TERREBONNE PARISH, LOUISIANA

HAZARD MITIGATION PLAN

Project No. PDMC – PC – 06 – LA – 2012 – 003

October 2014

Terrebonne Parish Consolidated Government
8026 W. Main Street
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LIST OF ATTACHMENTS

EXECUTIVE SUMMARY

Terrebonne Parish, Louisiana

2015 Hazard Mitigation Plan Update

Introduction

This Hazard Mitigation Plan Update is the third such plan in 15 years. The last update development was completed in 2008 just prior to hurricanes Gustav and Ike. Due to the severity of the storms, Terrebonne Parish was allocated significant federal funds to recover from the damage, retrofit existing structures to increase resilience, improve and add to the levee system, or relocate critical infrastructure outside the floodplain. The Parish benefitted from the flexibility of not only Federal Emergency Management Agency (FEMA) funds, but Community Development Block Grant (CDBG) funds from the U.S. Department of Housing and Urban Development (HUD) as well. The agencies have complementary goals and preferred projects which allowed the Parish to implement many of the priorities that had been identified in the meetings held right before the storm. Located directly on the Gulf of Mexico, the risks are still significant, and there is much that can be implemented to adapt from education and better building to regulations and coastal restoration.

Since 2010, Terrebonne Parish implemented 26 projects specifically listed in the HMPU 2010. Advances were from across the spectrum of activities from increased public education and outreach to the local implementation of levees to protect the lower reaches of the Parish and the flood control structure on the Houma Navigational Canal to stop surge from reaching the City of Houma. A complete list of the accomplishments in the last five years is included on pages 76-79. Each project completed or ongoing has resulted in an incremental reduction in risk of damages, from flood and wind in particular. The risk of continued inundation is reduced in the areas with the elevated pump stations, and the bar screen cleaners reduce the risk of pump failure when debris levels are high. Essential government functions are being moved from the special flood hazard area or, if the facility must function in place, the structures are hardened and supplied with alternative power sources to facilitate continuous function or expedited recovery after an evacuation/event.

Due in part to the significant and unexpected insecurity regarding flood insurance over the past two years, the Parish has escalated plans in place since 2011 to revise and streamline the flood ordinance to maximize all areas of the Community Ratings System. The process undertaken to update this plan followed the eight (8) steps required in Section 510 of the Community Ratings System Coordinators Manual (September 2013) and other planning guidance to engage the public and thereby reduce risk through engagement.

Through the HMPU process, the Parish HMPU Steering Committee engaged members of the public, neighboring parishes, and statewide stakeholders to develop a consensus of priorities. While the implementation of the plan is fluid based on funding sources and

storm evens, the HMPU will serve as a resource in all Parish planning, response, and recovery activities.

Step 1 - Organize
The Parish has embarked on multiple lines of defense as a strategy to reduce risk through various mechanisms including levees, nonstructural elevation projects, wind hardening projects and other infrastructure hardening projects. As important are the educational activities taken on throughout the Parish to invite participation from the general public both in planning and risk reduction activities.

Recognizing the importance of mitigation to every department and division in the Parish, all were invited to participate in the project and every department committed at least one individual to participate in the meetings. Further, specialists in various divisions provided data and their professional opinion upon request, which uncovered a number of previously obscure needs not previously captured. The planning department was the best represented due to the mandate to enforce building codes, land use, floodplain, as well as the subdivision and stormwater management regulations, and to implement the Comprehensive, Hazard Mitigation, and the Long Term Recovery Plans. The Chair of the Planning Commission participated as well. The Office of Emergency Preparedness assisted from the beginning participating in the procurement process, the public meetings, and updates on critical facilities. The Utilities Department, the Public Information Officer, and the Coastal Restoration and Preservation Department director provided feedback as did several divisions of the Public Works Department. Prior to the meetings, the Departments combed through the existing Hazard Mitigation Plan updating the status of the projects proposed at that time in preparation for the public meetings. This was a gratifying process, but was a reminder that there is still much more to be done to make the Parish safer and more resilient.

Step 2 - Involve the Public
The Parish Council adopted the steering committee and proposed process by resolution. Some members of the Council participated in the public meetings thereafter. The Steering Committee was comprised of members from the private and public sectors. The Parish President approached each member and invited them to participate. This group was established prior to the first meeting and committed to up to six (6) meetings. These members represented a broad spectrum of interests including industries, tribes, nonprofits, academia and public safety. Each brought their perspective and interests to the table providing a range of expertise.

The general public was invited to participate through multimedia invitations and documentation of the meetings. The Parish President invited participants to join the effort in his town hall meetings and other public appearances. Each planning effort in the Parish has been augmented by multimedia recruitment of public input through meetings around the Parish, ads in the newspaper, posts on the TPTV site, and several specialized web sites. The Hazard Mitigation Plan Update was the fourth major planning effort since the current plan was adopted. The public was invited to five meetings and all presentations, meeting notes, and advertisements were posted on a website. Three

FloodSafe Minutes regarding the planning process, the importance of the plan, and chances to participate were sent to the Council and posted on the website. Members of the media were invited to observe or participate and the process earned coverage in news print (Houma Courier) and the radio (WWNO, NPR). People who had participated in the Comprehensive Plan and the focus group for the Flood Ordinance Amendment Outreach were approached for their input due to their prior commitment to reducing risk and willingness to engage.

It is worth noting that the Parish had encouraged and facilitated discussion throughout the Parish since the last plan was developed. Throughout the recovery for hurricanes Gustav and Ike, the Flood Ordinance Outreach, the Comprehensive Plan Vision 2030 process, and a targeted repetitive loss study in two neighborhoods, meetings were held throughout the Parish to encourage participation. This advance research has been incorporated into this plan, and the public feedback has been appended to document the results of in person and web surveys and the memorialization of input in these public meetings.

Step 3 - Coordinate

In order to prepare for the kickoff of this planning process, the Parish provided copies of a set of relevant plans on the website for all to access and a CD for all Steering Committee members and forecasted discussion of the sufficiency of the subdivision regulations, stormwater regulations, flood ordinance and invited submission of other plans that might affect future risk. This included the Hazard Mitigation Plan from 2010 and the updated project list showing what had been accomplished since that time. The deliberations included the review of these earlier plans, studies, and the list of projects completed since the last update to reduce risks of hazards.

The content and sufficiency of the plans was discussed during multiple meetings. During one such discussion, it was proposed that the Comprehensive Plan did not deal directly with relative sea level rise, or how regulations might best reflect adaptations for subsidence. Though this issue was not resolved in the meeting process, this area of research and future action has been captured as a higher priority area of interest.

During the planning process, the consultant and committee members sought out data and input from a number of agencies and groups outside the government. Local tribes were members of the steering committee, and were approached outside the meetings as well to discuss what goals the tribes individually or collectively were planning to achieve independent of the Parish process to ensure the safety of their community.

Step 4 - Assess the Hazard

Due to the long history of natural disasters in Terrebonne Parish, a broad range of hazards are always a consideration in planning, building, regulations, and discussions of future investment. The 2010 Hazard Mitigation Plan Update reviewed the history up to hurricane Katrina, and this update includes flooding and wind damage from hurricanes Gustav, Ike, Isaac and tropical storm Lee. The HAZUS model compiles the inundation maps of all of the national presidential disaster declared storms in Terrebonne Parish to estimate the level of risks from the composite flood hazard.

The events of the last five years have increased understanding of the dangers of coastal changes and projections of effects on the built environment and cultural assets. The Parish has expanded the objectives to prepare or respond to these challenges in addition to the original plan. The steering committee discussed the options for action at this time and the consensus was to commit the Parish to study the projections and consideration of alternative development or mitigation strategies in light of those projections. The future stability of the land, and ability or lack of ability of the Parish and its partners to improve that stability, will be a consideration factor in future decision making. This is consistent with the Comprehensive Plan and allows the Parish flexibility based on the findings of future studies at the local, regional, state and national levels.

All hazards were discussed though, other than flood and wind, no significant occurrences have been experienced in the Parish since the 2010 plan was adopted. A synopsis is provided in summary fashion on pages 26-29. There was some discussion of the sink holes in other parts of the state, but this was not added as a concern in Terrebonne at this time. There are few geological features in Terrebonne Parish that would logically become a sink hole, and saltwater injection wells and other landfills have been banned from the special flood hazard area in a 2014 flood ordinance amendment. Other proposed ordinance changes will be discussed on page 65 including the data on the Coastal A zone and a new zoning designation to protect environmentally sensitive lands.

Step 5 - Assess the Problem

The planning process provided an opportunity to review the accomplishments of the past, the new or postponed challenges of today and in the future. In some cases, the residual risk requires more of the same approaches. In other cases, the activity itself created a need for more action, whether that would be a physical project or education. For example, the Parish identified an issue with pump station and stormwater intake in the last plan, and elevated pump stations, purchased portable and stationary generators, and installed automatic trash screens on key facilities. During this plan development, the remaining targets were updated, and a new project for telemetry automation on pump stations was added to supplement these efforts. A business owner suggested that much of this work was not understood by the general public, and requested to see simple maps throughout the Parish that show where the water is expected to flow in a storm event. By educating the public, misimpressions and feelings of either false security or overestimated risk could be moderated through a better understanding of the pump systems.

Some of these discussions are captured in the text of the plan in that section, but there was a lot of effort to identify gaps in the proposed projects to address outstanding risk, and the responses are recorded in part by the listing of the updated project list.

Step 6 - Set Goals

The goals of the Parish remain broad as the threats and risks are great. While there is some level of predictability in coastal areas, for example, that there will be another hurricane, the trajectory and strength of the event can't be forecast. Therefore, the goals

remained broad and were considered representative of the overarching Parish perception of the risks and risk reduction options.

The objectives were broadened to include some discussions that have been ongoing within the Parish, but not included in previous plans. The connection between oil mining and subsidence has been discussed, but the oil spill and those ramifications had not been entertained. There are risks from combining manmade disasters with natural disasters including the spread of pollutants over a larger area that would not otherwise have been contaminated. These manmade risks and cultural sensitivity were added as objectives.

Step 7 - Review Possible Activities
Regardless of the topic, education was central to all activities reviewed. Ongoing efforts were applauded, but in most instances, increased education was identified as a necessary component of any resulting plan. Several of the newly proposed projects are related to improved outreach regarding preparation for storm season, immediate response, recovery, and general risk management decisions at the government, business, and individual scale. Committee members and business interests stressed the need for increased education and enforcement of existing regulations.

Section 8 - Draft and Action Plan
The Steering Committee and participants discussed the priorities of the Parish and the feasibility of certain actions throughout the process. A rough survey was given to pit types of projects against each other to stimulate conversation about priorities. The outcome of the survey is included in the following section. The priory projects, the approximated cost where available; feasibility, and the responsible party are provided in a chart form.

1.0 INTRODUCTION AND PARISH BACKGROUND

The information presented in this section provides a synopsis of Terrebonne Parish, Louisiana, including descriptions of its geographic location, land use characteristics, geologic features, and socioeconomic composition. With this context, data provided in subsequent sections may be more easily evaluated.

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

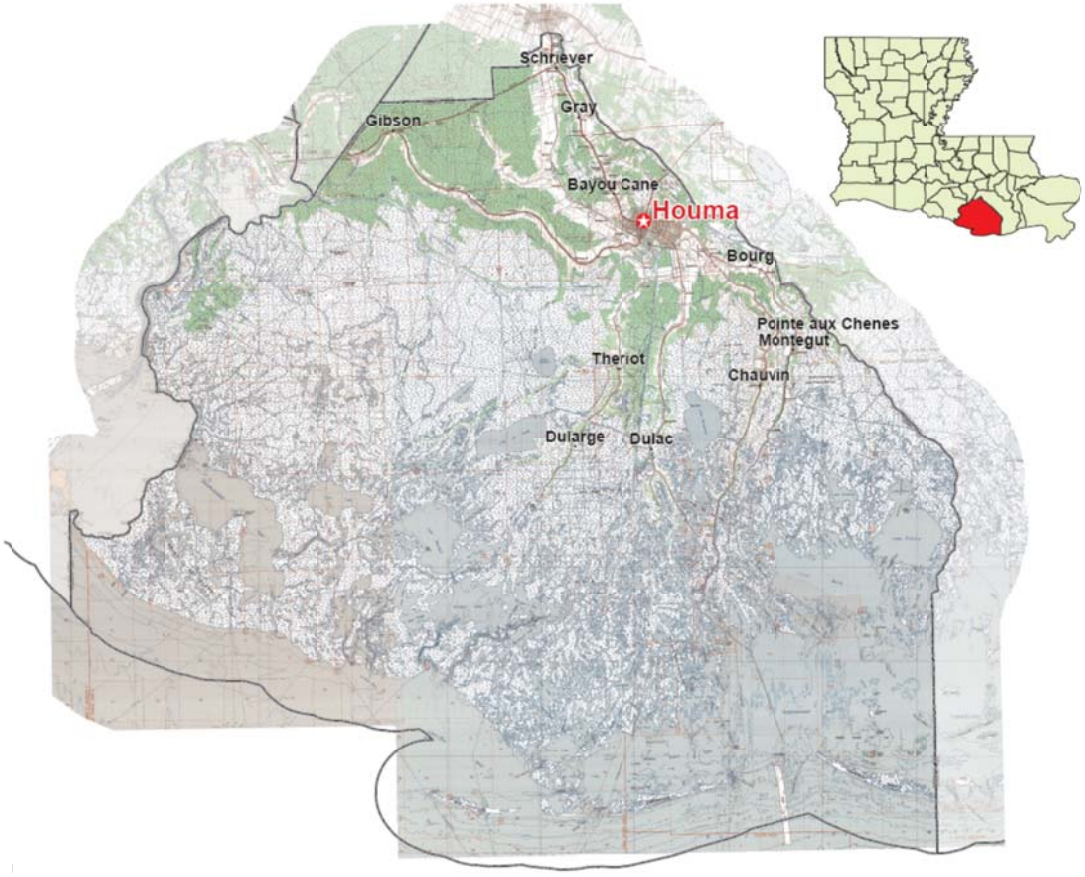
In 1984, Terrebonne Parish instituted a consolidated form of government. At that time, the governmental functions of the City of Houma (the sole municipality in the parish) were consolidated with the governmental functions of Terrebonne Parish. The formal name of the parish's government is the Terrebonne Parish Consolidated Government which is commonly referred to as the "parish government." The governing authority consists of an elected parish president who is the chief executive officer, (i.e.) head of the executive branch, and nine elected council members. The council members each represent a single district consisting of relatively equal areas of population. The Terrebonne Parish Council represents the legislative branch of the parish government. As stated in its Home Rule Charter and parish code, the Terrebonne Parish Consolidated Government has all the powers, rights, privileges, immunities, and authority heretofore possessed by the City of Houma and Terrebonne Parish under the laws of the state. The parish government shall have and exercise such other powers, rights, privileges, immunities, authority and functions not inconsistent with this charter as may be conferred on or granted to a local governmental subdivision by the constitution and general laws of the state. More specifically, the parish government shall have and is hereby granted the right and authority to exercise any power and perform any function necessary, requisite or proper for the management of its affairs, not denied by this charter, or by general law, or inconsistent with the constitution.

The parish government has the right, power, and authority to pass all ordinances requisite or necessary to promote, protect and preserve the general welfare, safety, health, peace and good order of the parish, including, but not by way of limitation, the right, power and authority to pass ordinances on all subject matters necessary, requisite or proper for the management of parish affairs, and all other subject matter.

Eleven unincorporated communities with small concentrations of residences and assets are dispersed throughout the parish. The aggregate population of each of these communities represents approximately two-thirds of the parish's total population. These communities are also governed by the Terrebonne Parish Consolidated Government. The following communities are identified on many maps and figures throughout this Hazard Mitigation Plan Update (HMPU); Bayou Cane, Gray, Bourg, Montegut, Chauvin, Point, Aux Chene, Dulac, Schriever, Dularge, Theriot, and Gibson.

1.1 Geographic Setting

Terrebonne Parish is situated in southeast Louisiana along the state's Gulf of Mexico coastline. The parish includes approximately 2,100 square miles and is the second largest parish in Louisiana regarding land area. Greater than 85% of the parish area is water and wetlands. Lafourche Parish is to the east, St. Mary Parish is westward, and Assumption Parish is located north of Terrebonne. The map below shows communities in Terrebonne Parish, its position in the state, and its large expanse of water and wetlands (light blue and gray).



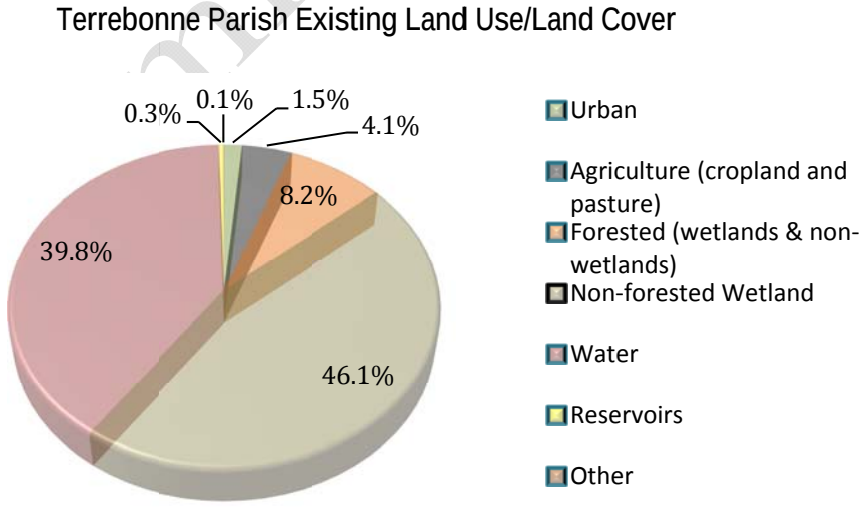
The Terrebonne Levee Conservation District is currently constructing reaches of the Morganza to the Gulf system. The majority of the parish's existing levee system is comprised of a series of forced drainage levees (<6 feet above ground). The levee system is augmented with pump stations in the populated portions of the parish to drain storm water and minimize flooding. According to the Terrebonne Parish needs assessment provided via the Louisiana Speaks Long-Term Community Planning website (www.louisianaspeaks-parishplans.org), all levees in the parish located south of the Intracoastal Canal, and with a less than 10' crown height, were breached during Hurricane Rita in 2005. The layout of all drainage districts, including levees and pump stations, is presented in the risk assessment section of this HMPU (Section III).

1.2 Land Use

As a snapshot of the community, the following land use/land cover table and associated chart are provided. Based upon Environmental Protection Agency data, only 5.6% of the parish is urbanized and/or under cultivation. The remaining 94.6% of the 1,326,748 acre parish is forested, wetlands, or water.

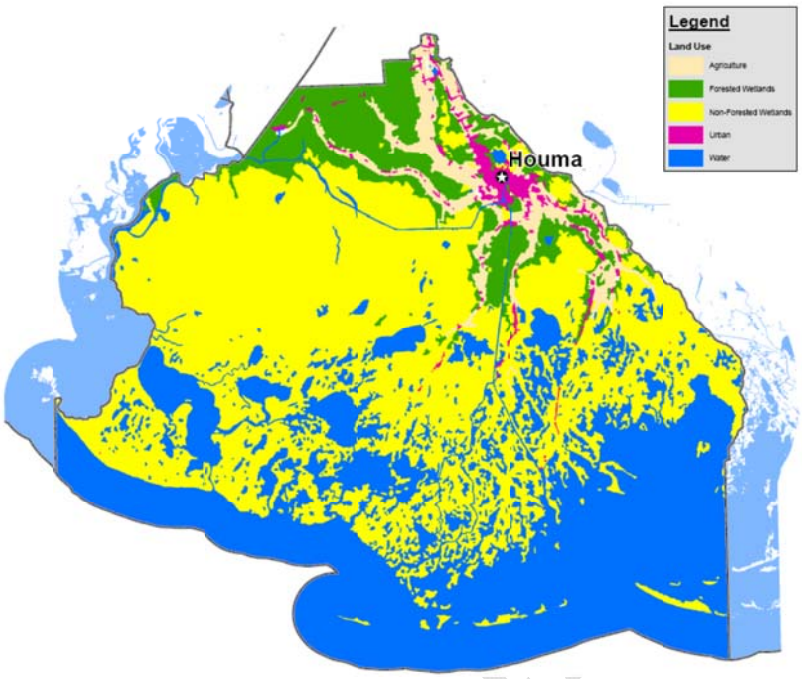
Table 2-1: Terrebonne Parish Existing Land Use/Land Cover

Description	Acres	%
Urban	**19,503**	**1.5%**
Residential	11,065	0.8%
Commercial and Service	3,016	0.2%
Industrial	1,849	0.1%
Transportation, Communication, and Utilities	1,014	0.1%
Mixed Urban or Built-Up	1,280	0.1%
Other Urban or Built-Up	1,279	0.1%
Agriculture (cropland and pasture)	**54,103**	**4.1%**
Forested (wetlands & non-wetlands)	**109,250**	**8.2%**
Decidious Forest Land	116	0.0%
Forested Wetland	109,134	8.2%
Non-forested Wetland	**613,371**	**46.2%**
Water	**529,580**	**39.9%**
Bays and Estuaries	385,877	29.1%
Streams and Canals	16,760	1.3%
Lakes	122,366	9.2%
Reservoirs	4,577	0.3%
Other	942	0.1%
Total	**1,326,749**	**100.0%**



The geographic distribution of land use/land cover is illustrated on the following parish map. The 5.6% of the parish that is urbanized (pink) or under cultivation (tan) is

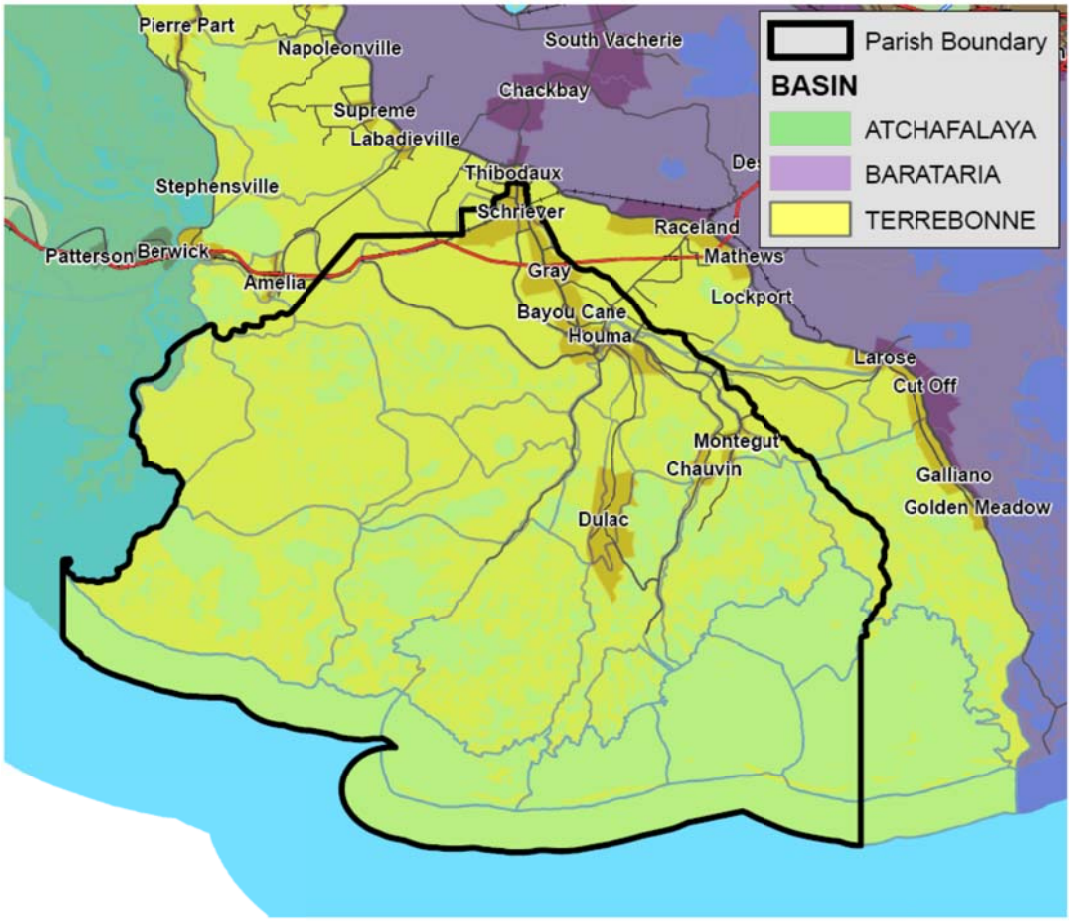
concentrated in the north-central portion of the parish in the vicinity of Houma and the previously described ridges along major bayous.



The land formation of Terrebonne Parish is largely a result of an historic alignment of the Mississippi River delta known as the Lafourche Delta. The following is an excerpt from the *Roadside Geology of Louisiana* by Darwin Spearing, which explains the development of the Lafourche Delta:

> "About 3,500 years ago, the Mississippi River shifted west again, this time running south along the course of Bayou Lafourche. Many remnants of the distributary streams of the Lafourche delta remain as part of the landscape south of Thibodaux. The Lafourche delta grew between 3,500 and 400 years ago, the last of the great deltas that preceded the modern delta. Lake-filled marshes in Terrebonne Parish, Terrebonne Bay, and Timbalier Bay, and the arcuate offshore islands of Isles Dernieres, Timbalier, and East Timbalier are relics of the Lafourche Delta."

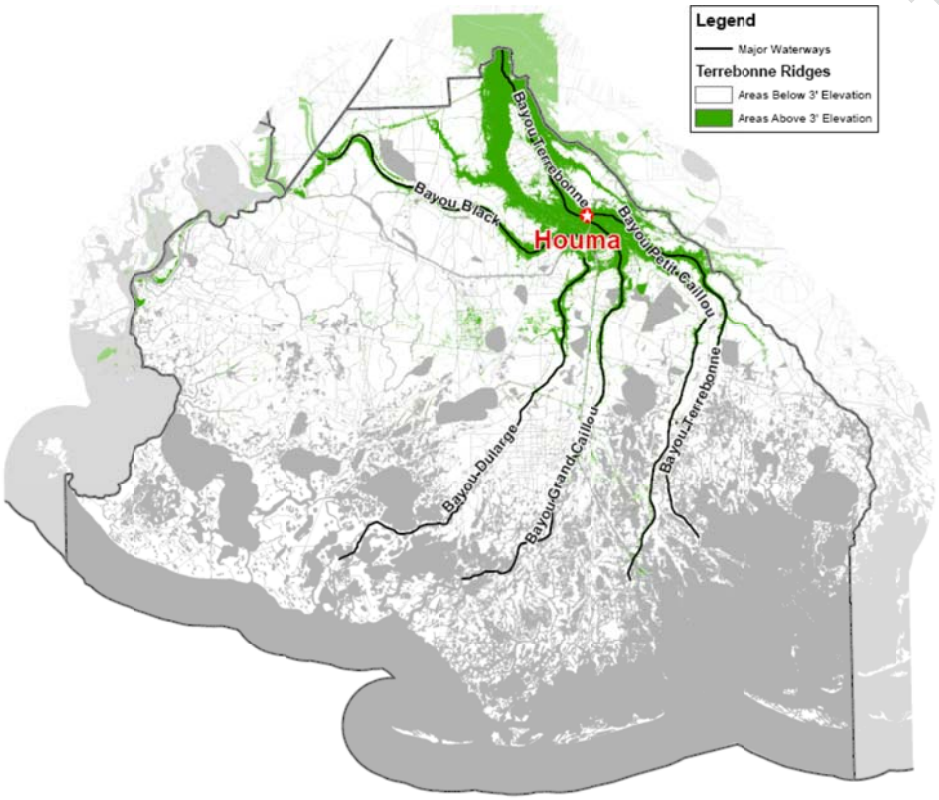
The parish is located at the southernmost reach of the Terrebonne drainage basin. The drainage basins within and in the immediate vicinity of Terrebonne Parish are identified in the following illustration.



A combination of its deltaic creation, its proximity to the Gulf of Mexico, and a historical concentration of oil and gas exploration activities (construction of man-made access canals) is responsible for greater than 85% of the parish's total acreage being represented by either water or wetlands. Generally from north to south, the wetlands include fresh marsh, intermediate brackish marsh, and salt marsh near the coast line. These marshes are intertwined with hundreds of lakes, bays, bayous, and canals. Some of the more notable water bodies within the parish include:

- Bayou Black
- Bayou Dularge
- Bayou Grand Caillou
- Bayou Petit Caillou
- Bayou Terrebonne

These bayous are significant as they have historically provided the land-building sediment that created the highest areas of the parish. The sediment was deposited during annual flooding cycles of Bayou Lafourche on the Lafourche delta lobe. It is upon these finger-like ridges that all urban and agriculture land exist in the parish today. Because of the formation of these ridges through alluvial processes, the three-foot contour clearly defines the ridges as the "high-ground" of the parish. The depiction of these ridge lines form an image that is repeated in this report as virtually all land area other than these ridge areas is susceptible to frequent flooding of some sort; either stormwater, river/bayou flooding, storm surge, or backwater flooding. The graphic below depicts the ridges that form the bulk of non-flooding urban and agricultural land in the parish.



Land Loss: An Ongoing Threat

Land subsidence and coastal erosion are two causes of land loss in coastal Louisiana. Coastal erosion destroys land and removes sediments critical to the existence of environmental features such as beaches, dunes, and wetlands. High wind and water events, especially wave action, are increasing contributors to coastal erosion. Land subsidence refers to the lowering of lands' elevation, or land sinking. Land subsidence is often related to events such as the extraction and storage of natural resources and their byproducts, as well as natural hazard events such as earthquakes. Land subsidence related to man-made activity such as the collapsed salt dome in Bayou Corne in Assumption Parish can lead to sinkholes that reclaim surface land, inundating the cavern to the surface with water.

Terrebonne Basin Persistent Land Loss 1932-2010

The figure below details wetland loss along coastal Louisiana, showing persistent land loss and land gain along the Terrebonne Basin. It can be observed in the figure that between 1932 and 2010 Terrebonne Basin lost land at a faster rate than it was replaced. Though USGS cites hurricanes and extreme storms as major drivers of this historic land loss, the figure to follow also shows that land is eroding at a slower rate than the previous highs seen in the 70's. The tables on the following pages show persistent land loss and gain in the coastal Louisiana basin as well as total land areas in Louisiana. Terrebonne Basin has lost 29.3 percent of its land area while 25 percent of land has been lost coastwide between 1932 and 2010.

Persistent Land Loss and Land Gain in Terrebonne Basin, as defined by the Coastal Wetlands Planning, Protection and Restoration Act Program (n.d.), 1932-2010

Loss															
1932-1956	1956-1973	1973-75	1975-77	1977-85	1985-88	1988-90	1990-95	1995-98	1998-99	1999-02	2002-04	2004-06	2006-08	2008-09	2009-10	Total Land Loss
-75.28	-46.25	-46.65	-50.87	-35.11	-22.97	-27.54	-30.63	-23.12	-22.5	-11.99	-9.63	-18.27	-23.4	-12.31	-4.49	-459.99
Gain															
1932-1956	1956-1973	1973-75	1975-77	1977-85	1985-88	1988-90	1990-95	1995-98	1998-99	1999-02	2002-04	2004-06	2006-08	2008-09	2009-10	Total Land Gain
2.96	0.21	0.25	0.31	0.49	0.26	0.24	0.28	0.4	0.76	0.47	0.37	1.67	0.67	0.66	0.43	10.43

Source: USGS

Persistent land loss and land gain in coastal Louisiana by basin, as defined by the Coastal Wetlands Planning, Protection and Restoration Act Program (n.d.), 1932-2010

[Land area in square miles]

Basin	1932–56	1956–73	1973–75	1975–77	1977–85	1985–88	1988–90	1990–95	1995–98	1998–99	1999–2002	2002–4	2004–6	2006–8	2008–9	2009–10	Total persistent
	Loss											Loss				Negative change	
Atchafalaya Delta	-4.48	-1.92	-1.75	-0.90	-0.64	-0.99	-1.37	-1.15	-0.83	-0.49	-0.39	-0.51	-0.37	-0.66	-0.01	-0.02	-16.49
Barataria	-56.46	-70.98	-64.21	-27.94	-42.81	-16.80	-26.30	-26.76	-16.76	-17.83	-9.12	-8.95	-13.76	-15.86	-3.94	-3.23	-421.71
Breton Sound	-30.94	-11.34	-9.95	-9.58	-7.97	-5.67	-8.28	-9.64	-6.93	-6.47	-4.26	-5.48	-29.32	-12.25	-0.98	-1.79	-160.87
Calcasieu-Sabine	-8.41	-66.70	-17.30	-15.08	-9.59	-6.19	-4.22	-6.90	-7.15	-5.19	-2.85	-1.59	-22.00	-23.74	-1.30	-0.72	-198.94
Mermentau	-18.68	-24.35	-7.00	-9.31	-10.01	-6.59	-5.49	-6.58	-5.74	-3.96	-4.03	-2.76	-22.26	-6.13	-0.43	-0.60	-134.37
Mississippi River Delta	-34.06	-61.93	-10.51	-9.61	-4.86	-2.44	-5.64	-4.41	-1.89	-1.02	-1.02	-3.46	-10.11	-0.90	-0.14	-0.03	-152.02
Pontchartrain	-34.41	-32.50	-12.74	-12.84	-9.47	-6.88	-9.67	-11.07	-7.85	-6.68	-4.20	-5.70	-15.14	-7.24	-1.26	-1.60	-179.25
Teche-Vermilion	-14.68	-8.40	-4.43	-4.22	-3.06	-3.23	-3.23	-2.81	-3.57	-3.15	-1.71	-3.23	-3.78	-4.51	-0.29	-0.29	-64.61
Terrebonne	-75.28	-46.25	-45.65	-50.87	-35.11	-22.97	-27.54	-30.63	-23.12	-22.50	-11.99	-9.63	-18.27	-23.40	-12.31	-4.49	-459.99
Total	**-277.41**	**-324.39**	**-173.55**	**-140.35**	**-123.52**	**-71.78**	**-92.18**	**-99.94**	**-73.83**	**-67.29**	**-39.57**	**-41.30**	**-135.02**	**-94.69**	**-20.65**	**-12.77**	**-1,788.24**[1]

Basin	1932–56	1956–73	1973–75	1975–77	1977–85	1985–88	1988–90	1990–95	1995–98	1998–99	1999–2002	2002–4	2004–6	2006–8	2008–9	2009–10	Total persistent
	Gain											Gain				Positive change	
Atchafalaya Delta	0.89	1.12	0.63	0.32	1.77	1.17	0.60	2.47	0.76	4.74	0.98	1.12	2.28	2.08	3.77	5.25	29.95
Barataria	1.11	0.10	0.05	0.45	0.24	0.05	0.08	0.15	0.29	0.09	0.30	0.31	1.25	0.58	0.35	0.52	5.91
Breton Sound	1.34	0.32	0.01	0.12	0.20	0.06	0.16	0.14	0.38	0.20	0.31	0.27	1.15	0.59	0.29	0.49	6.03
Calcasieu-Sabine	1.87	1.68	0.18	0.26	0.74	0.19	0.19	0.57	0.20	0.28	0.40	0.86	0.81	0.51	0.08	0.19	9.02
Mermentau	1.71	0.57	0.12	0.10	0.28	0.13	0.53	1.16	0.70	0.18	0.33	0.28	0.44	0.19	0.04	0.11	6.87
Mississippi River Delta	2.43	0.50	0.95	2.34	2.52	1.10	1.06	0.67	0.83	1.62	1.43	0.63	2.62	2.52	0.37	2.16	23.74
Pontchartrain	1.59	1.69	0.61	0.17	0.30	0.16	0.28	0.20	0.16	0.07	0.32	0.30	1.11	0.64	0.27	0.46	8.31
Teche-Vermilion	1.64	0.34	0.01	0.04	0.13	0.05	0.05	0.16	0.09	0.10	0.12	0.14	0.51	0.24	0.13	0.11	3.85
Terrebonne	2.96	0.21	0.25	0.31	0.49	0.26	0.24	0.28	0.40	0.76	0.47	0.37	1.67	0.67	0.66	0.43	10.42
Total	**15.53**	**6.52**	**2.82**	**4.10**	**6.68**	**3.17**	**3.21**	**5.79**	**3.80**	**8.03**	**4.66**	**4.27**	**11.82**	**8.03**	**5.95**	**9.71**	**104.11**[1]

[1]Data are rounded to two decimal places; values shown may not add to totals shown.

Source: USGS

Land area in coastal Louisiana by basin, as defined by the Coastal Wetlands Planning, Protection and Restoration Act Program (n.d.), 1932-2010

[Land area in square miles. Dates are approximate averages of imagery used for various portions of the coast. Area estimates are known to be highly influenced by water levels on the date of acquisition of the imagery. Refer to table 2 for water level information]

Decimal date[1]	Basin									
	Atchafalaya Delta	Barataria	Breton Sound	Calcasieu-Sabine	Mermentau	Mississippi River Delta	Pontchartrain	Teche-Vermilion	Terrebonne	Coastwide
1932[2]	212.58	1,479.78	427.63	824.99	958.27	262.07	1,105.19	548.94	1,726.48	7,545.92
1956[2]	197.57	1,382.60	376.07	810.52	918.78	241.82	1,038.25	520.24	1,618.43	7,104.28
1973.9	197.04	1,339.06	395.08	691.40	888.94	80.34	1,029.61	529.78	1,598.43	6,749.68
1975.7	210.52	1,224.77	347.76	697.76	902.95	94.27	999.08	528.12	1,529.68	6,534.90
1977.4	190.51	1,297.88	356.49	591.98	799.89	138.71	993.72	500.33	1,396.13	6,265.65
1985.1	186.80	1,149.74	333.87	615.44	780.54	121.63	979.22	492.36	1,325.53	5,985.12
1988.1	205.89	1,170.51	339.86	636.36	785.76	129.06	991.19	487.43	1,393.58	6,139.65
1990.8	198.92	1,104.10	313.00	659.23	835.71	137.99	970.87	477.91	1,322.58	6,020.31
1995.7	225.18	1,026.72	292.17	637.31	849.77	136.91	934.51	476.86	1,263.14	5,842.57
1998.2	180.94	1,092.40	313.33	596.14	738.04	114.04	961.99	484.70	1,266.84	5,748.43
1999.9	231.23	1,055.72	300.26	644.40	834.03	152.01	946.91	489.33	1,270.68	5,924.58
2002.2	211.68	1,082.12	304.58	629.88	781.19	133.59	944.58	485.88	1,294.11	5,867.61
2004.9	218.90	1,048.56	295.87	654.05	816.48	119.02	936.71	474.31	1,253.01	5,816.89
2006.8	213.99	1,035.94	264.10	625.14	731.29	105.98	912.33	477.43	1,241.69	5,607.89
2008.8	203.15	1,016.36	240.40	580.23	727.70	113.74	900.98	464.57	1,204.62	5,451.75
2009.8	219.35	1,010.85	242.50	568.86	731.03	108.69	903.23	470.82	1,204.45	5,459.78
2010.8	229.31	1,024.19	253.40	611.42	803.09	138.03	910.96	471.57	1,220.73	5,662.71

[1]Decimal dating is a more specific dating system than the calendar year and is used to facilitate statistical analyses. It is derived by dividing the day of the year (in the Julian system) by the number of days in the year.
[2]Calendar dates were not available.

Source: USGS

1.4 Economy

The population of the parish was 104,503 in 2000 and grew seven percent by 2010, to 111,860. As of 2013, the United States Census estimates the population of Terrebonne to be 111,713. Twelve percent of the population is over the age of 65 and approximately 26% are under 18 years of age. The population is distributed such that the heaviest concentration of people and most urbanized area is in Houma.
According to 2012 U.S. Census data, the parish's top four primary industry sectors based on employment include (1) educational services, and health care, and social assistance, (2) agriculture, forestry, fishing and hunting, and mining (3), retail trade, and (4) manufacturing. These sectors represent over 50 percent of the parish's total employment (populations 16 years and older) of 47,750 in 2012. The following table provides a summary of the overall economy based upon employment.

Table 2-2: Terrebonne Parish Employment by Industry Sector, 2012

2012 American Community Survey 5-Year Estimates		
Industry Sector	**Number of Workers***	**Approx. %**
Educational Services, and Health Care and Social Assistance	8,999	19%
Agriculture, Forestry, Fishing and Hunting, and Mining	6,741	14%
Retail Trade	5,716	12%
Manufacturing	4,520	9%
Arts, Entertainment, Recreations, and Accommodation, and Food Services	3,979	8%
Construction	3,689	8%
Professional, Scientific, and Management, and Administrative and Waste Management Services	3,373	7%
Other Services Except Public Administration	2,935	6%
Transportation and Warehousing, and Utilities	3,094	6%
Finance and Insurance, and Real Estate, Rental, and Leasing	2,751	6%
Wholesale Trade	1,397	3%
Information	556	1%
Total	**47,750**	**100%**

* Population 16 years and over in the labor force

According to 2012 U.S. Census data, the parish's primary industry sectors based on employment include (1) educational services, health care, and social assistance, (2) retail trade, (3) agriculture, forestry, fishing and hunting, mining, and (4) manufacturing. These four sectors represent 54% of the parish's total employment of 47, 750 in 2012. The table above provides a summary of the overall economy based upon employment.

Regarding annual payroll by industry, Transportation and Warehousing ($583,078), Healthcare and Social Assistance ($470,778), Manufacturing ($462,576), Mining, Quarrying, and Oil and Gas Extraction ($356,921), and Construction ($266,811) generate

the five largest payrolls in the Houma-Thibodaux MSA. The table on the following page shows payroll for all industries MSA-wide.

Regarding the number of businesses located within the parish by industry, a majority of firms within the parish employ between one and four employees.

2012 Houma - Thibodaux MSA Business Patterns, Payroll by Industry

Industry code description	Paid employees for pay period including March 12 (number)	First-quarter payroll ($1,000)	Annual payroll ($1,000)	Total establishments
Total for all sectors	77,518	826,982	3,574,802	4,826
Agriculture, Forestry, Fishing and Hunting	67	341	1,288	24
Mining, Quarrying, and Oil and Gas Extraction	5,302	82,670	356,921	140
Utilities	172	2,275	9,590	9
Construction	4,427	58,599	266,811	360
Manufacturing	7,373	108,712	462,576	201
Wholesale Trade	3,426	49,668	199,384	296
Retail Trade	11,195	63,802	265,753	794
Transportation and Warehousing	8,747	134,814	583,078	352
Information	662	7,061	28,053	46
Finance and Insurance	2,196	24,365	97,163	375
Real Estate and Rental and Leasing	2,207	30,627	143,349	238
Professional, Scientific, and Technical Services	3,191	36,514	164,697	449
Management of Companies and Enterprises	409	7,927	39,277	23
Administrative and Support and Waste Management and Remediation Services	4,923	48,752	228,253	195
Educational Services	332	2,334	9,739	33
Health Care and Social Assistance	11,180	110,939	470,778	476
Arts, Entertainment, and Recreation	679	2,644	11,382	67
Accommodation and Food Services	7,591	28,214	117,949	396
Other Services (except Public Administration)	3,423	26,563	118,127	350
Industries not classified	a	D	D	2

2012 Houma - Thibodaux MSA Business Patterns, Total Establishments by Industry

		Number of establishments by employment-size class								
Industry code description	Total establishments	1-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000 or more
Total for all sectors	4,826	2,292	1,070	697	485	156	86	30	9	1
Agriculture, Forestry, Fishing and Hunting	24	20	3	0	1	0	0	0	0	0
Mining, Quarrying, and Oil and Gas Extraction	140	47	21	26	27	10	4	3	2	0
Utilities	9	3	0	2	3	1	0	0	0	0
Construction	360	211	72	34	26	7	8	2	0	0
Manufacturing	201	73	39	28	28	15	11	6	1	0
Wholesale Trade	296	115	88	48	34	9	2	0	0	0
Retail Trade	794	316	245	143	56	12	17	5	0	0
Transportation and Warehousing	352	152	57	68	37	21	10	4	3	0
Information	46	14	8	13	9	2	0	0	0	0
Finance and Insurance	375	222	105	32	13	3	0	0	0	0
Real Estate and Rental and Leasing	238	144	44	24	19	3	4	0	0	0
Professional, Scientific, and Technical Services	449	320	64	37	17	6	4	1	0	0
Management of Companies and Enterprises	23	12	1	5	3	1	1	0	0	0
Administrative and Support and Waste Management and Remediation Services	195	92	31	23	27	12	5	5	0	0
Educational Services	33	19	5	4	3	2	0	0	0	0
Health Care and Social Assistance	476	185	128	79	52	13	13	3	2	1
Arts, Entertainment, and Recreation	67	31	15	12	7	2	0	0	0	0
Accommodation and Food Services	396	95	78	83	107	26	6	1	0	0
Other Services (except Public Administration)	350	220	66	35	16	11	1	0	1	0
Industries not classified	2	1	0	1	0	0	0	0	0	0

2.0 §201.6 (b) THE PLANNING PROCESS

An open public involvement process is essential to the development of an effective plan. To develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include the following:

2.1 §201.6 (b)(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval

Various methods which encouraged and facilitated public comment during the drafting stage and prior to plan approval were incorporated into the planning process. To create the nucleus of parish/local participation, a Hazard Mitigation Plan Update (HMPU) Steering Committee was formed. The HMPU Steering Committee was comprised of a diverse group of citizens and professionals from throughout the parish. The Terrebonne Parish Council approved the steering committee.

The primary mode of plan update participation included five HMPU Steering Committee meetings. Each HMPU Steering Committee meeting was open to the public and advertised to increase public awareness and encourage participation. Additionally, the news media was contacted prior to all meetings. The HMPU Steering Committee meetings occurred on the following dates:

- May 22, 2014
- July 17, 2014
- August 7, 2014
- September 12, 2014
- October 6, 2014

Supporting documentation (advertisements, attendance lists, agendas, PowerPoint presentations, etc.) related to the aforementioned meetings are included in Attachments c1-3.1A—c1-3.5D (page 5-83).

2.2 §201.6 (b)(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 business, academia and other private non-profit interests to be involved in the planning process

Local and regional agencies were directly involved in the planning process by way of their participation on the HMPU Steering Committee. These parties included the parish planning and zoning director, the parish director of emergency preparedness, and key operations personnel from the public works departments of the parish. Business interests, non-profit and academic institutions such as the Terrebonne Parish School Board, the

Louisiana State University (LSU) Agricultural Center, and Sea Grants, as well as Tribes with interests in multiple parishes were also represented on the committee. Additionally, the real estate industry, engineering firms, and the Southeast Louisiana Homebuilders Association served on the committee or participated as stakeholders. The HMPU Steering Committee member list is provided as attachment c1-1 (page 1-2).

Both FEMA and GOHSEP representatives from Planning and Hazard Mitigation were invited to all committee meetings. They provided input as needed throughout the planning process.

2.3 §201.6 (b)(3) Review and incorporation if appropriate, of existing plans, studies, reports, and technical information

At the outset of the HMPU planning process, a preliminary list of existing plans, studies and guidance documents was established in cooperation with parish officials and the HMPU Steering Committee. Documents that were initially identified included the following:

- Louisiana State Hazard Mitigation Plan, April 2014
- Terrebonne Parish – Vision 2030 Comprehensive Master Plan, February 2013
- NFIP Community Ratings System Coordinator's Manual (2013)
- Local Mitigation Plan Review Guide (2011)
- Terrebonne Parish Hazard Mitigation Plan Update, 2010
- Local Multi-Hazard Mitigation Planning Guidance (2008)
- Terrebonne Parish Long Term Recovery Plan (ESF-14), February 2007
- Louisiana's Comprehensive Master Plan for a Sustainable Coast (CPRA), April 2007
- Louisiana Coastal Impact Assistance Plan (CIAP), June 2007
- Coastal Wetlands Planning Protections & Restoration Act (CWPPRA), April 2006
- Terrebonne Parish Hazard Mitigation Plan, 2004
- Terrebonne Parish Comprehensive Master Plan, October 2003

Each document was reviewed for relevant content. Information from the plans was incorporated into the planning process as necessary following discussions with the HMPU Steering Committee.

Examples of technical information reviewed and incorporated into the HMPU include historical flood data from FEMA, documented high water marks from the U. S. Army Corps of Engineers, and light detection and ranging (LIDAR) elevation data from the U.S. Geological Survey. Much of this data was incorporated into the risk assessment component of the plan relative to plotting historical events and the magnitude of damages that occurred. Relevant geospatial information was provided upon request by the Terrebonne Parish geospatial information group (GIS). In addition, the Area Risk Assessment of Roberta Grove and Senator Circle, developed by the University of New

Orleans Center for Hazards Assessment, Response & Technology (CHART), was consulted for this HMPU as well.

The discussion of the sufficiency of the Comprehensive Plan, building codes, zoning ordinances, floodplain management regulations, subdivision ordinance and stormwater management regulations spanned several meetings. Each was revisited as projects and proposed risk reduction solutions were proposed. Members of the building community, developers, engineering firms, the planning commission, and the building code enforcement staff participated providing for depth of experience and motivations.

The Office of Homeland Security and Emergency Preparedness and Public Works Departments provided projects and perspectives regarding preparation, response, and mitigation. The advance registration system; outreach messaging over the internet, Twitter, and Facebook; sandbag site consistency; and evacuation procedures were considered sufficient. Due to the advance notice the Parish has for the types of events most likely, the warning system has a greater amount of time to reach the public than other more acute events elsewhere. Some projects were proposed to broaden the definition of critical facilities to include industry key to recovery. The maps of critical facilities therefore include hospitals, home improvement stores, pharmacies, gas stations, and communications towers. This information was not included in the HAZUS loss estimate as the information regarding the costs of the outage on this number of structures was not attainable in the timeline of the plan update process.

The Houma Police Department proposed several efforts including better coordination between agencies to ensure that Tier 1 critical businesses are assured reentry privileges, and better mobile signage to communicate when major roads and bridges are inoperable.

The Department of Coastal Preservation and Restoration (DCRP) provided a set of projects and educational initiatives that included actions by the state and federal governments. Protection and nurturing of the natural environment is crucial to the stability of the culture and the structural installations to protect the built environment. The Planning Department has teamed with the DCRP to successfully earn a grant for a Living Mitigation Pilot Program. This partnership with local, state, and federal agencies including the Army Corps of Engineers will showcase the efficacy of natural enhancements such as mangroves to stabilize the coast and lakeshores. This will be the Parish's first opportunity to work with the newly developed Louisiana Silver Jackets program.

In another case, business interests close to the East Houma Surge Levee and the extension of Thompson Road indicated that they did not know what the plan was for water movement now that this was installed. The resolution of this insecurity was proposed by a business owner. They would like to see a simple map, in this case and throughout the Parish, that shows where the water is expected to flow in a storm event. By educating the public, misimpressions and feelings of either false security or overestimated risk could be moderated.

3.0 §201.6 (c) PLAN CONTENT

3.1 §201.6 (c)(1) Documentation of the planning process used to develop the plan including (a) how it was prepared, (b) who was involved in the process, and (c) how the public was involved.

3.1.1 How it was prepared…

Terrebonne Parish's most recent Hazard Mitigation Plan was adopted in 2010. The development of the 2015 Terrebonne Parish HMPU complies with 44 CFR §201.6(d)(3) which requires the adoption of formalized hazard mitigation plan updates every five years. These updates ensure that the parish maintains eligibility for FEMA hazard mitigation project funding. The update is meant to reflect changes in development, to document progress on local mitigation efforts outlined in the 2010 HMPU, and to adapt mitigation efforts to changing priorities. The HMPU Steering Committee provided information that was critical to developing the HMPU.

A combination of procedures spelled out in CFR §201.6, workshop manuals, and how-to guidelines were followed throughout the update process. They include the Local Multi-Hazard Mitigation Planning Guidance (2008), the Local Mitigation Plan Review Guide (2011), and the NFIP Community Ratings System Coordinator's Manual (2013).

3.1.2 Who was involved in the process…

The HMPU Steering Committee served as the parish's primary representative body throughout the plan update. Goals of the HMPU Steering Committee included incorporating new data, especially that from recent storm and flood events, identifying new hazards, updating risk and vulnerability assessments, and updating mitigation goals and action items.

Committee membership was comprised of a broad cross-section of the community. A detailed list of HMPU Steering Committee members is presented as Attachment c1-1 (page 1-2). Pat Gordon, Planning & Zoning Director, volunteered to accept the position of committee chair. Agencies represented by the 35-person committee included the following:

- Terrebonne Parish Consolidated Government
- Terrebonne Parish Readiness and Assistance Coalition
- Terrebonne Parish Sheriff's Office
- Terrebonne General Medical Center
- Terrebonne Parish School Board
- Terrebonne Parish Levee & Conservation District
- Houma Fire Department
- Houma-Terrebonne Chamber of Commerce

- Board of Health
- Consolidated Waterworks District No. 1
- Traditional Chief Albert P. Naquin Isle de Jean Charles Band of Biloxi-Chitimacha-Choctaw
- Thomas Dardar, Jr, Principal Chief, United Houma Nation
- Shirell Parfait-Dardar, Chief, Grand Caillou/Dulac Band of Biloxi-Chitimacha-Choctaw
- Pointe-au-Chien Indians
- Regulatory Planning Commission
- South Central Industrial Association
- 911 Communications
- Local Engineering Firms
- Office of Homeland Security and Emergency Preparedness
- Southeastern Louisiana Home Builders Association

Separate from the HMPU Steering Committee, select members were assigned additional roles for Community Rating System (CRS) compliance. Committee members serving dual CRS roles are as follows:

- Geoff Large - Preventative Measures (codes)
- Pat Gordon - Property Protection
- Lisa Ledet - Floodplain Manager
- Mitch Marmande, Reggie Dupre, Nick Matherne - Natural Resources Protection
- Darrel Waire - Housing
- Earl Sues, Chief Dufrene, Sherriff - Emergency Services
- Todd Duplantis - HPD, Structural Flood Control Projects (Greg Bush, Mitch Matherne/Reggie Dupre)
- Doug Bourg - Public Information

3.1.3 How the public was involved

The public was well represented through the participation of the Consolidated Government, a comprehensive group of parish regulatory agencies, and local engineering firms on the HMPU Steering Committee. Over a five month period, the group met five times to collaborate on the plan's development. Input from the steering committee was key to identifying potential hazard events, collecting data on hazard events that had occurred since the 2010 update, identifying critical facilities, and identifying and prioritizing hazard mitigation projects. Summaries of the public meetings are presented below and a listing of attendees is presented as Attachment c1-2 on pages 3 and 4.

Public participation was also encouraged through public advertisement of HMPU Steering Committee meetings on the parish website and through local media outlets. Media coverage served as another medium to convey information to and encourage future participation of members of the public unable to attend face-to-face meetings. A public notice was also published in the newspaper of record and the *Tri-Parish Times* prior to

each HMPU Steering Committee meeting. Highlights from press coverage included a *The Courier* article that was picked up by WWNO radio and at least the KLFY 10, WHFB 9, WLOX, KTBS, and KNOE 8 television station websites following the September 12, 2014 steering committee meeting. *The Courier* also ran an article for the July 17, 2014 meeting. PowerPoint presentations and meeting notes were posted on the Parish website following all four meetings, and meeting notices were posted on bulletin boards in the Government Tower where council and other civic announcements are viewed.

Meeting No. 1 - May 22, 2014

The Terrebonne Parish Hazard Mitigation Plan Update Committee held its first public meeting at the Terrebonne Parish Council Meeting Room in Houma, Louisiana, on Thursday, May 22, 2014. The purpose of the meeting was to introduce the steering committee and discuss an overview of the Plan Update process. Prepared handouts included an agenda, the Hazard Mitigation Plan Update from 2010, the Terrebonne Parish Comprehensive Master Plan, and the mitigation project list. Below is a general summary of meeting highlights. A PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.1C (pages 8-11) and Attachment c1-3.1D (pages 12-22).

The steering committee structure was discussed and Pat Gordon, Terrebonne Parish Consolidated Government (TPCG) Planning and Zoning Director, volunteered to assume the role of Committee Chair Person for the Terrebonne Parish Hazard Mitigation Plan Update. CB&I discussed new data that should be incorporated into the plan update, including vulnerability analyses, changes in hazard identification, different flood inundation areas, committee priorities for modeling, and progress of projects that have been implemented since the 2010 plan. Such projects were updated in the plan maintenance process by the responsible Parish departments. CB&I noted that Community Rating System (CRS) principles would be discussed throughout the planning process.

Goals and Critical Facilities were discussed. The steering committee recommended that the Civic Center, Public Works, and Acadian Ambulance be added to the Critical Facilities list.

The hazards to be identified in the plan were discussed. Some hazards that the steering committee recommended for inclusion were sea level rise, coastal erosion, sinkholes, and ice events. Also, Hurricane Lee, Atchafalaya Flooding of 2011, and May/October flooding were to be added to the plan's flood event profiles.

Meeting No. 2 - July 17, 2014

The Terrebonne Parish Hazard Mitigation Plan Update Committee held their second open to the public meeting at the Folk Life Museum in Houma, Louisiana, on Thursday, July 17, 2014. The purpose of the meeting was to review updated maps, add new or update existing projects on the project list, and receive attendees' input on hazard events.

The steering committee was presented with updated maps and provided an opportunity to provide feedback for integration in future map revisions.

CB&I discussed impacts that occurred during past hurricanes, such as Gustav, Ike, Isaac, etc. and flooding events, such as Flood of May 2011, Flood of July 18, 2011, Tropical Storm Lee, etc. The role of the Bayou Chene barge in preventing backwater flooding from reaching Terrebonne Parish during the Flood of May 2011 was also discussed. CB&I shared that data was unavailable for the October Flooding (2013) and May Flooding (2014). As such, the steering committee agreed to remove these flood events from the hazard mitigation plan.

Reggie Dupre, Executive Director of the Terrebonne Levee & Conservation District noted that Reach J2 experienced flood damage during Hurricanes Lee and Isaac. Temporary levee reach overtopping occurred during Hurricane Gustav and the parish jail flooded during Hurricane Ike.

Nicole Cutforth, the CB&I Project Manager, explained that historically, the identification of hazard events has emphasized flooding and wind because those hazards generate the most damage in South Louisiana. However, Ms. Cutforth stressed that the 2015 HMPU will also profile every other natural hazard that impacts Terrebonne Parish and is eligible for mitigation funds. Other hazards include drought, hailstorms, tornadoes, winter storms, land subsidence, sea level rise, coastal erosion, saltwater erosion, and sinkholes.

Mitigation goals and the project list were discussed. The project list will be prioritized at Meeting No. 3.

Meeting No. 3 - August 7, 2014

The Terrebonne Parish Hazard Mitigation Plan Update Committee held their third open to the public meeting at the Bayou Terrebonne Waterlife Museum in Houma, Louisiana, on Thursday, August 7, 2014. The purpose of the meeting was to provide an opportunity to review updated risk assessment maps, review Worksheet #3A and Worksheet #4, and allow attendees to provide input on project prioritization.

Nicole Cutforth, CB&I Project Manager, explained the flood composite risk assessment process to the steering committee as well as how inundation information and loss estimates were developed using FEMA's HAZUS software program.

Repetitive Loss Structures were defined and it was noted that they are tracked by FEMA and the National Flood Insurance Program (NFIP). The definition of Repetitive Loss properties changed since the last update.

The project priority list was also discussed at Meeting No. 3. In order to gauge committee members' project priorities, a series of questions were posed, to which committee members responded, revealing their preferences. The list of questions and response percentages can be viewed in the project prioritization subsection within Section 5.0 of this plan.

Recommendations regarding critical facilities and priority projects are as follows:

- Chief Dufrene discussed that he would like to add a Safe House to the project list. The chief shared that this recommendation and all of his previous recommendations were vetted through all of the Fire Chiefs prior to submission ensuring that the goals of all stations and communities were included.
- Chris Pulaski with Terrebonne Parish questioned where major retail outlets such as Home Depot, Lowes, etc. would fit in on the Critical Facilities list. Nicole explained that the critical facilities list is typically just Government Buildings but all major retail outlets can be listed if locations are provided along with a replacement value, contents value, and a value of how much it would cost a day that each store is out of commission.
- It was noted that the CNG Station located at 550 South Van Ave. should be listed as a priority on the project list.

Meeting No. 4 -- September 12, 2014

The fourth open to the public and advertised HMPU steering committee meeting was held on September 12, 2014 at the Waterlife Museum at 7910 W. Park Avenue Houma, Louisiana 70360. Nicole Cutforth, with CB&I, reviewed the maps, risk assessment, and repetitive loss inventory with the committee. It was noted that zoom-in maps of the composite risk area would be removed due to the Privacy Act of 1974. The mitigation project list was also reviewed and no new projects were discussed. Ms. Cutforth also reviewed with the committee the mitigation project list and provided an opportunity for new projects to be added. No new projects were discussed.

CD's of the draft plan were provided to all attendees and a copy was placed on the Parish Website. Ms. Cutforth requested that the committee review the draft plan and provide

comments so that FEMA and GOHSEP can begin reviewing the draft mid-October. Once pertinent comments are incorporated, the draft plan will be submitted to GOHSEP and FEMA. Once approved by GOHSEP and FEMA, a resolution will be placed on the TPCG Council agenda for review and adoption. It is estimated that this will occur in February or March of 2015.

Meeting No. 5 -- October 6, 2014

The Terrebonne Parish Hazard Mitigation Plan Update Committee held their fifth open to the public meeting at the Bayou Terrebonne Waterlife Museum in Houma, Louisiana, on Monday October 6, 2014. The purpose of the meeting was to provide an opportunity to review the preliminary draft, and allow attendees to provide further input on all aspects of the plan.

Comments and questions that arose from this meeting are as follows:

1. According to the plan, there are 158 pumps in the Parish. Where is the water from a particular destination supposed to go? Education necessary for the public about how the pump systems work would better set expectations. Plan shows the maps, but doesn't show the area that each pump drains.

    a. Response: This information was not available at the meeting. The educational component will be taken into consideration in the plan if there is no current document available.

2. Maintenance of the drainage system needs to be improved. Is there a maintenance plan and a set schedule that ensures that the system will work in an event? An education campaign about litter is needed to protect the drainage system, and at least as important is enforcement by the Sheriff's office.

    a. Response: These are important observations. The parish does have a maintenance schedule that is too broad to include in the plan. However, committee members not present at the meeting will respond to the request. On the litter issue, there have been ongoing educational efforts to encourage proper trash disposal. Fines for littering have been increased. Storm drain protection and maintenance have been brought up by community members in offline discussions during the planning process.

    In continued discussion, the increased fines were not seen as a strong deterrent since enforcement was not consistent. The storm drains in particular were a concern (grass clippings, etc) as it can create backup and flooding in an event.

3. Chabert has a new levee system and drainage valves. Who is responsible for those valves and their operation? Is there a maintenance or day to day operational plan that is available to the public?

a. Response. The levee department is participating on the committee, and will respond with the information that is available. If the information is not available, the development of this and other levees will be considered as a project to update public information in the future.

4. Who is responsible for which levees, and is there a maintenance plan for that? Is the same party responsible for enforcement of restrictions on levee use or abuse? Without enforcement, how are people to know the importance of the levee system, how it performs, and what activities are allowed? Is the maintenance proactive?

    a. Response. There are surge levees and drainage levees, and the Levee District and the Parish have responsibility for specific levees. The responsible party was not certain though the sheriff's office may prosecute. This was tabled until further information could be provided. There is a new levee safety video being developed as a result of a grant. Like other videos on topics such as permitting and mitigation options, the video provides an overview of the importance of the levees, appropriate and inappropriate activities, and the need for citizens to report any activity that could weaken the levee and increase risk of failure.

5. The plan doesn't speak to threats from outside the parish. Flooding from the Mississippi and the Atchafalaya is not covered. Is there a plan for a breach in Donaldsonville or elsewhere?

    a. Response: The Steering Committee discussed this topic in light of the potential flooding in 2013 that was averted. Due to the lack of control the Parish felt it had over the upstream dams and levees, the topic was not pursued. Rather, state and federal sources were considered more appropriate to lead these efforts.

6. What protections do we have for the water supply if there is a manmade disaster or act of terrorism. Examples could be an oil spill followed by a hurricane which washes the oil into the bayou system, or contamination within the water system. How secure are the water treatment facilities, and can this be a part of this multithread plan?

    a. Response: The tribes submitted similar concerns about the combination of manmade and natural disasters on recovery and resources. This objective is being considered for inclusion in the plan. The plan does outline various methods for providing potable water in the event that saltwater intrusion affects the water sources for the Parish. These plans for saltwater intrusion are likely to be applicable to other contamination scenarios.

b. The plan is focused on natural disasters for the most part, and not terrorism. Staff will request any plan related to this threat to the water system be provided.

The summary of the public discussion was that proactive maintenance of the built infrastructure and enforcement of current regulations will be more effective than more new regulations that are not enforced. Likewise, plans or standard operating procedures for maintenance should be developed if they don't exist, but regularly scheduled implementation is just as important.

3.2 §201.6 (c)(2) A risk assessment that provides 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.

Risk Assessment is a four-step process: hazards are identified; hazard events are profiled; an inventory of assets within the community is conducted, and; the potential losses experienced by a community due to a hazard event are estimated. This section is divided into subsections that address each component of the risk assessment process. This section contains data from the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), Terrebonne Parish, and FEMA HAZUS software which is used to support the four-step risk assessment process.

The Terrebonne Parish Hazard Mitigation Plan Risk Assessment is outlined below. The section is divided in components parts including **§201.6 (c)(2)(i), §201.6 (c)(2)(ii), §201.6 (c)(2)(ii) (A), §201.6 (c)(2)(ii)(B), and §201.6 (c)(2)(ii)(C),**

The risk assessment shall include the following:

3.2.1 §201.6 (c)(2)(i) A description of the type, 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 hazards events.

The identification of hazards is in the risk assessment process. The planning team utilized a combination of sources such as the NOAA National Climatic Data Center (NCDC) information, the 2010 Terrebonne Parish HMPU, and the HMPU Steering Committee to identify hazards that may potentially impact Terrebonne Parish.

According to the NCDC, there have been 245 recorded climatic events recorded in Terrebonne Parish within the 56-year period from 1957 to 2013. Table 4-1 is a summary of those events. In order of highest magnitude, Floods, Hurricanes/Tropical Storms/Tropical Depressions, and Wind generate the most property damage within the

parish. It should be noted that the Wind climatic event has the highest probability of occurring and is most attributable to thunderstorm wind.

Table 4-1: NOAA National Climatic Data Center Recorded Climatic Events in Terrebonne Parish, 1957 - 2013

Event Type	Number of Events	Events/Year	Probability	Property Damage	Crop Damage	Damage/Event
Flood	**35**	**0.63**	**63%**	**$ 295,718,000**	**$ -**	**$ 8,449,086**
Flash Flood	15	0.27	27%	$ 1,445,000		$ 96,333
Coastal Flood	4	0.07	7%	$ -		$ -
Flood	2	0.04	4%	$ -		$ -
Storm Surge	13	0.23	23%	$ 294,273,000		$ 22,636,385
Heavy Rain	1	0.02	2%	$ -		$ -
Cold	**8**	**0.13**	**13%**		**$ 100,000**	**$ 20,000**
Cold/Wind Chill	5	0.09	9%	$ -	$ 100,000	$ 20,000
Winter Storm	2	0.04	4%	$ -	$ -	
Heavy Snow	1	0.02	2%			
Wind	**121**	**2.16**	**216%**	**$ 13,201,500**		**$ 109,103**
Funnel Cloud	10	0.18	18%	$ -	$ -	$ -
High Wind	2	0.04	4%	$ -	$ -	$ -
Thunderstorm Wind	76	1.36	136%	$ 402,000	$ -	$ 5,289
Tornado	31	0.55	55%	$ 12,779,500	$ -	$ 412,242
Waterspout	2	0.04	4%	$ 20,000	$ -	$ 10,000
Excessive Heat	**2**	**0.04**	**4%**	**$ -**	**$ -**	**$ -**
Drought	**6**	**0.11**	**11%**	**$ -**	**$ 4,390,000**	**$ 731,667**
Hail	**21**	**0.38**	**38%**	**$ -**	**$ -**	**$ -**
Hurricane/Tropical Storm/ Tropical Depression	**37**	**0.66**	**66%**	**$ 137,087,000**	**$ -**	**$ 3,705,054**
Lightning	**15**	**0.27**	**27%**	**$ 677,500**	**$ -**	**$ 45,167**
Total	**245**	**4.36**	**436%**	**$ 446,684,000**	**$ 4,490,000**	**$ 13,060,076**

Hazard Identification

Based on the combination of NOAA Climatic Data Center Recorded Climatic Events listed in the above table, the 2010 HMPU, and the HMPU Steering Committee, this section lists and describes potential hazard events that may impact the community.

During the HMPU Steering Committee kick-off meeting held on May 22, 2014 (meeting presentation as Attachment c1-3.1D), HMPU Steering Committee members were presented with a list of identified hazards. The worksheet was developed based on the abovementioned data sources, and was reviewed and revised based on HMPU Steering Committee comments. The HMPU Steering Committee recommended that the 2010 list of identified hazards be amended to include sea level rise, coastal erosion, sinkholes, and ice events.

For reference, the ten hazards listed in the 2010 Terrebonne Parish HMPU identified ten hazards as potential threats to Terrebonne Parish are listed below.

- Coastal Erosion
- Coastal (Tropical) Storm
- Levee (Dam) Failure
- Drought

- Flood
- Hurricane
- Land Subsidence
- Saltwater Intrusion
- Tornado
- Thunderstorms/Lightning/High Winds

Each hazard in the "Identified Hazards" list is referenced below with an explanation of its potential probability (based on NOAA Recorded Climatic Events) as a hazard to the parish.

Identified Hazard	Comments	Hazards Profiled in Plan Update
Natural Hazards		
Avalanche	No recorded avalanche events have occurred in the parish and therefore will not be explored further as a potential threat in this HMPU.	-
Coastal Erosion	As previously described in Section II of this HMP, more than 85% of the parish's land area consists of water and wetlands. The Gulf of Mexico comprises the entire southern border of the parish, a large portion of which is subjected to erosion. The condition is prevalent and is considered a significant hazard.	Coastal Erosion
Coastal (Tropical) Storm	During the planning session, "coastal storm" was regarded as similar to hurricanes and therefore considered redundant. Impacts of coastal storms are similar to those generated by hurricanes. For purposes of this report, storm water and surge events created by tropical storms and tropical depressions and hurricanes are considered. However, storm water and surge events related to hurricanes are considered the most serious. Based upon historical events, coastal storms are often the cause of heavy rainfall events with less wind than hurricanes. The heaviest rainfalls in recent history resulted from tropical depressions.	Tropical Storm
Hurricane	Hurricane hazards are a primary concern regarding flooding from both storm water events and storm surge. Wind damage is also of significant concern. Storm water issues and surge issues are also addressed as flood concerns.	Hurricane

Flood	Flooding is the second most prevalent hazard event type recorded by the NCDC in Terrebonne Parish. Thirty-three flood events have been recorded in the last 56 years. Flood concerns are addressed as the major hazard issue in the parish, and as such, will be detailed throughout this HMPU. Additionally, with high river stages and as a result of storm surge, flooding occurs in areas far removed from the source of the primary event. Locally, the term "backwater flooding" identifies this phenomenon. The issue is of such concern that the steering committee chose to identify flooding as a hazard independent of the riverine, stormwater, and storm surge hazards.	Flood
Earthquake	No recorded earthquake events have occurred in the parish.	-
Drought	Drought is a minimal concern in Terrebonne Parish as depicted in the NOAA table above. Only six recorded events were noted in the last 56 years, and no anticipated drought related mitigation issues were noted in Terrebonne Parish. While the hazard is possible, it is not considered to be probable.	-
Expansive Soils	According to Terrebonne Parish's 2005 HMP, expansive soils are likely to occur. However, the HMPU Steering Committee determined that expansive soils in the parish are not of a magnitude that warrants inclusion in this plan.	-
Extreme Heat	One recorded excessive heat event has been recorded in the last 56 years in Terrebonne Parish. Therefore, the HMPU Steering Committee determined that the hazard is not of a magnitude to be addressed as a prevalent hazard in this plan.	-
Saltwater Intrusion	The parish has three freshwater intakes available for its supply of potable water. These intakes have become increasingly vulnerable to saltwater intrusion. In fact, storm surge from past hurricanes has forced the parish to abandon certain intakes due to high salt concentrations. For this reason, the HMPU Steering Committee agreed that saltwater intrusion should be recognized as a significant hazard within this HMPU.	Saltwater Intrusion
Land Subsidence	According to Terrebonne Parish's 2005 HMP, land subsidence is likely to occur in the region. As of 2012, this hazard has recently become a concern for the parish in consideration of the Assumption Parish Bayou Corne	Land Subsidence

	sinkhole which developed as a result of severe land subsidence related to underground energy storage. The hazard is thus identified as a prevalent hazard although targeted mitigation actions to be implemented by TPCG will not be identified for the purpose of this plan.	
Sinkhole	There have been no recorded sinkhole events in Terrebonne Parish. Terrebonne's location on the Gulf Coast Salt Dome Basin makes it vulnerable to sinkholes that have been mined and/or utilized for energy storage. Concerns for potential sinkholes in Terrebonne Parish are heightened given the Bayou Corne (Assumption Parish) sinkhole that formed in 2012 as a result of a collapsed underground salt dome. As of February 2014, the sinkhole has expanded to 25 acres. However, according to the Department of Natural Resources there is only one permitted salt cavern facility location in Terrebonne Parish. This location is the Caillou Island location which is plugged and abandoned.	-
Hail Storm	The steering committee concurred that hailstorms will not be of further consideration for the purposes of this plan because the damages incurred per event and frequencies are not significant.	-
Wildfire	No wildfire events of significance have been recorded in Terrebonne Parish and will not be of further consideration for the purposes of this HMPU.	-
Tsunami	Tsunami events have never been noted in Terrebonne Parish and will not be considered further in this HMPU.	-
Volcano	No volcanoes exist in Terrebonne Parish and will not be of further consideration for the purposes of this HMPU.	-
Severe Winter Storm	Because severe winter storms are so seldom in the coastal area, impacts were considered neither prevalent nor applicable to this planning effort.	-
Landslide	No recorded landslide events have occurred in Terrebonne Parish and will not be of further consideration for the purposes of this HMPU.	-
Tornadoes	Tornadoes are a function of high winds. They have occurred historically in the parish and are likely to occur in the future. Due to the limited impacts created by any single event upon the parish, the HMPU Steering Committee concluded that addressing mitigation measures relative to tornados as a stand-alone hazard should not be considered in this plan, but the tornado hazard will be profiled due to the high probability of occurrence.	Tornadoes
Ice Events	In January 2014, a mixture of freezing rain and ice impacted the Gulf Coast of Louisiana. However, ice	-

	events are not a common occurrence in Louisiana and the NCDC does not record any ice events occurring between 1957 and 2013. This hazard will not be profiled in this HMPU.	
Sea Level Rise	Sea level rise is directly related to land subsidence in coastal Louisiana. Despite the magnitude of the impact that land subsidence has on Louisiana, GOHSEP acknowledges that the scale of the problem would be better addressed under the auspices of the Louisiana Department of Transportation and Development, the Department of Natural Resources, and the Coastal Protection and Restoration Authority. This hazard will not be profiled in this HMPU.	-
Man Made Hazards		
Dam Levee Failure	Dams do not exist in Terrebonne Parish. However, levees, as in most areas of south Louisiana, are common. In the case of Terrebonne Parish, the majority of the levees that do exist were not designed for hurricane protection, but are rather used as forced drainage mechanisms due to their limited height. All levees within the parish that are located south of the Intracoastal Canal were reportedly topped and/or breached during Hurricane Rita in 2005. Therefore, levee failure is considered a highly significant hazard event in the area. A map of levees and pump stations, as well as, drainage areas is displayed in Attachment c2-3 (page 86) at the end of this section.	Levee Failure

Prevalent Hazards to the Community

Although many of the hazards in the previous section occur in the parish, attention was focused on the most prevalent hazards which include the following:

(a) Levee failure
(b) Flooding
(c) Hurricanes and Coastal/Tropical Storms
(d) Saltwater Intrusion
(e) Tornadoes
(f) Subsidence
(g) Coastal Erosion

This list was confirmed by HMPU Steering Committee members in Meeting No. 1and with consideration of the former HMP (2010).

Additional Hazards of Concern

In addition to the hazards identified by the HMPU Steering Committee, manmade hazards, such as environmental disasters, have the potential to cause extensive detrimental impacts to the residents, environment, and economy of Terrebonne Parish. Although this plan does not profile environmental disasters, it is worth noting that the Deepwater Horizon incident in 2010 had profound impacts on various economic sectors within the Parish that resulted in social disruption as well as health impacts on individuals. The impacts of the oil spill continue to be felt by Parish residents, and the long-term consequences to the environment, as well as to the health of residents, as yet unknown.

3.2.2 §201.6 (c)(2)(ii) 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.

A general description of specific events and their overall impact to the community is addressed in the following section. This section will be followed by an inventory of critical facilities and a detailed estimation of losses that could occur as a result of future hazards. A detailed analysis of buildings, infrastructure, values, etc. follows in later sections (c)(2)(ii)(A and B).

Hazard Vulnerability
A Profile of Hazard Events and Hazard Impacts

As discussed in section §201.6 (c)(2)(i), levee failure, flooding, hurricanes, coastal/tropical storms, coastal erosion, and saltwater intrusion were identified as prevalent hazards to Terrebonne Parish.

3.2.2.1 *Flooding*

The issue of flooding was discussed in detail and committee members determined that it is the most prevalent and the most frequent hazard to the parish. Committee members recommended that the issue of flooding be the main focus during this HMPU planning process. It was also determined that flooding would be subdivided into four categories based on the type of flooding: riverine, backwater, storm water, and storm surge. By separating the types of flooding into these four categories, the parish was able to identify specific portions of the parish that may be prone to each type of flooding or hazard event. This approach proved valid in defining both the varying causes of flooding hazards and in determining vulnerability.

In addition to damages from storm surge that would be expected near the coast, the Parish experiences flooding in the northern communities that may be caused by poor drainage, road improvements, or subsidence. These flood prone areas outside the SFHA are included in the repetitive loss map. The addresses of repetitive loss structures are not shown specifically due to privacy concerns, but are shown generally both within the

SFHA and without. The data mapped is from NFIP claims and calls to the public works department, the Office of Emergency Preparedness, and the mitigation division of the planning department that are logged after every moderate to severe storm. NFIP claims are not reflective of the flooding in these areas. Claims are suppressed due to ignorance of flood insurance rules or a desire to retain a preferred insurance rate. More specific education regarding flood insurance details is needed rather than general information about the importance of getting flood insurance. The importance of flood insurance and the mitigation benefits of insurance have been the focus to this point. [1]

Storm water
Storm water excesses caused by large amounts of rainfall in a short period of time occur frequently in this coastal parish. Generally, the most damaging events were a function of tropical storms and hurricanes. Primarily low lying areas of the parish suffered damage from past events including Hurricane Juan in 1985 and Tropical Storm Allison in 2001.

Storm surge
Storm surge caused by winds of hurricanes and tropical storms cause inundation of coastal floodplains and through coastal river and drainage systems. In the case of storm surge, southerly winds and high tides rise over and through bayous, canals and marshlands. Low lying coastal areas of Terrebonne Parish are vulnerable to this type of flooding due to its predominate marshland coast and its proximity to the Gulf of Mexico.

Riverine
Riverine flooding, by definition, is river based. Despite the abundance of waterways located within the parish, there are no rivers that are subject to significant water level fluctuations and contribute to flooding. There are however, many bayous, canals, and marshland that effectively drain the parish into the Gulf of Mexico in the absence of a strong southerly push created by wind. Riverine flooding is not considered a significant threat to Terrebonne Parish.

Backwater flooding
Backwater flooding is normally associated with riverine flooding and connotes a lack of velocity. Low lying areas, particularly those outside of protection levees are at risk. A heavy rainfall event combined with a strong southerly wind hinders drainage outflow causing backwater flooding to the same areas susceptible to storm surge. This phenomenon generally results in the flooding of areas of the parish located south of the City of Houma. Historically, flooding is generally wide spread but shallow in these areas. Backwater flooding occurred when the storm surge flowed through the pump station outfall pipes inhibiting drainage as recently as Hurricane Rita.

[1] The Parish has applied for and was awarded a grant for Flood Risk Modeling. From the assessment of available data, it seems likely after committee discussion that data gathering and modeling will target the areas north of Woodland Ranch Road and Bayou Cane in particular to assess the relationship of the structure first floor elevations in relation to the centerline of the road and/or nearby forced drainage or other flood reduction infrastructure components.

Previous occurrences of flood events are detailed in the table to follow.

Terrebonne Parish Historical Flood Events 1998-2013

Date	Type	Property Damage
1/6/1998	Flash Flood	$35,000
6/26/1999	Flash Flood	$500,000
6/6/2001	Flash Flood	$575,000
6/10/2001	Flash Flood	$250,000
10/9/2004	Flash Flood	$50,000
10/22/2007	Flash Flood	N/A
5/22/2008	Flash Flood	N/A
8/17/2008	Flash Flood	N/A
3/27/2009	Flash Flood	N/A
12/14/2009	Flash Flood	N/A
7/18/2011	Flash Flood	N/A
9/4/2011	Flash Flood	$25,000
3/23/2012	Flash Flood	N/A
7/20/2012	Flash Flood	$10,000
2/12/1997	Flood	N/A
9/10/1997	Flood	N/A
9/12/1998	Storm Surge/Tide	N/A
6/30/2003	Storm Surge/Tide	$1,000,000
9/15/2004	Storm Surge/Tide	$5,000
9/22/2004	Storm Surge/Tide	$5,000
10/9/2004	Storm Surge/Tide	$18,000
9/23/2005	Storm Surge/Tide	$172,800,000
8/3/2008	Storm Surge/Tide	N/A
9/1/2008	Storm Surge/Tide	$9,400,000
9/11/2008	Storm Surge/Tide	$100,000,000
9/2/2011	Storm Surge/Tide	$45,000
8/28/2012	Storm Surge/Tide	$11,000,000
10/5/1996	Coastal Flood	N/A
4/5/1997	Coastal Flood	N/A
10/16/2006	Coastal Flood	N/A
5/1/2010	Coastal Flood	N/A
	Total	**$295,718,000**

Source: NCDC

The Mississippi River Flood of 2011 (April – May)

The combination of springtime snowmelt and rainfall resulting from multiple major storm systems between April 23 and May 2 made 2011 a record-setting year for flooding in the central United States.[2] For the Mississippi River, this caused the most intense river flooding recorded within the past century. The National Oceanic and Atmospheric Administration estimates that economic losses related to the flooding ranged from three to $4 billion.

Lake Pontchartrain near the Bonnet Carre Spillway, 2011

Source: nola.com

The picture above shows water being diverted from the Mississippi River to Lake Pontchartrain on May 10, 2011 via the Bonnet Carre Spillway. Water from the Mississippi River was also diverted to the Atchafalaya River, which resulted in its cresting on May 30, 2011. Terrebonne Parish mobilized pumps to the western part of the parish in preparation for flooding; however, St. Mary Levee District installed a barge in Bayou Chene, which prevented flooding in Terrebonne Parish.

3.2.2.2 *Hurricane and Tropical Storm Hazard Events*

Because of the proximity of the parish along the Gulf coast, the region is highly prone to hurricanes and tropical storms. The parish has a history of damage linked to hurricanes and tropical storms that have occurred in the past. Seventeen presidentially declared disasters associated with hurricanes and tropical storms have occurred in the parish since 1965. As such, hurricanes and the resultant wind and flooding damage were designated as a significant hazard to the community. More detailed examples are noted in Attachments c2-17 through c2-23 (pages 100 through 106).

The design of the Morganza to the Gulf Hurricane Protection Levee in Terrebonne Parish does not provide protection for several communities, including: Grand Caillou, Dulac, Isle de jean Charles, and portions of Bayou Dularge and Point-au-Chene. These communities may even see increased surge heights as a result of the construction of the Morganza levees. Hazard mitigation strategies, including community relocation, may become necessary in order to reduce the vulnerability of these communities.

Numerous hurricanes and tropical storms have impacted the study area. A table summarizing these instances is noted in this section. Information includes dates, names, impact to the area, and dollar damage estimates (if available).

[2] http://www.srh.noaa.gov/jan/?n=2011_05_ms_river_flood

Table 4-2: Terrebonne Parish Presidential Disaster Declarations (1965 to 2013)

Year	DR#	Storm Name	Impact	Damage (billions)
1965	208	Hurricane Betsy	Storm surge, flooding, and destructive winds	$ 21.9
1971	315	Hurricane Edith	Flooding and high winds	$ 0.3
1973	374	Severe storms, flooding	Heavy rains and flooding	N/A
1974	448	Hurricane Carmen	High winds and tidal flooding	$ 1.6
1980	616	Severe storms/flooding	Heavy rains and flooding	N/A
1985	752	Hurricane Juan	Storm surge, heavy rain, and flooding	$ 4.1
1991	902	Severe storms/flooding	Heavy rains and flooding	N/A
1991	904	Flooding, severe storm, tornado	Heavy rains and flooding	N/A
1992	956	Hurricane Andrew	High winds, heavy rains, and flooding	$ 56.0
1995	1049	Rain storm/flood	Heavy rains and flooding	N/A
1998	1246	Tropical Storm Frances & Hurricane Georges	Destructive winds, storm surge, tornado, and flooding	$ 4.6
2001	1380	Tropical Storm Allison	High winds, heavy rains, and flooding	$ 6.5
2002	1435	Tropical Storm Isidore	High winds, heavy rains, and flooding	$ 0.4
2002	1437	Hurricane Lili	High winds and storm surge	$ 1.1
2004	1548	Hurricane Ivan	Winds	$ 15.5
2005	1603 & 3212	Hurricane Katrina	High winds	$ 81.0
2005	1607 & 3260	Hurricane Rita	Storm surge and flooding	$ 10.0
2008	1792	Hurricane Ike	Heavy rains, high winds	Gustav and Ike cause
2008	1786	Hurricane Gustav	Heavy rains, high winds	$8 to $20B
2009	1863	Severe Storms/ Tornadoes/Flooding	High winds, heavy rains, and flooding	N/A
2011	4015	Flooding	Mississippi River flooding	$ 4.0
2011	4041	Tropical Storm Lee	High winds, heavy rains, and flooding	$ 1.6
2012	4080	Hurricane Isaac	Heavy rains, high winds	$ 1.0
2013	4102	Severe Storms and Flooding	High winds, heavy rains, and flooding	N/A

Note (1): Loss estimates for all affected areas and are not necessarily limited to Terrebonne Parish, estimates in 2000 dollars. Data obtained from *Normalized Hurricane Damage in the United States*: 1900-2005, R. Pielke, et. al.

Hurricane and Tropical Storm Profiles

The most extreme examples of the hazard events that have impacted Terrebonne Parish are presented in the following text beginning in 1965 with Hurricane Betsy. Each event description includes a graphic that illustrates the path taken by the storm. The path is color coded according to the Saffir-Simpson Hurricane Scale to establish the storm's intensity as it approached and made landfall. Every category of hurricane (1-5) can occur in the entirety of the planning area. The colors and the Saffir-Simpson Hurricane Scale are illustrated to the right.

Saffir-Simpson Hurricane Wind Scale	
Category	**Wind Speed**
5 (major)	≥157 mph ≥252 km/h
4 (major)	130–155 mph 209–251 km/h
3 (major)	111-129 mph 178-208 km/h
2	96-110 mph 154-177 km/h
1	74-95 mph 119-152 km/h
Additional Classifications	
Tropical Storm	39-73 mph 63-117 km/h
Tropical Depression	0-38 mph 0-62 km/h

Hurricane Betsy (1965)

Hurricane Betsy made landfall near the mouth of the Mississippi River in Louisiana on September 9, 1965. The hurricane was a category 3 storm with maximum winds of 140 miles per hour recorded in Terrebonne Parish. The event caused wide spread wind and water damage to area homes and business. In addition, the area's agricultural crops (sugarcane) suffered significant losses. One fatality was reported.

Hurricane Betsy's Storm Track

Source:noaa.gov

A map of the flood impact area of Hurricane Betsy is shown in Exhibit c2-16 (page 79) at the end of this section. The storm's path is illustrated in the following graphic.

Hurricane Juan (1985)

Hurricane Juan struck the Louisiana coast in the vicinity of Morgan City on October 29, 1985 as a Category 1 hurricane. Maximum sustained winds were approximately 85 miles per hour. The storm had a very erratic and slow moving track allowing several passes over coastal Louisiana before moving eastward (see storm path below).

Hurricane Juan's Storm Track

Source: noaa.gov

Hurricane Juan consisted mainly of large amounts of rainfall dropped over a short period of time. Rainfall totals for southern Louisiana ranged from 10 to 15 inches accounting for the extreme amount of flooding. Greater than 11 inches of rainfall was recorded in the City of Houma over a four day period. A combination of storm surge and extraordinary rainfall led to extensive flooding. The flooding caused significant losses to agricultural crops and hundreds of homes and businesses were flooded in Terrebonne Parish. A map of inundation for Hurricane Juan is shown in Attachment c2-18 (page 101).

Hurricane Andrew (1992)

Hurricane Andrew is the second most destructive hurricane in United States (U.S.) history with damages estimated at $56 billion. It made its second U.S. landfall (first in Florida) on August 26, 1992 at Point Chevreuil Louisiana (southwest of Morgan City) as a Category 3 storm with winds of 115 miles per hour. The storm's track would guide it up the

Hurricane Andrew's Storm Track

Source: noaa.gov

Atchafalaya River system just west of Terrebonne Parish. Hurricane Andrew's path is illustrated in the following graphic.

Terrebonne Parish was located on the eastern side of the storm's eye wall and therefore sustained widespread damage. The damage was caused by a combination of high winds and storm surge (9 feet recorded in Terrebonne Bay). Notable effects include estimated losses of 25% of the parish's sugarcane crop, extensive power outages, and inundation of several hundred homes by flood waters. Flooded communities included Pointe aux Chene, Chauvin, Dulac, Montegut, Isle de Jean Charles, and Dularge. A map of the inundation caused by Hurricane Andrew in Terrebonne Parish is included as Attachment c2-19 (page 102). The following graphic illustrates the magnitude of the storm's surge on Louisiana's central coastline.

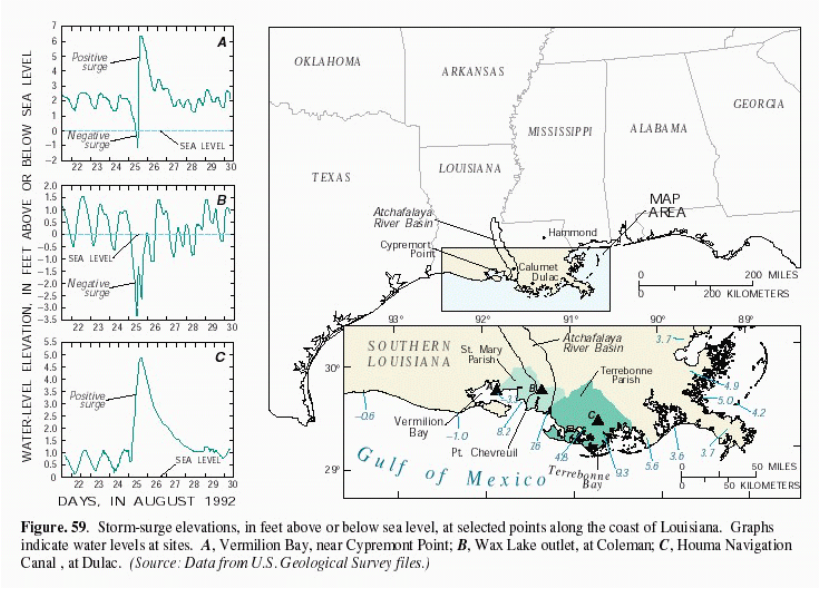
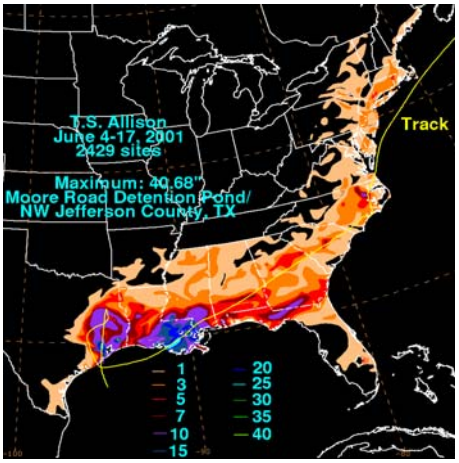


Figure. 59. Storm-surge elevations, in feet above or below sea level, at selected points along the coast of Louisiana. Graphs indicate water levels at sites. ***A***, Vermilion Bay, near Cypremont Point; ***B***, Wax Lake outlet, at Coleman; ***C***, Houma Navigation Canal , at Dulac. *(Source: Data from U.S. Geological Survey files.)*

Illustration of Hurricane Andrew's Storm Surge

Tropical Storm Allison (2001)

Tropical Storm Allison's Storm Track and Rainfall Data



Tropical Storm Allison made its initial landfall near Freeport, Texas on June 5, 2001 with 50 mile per hour winds. The storm stalled over land in Texas and retreated south and re-entered the Gulf of Mexico. It slowly drifted to the east and made a second landfall near Morgan City, Louisiana on June 11, 2001. Tropical Storm Allison left a severely drenched Texas and Louisiana in its path. Many areas in southeast Louisiana received as much as 20" of rain over three days. Isolated areas, including Terrebonne Parish, reported rainfall totals approaching 35 inches as a result of the storm. The community of Schriever in

northern Terrebonne Parish experienced 30 inches of rain. 131 homes in the parish were damaged or destroyed by flood waters and 25,000 residents were displaced due to high water. The following graphic illustrates the storm's track as well as rainfall accumulations produced by the storm. Allison will be remembered as the costliest Tropical Storm in U.S. history with 41 deaths and a $5 billion price tag associated with the damage. A map of the inundation caused by Tropical Storm Allison in Terrebonne Parish is included as Attachment c2-20 (page 103).

Hurricane Lili (2002)

Hurricane Lili made landfall on October 3, 2002 near Intracoastal City, Louisiana (Vermilion Parish) as a Category 1 storm; however, the designation of the storm is not truly representative of the storm itself. Just prior to making landfall, the storm had a maximum designation of a Category 4, causing all oil production in the central area of the Gulf of Mexico to cease operations. Hurricane Lili's path is illustrated below.

Hurricane Lili's Storm Track

Source: noaa.gov

The storm was responsible for damages associated with both wind (greater than 78 miles per hour) and storm surge (6 to 8 feet) in Terrebonne Parish. The strongest effects of the storm were experienced in the southern portion of the parish. Damage included widespread power outages, destruction of approximately 35% of the parish's sugarcane crop, substantial damage of more than 300 homes, and levees that were breached. The extent of parish inundation caused by the storm is displayed in Attachment c2-21 (page 104) at the end of this section.

Hurricane Katrina (2005)

After crossing southern Florida, Hurricane Katrina made U.S. landfall for the second time on August 29, 2005, near Buras/Triumph, Louisiana. The hurricane was a category 3 storm with wind speeds of 125 miles per hour. Hurricane Katrina was the most damaging natural disaster in U.S. history with an estimated $81 Billion worth of damage. Much of that damage was limited to extreme east and southeast Louisiana and the Mississippi gulf coast and was caused by high winds and large storm surge (estimated 14 feet in Plaquemines Parish, Louisiana). However, Terrebonne

Hurricane Katrina's Storm Track

Source: noaa.gov

Parish was largely spared of Hurricane Katrina's devastating effects due to its location on the western side of the storm's eye wall. The parish experienced minimal wind damage as a result of the storm. As the graphic illustrates, Katrina pushed inland along the southeastern Louisiana-Mississippi border and then established a north-northeast track.

Hurricane Rita (2005)

Hurricane Rita made landfall on September 24, 2005, along the Louisiana-Texas border near Johnsons Bayou, Louisiana. The hurricane came ashore as a Category 3 storm with sustained winds of 120 mph. As graphically depicted below, Hurricane Rita initially followed a path along the western Louisiana-Texas border and then turned northwest.

Hurricane Rita's Storm Track

Source: noaa.gov

Hurricane Rita caused an estimated $10 billion in damages. Despite the fact that the eye of the storm made landfall approximately 190 miles west of the City of Houma, Hurricane Rita had a significant impact on Terrebonne Parish—much more than did Hurricane Katrina. The impact and damages were largely a result of storm surge that caused extensive flooding, primarily south of Houma. All levees located south of the Intracoastal Canal were reportedly breached and More than 10,000 homes and business were flooded. The Rita inundation map is presented as Attachment c2-22 (page 105).

Cattle Round Up After a Levee Break in Chauvin, Louisiana

Hurricanes Gustav (Sept. 1) and Ike (Sept. 12-13), 2008

Hurricane Gustav is known as one of the most devastating hurricanes of 2008, causing physical damage and fatalities in multiple countries including Jamaica, the Cayman Islands, Cuba, Haiti, the Dominican Republic, and the United States (namely Louisiana). Hurricane Gustav was the first storm in Louisiana's history to necessitate a mandatory evacuation of residents within all at-risk coastal parishes.[3] Over two million people were evacuated from the region.

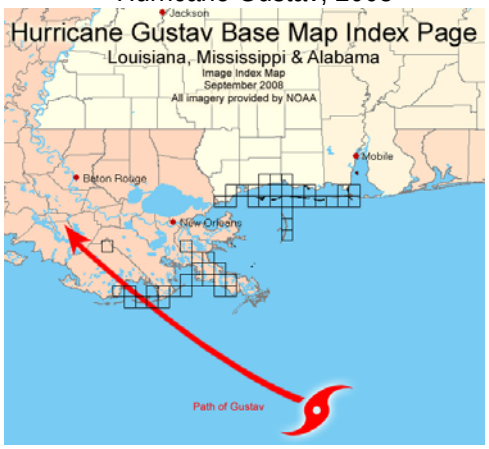
The hurricane entered the Gulf of Mexico and made its final landfall on September 1, 2008, as a Category 2 hurricane in Cocodrie, Louisiana, a shrimping and crabbing village

[3] State of Louisiana Governor's Office of Homeland Security and Emergency Preparedness. State of Louisiana After-Action Report and Improvement Plan: Hurricanes Gustav and Ike.

located in Terrebonne Parish south of Houma. The storm produced maximum sustained winds of 104 miles per hour and inundated the southernmost portion of the parish from the Lower Atchafalaya River to just east of State Route 317. Terrebonne Parish experienced mostly wind damage from the hurricane and avoided widespread flooding.

Another hurricane impacted Louisiana approximately two weeks after Hurricane Gustav. Though Hurricane Ike made landfall in Galveston Island, Texas, on September 12 and 13, 2008, Category 2 winds from Hurricane Ike produced surges in coastal Louisiana that ranged between three feet and six feet in height in areas east of Grand Isle. Storm surge heights increased west of Grand Isle, reaching a maximum of 10 feet at some locations. In Terrebonne nearly every levee was overtopped, and there was widespread residential and roadway flooding.

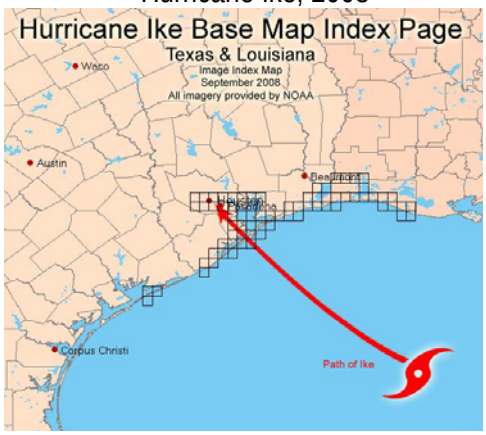
Hurricane Gustav, 2008



Source: noaa.gov

The Louisiana Economic Development Department estimates that Hurricanes Gustav and Ike caused 51 deaths and between $8 and $20 billion in physical damage across the state.

Hurricane Ike, 2008



Source: noaa.gov

The following table details Terrebonne Parish recovery projects that resulted from Hurricanes Gustav and Ike impacts.

Problem	Recovery Action	Storm	PW #	Project Cost	CAT
Fence Down	Demolition and installation of new galvanized steel fence	Gustav	5148	$5,596.32	G
Part of Roof Damaged	Replaced damaged metal in permanent roof repair	Gustav	5151	$4,987.93	E
Northside Corner Blown	Remove	Gustav	5158	$4,392.49	E

Out - Fiberglass shattered and metal ripped off. Door damaged by flyibg debris beyond repair.	damaged elements and replace fiberglass, sluminum, and door.				
Roof damage and light damaged by flying debris beyond repair	Replaced aluminum and lighting fixture	Gustav	5311	$1,211.88	E
Chain Door Blew Out. Radio Tower for SCADA structurally damaged beyond repair by wind.	Tower replaced by higher wind resistance tower and new antenna. Door repaired.	Gustav	5508	$9,108.67	G
One Side of Building Gone	Damaged siding removed and replaced.	Gustav	5123	$1,299.21	E
Fene on Both Ends Torn Up	Demoition and replacement of fencing	Gustav	5133	$5,596.32	G
Minor Roof Damage (One Panel).	Removal of damaged material and replacement	Gustav	5442	$1,187.42	E
Minor Roof Damage (One Panel) ,	Tower replaced by higher wind resistance tower. Roof repaired.	Gustav	5516	$584.00	
Radio Tower for SCADA Down			5516	$6,194.00	G
Roll Up Door Blown Out, Roof Flapping	Replaced the door	Gustav	5162	$1,556.32	E
Roll Up Door Blown Out, Roof Flapping	Replaced the door	Gustav	5157	$2,161.08	E
Radio Tower for SCADA Down	Tower replaced by higher wind resistant tower and new antenna.	Gustav	5431	$6,194.60	G
Utility Pole	Replace utility pole and	Gustav	5015	$2,383.65	D

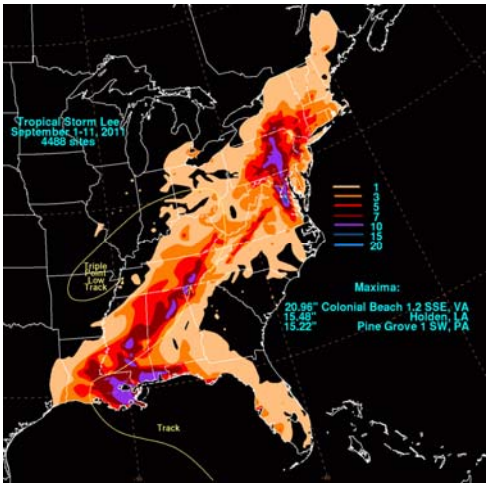
	associatied connections/ ground.				
Forced Account: Labor, Equip., Material. Rented and Contract Service	Employee labor and force account materials /equipment	Gustav	4479	$340,690.98	B
Gustav Total				**$393,144.87**	
Forced Account: Labor, Equip., Material. And Rented	Employee labor and force account materials/ equipment	Ike	1272	$893,395.00	B
Contract Work	Levee assessments and engineering services	Ike	1295	$182,343.67	B
Forced Account: Labor, Equip., Material. Rented and Contract Service	Employee labor and force account materials/ equipment. List of pump stations repaired and other detail available.	Ike	1234	$79,291.41	B
Southern Face of Building Gone	Labor, equipment, and materials to remove and permanently replace damaged siding.	Ike	1293	$7,407.66	E
Truck was Flooded When Operator was Driving and Road Gave Way $30,000.00	Truck replacement. No record of road repair costs.	Ike	1235	$12,938.32	E
Building Flooded, All Electrical Destroyed	Replaced pwer feed, pump motore, switch	Ike	1347	$12,287.25	F

	panel and motor starter and raised all elements to avoid future flooding.				
Ike Total				$1,187,663.31	
2008 Total				**$1,973,953.05**	

Tropical Storm Lee (September 2011)

On October 28, 2011, President Obama declared a state of emergency in Louisiana as a result of damage caused by Tropical Storm Lee. The storm made landfall between September 1 and 11, 2011. The tropical storm impacted the parishes of East Feliciana, Jefferson, Lafourche, Plaquemines, St. Bernard, St. Charles, Terrebonne, and West Feliciana. Terrebonne Parish was impacted by tidal surge that brought Bayou Terrebonne to 6.5 feet above sea level and up to five feet of flood waters into some areas.

Tropical Storm Lee Storm Track and Rainfall Data



Source: NOAA

Hurricane Isaac Aug. 29, 2012

Hurricane Isaac was a Category 1 hurricane that made landfall in Plaquemines Parish on August 29, 2012.[4] The hurricane generated maximum sustained winds of 80 miles per hour but weakened to a tropical storm and then a tropical depression as it progressed over southeastern Louisiana. Approximately one billion dollars in damage was caused by the hurricane. In Terrebonne, over 1,000 homes were damaged with approximately 20 homes with reported water inside. Fields of sugar cane were also damaged.

Hurricane Isaac, 2012

Source: noaa.gov

It should be noted that according to the National Climatic Data Center, there have been no reported injuries or deaths associated with hurricanes or tropical storms in Terrebonne Parish.

[4] http://www.doa.louisiana.gov/cdbg/DR/Isaac/Isaac_Background.htm

3.2.2.3 *Saltwater Intrusion*

The parish has the ability to obtain its potable water supply from three different sources referred to as "water treatment plants." The location of each plant is provided on a map of the critical facilities associated with potable water included as Attachment c2-14 (page 97). A brief description of each source follows.

Schriever Water Treatment Plant - This plant pumps surface water from Bayou Lafourche, which in turn, obtains most of its water from the Mississippi River.

Houma Water Treatment Plant # 1 - The primary source of water for this treatment plant is surface water pumped from the Gulf Intracoastal Waterway (GIWW). The GIWW is fed by a combination of sources, including: rainwater runoff, Mississippi River influence, Atchafalaya River influence, and tidal water influence.

Houma Water Treatment Plant # 2 - Surface water pumped from Bayou Black serves as the secondary or backup supply of water for this treatment plant. This supply is activated when excessive chloride (salt) concentrations are detected in the GIWW.

A marked harm of salt water intrusion is the loss of marsh or wetland. This leads to further land subsidence, more open water, more erosion of soils, and higher winds over newly open water in a hurricane situation. In the case of a strong northward tidal push due to sustained south winds (as is the case in a tropical storm or hurricane event), the parish's potable water intakes are jeopardized by salt water from the Gulf of Mexico, especially the Houma water treatment plant # 1. There have been documented instances where the City of Houma has resorted to its secondary potable water intake at Houma Water Treatment Plant # 2 due to chloride concentrations in excess of the U.S. EPA's regulatory threshold of 250 parts per million. An example of this occurred following the storm surge of Hurricane Rita. As saltwater intrusion is a result of hurricane storm surge, one can assume the probability of the occurrence to be the same as a hurricane in any given year, or 28%. As the water supply does have a backup source, the losses of the past saltwater intrusion occurrences are difficult to quantify for the purposes of this HMPU. If both water intakes were to be exposed to saltwater intrusion, resulting in water having to be trucked in, the cost would exceed millions of dollars.

3.2.2.4 *Levee Failure (includes floodwalls) and Pump Stations*

As previously discussed in Section II of this HMPU, hurricane protection levees are being constructed in Terrebonne Parish. The parish also relies on levees of minimal height (typically 2 to 8 feet) to force water to drain in certain patterns. These levees are no match for tropical storm or hurricane induced surge waters. Therefore, the parish's drainage levees essentially fail with every storm that makes landfall in the vicinity. All hurricane protection levees in the parish are maintained by the Terrebonne Levee & Conservation District. There are no USACE certified levees in the parish. All drainage levees and pump stations are operated by TPCG.

Pump stations are also a major consideration in the parish. According to information provided by the Terrebonne Parish Department of Public Works (DPW), there are individual pumps dispersed throughout the parish. These pumps are a critical component of the parish's flood protection system as they facilitate the movement of storm water out of developed areas, over drainage levees, and into the surrounding bayous and marshes. A detailed inventory of pump stations in the parish is provided in Attachment c2-3 (page 86.)

Pump Station D-58 in Coteau

Source: Terrebonne Parish Department of Public Works

Pump Station D-45 in Tiger Bayou

Source: Terrebonne Parish Department of Public Works

The forced drainage levees and the drainage pumps combine to form individual drainage systems. These systems or areas are managed by the Terrebonne Parish DPW. A map depicting the drainage areas is presented as Attachment c2-3 on page 86.

Levee failure has had devastating effects on Terrebonne Parish as evidenced by past storm events - Hurricane Isaac being the most recent. This hazard will persist with each passing storm until a hurricane protection levee system is completed.

However, the Parish is taking steps to educate its residents on the important role of levees in their communities and what efforts they can take to preserve them. One such effort involves the Levee Safety Project. Central to the program is Terrebonne Parish's belief that a complete system of storm protection includes structural (levees and pumps), non-structural (elevation, land use planning and flood proofing), and coastal restoration and protection (wetland and forest restoration). This system relies on all strategies working together and protecting one another – wetlands protect levees from direct storm surge, etc. In order to sustain these systems, the Parish is charged with educating the public on how to care for them. The Gulf of Mexico Alliance and Mississippi-Alabama Sea Grant have awarded Terrebonne Parish a grant to design and implement a program to inform and educate local agencies, emergency responders and the general public on the various activities that are permitted in and around parish levees. The importance of the levee system is generally understood by area residents; however, there are still those who engage in personal activities on levees that may weaken the system. The Levee Safety Project consists of creating a campaign and image that over time will be representative of levee safety along with accompanying video, publications and public safety awareness messages.

3.2.2.5 Tornadoes

As previously stated, HMPU Steering Committee concluded that the tornado hazard will be profiled in this plan due to its high probability of occurrence although addressing mitigation measures relative to tornados as a stand-alone hazard will not be considered.

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. It is spawned by a thunderstorm or sometimes as a result of a hurricane and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Tornadoes often form in convective cells like that of thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. The damage from a tornado is the result of high wind speeds and wind-blown debris. Tornadoes can occur at any time of year. Tornado damage severity is measured by the Fujita Tornado Scale based on wind speed and described in the table to follow. All categories as described in the table below (F0-F5) can occur in the entirety of the planning area.

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

Note: *These precise wind speed numbers are actually guesses and have never been scientifically verified. Different wind speeds may cause similar-looking damage from place to place even from building to building. Without a thorough engineering analysis of tornado damage in any event, the actual wind speeds needed to cause that damage are unknown.*
Source: NOAA

Because of the unpredictability of tornado paths and the destruction of commonly used instruments, direct measurements of wind speeds have not been made in tornadoes. Wind speeds are judged from the intensity of damage to buildings.

High winds are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on the following factors:

- Wind speed (sustained and gusts) and duration of high winds
- Height of building above ground
- Exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- Strength of the structural frame, connections, and envelope (walls and roof)
- Shape of building and building components
- Number, size, location, and strength of openings (windows, doors, vents)
- Presence and strength of shutters or opening protection
- Type, quantity, velocity of windborne debris

A tornado watch is issued to alert people to the possibility of a tornado developing in the area. Under a tornado watch, a tornado has not been seen but the conditions are very favorable for tornadoes to occur at any moment. Conditions favorable for a tornado to occur include:

- Dark greenish or orange-gray skies
- Large hail
- Large, dark, low-lying, rotating or funnel-shaped clouds
- A loud roar that is similar to a freight train

A tornado warning is issued when a tornado has actually been sighted or when Doppler radar identifies a distinctive "hook-shaped" area within a local partition of a thunderstorm line that is likely to form a tornado.

People who reside in mobile homes are most exposed to damage from tornadoes. Even if anchored, mobile homes do not withstand high wind speeds as well as permanent, site-built structures.

Terrebonne Parish is most vulnerable to the effects of tornadoes during severe tropical storms and hurricanes. Some structural mitigation actions have been identified which will reduce damages caused by tornadoes; however, some wind mitigation actions identified under the hurricane hazard may also lessen the effects of tornado-force winds. Historical occurrences of tornadoes are detailed in the table to follow.

Terrebonne Parish Tornado History 1957-2013

Date	Type	Magnitude	Injury	Property Damage
3/21/1957	Tornado	N/A	0	$25,000
5/11/1959	Tornado	F0	0	N/A
11/22/1961	Tornado	F2	0	$2,500
9/6/1967	Tornado	F1	0	$25,000
11/1/1977	Tornado	F1	0	$25,000
11/8/1977	Tornado	F1	2	$250,000
7/9/1982	Tornado	F0	0	$2,500
2/12/1984	Tornado	F1	0	$250,000
11/16/1987	Tornado	F1	0	$250,000
7/24/1988	Tornado	F1	0	$25,000
3/29/1990	Tornado	F1	7	$250,000
5/28/1990	Tornado	F0	0	N/A
11/1/1991	Tornado	F1	0	$250,000
11/20/1992	Tornado	F1	0	$2,500
1/17/1994	Tornado	F0	0	$5,000
1/18/1995	Tornado	F1	0	$250,000
8/24/1998	Tornado	F0	0	N/A
1/2/1999	Tornado	F1	0	$700,000
3/15/2000	Tornado	F2	36	$10,000,000
8/31/2000	Tornado	F0	0	N/A
12/13/2001	Tornado	F1	0	$100,000
3/31/2002	Tornado	F1	0	$75,000
10/3/2002	Tornado	F1	0	$25,000
7/6/2004	Tornado	F0	0	$5,000
11/2/2004	Tornado	F0	0	$2,000
11/27/2004	Tornado	F1	0	$50,000
3/14/2007	Tornado	F0	0	$5,000
12/26/2007	Tornado	F0	0	$25,000
3/5/2011	Tornado	N/A	0	$50,000
11/16/2011	Tornado	N/A	0	$30,000
2/25/2013	Tornado	N/A	0	$100,000
		Total	**45**	**$12,779,500**

Source: NCDC

The parish has not had any federally declared disasters due to a tornado alone. Climate data from the NOAA reports 31 tornadoes within Terrebonne Parish between the years 1957-2013 with an annual probability of fifty-five percent. All 42,560 structures in the parish are vulnerable to some sort of tornado damage at any given time. One can estimate that the average annual losses for a tornado would average $226,733, based on historical losses from the NOAA. For this reason, the steering committee agreed to assign the Terrebonne Parish at a medium risk for tornadoes. All wind related mitigation actions can be found in Attachment c3-1 on page 139.

3.2.2.6 Coastal Erosion and Land Subsidence

Coastal erosion and land subsidence are intricately connected in Louisiana. According to Restore or Retreat, a non-profit organization focused on coastal advocacy, 90 percent of all wetlands loss in the lower 48 states occurs in Louisiana, with approximately 60 percent of Louisiana's land loss occurring in the Barataria and Terrebonne basins. Barataria and Terrebonne Basins are losing between 10 and 11 square miles of wetlands per year, as stated by Restore or Retreat. As discussed in Section I of this report, coastal erosion destroys land and removes sediments critical to the existence of environmental features such as beaches, dunes, and wetlands. High wind and water events, especially wave action, are increasing contributors to coastal erosion. Coupled with land subsidence, Terrebonne faces marked challenges to storm protection.

Land subsidence in Terrebonne Parish can be defined as the loss of surface elevation due to the loss of subsurface density. According to *Faulting, Subsidence and Land Loss in Coastal Louisiana* subsidence in Terrebonne Parish has been measured to be between 2.1' and 3.5' of loss of elevation every 100 years with the probability of continued subsidence at 100 percent. It is assumed that subsidence has always occurred in Terrebonne, but because seasonal flooding and the sediment associated with it has been limited by water control structures, the natural balance has been adversely affected by man-made structures. Subsidence is caused by a diverse set of human activities and natural processes. Those two causes are profiled below.

Collapse of surface materials into underground voids is the most dramatic form of subsidence. In Terrebonne Parish, it is presumed that the removal of oil and gas deposits have caused most of the subsidence-related voids in this area. The area most affected by this process has been the wetlands. In the early part of the 20th century, this area was found to be rich in oil and gas, and significant amounts of these resources were removed from the wetlands.

In addition, tides and heavy storms in the Gulf are eroding Louisiana's marshy coastline at an alarming rate. Coastlines in southern Terrebonne Parish are sinking or eroding away with incoming water eating at the marshes and wetlands that buffer and drain the higher and drier land.

Land Subsidence has been measured and is a hazard throughout all areas of the Parish. Subsidence has been more extreme in the southern portion of Terrebonne Parish. The areas above the Intracoastal Canal have measured subsidence levels which are less extreme than the southern part of the Parish.

Two related factors contributing to subsidence in Terrebonne Parish have been the disconnection of Bayou Terrebonne to the Mississippi River and the introduction of levee systems. The construction of levee systems with forced drainage has eliminated natural river sediment functions from occurring. These forced drainage areas have essentially dried out and compacted at a higher rate than surrounding areas, causing subsidence

within the levee system. These risks are most prominent in the Southern region of Terrebonne Parish, south of the Intracoastal Canal but areas to the north have been affected, to a lesser extent. Maximum rates measured by geodetic surveys are approximately 0.5 inches per year.

All states with low-lying coasts are vulnerable to accelerated sea-level rise, but Louisiana's coast is much more so because of the subsidence of the Mississippi River delta. Until humans intervened, the surface elevation of the broad delta complex had kept pace with rising sea level for several thousand years, largely because the river built delta lobes and nourished wetland vegetation. The rates of natural subsidence and sea-level rise along the Louisiana coast have been exacerbated by human modifications, primarily levees which have isolated the Mississippi River from a delta complex that depends on an annual flooding cycle. These modifications cut off the delta-building process of the river. Louisiana's coastal system has also been heavily impacted by channels dug for navigation and mineral extraction, which have allowed high-salinity Gulf waters to migrate inland. Over a million acres of coastal land have been lost since the 1930s, and between 25 and 35 square miles continue to be lost each year. Louisiana's coastal ecosystems are threatened with systemic collapse.

Areas of Terrebonne Parish, as described above, face a high risk of continued subsidence in years to come. Terrebonne Parish is highly vulnerable to continued subsidence due to its close proximity to the surrounding wetlands, highly organic soils, and dependence on forced drainage systems which remove water from localized areas. All 42,560 structures in the parish are vulnerable to the effects of subsidence, including agricultural, commercial, government, industrial, residential, religious/non-profit, and school structures. Loss estimates for strictly subsidence are not practical for the purposes of this plan, but since subsidence heightens the effects of flooding, one can assume subsidence increases flood losses by 0.01% per year.

Rates of Relative Sea Level Rise Across the Northern Gulf of Mexico Region

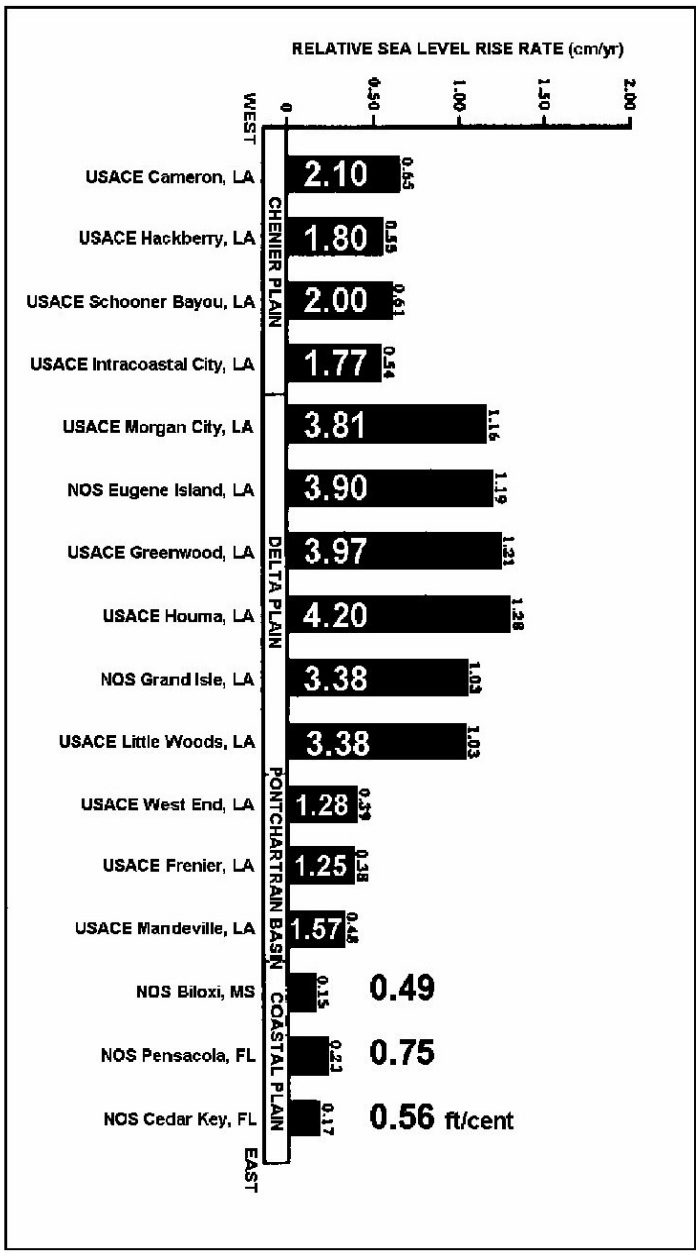
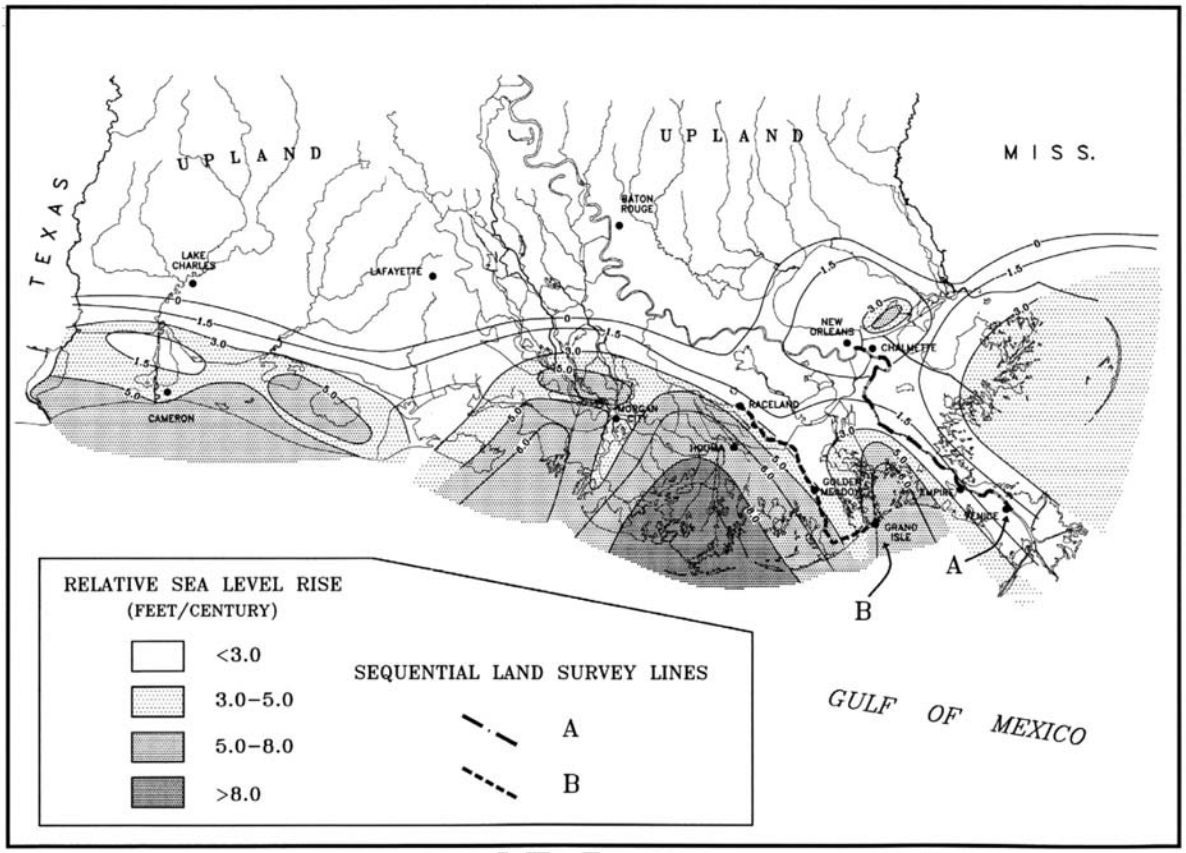


Figure 1-19. Rates of relative sea level rise across the northern Gulf of Mexico region from Cameron, LA to Cedar Key, FL based on records from the National Ocean Survey and U.S. Army Corps of Engineers tide gage stations. The Pensacola, FL gage land location is considered to be stable, and this gage provides a record of eustatic sea level rise in the Northern Gulf Region. The rates of rise of all stations in coastal Louisiana exceed the rate of eustatic rise. The differences are attributed to subsidence (after Penland et al. 1988).

Source: *Faulting, Subsidence and Land Loss in Coastal Louisiana,* Coastal Environments, Inc., 1999.

Evaluating land loss at a narrower geographic scale, the Deltaic Plan of Louisiana has experienced the greatest sea level rise as recorded by USACE tide gage stations located between Cameron, Louisiana to Cedar Key Florida. According to *Faulting, Subsidence and Land Loss in Coastal Louisiana,* the rate of sea level rise attributable to melted glaciers has been exceeded by the rate of sea level rise observed along coastal Louisiana. This increased sea level rise is related to subsidence.

Relative Sea Level Rise in Coastal Louisiana



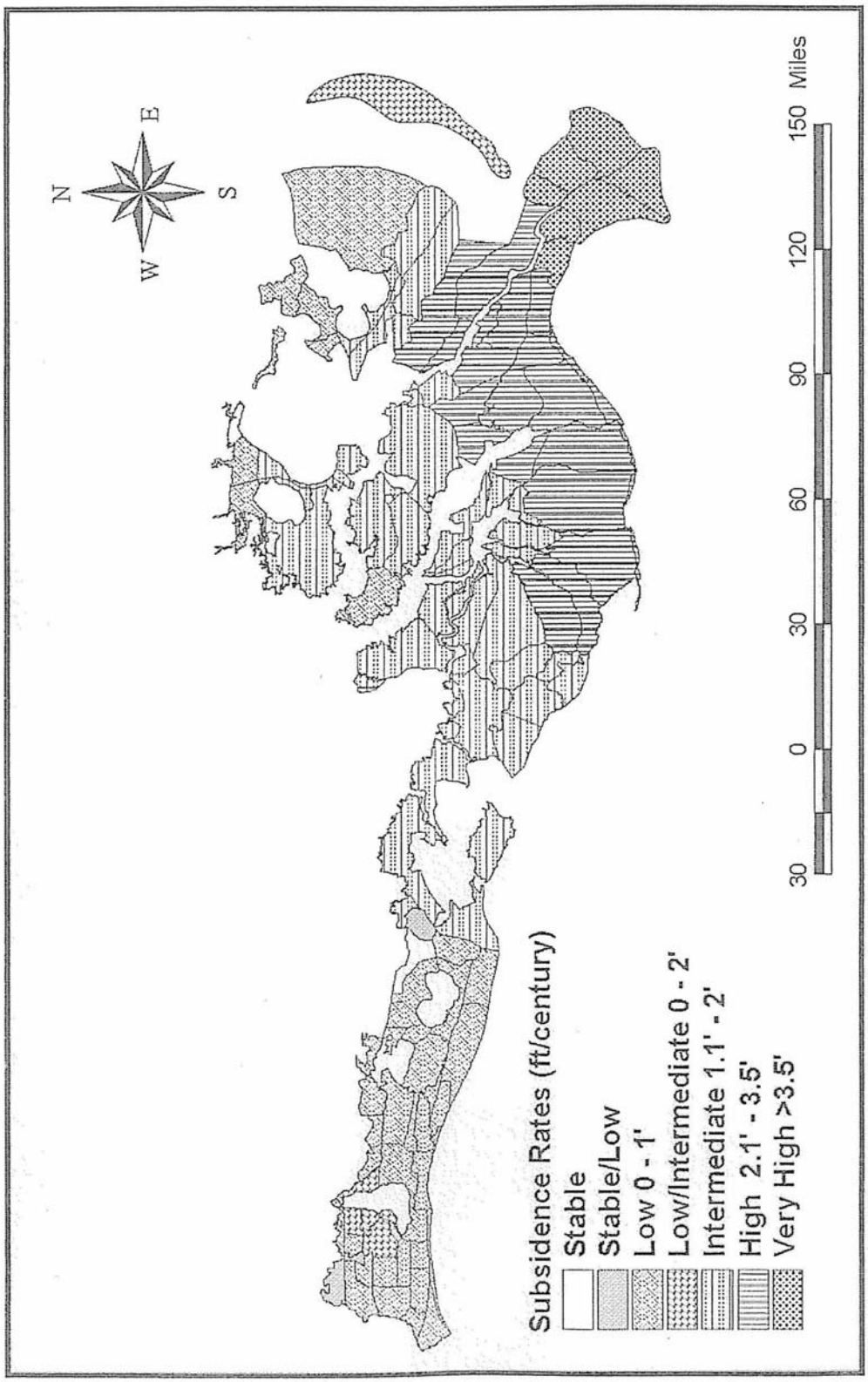
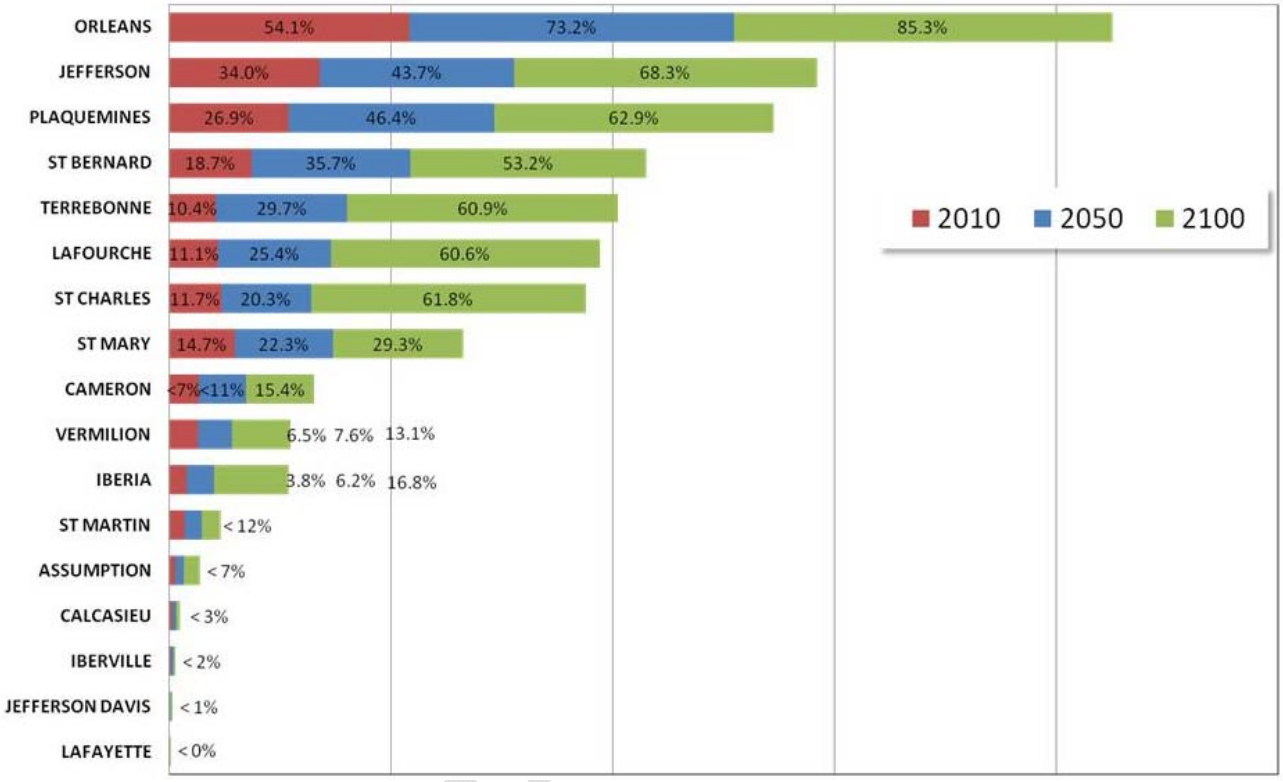


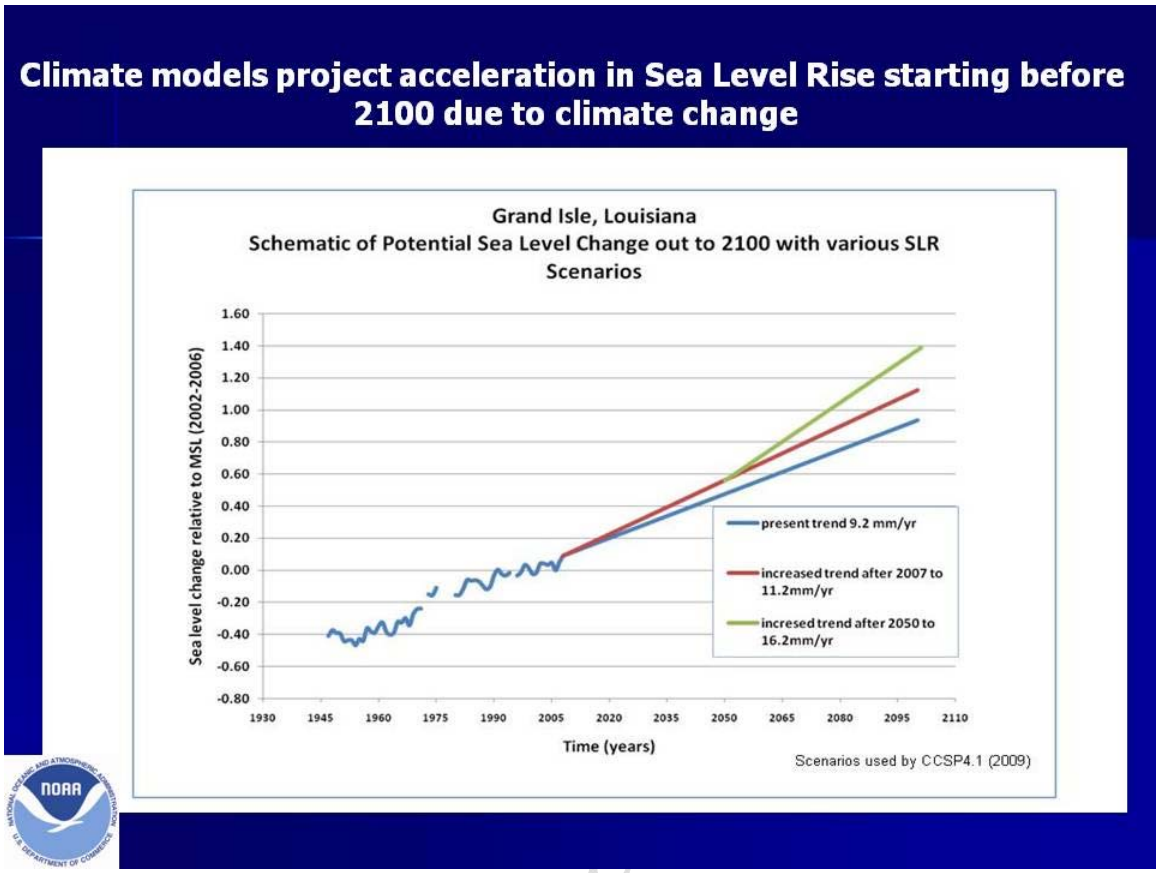
Figure 1-29. Coastal subsidence rates by environmental planning units.

Terrebonne Parish is located within a local planning unit that has a "high" subsidence rate that ranges between 2.1' and 3.5' of land loss per century.

Percent Land Below Sea Level by Parish Through 2100



Approximately 60.9 percent of Terrebonne's land mass is anticipated to be below sea level by the year 2100. This percentage is nearly double the projected proportion of land below sea level in Terrebonne by 2050.



The aforementioned rise in the proportion of Terrebonne's land mass below sea level is attributable to climate change, according to the National Oceanic and Atmospheric Administration (NOAA). As can be observed in the above NOAA graphic, the rate of sea level rise accelerates after 2050.

Some steering committee members were concerned about the lack of information on the effects of relative sea level rise and subsidence. Due in part to the statewide efforts to confront sea level rise and resulting coastal land loss it was decided that the Parish would not take independent action on these issues, but would work in tandem with the state to ascertain the rates of each hazard independently and combined and developed adaptations in the future to reduce associated risks.

3.2.3 Risk Assessments

The risk assessment process was developed using data from past hazard events, existing land use data, HAZUS, FEMA flood maps, and FEMA repetitive loss structures. The land use map used for this purpose is displayed in Attachment c2-6 (page 89) of this section.

The four individual risk assessment analyses include: the 100-year flood plain based on DFIRMs and the data included therewith; risk assessment based on past storm events;

levee failure; and FEMA repetitive loss structures. A summary of the approach utilized in each independent map of the composite series is noted below.

100-Year Flood Plain—FEMA DFIRMs

The 100-year flood plain map was developed using FEMA FIRM data and GIS software. Since a majority of the parish is within the 100-year flood plain, this mapped data along with the ABFEs were used in evaluation of the parish that is prone to present and future flooding damage. This map depicts which areas of the parish are vulnerable to a 100-year flood regardless of land use and with no regard for the source or type of flooding. A map of the 100-year flood plain is displayed as Attachment c2-5 (page 88) at the end of this section.

Risk Assessment Based on Past Storm Events

The second risk assessment technique utilized in the preparation of this HMPU is based upon past storm events. This approach was developed using data such as specific flood elevations from major past hazard events. The events and data captured to create this image are as follows (in chronological order): Hurricane Betsy, Hurricane Juan, Hurricane Andrew, Tropical Storm Allison, Hurricane Lili, Hurricane Rita, Hurricane Gustav, and Hurricane Ike.

The approach and methodology was found to be useful in determining what specific areas and land uses of the parish are vulnerable to hazards (primarily flooding) and which specific types of flooding are generating or creating that vulnerability. The past storm event assessment maps are displayed in Attachments c2-17 through c2-23 (pages 100 through 106) at the end of this section.

Levee Failure

The third risk assessment technique utilized in the preparation of this plan was based on catastrophic, parish wide levee failure. Historical high water levels from the USACE gauge data as well as USGS gauge data were used to establish theoretical elevation for flood waters that would inundate the parish if all levees were to fail. The inundation area was interpreted with LIDAR to produce water depth levels. A parish wide levee failure map is displayed as Attachment c2-27 (page 110).

FEMA Repetitive Loss Structures

The fourth independent vulnerability assessment mapping task was based on the FEMA repetitive loss structures inventory. According to the parish and GOHSEP, Terrebonne Parish has a total of 1,067 repetitive loss structures defined as structures flooded two times or more at a value of at least $1,000 per occurrence. Of these, 141 are severe repetitive loss structures, 107 of which are residential. Of these only thirty-three are insured according to the latest record provided by FEMA. A Severe Repetitive Loss is defined as a one-to-four family residential property with at least four National Flood

Insurance Program (NFIP) payments over $5,000 and the cumulative amount exceeds $20,000 or two to three separate claims payments have been made with the total payments exceeding the market value of the building (FEMA 2004).

Due to the new definition from the Biggert Waters Act of 2012, the Flood Mitigation Assistance funding is limited to a more restrictive definition of repetitive loss that requires the structure to have flooded at least twice with damages exceeding 25 percent of the value of the structure. This is consistent with the historical requirement for the insurance benefit called "Increased Cost of Compliance." When a structure has been over 50 percent damaged by flood (rising water), it is considered substantially damaged and out of compliance with the National Flood Insurance Program (NFIP) requirements. To encourage mitigation, the NFIP provides policy holders with up to $30,000 to help in attaining compliance. Uninsured structures do not have access to this benefit. In Terrebonne, the new definition limits eligible applicants to 514 repetitive loss structures, 64 of which are on the FEMA Severe Repetitive Loss list. This is a subset of the broader definition used more generally.

This data was useful in (a) determining which residential and commercial properties have been damaged as a result of past hazard events and (b) in focusing on specific losses and groups of losses, especially when common causes were apparent.

The FEMA repetitive loss structure map is displayed as Attachment c2-25 (page 108). Findings noted significant vulnerability throughout the inhabited areas of the parish.

As noted in Attachment c2-4, the majority of the parish is within the 100-year flood zone as defined by FEMA's DFIRM maps. When comparing this data to actual flood event data, the land comprising the meandering ridges of various bayous that converge in Houma in the northern portion of the parish are readily discernable. This layered combination shows the vulnerable areas in the parish.

Even with the magnitude of technical data used, the most accurate and objective data inventoried was that of specific repetitive losses. As previously stated, the parish has greater than 500 repetitive loss structures that are essentially dispersed throughout the inhabited areas of the parish. Areas south of the City of Houma are highly susceptible to storm surge, while areas in and north of Houma are more likely to be impacted by a combination of storm water and poor drainage.

3.2.4 §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 locates on the identified hazard areas

A general list of assets that could be damaged by a hazard event was developed and mapped using GIS software. This list was collected from sources including local government officials and HAZUS following the guidelines prepared for HMPU preparation. Details and results of that process are noted below.

Worksheet #3A
Composite Flood Risk
Inventory of Assets for Entire Parish

Composite Flood Risk - Inventory of Assets for Entire Parish Worksheet #3A (Attachment c2-28) provides a general overview of the assets of the parish as a whole as well as the assets located in the hazard area. Two scenarios are represented in the worksheet – flood events and levee failure.

While collecting and researching the data within this worksheet, several information sources were utilized including HAZUS, mapped data from parish, state mapping sources, and mapped and tabular data from the parish assessor's office. For this worksheet and supporting tabular data, a combination of the 100-year flood plain and the past storm event risk assessment map coverage area was used as the hazard area for the entire parish.

In the determination of hazard area percentages, a census block map from HAZUS was overlaid onto the 100-year flood plain and risk assessment maps. The composite was necessary to account for differences in the data sets. The worksheets are represented as Attachment c2-28 (page 111-112). The following summary represents the information provided in composite version of Worksheet #3A.

Parishwide HAZUS
A total of 42,560 structures in the parish with an estimated value of $7,275,577,000 were noted. An estimated 26,373 of these with a value of $4,407,015,000 are in the hazard area. The total residential population within Terrebonne Parish is 104,503, and 64,961 or 62% are in the composite risk area, which is the area within the 100-year floodplain, in addition to those areas that are at risk beyond the floodplain as evidenced by past storm events.

Residential
The residential classification of Terrebonne Parish is the largest building group within the parish. Data indicates that 39,273 structures (dwelling units) with an estimated value of $5,323,060,000 are located within the Parish. Of these buildings, 62% are located in the hazard area with an estimated value of $3,108,102,000.

Commercial
Commercial buildings number 2,200 in the parish. The estimated value of these buildings is $1,274,572,000 and 56% of the buildings are located in the hazard area. The value of the buildings in the hazard area is estimated at $789,141,000.

Industrial
The industrial classification of the parish consists of 669 buildings with an estimated value of $424,320,000. Of the buildings noted, approximately 67% are in the hazard area with an estimated value of $347,546,000.

Agricultural
In the agricultural class, 104 buildings exist with an estimated value of $23,133,000. Of these, approximately 65% are in the hazard area and have an estimated value of $19,067,000. While many of these structures are in the areas classified as agricultural, many are actually residential in use.

Religious/Nonprofit
The religious/non-profit buildings total 188 with an estimated value of $127,108,000. In this classification, it is estimated that 57% of the buildings are in the hazard area and have an estimated value of $73,180,000.

Government
Government buildings in the parish total 60 with an estimated value of $36,499,000. Approximately 62% of these buildings are located in the hazard area and have an estimated value of $16,690,000.

Educational
Educational structures number 66 having an estimated value of $66,885,000. Of these buildings, 68% are within the hazard area with an estimated value of $53,289,000.

Houma HAZUS

A total of 13,973 structures in the city with an estimated value of $2,569,733,000 were noted. An estimated 5,508 of these with a value of $1,001,028,000 are in the hazard area. The total of the residential population within the City of Houma is 32,970, and 14,197 or 43% of these are in the hazard area.

Unincorporated Areas HAZUS

A total of 28,587 structures in the unincorporated areas of the parish with an estimated value of $4,705,844,000 were noted. An estimated 20,865 of these with a value of $3,405,987,000 are in the hazard area. The total of the residential population within the unincorporated areas of Terrebonne Parish is 71,533, and 50,764 or 71% of these are in the hazard area.

Critical Facilities of the Parish

A detailed list of 195 critical facilities located throughout the parish is seen in Attachment c2-29 (pages 113 through 120). This list was compiled according to the following pre-defined groups:

- Essential facilities
- Lifeline utility systems
- Other important facilities

This information was gathered from sources including HAZUS and interviews with Terrebonne Parish government officials. After the list of critical facilities for the parish was completed, the HMPU Steering Committee reviewed the list and made necessary revisions. Critical facility maps are displayed in Attachments c2-7 through c2-16 (pages 90 through 99) at the end of this section.

Although this list includes only critical facilities, repetitive loss structures, including residential properties, were considered during mitigation planning. However, repetitive loss structures are not listed on the critical facilities table as not all RL properties are critical facilities, in addition to the inability to determine content and function values or displacement costs as needed. This information is presented in Section (c)(2)(iii).

Critical Facilities within Hazard Areas

A list of critical facilities within the hazard area was compiled to identify at risk areas. As with critical facilities in the parish, the definition of the hazard area was based on risk assessment determined as a function of past storm events in combination with the FEMA-based 100-year flood plain. All facilities within these areas are identified in a second critical facilities list as seen in Attachment c2-30 (pages 121-126) at the end of this section.

Past discussions considered moving all critical facilities from the SFHA, but due to the extent of the bayou system, fire, drainage, water, energy, and police all need a functional presence in the area. The police are mobile, but fire first responders are required by law to be within a certain distance of the at risk structures.

Several critical facilities are being relocated out of the SFHA currently (O.H.S.E.P., public works administration, and the Juvenile Justice Complex, for examples). Those remaining in place are being hardened or are priorities to be wind hardened or if possible floodproofed in order to provide continuity of services. Several critical facilities have been retrofitted with alternative power supplies or quick connects and portable generators to enable continuous service or quick recovery."

Worksheet #4

Using the aforementioned critical facilities list, HAZUS replacement value data, GIS models, and input from the HMPU Steering Committee members, FEMA Worksheet #4 loss estimates were compiled (as presented in attachments c2-31 and c2-32) for hypothetical levee failure and hurricane flood events.

Using historical high water flood marks, the respective areas were inundated and the critical facilities flood levels noted. The flood levels were then compared to FEMA damage estimate models for structure percent damaged, contents loss, and function loss, to come up with a total loss estimate for the parish critical facilities in each event.

The total estimated losses were $72,221,031 for the levee failure and $80,053,508 for the total structure use and function loss resulting from that failure. Detailed cost estimates for each critical facility can be found in attachment c2-31 and c2-32. Total estimates losses are projected to be $288,190,959 for a hurricane flood event with $77,231,290 in structure use and function loss resulting from that event.

3.2.5 §201.6 (c)(2)(ii)(B) 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

The HMPU planning team used GIS software, HAZUS, interviews with parish officials, and historical data to estimate the potential dollar losses if the parish was to experience a flooding event. The vulnerable structures and facilities were identified earlier in section §201.6 (c)(2)(ii)(A). As noted previously, all FEMA repetitive loss data was gathered from GOHSEP, FEMA Region IV, and the parish. Efforts to identify accurate addresses were exhaustive.

The repetitive loss structures map is displayed in Attachment c2-25 (page 108). Supporting data was gathered from GOHSEP. Information such as function loss, displacement days, function use, and capacity do not apply to residential properties. Therefore, the FEMA average claimed loss value was used in estimating losses for residential structures. The estimated costs are as follows:

Potential Flood Losses:

FEMA defines a **repetitive loss** (**RL**) property as one for which two or more National Flood Insurance Program losses of at least $1,000 each have been paid within any 10-year rolling period since 1978. A **severe repetitive loss** (SRL) property is recognized as a one-to-four family property that has had four or more claims of more than $5,000 or two to three claims that cumulatively exceed the building's value. For the purposes of the Community Rating System (CRS), non-residential buildings that meet the same criteria as for the one-to-four family properties are considered SRL properties.

Terrebonne Parish has a total of **514 repetitive loss properties**; 493 residential and 21 non-residential properties. FEMA insurance paid a total average of $35,694 per event for the 493 residential properties and $50,999 per event for the 21 non- residential properties. Approximately 245 of the 514 RL properties are SRL properties.

Due to the prevalence of repetitive loss properties and the disproportionate number of severe repetitive loss properties, Terrebonne Parish will need to initiate a plan to address its repetitive loss problem as specified in Sections 501-504 of the *NFIP CRS Coordinator's Manual.* In the past, Terrebonne Parish has taken measures to identify concentrations of RL properties, better understand the causes of those losses, and develop recommendations for reducing those losses. As recently as 2013, The University of New Orleans Center for Hazards Assessment, Response and Technology evaluated the prevalence of repetitive loss and severe repetitive loss structures for the Terrebonne

Parish Roberta Grove and Senator Circle neighborhoods. The study, which was initiated by Terrebonne Parish, found that 60.19 percent of building in the Roberta Grove neighborhood were repetitive loss structures, with 5.82 percent of those considered severe repetitive loss structures. The Senator Circle neighborhood had 25.38 percent repetitive loss structures with no severe repetitive loss structures noted. A detailed listing of recommendations for decreasing the number of repetitive loss and severe repetitive loss structures are disclosed in the *Roberta Grove – Senator Circle Repetitive Loss Area Analysis* found in Attachment C3-3 (pages 172-233). Improvement of the Parish's Community Rating System (CRS) Class is one key recommendation from the report.

Terrebonne Parish has engaged in a public outreach effort to inform the public and industry about flood damage prevention and to obtain their preferences regarding flood damage prevention issues. Feedback obtained at meeting and through survey results were used to develop the Parish's Flood Damage Prevention Ordinance Update.

Flood Insurance and Community Rating System

Terrebonne Parish participates in both the National Flood Insurance Program (NFIP) and the Community Rating System (CRS). The following tables provide details regarding NFIP and CRS participation.

NFIP Participation in Terrebonne Parish

CID	Community Name	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Reg-Emer Date	Tribal
225206	Terrebonne Parish	NA	11/20/1970	04/02/92	11/20/70	No

This information was obtained from FEMA's Community Status Book – www.fema.gov/cis/LA.html

CRS Participation in Terrebonne Parish

Community Number	Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
225206	Terrebonne Parish	10/1/92	10/1/11	6	20	10	C

This information was obtained from FEMA's Community Rating System – www.fema.gov

Repetitive Loss Strategy

The approach to repetitive loss structures is multifaceted. The Parish has approached high risk structures individually and by area. Terrebonne Parish has developed a strategy to approach, motivate, and fund owners of repetitive loss structures. Structures have been targeted for elevation, demolition, and acquisition. Communities have been targeted for education and improved drainage and continuous pumping station service. Where feasible, levee structures and floodgates have been constructed to limit water flow and assist nonstructural flood control efforts.

For example, since the last plan was adopted, the Parish embarked on a Repetitive Loss Strategy for two communities with substantial and repetitive flooding; Roberta Grove and Senator Circle. The communities are different in that one is single family residential, and the other, rental units, but both suffer from repeated flooding. Both communities met with the parish and UNO CHART to discuss their vulnerability and the resulting plan can be viewed in Attachment c3-3. The approach mirrors that for most of the Parish which is to elevate structures as funding becomes available, educate the community on the mitigation funds in insurance policies, and improve structural installations such as levees and improved drainage to avoid the need for individual nonstructural projects. The report goes further to identify relatively inexpensive methods to avoid shallow flooding without elevation. To date Roberta Grove households have participated in the elevation or buyout programs. Senator Circle residents learned about their ability to purchase contents insurance to protect themselves and outreach will continue. The East Houma Surge Levee and floodgate on the Houma Navigational Canal were developed in part to protect these areas as well. In the next event, this area is expected to have significantly lower losses. Efforts to educate and recruit participation will continue.

Proceeds from the sales of the land from the buyout program should be reinvested in mitigation efforts whenever possible. The funding raised from mitigation efforts should naturally be used to further decrease risk in the Parish through proven existing programs or new initiatives. On a broader scale, the Parish will continue to target funding to substantially damaged structures whether on the repetitive loss list (NFIP insured losses) or designated as substantially damaged through permitted activity not covered by insurance. This is broader than the NFIP focus, and includes the uninsured in the Parish risk reduction strategy. At this time the Hazard Mitigation Grant Program benefit cost assessments are based on risk and risk reduction rather than past NFIP damages. This is an opportunity to take advantage of that advance in approach to serve those who might not have been served in the past. This population is often of lower income, and highest vulnerability to disruption in the event of a disaster. Currently, the Parish has declared 332 properties to be substantially damaged and not yet mitigated. The Parish participation in NFIP insurance relies, in part, on the enforcement of this provision. Substantially damaged structures are also targets of significant insurance premium increases, which will burden homeowners and may require them to sell the structure if they can. Funding will be prioritized to mitigate these structures.

As a result of hurricane Gustav, the Parish was allocated funding from the Department of Housing and Urban Development (HUD) managed through the Louisiana Office of Community Development Disaster Recovery Unit. This new funding source allowed the Parish to acquire flooded or wind damaged properties without leaving the land as open space. While some lots may not be redeveloped, due to the scarcity of buildable land, and the high percentage of participants in established neighborhoods, the Parish will only acquire structures if rebuilding is possible. The cost of maintaining lots, particularly in neighborhoods, is prohibitive, and the loss of property taxes and economically viable land is not sustainable. This program will also prioritize repetitive loss structures and substantially damaged homes.

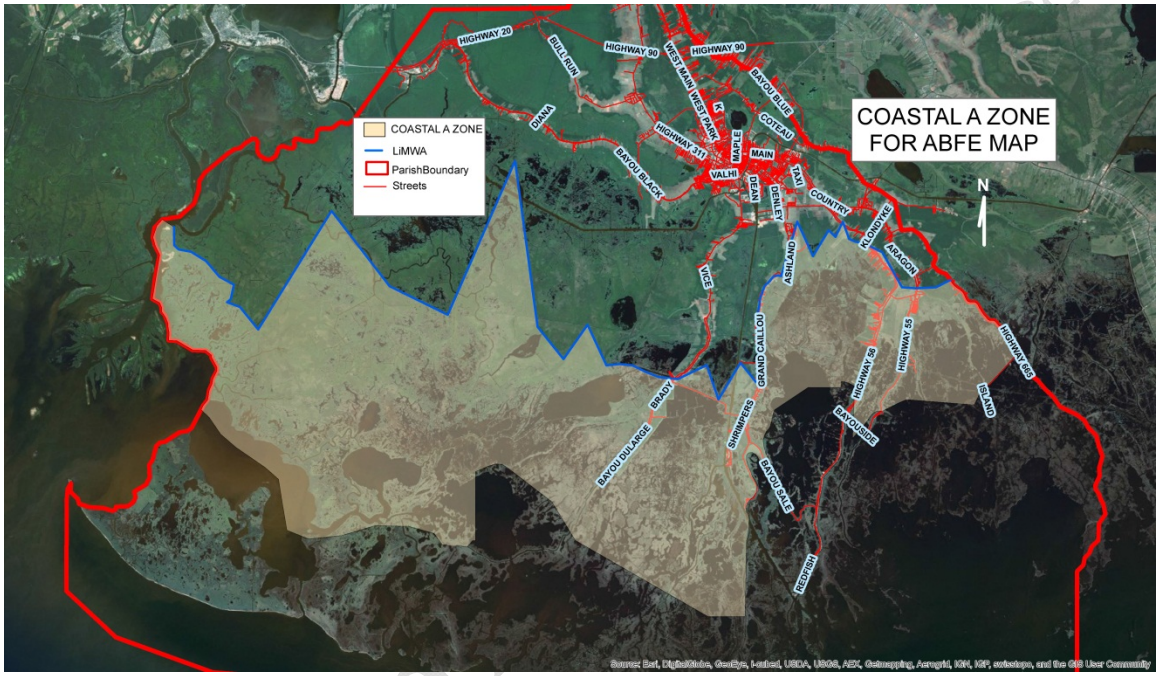
Funding from HUD has also opened the door to recruitment for elevation from low to moderate income applicants. The parish is participating in a pilot program to provide the homeowner match for the FEMA funded projects. The programs generally require the homeowner to pay at least 25% of the cost of an elevation project. This is cost prohibitive, particularly for the uninsured. This new program could make these programs accessible to a previously underserved population reducing risk where it was not possible before.

The Parish will meet with stakeholders and property owners to develop a plan specific to severe repetitive loss structures. These structures may be camps, and it was suggested by some committee members that they should not participate in the NFIP as they are not held to the same building standards and are not critical to recovery like residences or businesses. Records show that two thirds of the structures are not insured, which suggests that they are not under a mortgage. Federally backed mortgages require flood insurance. Therefore, the insurance reform that increases the premiums for severe repetitive loss structures to the actuarial rates may encourage owners to drop insurance rather than encourage elevation or other mitigation options. This increases risk rather than lowers it. The parish participates in the yearly, nationally competitive funding opportunities the pay 90 to 100 percent of the cost. More needs to be learned about motivating the owners of these structures to participate.

Terrebonne Parish is continuously implementing mitigation strategies and actions that improve its CRS rating. The Parish has recently studied the costs and benefits of streamlining the codes that are pertinent to flood risk reduction. The Planning Department commissioned an engineering study of flood ordinance changes that could be adopted by the Council to decrease flood risk and keep flood insurance rates within reach. The recommendations were then presented to the general public, professional associations and the business community. The outreach summaries are included in c1-3.5A – c1-3.5D (pages 76-83). To date, two recommendations have been adopted to limit landfills in the SFHA and make mobile homes as floodsafe as other homes. During the HMPU meetings, several of the proposed flood ordinance amendments were discussed, and members supported various approaches to risk reduction. None were highlighted for prioritized action by the steering committee in part due to the deliberative character of the separate hearings and council approval needed for any advances.

The discussion of the expansion of erosion control education, enforcement and applicability was discussed above. In a similar discussion arose out of the proposed addition of some freeboard to new construction and substantially improved properties. The home builders explained that the mortgage banking industry did not value the additional flood safety, and therefore would not pay the incremental increase in the cost of construction. The assessor's office representative concurred in a later meeting that there was an adaptation to recognize the value of a newly elevated structure above the base flood elevation, but no corresponding reduction for substantially damaged or high risk structures. Both supported educational efforts to bring banks, mortgage companies and appraisers up to speed on the value of safer homes, and the risks with properties with higher risk.

In 2014, the Parish commissioned a study of the available data to develop a Coastal A Zone map, shown on the following page. In the Flood Ordinance Outreach effort, the public supported the extension of V zone floodplain requirement to the Coastal A Zone (insert Map provided). The V zone is defined as an area with a risk of wave action three (3) feet or higher. The Coastal A Zone was defined as "the limited wave action zone," which is the area that has a prediction of waves between 1 ½ and 3 feet. This will be revisited as the recommendations come before council over the next year.



LAMP

The Levee Analysis and Mapping Procedures for Non-Accredited Levees sets out procedures used for analyzing flood risk and mapping areas on the landward side of levees that do not meet all Title 44 Code of Federal Regulations 65.10 NFIP requirements (also known as non-accredited levees). Previously, FEMA showed non-accredited levees on NFIP maps but did not calculate any effect of the levee on flood risk reduction. This resulted in development of areas landward of the non-accredited levee being developed as if the levee did not exist. The inclusion of non-accredited levees' flood reduction capabilities as inputs to flood modeling will result in more accurate forecasts.

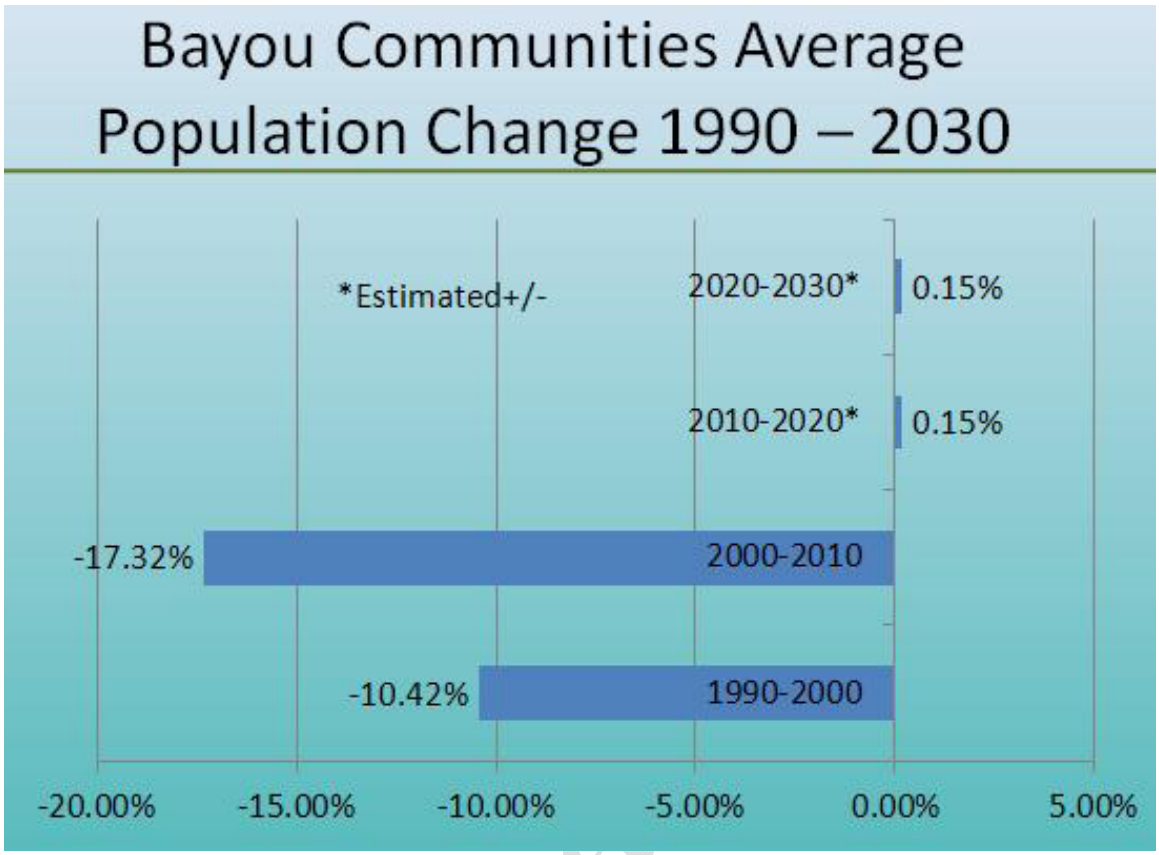
TPCG is currently engaged in the LAMP process which is anticipated to be complete in 2016.

3.2.6 §201.6 (c)(2)(ii)(C) 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

A detailed description of land use data is provided in the first section of this report in the section entitled "Introduction." Physical and cultural aspects of the parish including land use, drainage basins, and the economy were noted. The text below focuses on future land use and its bearing on this Hazard Mitigation Plan.

From 1980 to 2000, the parish population increased from 94,393 to 104,503. In October of 2003, when the parish government completed its comprehensive master plan (CMP), it was anticipated that the population would continue to experience positive growth. According to the 2010 U.S. Census, Terrebonne's population grew to 111,860 over the ten year period from 2000 to 2010, exceeding previous growth projections.

The parish recently completed a Comprehensive Plan Update, *Vision 2030: Terrebonne's Plan for Its Future*, in February 2013. The plan asserts that while the parish has experienced considerable growth over the last 20 years, the parish's population will grow at a slower rate over the next 20 years, peaking at 122,250 by 2030. Nevertheless, the importance of orderly land development remains a concern for the parish, and as such, the CMP presented three land use projection scenarios for the parish based on past and current comprehensive plans. The percent population change is presented in the figure below, follows by a table showing the three land use scenarios.



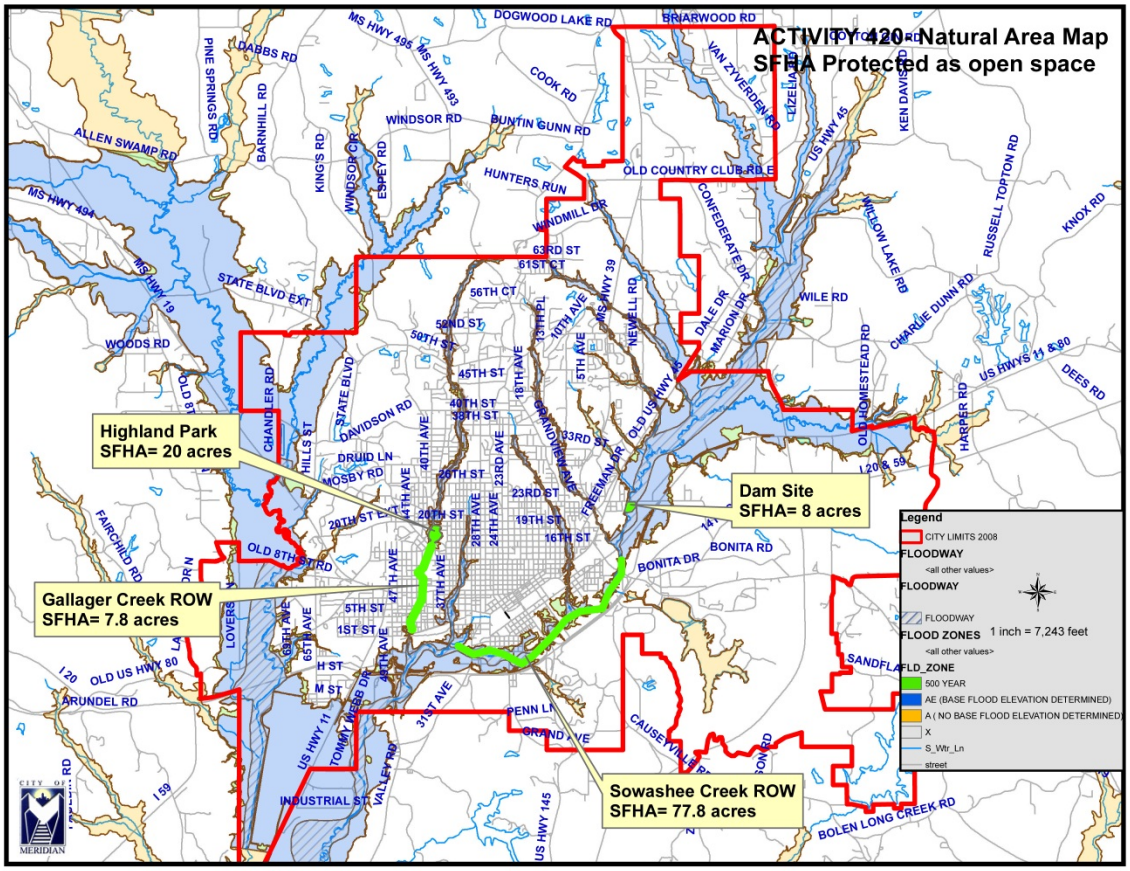
Scenario	Projection Span	Acres Consumed Per Span	Year of Total Consumption
Scenario #1	7 Years	3,021	2154
Scenario #2	19 Years	5,832	2229
Scenario #3	20 Years	3,085	2450
Source: Vision 2030: Terrebonne's Plan for Its Future			

It should be noted that 90 percent of Terrebonne's land is considered environmentally sensitive. Therefore, the land that is available for development is generally related to farming, vacant, and open space uses. Regardless of the year of total consumption of available developable land, the increase in impervious surfaces related to development and the resulting reduction in agricultural, vacant, and open space land will undoubtedly increase pressure on environmentally sensitive lands within the parish. In response, the 2013 Comprehensive Plan proposes a series of action items that aim to achieve a sustainable balance between development activities, preservation of natural resources, and open space.

Furthermore, Terrebonne Parish Consolidated Government has instituted preventative measures to minimize repetitive losses resulting from hazard events. The Parish's existing zoning ordinances and corresponding maps conform to FEMA guidelines, and the parish will update its zoning ordinances if and when needed to ensure compliance to

FEMA regulations. There Parish has proposed an open space zoning area that includes the environmentally sensitive marshland and wetlands as viewed in the figure below. No permits will be awarded in the zone. The Parish also has adopted the International Building Codes (IBCs) and advisory base flood elevations (ABFEs) which dictate wind and flood related guidelines.

Terrebonne Parish Natural Areas Map



Source: Terrebonne Parish

3.2.7 §201.6 (c)(2)(iii) For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area

As discussed previously in Section II of this HMPU, Terrebonne Parish is a consolidated government so the plan is not multi-jurisdictional.

4.0 §201.6 (c)(3) HAZARD MITIGATION STRATEGIES

Information presented below provides documentation in conformance with sections (c)(3)(i, ii, iii, and iv) relative to mitigation strategies evaluated for hazards identified in Terrebonne Parish, Louisiana.

4.1 §201.6 (c)(3)(i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The Terrebonne Parish HMPU Steering Committee reviewed and analyzed the risk assessment evaluation performed for the parish as well as goals reflective of that risk assessment. Goals and action items that would have the greatest benefit in reducing or eliminating hazard damage to the parish were identified. The evaluation criteria used in determining these goals and action items are as follows:

- *Social* - Is the mitigation strategy socially acceptable?
- *Technical* - Is the proposed action technically feasible and cost effective? Does it provide the appropriate level of protection?
- *Administrative* - Does the parish have the capability to implement the action? Is the lead agency capable of carrying out oversight of the project?
- *Political* - Is the mitigation action politically acceptable?
- *Legal* - Does the parish have the authority to implement the proposed measure?
- *Economic* - Does the economic base, protected growth and opportunity costs justify the mitigation project?
- *Environmental* - Does the proposed action meet statutory considerations and public desire for sustainable and environmentally healthy communities?

The goals developed to reduce or avoid long-term vulnerabilities to the identified hazards are listed below:

Goal 1: Identify and pursue preventive measures that will reduce future damages from hazards.

Goal 2: Enhance public awareness and understanding of disaster preparedness.

Goal 3: Reduce repetitive flood losses in the parish.

Goal 4: Facilitate sound development in the parish to reduce or eliminate the potential impact of hazards.

4.2 §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.

The Terrebonne Parish Hazard Mitigation Plan Update Committee identified several projects that would reduce and/or prevent future damage from naturally occurring hazard events. This coordinated effort, which included the planning committee, the consultant team, and other engineering representatives, was accomplished with frequent and open communications including committee meetings, telephone conversations, emails, and face-to-face meetings.

The projects and resulting action items relate to community goals which are presented immediately following the Project List attachment. Projects were initially filtered to only include those projects that were eligible under FEMA's HMG program and those of the highest local priority. However, to ensure a comprehensive list of mitigation projects, non-HMPG eligible projects and those from the original hazard mitigation plan (2005) and the first update (2010) are included with status updates.

Regardless of the topic, education was central to all activities reviewed. Ongoing efforts were applauded, but in most instances, increased education was identified as a necessary component of any resulting plan. For example, a modest expansion of erosion control requirements was proposed to a subcommittee for approval, and was not voted on yea or nay. Rather, the Department of Planning and Zoning began a series of educational events to explain what erosion control methodologies were required, how to implement them, and what the benefits are to the stormwater drainage system. While the ordinance revision may move forward to protect the stormwater system capacity, the educational initiatives are necessary to bring the industry a more detailed knowledge of the expectations. Without the education, the enforcement would be frustrating, expensive, and less productive, it was decided, than to work toward a common goal. Action items and the proposed project list includes outreach initiatives from the Multijurisdictional Program for Public Information, Levee Safety, Safe Harbor, etc.

The established and agreed upon objectives and actions relative to the established goals are as follows:

- **<u>Goal 1: Identify and pursue preventative measures that will reduce future damages from hazards</u>**
  - **Objective 1.1:** Ensure existing structures are structurally sound to endure hurricane-force winds
    Action 1.1.1: *Wind harden structures (see c3-1 for locations)*

- Timeframe: 1-5 years, as funding permits
- Funding: HMGP, local, regional, and federal
- Staff: Public Works, Planning and Zoning

- **Objective 1.2:** Ensure all citizens and employees of Terrebonne Parish are safe from high winds (hurricanes and tornado related)

  Action 1.2.1: *Construct safe rooms at critical facilities (see Attachment c3-1 for locations)*
  - Timeframe: 1-5 years, as funding permits
  - Funding: HMGP, local, regional, and federal
  - Staff: Public Works, Planning and Zoning, Public Safety

  Action 1.2.2: *Install a hazard early warning system*
  - Timeframe: 1-5 years, as funding permits
  - Funding: HMGP, local, regional, and federal
  - Staff: Public Safety

  Action 1.2.3: *Work with communities currently residing in at risk areas on the development of evacuation plans including access to shelter and transportation assistance as needed.*
  - Timeframe: 1-5 years, as funding permits
  - Funding: HMGP, local, regional, and federal
  - Staff: Planning and Zoning, Public Safety

- **Objective 1.3:** Ensure all first responders are adequately equipped to respond to a storm event

  Action 1.3.1: *Purchase communication devices (see Attachment c3-1 for details)*
  - Timeframe: 1-5 years, as funding permits
  - Funding: HMGP, local, regional, and federal
  - Staff: Existing parish administration

  Action 1.3.2: *Purchase generators for critical facilities (see Attachment c3-1 for locations) to ensure operation during and after a hazard event*
  - Timeframe: 1-5 years, as funding permits
  - Funding: HMGP, local, regional, and federal
  - Staff: Public Safety

- **Objective 1.4:** Protect citizens from saltwater intrusion

  Action 1.4.1: *Maintain dual potable water intakes*
  - Timeframe: Ongoing
  - Funding: Local
  - Staff: Planning and Zoning

  Action 1.4.2: *Acquire bottled water in event of saltwater intrusion*
  - Timeframe: As needed
  - Funding: local, federal
  - Staff: Public Safety

Action 1.4.3: *Continue to construct Morganza to the Gulf storm surge protection levee which in turn would reduce the effects of saltwater intrusion*

- Timeframe: 1-5 years
- Funding: local, federal
- Staff: Public Works, Planning and Zoning

- **Objective 1.5:** Reduce the effects of Land Subsidence

Action 1.5.1: *Pursue coastal protection projects to reduce land subsidence in coastal areas*

- Timeframe: Ongoing
- Funding: Local
- Staff: Planning and Zoning, Public Works

Action 1.5.2: *Ensure accurate survey points are located throughout the parish to monitor continued subsidence*

- Timeframe: Ongoing
- Funding: local, federal
- Staff: Existing parish administration

Action 1.5.3: *Monitor agricultural activities and encourage smart farming practices to reduce soil compaction and acceleration of subsidence*

- Timeframe: As needed
- Funding: local, federal
- Staff: Planning and Zoning

- **Objective 1.6:** Protect historic and cultural resources, such as cemeteries and gathering places from all hazards

Action 1.6.1: *Identify vulnerable historic and cultural resources, as well as opportunities to protect and/or relocate historic assets*

- Timeframe: Ongoing
- Funding: local, federal
- Staff: Planning and Zoning

- **Goal 2: Enhance public awareness and understanding of disaster preparedness**

- **Objective 2.1:** Increase public awareness of hazard areas and educate the public on mitigation

Action 2.1.1: *Continue to advertise public meetings during the hazard mitigation planning process*

- Timeframe: 3-5 years
- Funding: HMGP
- Staff: Planning and Zoning

Action 2.1.2: *OEP continues to attend public gatherings, provide yearly materials for preparedness, and updates to the registration system for people needing evacuation or other services in preparation for an event.*

- Timeframe: Ongoing
- Funding: Local
- Staff: OEP

Action 2.1.3: *Continue web and email postings of mitigation programs available to reduce risks.*

- Timeframe: Ongoing
- Funding: Local
- Staff: Planning and Zoning

- **Goal 3: Reduce repetitive flood losses in the parish**

  - **Objective 3.1.:** Eliminate threat of flood damage to structures in Terrebonne Parish including storm surge and levee failure

    Action 3.1.1: *Upgrade current drainage infrastructure (see Attachment c3-1 for locations)*

    - Timeframe: 1-5 years
    - Funding: HMGP
    - Staff: Public Works, Planning and Zoning

    Action 3.1.2: *Construct new flood control structures and levees (see Attachment c3-1 for locations)*

    - Timeframe: 1-10 years
    - Funding: local, regional, and federal
    - Staff: Public Works, Planning and Zoning

    Action 3.1.3: *Elevate all RL and SRL structures in Terrebonne Parish (see Attachment c2-25 on page 108)*

    - Timeframe: 1-10 years, as funding permits
    - Funding: HMGP, FMA, PDM
    - Staff: Planning and Zoning

    Action 3.1.4: *Acquire all RL and SRL structures in Terrebonne Parish (see Attachment c2-25 on page 108)*

    - Timeframe: 1-10 years, as funding permits
    - Funding: CDBG, FMA, PDM
    - Staff: Planning and Zoning

    Action 3.1.5: Elevate equipment that is vulnerable to flood damage (see Attachment c3-1 for locations)

    - Timeframe: 1-5 years, as funding permits
    - Funding: HMGP
    - Staff: Public Works

    Action 3.1.6: *Flood proof all public buildings vulnerable to flood damage (see Attachment c3-1 for locations)*

    - Timeframe: 1-5 years, as funding permits
    - Funding: HMGP

- Staff: Public Works, Planning and Zoning

Action 3.1.7: *Construct Morganza to the Gulf Hurricane Protection Levee which would protect both new and current developments*

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Public Works, Planning and Zoning

Action 3.1.8: *Collaborate with communities to design, evaluate, and implement Relocation Strategies for communities located outside the levee systems*

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Planning and Zoning, Public Safety

Action 3.1.9: *Ensure that current and future building elevations take the needs of those individuals with access and functional needs into account. This includes the incorporation of lifts.*

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Public Works, Planning and Zoning

Action 3.1.10: *Identify mechanisms to protect the Island Road from surge and tidal impacts. This might include engineered solutions to decrease wave impacts and/or erosion control mechanisms along the edges of the road.*

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Public Works, Planning and Zoning

- **Goal 4: Facilitate sound development in the parish to reduce or eliminate potential impacts of hazards**

  - **Objective 4.1:** Promote and permit commercial and industrial development, including public critical facilities, outside of hazard areas to limit business interruption, property damage, and impairment to critical facilities in strict accordance with the parish zoning, flood management, and other applicable state and federal regulations.

    Action 4.1.1: *Ensure that future development does not increase hazard losses by enforcing building codes*

    - Timeframe: Ongoing
    - Funding: No additional funds required
    - Staff: Planning and Zoning

    Action 4.1.2: *Guide future development away from hazard areas using zoning regulations while maintaining other parish goals such as economic development and improving the quality of life*

    - Timeframe: Ongoing
    - Funding: No additional funds required
    - Staff: Planning and Zoning

Action 4.1.3: *Enforce the International Building Code requirements for all new construction to strengthen buildings against high wind damage*

- Timeframe: Ongoing
- Funding: Not additional funds required
- Staff: Planning and Zoning

  ***** The parish is pursuing the hiring of additional code enforcement staff to monitor sites, process permits, and make sure that unpermitted work or work outside of the permit and NFIP regulations is stopped. One project meant to track development in the parish is described in the HMPU - Code Enforcement document as Attachment c3-4 (page 234).

Action 4.1.4: *Examine current zoning regulations and determine what new regulations could be passed to reduce the effects of hazards on new buildings and infrastructure*

- Timeframe: Ongoing
- Funding: Not additional funds required
- Staff: Planning and Zoning

- **Objective 4.2**: Promote preservation and/or conservation of flood prone areas for parish parks, recreation areas, and general flood plain management

  Action 4.2.1: *Participate in existing programs at the state and federal levels oriented to environmental enhancement and conservation*

  - Timeframe: Ongoing
  - Funding: local, regional, and federal
  - Staff: Planning and Zoning, Recreation, Parks, & Grounds, Coastal Restoration and Preservation

  Action 4.2.2: *Continue to participate in the NFIP (including Houma under the Consolidated Government)*

  - Timeframe: Ongoing
  - Funding: No additional funds required
  - Staff: Planning and Zoning

  Action 4.2.3: *Establish a public outreach campaign to ensure all homeowners in floodplains are aware of the various types of coverage options under the NFIP*

  - Timeframe: Ongoing
  - Funding: HMGP, state
  - Staff: Planning and Zoning, Housing and Human Services

  Action 4.2.4: Establish homeowner education program on flood mitigation measures

  - Timeframe: Ongoing
  - Funding: HMGP, state
  - Staff: Planning and Zoning, Housing and Human Services

  Action 4.2.5: Multijurisdictional Program for Public Information to educate population on risk reduction strategies, their responsibilities, and the Parish's responsibility for enforcement

- Timeframe: Ongoing
- Funding: HMGP, state
- Staff: Planning and Zoning

Action 4.2.6: Work with communities currently residing in flood prone areas, particularly outside of the levee systems, on the identification of flood mitigation and climate adaptation measures to reduce flood risk.

- Timeframe: Ongoing
- Funding: HMGP, state
- Staff: Planning and Zoning

2015 HMPU Project List

The Terrebonne Parish Project List resulting from the 2015 HMPU is presented in Attachment c3-1 (pages 139-146). Two truncated listings of projects based on projects' status and prioritization are provided in this section.

The parish's mitigation consultant, CB&I, assisted the HMPU Steering Committee in reviewing and evaluating the potential project list. Consideration was given to a variety of factors including the STAPLEE method, as previously noted, a project's eligibility for federal mitigation grants and its ability to be funded. This process required evaluation of each project's engineering feasibility, cost effectiveness, and environmental and cultural factors.

The following table lists projects that are ongoing or have been completed, funded, or removed from the project list since the 2010 Hazard Mitigation Plan Update.

Terrebonne 2004 HMPU Ongoing or Completed Projects		
	Project Description	**Status**
1	Promote Purchase of Flood Insurance	Ongoing
2	Increase Public Awareness of Hazards and Hazard Areas	Ongoing
3	Pursue elevation/acquisition/flood proofing project and structural solutions to flooding	Ongoing
4	Review the existing floodplain ordinance and evaluate ways to improve the Parish's Community Rating System (CRS) rating to reduce flood insurance premium. Choose from a variety of methods and projects available that can be implemented to improve the CRS rating.	Ongoing
Terrebonne 2010 HMPU Ongoing or Completed Projects		
5	Drainage Improvement – (Chabert Medical Center Levee/Houma Industrial Park) Build Levee from Thompson Road to Industrial Pump Station	Completed
6	Drainage Improvement – Ann Carroll, Jean Street, Duet Street, and Grace Street (Upgrade culvert size to drain water from middle of streets)	Ongoing/ Priority
7	Drainage Improvement – Ashland North D-60 Tideflex valves on discharge pipes	Completed
8	Drainage Improvement – Bayou Lacache Pump Canal (Widen and Deepen Canal from Lacache Estate to Pump Station)	Ongoing
9	Drainage Improvement – Bayou Lacarpe (Widen Channel from Tunnel Blvd to pump station and upgrade bar screen cleaner	Ongoing/ Priority
10	Drainage Improvement – Bonanza Pump Station D-27 Tideflex valves on discharge pipes	Funded by HMGP
11	Drainage Improvement – Coteau 1-1B Bar Screen Cleaner	Completed
12	Drainage Improvement – D-07 Smithridge Pump Station	Completed

	Bar Screen Cleaner	
13	Drainage Improvement – D-3 Upper Montegut Bar Screen Cleaner	Completed
14	Drainage Improvement – Island Road (Stabilize roadway shoulders and embankment)	Funded and Completed
15	Drainage Improvement – Lower Montegut D-2 Tideflex Valves on discharge pipes	Completed
16	Drainage Improvement – Michael Street, Buquet Street, and Daigle Street (Increase culvert size to drain streets during heavy rainfall)	CDBG Funded and Completed
17	Drainage Improvement – Woodlawn Ranch pump Canal (From D-12 to Cement in Lined Ditch, Widen and Deepen Canal)	Completed
18	Elevator – Generator for Riley Drive Lift Station	Completed
19	Elevation – Lift Stations with Self Priming Pumps (Bourg heights, Edgewood, Ashland North, Ashland North II, Ashland South, Woodlawn Ranch, Saia, Prospect, Carriage Cove, Green Acres I, Green Acres II, Lafayette Woods, Lorraine Park, Presque Isle, Presque isle II, Chabert Medical Center, Service Center, Smithridge I, Smithridge II, South Terrebonne Estates, Riley Drive)	Completed
20	Elevation – Lift Stations with Submersible Pumps (Bobtown, Dulac, Orange Street, Airbase Jr., Patriot Point, Rounds Road, Applied Hydraulics, Gemoco, Indian Ridge, James Road, Sandcastle, Thunderbird)	Completed
21	Elevation – Orange Street Wastewater Plant Controls	Completed
22	Elevation – Terrebonne General Medical Center Main Plant Electrical Switch Gear, Boilers, and Chillers ($2,750,000)	Completed
23	Emergency Preparedness – Message Boards	Ongoing
24	Flood Protection – Sea wall at Public Works Yard Grand Caillou Road	Completed
25	Emergency Preparedness – Nursing Home Evacuation Coordination/Plan	Remove/ Obsolete
26	Emergency Preparedness – Message Boards	Ongoing
27	Generator -- 150KW for Valhi Lift Station	Completed
28	Generator -- 200KW for South Wastewater Treatment Plant	Completed
29	Generator -- City Hall (with switching capacity)	Completed
30	Generator -- Gov't Towers	Completed
31	Generator -- Houma Police Department Building (Cummings model GFGA 500 KW 120/208 Volt 3 phase, 60 hertz, 1800RPM NG set)	Completed
32	Generator -- North Terrebonne Treatment Plant	Completed
33	Generator -- OEP 911 (60KW)	Completed
34	Generator -- Pollution Control Portable Unit Trailer	Ongoing

	Mounted for 10 treatment plants (50 KW)	
35	Generator -- Pollution Control, S. Treatment Plant Effluent Lift Station (250 KW)	Completed
36	Generator -- Public Works -- Portable Generator for Bridges (80 KW)	Completed
37	Generator -- Public Works -- Portable Trailer Unit Mounted for 6 Treatment Plants (56KW)	Completed
38	Generator -- Public Works Service Center Yard (400KW)	Completed
39	Generator -- Public Works, Buquet Bridge (75 KW 120/240 Volt)	Completed
40	Generator -- Public Works, Klondyke Bridge (75 KW 120/240 Volt)	Completed
41	Modification to Village East Lift Station (Conversion from Dry Pit to Submersible Station)	Completed
42	Infiltration Reduction of Underground Wastewater System (Testing needed for Locations)	Some completed, more to test
43	RL and Severe RL Properties -- Elevation, Acquisition, Mitigation Reconstruction (Parish)	Ongoing
44	Safe Room -- Gov't Towers Parking Structure (Pet Shelter)	Funded
45	Wind Retrofit -- City Hall (IT Department)	Ongoing
46	Wind Retrofit -- Civic Center (Shutters or Window Film)	Funded
47	Wind Retrofit -- Courthouse Annex (Window Film)	Funded
48	Wind Retrofit -- Government Tower (Window Film)	Ongoing
49	Wind Retrofit -- Harden Front and Back Doors of Convention Center	Funded
50	Wind Retrofit -- Houma PD	Ongoing
51	Wind Retrofit -- Juvenile Detention Center	Ongoing
52	Wind Retrofit -- New Roll-up Door at EOC -- 911	Ongoing
53	Wind Retrofit -- Roof of Convention Center	Ongoing
54	Wind Retrofit -- Schriever Elementary	Funded
55	Generator -- Major Lift Stations, Highland Drive (150 KW)	Budgeted for 2014
56	Drainage Improvement -- Highway 24 in Gray	Removed/ Obsolete
57	Drainage Improvement -- Isle of Cuba Transfer (Off-site fuel storage -- gas and diesel)	Removed/ Obsolete
58	Emergency Preparedness -- Military Showers	Under Contract
59	Emergency Preparedness -- Small Power Radio Station for Hazard Alert	Removed
60	Emergency Preparedness – Creation of alternative staging area	Removed
61	Wind Retrofit -- Coteau Fire Station (Include main structure, apparatus room, generator room doors)	Completed
62	Wind Retrofit -- Fire Stations (central) Shutters	Removed/Duplicate
63	Doors (22’x10,’14’x10’) and 3 windows (35”x36”)	Removed/Duplicate

64	Elevation -- Fire Station (raise 2', history of flooding, 75'x75' Slab) (1466 Highway 665	Removed
65	Elevation Montegut Station (100'x75')	Removed
66	Wind Retrofit --Bourg Fire Station, 2 Bay Doors (22'x10', 14'x10') and 3 windows (35"x36")	Removed

On August 7, 2014, Hazard Mitigation Plan Update Committee Meeting No. 3 was held. At this meeting, members were asked to respond to a series of questions that gauged their input on project priorities. Feedback gained from these questions was utilized in prioritizing projects for the HMPU. Below is a list of questions along with the corresponding percent of individuals who voted for each option. If the top rated answer equaled less than 50 percent, the top two rated answers were used to develop the highest priority.

HMPU Steering Committee Priority Projects Survey Responses		
Question 1 Which type of project do you consider the highest priority? 1. Residential Elevations (30%) 2. Commercial Elevations (5%) 3. Elevations of Critical Facilities **(65%)**	**Question 2** Which type of project do you consider the highest priority? 1. Generators for Schools (5%) 2. Generators for Sewer Lift Stations (10%) 3. Generators for Potable Water Facilities (15%) 4. Generators for First Responders **(30%)** 5. Generators for Drainage Pump Stations **(40%)**	**Question 3** What type of drainage improvement do you think should be the highest priority? 1. Existing Culvert or Ditch Upgrades (35%) 2. Pump Station Upgrades **(59%)** 3. Installation of new Drainage Ditches/ Culverts where none currently exists (6%)
Question 4 What type of critical facility elevation do you think should be the top priority? 1. Elevation of utilities (water/sewer) (0%) 2. Elevation of First Responder structures **(38%)** 3. Elevation of evacuation routes with flood history **(46%)**	**Question 5** What type of wind hardening project do you think should be the top priority? 1. Schools (12%) 2. First Responders **(35%)** 3. Utilities (18%) 4. Evacuation Shelters **(35%)**	**Question 6** What type of project would be of the highest priority to prevent coastal erosion? 1. Inform community of risks (0%) 2. Acquire and demolish structures in at risk area (18%) 3. Stabilization or rebuilding of barrier islands

3. Elevation of pump station controls (15%)	5. Other Government Structures (0%)	**(82%)**

HMPU Steering Committee Priority Projects Survey Responses Continued		
Question 7 What type of project do you think would be of the highest priority to combat sea level rise? 1. Study to investigate baseline risk (21%) 2. Zoning/Subdivision Regulations (7%) 2. Locate utilities outside high risk areas (7%) 3. Additional Freeboard requirement (7%) 4. Natural Buffer Restoration **(57%)**	**Question 8** What type of project do you think would be the highest priority to combat subsidence? 1. Study to Identify Baseline Risk (24%) 2. Zoning/Subdivision Regulations (12%) 3. Generators for Potable Water Facilities **(65%)**	*This cell is intentionally left blank*

Below is a list of prioritized projects identified through consideration of the abovementioned survey results as well as HMPU Steering Committee input. It should be noted that projects were extracted from Attachment c3-1 (pages 139-146). Only those projects that are potentially eligible for Hazard Mitigation Grant Program funding were prioritized.

Parish Priority Projects List	
Question 1 Which type of project do you consider the highest priority?	
Q1. Elevations of Critical Facilities (65%)	
	Project Description
1	Elevation -- Bayou Dularge Tank building and chlorination equipment
2	Elevation -- Fire Station in Chauvin 6668 Hwy 56
3	Elevation -- Grand Caillou Tank building
4	Elevation -- Industrial Blvd from Van Ave to Pump Station
5	Elevation -- Leachate Removal System
6	Elevation -- Lower Dulac Tank building and chlorination equipment
7	Elevation -- Pointe-Aux Chenes Pump Station building and electrical

	pump, regulating valve and meter
8	Elevation -- Robinson Canal P.S. Building, electrical pump, regulating valve and meter
9	Elevation -- South Terrebonne Pump Station building and pump
10	Elevation -- Texaco Master Meter Building, regulating valve and meter
11	Elevation -- West Gibson Tank building and chlorination equipment
12	Elevation of Pump Station Roads -- D-19, D-12, and D-5 Pumps
13	Elevation to ABFE -- D-02 Gear Drives, Motors, and Controls
14	Elevation to ABFE -- D-02 Gear Drives, Motors, and Controls
15	Elevation to ABFE -- D-04 Gear Drives, Motors, and Controls
16	Elevation to ABFE -- D-06 Gear Drives, Motors, and Controls
17	Elevation to ABFE -- D-11 Gear Drives, Motors, and Controls
18	Elevation to ABFE -- D-15 Gear Drives, Motors, and Controls
19	Elevation to ABFE -- D-21 Gear Drives, Motors, and Controls
20	Elevation to ABFE -- D-36 Gear Drives, Motors, and Controls
21	Elevation to ABFE -- D-37 Gear Drives, Motors, and Controls
22	Elevation to ABFE -- D-40 Gear Drives, Motors, and Controls
23	Elevation to ABFE -- D-42 Gear Drives, Motors, and Controls
24	Elevation to ABFE -- D-43 Gear Drives, Motors, and Controls
25	Elevation to ABFE -- D-44 Gear Drives, Motors, and Controls
26	Elevation to ABFE -- D-46 Gear Drives, Motors, and Controls
27	Elevation to ABFE -- D-47 Gear Drives, Motors, and Controls
28	Elevation to ABFE -- D-48 Gear Drives, Motors, and Controls
29	Elevation to ABFE -- D-49 Gear Drives, Motors, and Controls
30	Elevation to ABFE -- D-50 Gear Drives, Motors, and Controls
31	Elevation to ABFE -- D-51 Gear Drives, Motors, and Controls
32	Elevation to ABFE -- D-53 Gear Drives, Motors, and Controls
33	Elevation to ABFE -- D-54 Gear Drives, Motors, and Controls
34	Elevation to ABFE -- D-56 Gear Drives, Motors, and Controls
35	Elevation to ABFE -- D-59 Gear Drives, Motors, and Controls
36	Elevation to ABFE -- D-60 Gear Drives, Motors, and Controls
37	Elevation to ABFE -- D-61 Gear Drives, Motors, and Controls
38	Elevation to ABFE -- D-62 Gear Drives, Motors, and Controls
39	Elevation to ABFE -- D-65 Gear Drives, Motors, and Controls
40	Elevation to ABFE -- D-69 Gear Drives, Motors, and Controls
41	Wind Retrofit and Elevation -- Houma Plant 3 (Install shutters or impact resistant glass on windows, strengthen doors, raise pumps and electrical panels)
42	Wind Retrofit and Elevation -- Houma Plant High Service pumps and electrical panels, strengthen door
43	Wind Retrofit and Elevation -- Lafort Canal RW PS (elevate pumps and generator, strengthen door)
44	Wind Retrofit and Elevation -- Munson PS (Elevate Building, electrical pumps, regulating valves and meters, Install Shutters on windows,

	strengthen the doors)
45	Wind Retrofit and Elevation -- Schriever Plant (install shutters or impact resistant glass on windows, strengthen doors, elevate pumps)
46	Wind Retrofit and Elevation -- Williams Street Pump Station (elevate pumps and electrical panels, strengthen door)
Q1. Residential Elevations (30%)	
All Repetitive Loss Properties	
Q1. Commercial Elevations (5%)	
From Repetitive Loss List	
Question 2 Which type of project do you consider the highest priority?	
Q2. Generators for First Responders + Generators for Pump Stations (70%)	
1	Generator -- 100KW for W. Woodlawn Station
2	Generator -- Pollution Control, S. Treatment Plant Perimeter Drainage Pump Station (100 KW)
3	Generator -- Port Commission Forced Drainage (50 KW)
4	100 Amp, 3-way SS Disconnects for generator ready connections (approx. 40 Lift station sites)
5	Connect Station to emergency generator – Munson PS
6	Generator -- Coteau Fire Station (Natural Gas, includes change over switch to ensure response to emergency calls)
7	Generator -- Houma Fire Department, Central Station (50KW)
Q2. Generators for Potable Water Facilities (15%)	
No Sites Noted	
Q2. Generators for Sewer Lift Stations (10%)	
1	150kw generators for Mire, Idlewild, and Elysian Lift Stations
2	Generator -- Lift Stations Receiving Effluent from Hospitals, Terrebonne General Medical Center (50 KW)
3	Generator -- Lift Stations Receiving Effluent from Hospitals, Chabert Medical Center (50 KW)
4	Generator -- Major Lift Stations, Douglas (50 KW)
5	Generator -- Major Lift Stations, Mire (75 KW)
6	Generator -- Major Lift Stations, Westside (50 KW)
7	Generator -- Major Lift Stations, Westview (100 KW)
8	Generators -- Lift Stations Receiving Effluent from Hospitals, Valhi II (125 KW)
Q2. Generators for Schools (5%)	
No Sites Noted	
Question 3 What type of drainage improvement do you think should be the highest priority?	
Q3. Pump Station Upgrades (59%)	
1	Drainage Improvement -- Industrial Pump D-13 Trash Screen and Bar Screen Cleaner

2	Drainage Improvement -- D-20 Schriever Pump Station Bar Screen Cleaner
3	Drainage Improvement -- Pump Station Telemetry
4	Scada telemetry, The automation of Forced drainage Pump Stations To reduce response time and flooding.
Q3. Existing Culvert or Ditch Upgrades (35%)	
1	Drainage Improvement –Bellaire Drive (Increase culvert sizes and slope ditches)
2	Drainage Improvement – Martin Luther King Blvd. (Increase culvert size in pump canal under highway in bonanza system)
3	Drainage Improvement – Oak Forest Street (Increase culvert sizes and pump station)
4	Drainage Improvement – Royce Street (Increase culvert size to stop rainfall flooding)
5	Elevation of Local Evacuation Route -- 1 Mile Section of LA 56 in Chauvin, LA (Ward 7 Evacuation Routes)
6	Elevation of Local Evacuation Route -- 1.5 Mile Section of LA 315 near the Dularge Bridge (Evacuation Route for Bayou Dularge and Crozier, Floods in a strong south wind)
Question 4 What type of critical facility elevation do you think should be the top priority?	
Q4. Elevation of pump station controls (15%)	
All locations below BFE	
Q4. Elevation of utilities (water/sewer) 0%	
All locations below BFE	
Q5. Wind Hardening for First Responders and Evacuation Shelters (70%)	
1	Wind Retrofit and Garage Doors -- 407 Island Road
2	Wind Retrofit -- Fire Stations (#2, #3, #4) Shutters
3	1105 Highway 55 Montegut Street Garage Doors
4	Wind Retrofit -- 4317 Highway 24 Bourg Street Shutters
5	Wind Retrofit -- Gulf States LTAC
6	Wind Retrofit -- 2325 Coteau Road Coteau Street Shutters
7	Wind Retrofit -- 4588 Highway 56, 5610 Highway 56, and 6668 Highway 56 Shutters
8	Safe House -- EOC (2101 East Tunnel Blvd)
9	Safe Room -- Coteau Fire Station
10	Wind Retrofit -- Morgue
11	Wind Retrofit -- Montague, Pointe Aux Chene Fire Stations (5 windows at 1466 Hwy 665, 6 Windows at1746 Hwy 55, 6 windows at 407 Island Road)
Question 5 What type of wind hardening project do you think should be the top priority?	
Q5. Wind Hardening for Utilities (18%)	

1	Wind Retrofit -- Schriever Water Treatment Facility
2	Wind Retrofit -- Bac-T Lab at Schriever Water Treatment Facility (install shutters or impact resistant glass on windows, strengthen doors)
Q5. Wind Hardening for Schools (12%)	
1	Wind Retrofit -- Evergreen Junior High
2	Wind Retrofit -- Headstart Center
3	Wind Retrofit -- Houma Junior High
4	Wind Retrofit -- Houma Municipal Auditorium
5	Wind Retrofit -- Legion Park Middle
6	Wind Retrofit -- South Terrebonne High School
7	Wind Retrofit -- Southdown Elementary
8	Wind Retrofit -- Terrebonne High School
Q5. Wind Hardening for Other Government Structures (0%)	
1	Wind Retrofit -- Bob Jones Building (Cat 4 or 5)
2	Wind Retrofit -- Buquet Bridge and Klondyke Bridge Tender's Buildings (Cat 3)
3	Wind Retrofit -- Director's Building (Cat 3)
4	Wind Retrofit -- Drainage Building (Cat 3)
5	Wind Retrofit -- Gulf States LTAC
6	Wind Retrofit -- Mail Library
7	Wind Retrofit -- Main Office (Install shutters or impact resistant glass on windows, strengthen doors)
8	Wind Retrofit -- Sludge Press Building (strengthen doors)
9	Wind Retrofit -- Waterworks Office Complex at 8814 Main Street, Houma, LA
Question 6 What type of project would be of the highest priority to prevent coastal erosion?	
Q6. Stabilization or rebuilding barrier islands (82%)	
Q6. Acquire and demolish structures in at risk area (18%)	
Q6. Inform community of risks (0%)	
Question 7 What type of project do you think would be of the highest priority to combat sea level rise?	
Q7. Natural Buffer Restoration	
Q7. Zoning/Subdivision Regulations + Local utilities outside high risk areas + Additional freeboard requirement (21%)	
No Applicable Projects	
Question 8 What type of project do you think would be the highest priority to combat subsidence?	

Q8. Generators for Potable Water Facilities (65%)
All locations currently without generators.
Q8. Study to Identify Baseline Risk (24%)
Q8. Zoning/Subdivision Regulations (12%)

4.3 §201.6 (c)(3)(iii) ...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.

The Hazard Mitigation Committee has identified several hazard mitigation projects to be included in the parish Hazard Mitigation Plan. The actions presented on the previous pages were categorized to organize priorities by HMGP grant eligibility. Projects not deemed eligible and/or covered in other programs can be located in the full project list in Attachment c3-1. Potential projects identified included properties and areas that have localized flooding or drainage problems as noted in the Terrebonne Parish Hazard Mitigation Plan (2010). Projects carried over from the HMP (2010) can also be found in Attachment 3-1. Most of the projects from the original plan were not eligible for HMGP funding, but those that were carried forward to project prioritization. The project list reviewed for prioritization also included consideration of repetitive loss (RL) and severe repetitive loss (SRL) properties in the parish.

Implementation

Upon approval of the Hazard Mitigation Plan by state and federal authorities, parish officials will meet with each of the respective governmental units regarding planning and implementation of the respective projects. The parish will then initiate activities required to implement the projects in each district.

On parishwide projects the Planning and Zoning Director, and Mitigation Planner will meet with appropriate staff to ensure conformance to the plan requirements.

Administration

As noted, the administration of said projects is the responsibility of policy and permitting matters as they relate to the siting of structures in flood-prone areas will continue to be administered by the parish government. Public awareness of all of the above initiatives will also be facilitated by the parish government.

5.0 §201.6 (c)(4) PLAN MAINTENANCE PROCEDURES

A plan maintenance process that includes:

5.1 §201.6 (c)(4)(i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Terrebonne Parish has developed a plan maintenance process to ensure that regular review and update of the Hazard Mitigation Plan occurs. The parish has formed a Hazard Mitigation Plan Evaluation Committee that consists of select members from municipalities, local agencies, and the Hazard Mitigation Plan Update Committee, which was responsible for preparing the HMPU as included herewith. The HMP Evaluation Committee consists of the following representation:

1. Terrebonne Parish President
2. Terrebonne Parish Manager
3. Planning and Zoning Director (responsible for overall coordination of HMP maintenance activities)
4. Terrebonne Parish Recovery Planner
5. Terrebonne Parish Director of Public Works
6. Terrebonne Parish OEP director
7. Terrebonne Parish Sheriff
8. Houma Police Department Chief
9. Houma Fire Department Chief

The Parish Planning and Zoning Director is responsible for contacting HMP Evaluation Committee members in January on an annual basis. Members have a one-month period in which to respond to or initiate a meeting if any one member feels that issues need to be addressed. However, should a hazard event occur and the need for update analysis surface, a meeting can be called by the Parish Planning and Zoning Director or requested by a committee member through the Parish Administration.

The Parish Planning and Zoning Director is also responsible for maintaining plan review comments. Members of the evaluation committee will monitor the plan on an ongoing basis using phone calls and emails to contact those responsible for implementing the plan's action items and bring the project status reports to the yearly evaluation meetings. Ideas to be discussed will include, but are not limited to, the following:

- Does the steering committee membership need to be updated?
- Have new hazard events occurred?
- Has new funding been allotted?
- Have projects been implemented?
- Have project priorities changed?
- Are there new projects to discuss?

In addition to the yearly evaluations, the questions listed above and additional considerations will be made during the formal update process to be completed and approved by FEMA within a five-year cycle. Updates to the Hazard Mitigation Plan will be made fully utilizing the representation of the HMP committee formed for this purpose. The Parish Planning and Zoning Director is also responsible for monitoring the progress of the action items and will report the status of the projects to the HMP Evaluation Committee yearly.

5.2 §201.6 (c)(4)(ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate

Members of parish departments who interact on planning issues, such as the Parish President, Parish Manager, Parish Director of Planning and Zoning, Parish OEP Director, and the Sheriff will review the relevance of the HMP's risks and vulnerabilities identified. They will also review the goals, objectives, and actions for mitigating the risks, and catalogue all said information for use in future HMP updates as well as other local planning mechanisms.

When appropriate, Parish Government, by way of the individuals who served on the HMPU Steering Committee and the HMP Evaluation Committee, will address the need to incorporate requirements of the mitigation plan into the respective zoning ordinances, comprehensive plans, and/or capital improvement plans if deemed necessary and if not previously included. An effort will be made by all HMPU Steering Committee members to ensure consistency in all future planning efforts with the mitigation goals and risk assessment presented in this plan. Consistency between all planning efforts will ensure a decrease in losses related to hazard events within future and existing developments. During the last five year update cycle, the former hazard mitigation plan's (2010) goals were incorporated into Goal 5 of *Vision 2030: Terrebonne's Plan for Its Future.* If amendments to existing ordinances or new ordinances are required, the Parish Council will be responsible for its respective updates.

5.3 §201.6 (c)(4)(iii) Discussion on how the community will continue public participation in the plan maintenance process

The Parish Planning and Zoning Director is responsible for coordinating continued public participation. Copies of the plan will be kept on file at the parish government office. Contained in the plan and presented in section (c)(4)(i) is a list members of the plan evaluation committee that can be contacted. In addition, copies of the plan and proposed changes will be posted on the parish government website. This website will also have an e-mail address and phone numbers to which the public can direct their comments or concerns. The local newspaper will also be notified if HMP issues arise.

6.0 PREREQUISITES—COPY OF FORMAL PLAN ADOPTION

6.1 §201.6 (c)(5) Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council). For multi-jurisdiction requesting approval of the plan must document that it has been formally adopted.

Documentation that the plan has been formally approved by the Terrebonne Parish Council is presented on the following page. Terrebonne Parish is a consolidated government with no independent incorporated municipalities.

Terrebonne Parish
Resolution