TERREBONNE PARISH, LOUISIANA

HAZARD MITIGATION PLAN

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

September 2014

Submitted to:

Terrebonne Parish Consolidated Government
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List of Attachments

Terrebonne Parish Hazard Mitigation Plan

This plan continues the process of updating the Terrebonne Parish Hazard Mitigation plan (HMP) to address the following: 1) reflect existing conditions with the natural, human, and built environments; 2) formalize revisions to risk assessments and mitigation strategies the lessons learned from hazard events that have occurred during the 2010 plan update; and 3) to make the parish more resilient to future hazards.

The planning pilot grant program was approved in 2007 to assist Louisiana parishes in completing Hazard Mitigation Plan Updates (HMPU) and Amendments. Terrebonne's original Hazard Mitigation Plan was approved in 2006 and the most recent update was adopted in 2010.

At the commencement of the 2015 HMPU process, the HMPU Committee identified four sections of the 2010 Terrebonne Parish Hazard Mitigation Plan that required updates. These targeted sections include the Planning Process, Risk Assessment, Mitigation Strategies, and Plan Maintenance.

The planning process update also includes the incorporation of new or updated plans and project lists. The Risk Assessment section includes updates to a table of National Oceanic and Atmospheric Administration (NOAA) recorded events and a new multi-jurisdictional risk assessment. Applicable attachments were added or updated. The goals to reduce or avoid long-term vulnerabilities to identified hazards were retained within Mitigation Strategies; however, the objectives and action items used to achieve the goals were updated.

The Plan Maintenance section was also updated to include procedures and issues to be addressed annually by a subcommittee of the HMPU committee. Public notifications of future meetings are also described in this section. The next plan update will occur within five years from the date that this HMPU is approved, as per FEMA regulations.

1.0 PREREQUISITES—COPY OF FORMAL PLAN ADOPTION

1.1 §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 governing authority of Terrebonne Parish is presented on the following page. Terrebonne Parish is a consolidated government with no independent incorporated municipalities.

Terrebonne Parish
Resolution

2.0 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

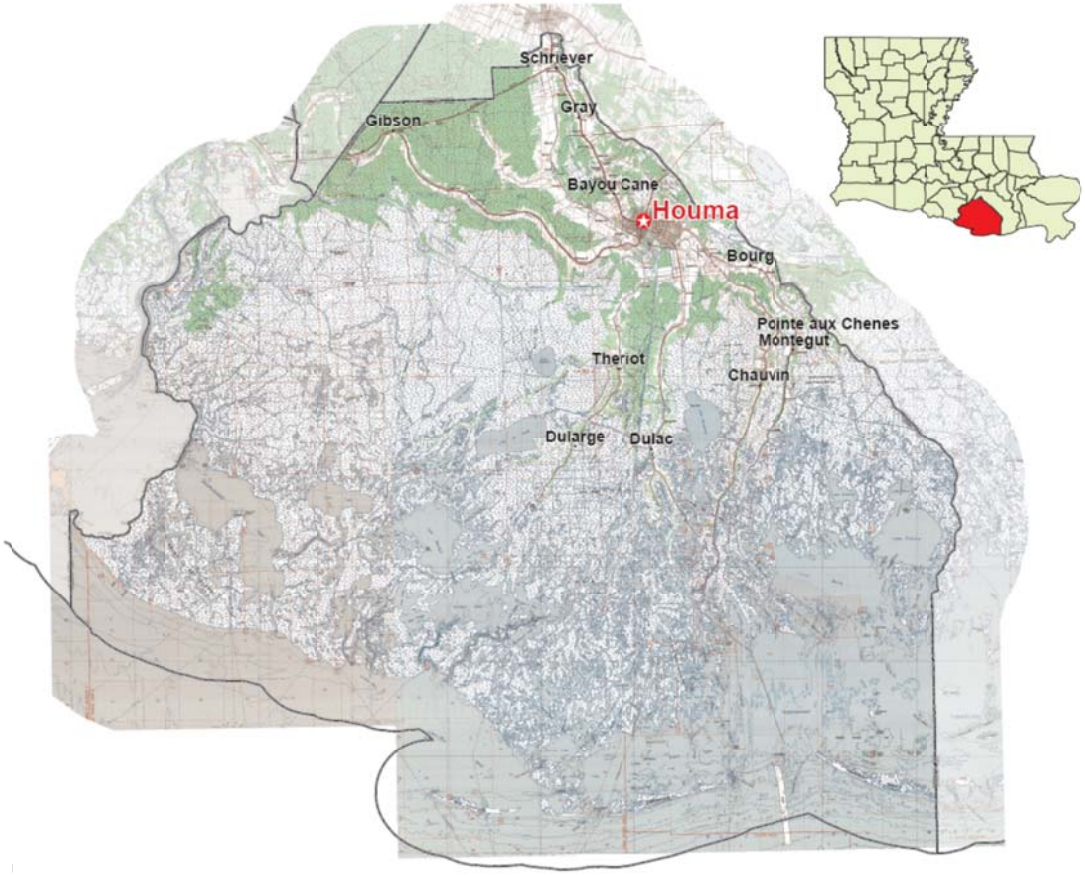
In 1984, Terrebonne Parish instituted a consolidated form of government. At that time, the governmental functions of the City of Houma (the sole municipality in the parish) were consolidated with the governmental functions of Terrebonne Parish. The formal name of the parish's government is the Terrebonne 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.

2.1 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).



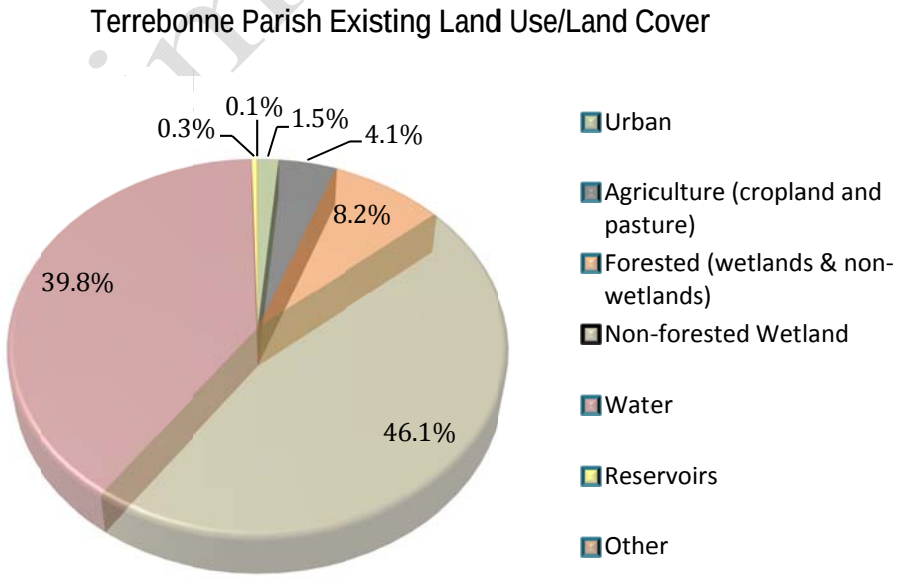
The Terrebonne Levee Conservation District is currently constructing reaches, of the Morganza to the Gulf system. The majority of the parish's existing levee system is comprised of a series of forced drainage levees (<6 feet above ground). The levee system is augmented with pump stations in the populated 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 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 IV).

2.2 Land Use

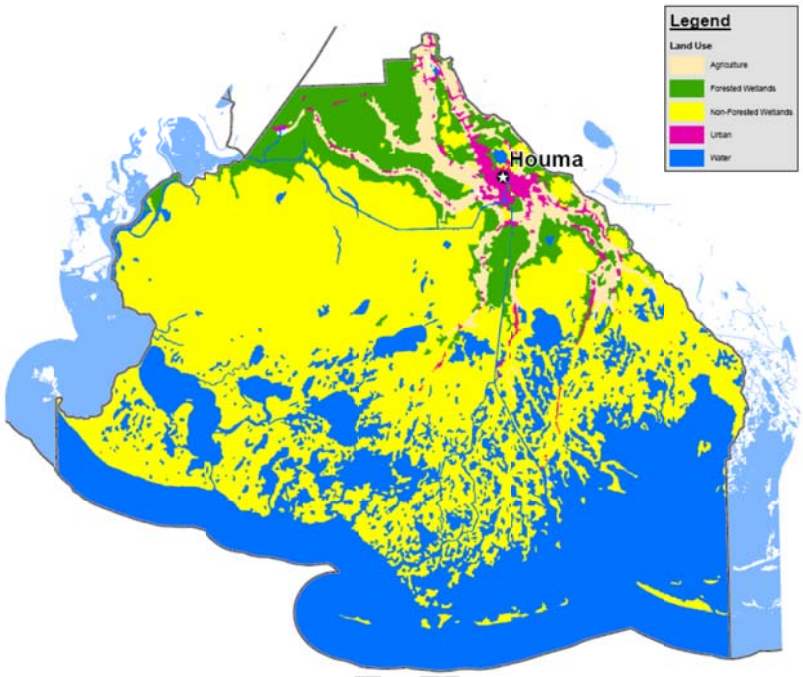
As a snapshot of the community, the following land use/land cover table and associated chart are provided. Based upon Environmental Protection Agency data, only 5.6% of the parish is urbanized and/or under cultivation. The remaining 94.6% of the 1,326,748 acre parish is forested, wetlands, or water.

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%**



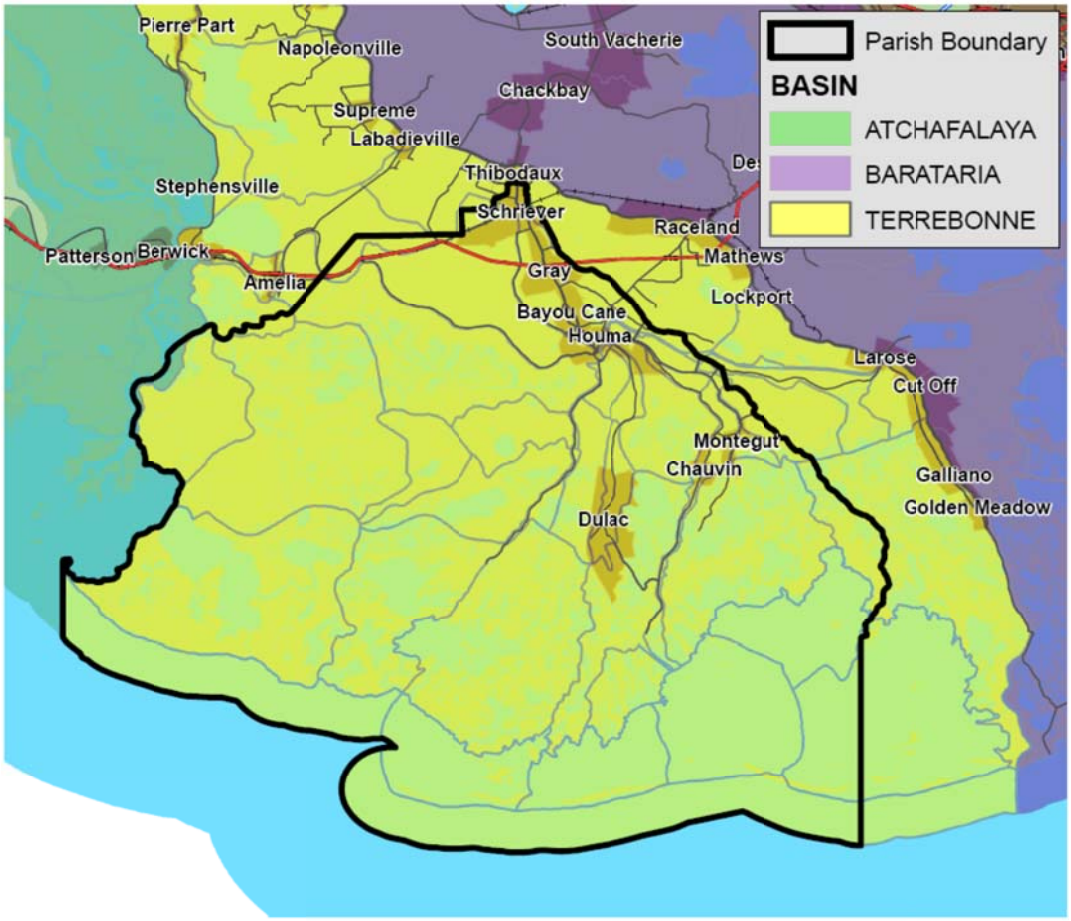
The geographic distribution of land use/land cover is illustrated on the following parish map. The 5.6% of the parish that is urbanized (pink) or under cultivation (tan) is concentrated in the north-central portion of the parish in the vicinity of Houma and the previously described ridges along major 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.

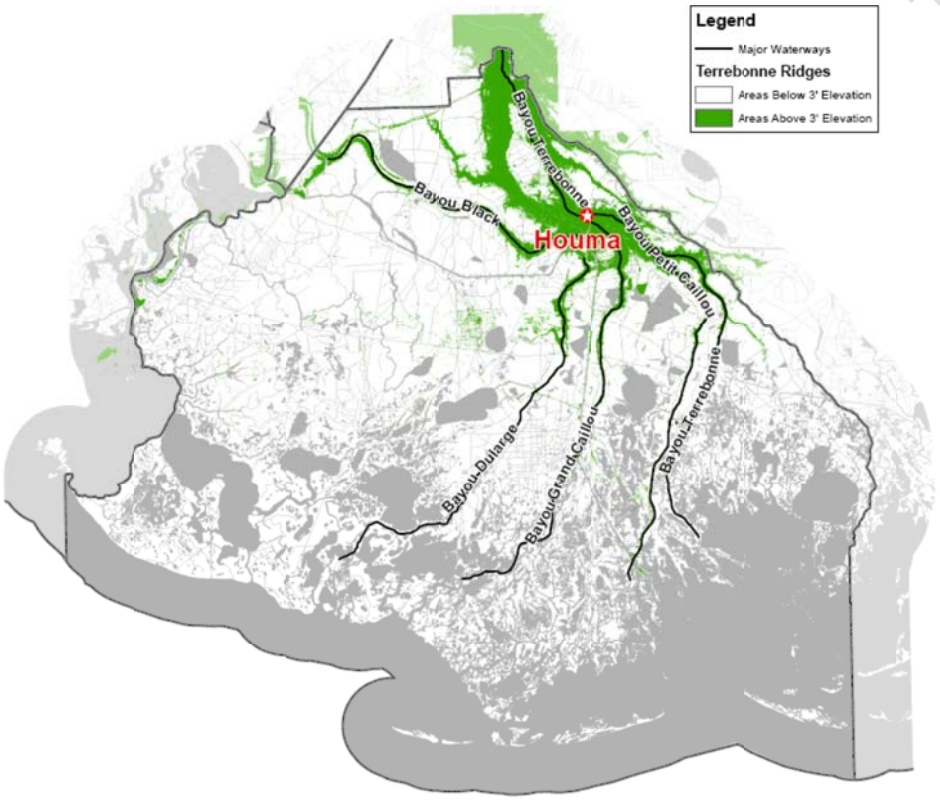
The parish is located at the southernmost reach of the Terrebonne drainage basin. The drainage basins within and in the immediate vicinity of Terrebonne Parish are identified in the following illustration.



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.



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. Nevertheless, coastal communities such as Terrebonne Parish must continue to plan and effectively mitigate the impacts of such land loss on storm protection.

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

The population of the parish was 104,503 in 2000 and grew seven percent by 2010 to

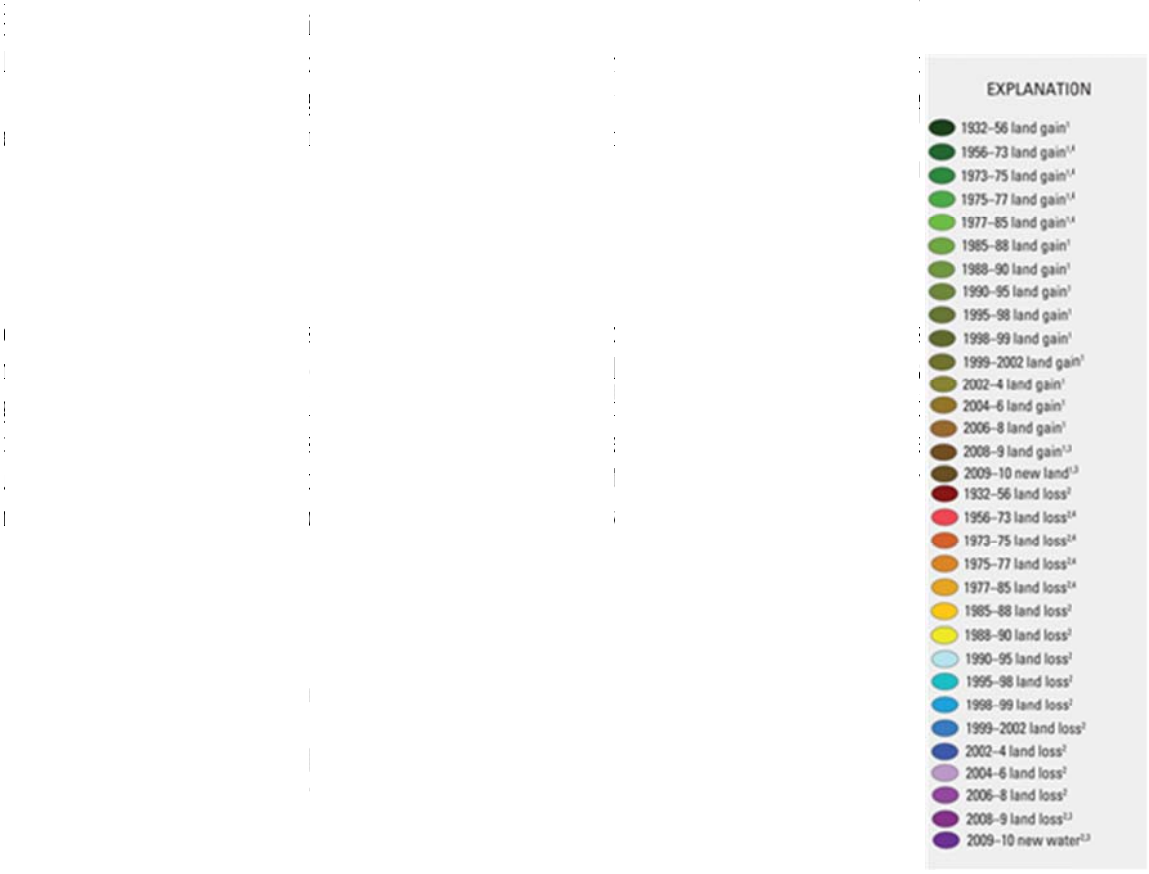


Table 2-2: Terrebonne Parish Employment by Industry Sector, 2012

2012 American Community Survey 5-Year Estimates		
Industry Sector	**Number**	**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%**

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.

3.0 §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:

3.1 §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) committee was formed. The HMPU committee was comprised of a diverse group of citizens and professionals from throughout the parish.

The primary mode of plan update participation included four HMPU committee meetings. Each HMPU 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 meeting. The HMPU committee meetings occurred on the following dates:

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

Supporting documentation (advertisements, attendance lists, agendas, PowerPoint presentations, etc.) related to the aforementioned meetings are included in Attachments c1-3.1A—c1-3.4D (page 1-67).

3.2 §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 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. Private and non-profit interests were also involved in the process as were business interests by way of committee participation. The HMPU committee member list is provided as attachment c1-1 (page 1-2).

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

3.3 §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 and studies was established in cooperation with parish officials and the HMPU committee. Plans that were initially identified included the following:

- Terrebonne Parish Comprehensive Master Plan, October 2003
- Terrebonne Parish – Vision 2030 Comprehensive Master Plan, February 2013
- Terrebonne Parish Hazard Mitigation Plan, 2004
- Terrebonne Parish Hazard Mitigation Plan Update, 2010
- Louisiana State Hazard Mitigation Plan, April 2014
- Coastal Wetlands Planning Protections & Restoration Act (CWPPRA), April 2006
- 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

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

4.0 §201.6 (c) PLAN CONTENT

4.1 §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.

4.1.1 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 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.

4.1.2 Who was involved in the process…

The HMPU committee served as the parish's primary representative body throughout the plan update. Goals of the HMPU 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 committee members is presented as Attachment c1-1 (page 1-2) in Section IV that follows this section. 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
- Water District
- Regulatory Planning Commission
- South Central Industrial Association

- 911 Communications
- Local Engineering Firms

4.1.3 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 committee. Over a five month period, the group met four times to collaborate on the plan's development. Input from the 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 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 prior to each HMPU committee meeting. Additionally, PowerPoint presentations and meeting notes were posted on the Parish website following all four meetings.

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 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 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. CB&I noted that Community Rating System (CRS) principles would be discussed throughout the planning process.

Goals and Critical Facilities were discussed. The 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 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 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 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 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.
- 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 (Forthcoming)

4.2 §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:

4.2.1 §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 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 committee, this section lists and describes potential hazard events that may impact the community.

During the HMPU committee kick-off meeting held on May 22, 2014 (meeting presentation as Attachment c1-3.1D), HMPU 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 committee comments. The HMPU 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	Tropical Storm

	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.	
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 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 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 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,	Saltwater Intrusion

	storm surge from past hurricanes has forced the parish to abandon certain intakes due to high salt concentrations. For this reason, the HMPU Committee agreed that saltwater intrusion should be recognized as a significant hazard within this HMPU.	
Land Subsidence	According to Terrebonne Parish's 2005 HMP, land subsidence is likely to occur in the region. However, the HMPU Committee felt that the issue is not of a magnitude to be addressed as a prevalent hazard for purposes 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 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 Committee concluded that addressing mitigation measures relative to tornados as a stand-alone hazard should not be considered	Tornadoes

	in this plan, but the tornado hazard will be profiled due to the high probability of occurrence.	
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 76) 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 committee members in Meeting No. 1and with consideration of the former HMP (2010).

4.2.2 §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.

4.2.2.1 *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.

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.

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

Terrebonne Parish Historical Flood Events 1957-2013

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	$0
5/22/2008	Flash Flood	$0
8/17/2008	Flash Flood	$0
3/27/2009	Flash Flood	$0
12/14/2009	Flash Flood	$0
7/18/2011	Flash Flood	$0
9/4/2011	Flash Flood	$25,000
3/23/2012	Flash Flood	$0
7/20/2012	Flash Flood	$10,000
2/12/1997	Flood	$0
9/10/1997	Flood	$0
9/12/1998	Storm Surge/Tide	$0
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	$0

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	$0
4/5/1997	Coastal Flood	$0
10/16/2006	Coastal Flood	$0
5/1/2010	Coastal Flood	$0
	Total	**$295,718,000**
Source: NCDC		

4.2.2.2 *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 90 through 96).

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).

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 Scale

Category	Wind speed mph (km/h)	Storm surge ft (m)
5	≥156 (≥250)	>18 (>5.5)
4	131–155 (210–249)	13–18 (4.0–5.5)
3	111–130 (178–209)	9–12 (2.7–3.7)
2	96–110 (154–177)	6–8 (1.8–2.4)
1	74–95 (119–153)	4–5 (1.2–1.5)
Additional classifications		
Tropical storm	39–73 (63–117)	0–3 (0–0.9)
Tropical depression	0–38 (0–62)	0 (0)

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 91).

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

Hurricane Andrew's Storm Track

Source: noaa.gov

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 92). The following graphic illustrates the magnitude of the storm's surge on Louisiana's central coastline.

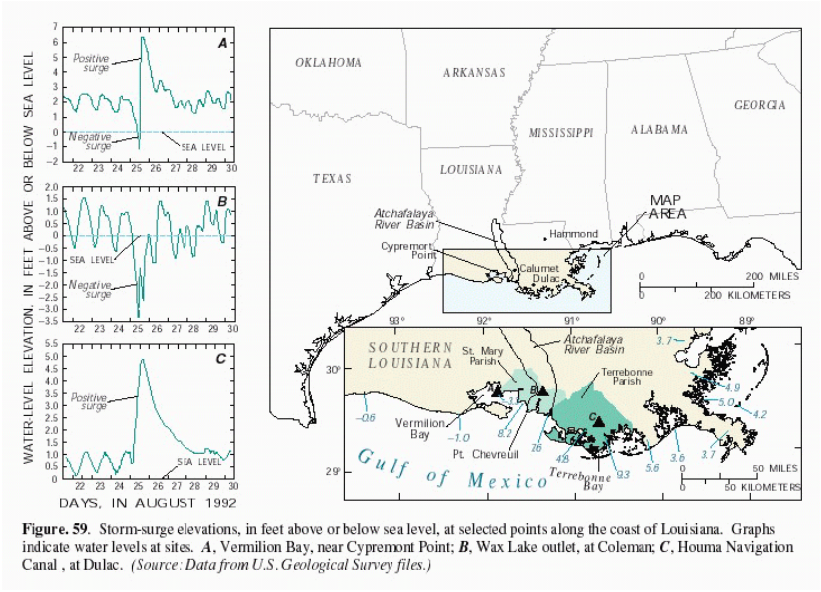
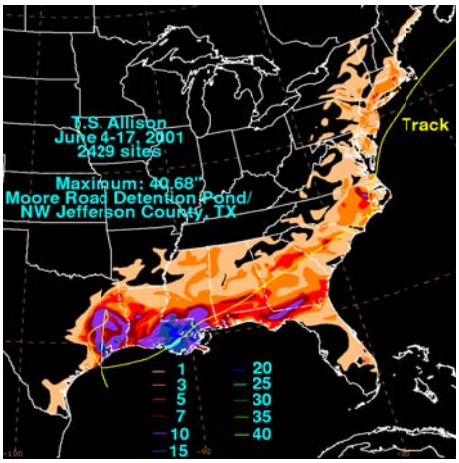


Figure. 59. Storm-surge elevations, in feet above or below sea level, at selected points along the coast of Louisiana. Graphs indicate water levels at sites. ***A***, Vermilion Bay, near Cypremont Point; ***B***, Wax Lake outlet, at Coleman; ***C***, Houma Navigation Canal , at Dulac. *(Source: Data 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 c2-19 (page 82).

Hurricane Lili (2002)

Hurricane Lili's Storm Track

Source: noaa.gov

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.

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 94) 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 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 Katrina's Storm Track

Source: noaa.gov

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

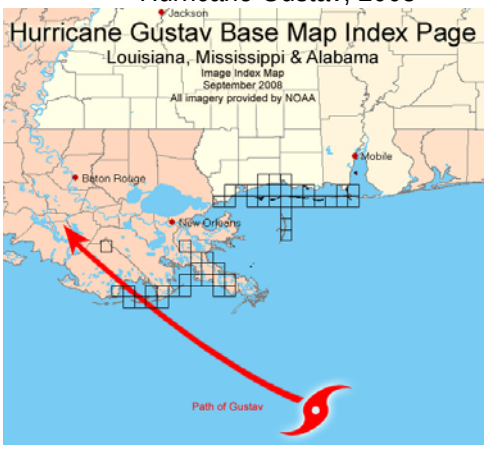
Hurricane Rita caused an estimated $10 billion in damages. Despite the fact that the eye of the storm made landfall approximately 190 miles west of the City of Houma, Hurricane Rita had a significant impact on Terrebonne Parish—much more than did Hurricane Katrina. The impact and damages were largely 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 c2-21 (page 84).

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.[1] Over two million people were evacuated from the region.

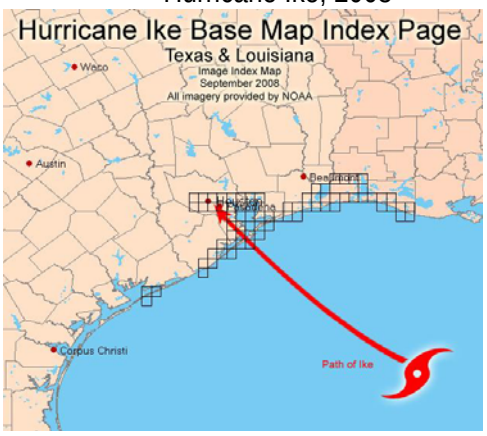
Hurricane Gustav, 2008



Source: noaa.gov

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 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.

Hurricane Ike, 2008



Source: noaa.gov

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.

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.

[1] 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.

The Mississippi River Flood of 2011 (April – May)

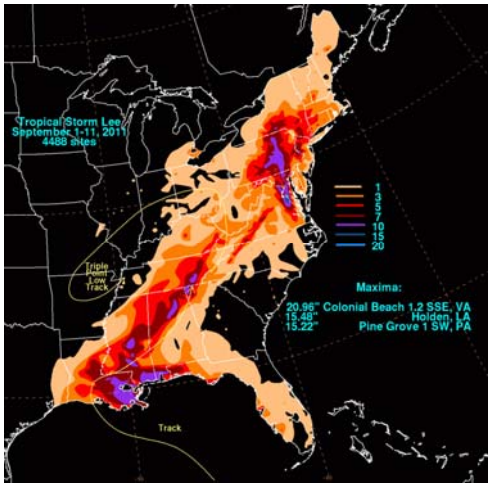
The combination of springtime snowmelt and rainfall resulting from multiple major storm systems between April 23 and May 2 made 2011 a record-setting year for flooding in the central United States.[2] For the Mississippi River, this caused the most intense river flooding recorded within the past century. 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.

Tropical Storm Lee Storm Track and Rainfall Data



Source: NOAA

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.

Hurricane Isaac, 2012

Source: noaa.gov

Hurricane Isaac Aug. 29, 2012

Hurricane Isaac was a Category 1 hurricane that made landfall in Plaquemines Parish on August 29, 2012.[3] 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.

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

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

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.

4.2.2.3 *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 87). 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.

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.

4.2.2.4 *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 76)

Source: Terrebonne Parish Department of Public Works

Pump Station D-58 in Coteau

Pump Station D-45 in Tiger Bayou

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 76.

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.

4.2.2.5 Tornadoes

As previously stated, HMPU 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**
F0	Gale (40-72 mph)	Light damage. Some damage to chimneys; break branches of trees; push over shallow rooted tress; damage to sign boards
F1	Moderate (73-112 mph)	Moderate damage. Peel surface off roofs; mobil homes pushed off foundations or overturned; moving autos pushed off roads.
F2	Significant (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	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.
F4	Devastating (207-260 mph)	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly though air in excess of 100 yards; trees debarked; incredible phenomena will occur.

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: http://www.fema.gov/hazards/tornadoes**

- 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	$0
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	$0
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	$0

1/2/1999	Tornado	F1	0	$700,000
3/15/2000	Tornado	F2	36	$10,000,000
8/31/2000	Tornado	F0	0	$0
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 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.

4.2.2.6 Land Subsidence

Land subsidence in Terrebonne Parish can be defined as the loss of surface elevation due to the loss of subsurface density. Subsidence in the developed areas of Terrebonne Parish has been measured to be an average of 1 foot of loss of elevation every 100 years and the probability of continued subsidence is 100%. 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.

Natural Causes

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 drier land. Parts of Louisiana's coastal evacuation routes are indeed vulnerable to storm flooding.

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.

Man-made Causes

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.

4.2.3 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 79) 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 78) 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 90 through 96) 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 104).

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 514 repetitive loss structures, 64 of which are on the FEMA Severe Repetitive Loss list. A Severe Repetitive Loss is defined as a residential property with at least four National Flood Insurance Program (NFIP) payments over $5,000 and the cumulative amount exceeds $20,000 or at least two separate claims payments have been made with the total payments exceeding the market value of the building (FEMA 2004). 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 98). Findings noted significant vulnerability throughout the inhabited areas of the parish.

The final Terrebonne Parish Risk Assessment Map is a composite of the four mapped data sets outlined above. Composite risk assessment maps are displayed as Attachments c2-26.1-4 (pages 99 through 103) at the end of this section.

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.

4.2.4 §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 of this section) 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 105-106). 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 hazard area.

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/Non-Profit

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 107 through 114). 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 Committee reviewed the list and made necessary revisions. Critical facility maps are displayed in Attachments c2-7 through c2-16 (pages 80 through 89) 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 due 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 115-120) at the end of this section.

Worksheet #4

Using the aforementioned critical facilities list, HAZUS replacement value data, GIS models, and input from the HMPU 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 were $288,190,959 for a hurricane flood event with $77,231,290 in structure use and function loss resulting from that event.

4.2.5 §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 Attachments c2-25 (page 98). Repetitive loss structures are also depicted on all risk assessment maps (Attachments c2-26 through c2-26.4). 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 repetitive loss structures (Residential Properties):** 493 total losses with a total average insurance pay of $35,694 per event.

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

Terrebonne Parish is continuously implementing mitigation strategies and actions that improve its CRS rating.

4.2.6 §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 scenarios are presented in the following table.

Scenario	Projection Span	Acres Consumed Per Span	Years 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% 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. 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 need for mitigation options in future land use decisions. At the municipal level, the City of Houma has existing zoning ordinances and corresponding maps that conform to FEMA guidelines. The parish will update their zoning ordinances if and when needed to ensure compliance to FEMA regulations. The parish also has adopted the International Building Codes (IBCs) and advisory base flood elevations (ABFEs) which dictate wind and flood related guidelines.

4.2.7 §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.
To assess these varying levels of risk, a summary table is provided below to establish the probability of occurrence of each hazard event within the parish.

5.0 §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.

5.1 §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 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.

5.2 §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.

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: Existing parish administration

    - **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: Existing parish administration

Action 1.2.2: *Install a hazard early warning system*

- Timeframe: 1-5 years, as funding permits
- Funding: HMGP, local, regional, and federal
- Staff: Existing Parish administration

- **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: Existing parish administration

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

Action 1.4.1: *Maintain dual potable water intakes*

- Timeframe: Ongoing
- Funding: Local
- Staff: Existing parish administration

Action 1.4.2: *Acquire bottled water in event of saltwater intrusion*

- Timeframe: As needed
- Funding: local, federal
- Staff: Existing parish administration

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: Existing parish administration

- **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: Existing parish administration

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: Existing parish administration

- **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: Existing Parish administration

- **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: Existing designated full-time personnel in public works department

    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: Existing designated full-time personnel in public works department

    Action 3.1.3: *Elevate or acquire all RL and SRL structures in Terrebonne Parish (see Attachment c2-25 on page 98)*

    - Timeframe: 1-10 years, as funding permits
    - Funding: HMGP
    - Staff: Existing parish administration

Action 3.1.4: Elevate equipment that is vulnerable to flood damage (see Attachment c3-1 for locations)

- Timeframe: 1-5 years, as funding permits
- Funding: HMGP
- Staff: Existing parish administration

Action 3.1.5: *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: Existing parish administration

Action 3.1.6: *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: Existing parish administration

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

  - **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: Parish administration

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: Parish administration

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: Parish administration

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: Parish administration

- **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: One current full-time member of the parish

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

- Timeframe: Ongoing
- Funding: No additional funds required
- Staff: Parish administrative staff

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: No additional funds required
- Staff: Parish administrative staff

Action 4.2.4: Establish homeowner education program on flood mitigation measures

- Timeframe: Ongoing
- Funding: No additional funds required
- Staff: Parish administrative staff

2015 HMPU Project List

The Terrebonne Parish Project List resulting from the 2015 HMPU is presented in Attachment c3-1 (pages 133-140). 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 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	Ongoing
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	Ongoing
11	Drainage Improvement – Coteau 1-1B Bar Screen Cleaner	Completed
12	Drainage Improvement – D-07 Smithridge Pump Station Bar Screen Cleaner	Completed
13	Drainage Improvement – D-3 Upper Montegut Bar Screen	Completed

	Cleaner	
14	Drainage Improvement – Island Road (Stabilize roadway shoulders and embankment)	Ongoing
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)	Ongoing
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 -- Coteau Fire Station (Natural Gas, includes change over switch to ensure response to emergency calls)	Completed
31	Generator -- Gov't Towers	Completed
32	Generator -- Houma Fire Department, Central Station (50KW)	Completed
33	Generator -- Houma Police Department Building (Cummings model GFGA 500 KW 120/208 Volt 3 phase, 60 hertz, 1800RPM NG set)	Completed
34	Generator -- North Terrebonne Treatment Plant	Completed
35	Generator -- OEP 911 (60KW)	Completed
36	Generator -- Pollution Control Portable Unit Trailer Mounted	Ongoing

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

The following table displays 13 projects that have been added to the ongoing Terrebonne Parish HMPU project list.

Terrebonne 2015 HMPU Project List Additions			
	Project Description	**HMPG Eligible**	**Prioritization**
1	Safe House -- EOC	Potentially	Funded
2	Communications -- Community Alert System (First Call), Reverse 911, Community Hotline, Alert FM, Redundant Phone System at EOC	Potentially	N/A Completed
3	Emergency Preparedness -- Gauge installation at pump stations near major roadways and at bridges/floodgates	No	High Priority
4	Communications -- Additional Communications Tower for office	No	High Priority
5	Emergency Preparedness -- Purchase of Drone for Damage Assessment	No	Low Priority
6	Emergency Preparedness -- Evacuation Sign Purchase and Placement	No	High Priority
7	100 Amp, 3-way SS Disconnects for generator ready connections (approx. 40 Lift station sites)	Potentially	High Priority
8	Replacement of wooden lift station fence/gates with chain link to mitigate wind damage	Potentially	High Priority
9	150 KW generators for Mire, Idlewild, and Elysian Lift Stations	5%	High Priority
10	Scada telemetry, The automation of Forced drainage Pump Stations To reduce response time and flooding.	5%	High Priority
11	Wind Retrofit -- Houma Water Treatment Facility	Potentially	High Priority
12	Wind Retrofit -- Schriever Water Treatment Facility	Potentially	High Priority
13	Wind Retrofit -- Waterworks Office Complex at 8814 Main Street, Houma, LA	Potentially	High Priority

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

HMPU 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 committee input. It should be noted that projects were extracted from Attachment c3-1 (pages 133-140). Only those projects that are potentially eligible for Hazard Mitigation Grant Program funding were prioritized

Parish Priority Projects List		
Q1. Elevations of Critical Facilities (65%)		
	Project Description	**HMPG Eligible**
1	Elevation -- Bayou Dularge Tank building and chlorination equipment	Potentially
2	Elevation -- Fire Station (raise 2', history of flooding, 75'x75' Slab) (1466 Hwy 665)	Potentially
3	Elevation -- Fire Station in Chauvin	Potentially
4	Elevation -- Grand Caillou Tank building	Potentially
5	Elevation -- Industrial Blvd from Van Ave to Pump Station	Potentially
6	Elevation -- Leachate Removal System	Potentially
7	Elevation -- Lower Dulac Tank building and chlorination equipment	Potentially
8	Elevation -- Montegut Station (100'x75')	Potentially
9	Elevation -- Pointe-Aux Chenes Pump Station building and electrical pump, regulating valve and meter	Potentially

10	Elevation -- Robinson Canal P.S. Building, electrical pump, regulating valve and meter	Potentially
11	Elevation -- South Terrebonne Pump Station building and pump	Potentially
12	Elevation -- Texaco Master Meter Building, regulating valve and meter	Potentially
13	Elevation -- West Gibson Tank building and chlorination equipment	Potentially
14	Elevation of Pump Station Roads -- D-19, D-12, and D-5 Pumps	Potentially
15	Elevation to ABFE -- D-02 Gear Drives, Motors, and Controls	Potentially
16	Elevation to ABFE -- D-02 Gear Drives, Motors, and Controls	Potentially
17	Elevation to ABFE -- D-04 Gear Drives, Motors, and Controls	Potentially
18	Elevation to ABFE -- D-06 Gear Drives, Motors, and Controls	Potentially
19	Elevation to ABFE -- D-11 Gear Drives, Motors, and Controls	Potentially
20	Elevation to ABFE -- D-15 Gear Drives, Motors, and Controls	Potentially
21	Elevation to ABFE -- D-21 Gear Drives, Motors, and Controls	Potentially
22	Elevation to ABFE -- D-36 Gear Drives, Motors, and Controls	Potentially
23	Elevation to ABFE -- D-37 Gear Drives, Motors, and Controls	Potentially
24	Elevation to ABFE -- D-40 Gear Drives, Motors, and Controls	Potentially
25	Elevation to ABFE -- D-42 Gear Drives, Motors, and Controls	Potentially
26	Elevation to ABFE -- D-43 Gear Drives, Motors, and Controls	Potentially
27	Elevation to ABFE -- D-44 Gear Drives, Motors, and Controls	Potentially
28	Elevation to ABFE -- D-46 Gear Drives, Motors, and Controls	Potentially
29	Elevation to ABFE -- D-47 Gear Drives, Motors, and Controls	Potentially
30	Elevation to ABFE -- D-48 Gear Drives, Motors, and Controls	Potentially
31	Elevation to ABFE -- D-49 Gear Drives, Motors, and Controls	Potentially
32	Elevation to ABFE -- D-50 Gear Drives, Motors, and Controls	Potentially

33	Elevation to ABFE -- D-51 Gear Drives, Motors, and Controls	Potentially
34	Elevation to ABFE -- D-53 Gear Drives, Motors, and Controls	Potentially
35	Elevation to ABFE -- D-54 Gear Drives, Motors, and Controls	Potentially
36	Elevation to ABFE -- D-56 Gear Drives, Motors, and Controls	Potentially
37	Elevation to ABFE -- D-59 Gear Drives, Motors, and Controls	Potentially
38	Elevation to ABFE -- D-60 Gear Drives, Motors, and Controls	Potentially
39	Elevation to ABFE -- D-61 Gear Drives, Motors, and Controls	Potentially
40	Elevation to ABFE -- D-62 Gear Drives, Motors, and Controls	Potentially
41	Elevation to ABFE -- D-65 Gear Drives, Motors, and Controls	Potentially
42	Elevation to ABFE -- D-69 Gear Drives, Motors, and Controls	Potentially
43	Wind Retrofit and Elevation -- Houma Plant 3 (Install shutters or impact resistant glass on windows, strengthen doors, raise pumps and electrical panels)	Potentially
44	Wind Retrofit and Elevation -- Houma Plant High Service pumps and electrical panels, strengthen door	Potentially
45	Wind Retrofit and Elevation -- Lafort Canal RW PS (elevate pumps and generator, strengthen door)	Potentially
46	Wind Retrofit and Elevation -- Munson PS (Elevate Building, electrical pumps, regulating valves and meters, Install Shutters on windows, strengthen the doors)	Potentially
47	Wind Retrofit and Elevation -- Schriever Plant (install shutters or impact resistant glass on windows, strengthen doors, elevate pumps)	Potentially
48	Wind Retrofit and Elevation -- Williams Street Pump Station (elevate pumps and electrical panels, strengthen door)	Potentially
Q1. Residential Elevations (30%)		
All Repetitive Loss Properties		
Q1. Commercial Elevations (5%)		
From Repetitive Loss List		

Q2. Generators for First Responders + Generators for Pump Stations (70%)		
1	Generator -- Montegut, Pointe Aux Chenes Fire Stations (need 40-50 KW -- $15,000)	Potentially
2	Generator -- 100KW for W. Woodlawn Station	Potentially
3	Generator -- Pollution Control, S. Treatment Plant Perimeter Drainage Pump Station (100 KW)	Potentially
4	Generator -- Port Commission Forced Drainage (50 KW)	Potentially
5	100 Amp, 3-way SS Disconnects for generator ready connections (approx. 40 Lift station sites)	Potentially
6	Connect Station to emergency generator – Munson PS	Potentially
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	Potentially
2	Generator -- Lift Stations Receiving Effluent from Hospitals, Terrebonne General Medical Center (50 KW)	Potentially
3	Generator -- Lift Stations Receiving Effluent from Hospitals, Chabert Medical Center (50 KW)	Potentially
4	Generator -- Major Lift Stations, Douglas (50 KW)	Potentially
5	Generator -- Major Lift Stations, Mire (75 KW)	Potentially
6	Generator -- Major Lift Stations, Westside (50 KW)	Potentially
7	Generator -- Major Lift Stations, Westview (100 KW)	Potentially
8	Generators -- Lift Stations Receiving Effluent from Hospitals, Valhi II (125 KW)	Potentially
Q2. Generators for Schools (5%)		
No Sites Noted		
Q3. Pump Station Upgrades (59%)		
1	Drainage Improvement -- Industrial Pump D-13 Trash Screen and Bar Screen Cleaner	Potentially
2	Drainage Improvement -- D-20 Schriever Pump Station Bar Screen Cleaner	Potentially
3	Drainage Improvement -- Pump Station Telemetry	Potentially

4	Scada telemetry, The automation of Forced drainage Pump Stations To reduce response time and flooding.	Potentially
Q3. Existing Culvert or Ditch Upgrades (35%)		
1	Drainage Improvement –Bellaire Drive (Increase culvert sizes and slope ditches)	Potentially
2	Drainage Improvement – Martin Luther King Blvd. (Increase culvert size in pump canal under highway in bonanza system)	Potentially
3	Drainage Improvement – Oak Forest Street (Increase culvert sizes and pump station)	Potentially
4	Drainage Improvement – Royce Street (Increase culvert size to stop rainfall flooding)	Potentially
Q3. Installation of new Drainage Ditches/Culverts where non currently exists (6%)		
No Sites Noted		
Q4. Elevation of Evacuation Routes with Flood History + Elevation of First Responders Structures (84%)		
1	Elevation of Local Evacuation Route -- 1 Mile Section of LA 56 in Chauvin, LA (Ward 7 Evacuation Routes)	Potentially
2	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)	Potentially
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 -- Bourg Fire Station, 2 Bay Doors (22'x10', 14'x10') and 3 Windows (36"x36")	Potentially
2	Wind Retrofit -- Coteau Fire Station (include main structure, apparatus room, generator room doors)	Potentially
3	Wind Retrofit -- Fire Stations (central, #2, #3, #4) Shutters	Potentially
4	Wind Retrofit -- Gulf States LTAC	Potentially
5	Wind Retrofit -- Montague, Pointe Aux Chenes Fire Stations (5 Windows at 1466 Hwy 665, 6 Windows at 407 Island Rd, 6 Windows at 1746 Hwy 55)	Potentially
6	Wind Retrofit -- Morgue	Potentially
7	Safe House -- EOC (2101 East Houma Drive)	Potentially
8	Safe Room – Coteau Fire Station	Potentially
9	Wind Retrofit --Bourg Fire Station, 2 Bay	Potentially

	Doors (22'x10', 14'x10') and 3 windows (35"x36")	
10	Wind Retrofit – Coteau Fire Station (include main structure, apparatus room, generator room doors)	Potentially
11	Wind Retrofit -- Fire Stations (central, #2, #3, #4) Shutters	Potentially
Q5. Wind Hardening for Utilities (18%)		
1	Wind Retrofit -- Houma Water Treatment Facility	Potentially
2	Wind Retrofit -- Schriever Water Treatment Facility	Potentially
3	Wind Retrofit -- Bac-T Lab at Schriever Water Treatment Facility (install shutters or impact resistant glass on windows, strengthen doors)	Potentially
Q5. Wind Hardening for Schools (12%)		
1	Wind Retrofit -- Evergreen Junior High	Potentially
2	Wind Retrofit -- Headstart Center	Potentially
3	Wind Retrofit -- Houma Junior High	Potentially
4	Wind Retrofit -- Houma Municipal Auditorium	Potentially
5	Wind Retrofit -- Legion Park Middle	Potentially
6	Wind Retrofit -- South Terrebonne High School	Potentially
7	Wind Retrofit -- Southdown Elementary	Potentially
8	Wind Retrofit -- Terrebonne High School	Potentially
Q5. Wind Hardening for Other Government Structures (0%)		
1	Wind Retrofit -- Bob Jones Building (Cat 4 or 5)	Potentially
2	Wind Retrofit -- Buquet Bridge and Klondyke Bridge Tender's Buildings (Cat 3)	Potentially
3	Wind Retrofit -- Director's Building (Cat 3)	Potentially
4	Wind Retrofit -- Drainage Building (Cat 3)	Potentially
5	Wind Retrofit -- Garage Doors (407 Island)	Potentially
6	Wind Retrofit -- Gulf States LTAC	Potentially
7	Wind Retrofit -- Mail Library	Potentially
8	Wind Retrofit -- Main Office (Install shutters or impact resistant glass on windows, strengthen doors)	Potentially
9	Wind Retrofit -- Sludge Press Building (strengthen doors)	Potentially
10	Wind Retrofit -- Morgue	Potentially
11	Wind Retrofit -- Waterworks Office Complex at 8814 Main Street, Houma, LA	Potentially

Q6. Stabilization or rebuilding barrier islands (82%)
Q6. Acquire and demolish structures in at risk area (18%)
Q6. Inform community of risks (0%)
Q7. Natural Buffer Restoration
Q7. Zoning/Subdivision Regulations + Local utilities outside high risk areas + Additional freeboard requirement (21%)
No Applicable Projects
Q8. Generators for Potable Water Facilities (65%)
All locations currently without generators.
Q8. Study to Identify Baseline Risk (24%)
Q8. Zoning/Subdivision Regulations (12%)

5.3 §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.

6.0 §201.6 (c)(4) PLAN MAINTENANCE PROCEDURES

A plan maintenance process that includes:

6.1 §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 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.

6.2 §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 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 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.

6.3 §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.