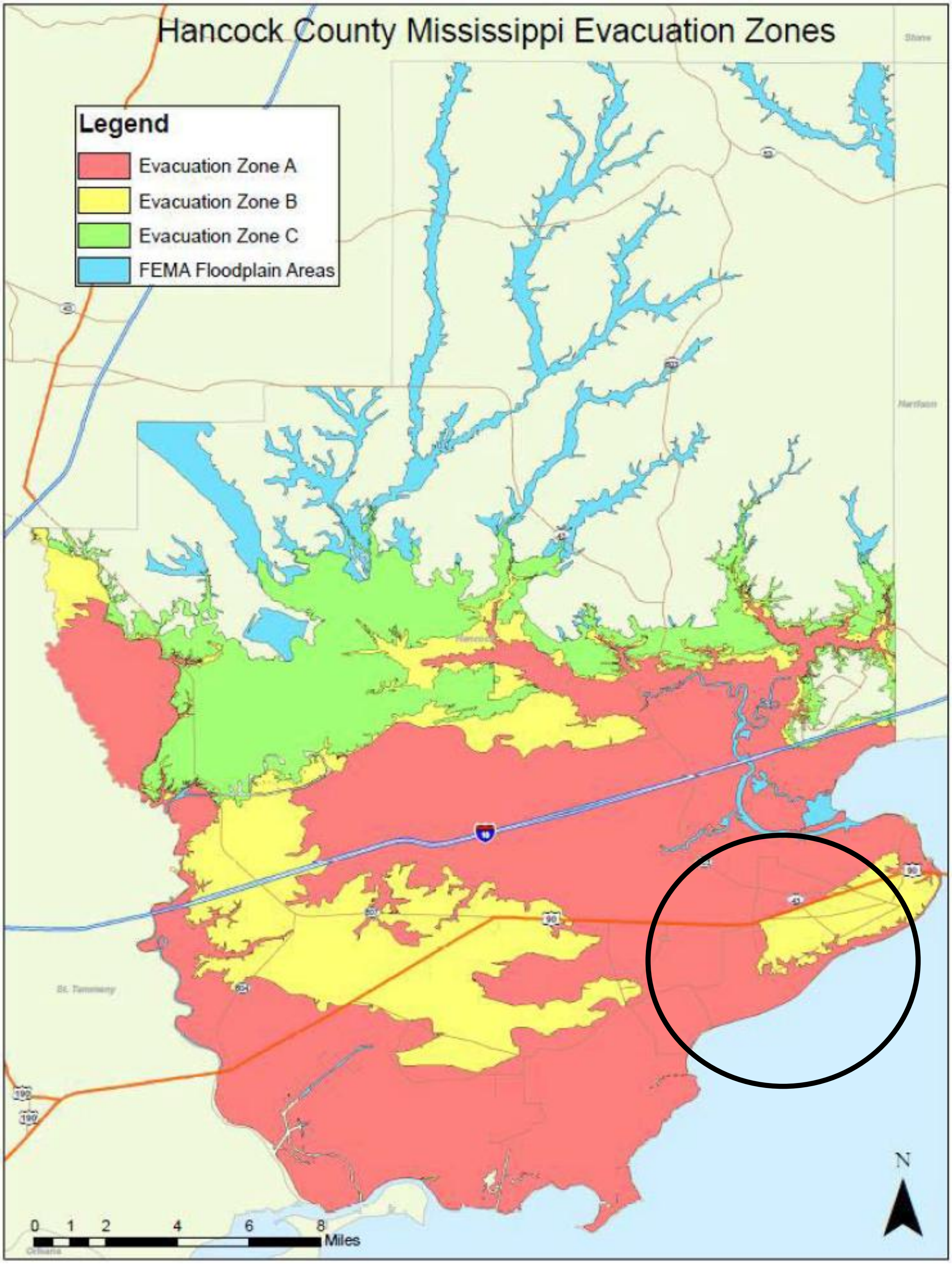
Table 4.78. Hancock County Evacuation Scenarios

Evacuation Zone	Storm Surge	Description
A	Category 2	Includes all areas in the Category1 and 2 surge area as well as all people living in an identified floodplain on the Current Flood Insurance Rate Maps for the County and all residents in mobile homes, FEMA cottages and travel trailers.
B	Category 3	Includes all areas in Evacuation Zone A plus all areas in the Category 3 surge area as well as all people living in an identified floodplain on the Current Flood Insurance Rate Maps for the County and all residents in mobile homes, FEMA cottages and travel trailers.
C	Category 5	Includes all areas in Evacuation Zones A and B plus all areas in the Category 5 surge area as well as all people living in an identified floodplain on the Current Flood Insurance Rate Maps for the County and all residents in mobile homes, FEMA cottages and travel trailers.

Source: FEMA - Vulnerability Analysis for MS Hurricane Events, 2010

Hancock County and the City of Waveland Evacuation Zones are shown on Figure 4.80. The City of Waveland is circled in black.

Figure 4.80. Hancock County Evacuation Zones



Ordinances

Building Codes (2012)

Waveland has by ordinance adopted and enforces the 2012 International Building Codes. To mitigate wind damage from hurricanes and other wind storms, the city has adopted the Hurricane Construction Standards. An ordinance amending the Building Code requires all new construction outside SFHAs be elevated at least 16 inches above the crown of adjacent streets to mitigate structural flooding that can occur when structures are built lower than the street surface and are flooded by drainage from the street. How well the community enforces its adopted building codes directly relates to how well structures withstand storm winds.

Flood Damage Prevention Ordinance (2009)

The City of Waveland first adopted flood control measures in special flood hazard areas in 1973. The Flood Damage Prevention Ordinance is perhaps the city's most important flood mitigation tool.

The ordinance has been amended several times, the latest amendment was made in 2009. The objectives of the ordinance (No. 342) are:

- To protect human life and health;
- To minimize expenditure of public money for costly flood control projects;
- To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- To minimize prolonged business interruptions;
- To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, street and bridges located in floodplains;
- To help maintain a stable tax base by providing for the sound use and development of flood prone areas in such a manner as to minimize flood blight areas, and
- To ensure that potential homebuyers are notified that property is in a flood area.

The ordinance reduces flood losses by:

- Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;
- Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
- Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;
- Controlling filling, grading, dredging, and other development which may increase flood damage; and,

- Preventing or regulating the construction of flood barriers that will unnaturally divert floodwaters or may increase flood hazards in other areas.

Prior to Katrina, FEMA was in the process of developing new Digital Flood Insurance Rate Maps (DFIRM), the current FIRM for the City dates back to 1983. In November 2005, FEMA published Advisory Base Flood Elevation (ABFE) maps for coastal communities affected by the storm. Katrina surge levels were factored into other historical data gathered prior to the storm to determine new flood levels with the result that V-Zones and A-Zones have expanded considerably along the coast. The ABFE now shows areas previously considered B- and C-Zones to be in A-Zones and V-Zone boundaries encroaching further into previous A-Zones. The DFIRM was finalized in October 2009 and replaced requirements extablished by the ABFE maps. The previous flood ordinances and their BFEs with construction requirements as presented in Table 4.79below assist in determining that status of the current built environment relative to its vulnerability to future flood hazard events:

Table 4.79. Waveland Flood Map and Ordinance History

Flood Map/Ordinance	BFE	Construction Standard
1970	Average of 13.1”	BFE+1
1983	13’-17’	BFE+1
2005 ABFE	unknown	BFE + 4
2009	17’-27’	BFE+1

Source: FEMA

The ordinance requires that in all Special Flood Hazard Areas:

- New construction and substantial improvements shall be anchored to prevent flotation, collapse or lateral movement of the structure;
- Manufactured homes shall be anchored to prevent flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This standard shall be in addition to and consistent with applicable state requirements for resisting wind forces;
- New construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage;
- New construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
- Electrical, heating, ventilation, plumbing, air conditioning equipment and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding, such facilities shall be located a minimum of 1 foot above the Base Flood.
- New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

- New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters;
- On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding;
- Any alteration, repair, reconstruction or improvements to a building that is in compliance with the provisions of this ordinance shall meet the requirements of "new construction" as contained in this ordinance; and,
- Any alteration, repair, reconstruction or improvements to a building that is not in compliance with the provisions of this ordinance, shall be undertaken only if said non-conformity is not furthered, extended, or replaced.
- New construction and substantial improvement of any building shall have he lowest floor (including basement) at least 15 inches above the centerline of the designated street, unless the topography of the property does not allow for strict adherence as determined by the City of Waveland Building Official.
- New construction and substantial improvements built on fill shall be constructed on the properly designed and compacted fill that extends beyond the building walls before dropping below the base flood elevation, and shall have appropriate protection from erosion and scour.

In Special Flood Hazard Areas where base-flood elevation data have been provided, the following standards also apply:

- Residential Construction. New construction or substantial improvement of any residential building (or manufactured home) shall have the lowest floor, including basement, elevated no lower than one foot above the base-flood elevation. Should solid foundation perimeter walls be used (Zone A, AO, A1-A30, AE, A99, AH) to elevate a structure, openings sufficient to facilitate the unimpeded movements of floodwaters shall be provided
- Non-Residential Construction. New construction or substantial improvement of any commercial, industrial, or non-residential building (or manufactured home) shall have the lowest floor, including basement, elevated to no lower than 1 foot above the level of the base flood elevation. Buildings located in all A-Zones may be flood-proofed in lieu of being elevated provided that all areas of the building below the BFE (plus any community free board) elevation are water tight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A registered professional engineer or architect shall certify that the standards of this subsection are satisfied.
- Elevated Buildings. New construction or substantial improvements of elevated buildings that include fully enclosed areas formed by foundation and other exterior walls below the base flood elevations shall be designed to preclude finished living space and designed to allow for the entry and exit of floodwaters to automatically equalize hydrostatic flood forces on exterior walls.

- Accessory improvement and other apparent structures shall be firmly anchored to prevent flotation that may result in damage to other structures.
- Property owners shall be required to execute and record with the structure's deed a non-conversion agreement declaring that the area below the lowest floor or the detached accessory building shall not be improved, finished or otherwise converted; the community will have the right to inspect the enclosed area at any time. Disclosures to new owners are required and restrictive declarations must be recorded in the Chancery Clerk's Office of Hancock County Mississippi. A certified Chancery Clerk's Office copy shall also be filed with the City of Waveland Code Enforcement Department.

The ordinance also requires that construction of new critical facilities shall be, to the extent possible, located outside the limits of the Special Flood Hazard Area (SFHA). Construction of new critical facilities shall be permissible within the SFHA if no feasible alternative site is available. Critical facilities constructed within the SFHA shall have the lowest floor elevated three feet (approximate 500-year floodplain) or more above the level of the base flood elevation at the site. Floodproofing and sealing measures must be taken to ensure that toxic substances will not be displaced by or released into floodwaters. Access routes elevated to or above the level of the base flood elevation shall be provided to all critical facilities to the extent possible.

Other standards in the ordinance address manufactured homes, streams without established base-flood elevations and or floodways, subdivision proposals, and coastal high hazard areas.

Zoning Ordinance (2010)

Pursuant to the Mississippi Code of 1972 Annotated, the purpose of this ordinance is to promote the public health, safety, morals, or general welfare, and to protect and preserve places and areas of historical, cultural, or architectural importance and significance. These regulations are adopted in accordance with the comprehensive plan for the purposes of:

- promoting health, safety, morals and general welfare of the municipality;
- lessening congestion in the streets;
- securing safety from fire, panic and other dangers;
- providing adequate light and air;
- preventing the overcrowding of land; avoiding undue concentration of population;
- conserving the value of land and building; and
- facilitating the adequate provision of transportation, water, sewage, schools, parks and other public requirements in accordance with the Comprehensive Plan of the City of Waveland.

In accordance with the foregoing purposes, this ordinance establishes regulations governing the following:

- The height, number of stories, and size of buildings and other structures;
- The percentage of a lot that may be occupied;

- The size of yards, courts, and other open spaces;
- Population density; and
- The location and use of buildings, other structures, and land for business, industrial, residential, or other purposes.

The Zoning Ordinance is consistent with the adopted Comprehensive Plan. Any amendments to this ordinance, including, but not limited to, rezoning approval pursuant to Article X procedures of the Zoning Ordinance, and all development approvals, shall be consistent with the adopted comprehensive plan, as it may be amended from time to time, in effect at the time of the request for amendment.

An amendment to the text of the Zoning Ordinance is consistent and in accordance with the comprehensive plan if it complies with the goals, objectives, policies and strategies and any vision statement contained in the comprehensive plan.

Coordination with Subdivision Ordinance

In all cases where the ownership of land is divided for the purpose of eventual development of lots of any kind (residential, commercial or industrial), the provisions of the City's Subdivision Ordinance shall apply in addition to the provisions of the Zoning Ordinance.

Subdivision Ordinance (2010)

In order to promote the health, safety, convenience, and general welfare of the inhabitants of the City of Waveland and to assist in bringing about the coordinated, efficient and economical development of the City, there exists a need for the following regulations and minimum standards to be followed in the development or redevelopment of land subdivisions in the City of Waveland, Mississippi. These regulations are enforceable through the application of procedures, standards, and requirements herein established. Specifically, these regulations are:

- To establish procedures governing the filing and approval of land subdivision plats and data in the City of Waveland.
- To establish minimum standards governing streets, utilities, and other required improvements.
- To establish minimum standards governing the preparation and filing of land subdivision plats and data to be submitted to the City of Waveland for approval.
- To insure the proper coordination of future streets and their development with existing or planned streets.
- To fix penalties for the violation of the provisions of these regulations.
- To provide that the City of Waveland may vary these regulations in certain cases or under certain conditions.

Erosion and Sediment Control (2004)

During the construction process, soil is highly vulnerable to erosion by wind and water. Eroded soil endangers water resources by reducing water quality and causing the siltation of aquatic habitat for fish and other desirable species. Eroded soil also necessitates repair of sewers and ditches and the dredging of lakes. In addition, clearing and grading during construction causes the loss of native vegetation necessary for terrestrial and aquatic habitat.

As a result, the purpose of this local regulation is to safeguard persons, protect property, and prevent damage to the environment in the City of Waveland. This ordinance will also promote the public welfare by guiding, regulating, and controlling the design, construction, use and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land in the City of Waveland.

Stream Dumping Ordinance

Localized flooding can be caused by debris clogging ditches, drainage ways, and culverts, resulting in backup and ponding of stormwater on streets and private property. Some debris occurs naturally; however, in many cases, improperly disposed of debris ends up in ditches. The City of Waveland has adopted and enforces an ordinance (No. 308) prohibiting dumping or depositing any form of debris into streams, ditches, and drainage ways.

4.4.1 Administrative/Technical Mitigation Capabilities

Table 4.80 identifies the City personnel responsible for activities related to mitigation and loss prevention in the City of Waveland.

Table 4.80. Waveland Administrative/Technical Capabilities

Personnel Resources	Yes/No	Department/Position	Comments
Planner/Engineer with knowledge of land development/land management practices	N		Utilize consultants
Engineer/Professional trained in construction practices related to buildings and/or infrastructure	N		Utilize consultants
Planner/Engineer/Scientist with an understanding of natural hazards	N		Utilize consultants
Personnel skilled in GIS	Y	Fire Chief	
Full time building official	Y	Building Department	
Floodplain Manager	Y	Building Department	
Emergency Manager	Y	Fire Chief	
Grant writer	N		Utilize consultants
Other personnel			
GIS Data – Hazard areas	Y	Fire Department	
GIS Data - Critical facilities	Y	Fire Department	

Personnel Resources	Yes/No	Department/Position	Comments
GIS Data – Building footprints	Y	Fire Department	
GIS Data – Land use	Y	Fire Department	
GIS Data – Links to Assessor's data	Y	Fire Department	
Warning Systems/Services (Reverse 9-11, cable override, outdoor warning signals)	Y	Fire Department	Currently 3 sirens but applying for two more
Other			

4.4.2 Fiscal Mitigation Capabilities

Table 4.81 identifies financial tools or resources that the City could potentially use to help fund mitigation activities.

Table 4.81. Waveland Fiscal Mitigation Capabilities

Financial Resources	Accessible/Eligible to Use (Y/N)	Comments
Community Development Block Grants	Y	
Capital improvements project funding	Y	
Authority to levy taxes for specific purposes	Y	
Fees for water, sewer, gas, or electric services	Y	
Impact fees for new development	N	
Incur debt through general obligation bonds	Y	
Incur debt through special tax bonds	Y	
Incur debt through private activities	N	
Withhold spending in hazard prone areas	N	
Other		

4.4.3 Mitigation Outreach and Partnerships

Section 17-13-3 of the Mississippi Code Annotated 1972 encourages local governments to cooperate and to contract with other local governmental units on a basis of mutual advantage and thereby provide services and facilities in a manner pursuant to forms of governmental organization that will accord best with geographic, economic, population and other factors influencing the needs and development of local communities. Local land use issues range from roadways and traffic congestion to rivers and environmentally sensitive areas, all of which rarely stop at jurisdictional boundaries. Following is a list of partnerships the City of Waveland has entered into to mitigate natural hazards. VERIFY THESE:

- Various State of Mississippi Agencies
- Red Cross
- School Systems

- Power and utility companies
- United Way
- OTHERS

Waveland is an active member of CHOST – the Coastal Hazard Outreach Strategy Team. C-HOST is a regional outreach team that was established March 5, 2008. Supported by FEMA, MEMA, and the Insurance Services Office (ISO), the Team consists of Building Officials, Certified Floodplain Managers, NFIP CRS Coordinators, along with Planning & Zoning Officials who serve the CRS communities, along the MS Gulf Coast, that include: Bay St Louis, Biloxi, D'Iberville, Gautier, Gulfport, Harrison County, Long Beach, Ocean Springs, Pascagoula, Pass Christian, and Waveland. 2 to 3 CRS community resident representatives, from the general public, serve on the Team, on a rotating basis, along with other community stakeholders, such as private businesses and major employers. The Team works to prepare and ensure the safety of our families, our businesses, and our communities. Now working together for over 4 years, the Team has proven dedication to the reduction of flooding and all other hazards affecting each community along the MS Gulf Coast. As part of CHOST, the City participates in the following:

- National Fire Prevention Week
- Mississippi Severe Weather Week
  - Flood Safety Awareness Week
  - Severe Weather Awareness Week
  - Tornado Drill
- National Flood Awareness Week
- National Air Quality Awareness Week
- National Safe Boating Week
- Heat Awareness Day
- National Hurricane Preparedness Week
- National Rip Current Awareness Week
- National Lightning Awareness Week

THIS INFORMATION BELOW WAS IN PAST PLAN – PLEASE VERIFY BELOW INFORMATION IS CORRECT AND REVISE AS APPROPRIATE

Annual Mailing of Hazard Information

Annually, the City of Waveland mails a brochure concerning flood-related subjects to every address in the city. Subjects discussed in the brochure include flood safety, flood warning, flood hazard areas, drainage system maintenance/stream ordinance, property protection measures, flood protection assistance, floodplain development regulations, substantial improvement/ damage requirements, the National Flood Insurance Program, natural and beneficial functions of wetlands, and flood-zone descriptions.

Since hurricanes and tropical storms are a major flood producer for the community, also included in the annual mailing is a Hurricane Evacuation Zone Map and a Hurricane Tracking Map with instructions concerning hurricane safety. The instructions provide information about sheltering, family disaster planning, flood hazards in Waveland due to hurricane storm surge, and evacuation as well as definitions of terms used by weather forecasters.

Hurricane Fairs and Conferences

Waveland officials also participate in an annual hurricane fair in Hancock County and set up a booth to distribute hurricane and flood safety information. The community also participates in the annual Mississippi and National Hurricane Conferences.

Civil Defense

The Mayor of the City of Waveland serves as the city's Public Information Officer for all information released to the public pertaining to disasters and emergency situations, makes decisions affecting the population of the city, and offers suggestions and instructions to the citizens of Waveland. The city's Fire Chief is the Civil Defense Director for Waveland. Waveland is a participating member of the Bay-Waveland-Hancock County Civil Defense Agency, which serves as the centralized point in Hancock County for information to be released to the public in the event of a disaster, along with decisions, suggestions, and instructions. The agency is responsible for developing and maintaining a public information and education program. Briefings are for media representatives are conducted in the Emergency Operations Center to ensure accurate and consistent information flow.

Public Library

In addition to the direct distribution of educational brochures, hurricane tracking maps, and other information by the city, the public library also houses and distributes a variety of emergency and disaster-related documents and brochures.

Hancock County Sand Beach Department

The sand beach south of Beach Boulevard was created to protect the roadway and prevent wave action from undermining the seawall and the roadway. The sand beach also serves to mitigate wave action and storm surge, protecting properties immediately north of the beach. Hancock County Board of Supervisors shares responsibility for maintenance of the sand beach with Waveland and Bay St. Louis. How well the sand beach and waterfront is maintained directly relates to how much damage waterfront infrastructure will sustain when storm tides occur.

There is ongoing maintenance of the beach, including sand netting to replenish sand dunes, and periodically lost sand is replenished through offshore dredging. A replenishment project was completed prior to Hurricane Katrina and another one has been completed since the storm. A

Seawall tax on gasoline in Hancock County funds beach maintenance which is now being contracted out by the county for the first time.

Katrina's storm tide eroded the beach and left it strewn with debris of all kinds. The county, cities, and volunteers have since cleaned the beach. The U.S. Coast Guard and Mississippi Department of Marine Resources, through private contractors, removed a wide range of debris from the water, including trees, vehicles, sunken boats, parts of houses, and other materials dropped as storm surge receded.

Public Utilities and Infrastructure

Mississippi Power Company and Coast Electric Power Association distribute electric power throughout Hancock County and Waveland. Bell South owns the telephone communications system and numerous companies provide local, long distance, and cellular service. The public utility companies all have mutual-aid agreements with other providers to furnish assistance when major damage occurs to their transmission system. All have disaster response plans in place and are responsible for their distribution systems and facilities, ensuring that service is restored as quickly as possible after a disaster occurs.

4.4.4 Other Mitigation Capabilities

City of Waveland

The City has the engaged in the following activities that were not previously captured in this plan:

- The Fire Department is in the process of renewing the City's StormReady status.
- There is a $6.9 million drainage project underway in the City.

Mississippi Coastal Improvements Plan

The Mississippi Coastal Improvements Plan (MsCIP) comprehensive plan for coastal Mississippi consists of structural, nonstructural and environmental project elements. The project elements address:

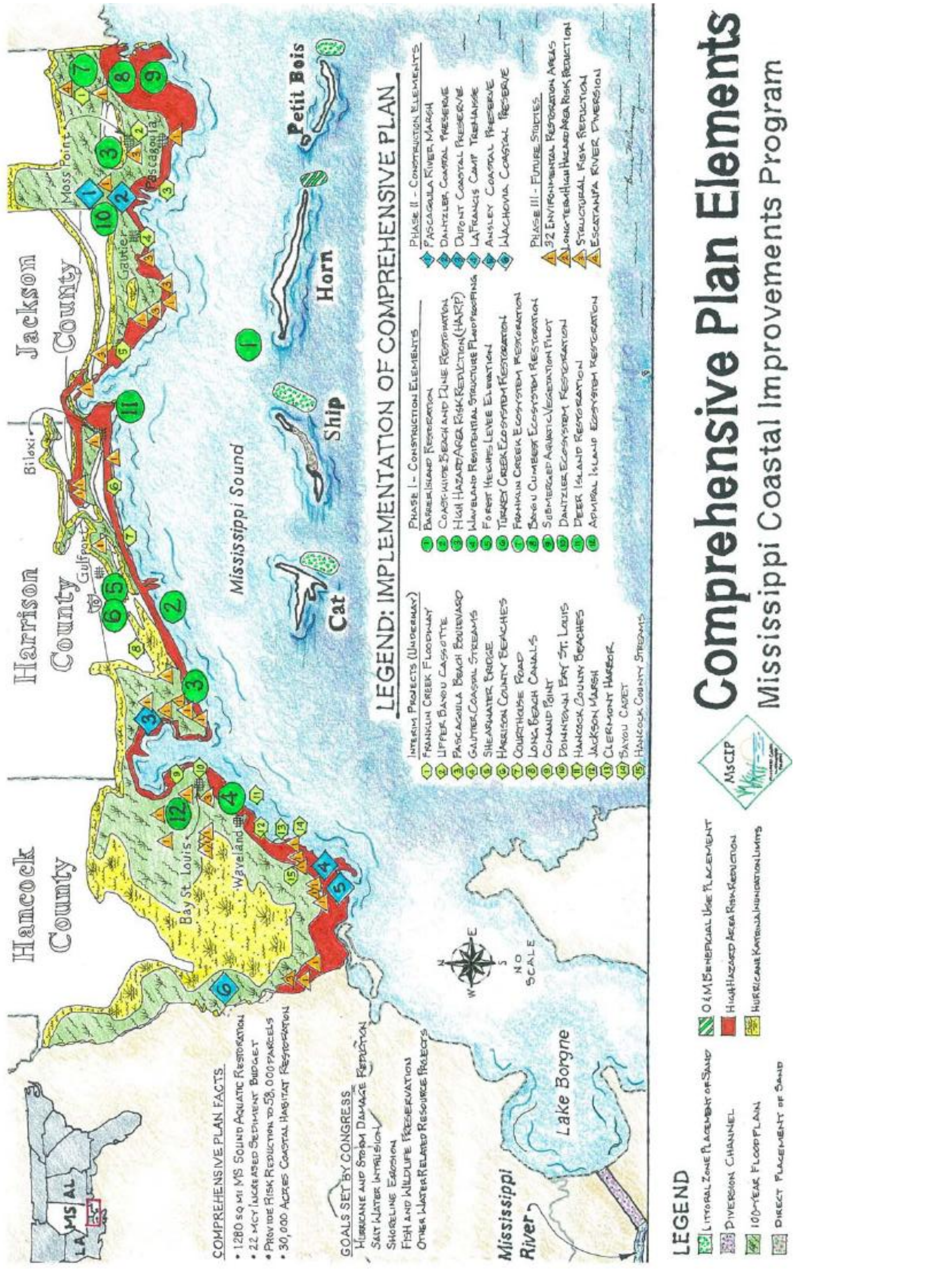
- Hurricane and storm damage reduction
- Salt water intrusion
- Shoreline erosion
- Fish and Wildlife Preservation

The plan recommends comprehensive water resources improvements associated with hurricane and storm damage reduction, flood damage reduction, and ecosystem restoration in the three coastal counties of Mississippi. This report is in partial response to authorizing legislation contained in the Department of Defense Appropriation Act of 2006 (P.L. 109-148), dated 30 December 2005. The study authorization states, in part, the following:

> "... the Secretary shall conduct an analysis and design for comprehensive improvements or modifications to existing improvements in the coastal area of Mississippi in the interest of hurricane and storm damage reduction, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and other related water resource purposes at full Federal expense; Provided further, that the Secretary shall recommend a cost-effective project, but shall not perform an incremental benefit-cost analysis to identify the recommended project, and shall not make project recommendations based upon maximizing net national economic development benefits; Provided further, that interim recommendations for near term improvements shall be provided within 6 months of enactment of this act with final recommendations within 24 months of this enactment."

Included in this plan are items that directly and indirectly mitigate coastal flooding in Waveland as shown in Figure 4.81. One of the actions called for in the MsCIP was a Floodproofing Pilot Project. In addition, the barrier islands of Cat, Ship, Horn, and Petit Bois will be restored.

Figure 4.81. MS Coastal Improvements Plan Program Plan Elements



5 MITIGATION STRATEGY

Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the mitigation strategy process and mitigation action plan for the Waveland Local Hazard Mitigation Plan (LHMP) Update. It describes how City met the following requirements from the 10-step planning process:

- Planning Step 6: Set Goals
- Planning Step 7: Review Possible Activities
- Planning Step 8: Draft an Action Plan

5.1 Mitigation Strategy: Overview

The results of the planning process, the risk assessment, the goal setting, and the identification of mitigation actions led to the mitigation strategy and mitigation action plan for this LHMP update. As part of the plan update process, a comprehensive review and update of the mitigation strategy portion of the plan was conducted. Some of the initial goals and objectives from the 2007 plan were refined and reaffirmed, some goals were deleted, and others were added. The end result was a new set of goals, reorganized to reflect the completion of 2007 actions, the updated risk assessment and the new priorities of this plan update. To support the new LHMP goals, the mitigation actions from 2007 were reviewed and assessed for their value in reducing risk and vulnerability to the planning area from identified hazards and evaluated for their inclusion in this plan update (See Section 2.0 What's New). Section 5.2 below identifies the new goals and objectives of this plan update and Section 5.4 details the new mitigation action plan.

Taking all of the above into consideration, the following umbrella mitigation strategy for this LHMP update was developed:

- **Communicate** the hazard information collected and analyzed through this planning process as well as HMPC success stories so that the community better understands what can happen where and what they themselves can do to be better prepared.
- **Implement** the action plan recommendations of this plan.
- **Use** existing rules, regulations, policies, and procedures already in existence.
- **Monitor** multi-objective management opportunities so that funding opportunities may be shared and packaged and broader constituent support may be garnered.

5.1.1 Continued Compliance with NFIP

Given the flood hazard in the planning area, an emphasis will be placed on continued compliance with the National Flood Insurance Program (NFIP) and participation in the Community Rating System. Detailed below is a description of City of Waveland's flood management program to ensure continued compliance with the NFIP.

Waveland's Flood Management Program

Waveland joined the NFIP in September of 1970, shortly after its inception. Since then, the City has administered floodplain management regulations that meet and exceed the minimum requirements of the NFIP. Under that arrangement, residents and businesses paid the same flood insurance premium rates as most other communities in the country.

The Community Rating System (CRS) was created in 1990. It is designed to recognize floodplain management activities that are above and beyond the NFIP's minimum requirements. Waveland joined the CRS in 1993 and is currently a Class5 community, which gives a 25% premium discount to individuals in Waveland in the Special Flood Hazard Area, and a 10% discount to policyholders outside the Special Flood Hazard Area.

The activities credited by the CRS provide direct benefits to Waveland and its residents, including:

- Enhanced public safety;
- A reduction in damage to property and public infrastructure;
- Avoidance of economic disruption and losses;
- Reduction of human suffering; and
- Protection of the environment.

The activities that Waveland implements and receives CRS credits (based on the 2007 Coordinator's Manual) include:

- **Activity 310 – Elevation Certificates:** The Building Department in Waveland requires and retains Elevation Certificates for all buildings constructed in flood hazard areas of the City. Elevation Certificates are maintained in a computer format and are available upon request. These are stored offsite at five sites in hardened structures.
- **Activity 320 – Map Determinations:** The Building Department of Waveland retains digital copies of the DFIRM and can make parcel level information available upon request.
- **Activity 340 – Hazard Disclosure:** Waveland participates in and receives credit for this activity. Credit is provided for the local real estate agents disclosure of flood hazards to prospective buyers. Credit is also provided for state and community regulations requiring disclosure of flood hazards.

- **Activity 350 – Flood Protection Information:** Documents relating to floodplain management are available in the reference section of the Hancock County Library. Credit is also provided for floodplain information displayed on the community's website. Waveland has flood protection information available in its building department and on its website.
- **Activity 360 – Flood Protection Assistance**: Credit is provided for having a service to provide advice and assistance on drainage concerns including, providing data on historic flooding and for providing retrofitting advice
- **Activity 420 – Open Space Preservation:** Credit is provided for preserving acreage in the Special Flood Hazard Area (SFHA) as open space. Waveland receives credit for this activity and supports the value of open space in flood mitigation.
- **Activity 430 – Higher Regulatory Standards:** Credit is provided for enforcing regulations that require freeboard for new and substantial improvement construction, foundation protection, cumulative substantial improvement, lower substantial improvement, natural and beneficial functions, other higher regulatory standards, and state mandated regulatory standards. Credit is also provided for staff education and certification as a floodplain manager. Waveland retains the services of several Certified Floodplain Managers in its Building Department. All of the building inspectors are certified in their field of expertise.
- **Activity 440 – Flood Data Maintenance:** Credit is provided for maintaining and using digitized maps (in GIS) in the day-to-day management of the floodplain.
- **Activity 450 – Stormwater Management:** The community enforces regulations for stormwater management, freeboard in non-SFHA zones, soil and erosion control, and water quality. Credit is also provided for stormwater management master planning.
- **Section 502 – Repetitive Loss Category:** Based on the updates made to the NFIP Report of Repetitive Losses as of April 13, 2012, Waveland has 66 repetitive loss properties and is a Category C community for CRS purposes. All requirements for a Category C community have been or are being met. Credit is provided for the adoption and implementation of the Floodplain Management Plan.
- **Activity 540 – Drainage System Maintenance:** Credit is provided for enforcing regulations prohibiting dumping in the community's drainage system. Waveland has a written SOP for drainage maintenance and schedules regular maintenance of all drainage ways throughout the city.
- **Activity 610 – Flood Warning**: Credit is provided for a flood warning program which includes a Flood Threat Recognition System, Early Warning Dissemination and other response efforts.
- **Activity 630 – Dam Safety**: Waveland and all CRS communities in Mississippi receive credit for the State's Dam Safety Program.

5.2 Goals and Objectives

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Up to this point in the planning process, the HMPC has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals, objectives, and mitigation actions were developed based on these tasks. The HMPC held a series of meetings and exercises designed to achieve a collaborative mitigation strategy as described further throughout this section.

During the initial goal-setting meeting, the HMPC reviewed the results of the hazard identification, vulnerability assessment, and capability assessment. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the HMPC to formulate planning goals and objectives and to develop the mitigation strategy for Waveland.

Goals were defined for the purpose of this mitigation plan as broad-based public policy statements that:

- Represent basic desires of the community;
- Encompass all aspects of community, public and private;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- Are time-independent, in that they are not scheduled events.

Goals are stated without regard to implementation. Implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that they are not dependent on the means of achievement. Goal statements form the basis for objectives and actions that will be used as means to achieve the goals. Objectives define strategies to attain the goals and are more specific and measurable.

HMPC members were provided with the list of goals from the 2007 plan as well as a list of other sample goals to consider. The 2007 plan had six goals:

- **Goal 1**: Coordinate and incorporate hazard mitigation into community recovery and redevelopment from Hurricane Katrina.
- **Goal 2**: Improve drainage, stormwater, and flood management.
- **Goal 3**: Reduce the damage to life and property caused by non-flood/hurricane hazards.
- **Goal 4**: Provide public education about hazards and how to minimize or avoid related impacts.
- **Goal 5**: Enhance emergency operations capabilities.

- **Goal 6**: Provide public education regarding terrorism situations and ways to reduce the impacts of terrorism and other accidental hazardous situations

The HMPC was told that they could use, combine, or revise the statements provided or develop new ones, keeping the risk assessment in mind. Each member was given three index cards and asked to write a goal statement on each. Goal statements were collected and grouped into similar themes and displayed on the wall of the meeting room. The goal statements were then grouped into similar topics (see Figure 5.1). New goals from the HMPC were discussed until the team came to consensus. Some of the statements were determined to be better suited as objectives or actual mitigation actions and were set aside for later use.

Figure 5.1. Goal Setting Exercise

Source: AMEC

Based on the risk assessment review and goal setting process, the HMPC identified the following goals and objectives, which provide the direction for reducing future hazard-related losses within the Waveland Planning Area.

Goal 1 – Minimize risk and vulnerability of the community to hazards and reduce damages and protect lives, properties, and public health and safety in the City of Waveland

- Prevent and reduce flood damage and related losses
- Minimize impact to both existing and future development

- Minimize economic and resource impact

Goal 2 – Provide protection for critical facilities, infrastructure, and services from hazard impacts.

Goal 3 – Increase public awareness of the risk and vulnerability of the community to hazards

- Enhance public outreach, education and preparedness program to include all hazards of concern
  - Educate residents on how to best protect themselves and their property during hazard events (include people new to the area)
  - Create targeted public outreach campaigns utilizing diverse and comprehensive outreach mechanisms (meetings, newspaper, radio, television, social media, schools)
- Increase public communications to keep the public well informed prior to, during and after a disaster event
  - Improve alert and warning capabilities informing public of hazard events, evacuation routes and sheltering options
- Increase public's awareness and involvement in communities' mitigation projects
  - Assist residents in utilizing grant funds to mitigate property damage

Goal 4 – Increase communities' ability to be prepared for a disaster event and capabilities to mitigate losses

- Enhance emergency services capabilities
- Enhance communication capabilities and interagency coordination
- Increase knowledge and use of technologies and data
- Enhance use of shared resources

Goal 5 – Enhance and improve floodplain management program to maximize CRS credits

Goal 6 – Maintain FEMA Eligibility/Position the communities for Grant funding

5.3 Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

In order to identify and select mitigation actions to support the mitigation goals, each hazard identified in Section 4.1 Identifying Hazards: Natural Hazards was evaluated. Only those hazards that were determined to be a priority hazard were considered further in the development of hazard-specific mitigation actions. The following were determined to be priority hazards:

- Climate Change (storm surge, sea level rise)
- Coastal/Canal Bank Erosion
- Floods: 100/500-year and Localized Flooding
- Hurricanes, Tropical Storms, and Storm Surge
- Thunderstorm (includes hail, lightning, high wind)
- Railroad: Hazardous Materials Release

Certain hazards identified below were determined to be profiled in Section 4.2, but were deemed to be low significance hazards to the City. The HMPC eliminated these hazards from further consideration in the development of mitigation actions because: the risk of a hazard event in the City is unlikely or non-existent; the vulnerability of the City is low; and/or capabilities are already in place to mitigate negative impacts. The eliminated hazards are.

- Dam/Levee Failure
- Drought
- Earthquake
- Excessive Heat
- Extreme Winter Weather
- Tornado
- Wildfire

Once it was determined which hazards warranted the development of specific mitigation actions, the HMPC analyzed viable mitigation options that supported the identified goals and objectives. The HMPC was provided with the following list of categories of mitigation actions, which originate from the Community Rating System:

- Prevention (required to be evaluated)
- Property protection
- Structural projects
- Natural resource protection
- Emergency services

- Public information

The HMPC was also provided with examples of potential mitigation actions for each of the above categories. The HMPC was also instructed to consider both future and existing buildings in considering possible mitigation actions. A facilitated discussion then took place to examine and analyze the options. This was followed by a brainstorming session that generated a list of preferred mitigation actions by hazard.

5.3.1 Prioritization Process

Priority Listing of Mitigation Actions

Once the mitigation actions were identified, the HMPC was provided with several decision-making tools, including FEMA's recommended prioritization criteria, STAPLEE sustainable disaster recovery criteria; Smart Growth principles; and others, to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE stands for the following:

- Social: Does the measure treat people fairly? (e.g., different groups, different generations)
- Technical: Is the action technically feasible? Does it solve the problem?
- Administrative: Are there adequate staffing, funding, and other capabilities to implement the project?
- Political: Who are the stakeholders? Will there be adequate political and public support for the project?
- Legal: Does the jurisdiction have the legal authority to implement the action? Is it legal?
- Economic: Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- Environmental: Does the action comply with environmental regulations? Will there be negative environmental consequences from the action?

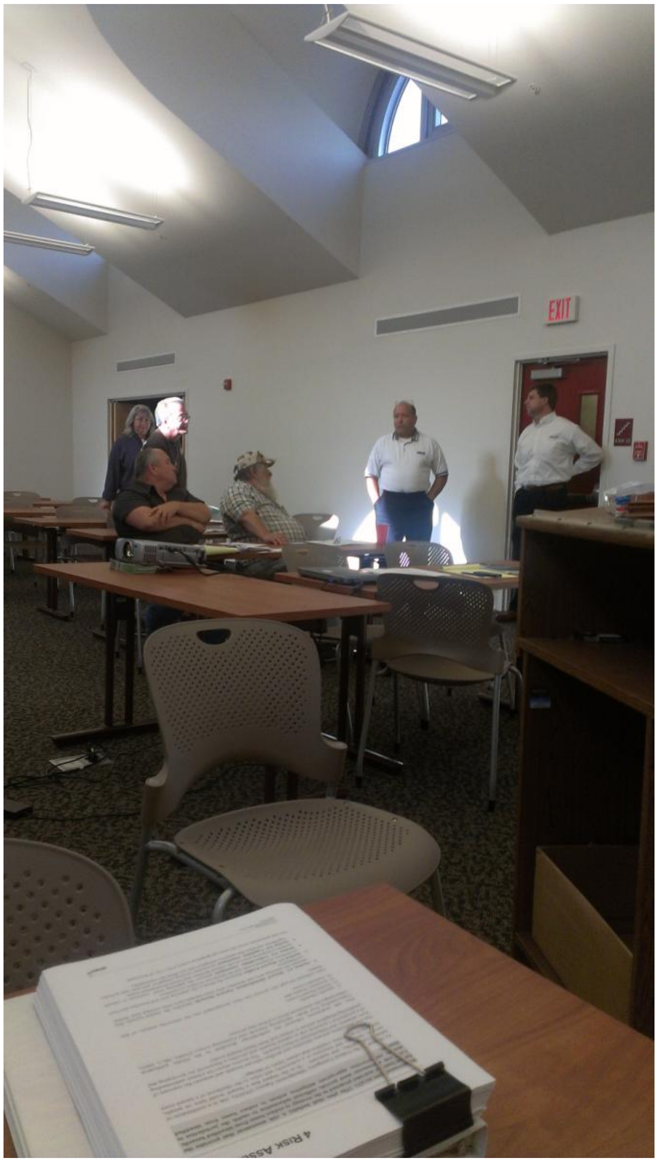
In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority. It was agreed that the following four criteria would be used to determine the priority of the action items:

- Contribution of the action to save life or property
- Availability of funding and perceived cost-effectiveness
- Available resources for implementation
- Ability of the action to address the problem

In addition to reviewing and incorporating the actions from the 2007 plan, the committee also considered and defined several new actions. A comprehensive review of mitigation measures was performed using the criteria (alternatives and selection criteria) in Appendix C.

With these criteria in mind, HMPC members were each given a set of nine colored dots, three each of red, blue, and green. The dots were assigned red for high priority (worth five points), blue for medium priority (worth three points), and yellow for low priority (worth one point). The team was asked to use the dots to prioritize actions with the above criteria in mind. The point score for each action was totaled. Appendix C contains the total score given to each identified mitigation action.

Figure 5.2. HMPC Members Discussion of Possible Mitigation Measures



Source: AMEC

The process of identification and analysis of mitigation alternatives allowed the HMPC to come to consensus and to prioritize recommended mitigation actions. During the voting process, emphasis was placed on the importance of a benefit-cost review in determining project priority; however, this was not a quantitative analysis. After completing the prioritization exercise, some team members expressed concern that prioritizing all the actions as a group is not very effective, since many of the actions are department-specific. However, the team agreed that prioritizing the actions collectively enabled the actions to be ranked in order of relative importance and helped steer the development of additional actions that meet the more important objectives while eliminating some of the actions which did not garner much support.

The Waveland Hazard Mitigation Committee determined that cost benefit review of each of the mitigation actions was clearly an important criterion in the prioritization process. They discussed the contribution of the action to saving lives or property as first and foremost, with additional consideration given to the benefit-cost aspect of a project. Table 5.1 indicates the action items for the 2013 Plan Update.

5.4 Mitigation Action Plan

Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This action plan was developed to present the recommendations developed by the HMPC for how the City of Waveland can reduce the risk and vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. Emphasis was placed on both future and existing development. The action plan summarizes who is responsible for implementing each of the prioritized actions as well as when and how the actions will be implemented. Each action summary also includes a discussion of the benefit-cost review conducted to meet the regulatory requirements of the Disaster Mitigation Act. Table 5.1 identifies the mitigation actions.

The action plan detailed below contains both new action items developed for this plan update as well as old actions that were yet to be completed from the 2007 plan. Table 5.1 indicates whether the action is new or from the 2007 plan and Section 2.2 contains the details for each 2007 mitigation action item indicating whether a given action item has been completed, omitted, or deferred.

Table 5.1. Waveland Mitigation Actions

Action Item	Priority	New Action/ 2007 Action
Protect external A/C equipment in the Central Fire Station and Install Underground Storage Tanks	High	New
Warning Sirens	High	New
Residential Elevation	High	New
Sarah Lane to Adams Lane Evacuation Route	High	New

Action Item	Priority	New Action/ 2007 Action
Culvert under Highway 603	High	New
Culvert under Railroad Track at South Street	High	New
Coordinate with and support the US Army Corps of Engineers on Projects in the MsCIP Relating to the City of Waveland	High	New
Public Outreach	High	New
Education of Residential Retrofitting	Medium	New
Evacuation Planning	High	New
Protection of Public Records	High	New
Public Warning Boards (Signs)	High	New
Enhance City of Waveland Website	Medium	New
Beach Front Erosion Protection	High	New
Protection of Marshes and Natural Barriers	High	New
Extension of Stormwater Drainage Facilities into Gulf	Medium	New
Property Acquisition Project	Medium	New
Drainage Projects	Medium	New
Green Space Development	Medium	New
Flood Insurance Promotion	High	New
Elevation Certificate Program	Medium	New
Dredge Jackson Marsh	High	New
Canal Cleanout	High	New
Mitigation Reconstruction/ Flood Proofing	Medium	New
Retrofitting	Medium	New
Sewage Lift Station Bypass Project	High	New
Continue to control construction site runoff through requirement of clearing and grading permits erosion and sediment control regulations.	High	2007
Continue to control post-construction site runoff so it does not exceed pre-development site runoff through enforcement of best management practices.	High	2007
Continue to strengthen floodplain regulations, as appropriate.	High	2007
Update list of City's repetitive flood loss properties to include properties in area annexed in 2006, encourage owners of repetitive and severe repetitive loss properties citywide to participate in mitigation activities such as flood proofing, elevation, or buyout programs, and prepare a floodplain management plan for the repetitive loss areas.	High	2007
Acquire or otherwise remove repetitive and severe repetitive loss properties from the floodplain.	High	2007
Encourage business owners to protect vulnerable structures through flood proofing, elevation, shutters, and other mitigation activities.	Medium	2007
Work with flood insurance agents and lending institutions to ensure that mandatory flood insurance requirements are being met in area annexed in 2006 and throughout Waveland when new maps are adopted.	High	2007
Continue to publicize evacuation routes and approximate travel times to evacuate the area.	High	2007

Action Item	Priority	New Action/ 2007 Action
Continue to mail flood safety information, including evacuation zones and routes, to every address in Waveland every year.	High	2007
Continue to publicize how families can prepare and plan for disaster.	High	2007
Consider establishing a program to train and certify neighborhoods in first response actions after hazards.	Medium	2007
Promote business continuity planning for small businesses and government.	Medium	2007
Publicize information about the special needs registry maintained by the Hancock County Emergency Management Agency and how residents with special needs can register themselves.	Medium	2007
Provide information on model construction techniques, such as storm shutters, in public places so people can learn about these mitigation techniques and adopt them for their own homes.	Medium	2007
Encourage residents to acquire and monitor NOAA weather radios.	Medium	2007
Establish a facility north of Interstate 10 that can be used as a command center in the event of a major hurricane that can also serve as a shelter for essential city personnel and equipment and house a critical records vault.	Medium	2007
Develop a generator plan for all critical facilities.	Medium	2007
Use the Reverse 911 system to issue evacuation warning and advisories, especially for special needs residents.	Medium	2007
Use existing data from the monitoring and warning gauges on waterways to predict hazardous situations. Use Hurrevac and other existing computer programs and data to predict hazardous situations.	Medium	2007
Maintain NOAA StormReady Designation.	Low	2007
Provide an annual pre-hurricane season workshop and exercise for elected officials and emergency operations staff.	High	2007
Enhance the communications system in a coordinated fashion between appropriate departments in the county, city, and the state.	Medium	2007
The City of Waveland will continue to train its personnel in weapons of mass destruction and hazardous materials response through the following education programs:	Low	2007
Continue to update CAMEO, MARPLOT, and ALOHA software where available and install in all response vehicles.	Medium	2007
Continue to update information about hazardous materials facilities in Waveland upon receiving Tier II Forms from the facilities.	Medium	2007
Continue to update the Pre-Plan Emergency Response Books for hazardous materials locations within Waveland.	Medium	2007
Continue to seek grant funding through FEMA Fire Act Grants and Homeland Security Grants for terrorist and HAZMAT equipment to enable its emergency response personnel to prepare and respond to acts of terrorism and hazardous materials incidents.	Medium	2007

New Actions for the Plan Update

1. Protect external A/C equipment in the Central Fire Station and Install Underground Storage Tanks

Project Description: The City wants to install both underground water and sewer storage tanks. Also, the City wants to include protective measures for the external A/C equipment.

Hazards Addressed: All

Issue/Background: The structure of the City's new fire station located on Highway 90 was designed and built to a 230 mph wind rating. The station does not have secondary utilities and the external A/C equipment needs to be protected.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire Department (Chief)

Priority (H, M, L): High

Cost Estimate: $145,000

Benefits (Losses Avoided): Eliminate need for fireman to move from station due to loss of utilities.

Potential Funding: HMGP

Schedule: Within five years

2. Warning Sirens

Project Description: Install two warning sires in the north and northeast areas of the City. Sirens will be located at a public park and a community center.

Hazards Addressed: All hazards

Issue/Background: The north and northwest areas are without warning sirens.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard Mitigation Plan.

Responsible Office: Fire Chief/Civil Defense

Priority (H, M, L): High

Cost Estimate: $50,000

Benefits (Losses Avoided): Increased warning times. Reduced risk to injury and death for residents.

Potential Funding: HMGP

Schedule: Within five years.

3. Residential Elevation

Project Description: Elevate residential structures located in the flood zones to comply with the current flood ordinance. Structures will be elevated on existing property.

Hazards Addressed: Flood

Issue/Background: There are several residential structures currently built below the local flood ordinance. These structures are repetitive loss properties.

Other Alternatives: Demolition/Acquisition

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard Mitigation Plan

Responsible Office: Fire Chief/Civil Defense/CRS Coordinator

Priority (H, M, L): High

Cost Estimate: $950,000

Benefits (Losses Avoided): Reduce risk to property in the City,

Potential Funding: HMGP, FMA

Schedule: Within next five years.

4. Sarah Lane to Adams Lane Evacuation Route

Project Description: Build access road from Sarah Lane north to Adams Lane to allow citizens living on Sarah Lane to evacuate during storms/

Hazards Addressed: Hurricane

Issue/Background: Currently there is no direct evactuation route for citizens living on Sarah Lane/

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard Mitigation Plan,

Responsible Office: Civil Defense

Priority (H, M, L): High

Cost Estimate: $1 million

Benefits (Losses Avoided): Reduced risk to loss of life and injury from hurricane.

Potential Funding: HMGP, CDBG

Schedule: Within next five years.

5. Culvert under Highway 603

Project Description: Install barrier (check valve) in culvert under Highway 603 to prevent storm surge from entering the City and flooding homes.

Hazards Addressed: Flood

Issue/Background: Currently storm surge during hurricanes backs up through Highway 603 culverts causing flooding.

Other Alternatives: Acquisition or elevation of flooded homes.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard Mitigation Plan.

Responsible Office: CRS Coordinator/Civil Defense

Priority (H, M, L): High

Cost Estimate: $150,000

Benefits (Losses Avoided): Eliminate flooding of homes

Potential Funding: HMGP, FMA, CDBG

Schedule: Within five years.

6. Culvert under Railroad Track at South Street

Project Description: Install barrier (check valve) in culvert under railroad track on South Street to prevent storm surge from entering the City and flooding homes.

Hazards Addressed: Flood

Issue/Background: Currently storm surge during hurricanes backs up through South Street railroad track culverts causing flooding.

Other Alternatives: Acquisition or elevation of flooded homes.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard Mitigation Plan.

Responsible Office: CRS Coordinator/Civil Defense

Priority (H, M, L): High

Cost Estimate: $150,000

Benefits (Losses Avoided): Eliminate flooding of homes

Potential Funding: HMGP, FMA, CDBG

Schedule: Within five years

7. Coordinate with and support the US Army Corps of Engineers on Projects in the MsCIP Relating to the City of Waveland

Project Description: The City will benefit from many of the projects in the Mississippi Coast Improvements Program (MsCIP). The City will partner with the US Army Corps of Engineers to support and help complete projects that benefit the City of Waveland.

Hazards Addressed: Hurricane, Flooding, Storm Surge, Sea Level Rise

Issue/Background: The hurricanes of 2005 caused an unprecedented level of destruction within the Gulf Region of the United States. Homes and businesses, industry, employment, regional economies, environmental resources, and life, health and safety were negatively affected, and a life-changing blow was dealt to residents of the region that has not yet abated. These storms also resulted in significant secondary impacts to the much broader region due to the subsequent migration of the displaced population, wholesale disruption of the region's economy, disruption of the region's infrastructure, and severe impacts on the human, physical and natural resources of the area. The direction provided by Congress to the Corps of Engineers established the purpose and scope for the MsCIP as "conduct an analysis and design for comprehensive improvements or modifications to existing improvements in the coastal area of Mississippi in the interest of hurricane and storm damage reduction, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and other related water resource purposes."

Projects, and brief descriptions, the Corps is taking that affect the City of Waveland include:

- Waveland Floodproofing - Using available GIS data, a geographic area within one of the most hard hit areas of the coast, Waveland, was identified where wet floodproofing would be an effective method of reducing flood damages. This selected area is outside of the identified high-hazard zones where wave action and surge would endanger an elevated residential structure and its occupants.
- Coast-wide Beach and Dune Ecosystem Restoration – The plan calls for Construction of a 2' high x 60' wide dune through the existing berm expansion, and placing sand fencing and plantings
- Comprehensive Barrier Island Restoration – The plan calls for the restoration of Ship Island, littoral zone sand additions at the east ends of Petit Bois and East Ship Island, changes in maintenance dredging practices that meet the requirements of the Regional Sediment Management Practice, and a study to define the best restoration option for Cat Island. This would help protect the City of Waveland from hurricanes and resulting wave action, and potentially sea level rise issues.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: MS Coastal Improvements Plan

Responsible Office: All City departments and the Board of Aldermen,

Priority (H, M, L): High

Cost Estimate: Staff time.

Benefits (Losses Avoided): Reduced risk to property in the City of Waveland. Increased life safety for citizens of Waveland. Reduced risk to cultural and natural resources in the City of Waveland.

Potential Funding: To be determined.

Schedule: Corps of Engineers to determine schedule.

8. Public Outreach

Project Description: Educate citizens of Waveland about preparedness for all hazards affecting the City.

Hazards Addressed: Multi-Hazard

Issue/Background: The City is currently educating citizens, but the City wants to continue these efforts and enhance their outreach strategies.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator

Priority (H, M, L): High

Cost Estimate: Undetermined

Benefits (Losses Avoided): Loss of life and injury

Potential Funding: City funds

Schedule: Ongoing

9. Education of Residential Retrofitting

Project Description: Homeowners need to be educated regarding structural upgrades that can be made to residential homes for added protection against damage during hurricanes and flooding. Upgrades can also help save citizens money on their annual homeowners insurance premiums.

Hazards Addressed: Hurricane and Flood

Issue/Background: City needs to strengthen their homeowner retrofitting education and outreach.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator and Planning Department

Priority (H, M, L): Medium

Cost Estimate: Undetermined

Benefits (Losses Avoided): Reduce structural damage to residential homes during storm events.

Potential Funding: FEMA grant funds

Schedule: Ongoing

10. Evacuation Planning

Project Description: City needs to review their current evacuation plan and access to evacuation routes throughout the City.

Hazards Addressed: Emergency Services/ Multi-Hazard

Issue/Background: Some of the City's evacuation routes maybe be blocked by flooding during severe storm events. Need to evaluate the routes for access.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP and Evacuation Plan

Responsible Office: CRS Coordinator

Priority (H, M, L): High

Cost Estimate: Undetermined

Benefits (Losses Avoided): Loss of Life

Potential Funding: FEMA grant programs

Schedule: Ongoing

11. Protection of Public Records

Project Description: City needs to designate an offsite storage facility for public records north of Interstate 10 or implement a system to protect all public records from flood or hurricanes.

Hazards Addressed: Emergency Services/ Multi-Hazard

Issue/Background: Currently the Waveland does not have an offsite storage facility north of the City for Public Records.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator

Priority (H, M, L): High

Cost Estimate: Undetermined

Benefits (Losses Avoided): Loss of Public Records

Potential Funding: FEMA grant funds

Schedule: Ongoing

12. Public Warning Boards (Signs)

Project Description: Develop a communication system utilizing LED boards along high traffic areas to warn citizens about the threat of potential hazards affecting the City of Waveland.

Hazards Addressed: Emergency Services/ Multi-Hazard

Issue/Background: Currently the Waveland does not have any type of communication signs or LED boards.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: Fire Chief

Priority (H, M, L): High

Cost Estimate: $200,000

Benefits (Losses Avoided): Loss of Life

Potential Funding: FEMA grants

Schedule: Within next five years

13. Enhance City of Waveland Website

Project Description: Enhance the usability and functionality of the City's website. The current website needs to be updated with a section to notify citizens about emergency services and hazards threatening the City of Waveland. The website also, needs to include emergency procedures for different types of hazards and evacuations routes.

Hazards Addressed: Emergency Services/ Multi-Hazard

Issue/Background: Currently the Waveland's website is not very user friendly and is limited regarding emergency management data.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator

Priority (H, M, L): Medium

Cost Estimate: Undetermined

Benefits (Losses Avoided): Loss of life or injury.

Potential Funding: City Funds

Schedule: Ongoing

14. Beach Front Erosion Protection

Project Description: Evaluate and implement the best option for beach protection. Alternatives include fences, concrete barriers, create dune/vegetative areas.

Hazards Addressed: Coastal/ Canal Bank Erosion

Issue/Background: The sand beach and mouths of the beach canals constantly erode during severe storms events and hurricanes.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Undetermined

Responsible Office: Harrison County Sand Beach Authority

Priority (H, M, L): High

Cost Estimate: Undetermined

Benefits (Losses Avoided): Loss of beach and canal banks due to erosion.

Potential Funding: Harrison County Beach Authority

Schedule: Ongoing

15. Protection of Marshes and Natural Barriers

Project Description: Develop a plan and implement that plan in an effort to protect and maintain the natural marshes and other barriers.

Hazards Addressed: Coastal/ Canal Bank Erosion

Issue/Background: City needs a formal plan to protect natural marshes and barriers.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Undetermined

Responsible Office: Public Works Director

Priority (H, M, L): High

Cost Estimate: Undetermined

Benefits (Losses Avoided): Loss of marsh and other natural barriers caused by erosion.

Potential Funding: Undetermined

Schedule: Ongoing

16. Extension of Stormwater Drainage Facilities into Gulf

Project Description: Extend stormwater drainage pipes into gulf to help eliminate sand from filling drainage pipes during storm events.

Hazards Addressed: Coastal/ Canal Bank Erosion

Issue/Background: The existing pipes fill with sand during storm events

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Master Drainage Plan

Responsible Office: Public Works Director

Priority (H, M, L): Medium

Cost Estimate: $1.2 million

Benefits (Losses Avoided): Stop backfill of sand into drainage pipes

Potential Funding: Grant funds

Schedule: Within next 5 years

17. Acquisition Project

Project Description: Acquisition and demolition of repetitive loss and severe repetitive loss properties.

Hazards Addressed: Flood

Issue/Background: The City has structures located in flood zones that do not meet the current flood elevation requirements.

Other Alternatives: Elevation of homes

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator

Priority (H, M, L): Medium

Cost Estimate: $1.5 million

Benefits (Losses Avoided): Flooding of structures

Potential Funding: HMGP and FMA Grant funds

Schedule: Within next 5 years

18. Drainage Projects

Project Description: Update the City of Waveland Master Drainage Plan and Implement new drainage improvement projects.

Hazards Addressed: Flood

Issue/Background: Current plan needs to be reviewed and updated.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Master Drainage Plan

Responsible Office: Public Works Director

Priority (H, M, L): Medium

Cost Estimate: $2.8 million

Benefits (Losses Avoided): Flooding of structures and roads

Potential Funding: HMGP, CDBG, PA, MDOT, etc. Grant funds

Schedule: Ongoing

19. Green Space Development

Project Description: The City has eight acres located on Waveland Avenue that can be used to develop football fields. These fields will create green space which will help reduce flooding within the surrounding areas.

Hazards Addressed: Flood

Issue/Background: City has eight acres that is currently vacant on Waveland Avenue that can be used for green space.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: none

Responsible Office: Mayor's Office, CRS Coordinator, and Public Works Director

Priority (H, M, L): Medium

Cost Estimate: to be determined

Benefits (Losses Avoided): Reduce flooding within surrounding areas.

Potential Funding: BP Settlement Funds and FEMA Grant Funds

Schedule: Within next 5 years

20. Flood Insurance Promotion

Project Description: Develop a plan to educate and promote flood insurance to the citizens of Waveland

Hazards Addressed: Flood

Issue/Background: Citizens need additional education and training regarding the coverage, cost, and benefits of flood insurance

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: CRS Program

Responsible Office: CRS Coordinator

Priority (H, M, L): High

Cost Estimate: unknown

Benefits (Losses Avoided): Reduce homeowner out of pocket cost after flood events.

Potential Funding: to be determined

Schedule: Ongoing

21. Elevation Certificate Program

Project Description: Develop and implement an automated database/GIS system for elevation certificates

Hazards Addressed: Flood

Issue/Background: City needs to update their elevation certificate filing system.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: none

Responsible Office: CRS Coordinator

Priority (H, M, L): Medium

Cost Estimate: unknown

Benefits (Losses Avoided): none

Potential Funding: FEMA funding

Schedule: Ongoing

22. Dredge Jackson Marsh

Project Description: Dredge Jackson Marsh to restore wetlands and help reduce flooding.

Hazards Addressed: Coastal/ Canal Bank Erosion

Issue/Background: Jackson Marsh has filled in over the past years and needs dredging.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Master Drainage Plan

Responsible Office: Public Works Director

Priority (H, M, L): High

Cost Estimate: $2.5 Million

Benefits (Losses Avoided): Reduce erosion and flooding

Potential Funding: FEMA Grant Programs

Schedule: Within next 5 years

23. Canal Cleanout

Project Description: Establish programs to cleanout drainage canals throughout the City on an annual basis.

Hazards Addressed: Coastal/ Canal Bank Erosion

Issue/Background: Existing drainage canals silt-in over the years and reduce stormwater flow.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Master Drainage Plan

Responsible Office: Public Works Director

Priority (H, M, L): High

Cost Estimate: $20,000 annually

Benefits (Losses Avoided): Reduce Flooding

Potential Funding: FEMA Grant Programs

Schedule: Annually

24. Mitigation Reconstruction/ Flood Proofing

Project Description: Reconstruction and flood proofing of structures following hurricanes and/ or other disasters.

Hazards Addressed: Hurricanes/ Flooding

Issue/Background: Following hurricanes and other disasters property owner or the City may need grant funds to assist with rebuilding and flooding proofing structures.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator

Priority (H, M, L): Medium

Cost Estimate: $1.5 million

Benefits (Losses Avoided): Structural damage during hurricanes.

Potential Funding: HMGP or FMA Grant Programs

Schedule: Ongoing

25. Retrofitting

Project Description: Retrofit City owned facilities and privately owned residential structures to help protect these structures from damage during hurricanes and other natural disasters.

Hazards Addressed: Hurricanes/ Flooding

Issue/Background: New and existing structures within the City may need to be retrofitted before and after storm events

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: CRS Coordinator

Priority (H, M, L): Medium

Cost Estimate: $1.8 million

Benefits (Losses Avoided): Structural damage caused by hurricanes and other disasters.

Potential Funding: HMGP, CDBG, PA or FMA Grant Programs

Schedule: Ongoing

26. Sewage Lift Station Bypass Project

Project Description: Install bypass valves at all City of Waveland sewer lift station pumps to reduce or eliminate the loss of sewer service and cost of vacuum trucks.

Hazards Addressed: Hurricanes/ Flooding

Issue/Background: When the existing lift stations fail the City has to hire vacuum trucks to pump sewage from the stations. This is a costly process for the City.

Other Alternatives: No Action

Existing Planning Mechanism(s) through which Action Will Be Implemented: LHMP

Responsible Office: Public Works Director

Priority (H, M, L): High

Cost Estimate: $900,000

Benefits (Losses Avoided): loss of sewage service.

Potential Funding: FEMA Grant Funds

Schedule: Within next 5 years

Previous Actions Carried Forward in the Plan Update

27. Continue to control construction site runoff through requirement of clearing and grading permits erosion and sediment control regulations

Project Description: Continuing to control construction site runoff through the requirement of cleaning and grading permits slows erosion and increases sediment control.

Hazards Addressed: Flooding, Localized Flooding, Coastal/Canal Bank Erosion

Issue/Background: Erosion from construction sites is a significant problem in urban watersheds. Sediment leaves as construction site through rainwater runoff, wind, and attached to construction equipment.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Erosion and Sediment Control Ordinance

Responsible Office: Planning/Code Office

Priority (H, M, L): High

Cost Estimate: To be determined

Benefits (Losses Avoided): Reduced erosion of land and sediment in drainage channels.

Potential Funding: To be determined

Schedule: In the next five years.

28. *Continue to control post-construction site runoff so it does not exceed pre-development site runoff through enforcement of best management practices.*

Project Description: Continuing to control post construction site run-off so it does not exceed pre-development site runoff through the enforcement of best management practices.

Hazards Addressed: Localized Flooding, Flooding, Canal/Streambank Erosion

Issue/Background: Development can greatly alter the existing landscape and hydrology of an area. Increased coverage of the landscape by impervious surfaces, compacted soils, and less foliage create increased surface water runoff.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Stormwater Management Plan Phase II Plan 2009-2013.

Responsible Office: Planning.

Priority (H, M, L): High.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced risk to property and life during times of flooding.

Potential Funding: To be determined.

Schedule: Within 5 years.

29. Continue to strengthen floodplain regulations, as appropriate.

Project Description: This project keeps the City in compliance with the NFIP and allows for future changes to the floodplain ordinances.

Hazards Addressed: Flooding.

Issue/Background: Flood insurance is available to property owners in communities that adopt the minimum floodplain ordinances recommended by the NFIP. Local governments have the authority to adopt regulations within their floodplain program that are more stringent than these minimum requirements.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Community Rating System NFIP/CRS

Responsible Office: Floodplain manager

Priority (H, M, L): High

Cost Estimate: Staff time

Benefits (Losses Avoided): Reduced flood risk to people and property.

Potential Funding: Existing budget.

Schedule: During mitigation plan five year cycle.

30. Update list of City's repetitive flood loss properties to include properties in area annexed in 2006, encourage owners of repetitive and severe repetitive loss properties citywide to participate in mitigation activities such as flood proofing, elevation, or buyout programs.

Project Description: Severe Repetitive Loss tracking and mitigation.

Hazards Addressed: Flooding

Issue/Background: Waveland has an extensive list of repetitive and severe repetitive loss properties. Since Hurricane Katrina in 2005, Waveland has enforced more stringent flood insurance and building regulations in the annexed area.

Other Alternatives: Acquisition, elevation, or no action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Floodplain Management Plan for RLPs.

Responsible Office: Floodplain Manager, Planning, CRS Coordinator, Building Official

Priority (H, M, L): High

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced risk to repetitive flooding as well as increased CRS points for reduced costs to homeowners for flood insurance.

Potential Funding: HMGP, FMA, RFC, SRL

Schedule: During next five years

31. Acquire or otherwise remove repetitive and severe repetitive loss properties from the floodplain.

Project Description: Property acquisition.

Hazards Addressed: Flooding

Issue/Background: The City will consider petitioning the MS Secretary of State for any tax sale properties in the states inventory that may be on the City's repetitive or severe repetitive loss lists.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Repetitive Loss List

Responsible Office: CRS Coordinator

Priority (H, M, L): High

Cost Estimate: Case by case basis.

Benefits (Losses Avoided): Reduced risk to repetitive flooding as well as increased CRS points for reduced costs to homeowners for flood insurance.

Potential Funding: HMGP, FMA

Schedule: 5 years.

32. Encourage business owners to protect vulnerable structures through flood proofing, elevation, shutters, and other mitigation activities.

Project Description: Mitigation of flood damages to businesses.

Hazards Addressed: Hurricane and flooding

Issue/Background: In 2001, Hancock County started participating in FEMA's Project Impact program. One of the accomplishments of the program was to set up a low interest loan pool to help small business owners retrofit their places of business.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Building Official, Planning, Mayor's Office, Floodplain Manager

Priority (H, M, L): Medium

Cost Estimate: Staff time

Benefits (Losses Avoided): Reduced risk to flood for businesses.

Potential Funding: HMGP

Schedule: 5 years

33. *Work with flood insurance agents and lending institutions to ensure that mandatory flood insurance requirements are being met in area annexed in 2006 and throughout Waveland when new maps are adopted.*

Project Description: Mandatory flood insurance program.

Hazards Addressed: Flooding,

Issue/Background: Most property buyers do not take the time to investigate whether or not a property is subject to flood. In 2009, a letter was mailed to realtors, lenders, and insurance offices informing them that the City of Waveland offers public information on map determination.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Floodplain manager

Priority (H, M, L): High

Cost Estimate: Staff time

Benefits (Losses Avoided): Reduced flood losses.

Potential Funding: State, HMGP, FEMA

Schedule: Ongoing during the next five years.

34. Continue to publicize evacuation routes and approximate travel times to evacuate the area.

Project Description: Public Evacuation Routes

Hazards Addressed: Flooding/Hurricanes/Other natural disasters

Issue/Background: The US Army Corps of Engineers is routinely in the process of updating the new Mississippi Hurricane Evacuation Study.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Mississippi Hurricane Evacuation Study.

Responsible Office: Floodplain Manager/CRS Coordinator

Priority (H, M, L): High

Cost Estimate: To be determined

Benefits (Losses Avoided): Reduced risk to loss of life.

Potential Funding: To be determined

Schedule: Within the next five years.

35. Continue to mail flood safety information, including evacuation zones and routes, to every address in Waveland every year.

Project Description: Flood safety information

Hazards Addressed: Flooding

Issue/Background: The City annually mails out a flood safety information brochure prior to the start of hurricane season.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Floodplain manager/Civil Defense Coordinator

Priority (H, M, L): High

Cost Estimate: To be determined.

Benefits (Losses Avoided): Increased life safety.

Potential Funding: To be determined.

Schedule: Within the next five years.

36. Continue to publicize how families can prepare and plan for disaster.

Project Description: Disaster preparedness.

Hazards Addressed: All

Issue/Background: Approximately 85% of Waveland's population live in singe family households with children present. Outreach to this segment of the community about potential hazards and about preparing for hazards can be particularly effective.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Civil Defense Coordinator/American Red Cross

Priority (H, M, L): High

Cost Estimate: To be determined.

Benefits (Losses Avoided): Increased life safety.

Potential Funding: To be determined.

Schedule: Within the next five years.

37. Consider establishing a program to train and certify neighborhoods in first response actions after hazards.

Project Description: Neighborhood first responders.

Hazards Addressed: All.

Issue/Background: FEMAs Community Emergency Response Team (CERT) program educates people about disaster preparedness for hazards that may impact their area. CERT members can assist others in their neighborhood following an event when professional responders are not immediately available for help.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Civil Defense Director

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided): Increased life safety.

Potential Funding: To be determined.

Schedule: Within the next five years.

38. Promote business continuity planning for small businesses and government.

Project Description: Business continuity planning.

Hazards Addressed: All.

Issue/Background: The US Small Business Administration indicates that 43% of small businesses are forced to close due to a disaster and never reopen. It is recommended that a program be established to help business recovery plans.

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Civil defense director/Fire Chief

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced loss of small businesses and the tax revenue and employment opportunities they provide.

Potential Funding: To be determined.

Schedule: Within the next five years.

39. Publicize information about the special needs registry maintained by the Hancock County Emergency Management Agency and how residents with special needs can register themselves.

Project Description: Special needs register.

Hazards Addressed: All.

Issue/Background: In Waveland, like many other communities, there is a percentage of residents with special needs that will need assistance during a disaster.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Community outreach program.

Responsible Office: Civil defense director.

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided): Eliminates loss of life and injury to vulnerable populations.

Potential Funding: To be determined.

Schedule: Within the next five years.

40. Provide information on model construction techniques, such as storm shutters, in public places so people can learn about these mitigation techniques and adopt them for their own homes.

Project Description: Residential construction mitigation.

Hazards Addressed: Wind/Hurricane/Flooding.

Issue/Background: The City of Waveland annually participates in several public outreach avenues to advise people about flooding hazards. This should be expanded to include wind protection techniques such as reinforcing of construction and storm shutters.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Building codes.

Responsible Office: Building official/CRS Coordinator

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided):

Potential Funding: To be determined.

Schedule: Within the next five years.

41. Encourage residents to acquire and monitor NOAA weather radios.

Project Description: NOAA Weather Radios

Hazards Addressed: All.

Issue/Background: Modern weather forecasting methods make it possible to predict severe weather systems well in advance of them becoming a problem in the City. The City wants to encourage residents to purchase a weather radio to monitor severe weather.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Civil defense coordinator.

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduce personal injury and loss of life due to early warning of impending hazards.

Potential Funding: To be determined.

Schedule: Within the next five years.

42. Establish a facility north of Interstate 10 that can be used as a command center in the event of a major hurricane that can also serve as a shelter for essential city personnel and equipment and house a critical records vault.

Project Description: FEMA 361 Shelter north of Interstate 10

Hazards Addressed: All.

Issue/Background: There is no building in Waveland that is considered 100% safe from flooding during a major hurricane/

Other Alternatives: No action

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard Mitigation Plan

Responsible Office: Board of Alderman/Mayor's Office

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Avoided loss of government records and safety of City personnel during storm events.

Potential Funding: HMGP/CDBG

Schedule: Within the next five years.

43. Develop a generator plan for all critical facilities.

Project Description: Generator Plan

Hazards Addressed: All

Issue/Background: Waveland should develop a plan that outlines how generators will be procured and used in all critical facilities.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Local Hazard mitigation plan.

Responsible Office: Fire Chief/Civil Defense Coordinator

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided): Avoid loss of power to critical facilities.

Potential Funding: HMGP/CDBG

Schedule: Within the next five years.

44. Use the Reverse 911 system to issue evacuation warning and advisories, especially for special needs residents.

Project Description: Reverse 911

Hazards Addressed: All

Issue/Background: The reverse 911 systems is invaluable with helping with evacuation orders issued by the local governments. As of the writing of this plan, the system was still down following Hurricane Katrina in 2005. System needs to be back up.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire Chief.

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Eliminate loss of life or injury.

Potential Funding: To be determined.

Schedule: Ongoing.

45. Use existing data from the monitoring and warning gauges on waterways to predict hazardous situations. Use Hurrevac and other existing computer programs and data to predict hazardous situations.

Project Description: Warning gages on waterways.

Hazards Addressed: Flooding.

Issue/Background: Hurrevac is a product of the Hurricane Evacuation Study. The City of Waveland uses Hurrevac to track hurricanes and assist with decision-making concerning evacuation times, tidal gages, traffic counts, shelter information, evacuation routes, and other information.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire department

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduce risks to people and property from flooding.

Potential Funding: To be determined.

Schedule: Ongoing.

46. Maintain NOAA StormReady Designation.

Project Description: StormReady.

Hazards Addressed: All.

Issue/Background: The StormReady program was developed by NOAA to ensure that communities are prepared for severe weather. StormReady provides guidelines for issuing warnings.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire Chief/Civil Defense Director

Priority (H, M, L): Low

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced risk to property from weather related hazards. Reduced risk to citizens of personal injury and death from weather related hazards.

Potential Funding: To be determined.

Schedule: Ongoing.

47. Provide an annual pre-hurricane season workshop and exercise for elected officials and emergency operations staff.

Project Description: Pre-hurricane season workshop.

Hazards Addressed: Hurricane.

Issue/Background: Since it is possible to have newly elected officials at the start of each hurricane season, many of them are unaware of the functions and policies of the Office of Civil Defense and are unaware of their role in the event of a hurricane.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Civil Defense.

Priority (H, M, L): High

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced property losses.

Potential Funding: To be determined.

Schedule: Ongoing.

48. Enhance the communications system in a coordinated fashion between appropriate departments in the county, city, and the state.

Project Description: Coordinate communications systems.

Hazards Addressed: All.

Issue/Background: It is critical that all departments responding to an emergency be able to communicate among themselves. Their communications systems must be interoperable.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Civil Defense Coordinator/Fire Chief/ Police Chief

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Increased life safety due to increased communications between departments.

Potential Funding: To be determined.

Schedule: Ongoing/Annual

49. The City of Waveland will continue to train its personnel in weapons of mass destruction and hazardous materials response through the following education programs:

Project Description: Weapons of mass destruction.

Hazards Addressed: Hazardous Materials

Issue/Background: There are several training courses that personnel need to attend such as Haz-Mat Level I and II and incident response to terrorist bombing.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Police/Fire/Civil Defense

Priority (H, M, L): Low

Cost Estimate: To be determined.

Benefits (Losses Avoided): Avoid loss of life.

Potential Funding: To be determined.

Schedule: Ongoing.

50. *Continue to update CAMEO, MARPLOT, and ALOHA software where available and install in all response vehicles.*

Project Description: Emergency vehicle software

Hazards Addressed: All hazards.

Issue/Background: The City Fire Department accesses several computer software programs as aids to day to day operations. These programs would be especially valuable in the event of a hazardous situation.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire/Civil Defense

Priority (H, M, L): Medium.

Cost Estimate: To be determined.

Benefits (Losses Avoided): Increased life safety.

Potential Funding: To be determined.

Schedule: Ongoing.

51. Continue to update information about hazardous materials facilities in Waveland upon receiving Tier II Forms from the facilities.

Project Description: Hazardous materials update.

Hazards Addressed: Hazardous Materials

Issue/Background: Each year all hazardous storage locations within Waveland report their inventory to the fire department and civil defense coordinator on Tier II Forms.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire/Civil Defense

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced risk to hazardous materials incident. Increased life safety.

Potential Funding: To be determined.

Schedule: Ongoing.

52. Continue to update the Pre-Plan Emergency Response Books for hazardous materials locations within Waveland.

Project Description: Pre-plan Emergency Response Books

Hazards Addressed: Hazardous Materials

Issue/Background: The Waveland Fire Department maintains and annually updates the pre-plan emergency books on all hazardous materials located with the City limits of Waveland.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Fire/Civil Defense

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced risk to hazardous materials incident. Increased life safety.

Potential Funding: To be determined.

Schedule: Ongoing.

53. Continue to seek grant funding through FEMA Fire Act Grants and Homeland Security Grants for terrorist and HAZMAT equipment to enable its emergency response personnel to prepare and respond to acts of terrorism and hazardous materials incidents.

Project Description: Fire Act Grants and Homeland Security Grants for haz-mat suits.

Hazards Addressed: Hazardous Materials

Issue/Background: Waveland does not currently have Class A or Class B haz-mat suits for its public safety personnel. Grant funds are vital in securing personnel safety equipment.

Other Alternatives: No action.

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office: Police/Fire/Civil Defense

Priority (H, M, L): Medium

Cost Estimate: To be determined.

Benefits (Losses Avoided): Reduced risk to hazardous materials incident. Increased life safety.

Potential Funding: To be determined.

Schedule: Ongoing.

6 PLAN ADOPTION

Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, county commissioner, Tribal Council).

The purpose of formally adopting this plan is to secure buy-in from the City of Waveland, raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 of the 10-step planning process: Adopt the Plan, in accordance with the requirements of DMA 2000. The City Board has adopted this Local Hazard Mitigation Plan by passing a resolution. A copy of the generic resolution and the executed copies are included in Appendix A: Adoption Resolution.

7 PLAN IMPLEMENTATION AND MAINTENANCE

Requirement §201.6(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This is Planning Step 10 of the 10-step planning process. This chapter provides an overview of the overall strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

Section 3.0 Planning Process includes information on the implementation and maintenance process since the 2007 plan was adopted. This section includes information on the implementation and maintenance process for this plan update.

7.1 Implementation

Once adopted, the plan faces the truest test of its worth: implementation. While this plan contains many worthwhile actions, the City of Waveland will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

An important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other plans and mechanisms, such as the City's Comprehensive Plan. Waveland already implements policies and programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government. Implementation will be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits to each program and the Waveland community. This effort is achieved through the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities. Simultaneous to these efforts, it is important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the more costly recommended actions.

This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding does become available, the City will be in a position to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and federal earmarked funds, benefit assessments, and other grant programs, including those that can serve or support multi-objective applications.

7.1.1 Role of Hazard Mitigation Planning Committee in Implementation and Maintenance

With adoption of this plan, Waveland will be responsible for the plan implementation and maintenance. Waveland agrees to continue its relationship with the HMPC and:

- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Ensure hazard mitigation remains a consideration for community decision makers;
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan’s recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Report on plan progress and recommended changes to the various governing boards or councils of all participating jurisdictions; and
- Inform and solicit input from the public.

The primary duty is to see the plan successfully carried out and report to the Board of Aldermen, MEMA, FEMA, and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the City’s website (and others as appropriate).

7.2 Maintenance

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized.

7.2.1 Maintenance Schedule

The City of Waveland’s Fire Chief is responsible for initiating plan reviews. In order to monitor progress and update the mitigation strategies identified in the action plan, Waveland will revisit this plan annually and following a hazard event. The City will submit a five-year written update to the State and FEMA Region IV, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

7.2.2 Maintenance Evaluation Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or
- Increased vulnerability as a result of new development (and/or further annexation).

Updates to this plan will:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to infrastructure inventories; and
- Incorporate new action recommendations or changes in action prioritization.

In order to best evaluate any changes in vulnerability as a result of plan implementation, the City will adhere to the following process:

- A representative from the responsible office identified in each mitigation measure will be responsible for tracking and reporting on an annual basis to the City lead on action status and provide input on whether the action as implemented meets the defined objectives and is likely to be successful in reducing vulnerabilities.
- If the action does not meet identified objectives, the action lead will determine what additional measures may be implemented, and an assigned individual will be responsible for defining action scope, implementing the action, monitoring success of the action, and making any required modifications to the plan.

Changes will be made to the plan to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the plan will be by written changes and submissions, as is appropriate and necessary, and as approved by the Board of Alderman. In keeping with the five-year update process, the HMPC will convene public meetings to solicit public input on the plan and its routine maintenance and the final product will be adopted by the Board of Alderman.

7.2.3 Incorporation into Existing Planning Mechanisms

Another important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other City plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. As previously stated in Section 7.1 of this plan, mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. The point is re-emphasized here. As described in this plan's capability assessment, the City of Waveland already implements policies and programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms. These existing mechanisms include:

- City Comprehensive Plan
- City Emergency Operations Plans
- City ordinances
- Flood/stormwater management/master plans
- Other plans, regulations, and practices with a mitigation focus

Those involved in these other planning mechanisms will be responsible for integrating the findings and recommendations of this plan with these other plans, programs, etc, as appropriate. As described in Section 7.1 Implementation, incorporation into existing planning mechanisms will be done through the routine actions of:

- monitoring other planning/program agendas;
- attending other planning/program meetings;
- participating in other planning processes; and
- monitoring community budget meetings for other community program opportunities.

The successful implementation of this mitigation strategy will require constant and vigilant review of existing plans and programs for coordination and multi-objective opportunities that promote a safe, sustainable community.

Examples of incorporation of the Local Hazard Mitigation Plan into existing planning mechanisms include:

1) Integration of flood actions identified in this mitigation strategy with the actions and implementation priorities established in existing Stormwater Drainage Plans. This is already in process. Specifically, key people responsible for development of the Stormwater Plan for

the City participated on the HMPC in the development of this LHMP. They identified key projects from their stormwater plans and integrated them into the Mitigation Strategy of this LHMP. Likewise, actual implementation of these flood mitigation projects will likely occur through the actual stormwater plans' implementation process.

2) Using the risk assessment information to update the hazard analysis in the City Emergency Operations Plan.

Efforts should continuously be made to monitor the progress of mitigation actions implemented through other planning mechanisms and, where appropriate, their priority actions should be incorporated into updates of this hazard mitigation plan.

7.2.4 Continued Public Involvement

Continued public involvement is imperative to the overall success of the plan's implementation. The update process provides an opportunity to solicit participation from new and existing stakeholders and to publicize success stories from the plan implementation and seek additional public comment. The plan maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated committee meetings, web postings, press releases to local media, and through public hearings.

When the HMPC reconvenes for the update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the plan. In reconvening, the HMPC plans to identify a public outreach subcommittee, which will be responsible for coordinating the activities necessary to involve the greater public. The subcommittee will develop a plan for public involvement and will be responsible for disseminating information through a variety of media channels detailing the plan update process. As part of this effort, a series of public meetings will be held and public comments will be solicited on the plan update draft.

USE THIS?

The subcommittee will coordinate this public outreach process with the public information program established pursuant to the 2012 guidelines from the Community Rating System (CRS). Specifically, this CRS public information program, as detailed further in Mitigation Action #2 from the Mitigation Strategy of this LHMP is being designed to ensure active public participation and outreach related to the successful identification and implementation of flood mitigation projects throughout the City.

Appendix A ADOPTION RESOLUTION

Note to Reviewers: When this plan has been reviewed and approved pending adoption by FEMA Region IV, the adoption resolutions will be signed by the participating jurisdictions and added to this appendix. Model resolutions are provided below:

Resolution #_______

Adopting the City of Waveland Local Hazard Mitigation Plan

Whereas, the City of Waveland, Mississippi recognizes the threat that natural hazards pose to people and property within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

Whereas, the U.S. Congress passed the Disaster Mitigation Act of 2000 ("Disaster Mitigation Act") emphasizing the need for pre-disaster mitigation of potential hazards;

Whereas, the Disaster Mitigation Act made available hazard mitigation grants to state and local governments;

Whereas, an adopted Local Hazard Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the City of Waveland, Mississippi fully participated in the FEMA-prescribed mitigation planning process to prepare this local hazard mitigation plan; and

Whereas, the Mississippi Emergency Management Agency and Federal Emergency Management Agency, Region IV officials have reviewed the City of Waveland Local Hazard Mitigation Plan and approved it contingent upon this official adoption of the participating governing body;

Whereas, the City of Waveland, Mississippi desires to comply with the requirements of the Disaster Mitigation Act and to augment its emergency planning efforts by formally adopting the City of Waveland Local Hazard Mitigation Plan;

Whereas, adoption by the governing body for the City of Waveland, Mississippi demonstrates the jurisdiction's commitment to fulfilling the mitigation goals and objectives outlined in this Local Hazard Mitigation Plan.

Whereas, adoption of this legitimacies the plan and authorizes responsible agencies to carry out their responsibilities under the plan.

Now, therefore, be it resolved, that the City Council of City of Waveland, Mississippi adopts the City of Waveland Local Hazard Mitigation Plan as an official plan; and

Be it further resolved, the City of Waveland will submit this adoption resolution to the Mississippi Emergency Management Agency and FEMA Region IV officials to enable the plan's final approval in accordance with the requirements of the Disaster Mitigation Act of 2000.

Passed:__________________
(date)

____
Certifying Official

Appendix B PLANNING PROCESS

B.1 Step 1: Organize to Prepare a Plan

B.1.1 Initial Invitation

All,

As most of you know, Waveland is in the process of updating its hazard mitigation plan. The plan update process was initiated in early fall 2012, with many of you attending the kick-off meeting in early November. Local governments are required to have a current, FEMA-approved Local Hazard Mitigation Plan as a condition of receiving FEMA pre- and post- disaster funding. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters.

Our next meetings of the hazard mitigation planning committee are being held next week: Tuesday, March 5th from 1-4 and Wednesday March 6th from 9-12. The meeting on the 4th will provide a risk assessment overview and will focus on updating plan goals and objectives from the previous plan. The meeting on the 5th will focus on identifying and prioritizing mitigation actions for the plan update.

It is very important to get your participation and input into these very important meetings. The development of an updated mitigation strategy for this plan update will be most effective if these meetings are well represented by key city departments and state, local and federal agencies and organizations.

Please come and bring your mitigation ideas to these meetings. See the attached FEMA document for a list of mitigation ideas by hazard. Please RSVP and feel free to call if you have questions.

Thanks very much,

Mike

B.1.2 Initial Invitation List

City of Waveland Steering Committee

- Roger Estopinal - Planning and zoning and also a local businessman with a business in a SFHA
- Brent Anderson - Building official and floodplain administrator
- Dwight Haskell - Public Works Superintendent
- Christine Gallagher - Permit clerk, Planning and Zoning and on CRS team
- Willie Moody - Parks and Recreation
- Alfred Harris - Resident living in SFHA
- Dwayne Raphael - County GIS department
- Mike Kopke – FILL IN
- Ray Cox - Manager of Wal-Mart living in SFHA
- Rhonda Rhodes - Hancock County Resource Center
- Steve Landry - Director of the Port and Harbor Commission
- Clarence Harris - Planning and Zoning Official
- Hank Wheeler - Hancock Medical Center
- Tony Mallini - Waveland Fire Department
- Mike Smith - Fire Chief, CRS Coordinator, Blighted Property, ETC
- Paul Pitts – Engineer

Table B.1. Steering Committee Members and Areas of Expertise – FILL IN

Name	Prevention	Emergency Services	Property Protection	Natural Resource Protection	Structural
Roger Estopinal					
Brent Anderson					
Dwight Haskell					
Christine Gallagher					
Willie Moody					
Alfred Harris					
Dwayne Raphael					
Mike Kopke					
Ray Cox					
Rhonda Rhodes					
Steve Landry					
Clarence Harris					
Hank Wheeler					
Tony Mallini					
Mike Smith					

Name	Prevention	Emergency Services	Property Protection	Natural Resource Protection	Structural
Paul Pitts					

Agency Contact Invites:

Anthony Cuevas
854 Highway 90 Bay St. Louis Ms 39520
1-228-467-4157

City of Bay St. Louis
Josh Hayes
302 Highway 90 Bay St. Louis Ms 39520
1-228-671-1433

Hancock County Development Commission
Steve Landry
706 Highway 90 Waveland Ms 39576
1-228-467-9231

Pearl River Basin Development Commission
Mike Davis
Po. Box 5332 Jackson Ms. 39296
1-601-354-6301

Hancock County School District
Adam Dedeaux
17034 Highway 603 Kiln Ms 39556
1-228-255-0376

Bay Waveland School District
Dr. Rebecca Ladner
201 Carroll Ave. Bay St. Louis Ms. 39520
1-220-467-6621

Red Cross – Waveland
Joshaua Joachim
2782 Fernwood Rd. Biloxi Ms. 39531
1-228-896-4511

FEMA Regon IV
Dave Spearrett
1800 South Bell St. Arlington Va 20598\

1-202-646-2780

Mississippi State NFIP Coordinating Office
1410 Riverside drive Jackson Ms. 39216
1-602-960-9031

Mississippi State Emergency Management Agency
Jana Henderson
PO. Box 4501 Jackson Ms. 39216
1-601-933-6884

Mississippi Wildlife Fisheries and Parks – Contact?

National Weather Service (New Orleans/ Baton Rouge)
Frank Ravette
62300 Airport Rd. Slidell La. 70460
1-504-522-7330 / 1-985-649-0357

Gulf Regional Planning Agency
Elaine Wilkinson
1232 Pass Rd. Gulfport Ms. 30501
1-228-864-1167

Other Invitees:

John Albert – Hancock County EM
Thomas Smith (USACE: MS Coastal Improvements Program)
Thomas.e.smith@usace.army.mil

MS Office of Coastal Ecology
Department of Marine Resources
1141 Bayview Ave. Suite 101
Biloxi MS 39530
Contact??

USACE
Mobile, AL District
109 St. Joseph Street
Mobile, AL 36602
Contact?

MS Department of Transportation
Contact?

Salvation Army

Contact?

Utility Companies
Contact?

HMPC Members

Will be filled in based on sign in sheets at end of plan

Email Invite to HMPC for Kickoff Meeting

All,

Waveland is in the process of updating its hazard mitigation plan. The first phase of this process is to setup the hazard mitigation planning committee with essential personnel from the different aspects of the community. I wanted to contact each of you to see if you would consider being a member of that committee. We will have a kickoff meeting either at the end of October or the first week of November with a public meeting to follow. As soon as the date and location are determined, I will let everyone know.

As most of you know; Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage in the next disaster. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters. State, Indian Tribal, and local governments are required to develop a hazard mitigation plan as a condition of receiving certain types of hazard mitigation disaster assistance, emergency and non-emergency. The requirements and procedures for State, Tribal and Local mitigation plans are found in the Code of Federal Regulations (CFR) at Title 44, Chapter 1, Part 201

Thank you for your consideration.

Mike

Email Invite to Steering Committee Members for Kickoff Meeting

Steering Committee Members,

First, I would like to say Thank You for accepting the invitation to be a vital part of Waveland's Hazard Mitigation Plan. Your expertise in the Mitigation Categories that will be included in the plan is paramount to having a successful living plan. We will have our kickoff committee meeting on Nov 7 at 1:30 pm at the Waveland Civic Center located at 335 Coleman Ave. A public meeting will follow at 6:00 PM.

Thank You Again!!

Mike Smith

Waveland Fire Department

AGENDA

City of Waveland
Local Hazard Mitigation Plan (LHMP) Update Project
Kickoff Meeting: November 7, 2012

1) Introductions
2) Mitigation, Mitigation Planning, & the Disaster Mitigation Act Requirements
3) National Flood Insurance Program's (NFIP) Community Rating System, 2012 Overview
4) The Role of the Hazard Mitigation Planning Committee (HMPC)
5) Planning for Public Input
6) Coordinating with other Agencies
7) Hazard Identification
8) Data Collection Needs (Handout)
9) Questions and Answers/Adjourn

SIGN-IN SHEET

CITY OF WAVELAND

LOCAL HAZARD MITIGATION PLAN UPDATE PROJECT

HMPC Kickoff Meeting #1

November 7, 2012

Name/Title	Email Address	Phone	City/Organization/ Affiliation
PAUL PITTS JR	PAUL@COMPTONENGINEERING.COM	228-467-2770	COMPTON ENGINEERING
Alfred Harris sr.	AHarrissr.@GMail.com	228-493 0896	Waveland
Mike Smith	Fireman39520@Att.	228-493-6643	WAVELAND Fire
BRENT Anderson	bldgofficial@mchsi.com	216-1630	Public works Director WAVELAND
Tony Mallini		467-2042	WFD
Willie Moody		216-5471	Public Wks/Rec
DAVID ALLEN	DALLEN@WAVELANDPOLICE.com	228-363-0757	WPD
HANK WASSLER	hwheeler@hancockmedical.net	228-467-8680	HANCOCK MEDICAL
STEPHEN LANDRY	slandry@hcdc.MS	323-3217 228-[illegible]	HCDC
ROGER ESTOPINAL JR.	aeRoger@bellsouth.net	228-493-9857	WAVELAND / LOCAL BUSINESSMAN CHAIRMAN P+Z
KENNETH HURT	KHURT@WAVELANDPOLICE.COM	228 216 0809	WAVELAND POLICE DEPT
[illegible]	mytimeTJRCoy@yahoo.com	228 493-3062	WAL MART
David A. Garcia	Wavelandchief@bellsouth.net	228 493-6642	City of Waveland

SIGN-IN SHEET
CITY OF WAVELAND
LOCAL HAZARD MITIGATION PLAN UPDATE PROJECT
HMPC Kickoff Meeting #1
November 7, 2012

Name/Title	Email Address	Phone	City/Organization/ Affiliation
Tracie Sempier / Coastal Storms Outreach Coord	tracie.sempier@usm.edu	228 818-8829	MS-AL Sea Grant
DAVID STROUD		919 325-6497	AMEC
PATRICK MOORE			AMEC

SIGN-IN SHEET
CITY OF WAVELAND
LOCAL HAZARD MITIGATION PLAN UPDATE PROJECT
Public Meeting #1
November 7, 2012

Name/Title	Email Address	Phone	City/Organization/ Affiliation
Alfred F. Harris Sr	AlHarris sr. @gmail.com	228-493 0896	WAveland
Robert Estopinal Jr.	aeRoger@bellsouth.net	228 493-9857	Business Owner Chairman PnZ Waveland
PAUL PITTS Jr	PAUL@COMPTONENGINEERING.COM	228-467-2770	COMPTON ENGINEERING
STEPHEN LANDRY	SLANDRY@HCDC.MS	323-3217	HANCOCK CO. PORT & HARBOR
Mike Smith	FireMAN39576@ Att.net	493-6643	WAVeland Fire
DAVID STROUD	AMEC	919-3256497	
PATRICK MOORE			AMEC

Email Invite to Mitigation Strategy Meeting

From: Mike Smith [mailto:fireman39576@att.net]
Sent: Tuesday, February 26, 2013 11:09 AM

To: bslfire@bellsouth.net; Stroud, David A; hcema2@att.net; Hwheeler@hancockmedical.net; khurt@wavelandpolice.com; parksandpiers@mediacombb.net; wavelandchief@bellsouth.net; aeroger@bellsouth.net; aeroger@bellsouth.net; Alfred Harrissr; Andrea Trzaska; Brent Anderson; Charles Gallagher; Christine Gallagher; David Allen; Dwayne Raphael; Dwight Haskell; Foster, Jeanine; Mike Smith; Moore, Patrick W; Paul Pitts; Ray Cox; Rhonda Rhodes; Sherry Blankenship; Steve Landry; Tracie Sempier; Willie Moody, Tony Mallini, Thomas Smith

Subject: Waveland Hazard Mitigation Planning Committee Meetings

Dear All,

We will be having 2 planning meetings for the Local Hazard Mitigation Plan Update on March 4th from 1pm to 4 pm and on March 5th from 9 am to 12 pm. The meeting on the 4th will provide a risk assessment overview and will focus on updating plan goals and objectives. The meeting on the 5th will focus on identifying and prioritizing mitigation actions for the plan update. It is very important that key players come to these meetings. The mitigation strategy will be most effective if the right people are involved. We ask that you please attend if possible to make sure that you have input on projects to protect existing built environment as well as strategies for future development. We appreciate your involvement!

Thank You,

Mike Smith
Fire Chief/CRS Coordinator
City of Waveland
228-467-2042

City of Waveland

LHMP Risk Assessment & Mitigation Strategy Meetings
Agenda

HMPC Meeting #2: March 5, 2013

1) Introductions
2) Status of the DMA Planning Process
3) Review of Risk Assessment
4) Update Plan Goals and Objectives
5) Review of Mitigation Alternatives

HMPC Meeting #3: March 6, 2013

1) Identify Updated List of Mitigation Actions
2) Review Mitigation Selection Criteria
3) Prioritize Mitigation Projects
4) Review of Schedule/ Final Data Needs

SIGN-IN SHEET
CITY OF WAVELAND
LOCAL HAZARD MITIGATION PLAN UPDATE PROJECT
Risk Assessment/Mitigation Strategy Meeting #2
March 5, 2013
(Day 1)

Name/Title	Email Address	Phone	City/Organization/ Affiliation
Jeanine Foster	jeanine.foster@amec.com	317-717-7171	AMEC
Mike Smith	FIREMAN3957@ATT	493-6643	WAVELAND FIRE
PAUL PITTS JR	PAUL@COMPTONENGINEERING.COM	467-2770	COMPTON ENGINEERING
DWAYNE Raphael	draphael@co.hancock.ms.us	467-4425	Hancock County
Willie Mosby	WavelandParks@	228-216-7476	Waveland Parks
AIRIEL HARRIS	alharris58@gmail.com	228-493-0596	Waveland MS
Charlene Favre	CFavre@hancockmedical.net	467-8690	Hancock Medical
PATRICK MOORE	patrick.w.moore@amec.com		AMEC
Roger Estopinal Jr	weRoger@BellSouth.net	228-493-4857	CHAIRMAN P&Z WAVELAND
STEPHEN LANDRY	SLandry@HCDC.MS	323-3217 467-3292	HANCOCK COUNTY RPT Commission
DAVID STROUD	david.stroud@amec.com	919132561 6447	AMEC

SIGN-IN SHEET
CITY OF WAVELAND
LOCAL HAZARD MITIGATION PLAN UPDATE PROJECT
Risk Assessment/Mitigation Strategy Meeting #3
March 6, 2013
(Day 2)

Name/Title	Email Address	Phone	City/Organization/ Affiliation
Paul Pitts Jr	paulp@comptonengineering.com	228 467-2770	Compton Engineering, Inc
Susan Lamey	susan.lamey@redcross.org	228-596-1523 / 596-4511	Red Cross
Dwayne Rhyhe	[illegible]@hancock.ms.us	228-467-4425	Hancock County
Tracie Sempier	tracie.sempier@usm.edu	228 818-8829	MS-AL Sea Grant
Mark Kidd	m.kidd@waveland.[illegible]	363-2391	AID [illegible] Waveland
Charlene Favre	cfavre@hancockmedical.net	467-8650	Hancock Medical
Sherri Rhodes	[illegible]rhodes@hancockchamber.org	228 463 8327	Hancock Resource Ctr
STEPHEN LANDRY	slandry@HCPC.MS	323-3217	HANCOCK COUNTY PORT Comm.
Mike Smith	FIREMAN[illegible]@att.	493-6643	WAVELAND FIRE
Roger Estopinal [illegible]	[illegible]@bellsouth.net	493 4857	WAVELAND CHAIRMAN Planning & Zoning
[illegible]	[illegible]	228 493-6596	[illegible]
PATRICK MCGUIRE	patrick.mcguire@amec.com		AMEC
DAVID STROUD	david.stroud@amec.com	9193256497	AMEC

LOCAL HAZARD MITIGATION PLAN (LHMP) UPDATE

DATA COLLECTION WORKBOOK

For:
City of Waveland
Hazard Mitigation Planning Committee (HMPC)

Prepared by:

AMEC Earth & Environmental

September 2012

1

OVERVIEW

The contents of this workbook have been designed to assist the City of Waveland in collecting necessary background information to support the hazard mitigation planning process pursuant to the Federal Disaster Mitigation Act (DMA) of 2000. The goal of this process is to produce a hazard mitigation plan that meets the needs of the City, as well as the requirements of DMA and that contains a list of projects that may be eligible for federal mitigation funding, pre and post disaster.

MITIGATION – Hazard Mitigation means any sustained action taken to reduce or eliminate long-term risk to human life and property from natural hazards.

AMEC'S 10 STEP PLANNING PROCESS USES A COMBINATION OF THREE RECOMMENDED PROCESSES – DMA, FMA AND COMMUNITY RATING SYSTEM (CRS)

FEMA Phases	Hazard Mitigation Grant and Pre-Disaster Mitigation Grant Programs (DMA, 44 CFR 201)	Flood Mitigation Assistance Program (44 CFR 78.5)	Community Rating System Floodplain Management Planning (10-Step Process)
Phase I Organize Resources	Coordination among agencies	Coordination with other agencies or organizations	Organize to prepare the plan
	Integration with other planning efforts	Involve the public, including a description of the planning process. Public involvement may include workshops, public meetings, or hearings	Coordination with other agencies
	Involve public throughout the planning process		Involve the public
Phase II Assess Risks	Identify all hazards	Flood hazard area inventory that identifies the flood risk, including estimates of the number and types of structures at risk and repetitive-loss properties	Assess the (flooding) hazard
	Profile hazard events		
	Assess vulnerability	Problem identification, including a description of the existing flood hazard, the extent of flood depth and damage potential, and the applicant's floodplain management goals	Assess the problem
	Estimate potential losses		
Phase III Develop the Mitigation Plan	Documentation of planning process	Review of possible mitigation actions, including the identification and evaluation of cost-effective and technically feasible mitigation actions	Set goals
	Capability assessment		Review possible activities
	Develop hazard mitigation goals		Draft an action plan
	Identification and analysis of mitigation measures		
	Funding sources		

2

FEMA Phases	Hazard Mitigation Grant and Pre-Disaster Mitigation Grant Programs (DMA, 44 CFR 201)	Flood Mitigation Assistance Program (44 CFR 78.5)	Community Rating System Floodplain Management Planning (10-Step Process)
Phase IV Implement and Monitor Progress and Project Management/ Project Tracking	Adoption	Documentation of the formal plan adoption by the legal entity submitting the plan (e.g., governor, mayor, county executive)	Adopt the plan
	Implementation of mitigation measures		Implement, evaluate, and revise the plan
	Monitoring, evaluating, and updating the plan		
	Continued public involvement		

PARTICIPATION

The DMA planning regulations and guidance stress that each jurisdiction seeking the required FEMA approval of their mitigation plan must:

- Participate in the process;
- Provide details about their specific geographical planning area where the risk in their area differs from that experienced by the entire area;
- Identify specific projects to be eligible for funding; and
- Have the governing board formally adopt the plan.

For HMPC members, 'participation' means the planning committee representatives will:

- Attend and participate in HMPC meetings;
- Provide available data that is requested of the HMPC coordinator
- Review and provide/coordinate comments on the draft plans;
- Advertise, coordinate and participate in the public input process; and
- Coordinate the formal adoption of the plan by the governing board.

DATA COLLECTION WORKBOOK

This workbook contains an explanation of the types of hazard mitigation or loss prevention data that is needed for the hazard mitigation planning process. This workbook identifies specific requirements for general community information, the Risk Assessment Process (ie., Hazard Identification and Profiles; Vulnerability Assessment; Capability Assessment), as well as defines requirements for development of the Mitigation Strategy.

The worksheets have been developed to facilitate the data collection process. These need to be completed by the City and returned as soon as possible. Completion of the data collection workbook will serve two purposes:

1) It will help facilitate the collection of the necessary information from the local perspective; and
2) It will function as evidence of "participation" in the planning process.

WORKSHEET #1: HAZARD IDENTIFICATION

Name of Department/Jurisdiction:____

Use this worksheet to identify possible hazards that may impact your jurisdiction. Please rank according to the guidelines that follow the table. Use the Hazard Event Worksheet #2 to provide evidence to justify your conclusions.

Hazard	Frequency of Occurrence	Spatial Extent	Potential Magnitude	Significance	Hazard Map? (paper/GIS/ source)
Climate Change (storm surge, sea level rise)					
Coastal/ Canal Bank Erosion					
Dam/Levee Failure					
Drought					
Earthquake					
Excessive Heat					
Extreme Winter Weather					
Flood: 100/500 year					
Flood: Stormwater/ Localized Flooding					
Hurricane and Tropical Storms (includes ocean surf events)					
Thunderstorm (includes hail, lightning, high wind)					
Tornado					
Wildfire					
Railroad: Hazardous Materials Release					

Prepared by: _______________________________
Phone: _______________________________
Email: _______________________________
Date:_______________________________

Please return worksheets by mail, email, or fax to:
Jeanine Foster, AMEC Earth & Environmental
1002 Walnut Street, Suite 200
Boulder, CO 80302
fax: (303) 442-0616
email: jeanine.foster@amec.com

4

Guidelines

Frequency of Occurrence:

Highly Likely: Near 100% probability in next year.

Likely: Between 10 and 100% probability in next year or at least one chance in ten years.

Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.

Unlikely: Less than 1% probability in next 100 years.

Potential Magnitude

Catastrophic: More than 50% of area affected

Critical: 25 to 50%

Limited: 10 to 25%

Negligible: Less than 10%

Spatial Extent

Limited: Less than 10% of planning area

Significant: 10-50% of planning area

Extensive: 50-100% of planning area

Significance (your subjective opinion)

Low, Medium, High

5

WORKSHEET #2: HISTORIC HAZARD EVENT

Name of Department/Jurisdiction:____

Please fill out one sheet for each significant hazard event with as much detail as possible. Attach supporting documentation, photocopies of newspaper articles, or other original sources.

Type of event	
Nature and magnitude of event	
Location	
Date of event	
Injuries	
Deaths	
Property damage	
Infrastructure damage	
Crop damage	
Business/economic impacts	
Road/school/other closures	
Other damage	
Insured losses	
Federal/state disaster relief funding	
Opinion on likelihood of occurring again	
Source of information	
Comments	

Prepared by: ______________________________
Phone: ________________________________
Email: _______________________________
Date:__________________________________

Please return worksheets by mail, email, or fax to:
Jeanine Foster, AMEC Earth & Environmental
1002 Walnut Street, Suite 200
Boulder, CO 80302
fax: (303) 442-0616
email: jeanine.foster@amec.com

6

WORKSHEET #3: VULNERABILITY ASSESSMENT

Name of Department/Jurisdiction:____

Use the table on the next page to compile a detailed inventory of specific assets at risk including critical facilities and infrastructure; natural, cultural, and historical assets; and economic assets as defined below. In the hazard specific column of the asset inventory table, indicate if there is a specific hazard to which the asset is at risk.

Critical Facilities

State of Mississippi, Standard Mitigation Plan: Critical Facilities Definition

The State of Mississippi developed the following definitions for Critical Facilities and Critical Infrastructure, with guidance from FEMA publication 386-2 and 42 U.S.C. 5195c. The intention of these definitions was to aid in the assessment of the vulnerability and operational necessity of facilities and systems within the state during the occurrence of a hazard event.

A Critical Facility is defined as any structure that provides or houses critical services necessary to ensure the health and welfare of the population following a natural or man-made hazard event, including any facilities designated by local governments in their Hazard Mitigation Plan. Types of critical facilities are presented in detail in the chart that follows at the end of this document (Attachment A.)

Critical Infrastructure is defined as systems so vital to the State of Mississippi that the incapacity of those systems would have a debilitating impact on security, economics, public health, safety, or any combination of those factors, including any infrastructure designated by local governments in their Hazard Mitigation Plan. Types of critical infrastructure are presented in the chars that follows at the end of this document (Attachment A.)

The critical facilities identified by Waveland in their 2006 LHMP Update are included as Attachment B to this document.

Natural, Cultural, and Historical Assets

Natural resource assets may include wetlands, threatened and endangered species, or other environmentally sensitive areas. Historical assets include state and federally listed historic sites.

Economic Assets

Economic assets at risk may include major employers or primary economic sectors, such as agriculture, whose losses or inoperability would have severe impacts on the community and its ability to recover from disaster.

7

Key Asset Inventory (Critical Facility & Infrastructure)
(Please update the list of Waveland critical facilities identified on the Previous Page)

Name of Asset	Facility Type	Facility Address	Replacement Value	Hazard Info

8

Additional Hazard, Risk, and Vulnerability Questions

Localized/Stormwater Flooding

1. Please describe the localized/stormwater flood issue specific to your jurisdiction in paragraph form. In addition, please complete a table similar to the below example detailing types and location of localized/stormwater flooding problems. If available, also attach a map of problem areas.

EXAMPLE TABLE

AMADOR COUNTY HAZARD EVENT MAP
ROAD LIST OF PROBLEM AREA REOCCURANCES

No.	Road Name	Usual Problems: Flooding	Pavement Deterioration	Washouts	High Water/ Creek Crossing	Landslides /Mudslides	Debris	Downed Trees
1	Latrobe Rd.					X		
2	Old Sacramento Rd.	X	X					
3	Spring Valley Rd.	X	X					
4	Fiddletown Rd.	X	X					
5	Quartz Mtn East	X		X	X			
6	Quartz Mtn No.	X		X	X			
7	New Chicago Rd.	X		X	X			
8	Vaira Ranch Rd	X		X	X			
9	Tonzi Rd.	X		X	X			
10	Barney Rd.	X	X					
11	Irish Hill Rd.	X	X					
12	Michigan Bar Rd.					X		
13	Carbondale Rd.	X	X					
14	Amador Creek Rd.	X		X				
15	Mayflower Rd.	X		X				
16	Turner Rd.	X		X	X			
17	Stringbean Alley	X		X				
18	Paine Rd.	X		X	X			
19	Sutter-Ione Rd.	X	X					
20	Five Mile Dr.	X	X					
21	W. Marlette	X	X					
22	Cook Rd.	X	X					
23	Old Stockton Rd.	X	X					
24	Martin Ln.	X		X				
25	Jackson Valley Rd.	X	X					
26	Camanche Rd. Brdg						X	
27	Camanche Rd.	X	X					
28	Buena Vista Rd.	X	X					
29	Coal Mine Rd.	X		X	X			
30	Curran Rd.	X	X					
31	Camanche Pkwy No.		X			X		
32	Maxwell Rd.	X	X					
33	Bell Rd.	X	X					
34	Ostrom Rd.	X	X					
35	Shakeridge Rd.					X		
36	Hale Rd.	X			X			
37	Charleston Rd.					X		
38	Rams Horn Grade					X		
39	Sutter Creek Rd.	X	X		X	X	X	
40	Pine Grove/Volcano Rd.	X					X	
41	Climax Rd.					X		
42	New York Ranch Rd.	X						
43	Argonaut Ln.	X	X					
44	Clinton Rd.				X			
45	Butte Mtn. Rd.				X			
46	Middle Bar Rd.					X		X
47	Electra Rd.				X	X		
48	West Lake Road							X
49	Kit Carson Rd.			X				

9

Special Populations

1. Describe any hazard-related concerns or issues regarding the vulnerability of special needs populations, such as the elderly, disabled, low-income, or migrant farm workers.

Development Trends

1. Describe development trends and expected growth areas and how they relate to hazard areas and vulnerability concerns/issues. Please provide zoning maps and maps and tables detailing areas targeted for future development within your jurisdiction.

Prepared by: ______________________________
Phone: ______________________________
Email: ______________________________
Date: ______________________________

Please return worksheets by mail, email, or fax to:
Jeanine Foster, AMEC Earth & Environmental
1002 Walnut Street, Suite 200
Boulder, CO 80302
fax: (303) 442-0616
email: jeanine.foster@amec.com

10

WORKSHEET #4: MITIGATION CAPABILITY ASSESSMENT

Name of Department/Jurisdiction: ____

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities.

Regulatory

The following planning and land management tools are typically used by local jurisdictions to implement hazard mitigation activities. Please indicate which of the following your jurisdiction has in place. If your jurisdiction does not have this capability or authority, please indicate in the comments column if a higher level of government has the authority. ***Also use the comments column to indicate how we can obtain a copy of the plan or document (i.e. available on the web, will put on ftp, will email or mail).***

Regulatory Tool (ordinances, codes, plans)	Y/N	Date	Comments
General plan			
Zoning ordinance			
Subdivision ordinance			
Growth management ordinance			
Floodplain ordinance			
Other special purpose ordinance (stormwater, steep slope, wildfire)			
Building code			Version:
BCEGS Rating			
Fire department ISO rating			Rating:
Erosion or sediment control program			
Stormwater management program			
Site plan review requirements			
Capital improvements plan			
Economic development plan			
Local emergency operations plan			
Community Wildfire Protection Plans			

11

Regulatory Tool (ordinances, codes, plans)	Y/N	Date	Comments
Flood insurance study or other engineering study for streams			
Repetitive Loss Plan			
Elevation certificates			
Other			

Administrative/Technical

Identify the technical and personnel resources responsible for activities related to hazard mitigation/loss prevention within your jurisdiction. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level government that can provide technical assistance, please indicate so in the comments column.

Personnel Resources	Yes/No	Department/Position	Comments
Planner/Engineer with knowledge of land development/land management practices			
Engineer/Professional trained in construction practices related to buildings and/or infrastructure			
Planner/Engineer/Scientist with an understanding of natural hazards			
Personnel skilled in GIS			
Full time building official			
Floodplain Manager			
Emergency Manager			
Grant writer			
Other personnel			
GIS Data – Hazard areas			
GIS Data - Critical facilities			
GIS Data – Building footprints			

12

Personnel Resources	Yes/No	Department/Position	Comments
GIS Data – Land use			
GIS Data – Links to Assessor's data			
Warning Systems/Services (Reverse 9-11, cable override, outdoor warning signals)			
Other			

Fiscal

Identify whether your jurisdiction has access to or is eligible to use the following financial resources for hazard mitigation

Financial Resources	Accessible/Eligible to Use (Y/N)	Comments
Community Development Block Grants		
Capital improvements project funding		
Authority to levy taxes for specific purposes		
Fees for water, sewer, gas, or electric services		
Impact fees for new development		
Incur debt through general obligation bonds		
Incur debt through special tax bonds		
Incur debt through private activities		
Withhold spending in hazard prone areas		
Other		

Additional Capabilities Questions

1. Does your community have any hazard-related certifications, such as Storm Ready certification?

13

2. List any past or ongoing public education or information programs, such as for responsible water use, flood and hurricane safety, household preparedness, or environmental education.

3. **By hazard, list any other past or ongoing mitigation projects or programs designed to reduce disaster losses.** These may include projects to protect critical facilities.

Prepared by: ______________________
Phone: ______________________
Email: ______________________
Date: ______________________

Please return worksheets by mail, email, or fax to:
Jeanine Foster, AMEC Earth & Environmental
1002 Walnut Street, Suite 200
Boulder, CO 80302
fax: (303) 442-0616
email: jeanine.foster@amec.com

14

Mitigation Action Worksheet

Instructions: Use this guide to record potential mitigation projects (1 page per project) identified during the planning process. Provide as much detail as possible and use additional pages as necessary. These will be collected following HMPC meetings on mitigation goals and measures and included in the plan.

Jurisdiction:

Mitigation Project Title:

Hazards Addressed:

Issue/Background:

Other Alternatives:

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office:

Priority (H, M, L):

Cost Estimate:

Benefits (Losses Avoided):

Potential Funding:

Schedule:

Worksheet Completed by:
Name and Title:
Phone:

15

Mitigation Action Worksheet - EXAMPLE

Action #12: Elevate Remaining 95 Homes in the Dry Creek Watershed

Hazards Addressed: Flood

Issue/Background: Historically, flooding in the Dry Creek watershed has been a major concern. The February 1986 flood caused widespread damage in most of the Dry Creek watershed. Nearly all bridges and culverts were overtopped, with 30 sustaining embankment damages and one crossing washing out; two bridges over Dry Creek were damaged, street cave-ins occurred at a number of locations, and over 125 homes flooded. Of the 145 homes subject to historical flooding within the Watershed, 95 structures remain non-elevated. Of these 95 remaining homes, 25-30 declined initial grant money for elevation as did the three repetitive loss structures. Placer County is not only concerned with existing flooding problems, but with future problems resulting from increased growth and development in the area. According to the 1992 Dry Creek Watershed, Flood Control Plan, substantial flood damages will occur with the 100-year flood under existing conditions. Areas with the most extensive and frequent damages include areas in the location of the 95 homes. The report indicates that some of these areas are susceptible to flooding from storms as frequent as the 10-year storm. Elevating the remaining 95 homes will reduce future flood-related losses.

Other Alternatives: No Action, Acquire homes, mitigation reconstruction

Existing Planning Mechanism(s) through which Action Will Be Implemented: Implemented through the County's CRS Repetitive Loss (RL) program.

Responsible Office: Placer County Flood Control and Water Conservation District, in conjunction with its member agencies including the cities of Rocklin, Loomis, and Roseville.

Priority (H, M, L): Medium

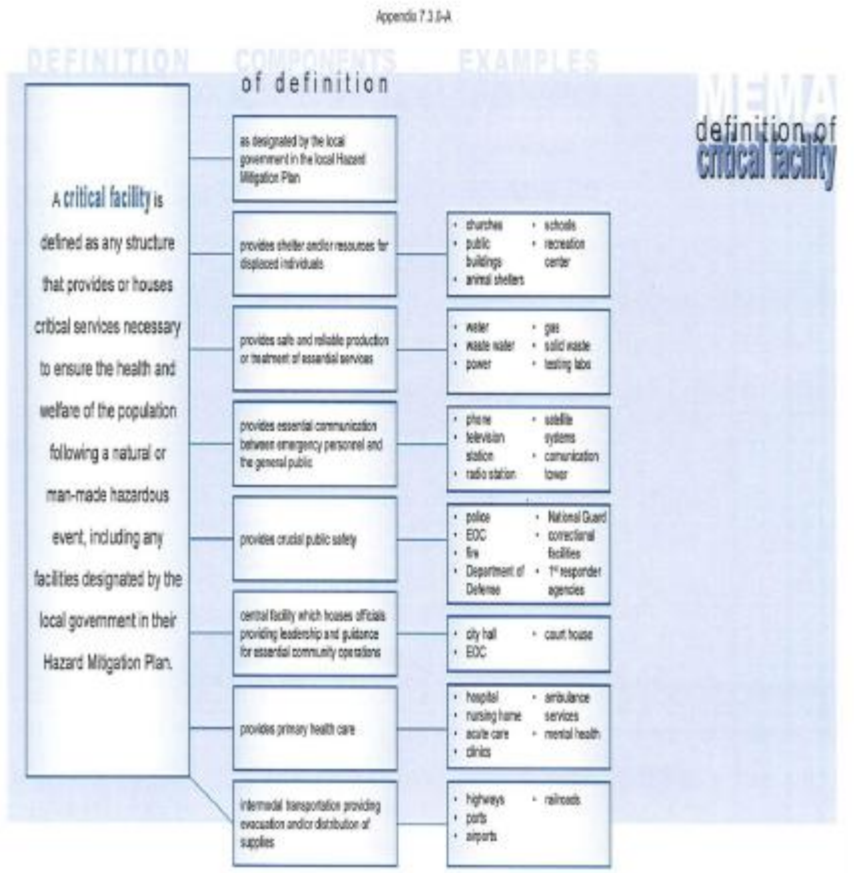
Cost Estimate: The cost to elevate is estimated at $40 per square foot. Homes need to be elevated anywhere from one to six feet. Of the 95 homes where elevating is feasible, it is estimated to cost $6 million or $50 to $60 K per home.

Benefits (Losses Avoided): Life Safety; Reduction in Property Loss.

Potential Funding: HGMP, PDM, Dry Creek Trust Fund

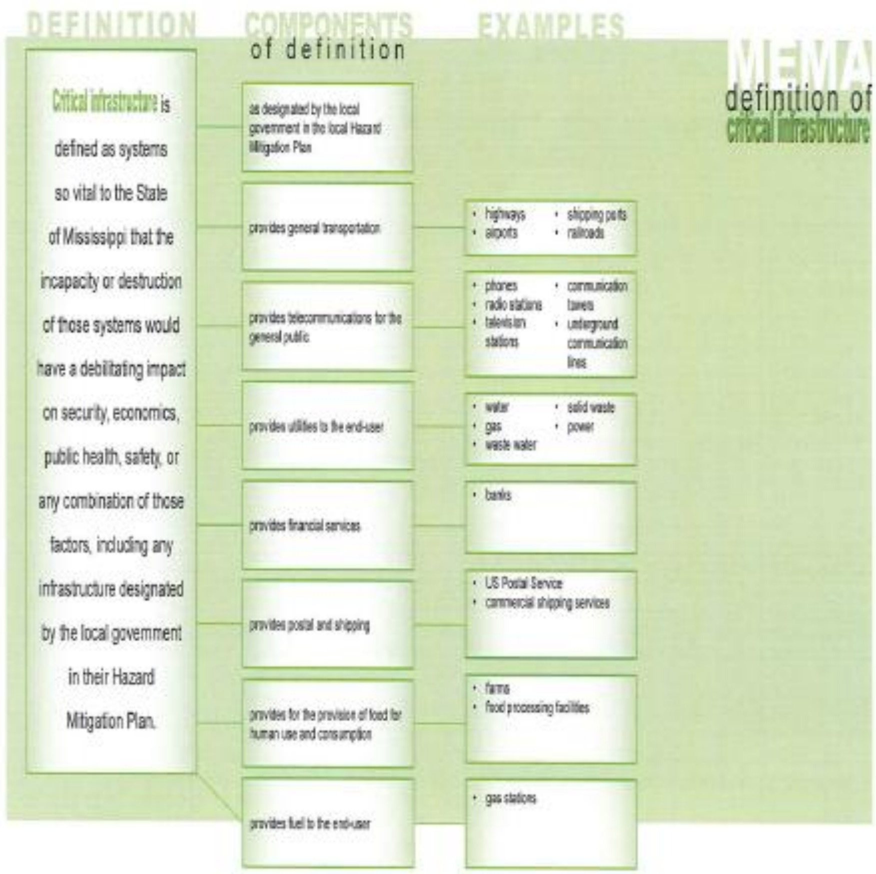
Schedule: Within three years

Attachment A.



17

APPENDIX 7.3.3-B



18

Attachment B.

City of Waveland Critical Facilities, 2006 LHMP

Waveland's officials have prepared the following list and description of critical facilities. These facilities are considered critical because they are used for operation of government, public safety, or concentrations of populations such as children, elderly, or lower-income persons/families.

- City Hall—Waveland's City Hall was located at 301 Coleman Avenue in a historic, two-story masonry and wood structure, approximately two blocks north of the beach. The building housed the offices of the Mayor, City Clerk, Purchasing Clerk, Public Works, and Building Permitting and was not located in an SFHA. The building was totally destroyed by the storm surge and wave action of Hurricane Katrina, which left only the steps, part of the mosaic mural, and the historic marker. City offices have been relocated to a group of mobile structures located on the west corner of Coleman Avenue and Central. The city intends to rebuild the City Hall and Annex at the site of the old City Hall. The building will be elevated with a foundation engineered to withstand wave and storm surge action and hurricane force winds. Design of the new structure is currently underway. The new City Hall and Annex will anchor the southern boundary of the proposed new central business district for the redeveloped Waveland.
- City Hall Annex—The City Hall Annex was located at 307 Coleman Avenue adjacent to the City Hall, approximately two blocks north of the beach. The single story, store-front building housed the 911 Coordinator's office and the room used for meetings of the Board of Aldermen and other public meetings. The building was not located in an SFHA but was totally destroyed by the storm surge and wave action of Hurricane Katrina. Waveland expects to locate the Annex immediately adjacent to the new City Hall. The building will be elevated and strengthened to withstand storm surge action and hurricane force winds. The City Hall and Annex will anchor the southern boundary of the proposed new central business district for the redeveloped Waveland.
- Fire Station No. 1—This building was located in a pre-engineered metal building on Bourgeois Street immediately west of City Hall, approximately two blocks from the beach. The building was not located in an SFHA, but was totally destroyed by the surge and wave action of Hurricane Katrina. All living and interior space in the reconstructed station will be elevated above the surge zone of Hurricane Katrina with equipment bays located beneath. The foundation of the new station will be engineered to withstand storm surge and flooding and wind resistant building techniques will be considered in design of the structure. It is still expected that the building will be evacuated and all equipment moved to higher ground in the event of a major hurricane, but it is hoped that the new building will withstand the wind and flooding of storms and be back in use quickly after future events.
- Fire Station No. 2—Located on Gulfside Drive, approximately 1.5 miles north of the beach, the pre-engineered metal building was constructed in 1977. This building is the central fire station housing the Chief's office and most the city's inventory of

firefighting and emergency response equipment. It also served as the city's Emergency Operations Center (EOC) during emergencies. Station No. 2 was not located in an SFHA, but was severely damaged by Katrina's storm surge, which destroyed all of the firefighting and emergency response equipment. Emergency personnel housed during the storm were forced to evacuate to a nearby two-story building to survive. Initially, FEMA Public Assistance investigators found that the building was not substantially damaged; however, in the year and a half since the storm, the building has continued to deteriorate, and it is now felt that the building should be considered more than 50 percent damaged.

- Police Department—Located on U.S. Highway 90 in a prefabricated metal building constructed in 1987, the police department was not located in an SFHA, but was completely destroyed by Katrina storm surge. All police records, equipment, and vehicles were destroyed. Personnel were forced to evacuate the building as the water rose and some survived by clinging to a tree near the building.
- Wastewater Treatment—Located on Gulfside Drive across the street from Fire Station No. 2, this facility was not located in an SFHA, but received major damage from the storm surge of Katrina, which knocked it offline for several weeks. Temporary repairs have been made and the facility is operational and awaiting permanent repairs. This is a regional treatment plant that receives and treats all of the effluent from homes and businesses in the southern part of Hancock County, including Waveland and Bay St. Louis.
- City Maintenance Yard—Located at 318 Gulfside Drive, this facility is the major storage site for vehicles and equipment used for day-to-day maintenance of the city's public infrastructure. The pre-engineered metal building housed the vehicle maintenance shop and reporting area for Public Works employees. The site was not located in an SFHA, but received major damage from the storm surge of Katrina. Additionally, all of the heavy equipment used for maintenance of the city's infrastructure was flooded and destroyed except for one back hoe.
- Water Wells—There are four water wells with chlorination systems at the following locations: Gulfside Drive, Faith Street, Davis Street, and Tide Street. None of these wells are located in an SFHA. Elevated water storage tanks are located at the Faith Street and Davis Street sites. The controls of all of these facilities were flooded and severely damaged but have been temporarily repaired and are back on line, but permanent repairs are still pending, including FEMA Public Assistance and Hazard Mitigation Grant Program mitigation.
- Public Library—Located on Coleman Avenue a block south of the railroad, the library was not located in an SFHA. The storm surge and wave action of Hurricane Katrina completely destroyed the Waveland Library.
- Waveland Elementary School—The only public school in Waveland is on St. Joseph Street and pre-Katrina accommodated a daily average of 450 kindergarten through third-grade children, teachers, and administrative staff. This facility was not located in an SFHA, but received severe damage from Hurricane Katrina. The building is being

rebuilt, partial demolition was required. Waveland Elementary students are presently being schooled in temporary classrooms.

- St. Clare School—This school was owned and operated by the Catholic Diocese of Biloxi and located adjacent to St. Clare Catholic Church on West Beach Boulevard in the western area of Waveland. Pre-Katrina, the average enrollment was 250 pre-kindergarten through sixth grade children. The school and church were completely destroyed by the storm surge and wave action of Hurricane Katrina. It is doubtful that the school with be rebuilt in Waveland; it will likely merge with the parochial school in Bay St. Louis to create one campus in a less vulnerable place.
- Southern Mississippi Regional Center—This residential facility on McLaurin Street housed 18 mentally challenged residents full time with 12 employees. It was not located in an SFHA, but experienced several feet of storm surge flooding from Katrina. The South Mississippi Regional Center has moved its staff and residents to their facility in Long Beach and at present does not intend to reoccupy the Waveland site. Since the location is one of the highest points in its corporate limits, Waveland is considering purchasing the six acres for the reconstructed police station.
- Hope Haven Shelter—This 24-hour, residential facility for neglected and abused children, was located on Herlihy Street. Pre-Katrina, there were five young children living at the facility with five employees. Not located in an SFHA, this facility sustained damage from Katrina's storm surge. The children housed in this facility had to be removed until damage could be repaired, but they have since returned.
- Housing Authority—Pre-Katrina, there were three public housing communities for elderly and lower income residents in Waveland: Herlihy Street with 48 units housing 74 elderly, handicapped, and/or very low income residents; Rue De LaSalle with 14 units housing 45 elderly, handicapped, and/or very low income residents; and Old Spanish Trail with 13 units housing 41 elderly, handicapped, and/or very low-income residents. The Herlihy Street and Old Spanish Trail properties were not located in SFHAs; the Rue De LaSalle property was partially located in an SFHA. All of Waveland's public housing stock was totally destroyed by Katrina's storm surge. Compounding the problem is the fact that the usual federal public housing assistance for rebuilding these facilities has not been forthcoming, leaving former residents no permanent option for returning to Waveland to live. The city and its Housing Authority are seeking funding from several sources to rebuild housing for these neediest of people.
- Gulfside Assembly—This religious conference and retreat facility was located on Beach Boulevard and housed up to several hundred young people and adults for special events and meetings. It was located in an SFHA and was totally destroyed by the storm surge, wind, and wave action of Hurricane Katrina. Privately owned, it is uncertain whether or to what extent this facility will rebuild.

B.2 Step 2: Involve the Public

CAN WE GET A COPY OF THE PUBLIC MEETING ARTICLE?

Public Meeting Notices for Kickoff Meeting

SATURDAY, NOVEMBER 3, 2012 • 3A

ebuts in the Bay

Public Notice

The city of Waveland is conducting a public meeting to discuss the development of the 2012 update to Waveland's Local Hazard Mitigation Plan

The public is encouraged to attend this meeting to learn about the planning process and to provide input. This plan update is required by FEMA's Disaster Mitigation Act of 2000 to maintain eligibility for future federal disaster funding. The meeting will be Nov. 7 at 6 p.m. at the Waveland Civic Center, 335 Coleman Ave Waveland.

World Hunger Festival

Boys & Girls Clubs of the Gulf Coast and Pizza Hut will host the World Hunger Festival today, 10 a.m.-6 p.m., at 310 Old Spanish Trail in Bay St. Louis. Food and other items available for purchase to benefit the World Hungry Relief Fund. Pizza, bake sale, face painting, bows & ribbons, $5 hair cuts, plant sale, hot dogs, cotton candy &

...apland said that he ...oted to pull to the ... was also taken to the hospital for a urine test, per department regulations. ... Shapland was not injured during the crash, De Nardo said.

...leritage Fest is today: ...l & Blues Experience'

...r stage all day and ...e night. ...St. Rose home ...ng is renowned ...hout the coast! Don't ...he great menus that ...Craig Saucier, and the ... fine cooks of St. ...De Lima Parish have ...ed for a weekend of ...ating. ...uth-watering tender ...erved with baked ... slaw and bread; ... burgers and hot ...Fried Chicken Plates; ...smoked pulled pork ...iches; red beans and ...jambalaya; chicken ...usage gumbo; boiled ...- with cob corn and ...otatoes; fried shrimp ... sides. Look for the famous St. Rose home baked desserts, plus cold beer, soft drinks, snowballs, and popcorn. The children will also be busy all day at the Heritage Festival enjoying the new and vintage activities in the First Heritage Park. * Face Painting * Sack Races * Musical Chairs * Coloring Booth * Basketball Throws*Family Jail * Ring Toss * Beanbag Throws * Children's Talent Show –all with prizes, treats, and games.

The fun and excitement and food and entertainment will be going on all day from 11 a.m. until 11 p.m. - complete with big raffles, ... even a "Little Miss and Mr. St. Rose Pageant."

Saints Style Lounge Monday

The NFL will unveil a Saints Style Lounge, a pop-up boutique to celebrate female fans. The lounge will be open to the public from 4-6:45 p.m. and accessible to ticket holders only from 7-9:30 p.m on Monday, at the Mercedes-Benz Superdome.

PUBLIC NOTICE

The City of Waveland
Is conducting a
Public Meeting to discuss
development of the
2012 Update to Waveland's
Local Hazard Mitigation Plan

Meeting will be
November 7, 2012
at 6:00 PM

Waveland Civic Center
335 Coleman Ave., Waveland

The Hancock County Democrats urge you to ...

On Air Radio Interview (WQRZ) Inviting Public Participation

PLAN PRESENTATION

MEETING RECORD

Client:	Contact Name: Brice Phillips	Date: 3-7-13
Project:	Contact Organization: WQRZ	Subject: LHMP
Project #:	Contact Phone #: 463-1035	

Meeting Attendees: WQRZ Radio Station

Items Discussed: On Air Interview About Hazard Mitigation Plan.

Advised Listeners that Waveland was in the Process of updating the Hazard Mitigation Plan And that we wanted suggestions & Comments on the update. Also Advised them that the Draft Plan is on the City website for viewing And that a public meeting will be on 3-18-13 At the Fire Station for Comments.

Follow-up:

By:
Name: Mike Smith
Organization: Waveland Fire
3-7-13

Public Meeting with Firefighting Staff

amec

MEETING RECORD

Client:	Contact Name:	Date:
Project:	Contact Organization:	Subject:
Project #:	Contact Phone #:	

Meeting Attendees: Waveland Firefighters
See Attached

Items Discussed: Had a staff meeting with firefighters and discussed the plan update and how the plan can be viewed and commented on

Follow-up:

By:
Name: Mike Smith
Organization: Waveland Fire
3-8-13

TRAINING RECORD

Date: 3-7-13 Class Number: ______

Type of Training: Hazard Mitigation

Time started: 1700 Time ended: 1800 Total: 1 Hrs 0 Min

Class location: WFD Central Station

Equipment used: WAVELAND'S DRAFT HAZARD MITIGATION PLAN WAS INTRODUCED & WAYS TO COMMENT ON SUGGESTIONS

Training Officer(s): M. SMITH

Number of Waveland Firefighters attending: ______

Number of Personnel attending from other departments: ______

Name	Department	Name	Department
Tommy Carter	WFD		
Norman Landry	WFD		
[illegible]	WFD		
Tim Burkett	WFD		
JAMES Butcher	WFD		
[illegible]	WFD		
KENT CUEVAS	WFD		
Justin Fayard	WFD		
Casey P. [illegible]	WFD		
Daniel [illegible]	WFD		
[illegible]	WFD		

This is to certify the above class has been held through the Waveland Fire Department.

MIKE SMITH 03-07-13

Training Officer Date

FORM 4/87.10

Public Meeting with National Weather Service

amec

MEETING RECORD

Client:	**Contact Name:** NAtioNAl weAther	**Date:**
Project:	**Contact Organization:** Storm Ready	**Subject:** Sky warn
Project #:	**Contact Phone #:**	

Meeting Attendees: SEE Attached

Items Discussed: Advised AttendEES About the LHmp update. How they Could View And make Comments And Suggestions on the plan. Handed out flyers About the planning Process

Follow-up:

By:
Name: Mike Smith
Organization: WAveland Fire
3-7-13

National Weather Service
New Orleans/Baton Rouge
Severe Weather Spotter Sign Up

Location Waveland, MS

Date 3/7/13

Name	Location - City Parish	Affiliation (EM, S.O., Fire Dept)	HAM Call Sign	Initial or Refresher Course
Example - Joe Thunderstorm	*5 mi NW of Amite, Tangipahoa Parish, LA*	*None*		*Refresher Course, last course in McComb 2008*
Stephanie Chapton	(Carriere) Pearl River County, MS			Initial
Michael J. McClain	HARRISON Co. LONG BEACH, MS.	NONE		INITIAL
SKIP GIFFIN	Harrison & Hancock Counties	Han. Pol VFD		Initial
JAMES BURCHER	WAVELAND FIRE HANCOCK	WFD		
Tim Burchett	WFD	WFD		Refresher
Pat Torrez				
Norman Loustalot	WFD	WFD		Initial
Tommy Carr	WFD	WFD		Refresher

National Weather Service
New Orleans/Baton Rouge
Severe Weather Spotter Sign Up

Location Waveland, MS

Date 3-7-13

Name	Location - City Parish	Affiliation (EM, S.O., Fire Dept)	HAM Call Sign	Initial or Refresher Course
Example - Joe Thunderstorm	5 mi NW of Amite, Tangipahoa Parish, LA	None		Refresher Course, last course in McComb 2008
Mike Many	WFD	WFD		Refresher w/ I
Tony Mallini	WFD	WFD		[illegible]
Casey Piazza	WFD			[illegible]
[illegible]	City of Waveland	Mayor		[illegible]
Justin Fayard	WFD	WFD		
Kent Cuevas	WFD	WFD		[illegible] (Refresher)
Don Peters	WFD	WFD		Refresher
Mike Smith	Waveland Fire	Fire Chief		Refresher

B.3 Step 3: Coordinate

This planning step credits incorporating other plans and other agencies' efforts into the floodplain management plan. Other agencies and organizations must be contacted to determine if they have studies, plans and information pertinent to the floodplain management plan, to determine if their programs or initiatives may affect the community's program, and to see if they could support the community's efforts. Invitation letters were sent to other agencies and are included below.

Table B.2. List of Agency Invites and How Contacted

Agency Name/ Contact	Contacted via Mail	Contacted via Phone	Contacted Face-to Face	Topics Discussed
FEMA Region IV Dave Spearret	X			Invitation to participate in LHMP update
Hancock County School District Adam Dedeaux	X			Invitation to participate in LHMP update
Red Cross- Waveland Joshua Joachim	X			Invitation to participate in LHMP update
Bay Waveland School District Dr. Rebecca Ladner	X			Invitation to participate in LHMP update
National Weather Service Frank Ravette	X			Invitation to participate in LHMP update
Gulf Regional Planning Agency Elaine Wilkinson	X			Invitation to participate in LHMP update
MS State NFIP Coordinator	X			Invitation to participate in LHMP update
MEMA Jana Henderson	X			Invitation to participate in LHMP update
John Evans	X			Invitation to participate in LHMP update
Gulf Coast Research Lab Tracie Sempier	X			Invitation to participate in LHMP update
Pearl River Basin Development Commission Mike Davis	X			Invitation to participate in LHMP update
Brian Adam	X			Invitation to participate in LHMP update

Agency Name/ Contact	Contacted via Mail	Contacted via Phone	Contacted Face-to Face	Topics Discussed
Hancock Development Commission Steve Landry	X			Invitation to participate in LHMP update
City of Bay St. Louis Joshua Hayes	X			Invitation to participate in LHMP update
Hancock County Anthony Cuevas	X			Invitation to participate in LHMP update
Hancock Board Of Supervisors David Yarborough	X			Invitation to participate in LHMP update
Hancock Board Of Supervisors Kenny Hoda	X			Invitation to participate in LHMP update
Hancock Board Of Supervisors Steve Seymour	X			Invitation to participate in LHMP update
Hancock Board Of Supervisors Tony Ladner				Invitation to participate in LHMP update
Hancock Board Of Supervisors Lisa Cowand				Invitation to participate in LHMP update
NOAA Gwen Shoughnessy			X	Climate Adaptation
Grand Bay National Estuarine Reserve Larissa Graham			X	Climate Adaptation Invite to mitigation action meeting
NOAA GIS James Brinckley			X	Discussed status of models used to approximate sea level rise in Waveland
USACE Thomas Smith			X	Discussed the MsCIP plan and what impact it may have on Waveland
NOAA Coastal Management Christa Rabenold			X	Coordinated literature for sea level rise hazard
Hancock County Emergency Management John Albert			X	Discussed data needs and input from County on City plan

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Dave Spearrett
FEMA Region IV
1800 South Bell Street
Arlington, VA 20598

Dear Mr. Spearrett:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

If your organization has any information or data relating to the natural hazards affecting Waveland such as stormwater flooding, coastal flooding, severe storms, etc., the City would appreciate your input into the planning process and the updating of their hazard identification, risk assessment, and mitigation strategy portions of the plan.

If your organization has any ongoing programs or plans that may impact the City, or affect flooding, or other natural hazards within Waveland, or properties in floodprone areas, your coordination and participation would be appreciated.

If your organization would like an opportunity to participate in the planning process or if you have any questions please contact Chief Mike Smith or Patrick Moore.

Chief Mike Smith
City of Waveland
427 Highway 90
Waveland, MS 39576
228-467-2042
email: fireman39576@att.net

Patrick Moore
AMEC Environmental & Infrastructure
13109 Shriners Blvd., Unit E
Biloxi, MS 39532
228-327-5166
email: patrick.w.moore@amec.com

All upcoming Hazard Mitigation Planning Committee (HMPC) meetings will be advertised in the Sea Coast Echo newspaper or you may contact Chief Smith at 228-467-2042 for further information about the plan update process.

Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

USA Justice FOREVER

Dave Spearits
FEMA Region IV
1800 South Bell St.
Arlington, VA 20598

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Adam Dedeaux
Hancock County School District
17034 Highway 603
Kiln, MS 39556

Dear Mr. Dedeaux:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

Justice
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WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

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Hancock County School District
17034 Highway 603
Kiln, MS 39556

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

Adam Dedeaux
Hancock County School District
17034 Hwy 603
Kiln, MS 39556

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Joshaua Joachim
Red-Cross - Waveland
2782 Fernwood Rd.
Biloxi, MS 39531

Dear Joshaua:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

Joshaua Joachim
Red Cross Waveland
2782 Fernwood Road
Biloxi, MS 39531

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Dr. Rebecca Ladner
Bay Waveland School District
201 Carroll Ave.
Bay St. Louis, MS 39520

Dear Dr. Ladner:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

MiKE Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

Equality
FOREVER
USA
Dr. Rebecca Ladner
Bay-Waveland School District
201 Carroll Ave
Bay St. Louis, MS 39520
WAVELAND

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Frank Ravette
National Weather Service (New Orleans/ Baton Rouge)
62300 Airport Rd.
Slidell, LA 70460

Dear Mr. Ravette:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604


WAVELAND
Freedom
FOREVER
Frank Revitte
National Weather Service (N.O./Baton Rouge)
62300 Airport Rd.
Slidell, La

Charles M. Smith, Fire Chief

January 16, 2013

Elaine Wilkinson
Gulf Regional Planning Agency
1232 Pass Road
Gulfport, MS 30501

Dear Ms. Wilkinson:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

Equality
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Elaine Wilkinson
Gulf Regional Planning Agency
1232 Pass Road
Gulfport, MS
39501

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Mississippi State NFIP Coordinating Office
1410 Riverside Drive
Jackson, MS 39216

To Whom it may concern:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

Mississippi state NFIP Coordinating Office
1410 Riverside Drive
Jackson, MS 39216

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Jana Henderson
Mississippi State Emergency Management Agency
P.O. Box 4501
Jackson, MS 39216

Dear Ms. Henderson:

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If your organization would like an opportunity to participate in the planning process or if you have any questions please contact Chief Mike Smith or Patrick Moore.

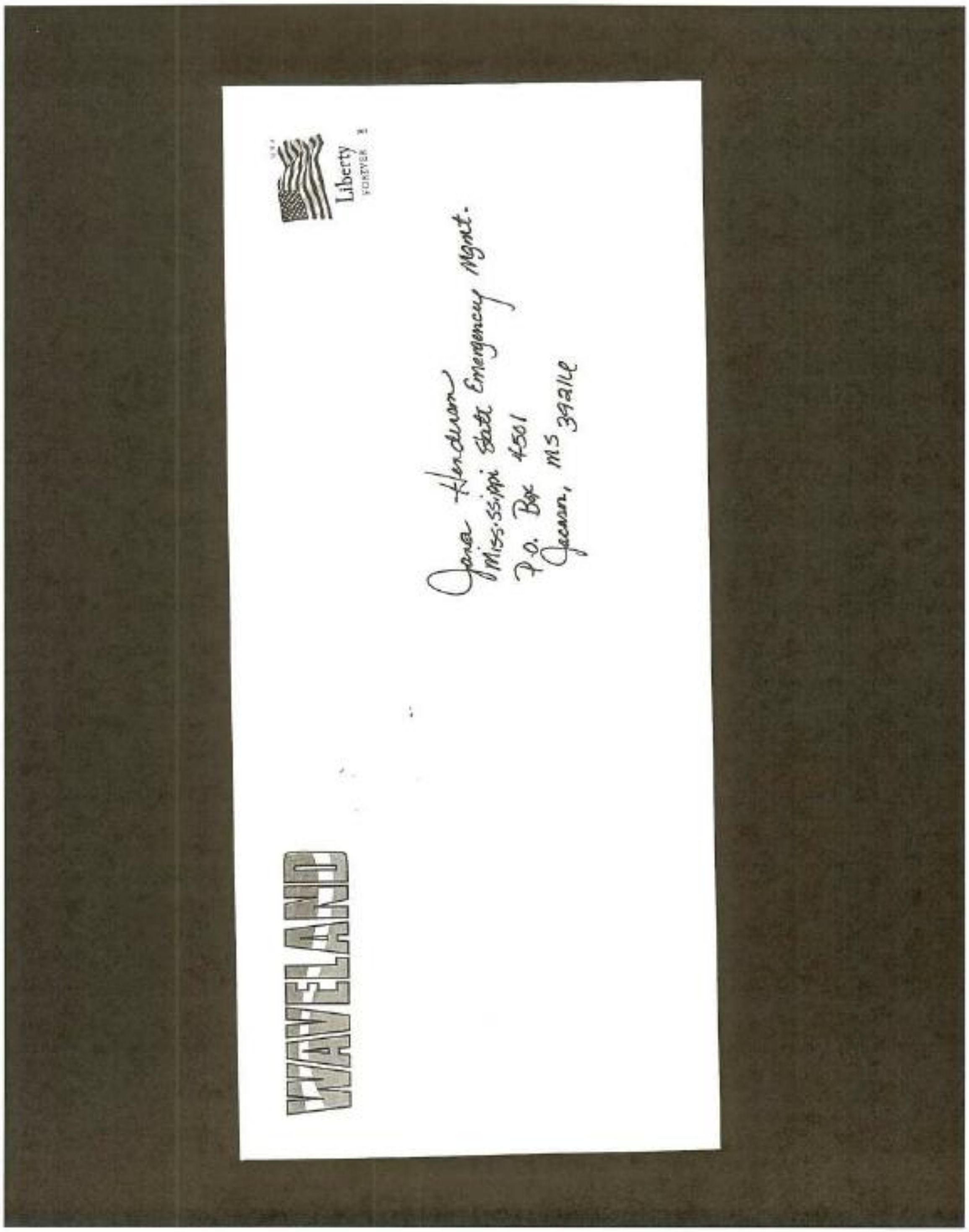
Chief Mike Smith
City of Waveland
427 Highway 90
Waveland, MS 39576
228-467-2042
email: fireman39576@att.net

Patrick Moore
AMEC Environmental & Infrastructure
13109 Shriners Blvd., Unit E
Biloxi, MS 39532
228-327-5166
email: patrick.w.moore@amec.com

All upcoming Hazard Mitigation Planning Committee (HMPC) meetings will be advertised in the Sea Coast Echo newspaper or you may contact Chief Smith at 228-467-2042 for further information about the plan update process.

Regards,
Mike Smith
Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604


Liberty
FOREVER
Jana Henderson
Mississippi State Emergency Mgmt.
P.O. Box 4501
Jackson, MS 39216
WAVELAND

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

John Evans
18333 Hwy 603
Kiln, MS 39556

Dear Mr. Evans:

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WAVELAND

John Evans
18333 Hwy 603
Kiln, MS 39556

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Tracie Sempier
Gulf Coast Research Lab
703 East Beach Drive
Ocean Springs, MS 39564

Dear Mrs. Sempier:

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WAVELAND

Tracie Simpier
Gulf Coast Research Lab
703 East Beach Drive
Ocean Springs, MS
39564

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Mike Davis
Pearl River Basin Development Commission
P.O. Box 5332
Jackson, MS 39296

Dear Mr. Davis:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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WAVELAND

Liberty
FOREVER

Mike Davis
Pearl River Basin Development Commission
P.O. Box 5332
Jackson, MS 39296

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Brian Adam
18333 Hwy 603
Kiln, MS 39556

Dear Mr. Adam:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

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426 Hwy 90 • Waveland, Mississippi 39576
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WAVELAND

Mr. Brian Adam
18333 Hwy 603
Kiln, MS 39556

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Steve Landry
Hancock Development Commission
706 Highway 90
Waveland, MS 39576

Dear Mr. Landry:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

MIKE Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

Waveland Fire Department
426 Hwy 90 • Waveland, Mississippi 39576
228-467-2042 • Fax 228-466-2604

WAVELAND

Steve Landry
Hancock Development Commission
7016 Hwy 90
Waveland, MS 39576

Charles M. Smith, Fire Chief

January 16, 2013

Josh Hayes
City of Bay St. Louis
302 Highway 90
Bay St. Louis, MS 39520

Dear Mr. Hayes:

The City of Waveland, MS is in the process of updating its Local Hazard Mitigation Plan "LHMP" as a requirement to maintain eligibility for FEMA federal disaster funding and to increase credit in the Community Rating System (CRS) Program. The City would like your participation, knowledge and feedback throughout the planning process to support the development of this LHMP Update for the City.

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Regards,

Mike Smith

Fire Chief Mike Smith
City of Waveland, Mississippi

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228-467-2042 • Fax 228-466-2604

WAVELAND

Freedom
FOREVER

Jack Hayes
City of Bay St. Louis,
302 Hwy 90
Bay St. Louis, MS
39520

WAVELAND

Charles M. Smith, Fire Chief

January 16, 2013

Anthony Cuevas
Hancock County
854 Highway 90
Bay St. Louis, MS 39520

Dear Mr. Cuevas:

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WAVELAND

Anthony Cuevas
Hancock County
854 Highway 90
Bay St. Louis, MS
39520

WAVELAND

David A. Garcia, Mayor, CFM

David Yarborough
Hancock County Board of Supervisors, District 1
854 Highway 90, Suite A
Bay St. Louis, MS 39520

Dear Mr. Yarborough:

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Regards,

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Chief Mike Smith
City of Waveland, Mississippi

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Mark Kidd, Alderman Ward #4 • Lisa B. Planchard, City Clerk • Gary Yarborough, City Attorney
301 Coleman Avenue • Post Office Box 539 • Waveland, Mississippi 39576 • 228-467-4134 • Fax 228-467-3177
mayorsoffice@mchsi.com / w.cityhall@mchsi.com

WAVELAND

David A. Garcia, Mayor, CFM

Kenny Hoda
Hancock County Board of Supervisors, District 2
854 Highway 90, Suite A
Bay St. Louis, MS 39520

Dear Mr. Hoda:

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WAVELAND

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Steve Seymour
Hancock County Board of Supervisors, District 4
854 Highway 90, Suite A
Bay St. Louis, MS 39520

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WAVELAND

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Tony Wayne Ladner
Hancock County Board of Supervisors, District 5
854 Highway 90, Suite A
Bay St. Louis, MS 39520

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WAVELAND

David A. Garcia, Mayor, CFM

Lisa Cowand
Hancock County Board of Supervisors, District 3
854 Highway 90, Suite A
Bay St. Louis, MS 39520

Dear Mrs. Cowand:

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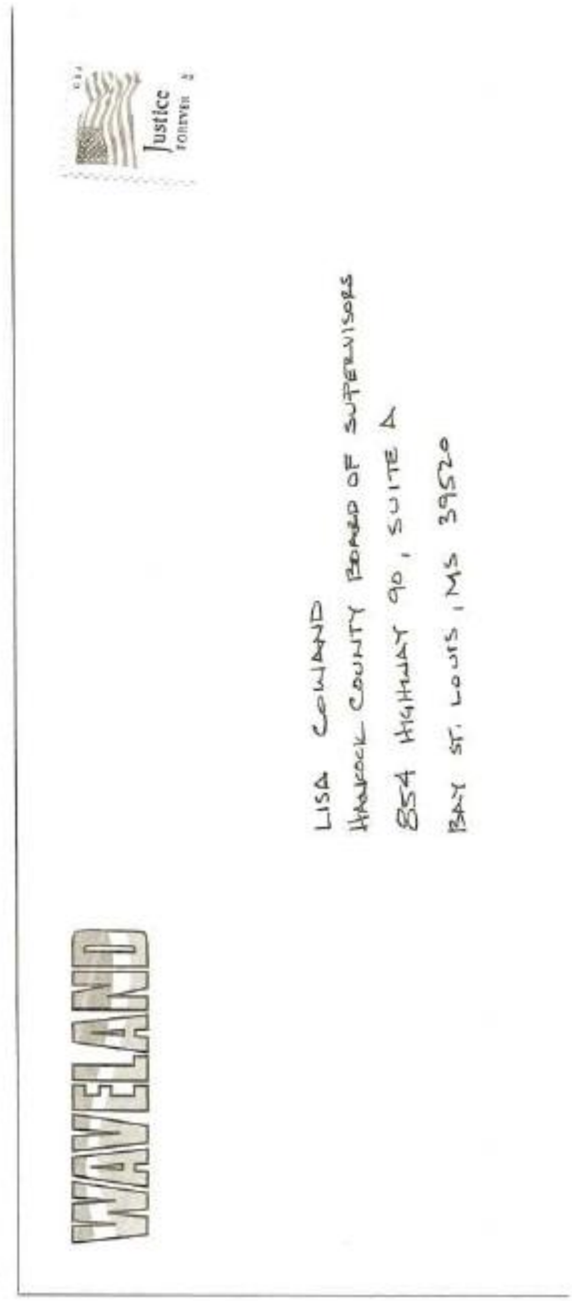
WAVELAND
Liberty FOREVER
TONY WAYNE LADNER
HANCOCK COUNTY BOARD OF SUPERVISORS
854 HIGHWAY 90, SUITE A
BAY ST. LOUIS, MS 39520



WAVELAND
Justice FOREVER
LISA COWAND
HANCOCK COUNTY BOARD OF SUPERVISORS
854 HIGHWAY 90, SUITE A
BAY ST. LOUIS, MS 39520

WAVELAND

Equality FOREVER

KENNY HODA
HANCOCK COUNTY BOARD OF SUPERVISORS
854 HIGHWAY 90, SUITE A
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Freedom FOREVER

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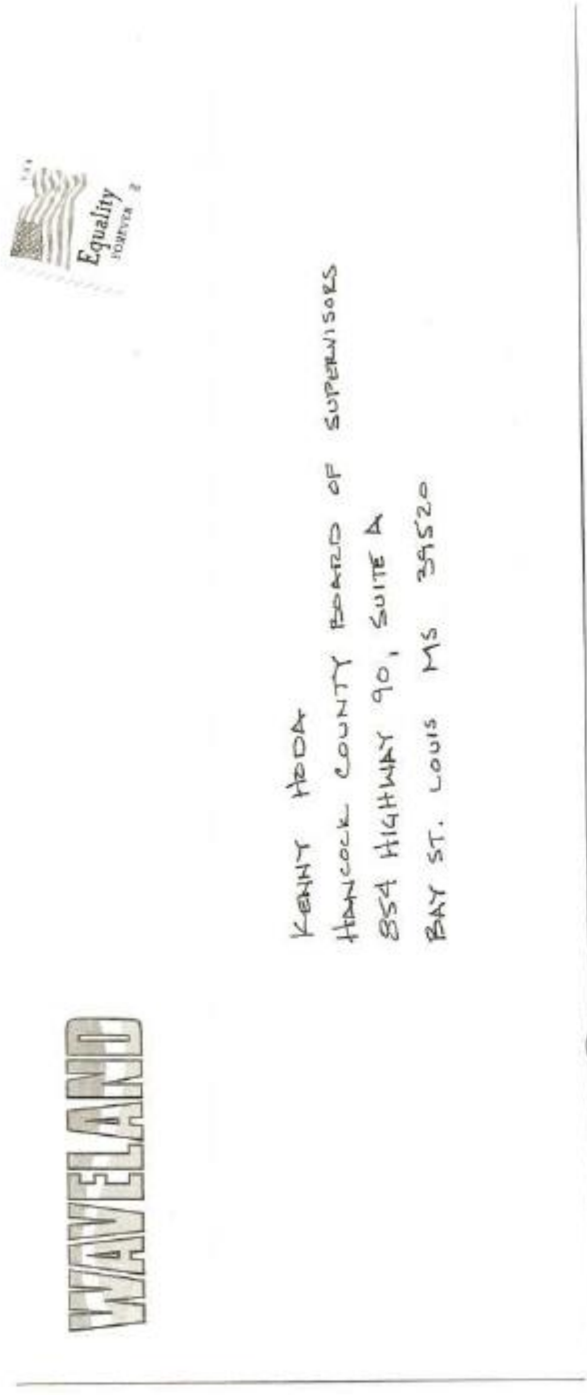
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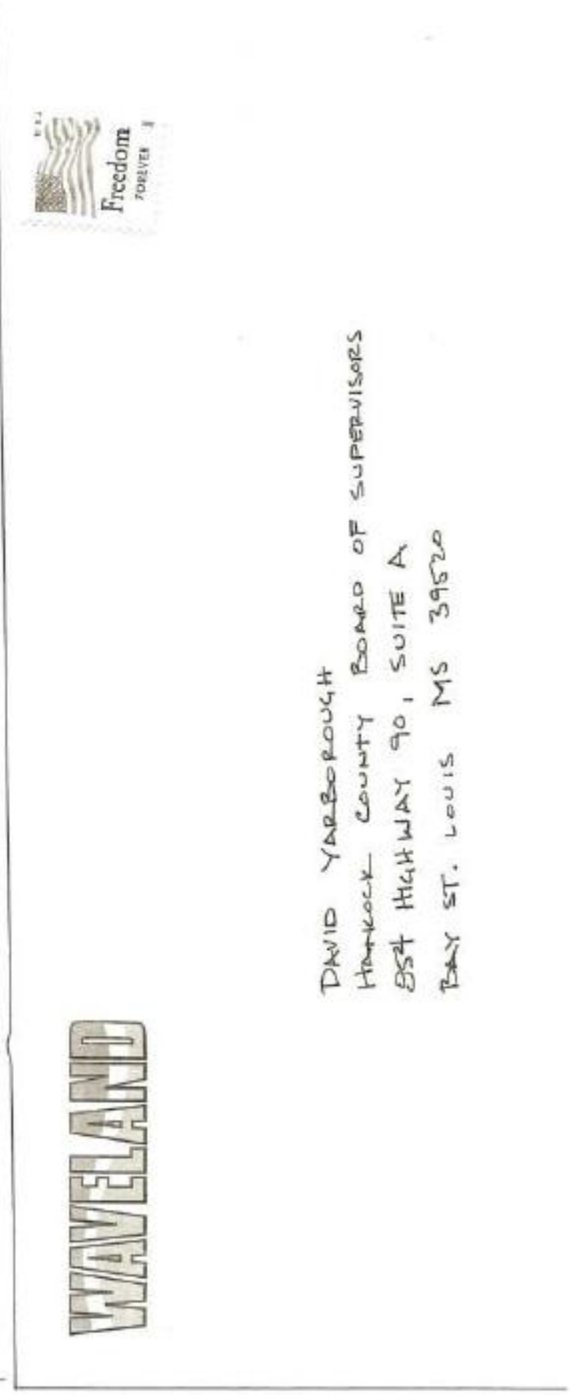
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WAVELAND

MEETING RECORD

Project: WAVELAND, MS HMGP UPDATE	Date: 2.28.13
Meeting Purpose: DISCUSS CLIMATE ~~ADAPTION~~ ADAPTATION AS PART OF WAVELANDS HMGP UPDATE	

Meeting Attendees: PATRICK MOORE & GWEN SHAUGHNESSY

Items Discussed: MS. SHAUGHNESSY IS A CLIMATE ADAPTATION SPECIALIST FOR NOAA. FOLLOWING A CLIMATE ADAPTATION WORKSHOP I EXPLAINED TO MS. SHAUGHNESSY THAT THE ~~$~~ CITY OF WAVELAND WAS INCLUDING CLIMATE ADAPTATION AS PART OF THEIR HMGP 2012 UPDATE. SHE STATED THAT SHE WOULD BE HAPPY TO PROVIDE ANY CLIMATE ADAPTATION DOCUMENTATION OR ANSWER ANY QUESTIONS I MIGHT HAVE.

Follow-up: NONE

By:
Name: PATRICK MOORE
[signature] 2.28.13

Organization: AMEC

MEETING RECORD

Project: WAVELAND, MS HMGP UPDATE	Date: 3.1.13
Meeting Purpose: DISCUSS HMGP 2012 UPDATE	

Meeting Attendees: PATRICK MOORE & LARISSA GRAHAM

Items Discussed: MS. GRAHAM WORKS FOR THE GRAND BAY NATIONAL ESTRUARINE RESERVE ~~AS~~ IN THEIR COASTAL TRAINING PROGRAM. I DISCUSSED WITH MS. GRAHAM HOW THE CITY OF WAVELAND ~~IS~~ IS INCLUDING CLIMATE ADAPTATION AS PART OF THEIR HAZARD MITIGATION PLAN UPDATE. SHE EXPRESSED HER INTEREST AND STATED THAT SHE WOULD LIKE TO ATTEND THE CITY'S NEXT WORKSHOP.

Follow-up: INVITE MS. GRAHAM TO NEXT MTG.

By:
Name: PATRICK MOORE
3/1/13

From: Moore, Patrick W
Sent: Monday, March 04, 2013 11:41 AM
To: larissa.graham@dmr.ms.gov
Subject: City of Waveland, 2012 HMGP Update

Ms. Graham,

I'm just following up per our conversion at the Climate Adaptation Workshop last week regarding the City of Waveland's Hazard Mitigation Plan Update. I know it is short notice, but below is an invite to the City's next HMGP update workshop. You are welcome to attend either day or both. If you have any questions, please contact me at 228-327-5166.

Thank you,

Patrick Moore

AMEC Environment and Infrastructure

amec

PHONE CONVERSATION LOG

Client: Waveland	Contact Name: James Brinckley	Date: 3/4/2013
Project: LHMP Update	Contact Organization: NOAA-GU-FL	Subject:
Project #: 54721	Contact Phone #: 305 229-4444	SLR/Storm Surge Data

Items Discussed: On referrals from the Corps - Thomas Smith, we contacted the Florida NOAA office trying to ascertain the status of models utilized a combination of SLR + storm surge for MS. Mr. Brinkley indicated that NOAA didn't have yet + he was not aware of other sources that combined SLR + storm surge into models for MS. In fact he indicated that they were just starting to scope out that effort (i.e. at the pen + paper stage) + that they would be working towards that end in the future. He did also say that what NOAA was likely going to come up with would be done on a more regional basis + would be likely difficult to assess the impacts to the City of Waveland specifically. We also asked if he had any input into the Waveland LHMP Update + how to provide that info + get involved. He indicated that knowing people were interested in this type of info would be taken in to consideration in their methodologies for developing future models.

Follow-up: Next Waveland LHMP update - see what new data have been developed.

By:
Name: Jeanine Foster
Organization: AMEC

amec

PHONE CONVERSATION LOG

Client: Waveland	Contact Name: Thomas Smith	Date: 2/19/13
Project: LHMP Update	Contact Organization: USACE	Subject:
Project #: 54721	Contact Phone #: 251 690-3270	LHMP Update

Items Discussed: Spoke w/ Mr. Smith regarding his position as Project Manager for the MS Coastal Improvements project and to that end what input he might have to the City of Waveland LHMP Update project.

We specifically focused on SLR & data the Corps might have to support that analysis. We talked about the LA Risk Reduction project being undertaken by the Corp + the potential downstream impacts that project could have on MS and the City of Waveland.

He referred me to others within the USACE Mobil District that might have GIS or other data that combines SLR w/ storm surge in GIS models. In following up on his leads, we got stuck in the Corps FOIA process - they clearly were going to make it difficult to figure out what they have & how to get it!

Mr Smith referred us to their MSCIP & we included a project in the plan update for the City to support those MSCIP projects to the benefit of Waveland

Follow-up: email: thomas.e.smith@usace.army.mil

Invite him to Risk Assessment / Mitigation strategy meetings - Done ✓

Get comments on plan.

By:
Name: Jeanine Foster
Organization: AMEC

amec

PHONE CONVERSATION LOG

Client: Waveland	Contact Name: Christa Rabenold	Date: 6/2012 – 3/2013
Project: LHMP Update	Contact Organization: NOAA affiliate	Subject: SLR/climate change data
Project #: 554721	Contact Phone #: 301 563-7201	

Items Discussed: from the beginning of this project, have coordinated w/ Christa on literature and resources to support our SLR/climate change hazard analysis for the City of Waveland LHMP update.

Christa conducted a literature search for us at the beginning of the project & provided us w/ data & direction w/ respect to identifying & using key SLR/climate change literature specific to MS & the Waveland area.

Most recently on 2/13, she followed up by providing us w/ a new research document that came from NOAA entitled: W180/Global Sea-Level Rise Scenarios for the US – National Climate Assess. This document contained several good ideas for regional mitigation of climate change issues. Many of these issues were considered in developing mitigation projects for the plan update.

Follow-up: send letter for LHMP review & comment.
Christa Rabenold, CFM
Coastal Management + Hazards Specialist JHT Cont. NOAA/OCRM/CPO
1305 East-West Highway
SSMC4, N/ORM3 #11237
Silver Spring, MD 20910

By:
Name: Jeanine Foster
Organization: AMEC

amec

PHONE CONVERSATION LOG

Client: Waveland	Contact Name: John Albert	Date: 2/13/13
Project: LHMP Update	Contact Organization: Hancock County	Subject:
Project #: 54721	Contact Phone #: 228-466-8320 EM	LHMP Update

Items Discussed: Spoke Mr. Mr. Albert regarding the LHMP Update process for Waveland. Asked him if he could provide data, including county fire plan, county EOP, county draft of hazard mitigation plan. He said he would.

We also talked about any input he might have to the plan update for the city & reminded him of our upcoming risk assessment and mitigation strategy meetings. He said he would try to attend & would coordinate additional input with Mike Smith at the city.

Follow-up:

By:
Name: Jeanine Foste
Organization: AMEC

Appendix C MITIGATION STRATEGY

C.1 LHMP Mitigation Strategy Meeting

C.1.1 Agenda

1) Introductions
2) Status of the Plan Update Process
3) Review of Risk Assessment Summary
4) Update Plan Goals and Objectives
5) Review of Mitigation Alternatives
6) Identify Updated List of Mitigation Actions
7) Review Mitigation Selection Criteria
8) Prioritize Mitigation Actions
9) Project Completion Schedule/Final Data Needs

Table C.1. Hazard Summary for the City of Waveland

Hazard	Frequency of Occurrence	Spatial Extent	Potential Magnitude	Significance
Climate Change (storm surge, sea level rise)	Highly Likely	Extensive	Catastrophic	Medium
Coastal/Canal Bank Erosion	Highly Likely	Limited	Negligible	Medium
Dam/Levee Failure	Unlikely	Limited	Negligible	Low
Drought	Likely	Significant	Negligible	Low
Earthquake	Occasional	Extensive	Critical	Low
Excessive Heat	Likely	Extensive	Limited	Low
Extreme Winter Weather	Unlikely	Negligible	Limited	Low
Flood: 100/500 year	Highly Likely	Significant	Critical	High
Flood: Stormwater/ Localized Flooding	Highly Likely	Significant	Critical	High
Hurricane and Tropical Storms (includes ocean surf events)	Likely	Extensive	Catastrophic	High
Thunderstorm (includes hail, lightning, high wind)	Highly Likely	Significant	Limited	High
Tornado	Likely	Limited	Negligible	Low
Wildfire	Likely	Limited	Negligible	Low
Railroad: Hazardous Materials Release	Occasional	Limited	Negligible	Medium

Guidelines:
Frequency of Occurrence:
Highly Likely: Nearly 100% probability in the next year.
Likely: Between 10 and 100% probability in the next year
Occasional: Between 1 and 10% probability in the next year
Unlikely: Less than 1% probability in the next year

Potential Magnitude:
Catastrophic: More than 50% of the area affected
Critical: 25 to 50% of the area affected
Limited: 10 to 25% of the area affected
Negligible: Less than 10% of the area affected

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning Area

Significance:
Low
Medium
High

C.2 Risk Assessment Methodology

C.2.1 Calculating Likelihood of Future Occurrence

The frequency of past events is used in this section to gauge the likelihood of future occurrences. Based on historical data, the likelihood of future occurrence is categorized into one of the following classifications:

- **Highly Likely**: Near 100% chance of occurrence in next year, or happens every year.
- **Likely**: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.
- **Occasional**: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.
- **Unlikely**: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years.

C.2.2 Calculating Vulnerability

Vulnerability is measured in general, qualitative terms, and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential:

- **Extremely Low**: The occurrence and potential cost of damage to life and property is very minimal to non-existent.
- **Low**: Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**: Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**: Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have already occurred in the past.
- **Extremely High**: Very widespread and catastrophic impact.

C.2.3 Defining Significance (Priority) of a Hazard

Defining the significance or priority of a hazard to a community is based on a subjective analysis of several factors. This analysis is used to focus and prioritize hazards and associated mitigation measures for the plan. These factors include the following:

- **Past Occurrences**: Frequency, extent, and magnitude of historic hazard events.
- **Likelihood of Future Occurrences**: Based on past hazard events.

- **Ability to Reduce Losses through Implementation of Mitigation Measures**: This looks at both the ability to mitigate the risk of future occurrences as well as the ability to mitigate the vulnerability of a community to a given hazard event. It also considers the extent to which existing mitigation measures are in place to adequately address the hazard.

C.2.4 City of Waveland Hazard ID/Vulnerability/Priority Summary

Climate Change (storm surge, sea level rise)

- Data shows climate change issues affecting Waveland
- LOFO: Highly Likely
- Vulnerability: Medium - High?
- Priority Hazard

Coastal/Canal Bank Erosion

- Data shows erosion is a problem in the city, but actual data is scarce
- LOFO: Highly Likely
- Vulnerability: Medium
- Priority Hazard

Dam/Levee Failure

- 20 Low hazard dams located in Hancock County, none in Waveland. No High or Significant Hazard dams identified outside of the County that would affect Waveland
- No levees in Waveland.
- There was only one dam breached in Hancock County. The Boy Scout Camp Dam located at the Salmon Reservation breached in April, 1983. There were no damages in the City of Waveland. No levees, thus no levee failures have been reported in the City.
- LOFO: Unlikely
- Vulnerability: Low (unless the LA levee -IHNC Surge Barrier- Extremely High)
- Non-Priority Hazard??

Drought

- The NCDC and SHELDUS databases report no incidents of extended drought for the City of Waveland.
- Given the fact that Waveland is located in sub-tropical South Mississippi and receives an annual average rainfall of 64 inches, extended periods of drought are extremely rare. Short term droughts are possible, but there is limited record keeping of minor droughts. Water supply would be the primary concern. IS IT?
- LOFO: Occasional

- Vulnerability: Low - Medium?
- Non-Priority Hazard

Earthquake

- There are a series of seaward facing normal fault lines along the northern Gulf of Mexico from western Florida to Texas, including Mississippi. The Gulf Margin faults along the Mississippi Coast are classified by the USGS as Class B since they have indicated low seismic activity and existing geologic information is unclear on the threat from damaging ground motion. The fault closest to the planning area is the Wiggins uplift.
- There have been 4 minor earthquakes that have affected Waveland since 1911
- The State Plan finds that Hancock County (and Waveland) has a low vulnerability to earthquake activity.
- LOFO: Unlikely - Damaging Earthquake; Occasional - Felt Occurrences
- Vulnerability: Low
- Non-Priority Hazard

Extreme heat

- Annual occurrences - it gets hot every summer
- Neither the NCDC nor SHELDUS reports any extreme temperature events in Waveland. However, temperatures of more than 90° F with relative humidity approaching 70% are not unusual for the Gulf Coast area and Waveland. On occasion, the temperature may approach or exceed 100° Fahrenheit
- Climate change might affect this hazard in the future
- LOFO: Highly Likely
- Vulnerability: Low
- Non-Priority Hazard

Extreme Winter Weather

- Between 1960 and 2010, there were 16 recorded extreme winter weather events for the City.
- The HMPC identified one winter storm occurring in Waveland since 1969.
- The February 2, 1996 winter weather event was an arctic airmass that affected much of southern Mississippi bringing the longest extended period of cold weather since 1989. Considerable property damage resulted from broken pipes due to the extended period of subfreezing temperatures.
- LOFO: Likely
- Vulnerability: Low
- Non-Priority Hazard

Flood Hazards

- 100/500 year
- Significant flood history throughout the City
- 2 Disaster Declarations for severe storm, tornadoes, flooding (1965-2012)
- LOFO: 100-Occasional; 500-Unlikely (By Definition)
- Vulnerability: Extremely High
- Priority Hazard

Localized/Stormwater flooding

- Numerous parcels and roads throughout the City both included and not included in the FEMA 100- and 500-year floodplains are subject to annual flooding in heavy rains.
- Grand Bayou and its tributaries are also sources of flooding during periods of heavy rainfall. Other flat, poorly drained areas of the community experience ponding during heavy rainfall:
- Nicholoson Avenue - Exxon & 90 - 100 Block on Beach
- Waveland Avenue - 100 Beach - Highway 90
- South Central Avenue - 100 Colman Avenue -Waveland Avenue & Central
- North Central Avenue - City line past Lakewood Drive - Colman Avenue
- Old Spanish Trail Highway 90 - Nicholson Avenue
- Waveland Beach Boulevard from Bay Oak Drive to Clermont Boulevard
- South Street to Clermont Boulevard
- Highway 603 at the Log Cabins between Avenue B and Kiln-Waveland Cutoff Road
- LOFO: Highly Likely
- Vulnerability: Medium-High?
- Priority Hazard

Hurricane and Tropical Storm (including Coastal Storm Surge)

- Since 1900, the Mississippi Coast and Hancock County has felt the effects of 20 hurricanes and 13 tropical storms, six of which were considered major (Category 3 or higher) with wind speeds exceeding 130 mph.
- 10 Hurricane Disaster Declarations and 2 Tropical Storm Declarations (1965-2012)
- Hancock County and Waveland sustained a direct hit from Hurricane Camille in 1969, one of only a few Category 5 storms to ever make landfall in the U.S. Hurricane Katrina was a Category 5 storm until only a few hours prior to landfall when its winds dropped to Category 3. The tide and storm surge experienced along the coastline actually exceeded that to be expected from a Category 5 storm.
- Since 1995 (the date the NCDC began collecting data), the NCDC reports that the Mississippi Coast and Hancock County has felt the effects of 17 coastal storm surges
- Climate change will affect this hazard in the future

- LOFO: Likely - Hurricane; Highly Likely - Storm Surge
- Vulnerability: Extremely High
- Priority Hazard

Thunderstorm (includes hail, lightning, high wind)

- Waveland is reported to average 70 to 80 days per year when thunderstorms occur.
- 14 reported thunderstorms with high winds between 1994 and 2012.
- 3 reported hail events between 1993 and 2012.
- 2 reported lightning events between 1993 and 2010
- Severe storms/heavy rains are the primary cause of most major flooding.
- 2 Disaster Declarations for severe storm, tornadoes, flooding (1965-2012)
- LOFO: Highly Likely?
- Vulnerability: High
- Priority Hazard

Tornadoes

- In the past 60 years 7 tornadoes have been sighted within the City Limits or about one every 8.5 years and 43 reported in Hancock County.
- No history of damaging tornadoes in the City
- LOFO: Likely - sightings; unlikely - damaging tornadoes
- Vulnerability: Low
- Non-Priority Hazard

Wildfire

- Past Wildfire History - Does Waveland have records?
- LOFO:
- Vulnerability: Low
- Non-Priority Hazard

Railroad: Hazardous Materials Release

- 1 reported haz mat event (Train Derailment) occurred in the City between 1970 and 2002. No product released; no damages or injuries. 200 people were evacuated as a precaution.
- LOFO: Occasional
- Vulnerability: Medium
- Priority Hazard

*LOFO=Likelihood of Future Occurrence

C.2.5 City of Waveland Priority Hazards

- Climate Change
- Coastal/Canal Bank Erosion
- Flood Hazards: 100/500 year & Localized Stormwater Flooding
- Hurricane and Tropical Storms (includes Ocean Surf Events)
- Thunderstorms (includes Hail, Lightning, Wind)
- Railroad: Hazardous Materials Release

Waveland Priority Hazards

- Climate Change (storm surge, sea level rise)
- Coastal/Canal Bank Erosion
- Flood: 100/500 year
- Flood: Stormwater/ Localized Flooding
- Hurricane and Tropical Storms (includes ocean surf events
- Thunderstorm (includes hail, lightning, high wind)
- Railroad Hazardous Materials Release?

Non-Priority Hazards

- Dam/Levee Failure
- Drought
- Earthquake
- Extreme Heat
- Extreme Winter Weather
- Tornado
- Wildfire

C.3 Mitigation Goals Development

C.3.1 Formulating Mitigation Goals

Up to now, the HMPC has been involved in collecting and providing data for the City of Waveland Local Hazard Mitigation Plan. From this information, a Risk Assessment has been developed that describes the risk and vulnerability of the City to identified hazards and includes an assessment of the area's current capabilities for countering these threats through existing policies, regulations, programs, and projects.

This analysis identifies areas where improvements could or should be made. Formulating Goals will lead us to incorporating these improvements into the Mitigation Strategy portion of the plan. Our planning goals should provide direction for what should be done to make the planning area more disaster resistant.

GOALS: Goals are stated without regard for implementation, that is, implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that the goals are not dependent on the means of achievement. Goals are public policy statements that:

- Represent basic desires of the jurisdiction;
- Encompass all aspects of planning area, public and private;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- Are time-independent, in that they are not scheduled events.

While goals are not specific (quantitative), they should not be so general as to be meaningless or unachievable.

Goals statements will form the basis for objectives. They should be stated in such a way as to develop one or more objectives related to each goal.

The key point in writing goals is to remember that they must deal with results, not the activities that produce those results.

Finally, before we formulate our goals, we should consider other planning area goals from other City plans and programs. This keeps us from "reinventing the wheel," as well as being consistent with Multi-Objective Management --- or "MOM" --- where communities strive for efficiency by combining projects/needs that are similar in nature or location. Utilizing "MOM" effectively results in multiple sources of funding that can be "packaged" and broadening the supporting constituency base by including "outcomes" desired by various stakeholder groups.

Types/Sources of other area mitigation plans and programs include:

- Emergency Operations Plans
- Comprehensive Plans
- Stormwater Program and Plans
- Flood/Watershed Management Plans and Studies
- Water Management/Drought Plans
- Community Wildfire Protection/Fire Plans
- Others

Goals from the Waveland Comprehensive Plan

- Residential Goals
  - Protect, maintain and strengthen the neighborhoods within the City of Waveland.
- Community Facilities Goals
  - Continue to support excellence in fire and police services and emergency response.
  - Establish a long term program to create adequate drainage in Waveland which reduces flooding from rain events, enhances the water quality of storm water runoff and remains economically feasible.
  - (Not many hazard-related mitigation goals in Comp Plan)

Goals from Flood Damage Prevention Ordinance (2009)

- To protect human life and health;
- To minimize expenditure of public money for costly flood control projects;
- To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- To minimize prolonged business interruptions;
- To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, street and bridges located in floodplains;
- To help maintain a stable tax base by providing for the sound use and development of flood prone areas in such a manner as to minimize flood blight areas, and to ensure that potential homebuyers are notified that property is in a flood area.

C.3.2 Goal Development

You will each be given 3 sticky notes. On each note you will write what you think the goals for this mitigation planning effort should be. To get you started, provided below are possible goals for this mitigation plan. You may reword these or develop your own. These goal statements should serve as examples. It is vital that our Hazard Mitigation Planning Committee establish its own goals. Use one note for each goal. The purpose of the goal development is to reach a consensus on plan goals --- something everyone can live with.

- Minimize risk and vulnerability from natural hazards

- Increase communities' awareness of vulnerability to hazards
- Increase the use of shared resources
- Improve communities' capabilities to mitigate losses
- Maintain coordination of disaster plans with changing MEMA/FEMA needs
- Maintain FEMA eligibility/position jurisdictions for grant funding
- Maintain current service levels
- Provide protection for existing facilities from hazards
- Provide protection for future development from hazards
- Provide protection for natural and cultural resources from hazard impacts
- Provide protection for people's lives from hazards
- Provide protection for public health
- Provide protection for critical facilities and services from hazard impacts
- Provide protection for critical lifeline utilities from hazard impacts
- Reduce exposure to hazard related losses
- Reduce the number of emergency incidents
- Make better use of technology

When done, we will:

- Pin/tape them to the wall/easel-chart and arrange them by category
- Combine and reword them into 3-4 goals for the plan.

Goals from Waveland 2007 LHMP

The 2006 plan contained the following goals:

- Goal 1: Coordinate and incorporate hazard mitigation into community recovery and redevelopment from Hurricane Katrina..
- Goal 2: Improve drainage, stormwater, and flood management.
- Goal 3: Reduce the damage to life and property caused by non-flood/hurricane hazards.
- Goal 4: Provide public education about hazards and how to minimize or avoid related impacts.
- Goal 5: Enhance emergency operations capabilities.
- Goal 6: Provide public education regarding terrorism situations and ways to reduce the impacts of terrorism and other accidental hazardous situations

C.4 Categories of Mitigation Measures Considered

The following categories are based on the Community Rating System.

- Prevention
- Property Protection
- Natural Resource Protection
- Emergency Services
- Structural Projects
- Public Information

C.5 Alternative Mitigation Measures per Category

Note: The CRS Credit Sections are based on the 2007 CRS Coordinator's Manual. Credits and minimum requirements to achieve certain CRS Classes are being modified in the 2013 CRS Coordinator's Manual.

C.5.1 Preventive Measures

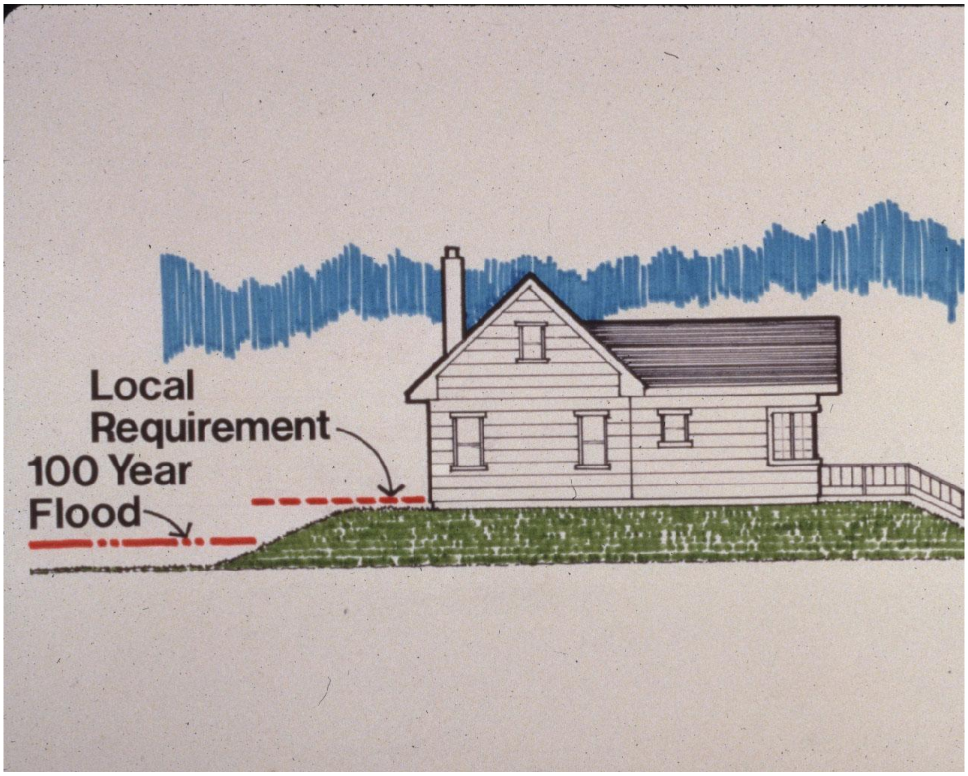
Preventive measures are designed to keep a problem - such as flooding - from occurring or from getting worse. The objective of preventive measures is to ensure that future development is not exposed to damage and does not cause an increase in damages to other properties. Building, zoning, planning and code enforcement offices usually administer preventive measures. Some examples of types of preventive measures include:

- Building codes
- Planning and zoning
- Open space preservation
- Floodplain regulations
- Stormwater management

Building Codes

Building codes provide one of the best methods of addressing natural hazards. When properly designed and constructed according to code, the average building can withstand many of the impacts of natural hazards. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. Building codes can ensure that the first floors of new buildings are constructed to be higher than the elevation of the 100-year flood (the flood that is expected to have a one percent chance of occurring in any given year). This is shown in Figure C.1.

Figure C.1. Building Codes and Flood Elevations



The City of Waveland's Building Code Ordinance adopts the International Building Code by reference. Just as important as having code standards is the enforcement of the code. Adequate inspections are needed during the course of construction to ensure that the builder understands the requirements and is following them. Making sure a structure is properly elevated and anchored requires site inspections at each step.

Manufactured Homes

Manufactured or mobile homes are usually not regulated by local building codes. They are built in a factory in another state are shipped to a site. They do have to meet construction standards set by the U.S. Department of Housing and Urban Development. All mobile homes constructed after 1976 must comply with HUD's National Manufactured Home Construction and Safety Standards. These standards apply uniformly across the country and it is illegal for a local unit of government to require additional construction requirements. Local jurisdictions may regulate the location of these structures and their on-site installation.

The NFIP allows communities to exempt mobile homes in existing mobile home parks from some of the flood protection requirements. The CRS provides up to 50 points if the community does not use this exemption. Waveland requires that manufactured homes in Zone A be elevated and anchored to resist flotation, collapse or lateral movement. Manufactured homes in Zones

AI-30, AH and AE that outside of a mobile home park, in a new mobile home park, in an expansion to an existing park, or in an existing park in which a different home has had substantial damage due to flood, be elevated and securely anchored. Manufactured homes must be placed or substantially improved on sites in an existing manufactured home park or subdivision within zones AI-30, AH and AE in existing parks that are not otherwise subject to these provisions should be elevated so that either the lowest floor is at or above the base flood elevation or the chassis is supported by reinforced piers or other foundation elements of equivalent strength. There are additional requirements for recreational vehicles.

Local Implementation

Waveland has adopted the 2009 edition of the international building code. The City of Waveland's Code of Ordinances requires that new residential construction be designed with the lowest floor, including the basement, elevated to or above the base flood elevation. For new nonresidential construction or substantial improvement, the City's Code requires that either the lowest floor be elevated to one foot above the base flood elevation or that the below the base flood level the structure is watertight, "with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy." In addition, all new construction or substantial improvements shall be:

- Designed or modified and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy
- Constructed in ways that minimize flood damage
- Constructed with materials resistant to flood damage
- Constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities designed or located so as to prevent water from entering or accumulating within components during flooding

Waveland's Codes also requires that :

- All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
- New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters in the system and discharge from the systems into flood waters; and
- On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

CRS Credit

The CRS encourages strong building codes. It provides credit in two ways: points are awarded based on the community's BCEGS classification and points are awarded for adopting the International Code series. Waveland's BCEGS rating is a Class 5 for both residential and commercial. Waveland uses the International Building Code and International Residential Code .

The CRS also has a prerequisite for a community to attain a Class 7 or better within the CRS program, the community must have a BCEGS class of 6/6 or better. To attain a Class 4 or better in the CRS program, the community must have a BCEGS class of 5/5 or better. Waveland's BCEGS class is 5/5.

Planning and Zoning

Building codes provide guidance on how to build in hazardous areas. Planning and zoning activities direct development away from these areas, particularly floodplains and wetlands. They do this by designating land uses that are compatible with the natural conditions of land that is prone to flooding, such as open space or recreation. Planning and zoning activities can also provide benefits by simply allowing developers more flexibility in arranging improvements on a parcel of land through the planned development approach.

Comprehensive Plans

These plans are the primary tools used by communities to address future development. They can reduce future flood-related damages by indicating open space or low density development within floodplains and other hazardous areas. Unfortunately, natural hazards are not always emphasized or considered in the specific land use recommendations.

Generally, a plan has limited authority. It reflects what the community would like to see happen. Its utility is that it guides other local measures, such as capital improvement programs, zoning ordinances, and subdivision regulations.

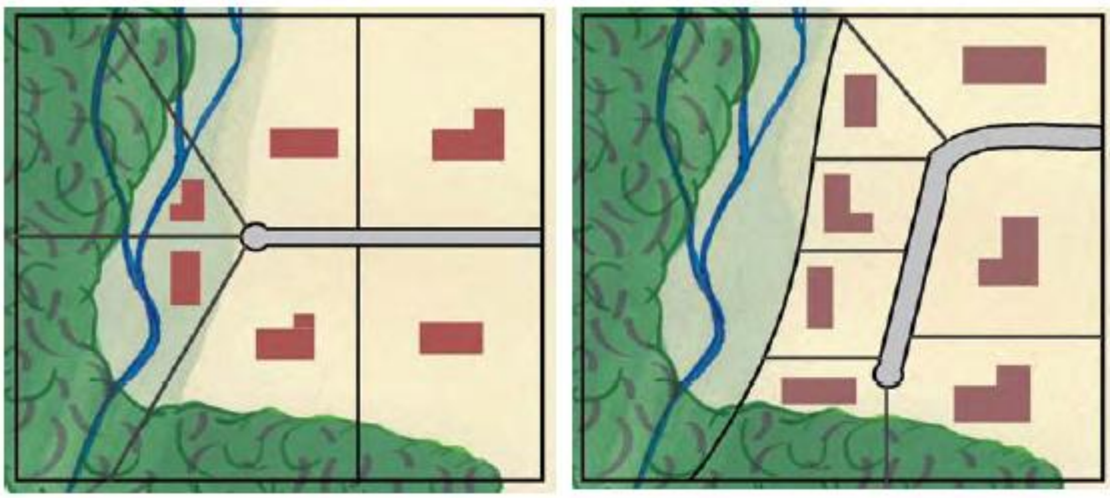
Zoning Regulations

A zoning ordinance regulates development by dividing a community into zones or districts and setting development criteria for each of those zones or districts. Zoning codes are considered the primary tool to implement a comprehensive plan's guidelines for how land should be developed.

Zoning ordinances can limit development in hazardous areas, such as reserving floodplain zones for agricultural uses. Often, developers will produce a standard grid layout. The ordinance and the community can allow flexibility in lot sizes and location so developers can avoid hazardous areas.

One way to encourage such flexibility is to use the planned unit development (PUD) approach. The PUD approach allows the developer to easily incorporate flood hazard mitigation measures into the project. Open space or floodplain preservation can be facilitated as site design standards and land use densities can be adjusted to fit the property's specific characteristics, as shown in Figure C.2.

Figure C.2. Zoning for Development in the Floodzone



PUD: In the standard zoning approach (left), the developer considers six equally-sized lots without regard for the flood hazard. Two properties are subject to flooding and the natural stream is disrupted. An alternative, flexible, PUD approach is shown on the right. The floodplain is dedicated as public open space. There are seven smaller lots, but those abutting the floodplain have the advantage of being adjacent to a larger open area. Four lots have riverfront views instead of two. These amenities compensate for the smaller lot sizes, so the parcels are valued the same. The developer makes the same or more income and the future residents are safer.

Capital Improvement Plans

A capital improvement plan can guide a community's major public expenditures for a five- to 20-year period. Capital expenditures may include acquisition of open space within the hazardous areas, extension of public services into hazardous areas, or retrofitting existing public structures to withstand a hazard.

Local Implementation

In 2009, the City of Waveland City approved a new comprehensive plan. (or a capital improvement plan). Waveland's zoning regulations separate land into two land uses: residential and commercial/industrial. The Town's zoning codes do not provide for any additional restrictions on development in floodplains, aside from what is required under the Flood Control regulations regarding building elevations .

CRS Credit

The CRS provides flood insurance discounts to those communities that implement various floodplain management activities that meet certain criteria. Comparing local activities to those national criteria helps determine if local activities should be improved.

Up to 100 points are provided for regulations that encourage developers to preserve floodplains or other hazardous areas from development. There is no credit for a plan, only for the enforceable regulations that are adopted pursuant to a plan. Up to 600 points are provided for setting aside floodplains for low density zoning, such as five acre lots or conservation.

Open Space Preservation

Keeping the floodplain and other hazardous areas open and free from development is the best approach to preventing damage to new developments. Open space can be maintained in agricultural use or can serve as parks, greenway corridors and golf courses.

Comprehensive and capital improvement plans should identify areas to be preserved by acquisition and other means, such as purchasing an easement. With an easement, the owner is free to develop and use private property, but property taxes are reduced or a payment is made to the owner if the owner agrees to no build on the part set aside in the easement.

Although there are some federal programs that can help acquire or reserve open lands, open space lands and easements do not always have to be purchased. Developers can be encouraged to dedicate park land and required to dedicate easements for drainage and maintenance purposes. These are usually linear areas along property lines or channels. Maintenance easements also can be donated by streamside property owners in return for a community maintenance program.

Local Implementation

The City of Waveland City does not currently have any ordinances protecting open space within the City jurisdiction. After Hurricane Katrina in 2005, much of the beach front properties remain vacant and open because of the cost of the land and the cost in elevating the structure and flood insurance.

CRS Credit

Preserving flood prone areas as open space is one of the highest priorities of the Community Rating System. Up to 700 points can be given, based on how much of the floodplain is in community public undeveloped properties, parks, wildlife refuges, golf courses, or other uses that can be depended on to stay open (Activity 420 - Open Space Preservation).

Subdivision Regulations

Subdivision regulations govern how land will be subdivided and they set construction standards. These standards generally address roads, sidewalks, utilities, storm sewers, and drainage ways. They can include the following flood protection standards:

- Requiring that the final plat show all hazardous areas
- Requiring that each lot be provided with a building site above the flood level
- Requiring that all roadways be no more than one foot below the flood elevation
- Local Implementation

Waveland's subdivision regulations require: CAN THE CITY VERIFY?

- All natural drainage courses into which other drainage courses empty shall be left undisturbed and shall be provided with adequate dedicated rights of way.
- All land developments shall be related to the surrounding drainage pattern with proper provisions made for proper drainage facilities.
- Adequate easements are required along any stream or important surface drainage course.

Floodplain Regulations

Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for the participating communities' standards for development, subdivision of land, construction of buildings, installation of mobile homes, and improvements and repairs to buildings. These are usually spelled out in a separate ordinance.

The NFIP minimum requirements are summarized in on the next page. It should be stressed that these are minimum requirements. Local conditions, such as high velocity flooding or the presence of a potential dam failure, may warrant higher local standards.

Enforcement

To ensure that communities are meeting the NFIP standards, FEMA periodically conducts a Community Assessment Visit. During this visit, the maps and ordinances are reviewed, permits are checked, and issues are discussed with staff. Failure to meet all of the requirements can result in one or more consequences:

- Reclassification under the Community Rating System to a higher class
- Probation, which entails a $50 surcharge on every flood insurance policy in the community, or
- Suspension from the NFIP.

In 2004, Lafourche Parish, Louisiana was cited and reclassified from a CRS Class 9 to a Class 10, in effect kicking the Parish out of the CRS. Suspension is more serious. It means that the community is out of the NFIP and the following sanctions are imposed:

- Flood insurance will not be available. No resident will be able to purchase a flood insurance policy.
- Existing flood insurance policies will not be renewed.
- No direct federal grants or loans for development may be made in identified flood hazard areas under programs administered by federal agencies, such as HUD, EPA, and the Small Business Administration.
- Federal disaster assistance will not be provided to repair insurable buildings located in identified flood hazard areas for damage caused by a flood.
- No federal mortgage insurance or loan guarantees may be provided in identified flood hazard areas. This includes policies written by FHA, VA, and others.
- Federally insured or regulated lending institutions, such as banks and credit unions, must notify applicants seeking loans for insurable buildings in flood hazard areas that there is a flood hazard and the property is not eligible for federal disaster relief.

These sanctions can be severe for any community with a substantial number of buildings in the floodplain. Most communities with a flood problem have joined the NFIP and are in full compliance with their regulatory obligations.

One way to assure good administration and enforcement is to have Certified Floodplain Managers on staff. The Association of State Floodplain Managers administers the national Certified Floodplain Manager (CFM®) program. Certification involves a three hour exam and a requirement for continuing education each year. The exam covers the regulatory standards of the National Flood Insurance Program as well as mapping, administration, enforcement and flood hazard mitigation.

Minimum National Flood Insurance Program Regulatory Requirements

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, communities that participate in the NFIP agree to regulate new construction in the area subject to inundation by the 100-year (base) flood. The floodplain subject to these requirements is shown as an A or V Zone on the Flood Insurance Rate Map (FIRM).

There are five major floodplain regulatory requirements. Additional floodplain regulatory requirements may be set by state and local laws.

1) All development in the 100-year floodplain must have a permit from the community. The NFIP regulations define "development" as any manmade change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging,

filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

2) Development along a river or other channel cannot obstruct flows so as to cause an increase in flooding on other properties. An analysis must be conducted to demonstrate that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.
3) New buildings may be built in the floodplain, but they must be protected from damage from the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to be at or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or floodproofed.
4) Under the NFIP, a "substantially improved" building is treated as a new building. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged.
5) Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the federal criteria. The NFIP's Community Rating System provides insurance premium credits to recognize the additional flood protection benefit of higher regulatory standards.

Local Implementation

Waveland's Flood Control ordinance meets all of the NFIP's minimum floodplain regulatory requirements and exceeds some of them such as establishing one foot of freeboard.

CRS Credit

There are many higher regulatory standards that warrant CRS credit. These standards include:

- Delineating a floodway, the area of higher hazard near the channel. This would allow development outside the floodway (called the "floodplain fringe") without engineering studies to determine their impact on others.
- Requiring all new construction to be elevated one or two feet above the base flood elevation to provide an extra level of protection from waves and higher floods. This extra protection is reflected in a distinct reduction in flood insurance rates.
- Having all developers (not just the larger ones) provide flood data where none are available.
- Specifications to protect foundations from erosion, scour and settling.
- Prohibiting critical facilities from all or parts of the floodplain.
- Prohibiting hazardous materials.
- Requiring buffers adjacent to streams or natural areas.
- Restrictions on use of enclosures below elevated buildings.

- Flood storage lost due to filling and construction must be compensated for by removal of an equal volume of storage.
- The CRS also provides credit for having trained staff and a higher credit if the staff members are Certified Floodplain Managers.

It should be noted that one of the prerequisites for participation in the CRS is that the community be in full compliance with the minimum requirements of the NFIP. A community with a number of "potential violations" risks being removed from the CRS entirely.

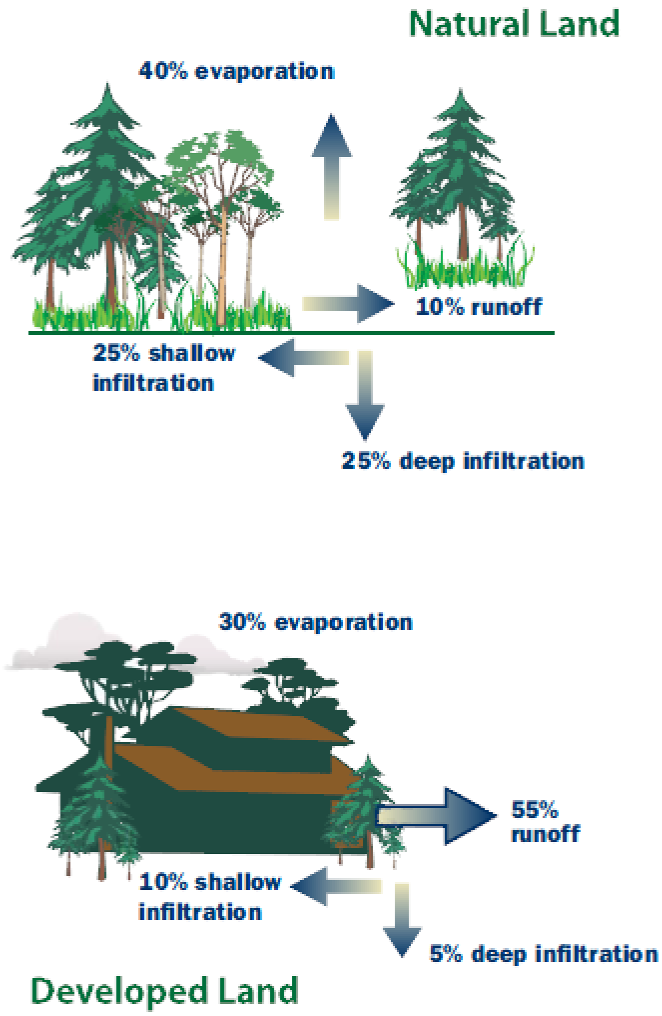
Waveland's Flood Control ordinance sets specific restrictions on the use of enclosures below elevated buildings, which is an extra requirement beyond NFIP's minimum requirements. Floodways within Waveland are delineated, and certain requirements apply to development within these floodways. New construction, substantial improvements, fill, and other encroachments are prohibited within the regulatory floodway without certification and supporting technical data, signed by a registered professional engineer, to show that the fill will not increase the water surface elevation of the base flood or the developer or applicant for new construction receives a conditional FIRM and floodway revision.

Stormwater Management

Development in floodplains is development in harm's way. New construction in the floodplain increases the amount of development exposed to damage and can aggravate flooding on neighboring properties.

Development outside a floodplain can also contribute to flooding problems. Stormwater runoff is increased when natural ground cover is replaced by urban development (see Figure C.3). Development in the watershed that drains to a river can aggravate downstream flooding, overload the community's drainage system, cause erosion, and impair water quality.

Figure C.3. Runoff and Infiltration of Natural and Developed Land



There are three ways to prevent flooding problems caused by stormwater runoff:

1) Regulating development in the floodplain to ensure that it will be protected from flooding and that it won't divert floodwaters onto other properties, and
2) Regulating all development to ensure that the post-development peak runoff will not be greater than it was under pre-development conditions.
3) Set construction standards so buildings are protected from shallow water.

Most communities participate in the NFIP, which sets minimum requirements for regulating development in the floodplain. All new buildings must be protected from the base or 100-year flood and no development can cause an increase in flood heights or velocities.

Stormwater runoff regulations require developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a rate higher than what existed under pre-development conditions.

Standards for drainage requirements are typical in subdivision regulations. Standards for storm sewers, ditches, culverts, etc., are best set when an area is laid out and developed. Traditionally, the national standard is to require that the local drainage system carry the 10-year storm. Recently, communities are finding that older estimates of the 10-year storm understated the true hazard, so they are addressing larger storms.

One problem with requiring the drainage system to carry water away is that runoff increases with urban development. The runoff equivalent of a 10-year storm occurs more frequently, and from smaller storms. The problem is just sent downstream onto someone else's property.

Accordingly, modern subdivision regulations require new developments to ensure that the post-development peak runoff will not be greater than it was under pre-development conditions. This is usually done by constructing retention or detention basins to hold the runoff for a few hours or days, until flows in the system have subsided and the downstream channels can accept the water without flooding.

If the storm sewers or roadside ditches cannot handle a heavy rain, the standard subdivision design uses the streets to carry excess runoff. If the flows exceed the streets' capacity, adjacent properties will flood. Therefore, the third approach to protecting from stormwater flooding is to make sure new buildings are elevated one or two feet above the street or above adjacent grade.

Local Implementation

Although Waveland does not have a stormwater management ordinance, Waveland' subdivision design standards require that subdivisions provide for adequate drainage of surface waters. All land development must be related to the surrounding drainage pattern, with provisions made for proper drainage facilities. The minimum runoff must be determined by the rational method. When stormwater is to be diverted from its natural course, a profile of the existing watercourse and a sketch showing the existing waterway and the location of the proposed drainage change must be provided. In addition, all natural drainage courses into which other drainage courses empty shall be left undisturbed and shall be provided with adequate dedicated rights of way. Street alignment should follow contour lines or be generally parallel to drainage ways .

CRS Credit

CRS credit is provided for both higher regulatory standards in the floodplain and stormwater management standards for new developments. Credit is based on how those standards exceed the minimum NFIP requirements.

Conclusions

- State administration of installation of mobile or manufactured homes does not guarantee that they will be adequately tied down or protected from flooding and other hazards.
- Most zoning ordinances do not designate floodprone areas for any special type of land use.
- Standards in subdivision regulations for public facilities should account for the hazards present at the site. New building sites, streets, and water systems should facilitate access and use by fire and emergency equipment.
- At least minimal amount of the City's floodplain is open space in public ownership. However, a large percentage of the floodplain is still undeveloped and not preserved as open space. Therefore, preventive measures can have a great impact on the future flood damages.
- The Town's floodplain development ordinance exceeds minimum national and state standards and will be helpful in preventing flood problems from increasing.

C.5.2 Property Protection Measures

Property protection measures are used to modify buildings or property subject to damage. Property protection measures fall under three approaches:

- Modify the site to keep the hazard from reaching the building,
- Modify the building so it can withstand the impacts of the hazard, and
- Insure the property to provide financial relief after the damage occurs.

Property protection measures are normally implemented by the property owner, although in many cases technical and financial assistance can be provided by a government agency.

Keeping the Hazard Away

Generally, natural hazards do not damage vacant areas. As noted earlier, the major impact of hazards is to people and improved property. In some cases, properties can be modified so the hazard does not reach the damage-prone improvements. For example, a berm can be built to prevent floodwaters from reaching a house.

Flooding

There are five common methods to keep a flood from reaching and damaging a building:

- Erect a barrier between the building and the source of the flooding.
- Move the building out of the floodprone area.
- Elevate the building above the flood level.
- Demolish the building.
- Replace the building with a new one that is elevated above the flood level.

Barriers

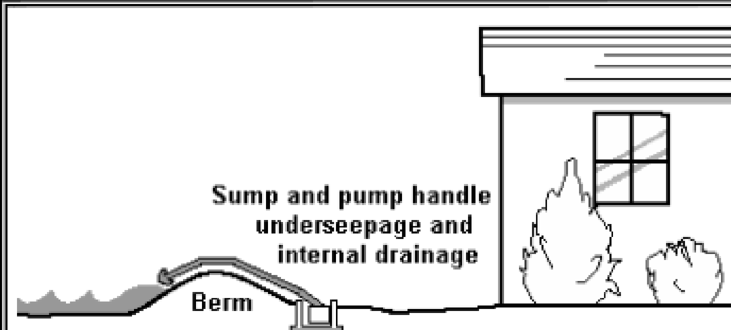
A flood protection barrier can be built of dirt or soil (a "berm") or concrete or steel (a "floodwall"). Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on how porous the ground is, if floodwaters will stay up for more than an hour or two, the design needs to account for leaks, seepage of water underneath, and rainwater that will fall inside the perimeter. This is usually done with a sump or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier.

Figure C.4. Types of Barriers


This low floodwall has landscaping to minimize the adverse impact on the property's appearance.


Small, wood frame buildings are the easiest to relocate

Source: Kennedy House Movers, Huntsville, AL



Small barriers can be effective against shallow flooding.

Barriers can only be built so high. They can be overtopped by a flood higher than expected. Barriers made of earth are susceptible to erosion from rain and floodwaters if not properly sloped, covered with grass, and properly maintained. A berm can also settle over time, lowering its protection level. A floodwall can crack, weaken, and lose its watertight seal. Therefore, barriers need careful design and maintenance (and insurance on the building, in case of failure).

Relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost increases for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. However, experienced building movers can handle any job.

In areas subject to flash flooding, deep waters, or other high hazard, relocation is often the only safe approach. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.

Building Elevation

Raising a building above the flood level can be almost as effective as moving it out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

One concern with elevation is that it may expose the structure to greater impacts from other hazards such as wind. If not braced and anchored properly, an elevated building may have less resistance to the shaking of an earthquake and the pressures of high winds.

Demolition

Some buildings, especially heavily damaged or repetitively flooded ones, are not worth the expense to protect them from future damages. It is cheaper to demolish them and either replace them with new, flood protected structures ("pilot reconstruction"), or relocate the occupants to a safer site. Demolition is also appropriate for buildings that are difficult to move - such as larger, slab foundation or masonry structures - and for dilapidated structures that are not worth protecting. Generally, demolition projects are undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public open space use, like a park.

Figure C.5. Demolition of Flooded Home

Demolishing a repetitively flooded home

One problem that sometimes results from an acquisition and demolition project is a "checkerboard" pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, are reluctant to leave their homes. Creating such an acquisition pattern in a community simply adds to the maintenance costs that taxpayers must support.

Pilot Reconstruction

If a building is not in good shape, elevating it may not be worthwhile or it may even be dangerous. An alternative is to demolish the structure and build a new one on the site that meets or exceeds all flood and wind protection codes. This was formerly known as "demo/rebuild." FEMA funding programs refer to this approach as "pilot reconstruction." It is still a pilot program, and not a regularly funded option.

Certain rules must be followed to qualify for federal funds for pilot reconstruction:

- Pilot reconstruction is only possible after it has been shown that acquisition or elevation are not feasible, based on the program's criteria.
- Funds are only available to people who owned the property at the time of the event for which funding is authorized.
- It must be demonstrated that the benefits exceed the costs.
- The new building must be elevated to the advisory base flood elevation.
- The new building must not exceed more than 10% of the old building's square footage.
- The new building must meet all flood and wind protection codes.

- There must be a deed restriction that states the owner will buy and keep a flood insurance policy.
- The maximum federal grant is 75% of the cost, up to $150,000. FEMA is developing a detailed list of eligible costs to ensure that disaster funds are not used to upgrade homes.

Local Implementation

Waveland has had experience with acquisition, demolition, or elevation to protect buildings from flooding, including acquiring repetitive loss properties. The Town has received grants from FEMA to manage these programs.

CRS Credit

The CRS provides the most credit points for acquisition and relocation, because this measure permanently removes insurable buildings from the floodplain. The CRS credits barriers and elevating existing buildings (Activity 530 - Flood Protection). Elevating a building above the flood level will also reduce the flood insurance premiums on that individual building. Because barriers are less secure than elevation, not as many points are provided. Higher scores are possible, but they are based on the number of buildings removed compared to the number remaining in the floodplain.

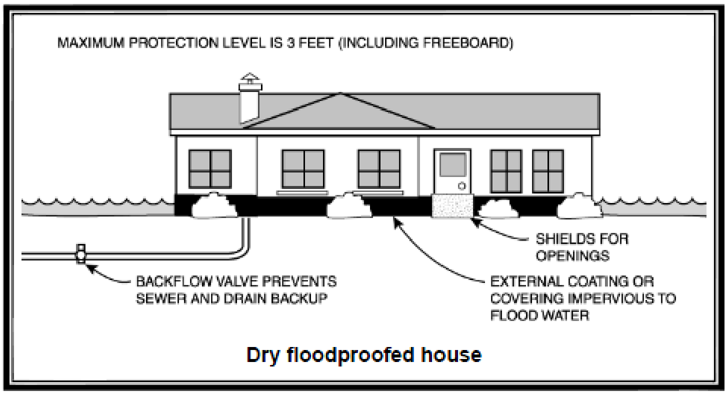
Retrofitting

An alternative to keeping the hazard away from a building is to modify or retrofit the site or building to minimize or prevent damage. There are a variety of techniques to do this, as described below.

Dry Floodproofing

Dry floodproofing means making all areas below the flood protection level watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows and vents, are closed, either permanently, with removable shields, or with sandbags. Dry floodproofing of new and existing nonresidential buildings in the regulatory floodplain is permitted under state, FEMA and local regulations. Dry floodproofing of existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Owners of buildings located outside the regulatory floodplain can always use dry floodproofing techniques.

Figure C.6. Dry Floodproofing



Dry floodproofing is only effective for shallow flooding, such as repetitive drainage problems. It does not protect from the deep flooding along lakes and larger rivers caused by hurricanes or other storms.

Wet Floodproofing

The alternative to dry floodproofing is wet floodproofing: water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater and laundry facilities are permanently relocated to a higher floor. Where the flooding is not deep, these appliances can be raised on blocks or platforms.

Local Implementation

Dry flood proofing would not be appropriate for most of the City of Waveland due to the current base flood elevations. Hurricane Katrina removed many structures which could have implemented retrofitting measures. There have been elevation projects within the City and "pilot reconstruction" projects, but the City is not aware of any structures that have been retrofitted from any other means and there are no records (permits) for them.

CRS Credit

Credit for dry and wet floodproofing and sewer backup protection is provided under Activity 530 - Retrofitting. Because these property protection measures are less secure than barriers and elevation, not as many points are provided.

Insurance

Technically, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild, and hopefully afford to incorporate some of the other property protection measures in the process. Insurance offers the advantage of protecting the property, as long as the policy is in force, without requiring human intervention for the measure to work.

Private Property

Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the NFIP. Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area.

Figure C.7. Flood Insurance Coverage

Table 5-1 Example Flood Insurance Premiums

Building Exposure	Premium
In the Special Flood Hazard Area (AE Zone)	
Pre-FIRM ("subsidized") rate	$1,689
Post-FIRM (actuarial) rates	
2 feet above the base flood elevation	$440
1 foot above the base flood elevation	$643
At the base flood elevation	$1,167
1 foot below the base flood elevation	$4,379
Outside the Special Flood Hazard Area	$1,029

Premiums are for $150,000 in building coverage and $75,000 in contents coverage for a one story house with no basement and a $500 deductible, using the October 2008 *Flood Insurance Manual*. Premiums include the 5% Community Rating System discount in unincorporated St. Tammany Parish. Premiums are higher in the municipalities, which are not in the CRS.

Most people purchase flood insurance because it is required by the bank when they get a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents. Contents coverage can be purchased separately. Renters can buy contents coverage, even if the owner does not buy structural coverage on the building. Most people don't realize that there is a 30-day waiting period to purchase a flood insurance policy and there are limits on coverage.

Public Property

Governments can purchase commercial insurance policies. Larger local governments often self-insure and absorb the cost of damage to one facility, but if many properties are exposed to damage, self-insurance can drain the government's budget. Communities cannot expect federal disaster assistance to make up the difference after a flood.

Under Section 406(d) of the Stafford Act:

> "If an eligible insurable facility damaged by flooding is located in a [mapped floodplain] … and the facility is not covered (or is underinsured) by flood insurance on the date of such flooding, FEMA is required to reduce Federal disaster assistance by the maximum amount of insurance proceeds that would have been received had the buildings and contents been fully covered under a National Flood Insurance Program (NFIP) standard flood insurance policy. [Generally, the maximum amount of proceeds for a non-residential property is $500,000.]

[Communities] Need to:

- Identify all insurable facilities, and the type and amount of coverage (including deductibles and policy limits) for each. The anticipated insurance proceeds will be deducted from the total eligible damages to the facilities.
- Identify all facilities that have previously received Federal disaster assistance for which insurance was required. Determine if insurance has been maintained. A failure to maintain the required insurance for the hazard that caused the disaster will render ineligible for Public Assistance funding…
- [Communities] must obtain and maintain insurance to cover [their] facility - buildings, equipment, contents and vehicles - for the hazard that caused the damage in order to receive Public Assistance funding. Such coverage must, at a minimum, be in the amount of the eligible project costs. FEMA will not provide assistance for that facility in future disasters if the requirement to purchase insurance is not met. - FEMA Response and Recovery Directorate Policy No. 9580.3, August 23, 2000

In other words, the law expects public agencies to be fully insured as a condition of receiving federal disaster assistance.

Local Implementation

Data on private insurance policies are not available; however, flood insurance is available in Waveland. As of April 13, 2012 there were 1,880 flood insurance policies in Waveland. These policies are described in Section 4.4.3 of the base plan.

CRS Credit

There is no credit for purchasing flood insurance, but the CRS does provide credit for local public information programs that explain flood insurance to property owners. The CRS also reduces the premiums for those people who do buy NFIP coverage.

The Government's Role

Property protection measures are usually considered the responsibility of the property owner. However, local governments should be involved in all strategies that can reduce flood losses, especially acquisition and conversion of a site to public open space. There are various roles a municipality can play in encouraging and supporting implementation of these measures.

One of the first duties of a local government is to protect its own facilities. Fire stations, water treatment plants and other critical facilities should be a high priority for retrofitting projects and insurance coverage. Often public agencies discover after the disaster that their "all-hazard" insurance policies do not cover the property for the type of damage incurred. Flood insurance is even more important as a mitigation measure because of the Stafford Act provisions discussed in section 5.15.2 above.

Providing basic information to property owners is the first step in supporting property protection measures. Owners need general information on what can be done. They need to see examples, preferably from nearby. Public information activities that can promote and support property protection are covered in section 5.7.

Communities can help owners by helping to pay for a retrofitting project. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups, street flooding, and other problems that arise from an inadequate public sewer or public drainage system. Less expensive community programs include low interest loans, forgivable low interest loans and rebates. A forgivable loan is one that does not need to be repaid if the owner does not sell the house for a specified period, such as five years. These approaches don't fully fund the project, but they cost the community less and they increase the owner's commitment to the flood protection project. Often, small amounts of money act as a catalyst to pique the owner's interest to get a self-protection project moving.

The more common outside funding sources are listed below. Unfortunately, the last three are only available after a disaster, not before, when damage could be prevented.

Pre-disaster funding sources:

- FEMA's Pre-Disaster Mitigation (PDM) grants
- FEMA's Flood Mitigation Assistance (FMA) grants
- Community Development Block Grants
- Conservation organizations, although generally these organizations prefer to purchase vacant land in natural areas, not properties with buildings on them.

Post-disaster funding sources:

- Insurance claims
- The NFIP's Increased Cost of Compliance. This provision increases a flood insurance claim payment to help pay for a flood protection project required by code as a condition to rebuild

the flooded building. It can also be used to help pay the non-federal cost-share of an elevation project.

Post-disaster funding sources, federal disaster declaration needed

- FEMA's disaster assistance (for public properties). However, after a flood, the amount of assistance will be reduced by the amount of flood insurance that the public agency should be carrying on the property.
- Small Business Administration disaster loans (for non-governmental properties)
- FEMA's Hazard Mitigation Grant Program

Acquisition Agent

The community can be the focal point in an acquisition project. Most funding programs require a local public agency to sponsor the project. The local government could process the funding application, work with the owners, and provide some, or all, of the local share. In some cases, the local government would be the ultimate owner of the property, but in other cases another public agency could assume ownership and the attendant maintenance responsibilities.

Mandates

Mandates are considered a last resort if information and incentives are insufficient to convince a property owner to take protective actions. An example of a retrofitting mandate is the requirement that communities have to disconnect downspouts from the sanitary sewer line.

There is a mandate for improvements or repairs made to a building in the mapped floodplain. If the project equals or exceeds 50% of the value of the original building, it is considered a "substantial improvement." The building must then be elevated or otherwise brought up to current flood protection codes.

Another possible mandate is to require less expensive hazard protection steps as a condition of a building permit. For example, many communities require upgraded electrical service as a condition of a home improvement project. If a person were to apply for a permit for electrical work, the community could require that the service box be moved above the base flood elevation or the installation of a separate ground fault interrupter circuits in the basement.

Local Implementation

As of the development of this plan, Waveland is not aware of any homes that have been retrofitted for flood protection or acquired and relocated to another site.

CRS Credit

Except for public information programs, the CRS does not provide credit for efforts to fund, provide incentives, or mandate property protection measures. CRS credits are provided for the actual projects after they are completed. However, to participate in CRS, a community must certify that it has adequate flood insurance on all properties that have been required to be insured. The minimum requirement is to insure those properties in the mapped floodplain that have received federal aid, as specified by the Flood Disaster Protection Act of 1973.

Repetitive Loss Properties and Analysis

Repetitive loss properties deserve special attention because they are more prone to damage by natural hazards than any other properties in the City. Further, protecting repetitive loss buildings is a priority with FEMA mitigation funding programs.

There are 66 repetitive loss properties in the City of Waveland. Flood insurance policies and paid amounts for repetitive loss properties in the City are shown in Table C.2.

Table C.2. Flood Insurance for Repetitive Loss Properties

Structure Type	Firm Zone	Insured	Number of Losses	Total Paid Claims*
Single Family	A-8	NO	2	$36,941
Non-Residential	AE	Yes	4	$90,831
Single Family	A	No	5	$266,688
Single Family	AE	No	2	$3,411

* Includes claims paid for both structure and contents

Conclusions

- There are several ways to protect individual properties from damage by natural hazards. The advantages and disadvantages of each should be examined for each situation.
- Property owners can implement some property protection measures at little cost, especially for sites in areas of low hazards (e.g., shallow flooding, sewer backup, and thunderstorms). For other measures, such as relocation and elevation, the owners may need financial assistance.
- (Less than 10% of the buildings in the City's floodplains are covered by flood insurance).
- Local government agencies can promote and support property protection measures through several activities, ranging from public information to financial incentives to full funding.
- It is unlikely that most government properties, including critical facilities, have any special measures to protect them from flooding.
- Property protection measures can protect the most damage-prone buildings in the City: repetitive loss properties.

Recommendations

- Public education materials should be developed to explain property protection measures that can help owners reduce their exposure to damage by floods and the various types of insurance that are available.

- Because properties in floodplains will be damaged at some point, a special effort should be made to provide information and advice to floodplain property owners. Special attention should be given to repetitive loss and high hazard areas.
- All property protection projects should be voluntary. Other than state and federally mandated regulations, local incentives should be positive as much as possible, such as providing financial assistance.
- (Jones should encourage "Safe Room" construction in residential structures).
- A standard checklist should be developed to evaluate a property's exposure to damage from floods. It should include a review of insurance coverage and identify where more information can be found on appropriate property protection measures. The checklist should be provided to each agency participating in this planning process and made available to the public.
- Waveland should evaluate its own properties using the standard checklist. A priority should be placed on determining critical facilities' vulnerability to damage and whether public properties are adequately insured.
- Waveland should protect its own publicly owned facilities with appropriate mitigation measures.

References

Disaster Mitigation Guide for Business and Industry, Federal Emergency Management Agency, FEMA-190, 1990.

Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings, FEMA, FEMA-259, 1995.

Flood Insurance Agent's Manual, FEMA, 2000.

Flood Proofing Techniques, Programs and References, U.S. Army Corps of Engineers National Flood Proofing Committee, 1991.

Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding. FEMA, FEMA-312, 1998.

Local Flood Proofing Programs, U.S. Army Corps of Engineers, 1994.

C.5.3 Natural Resource Protection

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. These activities enable the naturally beneficial functions of fields, floodplains, wetlands, and other natural lands to operate more effectively. Natural and beneficial functions of watersheds, floodplains and wetlands include:

- Reduction in runoff from rainwater and snow melt in pervious areas

- Infiltration that absorbs overland flood flow
- Removal and filtering of excess nutrients, pollutants and sediments
- Storage of floodwaters
- Absorption of flood energy and reduction in flood scour
- Water quality improvement
- Groundwater recharge
- Habitat for flora and fauna
- Recreational and aesthetic opportunities

As development occurs, many of the above benefits can be achieved through regulatory steps for protecting natural areas or natural functions. The regulatory programs are discussed in Section 5.3 Preventive Measures of the base plan. This section covers the resource protection programs and standards that can help mitigate the impact of natural hazards, while they improve the overall environment. Seven areas are reviewed:

- Wetland protection
- Erosion and sedimentation control
- River restoration
- Best management practices
- Dumping regulations
- Urban forestry
- Farmland protection

Wetland Protection

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and they provide habitat for many species of fish, wildlife and plants.

Wetlands that are determined to be part of the waters of the United States are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency (US EPA) under Section 404 of the Clean Water Act. Before a "404" permit is issued, the plans are reviewed by several agencies, including the Corps and the U.S. Fish and Wildlife Service. Each of these agencies must sign off on individual permits.

There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits. Wetlands not included in the Corps' jurisdiction or that are addressed by a nationwide permit may be regulated against by local authorities.

If a permit is issued by the Corps or the City, the impact of the development is typically required to be mitigated. Wetland mitigation can include creation, restoration, enhancement or preservation of wetlands elsewhere. Wetland mitigation is often accomplished within the development site, however, mitigation is allowed off-site and sometimes in another watershed. The appropriate type of mitigation is addressed in each permit.

Some developers and government agencies have accomplished the required mitigation by buying into a wetland bank. Wetland banks are large wetlands created for the purpose of mitigation. The banks accept money to reimburse the owner for setting the land aside from development.

When a wetland is mitigated at a separate site there are drawbacks to consider. First, it takes many years for a new wetland to approach the same quality as an existing one. Second, a new wetland in a different location (especially if it is in a different watershed) will not have the same flood damage reduction benefits as the original one did.

Local Implementation

Waveland ordinances do not require any specific wetland protection measures .

CRS Credit

The CRS focuses on activities that directly affect flood damage to insurable buildings. While there is no credit for relying on the Corps of Engineers' 404 regulations, there is credit for preserving open space in its natural condition or restored to a state approximating its natural condition. The credit is based on the percentage of the floodplain that can be documented as wetlands protected from development by ownership or local regulations.

Erosion and Sedimentation Control

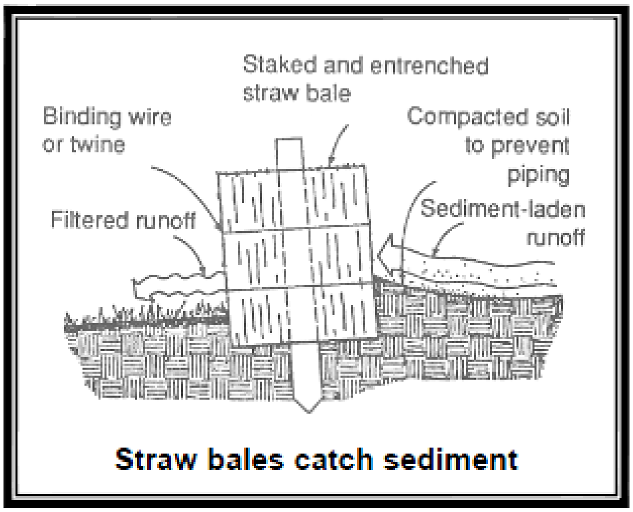
Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along stream banks and shorelines as the volume and velocity of flow or wave action destabilize and wash away the soil.

Sediment suspended in the water tends to settle out where flowing water slows down. This can clog storm drains, drain tiles, culverts and ditches and reduce the water transport and storage capacity of river and stream channels, lakes and wetlands. When channels are constricted and flooding cannot deposit sediment in the bottomlands, even more sediment is left in the channels. The result is either clogged streams or increased dredging costs.

Not only are the drainage channels less able to perform their job, but the sediment in the water reduces light, oxygen and water quality, and often carries chemicals, heavy metals and other pollutants. Sediment has been identified by the US EPA as the nation's number one nonpoint source pollutant for aquatic life.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing practices.

Figure C.8. Erosion Control



If erosion occurs, other measures are used to capture sediment before it leaves the site. Silt fences, sediment traps and vegetated filter strips are commonly used to control sediment transport. Runoff from the site can be slowed down by terraces, contour strip farming, no-till farm practices, hay or straw bales, constructed wetlands, and impoundments (e.g., sediment basins and farm ponds). Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site.

Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project. This allows the applicant to determine the best practices for the site.

Local Implementation

Waveland's ordinances do include standards for erosion and sedimentation control .

CRS Credit

Local governments whose ordinances include erosion and sedimentation control provisions can qualify for up to 45 points for this measure.

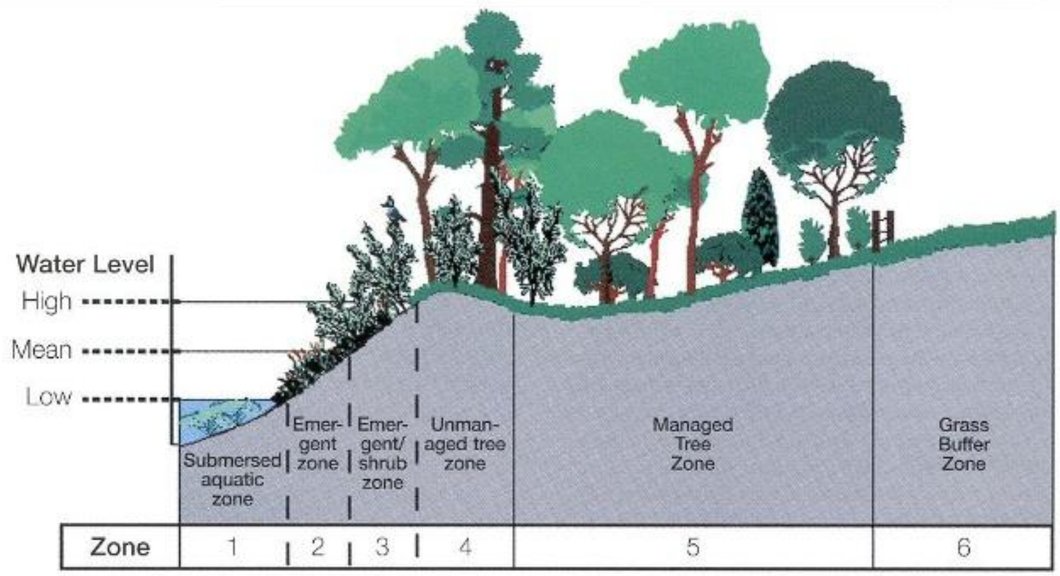
River Restoration

There is a growing movement that has several names, such as "stream conservation," "bioengineering," or "riparian corridor restoration." The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration," which restores native indigenous plants and animals to an area.

A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve retrofitting the shoreline with willow cuttings, wetland plants, or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

- In all, restoring the right vegetation to a stream has the following advantages:
- Reduces the amount of sediment and pollutants entering the water
- Enhances aquatic habitat by cooling water temperature
- Provides food and shelter for both aquatic and terrestrial wildlife
- Can reduce flood damage by slowing the velocity of water
- Increases the beauty of the land and its property value
- Prevents property loss due to erosion
- Provides recreational opportunities, such as hunting, fishing and bird watching
- Reduces long-term maintenance costs

Figure C.9. River Restoration Zones



Aquatic and riparian buffer plant zones

Different types of plants are used in different buffer zones along a channel. Zone 1 plants are normally submerged while zone 2 plants are inundated during much of the growing season. Zone 3 plants are water tolerant, but are flooded only during high water. By using the proper plants in each zone, they stabilize streambanks, filter polluted runoff, and provide habitat. *Source: Banks and Buffers – A Guide to Selecting Native Plants for Streambanks and Shorelines*, Tennessee Valley Authority

Local Implementation

Waveland does not yet implement these activities, but may consider adopting some of them in the future.

CRS Credit

The CRS focuses on activities that directly affect flood damage to insurable buildings. However, there are credits for preserving open space in its natural condition or restored to a state approximating its natural condition. There are also credits for channel setbacks, buffers and protecting shorelines.

Best Management Practices

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by the US EPA and the Mississippi Department of Environmental Quality. Nonpoint source pollutants come from non-specific locations and harder to regulate. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, other chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

The term "best management practices" (BMPs) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff rates and volumes, prevent erosion, protect natural resources and capture nonpoint source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, preserve beneficial natural features onsite, maintain natural base flows, minimize habitat loss, and provide multiple usages of drainage and storage facilities.

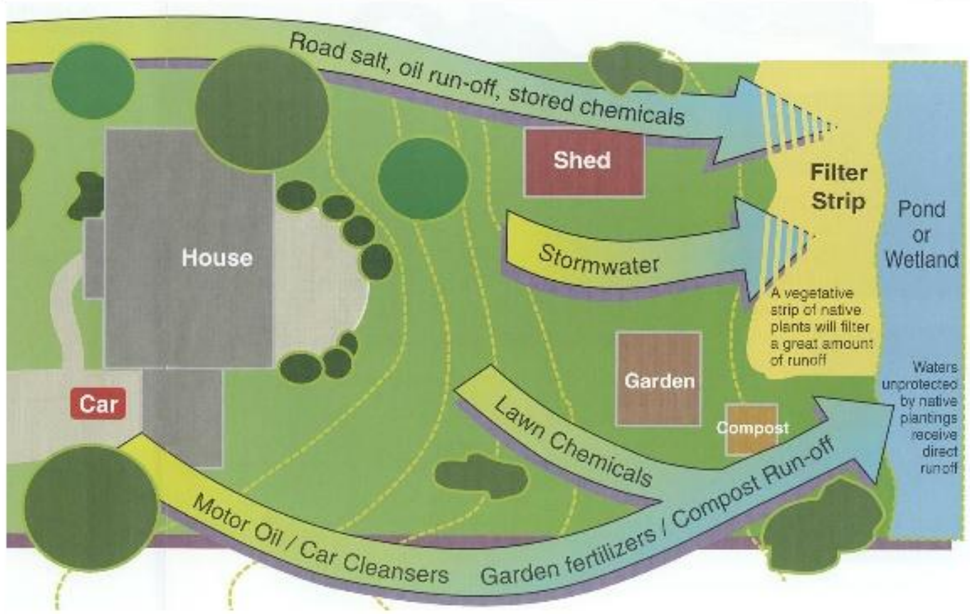
Local Implementation

Currently, Waveland is not required to participate in the National Pollutant Discharge Elimination System permitting program and does not require BMPs to minimize stormwater impacts.

CRS Credit

A community can receive 25 CRS points if regulations require new developments of five acres or more to include in the design of their permanent stormwater management facilities appropriate BMPs that will improve the quality of surface waters.

Figure C.10. Stormwater Best Management Practices



BMPs slow stormwater runoff and improve water quality.

Source: Living With Wetlands, A Handbook for Homeowners in Northeastern Illinois

Dumping Regulations

BMPs usually address pollutants that are liquids or are suspended in water that are washed into a lake or stream. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' abilities to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels. Regular inspections to catch violations should be scheduled.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard without realizing that is needed to drain street runoff. They may not understand how regarding their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Local Implementation

Waveland's ordinances makes it unlawful for anyone to deposit waste, grass, weeds, brush or other refuse in any street, ditch or watercourse, or on others' property, or on public property. It is also illegal to dispose of certain wastes in public sewers.

CRS Credit

The CRS provides up to 30 points for enforcing and publicizing a regulation that prohibits dumping in the drainage system.

Farmland Protection

Farmland protection is quickly becoming an important piece of comprehensive planning and zoning throughout the United States. The purpose of farmland protection is to provide mechanisms for prime, unique, or important agricultural land to remain as such, and to be protected from conversion to nonagricultural uses.

Frequently, farm owners sell their land to residential or commercial developers and the property is converted to non-agricultural land uses. With development comes more buildings, roads and other infrastructure. Urban sprawl occurs, which can lead to additional stormwater runoff and emergency management difficulties.

Figure C.11. Floodplain Damages to Farmland

Farms on the edge of cities are often appraised based on the price they could be sold for to urban developers. This may drive farmers to sell to developers because their marginal farm operations cannot afford to be taxed as urban land. The Farmland Protection Program in the United States Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to state, tribal, and local governments as well as nonprofit organizations to help purchase easements on agricultural land to protect against the development of the land. Eligible land includes cropland, rangeland, grassland, pastureland, or forest land that is part of an agricultural operation. Certain lands within historical or archaeological resources are also included.

The hazard mitigation benefits of farmland protection are similar to those of open space preservation, as discussed in section 5.3 Preventive Measures:

- Farmland is preserved for future generations,
- Farmland in the floodplain keeps damageable structures out of harm's way,
- Farmland keeps more stormwater on site and lets less stormwater runoff downstream,
- Rural economic stability and development is sustained,
- Ecosystems are maintain, restored or enhanced, and

The rural character and scenic beauty of the area is maintained.

Local Implementation

Waveland does not currently require any farmland protection provisions. Preserving existing farmland within Waveland can maintain open space and a feeling of the rural atmosphere that currently exists in parts of the City.

CRS Credit

Credit is given for preserving open space in the floodplain, regardless of why it is being preserved. Credit is also provided for density zoning of floodprone areas.

Conclusions

- A hazard mitigation program can use resource protection programs to support protecting areas and natural features that can mitigate the impacts of natural hazards.
- The City's ordinances prohibit illicit discharges into public sewers or onto public or private property.
- Preserving farmland in the floodplain will maintain open pace and prevent damage to homes, businesses, and other development.

Recommendations

- Waveland should consider adopting regulations that offer wetland protection.
- The public and decision makers should be informed about the hazard mitigation benefits of restoring rivers, wetlands and other natural areas. Restoration and protection techniques should be explained.
- Waveland should publicize its illicit discharge rules more widely.
- The public should be informed about the need to protect streams and wetlands from dumping and inappropriate development and the relevant codes and regulations .
- Jones should consider development setbacks or buffers to protect the watercourses within the town.

References

Banks and Buffers - A Guide to Selecting Native Plants for Stream banks and Shorelines, Tennessee Valley Authority, 1997.

CRS Coordinator's Manual, Community Rating System, FEMA, 2007.

Stream Corridor Restoration Principles, Processes and Practices, Federal Interagency Stream Restoration Working Group, 1998.

C.5.4 Emergency Services Measures

Emergency services measures protect people during and after a disaster. A good emergency management program addresses all hazards, and it involves all local government departments. At the state level, emergency services programs are coordinated by the Mississippi Emergency Management Agency (MEMA). Locally, Waveland's emergency services are coordinated by Hancock County Emergency Management.

This section reviews emergency services measures following a chronological order of responding to an emergency. It starts with identifying an impending problem (threat recognition) and continues through post-disaster activities.

Threat Recognition

The first step in responding to a flood, storm, or other natural hazard is to know when weather conditions are such that an event could occur. With a proper and timely threat recognition system, adequate warnings can be disseminated.

The National Weather Service (NWS) is the prime agency for detecting meteorological threats, such as tornadoes, thunderstorms and winter storms. Severe weather warnings are transmitted through NOAA's Weather Radio System. Federal agencies can only look at the large scale, e.g., whether conditions are appropriate for the formation of a thunderstorm. Local emergency managers can provide more site-specific and timely recognition by sending out NWS trained spotters to watch the skies when the Weather Service issues a watch or a warning.

Severe snow storms can often be forecast days in advance of the expected event, which allows time for warning and preparation. Though more difficult, the NWS can also forecast ice storms.

A flood threat recognition system predicts the time and height of a flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

On larger rivers, this measuring and calculating is performed by the NWS, a part of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Support for NOAA's efforts is provided by cooperating partners from state and local agencies.

Forecasts of expected river stages are made through the Advanced Hydrologic Prediction Service (AHPS) of the National Weather Service. Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio. NOAA Weather Radio is considered by the federal government as the official source for weather information.

On smaller rivers, locally established rainfall and river gauges are needed to establish a flood threat recognition system. The NWS may issue a "flash flood watch." This is issued to indicate current or developing hydrologic conditions that are favorable for flash flooding in and close to the watch area, but the occurrence is neither certain nor imminent. These events are so localized and so rapid that a "flash flood warning" may not be issued, especially if no remote threat recognition equipment is available. In the absence of a gauging system on small streams, the best threat recognition system is to have local personnel monitor rainfall and stream conditions. While specific flood crests and times will not be predicted, this approach will provide advance notice of potential local or flash flooding.

Local Implementation

The City monitors tornado and flood warnings issued by the County. Waveland does have an emergency operations plan. (There is one stream gauge serving Jones where the North Canadian River intersects East Britton Road. This gauge provides real-time forecasting and is monitored by Oklahoma County and Jones City along with the National Weather Service .)

CRS Credit

Credit can be received for using National Hurricane Center warnings and river flood stage predictions for the NWS's gages. The actual score is based on how much of the community's floodplain is affected by these systems. Potential CRS credit is possible under Activity 610 - Flood Warning Program.

Warning

After the threat recognition system tells the emergency management office that a flood, tornado, thunderstorm, hurricane or other hazard is coming, the next step is to notify the public and staff of other agencies and critical facilities. More people can implement protection measures if warnings are early and include specific detail.

The NWS issues notices to the public using two levels of notification :

- Watch: conditions are right for flooding, thunderstorms, tornadoes or winter storms.
- Warning: a flood, tornado, etc., has started or been observed.

A more specific warning may be disseminated by the community in a variety of ways. The following are the more common methods:

- Commercial or public radio or TV stations
- The Weather Channel
- Cable TV emergency news inserts
- Telephone trees/mass telephone notification
- NOAA Weather Radio
- Tone activated receivers in key facilities
- Outdoor warning sirens
- Sirens on public safety vehicles
- Door-to-door contact
- Mobile public address systems
- Email notifications

Multiple or redundant systems are most effective - if people do not hear one warning, they may still get the message from another part of the system. Each has advantages and disadvantages:

- Radio and television provide a lot of information, but people have to know when to turn them on. They are most appropriate for hazards that that develop over more than a day, such as a tropical storm, hurricane, or winter storm.
- NOAA Weather Radio can provide short messages of any impending weather hazard or emergency and advise people to turn on their televisions for more information, but not everyone has a Weather Radio.
- Outdoor warning sirens can reach many people quickly as long as they are outdoors. They do not reach people in tightly-insulated buildings or those around loud noise, such as at a factory, during a thunderstorm, or in air conditioned homes. They do not explain what hazard is coming, but people should know to turn on a radio or television when they hear the siren.
- Automated telephone notification services are also fast, but can be expensive and do not work when phone lines are down. Nor do they work for unlisted numbers, call screening services, or cellular service, unless people sign up for notifications.
- Where a threat has a longer lead time, going door-to-door and manual telephone trees can be effective.

Just as important as issuing a warning is telling people what to do in case of an emergency. A warning program should have a public information aspect. Citizens should know the difference between a tornado warning (when they should seek shelter in a low spot), a flood warning (when they should stay out of low areas), and other appropriate warnings and responses.

StormReady

The National Weather Service established the StormReady program to help local governments improve the timeliness and effectiveness of hazardous weather related warnings for the public. To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center,
- Have more than one way to receive severe weather warnings and forecasts and to alert the public,
- Create a system that monitors weather conditions locally,
- Promote the importance of public readiness through community seminars, and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Being designated a StormReady community by the National Weather Service is a good measure of a community's emergency warning program for weather hazards. It is also credited by the CRS.

Local Implementation

Waveland is in the process of re-establishing its StormReady designation. Waveland notifies residents of emergencies via telephone and door-to-door notice depending on the type of emergency. The Waveland police and fire departments are responsible for enforcing actions required during an emergency.

CRS Credit

Community Rating System points are based on the number and types of warning media that can reach the community's flood prone population. Depending on the location, communities can receive credit for the telephone calling system and more points if there are additional measures, like telephone trees. Being designated as a StormReady community can provide additional points. These credits are in Activity 610 - Flood Warning Program.

Response

The protection of life and property is the most important task of emergency responders. Concurrent with threat recognition and issuing warnings, a community should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- Activating the emergency operations center (emergency preparedness),
- Closing streets or bridges (police or public works),
- Shutting off power to threatened areas (utility company),
- Passing out sand and sandbags (public works),

- Holding children at school or releasing children from school (school superintendent),
- Opening evacuation shelters (the American Red Cross),
- Monitoring water levels (public works), and
- Establishing security and other protection measures (police).

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

A flood stage forecast map shows areas that will be under water at various flood stages. Different flood levels are shown as color coded areas, so the emergency manager can quickly see what will be affected. Emergency management staff can identify the number of properties flooded, which roads will be under water, which critical facilities will be affected, and who to warn. With this information, an advance plan can be prepared that shows problem sites and determines what resources will be needed to respond to the predicted flood level.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to ensure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and of changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner possible.

Local Implementation

The City of Waveland Fire Chief serves as the Emergency Manager . Most emergency management services are coordinated with Hancock County Emergency Management. The City provides search and rescue in cooperation with the police and the fire department.

CRS Credit

The CRS program provides credit under Activity 610- Flood Warning for a warning system that effectively notifies residents of a flood and has procedures for testing and monitoring the system.

Evacuation and Shelter

According to Emergency Management: Principles and Practice, "The principle of evacuation is to move citizens from a place of relative danger to a place of relative safety, via a route that does not pose significant danger." There are six key ingredients to a successful evacuation:

- Adequate warning
- Adequate routes
- Proper timing to ensure the routes are clear
- Traffic control

- Knowledgeable travelers
- Care for special populations (e.g., the handicapped, prisoners, hospital patients, and schoolchildren)

Those who cannot get out of harm's way need shelter. Typically, the American Red Cross will staff a shelter and ensure that there is adequate food, bedding, and wash facilities. Shelter management is a specialized skill. Managers must deal with problems like scared children, families that want to bring in their pets, and the potential for an overcrowded facility.

Local Implementation

There are XXX emergency evacuation centers in Waveland. The City has established evacuation routes. Portions of Highway 603 have been inundated with flood waters in the past, most recently with Hurricane Isaac.

CRS Credit

Because it is primarily concerned with protecting insurable buildings, the CRS does not provide any special credit for evacuation or sheltering of people (minimal credit is given in Activity 510 - Floodplain Management for evacuation policies and procedures). It is assumed that the emergency response plan would include all necessary actions in response to a flood.

Post-Disaster Recovery and Mitigation

After a disaster, communities should undertake activities to protect public health and safety and facilitate recovery. Appropriate measures include:

- Patrolling evacuated areas to prevent looting,
- Providing safe drinking water,
- Monitoring for diseases,
- Vaccinating residents for tetanus and other diseases,
- Clearing streets, and
- Cleaning up debris and garbage.

Throughout the recovery phase, everyone wants to get "back to normal." The problem is that "normal" means the way they were before the disaster, exposed to repeated damage from future disasters. There should be an effort to help prepare people and property for the next disaster. Such an effort would include:

- Public information activities to advise residents about mitigation measures they can incorporate into their reconstruction work,
- Evaluating damaged public facilities to identify mitigation measures that can be included during repairs,
- Identifying other mitigation measures that can lessen the impact of the next disaster,

- Acquiring substantially or repeatedly damaged properties from willing sellers,
- Planning for long-term mitigation activities, and
- Applying for post-disaster mitigation funds.

Regulating Reconstruction

Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to reenter and repair. There is a special requirement to do this in floodplains, regardless of the type of disaster or the cause of damage. The NFIP requires that local officials enforce the substantial damage regulations. These rules require that if the cost to repair a building in the mapped floodplain equals or exceeds 50% of the building's market value, the building must be retrofitted to meet the standards of a new building in the floodplain. In most cases, this means that a substantially damaged building must be elevated above the base flood elevation.

This requirement can be very difficult for understaffed and overworked offices following a disaster. However, if these activities are not carried out properly, not only does the community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP. In some areas, mutual aid agreements have been established so building inspectors from a community not affected by the disaster can work in the communities that were hit the hardest.

Local Implementation

There are currently no post-disaster recovery policies or plans in place for Waveland .

CRS Credit

The CRS does credit post-disaster mitigation procedures if the policies and procedures are incorporated into a flood mitigation or multi-hazard plan through Activity 510 - Floodplain Management Planning.

Conclusions

- There are several threat recognitions systems that can provide Waveland with advance notice of an impending emergency.
- The City depends on local media outlets, sirens, telephones and door-to-door notices to warn residents . These media should reach most people who need to know of a threat.
- Emergency management guidance could be very helpful when things happen quickly and for hazards that have predictable impacts, such as tornado, winter storms and flooding.

Recommendations

- Waveland should consider purchase of emergency generators for use at City Hall and emergency evacuation centers.
- Waveland should consider purchase of a second tanker to help in the event of wildfires .
- City staff members should work together to develop post-disaster procedures for public information, reconstruction regulation and mitigation project identification.
- Waveland should consider purchase of a water rescue boat for flood events

References

CRS Coordinator's Manual, FEMA, 2007.

CRS Credit for Flood Warning Programs, FEMA, 2006.

Emergency Management: Principles and Practice for Local Government, International City/County Management Association, 1991.

Flood Fight Operations, FEMA, 1995.

Guide for All-Hazard Emergency Operations Planning, FEMA SLG-101, 1996.

C.5.5 Flood Control Measures

Four general types of flood control projects are reviewed here: levees, reservoirs, diversions, and dredging. These projects have three advantages not provided by other mitigation measures:

- They can stop most flooding, protecting streets and landscaping in addition to buildings,
- Many projects can be built without disrupting citizens' homes and businesses, and
- They are constructed and maintained by a government agency, a more dependable long-term management arrangement than depending on many individual private property owners.

However, as shown below, structural measures also have shortcomings. The appropriateness of using flood control depends on individual project area circumstances.

Pros and Cons of Structural Flood Control Projects

- Advantages
  - They may provide the greatest amount of protection for land area used.
  - Because of land limitations, they may be the only practical solution in some circumstances.
  - They can incorporate other benefits into structural project design, such as water supply and recreational uses.
  - Regional detention may be more cost-efficient and effective than requiring numerous small detention basins.

- Disadvantages
- They can disturb the land and disrupt the natural water flows, often destroying wildlife habitat.
- They require regular maintenance, which if neglected can have disastrous consequences.
- They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage.
- They can create a false sense of security, as people protected by a project often believe no flood can ever reach them.
  - Although it may be unintended, in many circumstances they promote more intensive land use and development in the floodplain.

Levees and Floodwalls

Probably the best known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour. Key considerations when evaluating the use of a levee include:

- Design and permitting costs,
- Right of way acquisition,
- Removal of fill to compensate for the floodwater storage that will be displaced by the levee,
- Internal drainage of surface flows from the area inside the levee,
- Cost of construction,
- Cost of maintenance,
- Mitigation of adverse impacts to wetlands and other habitats,
- Loss of river access and views, and
- Creating a false sense of security, because while levees may reduce flood damage for smaller more frequent rain events, they may also overtop or breach in extreme flood events and subsequently create more flood damage than would have occurred without the levee.

Levees placed along the river or stream edge degrade the aquatic habitat and water quality of the stream. They also are more likely to push floodwater onto other properties upstream or downstream. To reduce environmental impacts and provide multiple use benefits, a setback levee is the best project design. The area inside a setback levee can provide open space for recreational purposes and provide access sites to the river or stream.

Floodwalls perform like levees except they are vertical-sided structures that require less surface area for construction. Floodwalls are constructed of steel sheet pile or reinforced concrete, which makes the expense of installation cost prohibitive in many circumstances. Floodwalls also degrade adjacent habitat and can displace erosive energy to unprotected areas of shoreline downstream.

Reservoirs and Detention

Reservoirs reduce flooding by temporarily storing flood waters behind dams or in storage or detention basins. Reservoirs lower flood heights by holding back, or detaining, runoff before it can flow downstream. Flood waters are detained until the flood has subsided, and then the water in the reservoir or detention basin is released or pumped out slowly at a rate that the river can accommodate downstream.

Reservoirs can be dry and remain idle until a large rain event occurs. Or they may be designed so that a lake or pond is created. The lake may provide recreational benefits or water supply (which could also help mitigate a drought).

Flood control reservoirs are most commonly built for one of two purposes. Large reservoirs are constructed to protect property from existing flood problems. Smaller reservoirs, or detention basins, are built to protect property from the stormwater runoff impacts of new development.

Figure C.12. Retention Pond

Retention pond

Regardless of size, reservoirs protect the development that is downstream from the reservoir site. Unlike levees and channel modifications, they do not have to be built close to or disrupt the area to be protected. Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to be stored.

In urban areas, some reservoirs are simply manmade holes, excavated to store floodwaters. Reservoirs in urban areas are typically constructed adjacent to streams (though usually outside of the floodplain). When built in the ground, there is no dam for these retention and detention basins and no dam failure hazard. Wet or dry basins can also serve multiple uses by doubling as parks or other open space uses.

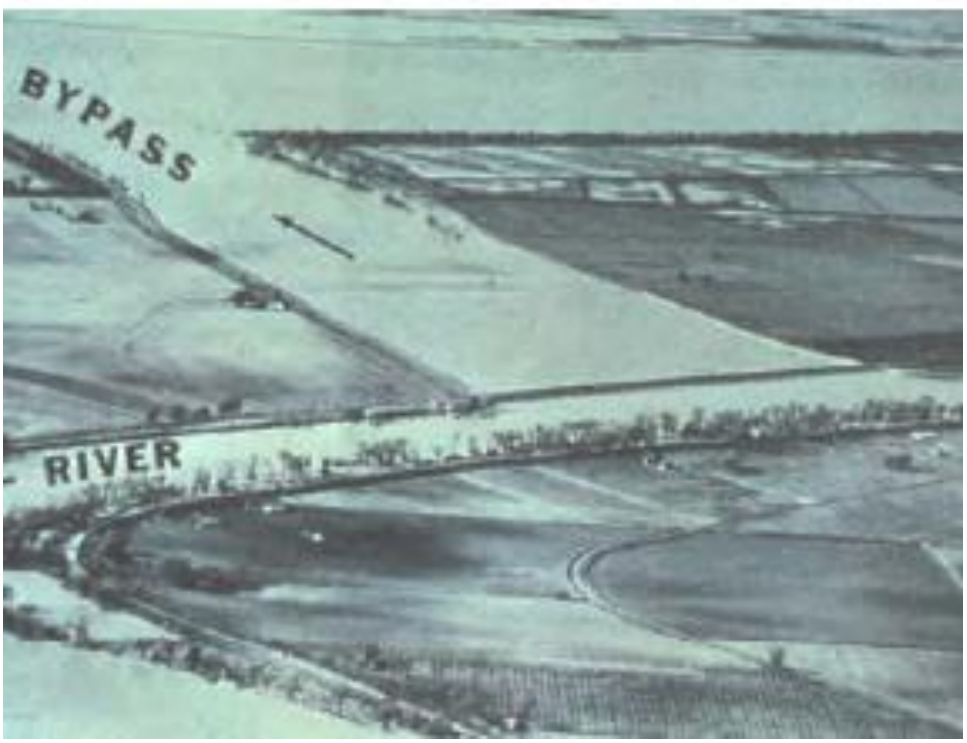
There are several considerations when evaluating the use of reservoirs and detention:

- There is the threat of flooding the protected area should the reservoir's dam fail,
- There is a constant expense for the management and maintenance of the facility,
- They may fail to prevent floods that exceed their design levels,
- Sediment deposition may occur and reduce the storage capacity over time,
- They can impact water quality as they are known to affect temperature, dissolved oxygen and nitrogen, and nutrient levels, and
- If not designed correctly, in-stream reservoirs may cause backwater flooding problems upstream

Diversion

A diversion is a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. Diversions can be surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel. During floods, the floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving lake or river.

Figure C.13. Diversion



Diversions are limited by topography; they will not work in some areas. Unless the receiving water body is relatively close to the floodprone stream and the land in between is low and vacant, the cost of creating a diversion can be prohibitive.

Dredging

Dredging is often viewed as a form of conveyance improvement. However, it has the following problems:

- Given the large volume of water that comes downstream during a flood, removing a foot or two from the bottom of the channel will have little effect on flood heights.
- Dredging is often cost prohibitive because the dredged material must be disposed of somewhere.
- Unless in-stream or tributary erosion is corrected upstream, the dredged areas usually fill back in within a few years, and the process and the expense have to be repeated.
- If the channel has not been disturbed for many years, dredging will destroy the habitat that has developed.

Figure C.14. Dredging Activity

To protect the natural values of the stream, federal law requires a U.S. Army Corps of Engineers permit before dredging can proceed. This can be a lengthy process that requires a lot of advance planning and many safeguards to protect habitats, which adds to the cost of the project.

CRS Credit

Structural flood control projects that provide 100-year flood protection and that result in revisions to the Flood Insurance Rate Map are not credited by the CRS in order to avoid duplicating the larger premium reduction provided by removing properties from the mapped floodplain.

The CRS credits smaller flood control projects that meet the following criteria:

- They must provide protection to at least the 25-year flood,
- They must meet certain environmental protection criteria,
- They must meet federal, state and local regulations, such as the Corps of Engineers' 404 permit and Mississippi Department of Environmental Quality -Dam Safety Division for dam safety rules, and
- They must meet certain maintenance requirements.

These criteria ensure that credited projects are well-planned and permitted. Any of the measures reviewed in this section would be recognized under Activity 530 - Flood Protection, although it would be very hard to qualify a dredging project. Credit points are based on the type of project, how many buildings are protected, and the level of flood protection provided.

Local Implementation

Waveland has received FEMA HMGP funds to execute a city-wide drainage improvement project. The project is currently in the design and approval stage.

Conclusions VERIFY THESE

- Waveland has received federal funding for construction of a city-wide drainage project that will move storm and flood waters more efficiently and reduced potential for overbank flooding.
- Regional detention does not appear to be a solution to control flooding on the North Canadian River and its tributaries.
- Approximately 14 homes along the north side of Cherokee Street could benefit from a less than a 100-year levee or berm to hold back flood waters from the North Canadian River.

Recommendations

- Waveland should implement the city-wide drainage improvement project to reduce the potential from overbank flooding along certain reaches of the tributary .
- Dredging project?
- Other?

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C.5.6 Public Information Measures

A successful hazard mitigation program involves both the public and private sectors. Public information activities advise property owners, renters, and businesses about hazards and ways to protect people and property from these hazards. These activities can motivate people to take the steps necessary to protect themselves and others.

Information can bring about voluntary mitigation activities at little or no cost to the government. Property owners mitigated their flooding problems long before government funding programs existed. The typical approach to delivering information involves two levels of activity. The first is to broadcast a short and simple version of the message to everyone potentially affected. The second level provides more detailed information to those who respond and want to learn more.

This chapter starts with activities that reach out to people and tell them to be advised of the hazards and some of the things they can do. It then covers additional sources of information for those who want to learn more. It ends with a general public information strategy.

Outreach Projects

Outreach projects are the first step in the process of orienting property owners to the hazards they face and to the concept of property protection. They are designed to encourage people to seek out more information in order to take steps to protect themselves and their properties.

Research has shown that outreach projects work. However, awareness of the hazard is not enough; people need to be told what they can do about the hazard. Thus, projects should include information on safety, health and property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

Community newsletters/direct mailings: The most effective types of outreach projects are mailed or distributed to everyone in the community. In the case of floods, they can be sent only to floodplain property owners.

News media: Local newspapers can be strong allies in efforts to inform the public. Press releases and story ideas may be all that's needed to gain their interest. After a flood in another community, people and the media become interested in their flood hazard and how to protect themselves and their property. Local radio stations and cable TV channels can also help. These media offer interview formats and cable TV may be willing to broadcast videos on the hazards.

Other approaches: Examples of other outreach projects include:

- Presentations at meetings of neighborhood, civic or business groups,
- Displays in public buildings or shopping malls,
- Signs in parks, along trails and on waterfronts that explain the natural features (such as the river) and their relation to the hazards (such as floods),
- Brochures available in municipal buildings and libraries, and
- Special meetings, workshops and seminars.

Local Implementation

Waveland has an extensive website that provides flood protection information. The City provides direct mail to residents which include flood protection and property protection measures. The City also has flood materials in the local library.

CRS Credit

The Community Rating System provides up to 290 points for projects on flood topics. One hundred of these points are for having a public information program strategy that deals with the flood hazard. A strategy that is focused on multi-hazards will earn 125 points.

Real Estate Disclosure

Many times after a flood or other natural disaster, people say they would have taken steps to protect themselves if they had known they had purchased a property exposed to a hazard. There are some federal and state requirements about such disclosures, but they have their limits.

Federal law: Federally regulated lending institutions must advise applicants for a mortgage or other loan that is to be secured by an insurable building whether the property is in a floodplain as shown on the Flood Insurance Rate Map. If so, flood insurance is required for buildings located within the floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only 10 days before closing, the applicant is often already committed to purchasing the property when he or she first learns of the flood hazard.

State law: State laws set standards for real estate sales and licensing of agents and brokers.

Local Implementation

Waveland receives credit for providing for the local real estate agents disclosure of flood hazards to prospective buyers. Credit is also provided for state and community regulations requiring disclosure of flood hazards.

CRS Credit

Communities in areas that have additional disclosure requirements are eligible for five points under the "Other disclosure requirements" as well as 10 points for the "Disclosure of other hazards."

Libraries and Websites

The two previous activities tell people that they are exposed to a hazard. The next step is to provide information to those who want to know more. The community library and local websites are obvious places for residents to seek information on hazards, hazard protection, and protecting natural resources.

Books and pamphlets on hazard mitigation can be given to libraries, and many of these can be obtained for free from state and federal agencies. Libraries also have their own public information campaigns with displays, lectures and other projects, which can augment the activities of the local government. Today, websites are commonly used as research tools. They provide fast access to a wealth of public and private sites for information. Through links to other websites, there is almost no limit to the amount of up to date information that can be accessed on the Internet.

In addition to online floodplain maps, websites can link to information for homeowners on how to retrofit for tornadoes and floods or a website about floods for children. The "FEMA for Kids" website teaches children how to protect their home and what to have in a family disaster kit.

Local Implementation

Waveland provides flood materials to the local Library. The City also has an extensive flood protection website credit at www.waveland-ms.gov.

CRS Credit

The Community Rating System provides up to 30 points for having a variety of flood references in the local public library and up to 36 more for similar material on municipal websites (Activity 350 - Flood Protection Information).

Technical Assistance

Hazard Information

Many benefits stem from providing map information to inquirers. Residents and business owners that are aware of the potential hazards can take steps to avoid problems or reduce their exposure to flooding. Real estate agents and house hunters can find out if a property is floodprone and whether flood insurance may be required.

Communities can easily provide map information from FEMA's Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies. They may also assist residents in submitting requests for map amendments and revisions when they are needed to show that a building is located outside the mapped floodplain.

Some communities supplement what is shown on the FIRM with information on additional hazards, flooding outside mapped areas and zoning. When the map information is provided, community staff can explain insurance, property protection measures and mitigation options that are available to property owners. They should also remind inquirers that being outside the mapped floodplain is no guarantee that a property will never get wet.

Property Protection Assistance

While general information provided by outreach projects or the library is beneficial, most property owners do not feel ready to retrofit their buildings without more specific guidance. Local building department staffs are experts in construction. They can provide free advice, not necessarily to design a protection measure, but to steer the owner onto the right track.

- Building or public works department staffs can provide the following types of assistance:
- Visit properties and offer protection suggestions,
- Recommend or identify qualified or licensed contractors,
- Inspect homes for anchoring of roofing and the home to the foundation,
- Provide advice on protecting windows and garage doors from high winds, and
- Explain when building permits are needed for home improvements.

There is a concern that a local official might provide the wrong information and the community would be sued if a project failed. To counter this, there are guidelines for local programs and training on how to identify the right measures. FEMA conducts a free week-long course at its Emergency Management Institute on property protection measures for flooding. FEMA and the Corps of Engineers periodically conduct one- or two-day retrofitting workshops.

Local Implementation

FEMA floodplain maps are available on Hancock County's website , as described above. Waveland responds to requests on whether a property is located in s Special Flood Hazard Area. Property protection measures are included on Waveland's website. Waveland also responds to drainage complaints and provides other property protection assistance to residents.

CRS Credit

The Community Rating System provides 140 points for providing map information to inquirers. Up to 71 points are available for providing one-on-one flood protection assistance to residents and businesses and for making site visits. Both services must be publicized.

Public Information Program Strategy

A public information program strategy is a document that receives CRS credit. It is a review of local conditions, local public information needs, and a recommended plan of activities. A strategy consists of the following parts, which are incorporated into this plan:

- The local flood hazard (discussed in Chapter 4 of this plan)
- The property protection measures appropriate for the flood hazard (discussed in Chapter 5 of this plan)
- Flood safety measures appropriate for the local situation (discussed in Chapter 5 of this plan)
- The public information activities currently being implemented within the community, including those being carried out by non-government agencies (discussed in Chapter 5 of this plan)
- Goals for the community's public information program (discussed in Chapter 3 of this plan)
- The outreach projects that will be done each year to reach the goals (discussed in the Recommendations section of Chapter 5 of this plan)
- The process that will be followed to monitor and evaluate the projects (discussed in Chapter 8)

Figure C.15 illustrates several flood safety tips that can be used in an outreach campaign to better inform the public of the hazards associated with flooding.

Figure C.15. Flood Safety Tips for Outreach Campaign

Flood Safety

Pay attention to evacuation orders. Listen to local radio or TV stations for forecasts and emergency warnings. Know about evacuation routes and nearby shelters and have plans for all family members on how to evacuate and where to meet if you're split up during an emergency.

Do not drive through a flooded area. During a flood, more people drown in their cars than anywhere else. Don't drive around road barriers; the road or bridge may be washed out.

Do not walk through flowing water. Flash flooding is the leading cause of weather-related deaths in the U.S. Currents can be deceptive; 6 inches of moving water can knock you off your feet in a strong current. If you walk in standing water, use a stick to help you locate the ground.

Stay away from power lines and electrical wires. Electrical currents can travel through water. Report downed power lines to the police or sheriff by calling 911.

Have the power company turn off your electricity. Some appliances, like TV sets, keep electrical charges even after they've been unplugged. Don't use appliances or motors that have gotten wet unless they have been taken apart, cleaned and dried.

Look before you step. After a flood, the ground and floors are covered with debris like broken bottles and nails. Floors and stairs that are covered with mud can also be slippery.

Be alert for gas leaks. Use a flashlight to inspect damage. Don't smoke or use candles, lanterns, or open flames unless you know the gas has been shut off and the area has been ventilated.

Look out for animals that may have been flooded out of their homes and who may seek shelter in yours. Use a pole or stick to turn things over and scare away small animals.

Look before you step. After a flood, the ground and floors are covered with debris. Floors and stairs that have been covered with mud will be very slippery.

Carbon monoxide exhaust kills. Use a generator or other gasoline-powered machine outdoors. The same goes for camping stoves. Charcoal fumes are especially deadly – cook with charcoal outdoors.

Clean everything that got wet in the flood. Floodwaters have picked up sewage and chemicals from roads, farms, factories, and storage buildings. Spoiled food, and flooded cosmetics and medicines can be health hazards. When in doubt, throw it out.

Take care of yourself. Recovering from a flood is a big job. It is tough on both the body and the spirit and the effects a disaster has on you and your family may last a long time.

CRS Credit

The CRS provides 100 points for a public information program strategy. A mass mailing to all properties can earn up to 60 more points and can meet the publicity requirements to receive credit for several other activities.

Conclusions

- There are many ways that public information can be used so that people and businesses will be more aware of the hazards they face and how they can protect themselves.
- Facebook, libraries, and websites are currently being used as public information tools in Waveland.
- The most important topics to cover in public information activities are:

- Safety precautions for all types of hazards, but especially tornados, earthquakes, thunder storms, winter storms and floods.
- Knowing where emergency evacuation shelters are in town.
- Flood protection measures, including rules for new construction and insurance.
- Keeping drainage ways clear and protection from local drainage problems.
- Family and emergency preparedness measures.
- What the Town and County are doing and sources of assistance.
- Protecting water quality and wetlands and the benefits of open space.

- The most appropriate ways to spread this information are:
  - Websites and social media
  - Mailings to everyone, in utility bills or otherwise
  - News releases or newspaper articles
  - Newsletters
  - Displays, particularly at special events
  - Handouts, flyers and other materials, which can be distributed at special events and presentations

Recommendations

- The City could add a page on its website to promote flood safety information for all natural hazards.
- The City could create a Twitter account and use its existing Facebook account, to maximize the number of people reached with flood hazard and safety information.
- The City could have a booth at its St. Patrick's Day Parade to promote life safety and preparedness.
- Staff should reach out to residents, civic organizations and faith-based organizations to help spread the word about flood hazards and safety measures.

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CRS Credit for Outreach Projects, FEMA, 2006.

C.6 Mitigation Alternative Selection Criteria

The following criteria were used to select and prioritize proposed mitigation measures:

STAPLE/E

- Social-Does the measure treat people fairly? (different groups, different generations)
- Technical-Will it work? (Does it solve the problem? Is it feasible?)
- Administrative-Do you have the capacity to implement and manage project?
- Political-Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support?
- Legal-Does your organization have the authority to implement? Is it legal? Are there liability implications?
- Economic-Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
- Environmental-Does it comply with environmental regulations?

Sustainable Disaster Recovery

- Quality of life
- Social equity
- Hazard mitigation
- Economic development
- Environmental protection/enhancement
- Community participation

Smart Growth Principles

- Infill versus sprawl
- Efficient use of land resources
- Full use of urban resources
- Mixed uses of land
- Transportation options
- Detailed, human-scale design

Other

- Does measure address area with highest risk?
- Does measure protect…
  - The largest # of people exposed to risk?
  - The largest # of buildings?
  - The largest # of jobs?
  - The largest tax income?
  - The largest average annual loss potential?
  - The area impacted most frequently?

- Critical infrastructure (access, power, water, gas, telecommunications)?
- What is timing of available funding?
- What is visibility of project?
- Community credibility

Table C.3. Waveland Initial Prioritization Process

Worksheet complete	Mitigation Action Title	Hazards Addressed	Points/ Worksheet Status
Yes	Public outreach: education and preparedness for all hazards	Multi-hazard	43
Yes	Parade of homes	Multi-hazard	6
Yes	Evacuation planning and assessment of Evacuation routes	Emergency Services/Multi-hazard	18
Delete	Develop a Blackboard System to enhance City communication and warning systems	Emergency Services/Multi-hazard	18
Yes	Identify and implement other communication enhancements	Emergency Services/Multi-hazard	9
Yes	Develop and implement system to protect public records	Emergency Services/Multi-hazard	3
Yes	Develop a communication system utilizing LED boards	Emergency Services/Multi-hazard	17
Yes	Enhance the usability and functionality of the City of Waveland website	Emergency Services/Multi-hazard	13
Yes	Support barrier island protection (combine with MSCIP project below)	Climate Change (sea level rise)	5
Yes	Support regional planning and project implementation (see MS coastal improvements project)	Climate Change (sea level rise)	6
Delete	Create living shoreline alternatives (e.g.,crushed oyster shells in wire bams, coconut logs)	Climate Change (sea level rise)/Coastal/Canal Bank Erosion	19
One work sheet for next three projects	Evaluate and implement best option for barrier fencing along the backside of the beach. Alternatives include fences, concrete barriers, other barriers/walls	Coastal/Canal Bank Erosion	38
	Create dune/vegetative area on backside of beach	Coastal/Canal Bank Erosion	6
	Construct breakwalls	Coastal/Canal Bank Erosion	8
Yes	Extension of drainage facilities into Gulf	Coastal/Canal Bank Erosion	8
Yes	Protection and maintenance of marshes and other natural barriers	Coastal/Canal Bank Erosion	25
Yes	Dredge Jackson Marsh	Coastal/Canal Bank Erosion	22
Yes	Railroad-side floodgate	Coastal/Canal Bank Erosion	19
Yes	Establish regular program for cleanout of canals	Coastal/Canal Bank Erosion	8

Worksheet complete	Mitigation Action Title	Hazards Addressed	Points/ Worksheet Status
Yes	Highway 603/Log Cabin Area, Pipe Flap Project	Coastal/Canal Bank Erosion	29
Delete	Enhance floodplain management/CRS program	Flood	21
Delete	Debris maintenance, including construction debris	Flood	6
Yes	Update drainage master plan and implement projects	Flood	14
Delete	Evaluate beach front setbacks (VE zone flood ordinance constraints	Flood	0
Delete	Citywide drainage project - $6.9M all watersheds	Flood	10
Yes	Green space development – Waveland Ave – 8 acres for football fields	Flood	3
Yes	Acquisition project	Flood	0
Yes	Elevation project	Flood	34
Yes	Mitigation reconstruction/floodproofing	Flood	0
Yes	Insurance promotion	Flood	1
Delete	Other green spaces	Flood	6
Yes	Elevation certificates – automated database/GIS system	Flood	3
Yes	Wind shutters - Fabric	Hurricane	1
Delete	Wind retrofit grant program (HMGP-direct access by homeowners), State Dept. of Finance and Admin	Hurricane	0
Delete	Evaluate Design Standards	Hurricane	0
Delete	Tree Mitigation	Hurricane/ Thunderstorms	0
Added two more projects			
Yes	Sarah Lane to Adams Lane evacuation route	Emergency Services/Multi-hazard	
Yes	Protect exterior A/C equipment at central fire station and install underground water and sewer storage tanks	Hurricane/ Thunderstorms	

Mitigation Action Status Summary Worksheet

Title of Project:

Progress to date:

INITIAL PRIORITIZATION INSTRUCTIONS

Connecting the Dots!

Our Team mitigation recommendations are listed on flip-chart paper around the room.

You each have 3 sets of colored dots:

- 3 red dots
- 3 blue dots
- 3 green dots

The red dots are for high priority

The blue dots are for medium priority

The green dots are for low priority

Place your dots on the recommendations, using the different colors to indicate your priority. You may use as many of your dots, of any color, on any recommendation --- or you may spread them out using as few of your dots as you wish. The dots will indicate the consensus of the team.

Use your list of criteria to help you make your determinations.

After the totals are counted, we will discuss them further to confirm or change any of the results as we see fit.

Mitigation Action Worksheet: New 2012 Projects

Instructions: Use this guide to record potential mitigation projects (1 page per project).

Mitigation Project Title:

Project Description:

Hazards Addressed:

Issue/Background:

Other Alternatives:

Existing Planning Mechanism(s) through which Action Will Be Implemented:

Responsible Office:

Priority (H, M, L):

Cost Estimate:

Benefits (Losses Avoided):

Potential Funding:

Schedule:

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