

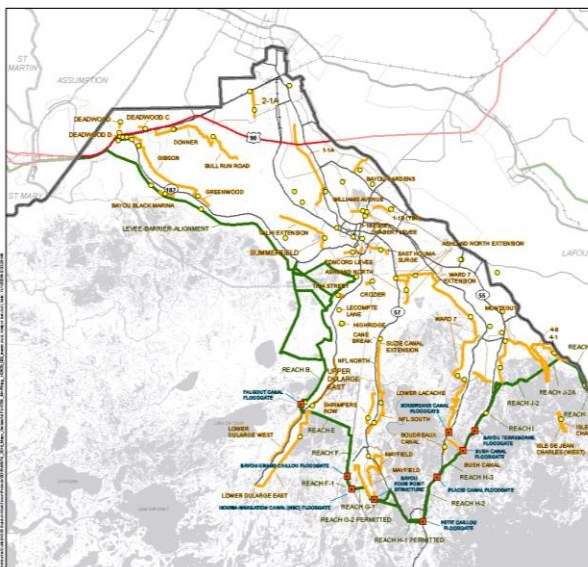
TERREBONNE PARISH HAZARD MITIGATION PLAN UPDATE 2020

Final June 16, 2020



Terrebonne Parish Consolidated Government
8026 W. Main Street
Houma, Louisiana 70360
985-868-5050

Parish President, Gordon E. Dove
Prepared by: Jennifer C. Gerbasi



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EXECUTIVE SUMMARY

Terrebonne Parish, Louisiana

Hazard Mitigation Plan Update 2020

INTRODUCTION

This Hazard Mitigation Plan Update is the third such plan in 15 years. The last update development was completed in 2015 with the last maintenance update in 2018. The parish has completed the first lift of 70 miles of the Morganza to the Gulf (MTTG) footprint, and dozens of projects to reduce the risk of flooding or wind damage. The levees are not built to the height required to be federally accredited, but provides protection for storms less than the 100-year event projected. The Parish benefitted from the flexibility of not only Federal Emergency Management Agency (FEMA) funds, but Community Development Block Grant (CDBG) funds from the U.S. Department of Housing and Urban Development (HUD) as well. The agencies have complementary goals and preferred projects which allowed the Parish to implement many of the priorities that had been identified in the meetings held right before the storm. Located directly on the Gulf of Mexico, the projected risks from hurricanes persists as well as relative sea level rise, and subsidence in the forced drainage areas. The focus of this plan moving forward embraces what has been learned over the last five (5) years and aims to educate the general public about the lessons learned and corrections made, and prepare to be resilient in the face of future foreseeable events.

Since 2015, Terrebonne Parish implemented 53 projects specifically listed in the Hazard Mitigation Plan Update (HMPU) 2015. Advances were from across the spectrum of activities from increased power redundancy, wind risk reduction, local implementation of levees to protect the lower reaches of the Parish, floodgates on every major bayou, and the funding of new pump stations and channels and the design of a lock system to augment the floodgates. A complete list of the HMP accomplishments in the last five years is included on pages 22-26. Each project completed or ongoing has resulted in an incremental reduction in risk of damages, from flood and wind in particular. The levee and floodgate systems are complemented by internal forced drainage levees, terraces, and pump stations directing fresh or brackish water into the marshes and lakes as appropriate. Essential government services and buildings have been moved from the special flood hazard area or, if the facility must function in place, many structures have been hardened and supplied with alternative power sources to facilitate continuous function or expedited recovery after an evacuation/event.

Several steps have been taken to revise and streamline the Flood Damage Prevention Ordinance (FDPO) to maximize all areas of the Community Ratings System. While the parish lost a rating class in the restructuring of the 2013 guidance, it has increased the resilience of mobile homes, banned hazardous waste storage in the special flood hazard area (SFHA), and has identified over 4,000 acres that will be dedicated to open space. The Parish also coordinated the FDPO with the plumbing code when that code is more conservative than the National Flood Insurance Program (NFIP) base flood elevation.

THE PROCESS

The process undertaken to update this plan followed the eight (8) steps required in Section 510 of the Community Ratings System Coordinators Manual (September 2013) and other planning guidance to engage the public and thereby reduce risk through engagement.

Through the HMPU process, the Parish HMPU Steering Committee engaged members of the public, neighboring parishes, and statewide stakeholders to develop a consensus of priorities. A list of the invited or participating entities is available at Attachment c4-2. While the implementation of the plan is highly dependent on funding sources and storm events, the HMPU will serve as a resource in all Parish planning, response, and recovery activities.

Step 1 - Organize

The Parish has embarked on multiple lines of defense as a strategy to reduce risk through various mechanisms including levees, nonstructural elevation projects, wind hardening projects and other infrastructure hardening projects. The Parish has increased the focus on the resilience of the government to provide services, businesses to get back to work timely, and residents to return to safe homes. We have also focused on the promotion of the Multi-jurisdictional Program for Public Information adopted formally in 2015 and updated in 2018. Since there has not been a major, generalized storm loss since 2008, we have had to work persistently to create messages that resonate with the public and communicate both risk and resilience.

Recognizing the importance of mitigation to every department and division in the Parish, all were invited to participate in the planning process and every department committed at least one individual to participate in the meetings. The planning department was the best represented from the parish government due to the mandate to enforce building codes, land use, floodplain, as well as the subdivision and stormwater management regulations, and to implement the Comprehensive, Hazard Mitigation, and the Long Term Recovery Plans. The Office of Emergency Preparedness assisted from the beginning offering their new, relocated category 5 rated state of the art facility just in front of the new Federal Emergency Management Agency (FEMA) funded a safe room that will support over 200 parish, regional and federal first responders during and after an event. The Utilities Department, the Department of Coastal Restoration and Preservation directors provided feedback as did several divisions of the Public Works Department. The Terrebonne Economic Development Authority and the Assessor's Office also participated and provided background data critical to our community profile (see Attachment c4-8). Last year, the parish directors and steering committee reviewed the past activities completed and underway and identified new or pressing future projects. These were adopted by the council and some have been accomplished in the year following. This was opened up for further scrutiny or additions in the public Steering Committee meetings held during business hours and general public evening meetings. This was a gratifying process, but was a reminder that there is still much more to be done to make the Parish safer and more resilient.

Step 2 - Involve the Public

The Parish Council adopted the Steering Committee and proposed process by resolution 19-382. A current council member participated in public meetings thereafter. The Steering Committee was comprised of members from the private and public sectors. This year, we had extensive input from the Terrebonne Levee and Conservation District, multiple engineering firms, the State Mitigation Planning Team, banking representatives, the South Central Industrial Association (SCIA), real estate and homebuilder representatives, public safety, South Central Planning and Development Commission, and the medical community. This group was established prior to the first meeting and committed to up to six (6) meetings. These members represented a broad spectrum of interests including industries, tribes, nonprofits, academia and public safety. Each brought their perspective and interests to the table providing a range of expertise. As this was the second plan for some participants, the discussions were candid and productive.

The general public was invited to participate through multimedia invitations, some of which are captured in the attachments relevant to each meeting (samples captured in Attachment c4-5). The public was invited to all five Steering Committee meetings and two standalone public meetings in the evening. Members of the media were invited to observe or participate, and the process earned coverage in newsprint along with the Bayou Black Area Analysis (Houma Courier). The press and members of the public did participate in those daytime meetings. The Parish emailed interested parties including the press, published each meeting in the newspaper, posted each on the Community Calendar, placed an invitation on the website banner, and hung notices on every bulletin board in the Government Tower. The Parish invited the tribes, hospitals, 9-1-1 service, the North Lafourche Levee District (NLLD), the Council on Aging, and Good Earth Transit to meet separately to allow for an indepth onsite tour of facilities and the subsequent development or improvement of goals and objectives or projects from each. These recommendations were reviewed by the Steering Committee and the public in meetings and/or the draft comment period.

The Parish has been included in the LA SAFE listening tours as well as local planning efforts, and elections and therefore may have contended with some meeting exhaustion. The Isle de Jean Charles resettlement process and the efforts of three local tribes to be federally recognized has limited the ability of the tribal members to fully engage, but they have come to meetings and provided input.

The Parish undertook a targeted repetitive loss study in three neighborhoods in the Bayou Black area, and meetings were in that area in the evening to encourage participation. Residents came out to discuss their flooding issues, and the projects the parish is designing or building to improve the persistent ground flooding. The presentations and draft report are included in Attachment c3-2.

Step 3 - Coordinate

In order to prepare for the kickoff of this planning process, the Parish provided copies of a set of relevant plans on the website for all to access and emailed the core documents for all Steering Committee members. This year we included the HMP from Lafourche Parish, the Flood Response Plan from OEP, the LA SAFE Terrebonne Parish Adaptation Strategy, and two sources to support a discussion of the Building Resilient Infrastructure

and Communities initiatives sponsored by both the Federal Emergency Management Agency (FEMA) and the Federal Department of Housing and Urban Development (HUD). The Parish coordinator forecasted discussion of the sufficiency of the extensive levee and floodgate system that was not in place in the last plan update, and opportunities to support revisions to subdivision regulations, stormwater regulations, or the flood ordinance if members thought it prudent to maintain our advances in resilience and broader funding mechanisms. The committee and public were invited to submit other plans that might affect future risk. The deliberations included the review of these earlier plans, studies, and the list of projects completed or not since the last update to reduce risks of hazards and several presentations outlining the progress of the last five years and the State Hazard Mitigation Plan were accepted as relevant to the past plan review and future risk assessment and strategy development.

The content and sufficiency of the plans was discussed during multiple meetings. In reviewing the Goals and Objectives, the Steering Committee requested a fifth goal, and a change to Goal 2. The new goal was to set or study the efficacy of a single design standard for the parish rather than having different standards for roads and culverts than the buildings that they are connecting or protecting. The goal was to focus more on public education and ownership rather than awareness.

Local tribes were invited to submit their response and recovery plans for either discussion or as addendums to the plan, but they were not provided. We did receive response and recovery input from energy sectors, and hospitals. Materials provided by these entities are listed in the resources list found in Attachment c4-4.

Step 4 - Assess the Hazard

Due to the long history of natural disasters in Terrebonne Parish, a broad range of hazards are always a consideration in planning, building, regulations, and discussions of future investment. The 2015 Hazard Mitigation Plan Update reviewed the history through 2019, but in truth, Terrebonne Parish has not had a significant event since Hurricane Ike. Terrebonne has been steadily building defenses to the storms, but has been spared from significant or widespread damage from Hurricane Isaac in 2012, Tropical Storm Lee in 2014, or the 2016 or 2017 storms. The Parish did not have the luxury of creating a new HAZUS prediction model in this update. Rather, the (CPRA), the Administration, our consultant engineers and the (TLCD) presented the work that has been accomplished since the last major disasters, and the projects and initiatives that are planned, and we reviewed the performance of those installations in Hurricane Barry and other events. Three structures in Terrebonne Parish reported inhouse flooding from Hurricane Barry.

The HAZUS model compiles the inundation maps of all of the national presidential disaster declared storms in Terrebonne Parish to estimate the level of risks from the composite flood hazard. However, as the coast has changed with the addition of a levee system at 12' above sea level, the rehabilitation of barrier islands, the reduced saltwater intrusion as a result of the floodgates, running the model without the revised topography was deemed to be pointless.

All hazards were discussed and then revisited in later meetings. After accepting that the levee, floodgate, pump station and lock systems are maturing reducing the threat of saltwater intrusion, and will be raised towards the 100 year level as funding is available,

the Steering Committee elected to focus on other areas where they thought that more progress could be made. This discussion resulted in the suggestion for several subcommittees. The subcommittees that were considered focused on:

- Sea Level Rise;
- Subsidence;
- Flooding from the Atchafalaya (riverine/backwater);
- Resilient Transportation through Debris Management; and
- The Effect of Extreme heat and cold on vulnerable populations.

These hazards, alone or in combination, were considered to be the most critical to discuss as the manner in which they are governed could make a significant difference in future resilience. Two groups committed to meet independently and the outcomes of these discussions and proposed revisions to the Goals and Objectives is captured on p. 107. Transportation and heat were noted but not pursued as a subcommittee topic.

Step 5 - Assess the Problem

The planning process provided an opportunity to review the accomplishments of the past, the new or postponed challenges of today and in the future. In some cases, the residual risk requires more of the same approaches. In other cases, the activity itself created a need for more action, whether that would be a change in development practices or education. For example, the Parish has increased the forced drainage areas and the pumping capacity such that it may if unbalanced from water infiltration exacerbate subsidence which is already present in this deltaic region. Public education was also identified as an area for improvement. The levee and lock system, the pump systems, the new evacuation routes, and the varied design standards are not perceived to be broadly understood by professionals or the general public. A broader discussion of gaps in the multiples lines of defense is provided in the risk assessment.

Step 6 - Set Goals

The goals of the Parish remain broad as the threats and risks are great, but the renewed interested in public education and a homogenous design standard were captured in the goals without objection by the Steering Committee or the public. While there is some level of predictability in coastal areas, for example, that there will be another hurricane, the trajectory and strength of the event can't be forecast. Therefore, the goals remained broad and were considered representative of the overarching Parish perception of the risks and risk reduction options.

The objectives were updated to recognize the progress in some areas that moved the objective from development or implementation into the public education arena. Other objectives capture areas of interest identified by the subcommittees.

Step 7 - Review Possible Activities

The possible activities discussion was broadened this year to include the even lifelines in the Building Resilient Infrastructure and Communities (BRIC) program that will be available in 2020 replacing the FEMA Predisaster Mitigation (PDM) program. To some

degree, this is similar to the whole community approach that the parish has worked to achieve through the multiple layers of defense, but the potential for mitigation funding for equipment for public safety providers, or capacity building in any number of areas was discussed at length. Several entities in response and recovery were interested in communications in particular. The Steering Committee, tribes, and nongovernmental organizations (NGOs), the departments and the general public were encouraged to provide project ideas and link them to the hazard that they would reduce. These were discussed considering the criteria from the Zurich Flood Resilience Alliance Approach and ranked for priority and are captured in Attachments c4-6 and c4-9. Attachment c4-9 is a survey of the preferences between various structural and nonstructural project types showing that even though we discussed moving beyond levees, betterments to the levee system and coastal restoration are still top priorities. Analyzing the results, the levee system ranked the top priority from 50% of the respondents with coastal restoration considered the top priority by 20% of the responses. Levee systems ranked in the top 4 priorities 80% of the time with Coastal Restoration and Barrier Islands in the top 4 50% of the time, Elevations 40%, and Locks and Bayou Shoreline protection, 30% each. Ranked by feasibility, levees and communications were thought most feasible with transportation second and individual mitigation efforts third. Barrier Island restoration ranked as the least feasible regardless of our successful projects in recent years. The cost reasonableness was considered roughly through the suggested equations in the National Hazard Mitigation Saves 2018 Interim Report. Regardless of the topic, education was central to all activities reviewed. Ongoing efforts were applauded, but in most instances, increased education was identified as a necessary component of any resulting plan. Several of the newly proposed projects are related to improved outreach regarding preparation for storm season, immediate response, recovery, and general risk management decisions at the government, business, and individual scale. Committee members and business interests stressed the need for increased education and enforcement of existing regulations.

Section 8 - Draft and Action Plan

The Steering Committee and participants discussed the priorities of the Parish and the feasibility of certain actions throughout the process. In the draft plan, a rough grouping was given allow a discussion on goals reached through multiple avenues and stimulate conversation about priorities without the minutiae of competing, discrete projects. The outcome of the priory projects, the approximated cost where available; feasibility and the responsible party are provided in a chart form. This process, like all input, was provided in meetings and could be captured through the online web form. This feedback tool could capture up to 8MB of attachments per entry. This enabled people who couldn't attend to provide robust and complete documentation of their suggestions. All comments were considered and are captured in Section 5 starting on page 118.

The draft action plan was made available for the Steering Committee and the public for review and comments and the later draft presented for adoption by the council. See Attachment c4-7 for reviewers at the Parish Government Tower. Steering Committee members have volunteered to serve on the maintenance committee and will follow the process set out in section 5 on page 118 along with the Parish and other agency personnel.

1.0 INTRODUCTION AND PARISH BACKGROUND

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

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

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

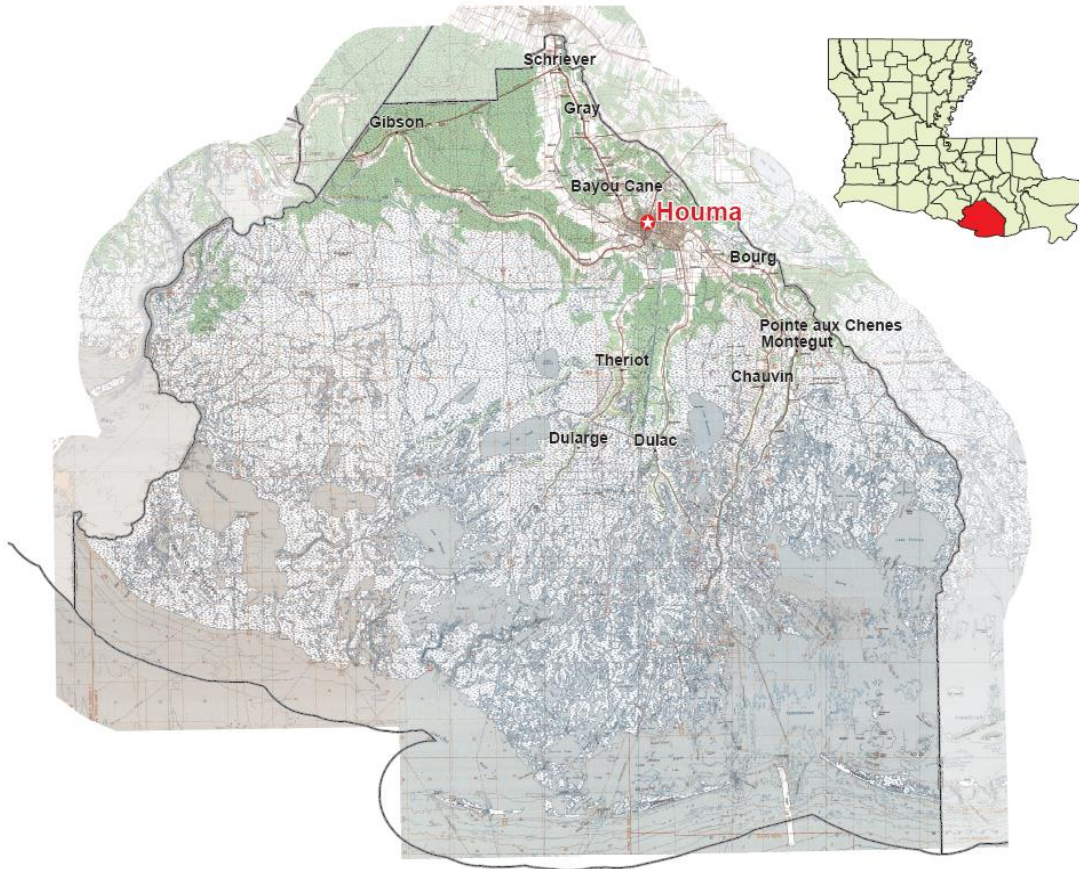
The parish has the right, power, and authority to pass all ordinances requisite or necessary to promote, protect and preserve the general welfare, safety, health, peace and good order of the parish, including, but not by way of limitation, the right, power and authority to pass ordinances on all subject 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, Pointe aux Chenes, Dulac, Schriever, Dularge, Theriot, and Gibson/Bayou Black.

1.1 Geographic Setting

Terrebonne Parish is situated in southeast Louisiana along the state's Gulf of Mexico coastline. The parish includes approximately 2,100 square miles and is the second largest

parish in Louisiana regarding land area. Greater than 85% of the parish area is water and wetlands. Lafourche Parish is to the east, St. Mary Parish is westward, and Assumption Parish is located north of Terrebonne. The map below shows communities in Terrebonne Parish, its position in the state, and its large expanse of water and wetlands (light blue and gray).



The Terrebonne Levee Conservation has constructed the first lift of 62 of the 70 miles of the Morganza to the Gulf (MTTG) system in Terrebonne Parish. Partners in neighboring Lafourche Parish have constructed another eight (8) miles, which also provides protection to Terrebonne. This outer levee is supplemented with redundant protection from the internal levee system is comprised of a series of forced drainage levees and flood gates. The levee system is augmented with pump stations in the populated portions of the parish to drain storm water and minimize flooding. According to the Terrebonne Parish needs assessment provided via the Louisiana Speaks Long-Term Community Planning website (www.louisianaspeaks-parishplans.org), all levees in the parish located south of the Intracoastal Canal, and with a crown height lower than 10 feet, were compromised during Hurricane Rita in 2005. The parish has responded by adding to the system or raising existing levees to 12 feet. This is not yet protection for a 100 year storm, but is greater than any storm surge that has been recorded in Terrebonne. The updated layout of all drainage districts, including levees and pump stations, is presented in the risk assessment section of this HMPU (Section III). In the past four years, the Parish has added 18 new

pump stations, automated management of 31 pump stations, and installed 21 backup generators on pump stations. More complete lists of the government structures and infrastructure within this geographical area are in attachments c2-29-30 and c3-4.

1.2 Land Use

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

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

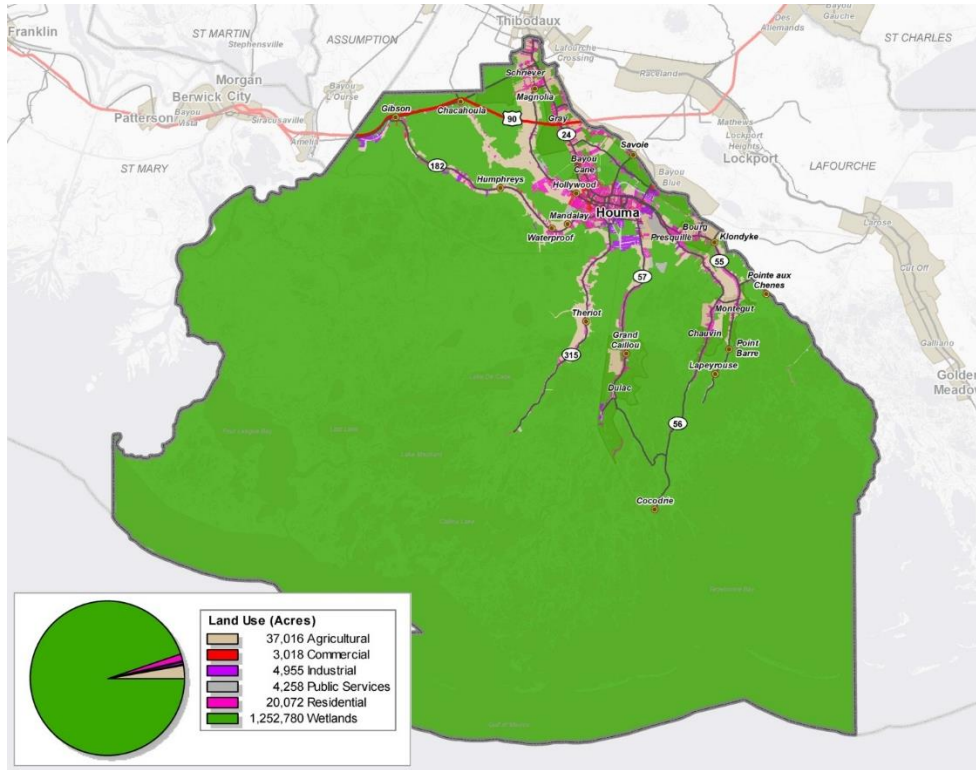
Description	Acres	%
Agricultural	37,016	2.8%
Commercial	3,018	0.2%
Industrial	4,955	0.4%
Public Services	4,258	0.3%
Residential	20,072	1.5%
Wetlands	1,252,780	94.8%
Total	1,322,099	100.0%

The geographic distribution of land use/land cover is illustrated on the parish map. Portions of the parish that are residential, industrial or commercial are 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:

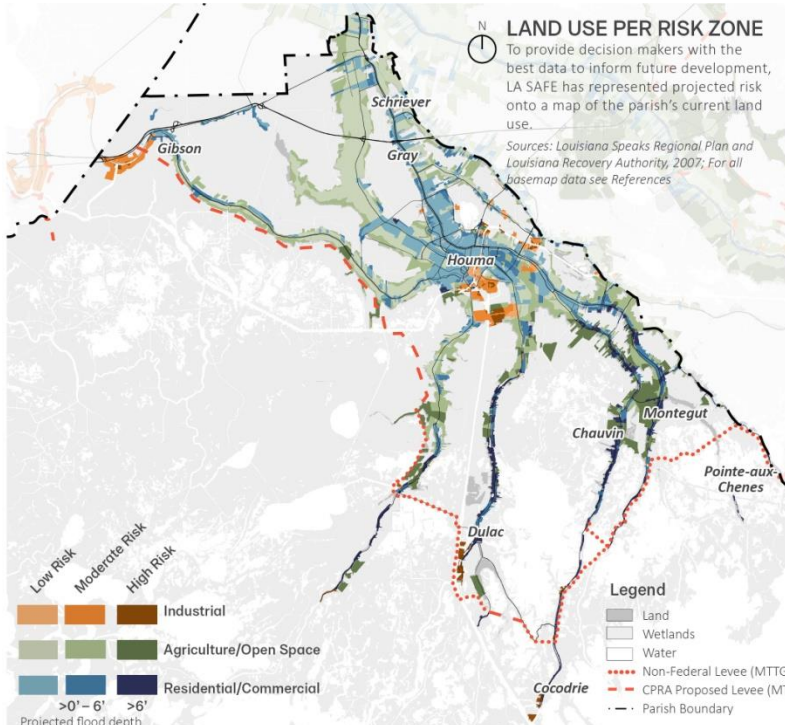
“About 3,500 years ago, the Mississippi River shifted west again, this time running south along the course of Bayou Lafourche. Many remnants of the distributary streams of the Lafourche delta remain as part of the landscape south of Thibodaux. The Lafourche delta grew between 3,500 and 400 years ago, 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.”

Terrebonne Parish Existing Land Use/Land Cover Map



Source: TPCG

During the LA SAFE meetings, three scenarios were developed based on the perceived risks to the community. The resulting overlay is below.



Low Risk: Minimal storm surge flood risk projected and outside the current 100 year floodplain.

Moderate Risk: >0-6' projected storm surge depths or in the 100 year floodplain (SFHA)

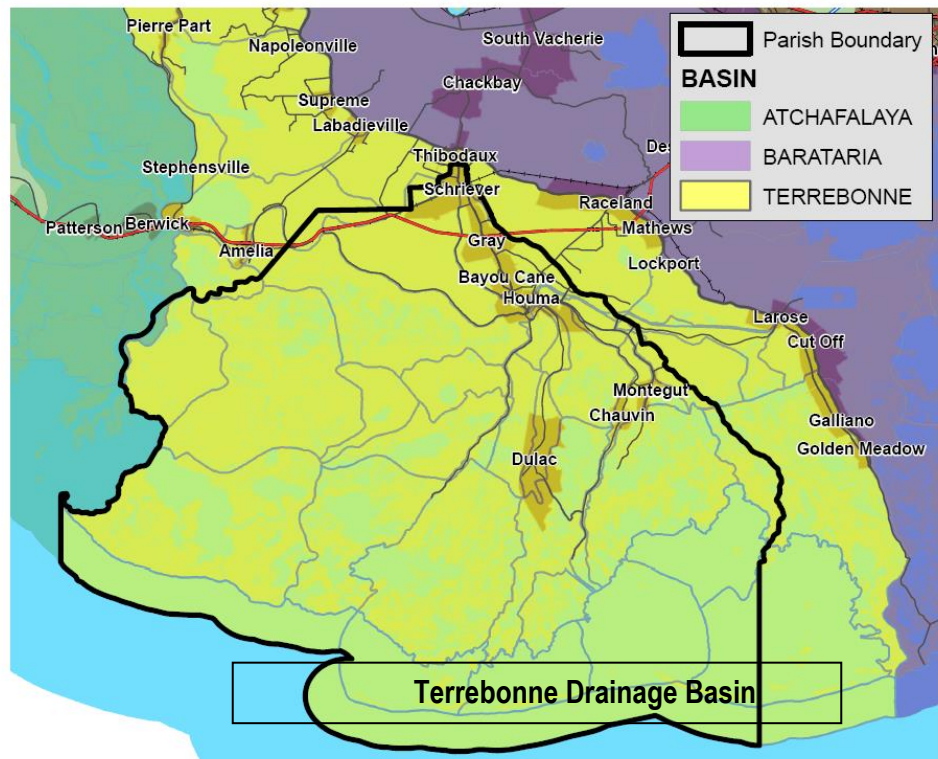
High Risk: >6' projected storm surge flood depths

Sources: CPRA Flood Risk Medium Scenario Modeling Data 2017 ; FEMA Preliminary DFIRM 100-year floodplain data for Terrebonne Parish 2008.

Most of the growth in the Parish over the last five years has been in the low risk areas.

Current Development Patterns Source: LA SAFE Terrebonne Parish Adaptation Strategy

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 illustration to the right.

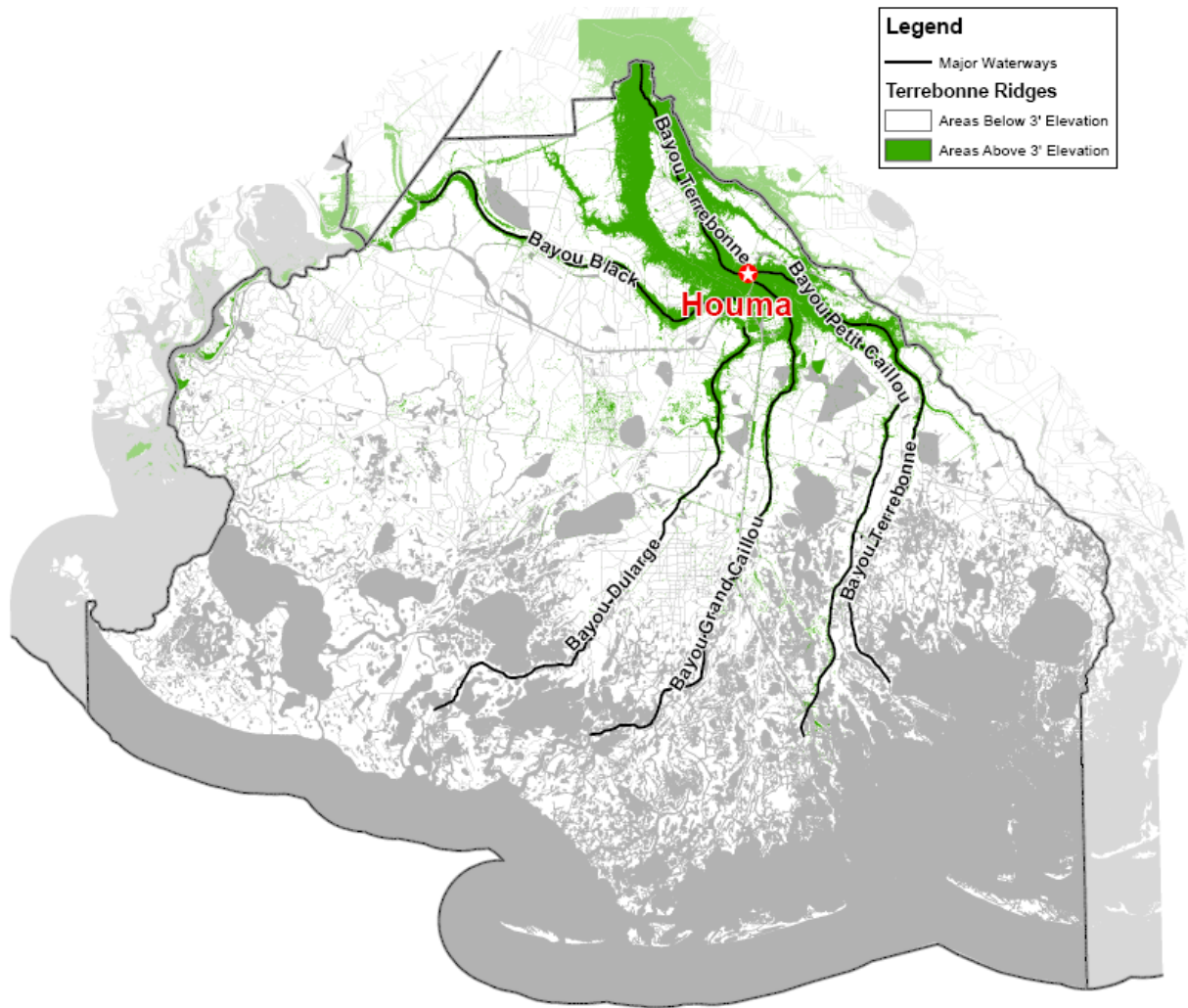


A combination of its deltaic creation, its Mexico, and a historical concentration of oil and gas exploration activities (construction of man-made access canals) is responsible for greater than 85% of the parish's total acreage being represented by either water or wetlands. Generally, from north to south, the wetlands include fresh marsh, intermediate brackish marsh, and salt marsh near the coastline. 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
- Houma Navigation Channel
- Intracoastal Waterway

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 on the following page depicts the ridges that form the bulk of non-flooding urban and agricultural land in the parish.



Land Loss: An Ongoing Threat

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

Terrebonne Basin Persistent Land Loss 1932-2010

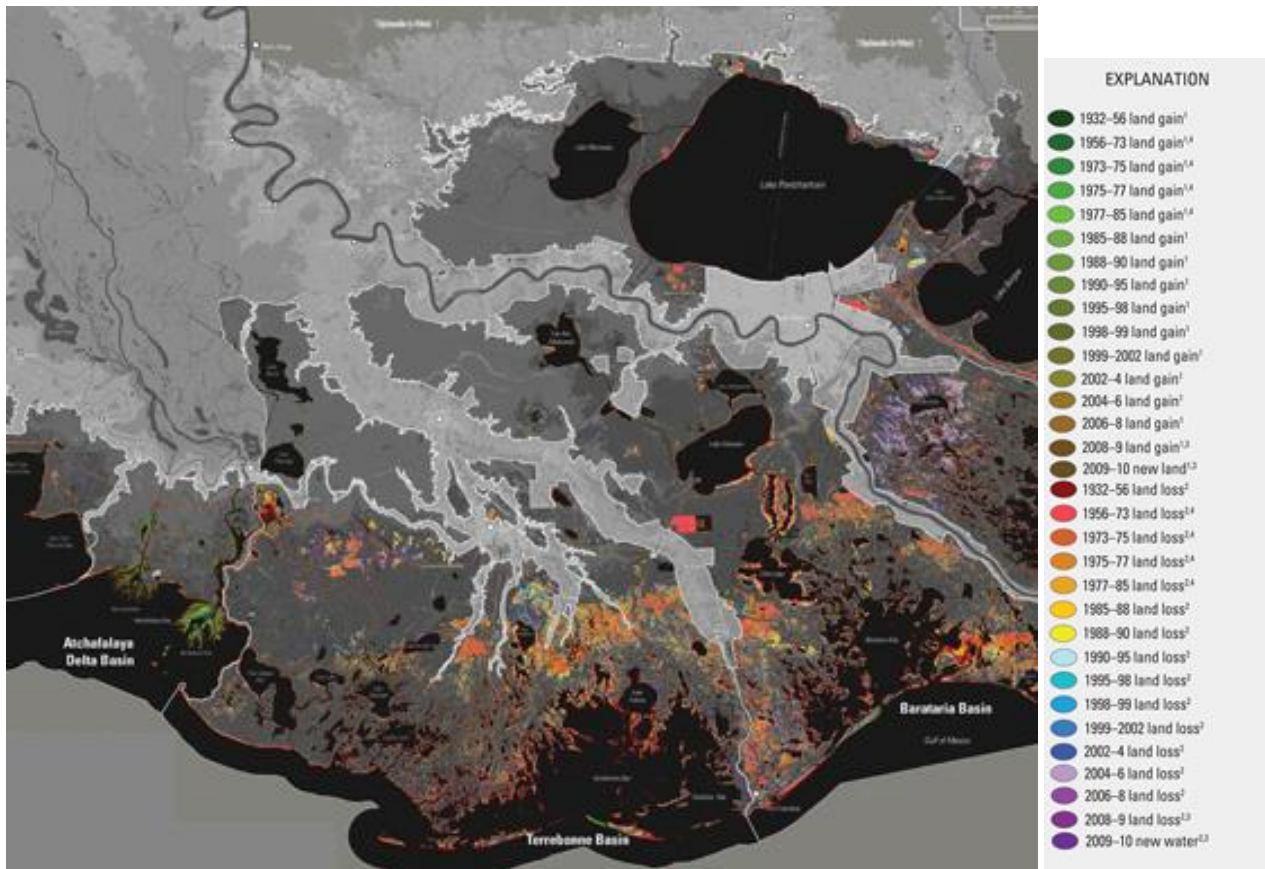
The figure below details wetland loss along coastal Louisiana, showing persistent land loss and land gain along the Terrebonne Basin. It can be observed in the figure that between 1932 and 2010 Terrebonne Basin lost land at a faster rate than it was replaced. Though USGS cites hurricanes and extreme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

USGS Coastal & Marine Geology Program report released on July 12, 2017, Louisiana U.S. Geological Survey scientists have recently found a further slowing since 2010. USGS suggested that the lack of major hurricanes since 2008 likely contributed to the stability of the land in the last eleven years.

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



1.4 Economy

The population of the parish was 111,860 in 2010 and fell 4 percent by 2019, to 111,021 according the U.S. Census Bureau in July 2019. Fourteen percent of the population is over the age of 65 and approximately 25% are under 18 years of age. The population is distributed such that the heaviest concentration of people and most urbanized area is in Houma.

According to 2017 U.S. Census Bureau data, the parish’s top four primary industry sectors based on employment include (1) educational services, and health care, and social assistance; (2) retail trade, (3) agriculture, forestry, fishing and hunting, and mining; and (4) Arts, entertainment, and recreation, and accommodation and food services. These sectors represent over 50 percent of the parish’s total employment (populations 16 years and older) of 47,254 in 2017. The following table provides a summary of the overall economy based upon employment.

Table 2-2: Terrebonne Parish Employment by Industry Sector, 2017

Subject	Terrebonne Parish, Louisiana	
	Total	%
	Estimate	Estimate
Civilian employed population 16 years and over	47,254	100%
Educational services, and health care and social assistance	8,900	19%
Retail trade	6,549	14%
Agriculture, forestry, fishing and hunting, and mining	5,465	12%
Arts, entertainment, and recreation, and accommodation and food services	4,757	10%
Construction	3,869	8%
Manufacturing	3,613	8%
Professional, scientific, and management, and administrative and waste management services	3,341	7%
Transportation and warehousing, and utilities	3,164	7%
Other services, except public administration	2,400	5%
Finance and insurance, and real estate and rental and leasing	1,735	4%
Public administration	1,707	4%
Wholesale trade	1,214	3%
Information	540	1%

* Population 16 years and over in the labor force

Regarding annual payroll by industry, Healthcare and Social Assistance (\$317,865), Manufacturing (\$238,839), Mining, Quarrying, and Oil and Gas Extraction (\$186,908), and Construction (\$182,944) generate the four largest payrolls in Terrebonne.

	Number of Establishments	Annual Payroll (\$1,000)
Health care and social assistance	275	317,865
Manufacturing	128	238,839
Mining, quarrying, and oil and gas extraction	86	186,908
Construction	199	182,944
Retail trade	471	177,979
Transportation and warehousing	144	177,547
Professional, scientific, and technical services	253	140,057
Wholesale trade	219	128,564
Administrative and support and waste management and remediation services	116	110,370
Real estate and rental and leasing	156	104,293
Other services (except public administration)	200	100,752
Accommodation and food services	249	78,880
Finance and insurance	187	63,338
Management of companies and enterprises	13	21,368
Information	35	16,221
Educational services	31	11,083
Utilities	3	6,375
Arts, entertainment, and recreation	36	5,788
Agriculture, forestry, fishing and hunting	21	1,459
Total for all sectors	2,823	\$2,070,634

This data is provided by the Census Bureau and the ACS 5-year Estimates from 2017 and 2019. The majority of firms within the parish employ between one and five employees.

2.0 §201.6 (b) THE PLANNING PROCESS

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

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

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

Five public meetings were held with the Steering Committee, each publicized inviting the general public. Summaries of these public meetings are presented below and a listing of attendees is presented in the attachments associated with the meetings. Two additional meetings were held in the evening to encourage participation of those who could not come during the day. A press release and multimedia posting announced the availability of the draft in addition to direct emails to people or organizations recognized as stakeholders.

The draft plan was provided to the Steering Committee via email and online for the public. All documents, materials, presentations and drafts were available for review in paper at the Government Tower from 8-4:30.

2.2 §201.6 (b)(2) *An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as business, academia and other private nonprofit interests to be involved in the planning process*

Local and regional agencies were directly involved in the planning process by way of their participation on the HMPU Steering Committee. These parties included the parish planning and zoning director, the parish director of emergency preparedness, and key operations personnel from the Public Works divisions of the parish. Business interests, nonprofit and academic institutions such as the Terrebonne Parish School Board, Sea Grants, and Tribes with interests in multiple parishes were also represented on the committee. Additionally, the real estate industry, developers, the South Central Industrial Association, the banking industry, Engineering firms, and the Southeast Louisiana Homebuilders Association served on the committee or participated as stakeholders. The complete HMPU Steering Committee member list is provided as Attachment c1-1.

A number of other agencies and businesses were invited to participate in the plan or, if not possible, to provide data or recommendations. These include, but are not limited to Entergy, SLECA, the Louisiana Department of Natural Resources, the Natural Resources Conservation Service Regional Office, FEMA Region VI, the Louisiana Department of Health and the Council on Aging. A list of partners and outreach efforts is available in Attachment c4-2.

The Parish also met with the North Lafourche Levee District to understand their recent mitigation efforts, and the relation to residual risks in Terrebonne Parish. As a neighbor to the north and along the entire eastern border of the Parish, their partnership is key to our resilience. Other conversations with Assumption and St. Mary Parishes in particular were pursued at the Louisiana Watershed Initiative meeting as we considered projects of regional significance.

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

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

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

- Comprehensive Master Plan Vision 2030
- Terrebonne Parish Hazard Mitigation Plan Update 2009
- Hazard Mitigation Plan Update 2014 - Adopted
- Louisiana Coastal Master Plan 2017
- Hazard Mitigation Plan Revised December 2005
- LA SAFE Terrebonne Parish Adaptation Strategy.
- Terrebonne Parish Stormwater Drainage & Design Manual
 - Status of Projects from March 2015/New Proposed Projects 2018
- Louisiana State Hazard Mitigation Plan, April 2019
- Roberta Grove – Senator Circle Repetitive Loss Area Analysis – June 25, 2013
- Roberta Grove – Senator Circle Repetitive Loss Area Analysis – April 2016
- Roberta Grove – Senator Circle Repetitive Loss Area Analysis 2019 Evaluation
- Bayou Cane Repetitive Loss Area Analysis – November 2015
- Bayou Cane Repetitive Loss Area Analysis 2019 Evaluation
- Lafourche Parish Hazard Mitigation Plan Update
- HNC Lock Complex Presentation – April 25, 2016
- National Flood Insurance Program Community Rating System Link
- How to Build a Hazard Mitigation Plan
- Fiscal State of Terrebonne Parish – Gordon Dove, September 12, 2019

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

Examples of technical information reviewed and incorporated into the HMPU include historical flood data from FEMA, documented high water marks from the U. S. Army Corps of Engineers, and light detection and ranging (LIDAR) elevation data from the U.S. Geological Survey. The State of Louisiana developed published the State Hazard Mitigation Plan Update in 2019, which provided data on the risks to Terrebonne Parish from various hazards. FEMA is currently processing the final comments from the parish submitted for the Levee Assessment and Mapping Procedures (LAMP) revisions to the 2008 Digital Flood Insurance Rate Maps. The current Flood Insurance Study and adopted maps are from the 2006 Advisory Base Flood Elevation maps. The parish worked with the LAMP consultants to obtain the digital elevation model (DEM) files to run HAZUS models based on accurate topography, but the two efforts were not compatible enough for portability of the files. When this data is available, the Parish will run the HAZUS and other available models and revisit the risk assessment and mitigation strategies as warranted. Project prioritization in particular may be informed by an accurate HAZUS output. The participants in the plan were also provided the *Fortified Home Re-Roofing Checklist for High Winds and Hurricanes* to retrofit and increase wind resilience and recommendations of higher standards to avoid multiple hazards.

The Steering Committee focused to large extent on assessing the projects completed in the last five years, presentations by the Coastal Protection and Restoration Authority (CPRA) and the Terrebonne Levee and Conservation District (TLCD), input from the Department of Public Works and Department of Planning, and discussions of recent events such as Hurricane Barry and Tropical Depression Olga October 25, 2019. These wind and rain events were recent and estimates are that they may cost the Parish over \$2M in preparation costs and damage repairs. The last major hurricane was in 2008. Smaller storms have tested the new levee and pump systems or informed what the Parish could do to reduce risk, but did not cause widespread damage. The Steering Committee considered the list of all completed and proposed projects inventories in the 2018 maintenance update of the plan. In addition, the Planning Department executed a Bayou Black Area Analysis to supplement the repetitive loss strategy. At least 20 members of the public attended the first meeting November 12, 2019.



Oneil Marlborough explains the pump stations.
Source: Houma Courier

The final draft analysis is in attachment c3-2. The second meeting was completed virtually by necessity due to the pandemic and the final completed.

The parish was fortunate to have also Louisiana's Strategic Adaptations for Future Environments (LA SAFE) input. The Parish, many of the Steering Committee staff, and hundreds of residents participated in a yearlong process of identifying the risks and strategies for resilience and economic stability appropriate for Terrebonne Parish from the community perspective, and strategies and projects to affect that adaptation to new conditions. The full report was made available prior to the first meeting and was supplemented by any number of reports from various nongovernment agencies, government entities, and academia. The full list of resources is available in Attachment c4-4. The Terrebonne Economic Development Authority provided documentation regarding the current industry, payroll, and employment trends to provide a snapshot of the economic advantages or stressors that might affect the focus of the goals and objectives to inform the prioritization of projects to protect assets critical to industry and workers.

The discussion of the sufficiency of the Comprehensive Plan, building codes, zoning ordinances, floodplain management regulations, subdivision ordinance and stormwater management regulations spanned several meetings. Each was revisited as projects and proposed risk reduction solutions were proposed. Members of the building community, developers, engineering firms, the planning commission, and the building code enforcement staff participated providing for depth of experience and motivations. Tribal and planning stakeholders were particularly interested in cost effective technologies to prevent coastal land loss and subsequent property damage. Technical partners from engineering firms were concerned that the models that we are using to ascertain the effect of new projects on the natural and built environments might be too old and layered to be accurate. Steering Committee members also requested that the Parish consider a development design level that is consistent for all construction whether it be a building or a road. Due to the complexity of this type of sweeping change, and the costs and benefits associated with it, this was added to the goals of the plan. Other outcomes are discussed in later sections of this plan.

The Steering Committee and parish staff reviewed all of the maps of the critical facilities, and updated them as necessary. The Terrebonne Parish School District asked that their office be considered a critical facility as the reopening of the school is critical to the recovery of the Parish after a storm. The students best recover from the mental stress by returning to the classroom schedule and parents can focus on recovery of their homes and returning to their jobs. Some of the schools have been rebuilt as well in lower risk areas. The parish added 30 cell towers and 18 pump stations, each of which is a critical facility. The Parish has made significant strides in the areas of evacuation and recovery, and public education of those efforts was a top priority for the Steering Committee. The Terrebonne 9-1-1 met with the Parish to request two towers be built to provide first responders with dedicated channels that could not be interrupted by a loss of cell phone service or satellites. Communications equipment was a concern for 9-1-1, OEP, and HPD and equipment and training is captured in the project lists.

The TLCD provided a list of projects that they would like to see prioritized now that the parish has largely funded or built the first lift of the levees, the major pump stations, the

flood gates, and is seeking funding for the lock system. The lock system will allow economic and recreational activities to continue unabated while the floodgates are closed to reduce saltwater intrusion and high tides. The Department of Coastal Preservation and Restoration (DCRP) supported each of these projects. The projects in general turn the focus from the levee system to freshwater introductions, marsh enhancements, project betterments, and small projects with big impacts. The full list of these projects and the rationale for each is available for review in the notes in attachment c1-3.5C. Protection and nurturing of the natural environment is crucial to the stability of the culture and the structural installations to protect the built environment. The Planning Department in partnership with local, state, and federal agencies including the United States Army Corps of Engineers (USACE) and the U.S. Department of Housing and Urban Development (HUD) will showcase the efficacy of terraces in open marsh for mitigation of storm surge and wave fetch. This is the Parish's first opportunity to work with the Louisiana Silver Jackets program, and is anticipated to add 100 acres of terraces in above Lake Boudreaux by 2021.

The CPRA 2017 Terrebonne Parish Fact Sheet was provided for consideration in the presentation by Stuart Brown, CPRA Implementation and 2023 Coastal Master Plan in the Steering Committee Meeting 3. One member of the public requested in the first evening meeting that the Parish put more effort into the sediment transfer project identified there. There is a threat of flooding from the Atchafalaya from a hurricane or the release of water from the Morganza Spillway. This was the subject of one of the subcommittees in the Steering Committee. With the threat, however, is the opportunity that the Parish could benefit from creating thousands of acres of marshland by reconnecting the land to a seasonal introduction of sediment. The pipeline feasibility study has been completed. Rather than limit the volume of sediment to that currently available through the pipeline, the suggestion was to increase the flow from the Mississippi into the Atchafalaya from 30% to a greater volume to be able to create more slurry and pressure, and therefore more easily deliver the sediment to the west side. A separate initiative to dredge the Gulf Intracoastal Waterway and increase fresh water from the Atchafalaya to increasingly brackish marshes has some funding from the National Fish and Wildlife Foundation (NFWF) through Restore or Retreat. Both are included in the list of proposed projects. A matrix of all of the plans and projects is captured in Attachment c3-1.

3.0 §201.6 (c) PLAN CONTENT

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

3.1.1 How it was prepared...

Terrebonne Parish's most recent Hazard Mitigation Plan was adopted in 2015. The development of the 2020 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 2015 HMPU, and to adapt mitigation efforts to changing priorities. The HMPU Steering Committee provided information that was critical to developing the HMPU.

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

3.1.2 Who was involved in the process...

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

Committee membership was comprised of a broad cross-section of the community. A detailed list of HMPU Steering Committee members is presented as Attachment c1-1. The committee determined at the first meeting that they did not need a committee chair in addition to the Parish plan coordinator. Entities represented by the 27-person committee included the following:

- Terrebonne Parish Consolidated Government
- Terrebonne Parish Sheriff's Office
- Terrebonne Parish School Board
- Terrebonne Parish Levee & Conservation District
- Houma Fire Department
- Houma-Terrebonne Chamber of Commerce
- Board of Health
- Consolidated Waterworks District No. 1

- Traditional Chief Albert P. Naquin Isle de Jean Charles Band of Biloxi-Chitimacha-Choctaw
- Coco Crappel, Principal Chief, United Houma Nation
- Shirell Parfait-Dardar, Chief, Grand Caillou/Dulac Band of Biloxi-Chitimacha-Choctaw
- South Central Industrial Association
- Local Engineering Firms
- Office of Homeland Security and Emergency Preparedness
- Southeastern Louisiana Home Builders Association
- Bayou Board of Realtors,
- Bayou Grace
- Terrebonne Parish Assessor's Office
- Louisiana Dept. of Health and Human Services
- South Central Industrial Association
- Terrebonne Regulatory Planning Commission

Some members of the HMPU Steering Committee are considered significant by the Community Rating System (CRS) compliance for more than one function. Committee members serving dual CRS roles are as follows:

- Carl Dupre - Preventative Measures (codes)
- Chris Pulaski - Property Protection
- Lisa Ledet - Floodplain Manager/ Public Information
- Mitch Marmande, Reggie Dupre, Mart Black - Natural Resources Protection
- Darrel Waire - Housing
- Earl Eues, Chief Ward, Sherriff - Emergency Services
- Structural Flood Control Projects (David Rome, /Reggie Dupre/ Mitch Marmande)

3.1.3 How the public was involved

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

- October 29, 2019
- November 5, 2019
- November 15, 2019
- December 3, 2019
- December 10, 2019

Two additional meetings were held in the evening for greater access to the public. Those meetings were held on:

- November 12, 2019
- December 19, 2019

This year, the Parish also created an online participation option. As well as providing all presentations and considered materials on the Parish website, there was a comment form that could be used by anyone, and accept 8MB of submitted data per entry. The meetings were all advertised on the front page banner and as news items on the site. Each posting provided the website as an option for information and input. Supporting documentation (advertisements, attendance lists, agendas, PowerPoint presentations, etc.) related to the aforementioned meetings are included in Attachments c1-3.1A - c1-3.7C. Examples of the postings on the web pages and calendars are included in Attachment c4-5.

The public was well represented through the participation of the Consolidated Government, a comprehensive group of tribes, nonprofits, parish regulatory agencies, and local engineering firms on the HMPU Steering Committee. Over a two month period, the full group and members of the public met five times to collaborate on the plan's development. Input from the steering committee was key to identifying potential hazard events, collecting data on hazard events that had occurred since the 2015 update, identifying critical facilities, and identifying and prioritizing hazard mitigation projects.

There were no meeting closed to the public other than additional one on one meetings provided to stakeholders to allow staff to go on site visits and discuss a specific topic at length or the subcommittee meetings scheduled by those members. The formal outreach included phone calls and meetings with 9-1-1, the Houma Terrebonne Airport, the North Lafourche Levee District and the Terrebonne General Medical Center.

Public participation was encouraged through public notices in the publication of legal record, *The Houma Courier*, of all 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. *The Houma Courier* also ran an article for the meeting and after the kickoff meeting for the Bayou Black Area Analysis. PowerPoint presentations, meeting notes and all materials discussed or presented were posted on the Parish website following all seven meetings, and meeting notices were posted on bulletin boards in the Robert (Bobby) Bergeron Government Tower where council and other civic announcements are viewed. Members of the general public came to both the steering committee and evening meetings. Due to the season and exhaustion from other planning efforts, attendance was not as high as optimal. Due to the significant participation in other well documented meeting series, the residents have provided significant input.

Steering Committee Meeting No. 1 - October 29, 2019

The Terrebonne Parish Hazard Mitigation Plan Update Committee held its first public meeting at the Joseph L. Waitz Emergency Operations Center in Gray, Louisiana, on Tuesday, October 29, 2019. The purpose of the meeting was to introduce the steering committee and discuss an overview of the Plan Update process. Prepared handouts included an agenda, the Hazard Mitigation Plan Update Project Maintenance List from 2018 and plans listed on p.12 and the June 2019 FEMA presentation of the Building Resilient Industry and Communities presentation. Below is a general summary of meeting highlights.



A PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.1C and Attachment c1-3.1D. After each meeting PowerPoint in the appendices, the Meeting Notes and all public notices and other postings are captured.

The steering committee structure was discussed as well as the process that was adopted by the Terrebonne Parish Council. A set of definitions of hazard mitigation and other terms were provided, as well as a list of deliverables that the group would be expected to consider. The resources provided in the room and on the website were introduced with a reminder that they had also been emailed directly in the meeting invitation. The presentation was intended to cover the reasons for planning, setting definitions, the legal requirements, financial benefits, the steering committee itself, and then the review of the plan. The group brainstormed new data that could 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 2015 plan. Such projects were updated in the plan maintenance process by the responsible Parish departments with Steering Committee review.

Prompted by the presentation, the committee made suggestions for updates to the Goals and objectives, the Hazards, and the Critical Facility maps. Several additions were written on maps provided on tabletops, which would later be provided to the GIS team.

The committee suggested that, since many of the objectives for developing standards, evacuation supports, and the drainage system had been completed, that public education was critical and should be highlighted more in Goal #2. It was proposed that the parish add a new goal of assessing the benefits of a consistent building standard for all activities. There was positive support for building roads and storm systems to a level equal to or closer to the building standards.

The hazards to be identified in the plan were discussed. Most hazards did not raise much interest, such as tornadoes, wind damage, and lightning. However, on the topics of sea level rise, Atchafalaya Flooding, and subsidence, it was proposed that subcommittees be developed to specifically research the realistic threat from each of these hazards given the projections of storms and mitigation activities ongoing and provide a strategy. There was some conversation regarding merging sea level rise and subsidence, but also of subsidence being a dual consideration. The majority of the Parish is now in a forced drainage area, and without a sophisticated system of capture and infiltrate, the movement

of too much water from the system could cause greater subsidence as an unintended consequence. The members were invited to meet after the presentation to develop the subcommittees.

Worksheet #1 Identify the Hazards step 1

Date: _____ What kinds of natural hazards can affect you?

<p>Task A. List the hazards that may occur.</p> <ol style="list-style-type: none"> 1. Research newspapers and other historical records. 2. Review existing plans and reports. 3. Talk to the experts in your community, state, or region. 4. Gather information on Internet Websites. 5. Next to the hazard list below, put a check mark in the Task A boxes beside all hazards that may occur in your community or state. 	<p>Task B. Focus on the most prevalent hazards in your community or state.</p> <ol style="list-style-type: none"> 1. Go to hazard Websites. 2. Locate your community or state on the Website map. 3. Determine whether you are in a high-risk area. Get more localized information if necessary. 4. Next to the hazard list below, put a check mark in the Task B boxes beside all hazards that pose a significant threat.
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Use this space to record information you find for each of the hazards you will be researching. Attach additional pages as necessary.

	Task A	Task B	Hazard or Event Description (type of hazard, date of event, number of injuries, cost and types of damage, etc.)	Source of Information	Map Available for this Hazard?	Scale of Map
Avalanche	<input type="checkbox"/>	<input type="checkbox"/>				
Coastal Erosion	<input type="checkbox"/>	<input type="checkbox"/>				
Coastal Storm	<input type="checkbox"/>	<input type="checkbox"/>				
Dam Failure	<input type="checkbox"/>	<input type="checkbox"/>				
Drought	<input type="checkbox"/>	<input type="checkbox"/>				
Earthquake	<input type="checkbox"/>	<input type="checkbox"/>				
Expansive Soils	<input type="checkbox"/>	<input type="checkbox"/>				
Extreme Heat	<input type="checkbox"/>	<input type="checkbox"/>				
Flood	<input type="checkbox"/>	<input type="checkbox"/>				
Hailstorm	<input type="checkbox"/>	<input type="checkbox"/>				
Hurricane	<input type="checkbox"/>	<input type="checkbox"/>				
Land Subsidence	<input type="checkbox"/>	<input type="checkbox"/>				
Landslide	<input type="checkbox"/>	<input type="checkbox"/>				
Severe Winter Storm	<input type="checkbox"/>	<input type="checkbox"/>				
Tornado	<input type="checkbox"/>	<input type="checkbox"/>				
Tsunami	<input type="checkbox"/>	<input type="checkbox"/>				
Volcano	<input type="checkbox"/>	<input type="checkbox"/>				
Wildfire	<input type="checkbox"/>	<input type="checkbox"/>				
Windstorm	<input type="checkbox"/>	<input type="checkbox"/>				
Other _____	<input type="checkbox"/>	<input type="checkbox"/>				
Other _____	<input type="checkbox"/>	<input type="checkbox"/>				
Other _____	<input type="checkbox"/>	<input type="checkbox"/>				

Note: **Bolded** hazards are addressed in this How-To Guide.

One new threat was identified based on losses in other areas. Extreme heat, and the disproportionate effect on vulnerable populations was submitted as a potential addition to the list. This was also offered up to others to develop a subcommittee as it was novel to the group. The presenter proposed that levee failure and dam failure be divorced as the dam failure was part of the Atchafalaya discussion. This was rejected as nominal or already being provided by current programs. The Parish will continue to monitor this for increased projections of risk.

The levee district suggested that we should, in our discussions of flood, be more discrete and look at surge, rainfall, and high river threats each independently, and then different combinations to assess the composite risks. The presenter explained that the HAZUS software would be able to run various scenarios regarding each threat, and we would look into threats that are combined.

Note: At each meeting, all but the largest resources were provided in print for review by the committee or the public. Each presentation was made available in hard copy as were any handouts from any presenter, or submitted by other stakeholders or agencies. The State Hazard Mitigation Plan was provided only by link (primarily for the risk projection data), and only the first 214 pages of the Natural Hazard Mitigation Saves: Interim 2018 Report provided in hard copy to assist in the decisions regarding the cost effectiveness of projects.

Steering Committee Meeting No. 2 - November 5, 2019

The Terrebonne Parish Hazard Mitigation Plan Update Committee held their second open to the public steering committee meeting at the Joseph L. Waitz Emergency Operations Center in Gray, Louisiana, on November 5, 2019. The purpose of the meeting was to complete the review of the current plan and the past damages, the work that had been completed to date, and input on hazard events not discussed in the first meeting, and begin the risk assessment and process. This was an opportunity to assess the problems facing the Parish considering the work already achieved and the events that have transpired.

The meeting was opened with a welcome and introduction, followed by the adoption of the notes from Meeting 1. By way of review for those that weren't at the first meeting, the presenter discussed the process and the step in the process that was the subject of the meeting.

As an update on the deliverables anticipated from the process, the presenter reported that the Parish, through Tara Lambeth, the Assistant Director of the Planning Department, was undertaking a Repetitive Loss Area Analysis for the Bayou Black area. There have been reports of flooding in yards that may be rectified by the pump stations and flood gate projects underway or in engineering. There are also \$433,000 in flood claims and several repetitive loss structures in the area.

The presentation of past damages that occurred during past hurricanes, such as Gustav, Ike, Isaac, etc. and recent flooding events elsewhere such as the 2016 and 2017 floods too far away geographically to affect the Parish and Hurricane Barry, which also had little effect on most residents in the Parish. The role of the Bayou Chene barge in preventing backwater flooding was of particular interest to some and current projects to upgrade that installation were explained by Oneil Marlborough of GIS Engineering, a Steering Committee member.

Hazards

The committee revisited two hazards that had not been discussed in the first meeting; saltwater intrusion and coastal erosion. The committee members were largely of the opinion that saltwater intrusion was significantly curtailed due to the levee system, terraces, and floodgates, and the OEP and water departments had agreements in place for drinking water. The focus should now be transitioned to documenting the freshening of the marshes in the MTTG footprint and replanting vegetation when possible.

Coastal erosion was the highest priority for the Dulac area representative, and the loss of road access due to flooding and property destruction from loss of land were identified as specific targets for improvement. A discussion ensued regarding potential projects for shoreline protection along the bayou, raised roads, and the efficacy and cost effectiveness of those projects. No final determinations were made. A member of the public suggested that the rim of the Gulf is moving, and the State should study it and include it on the models to better understand the potential loss to the coast.

A member of the public also provided a perspective on the reduction of wind damages, communication integrity and transportation, which are each critical to resilience. The poles owned by Entergy and SLECA are reportedly not maintained sufficiently, or anchored sufficiently, to remain standing when vegetation falls on them. It was suggested that the utility be required by the Louisiana Department of Transportation & Development (DOTD) to keep all trees cut back from the poles to avoid the loss of road access, communications over those phone lines, and electricity to the bayou communities that rely on them.

Risk Reductions Since 2015

The group reviewed quickly the status of projects that were in the previous plan and others projects from the 2018 update.

Project Status from the 2015 Plan

Project	Status
Drainage Study -- Airport Commission	Completed
Brady Canal Hydrologic Restoration	Completed
Coastwide Reference Monitoring Systems	Completed
Falgout Canal Planting Demonstration	Completed
Floating Marsh Creation	Completed
GIWW Bank Restoration of Critical Areas in Terrebonne Parish	Completed
Isles Dernieres Restoration East Island	Completed
Isles Dernieres Restoration Trinity Island	Completed
Lake Chapeau Sediment Input and Hydrologic Restoration	Completed
Mandalay Bank Protection Demonstration	Completed
New Cut Dune and Marsh Creation	Completed
North Lake Menchant Landbridge Restoration	Completed
Penchant Bases Natural Resources Plan--Increment 1	Completed
Point Au Fer Canal Plugs--Saltwater Intrusion	Completed
Raccoon Island Breakwater Demonstration	Completed
Raccoon Island Shoreline Protection/Marsh Creation	Completed
South Lake De Cade Freshwater Introduction	Completed
Terrebonne Bay Shore Protection Demonstration	Completed
Thin Mat Floating Marsh Enhancement	Completed
Timbalier Island Dune and Marsh Creation	Completed
Timbalier Island Planting Demonstration Overview	Completed
West Lake Boudreaux Shoreline Protection and Marsh Creation	Completed
Whiskey Island Restoration	Completed
Construct Emergency Operations Center	Completed
Develop a Program for Public Information	Completed
Falgout Canal Water Control Structure to +10'	completed

Whiskey Island Back Barrier Marsh Creation	Completed
Falgout Canal Freshwater Enhancement Phase I	Completed
Bayou Decade Ridge Restoration	Completed
Shoreline Protection on Houma Navigational Canal	Completed
Bayou Decade Marsh Creation	Completed
Bayou Penchant Marsh Creation	Completed
HNC-Lake Menchant Marsh Creation	Completed
Levee Safety Educational Promotions	Completed
Emergency Preparedness -- Purchase of Drone for Damage Assessment	Completed
Four P25 Motorola Communications Consoles	Completed
Communications - Community Alert System (First Call), Reverse 911, Community Hotline, Alert FM, Redundant Phone System at EOC	Completed
Drainage Improvement -- D-3 Upper Montegut Bar Screen Cleaner	Completed
Wind Retrofit -- Juvenile Detention Center	Completed
Wind Retrofit -- New Roll-up Door at EOC -- 911	Completed
Wind Retrofit -- Government Tower (Window Screens, Doors)	Completed
Safe Room - OEP (Substitute)	Completed
Wind Retrofit -- Civic Center (Shutters or Window Film)	Completed
Wind Retrofit -- Courthouse Annex (Window Film)	Completed
Wind Retrofit -- Harden Front and Back Doors of Convention Center	Completed
Wind Retrofit -- Roof of Convention Center	Completed
Drainage Improvement -- Coteau 1-1B Bar Screen Cleaner	Completed
Drainage Improvement -- Smithridge Pump Station Bar Screen Cleaner	Completed
Drainage Improvement -- Island Road (Stabilize roadway shoulders)	Completed
Drainage Improvement -- Michael Street, Buquet Street, and Daigle Street (Increase Culvert size to drain streets during heavy rain fall)	Completed
Wind Retrofit -- City Hall (IT Department)	Completed
Generator -- 100KW for Terrebonne General	Completed
Safe Room -- Government Drive	Completed
North Lost Lake Marsh Creation/Enhancement	Construction
Safe House -- Houma Fire Department 2101 East Tunnel Blvd.	Completed
Wind Retrofit -- Southdown Elementary	Completed
Coastwide Nutria Control Program	Continuous
Review the existing floodplain ordinance and evaluate ways to improve the Parish's "Community Rating System (CRS) rating to reduce the flood insurance premium. Choose from the variety of methods and projects available that can be implemented to improve the CRS rating.	Continuous
Reduce the Potential for Future Flood Losses through the Terrebonne Parish Flood Hazard Mitigation Program	Continuous

RL and Severe RL Properties -- Elevation, Acquisition, Reconstruction	Continuous
Increase Affordable Housing throughout the Parish	Continuous
Increase Public Awareness of Hazards and Hazard Areas	Continuous
Promote Purchase of Flood Insurance	Continuous
Elevation and Reconstruction-- Residential	Continuous
Madison Bay Marsh Creation & Terracing	Deauthorized
Generator -- Port Commission Forced Drainage (50 KW)	Withdrawn by Recipient
Wind Retrofit -- Houma Water Treatment Facility	Withdrawn by Recipient
Wind Retrofit -- Schriever Water Treatment Facility	
Wind Retrofit and Elevation -- Schriever Plant (install shutters or impact resistant glass on windows, strengthen doors, elevate pumps)	
Drainage Improvement -- Bonanza Pump Station D-27 Tideflex valves on discharge pipes	Design Complete
Upper Dularge East Levee to +10'	Engineering Funded
Cane Break to Ashland Levee -- 3.4 Miles to +8'	Engineering Funded
Bayou Dularge Ridge Restoration	Engineering Funded
Bayou Terrebonne Ridge Restoration	Engineering Funded
Increase Atchafalaya Flow to Eastern Terrebonne	Engineering Funded
Atchafalaya Long Distance Sediment Pipeline	Feasibility Study Completed
Ashland North -- 1.5 Miles to +8'	Funded
Upper Dularge East Levee -- 5.2 Miles to +8'	Funded
Small Bayou LaPointe Ridge Restoration	Funded
Relocation -- Jean Charles	Funded
150KW generators for Mire, Idlewild, and Elysian Lift Stations	Funded
Barrier Shoreline Restoration in Terrebonne Parish	Funding Requested
Ridge Habitat Restoration in Terrebonne Parish	Funding Requested
Terrebonne Bay Marsh Creation - Nourishment	Funding Requested
Generators -- Public Works -- Forced Drainage Pump Stations	Funded
100 Amp, 3-way SS Disconnects for generator ready connections (approx. 40 Lift station sites)	Funded
Generator -- 100KW for Chabert Medical Center	Funded
Generator -- 100KW for W. Woodlawn Station	Funded
Generator -- 200KW for South Wastewater Treatment Plant	Funded
Generator -- Lift Stations Receiving Effluent from Hospitals, Chabert Medical Center (50 KW)	Funded
Generator -- Lift Stations Receiving Effluent from Hospitals, Terrebonne General Medical Center (50 KW)	Funded
Generator -- Major Lift Stations, Douglas (50 KW)	Funded

Generator -- Major Lift Stations, Highland Drive (150 KW)	Funded
Generator -- Major Lift Stations, Mire (75 KW)	Funded
Generator -- Major Lift Stations, Westside (50 KW)	Funded
Generator -- Major Lift Stations, Westview (100 KW)	Funded
Generator -- Montegut, Pointe Aux Chenes Fire Stations (need 40-50 KW - \$15,000)	Funded
Generator -- North Terrebonne Treatment Plant	Funded
Generator -- Pollution Control, S. Treatment Plant Effluent Lift Station (250 KW)	Funded
Generator -- Pollution Control, S. Treatment Plant Perimeter Drainage Pump Station (100 KW)	Funded
Lower Bayou LaCache Hydrologic Restoration	Obsolete
Ship Shoal: Whiskey West Flank Restoration	Obsolete
Vehicle lift for HPD EOC	Obsolete
Generator Study/Environmental Review/Provision of Generators	Obsolete
Generator Study/Environmental Review/Provision of Quick Connects	Obsolete
Safe Room -- Gov't Towers Parking Structure (Pet Shelter)	Obsolete
Houma Navigational Canal Lock	Partially Funded
Mississippi River Long Distance Sediment Pipeline	Partially Funded
20 Pump Stations/Scada/Telemetry, the automation of forced drainage Pump Stations to reduce response time and flooding.	Partially funded by TPCG
Generator -- Public Works, Buquet Bridge (75 KW 120/240 Volt)	Funded
Generator -- Public Works, Klondyke Bridge (75 KW 120/240 Volt)	Funded
Timbalier Islands Barrier Island Restoration	Planning Funded
Isle Dernieres Barrier Island Restoration	Planning Funded
Marsh Restoration Using Dredged Material in Terrebonne Basin	Planning Funded
Bayou Chene Floodgate	TLCD
Barrier Plan (Big Bayou Black/Gibson) 1/3 of project -- 8.4 Miles to +6.5'	TLCD
Barrier Plan (Big Bayou Black/Gibson) 1/3 of project -- 8.4 Miles to +6.5'	TLCD
Barrier Plan (Big Bayou Black/Gibson) 1/3 of project -- 8.4 Miles to +6.5'	TLCD
Morganza to the Gulf	Underway
N. Lake Boudreaux Basin Freshwater Introduction and Hydrologic Mgt	Underway
Nutria Harvest for Wetland Restoration Demonstration	Underway
Cane Break to Ashland Levee to +10'	Underway
Education regarding flood safety and property valuation	Underway
Communications Tower North Campus/Telemetry/Forced Drainage	Underway
Wind Retrofit -- Houma PD	Completed
Blackstart Capacity -- Houma Power Plant	Completed

Select 2018 Proposed Project Status

Hanson Canal- Chacahoula Pump Station/Generator	In process.
Elliot Jones/Geraldine Pump Stations - WSI*	Engineered
Bayou Black Pump Station - WSI	Funding Requested
Oyster Bed Construction Phase	Partially funded.
Living Mitigation - Lake Boudreaux Construction Phase	Partially funded

The complete list of projects and the plans in which they were proposed is in Attachment c4-1.

Risk Assessment and Strategy

The group turned their attention to the next deliverable; the risk assessment and strategy. The presenter showed slides of the past events, losses from those events, and responses to avoid those losses in the future. Regarding the risk assessment, the committee voiced the desire to protect against smaller and larger threats. The Shell property was identified as a potential sink for water during smaller events as well as pumping down bayous when there are high volumes in the bayou prior to the storms. The Parish needs to have a plan for what to do when the bayous and land are already saturated and heavy or persistent rains add to that. The group recognized that the new LAMP process maps would help in the risk assessment. It was hoped that those may be available during this process, but it was in FEMA's control, and may not be available within this planning timeframe. However, the group committed to revisit the risk assessment in the first maintenance session when the new DEM and maybe even the DFIRMs might be available.



Source: TPCG Ronnie Shaw, Kurt Lirette, Cynthia Pellegrin, Jay Walker, Herdis Neal, Oneil Marlborough, Mart Black from left to right.

Mitigation funding was discussed as a primer to the Goals and Objectives and project agenda items in the next meetings. The Building Resilient Infrastructure and Communities funding source opens up new areas for support of services. The presenter suggested that in considering what solutions are available for the Parish to respond to the problems that are assessed through the process, the solutions be aspirational rather than bounded by funding limitations or discouraged due to novelty.

It was agreed by the committee that Hurricane Barry would have had a lot more impact but for the protection system in place at this time. It was suggested that the Parish should also focus on wind events and rain events that are 1) becoming more common, and 2) a different hazard within the forced drainage area.

Mart Black provided perspective that the Coastal Master Plan is, over 50 years, attempting to slow down the rate of land loss, but it is inevitable. We wrapped up confirming that some feedback from the State and regarding the coordination of the current protection system, and identification of remaining vulnerabilities would be beneficial. The presenter agreed to invite the Coastal Protection and Restoration Authority (CPRA) to provide that perspective.

The meeting dates proposed for the next three meetings were posted and discussed, along with an invitation to all present to attend the November 11th public evening meeting. The PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.2C and Attachment c1-3.2D.

Public Evening Meeting 1 – November 12, 2019

The first evening public meeting regarding the HMPU 2020 was held on November 12, 2019 at the Waterlife Museum at 7910 W. Park Avenue Houma, Louisiana 70360. The meeting was intended to provide the same information as had been covered in the first two meetings. The presentation provided the information about the planning process, the current plan, and the current risk assessment. We would next seek public input as to hazards, goals and objectives, and the vulnerability assessment.



While the meeting was not attended in large numbers, the attendees were very engaged regarding the topic. One was a resident with a house that had flooded in Bayou Black. She was invited to the meeting that was to be held on the 14th for the residents of that community.

There was a long discussion about two major projects to 1) bring sediment to the Parish to make up for sediment transfers that occurred until the Mississippi River was dammed, stopping the overflows each year. That discussion is captured for the most part in the following submission which was read into the record:

My name is W. Alex Osteheimer, I live at 101 Oak St here in Houma, LA next to the Intracoastal Canal and the following are my opinions:

While I understand and respected that this project list is necessary for money and it certainly it is better than doing nothing, I believe it does little to solve the real problem. The land is settling and the water is rising. We need dirt and lots of it. I believe the only economical way to get it is to let the Atchafalaya River bring it to us or at least as close as Morgan City where we can put it into the slang pipelines and start building.

Mother Nature and perhaps God himself is certainly doing their part to help us.

1. The freeing of the Mississippi River to divert must be planned, organized, and built. This should eliminate loss of life and all the silt down the Atchafalaya, maintain a viable shipping channel and continue to provide fresh water source for those who need it on the river. Not to mention reduced flooding on the upper river.

2. The silt should be harvested from the river in the Morgan City area, both above and below, since we know it is already being deposit there, remember the island just below the bridge after the water went down a few years ago.
3. We need an exemption from the government to build useable land that we can form or develop.
4. We need to start this as soon as possible.

Thank you

Alex Osteheimer.

After the submission of this project idea, the presenter suggested that this type of regional project would best be considered by the Watershed Initiative group that is considering expenditures to reduce flooding on a watershed basis. The statewide program funded with \$1.2B at this time, with \$600,000,000 available for our region to compete for might be the scale necessary for such an undertaking. The sediment pipeline feasibility project was discussed briefly, and it was agreed that the project would be brought to the attention of Pat Gordon of South Central Planning and Development Corporation as SCPDC is the Fiscal Agent of the region at this time. There is no Watershed Coordinator yet in the knowledge of the presenter.

The presenter submitted for the consideration of the group the suggestion from OEP made in a separate meeting that the tunnel under the GIWW could threaten Houma should a vehicle explode there from accident or a purposeful act. This was supported with some nods, but the conversation turned to the rerouting of traffic out of the GIWW in town to the loop in the Gulf.

The suggestion is that there is traffic in the Gulf Intracoastal Waterway (GIWW) that was not intended, such as barges that are too large for the twists and turns of the GIWW, and create opportunities for erosion of the bank, widening of the channel, and accidents with shoreline properties. The solution that was discussed first in 1971 was a loop that bypasses the City of Houma by going around the whole of the Parish towards the Gulf in a long U-shaped arc. Mr. Osteheimer asked that this be investigated to take all large shipments and hazardous cargo. There was no discussion about what the “hazardous cargo” might be.

The members of the public were thanked for their interest and participation and invited to participate in the future in the meeting or the Steering Committee meetings that were posted on the community calendar, the next one taking place November 15 from 9:30-11:30 at the OEP building on Government Street above Highway 90.

The PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.3C and Attachment c1-3.3D.

Steering Committee Meeting No. 3 - November 15, 2019

The Terrebonne Parish Hazard Mitigation Plan Update Committee held their third open to the public steering committee meeting at the Joseph L. Waitz Emergency Operations Center in Gray, Louisiana on November 15, 2019. The purpose of the meeting was to respond to the committee's request to hear about the work from the Terrebonne Levee and Conservation District (TLCD) and the Coastal Protection and Restoration Authority (CPRA) and assess the vulnerability of parish assets in the natural and built environment and to develop an updated risk assessment modeling requirement and risk reduction strategy. This was followed with informed discussion including a review of the updated hurricane HAZUS data, data from the Terrebonne Parish Assessor's Office, flood insurance premiums and claims paid, and revisions to the Goals and Objectives.

Jennifer Gerbasi, the Parish Presenter and Coordinator of the plan explained with some translation from the engineers in the room the flood composite risk assessment process to the steering committee as well as how inundation information and loss estimates were developed using FEMA's HAZUS software program. The software is limited at this time due to the significant changes in the modeling through the LAMP process, and the basic information in the HAZUS default data set. Therefore, new runs of the software are likely to misreport the current risks, and not show the current risk profile.

The presenter that this day they would hear presentations from Senator Reggie Dupre, Director of the TLCD, regarding the levee system and remaining vulnerabilities; and from Stuart Brown of CPRA discussing the Coastal Master Plan and ongoing or projected projects that are actually moving forward to protect the Barrier Islands and the coastlines protecting Terrebonne Parish.

By way of review for those that weren't at the first meeting, the presenter discussed the process and the step in the process that was the subject of the meeting and recapped the events of the public meeting. There was a very brief discussion about the sediment transfer and the GIWW bypass proposed in the first public evening meeting on November 12th (see Public Meeting 1 notes for full discussion).

The presenter then gave a brief account of the meeting held November 14th for the Repetitive Loss Area Analysis for the Bayou Black area. Approximately 20 people and 2 members of the Press were present. Mr. Carl Harding, aspiring to be the next Council Member, was present and provided feedback. The draft report is in Attachment c3-2 and the final report will be available within the period of drafting the HMPU.

At this time, the presenter turned the floor over to Stuart Brown, who provided a background on the CPRA and the Coastal Master Plan. The Plan itself is not a funding mechanism per se, but is a plan for how we might expend funds available through any source. A summary of projects updates presented is below.

CMP Projects Completed 2015-2018	CMP Projects In Construction 2019-	CMP Projects in Engineering and Design
Falgout Canal Road Levee (TE-0063)	Morganza to the Gulf (TE-0064)	Bayou Decade Ridge Restoration and Marsh Creation (TE-0138)
Lost Lake Marsh Creation and Hydrologic Restoration (TE-0072)	Terrebonne Basin Barrier Island and Beach Nourishment (TE-0143)	Terrebonne Basin Ridge and Marsh Creation - Bayou Terrebonne Increment (TE-0139)
NRDA Caillou Lake Headlands (TE-0100)	Island Road Fishing Piers (TE-0144)	Island Road Marsh Creation & Nourishment (TE-0117)
HNC Deepening Section 203 Study		Increase Atchafalaya Flow to Terrebonne (TE-0110)
Breach Management Plan (BA-0170)		
CIAP Performance Evaluation Borrow Area Management and Monitoring (LA-0012-7)		

Mr. Brown provided the Coastal Master Plan Process and expenditures and then move into the Terrebonne specific work that has been a priority in the plan. This included ongoing work (8 projects worth \$986M), completed projects (5 projects worth \$181M), and those in construction (3 projects worth \$554M). Two projects that had been discussed in the committee previously were the Increased Atchafalaya Flow to the Parish, and the HNC Lock Complex. The projects also focus on the barrier islands, and protection for Pointe aux Chenes and the Isle de Jean Charles access, Island Road. He invited the group to submit public comments on the plan and provided screening criteria.

S. Reggie Dupre then used a Google Earth projection of the Parish to discuss the MTTG footprint, and it's funding through state and local means without the Federal government, and other projects that had been discussed. As the Levee Director, he sees it as his mission to make the Hazard Mitigation Plan unnecessary due to the reduction in risk. Smaller targets, he said, can have a big impact, and he proceeded to list some additional to the multiple lines of defense that could reduce residual risk. For an example, he stated that the J-2 levee was not complete, so it overtopped for the 9' surge of Barry, but the 6'terrace behind it had no wave action hitting it and held and no structures in that area flooded. MTTG consists at this time of some height for 70 of the 90 miles between Terrebonne and Lafourche. The marsh behind is freshening, and over 30,000 trees have been planted to take advantage of this and increase the habitat and wind break from these installations. We should focus on "betterment" of our current system. The lock system was provided as an example of this as current floodgates are transitioned into locks so that boat traffic can always get through without saltwater intrusion.

Level of Protection

Reconvening, the presenter went over the preliminary damage results from HAZUS and indicated that the Parish was seeking new data for a more accurate run. The Committee would like to see runs for multiple evens from 10 through 500 year.

Project Discussion to respond to the problems, vulnerabilities

The presenter quickly reminded the group of the goals and the objectives that were identified for the last plan and invited an update for those as circumstances have changed.

In general, it was agreed that with the levee system at its current level, specific critical facility hardening, and targeted projects would best serve the Parish, particularly without the Flood Insurance Study or maps from the LAMP process to assess the current risk profile accurately. Oneil Marlborough requested that targets such as hospitals, the airport, and other critical facilities be modeled specifically to identify residual hazards. The Parish currently doesn't have the capacity or funding for small models of existing projects, or proposed.

Chris Pulaski suggested finding a way to provide additional flood insurance payments to help people be resilient through claims and meeting prerequisites for the mitigation programs. Oneil Marlborough asked about whether the Parish had data on how much flood insurance has gone up for individuals, and the Parish does not have that data readily available.

Continuing the discussion on flood insurance, it is sometimes unaffordable, and people try to sell their homes to move outside the SFHA. People expressed concern with a lack of affordable housing, and a significant reduction in perceived value in the floodplain. The presenter discussed an initiative to support appraisers in recognizing the value in an elevated structure in the floodplain, v. assuming all structures in the floodplain are unsafe.

The meeting was wrapped up with a quick discussion of typical and the BRIC mitigation options, and each member of the committee was invited to bring in a list of 10 projects that they believe would provide risk reduction to the Parish. This could include anything from the adoption of a higher standard like that discussed as a potential additional goal, or aspirational achievements that the community should shoot for. These would be reviewed for cost effectiveness and feasibility among other criterion.

A PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.4C and Attachment c1-3.4D. The advertisement can also be viewed in Attachment c1-3.4A.

Steering Committee Meeting No. 4 - December 3, 2019

The meeting began with a welcome from Jennifer Gerbasi, Recovery Planner and presenter at the revised location in the Robert J. 'Bobby' Bergeron Government Tower. Participants were asked to please sign in and pick up the materials available. Mr. Mike Toups, Parish Manager, was able to attend the meeting and also welcomed the participants. The presenter briefly went over the agenda for the day, and invited the subcommittees to have the floor if they had reports. They did not have reports at this

time, and reiterated their commitment to a longterm and ongoing interest in the subcommittee topics.

After a brief discussion of the past process, the meeting turned to the discussion of the projects and initiatives that will be necessary to reduce the residual risks faced by the Parish. This included updated maps, a reminder of the previous meeting presentations, a recap of project types available through The Federal Emergency Management Agency (FEMA) and the new Building Resilient Infrastructure and Communities (BRIC) initiative kicking off next year for FEMA and the Department of Housing and Urban Development (HUD) Community Development Block Grants (CDBG) program and the FEMA Strategic Plan approach and priorities.

Advanced Assistance for Modeling and Data Updates

The group thought that Advanced Assistance applications would be useful to provide studies and modeling that should be available for the Parish to be able to ascertain the value and impact of various activities. These included an update to basin models, drainage studies, and a review of the models used by FEMA to eliminate inaccuracies.

Transportation

Transportation was the most discussed new option from the BRIC program. Highway 90 is a main evacuation route, but it is exposed to overtopping by flooding at several places along the route, which is used by New Orleans and other populations beyond the Parish. Portions of the highway were impassable for a month in 1998 as a result of Hurricane George. This and our internal evacuation routes should be reviewed and the risks mitigated if possible. Oneil Marlborough stated that the lack of any benefit cost assessment for the loss of a major artery was a barrier to receiving federal funds towards the improvement of any of the routes. This will be revisited after study in the next meeting. Mart Black further discussed the importance of mass transit to move people to jobs and commercial activities in recovery, and the need to have roads clear and our buses present. All agreed that the transportation for evacuations run by the Parish was significantly improved since Gustav/Ike, and no further suggestions were made. Mark Stevenson suggested that the airport is underutilized and needs at least a generator if not a new tower to be certain that it is fully functional after an event.

Public Education

Public Education was a recurring theme in the meeting. Many items, including the six (6) parish evacuation routes available covered in the transportation discussion were identified as available, but not publicly known. To provide a culture of resilient residents, the opportunities, assets, contacts, or procedures must be known, maybe through social media.

Safety

Regarding safety, the Levee District requested a safe room, and Chris Pulaski suggested that during the design process for all public buildings built hereafter we should consider whether a safe “room” should be incorporated into design if the whole structure does not need to meet the Category 4 or 5 requirements. The current after event shelters were

rejected as options for hardening for safe rooms due to the expense, but generators should be available for use on the auditoriums and schools.

Standards and Financing

There was a suggestion that public buildings should all be built to the 500-year standard. Also, Katie Tabor suggested that designs should be forward thinking and make allowances for maintenance and increased height of the levee system and other construction to adjust for sea level rise or subsidence. The Morganza to the Gulf, Reggie Dupre explained, has a longterm maintenance plan that is supported by tax dollars. He also stated that some in the investment community are shying away from the Parish/coast, and they need to be educated as to the steps that have been taken in the Parish for our economic stability and resilience. To save and maybe raise funds, a wetland bank to pay for terraces to protect the levee system and marshes was proposed. Nia Picou-Bowens educated the group on the requirement that the bank had to offer the same type of wetland or other property type that was being replaced through the mitigation bank. Coastal marsh or estuary may not be in high demand as most wetland loss is in more upland areas, comparatively.

Tara Lambeth and Reggie Dupre introduced the need to use Law and Ordinance coverage to help substantially damaged homes to come into compliance.

There were several lists of projects that will be captured in the next presentation, and suggestions for changes to the objectives. The meeting wrapped up with a quick introduction of the model that will be used to prioritize projects in the next meeting including cost effectiveness. The FEMA 2018-2022 Strategic Plan highlights and National Hazard Mitigation Saves summaries were provided for consideration and the documents provided in the room, at the Parish, and online.

A PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.5C and Attachment c1-3.5D.

Steering Committee Meeting No. 5 - December 10, 2019

The Terrebonne Parish Hazard Mitigation Plan Update Steering Committee held their fifth meeting at the Joseph L. Waitz Emergency Operations Center in Gray, Louisiana on



December 10, 2019. The purpose of the meeting was to provide an opportunity to review the drafted materials including the updated maps, updated Goals and Objectives, and to discuss and prioritize the projects that had been proposed in the last meeting or sent in via email. The meeting notes and presentations can also be viewed in Attachment c1-3.6C and D for recording purposes.

As the first order of business, discussion of the

Meeting Notes was invited, which were accepted as sufficient at the motion of Collin Degueurce.

After a brief discussion of the past meeting and the step in the process that we had reached, the meeting turned to the discussion of the projects and initiatives that will be necessary to reduce the residual risks faced by the Parish so that this could be discussed prior to some participants having to leave for other obligations.

Project Prioritization Methodology

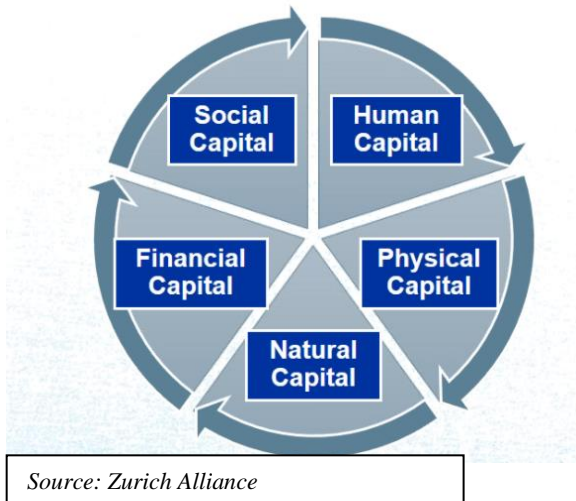
The discussion was preceded by the presentation of the criteria for selecting and then prioritizing projects. This follows the Zurich Flood Resilience Alliance Approach proposed by the Association of State Floodplain Managers in a recent training. The elements include five elements that are correlated to our interpretation for a risk mitigation application, and the addition of cost effectiveness and political feasibility:

Social Capital	Community Buyin and Cohesion
Human Capital	People to do the work – Public or Contract
Physical Capital	Raw Materials Available
Natural Capital	Land Available and Suitable
Financial Capital	Funding Available

The results of the project discussion are captured in the project draft list in the notes section attached hereafter. Projects supported or proposed in the meeting were also captured there. The presenter read into the record the rationale for the projects submitted by the Terrebonne Levee & Conservation District. As model ordinance options were requested by some of the committee and showed the highest rate of return on investment, the suggestions of the engineer consultants in 2013 were shared and discussed. Most are considered politically infeasible.

Strategy Discussion – FEMA Priorities

The types of projects invited again were covered briefly and the presenter remarked on the similarities of the first FEMA strategy goal of building a culture of preparedness, and the apparent movement of the Parish in that direction as well. Many of the objectives were related to public education, recruitment, and predisaster preparedness.



Goals and Objectives and Revisions Review

The changes to the Goals and Objectives (attached hereafter) were covered with few requested comments. Tara Lambeth asked that the Community Ratings System be explicitly mentioned in the National Flood Insurance Program objective. There was agreement that some of the options were duplicative.

Meeting discussions also included a review of the FloodSafe Outreach recommendations for the Flood Damage Prevention Ordinance. The topics covered more broadly included freeboard, valuation of properties according to risk and safety, and knowledge of the flood history of properties. It was agreed that knowing which houses were substantially damaged, and therefore limited in what permits they can receive due to noncompliance with flood regulations, would be valuable to both government agencies and consumers. Education of mortgage companies, architects and builders regarding freeboard were discussed as methods to increase the flexibility of builders to produce elevated houses without a financial loss as the foundation that has value not recognized by the mortgage community. The real estate stakeholders were very interested in this information, and in increased flood damage disclosures. This led to a discussion of broader educational activities and general knowledge of mitigation activities ongoing within the Parish and for individuals. This fit with the theme of these meetings, which focused on better data, better education, better modeling, and a set of smaller projects that have big impacts.

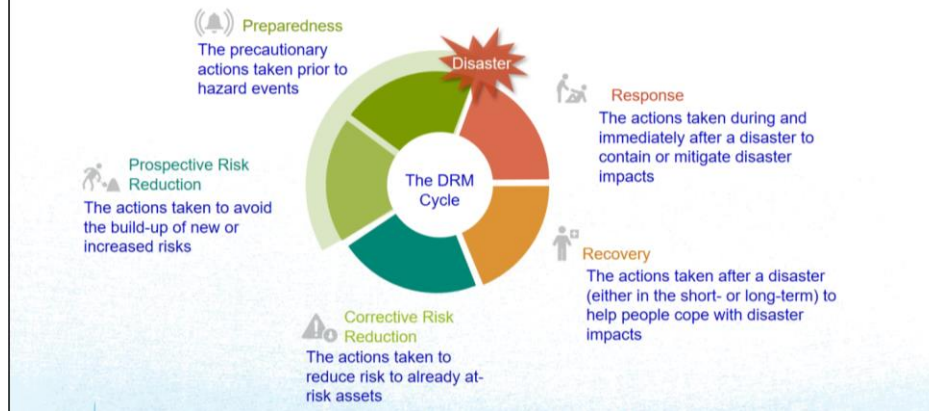
The next public meeting was discussed as an option for people who were not able to make the meeting. The availability of the online web portal was repeated for not only the public but any member with something to share that was not submitted in a meeting. The presenter suggested that there may not be another whole group meeting in person for the Steering Committee, but rather opportunities for reviewing the draft and any public input from the December 19th meeting online. Input can be provided through email as well. Separate meetings were announced to take place including with the airport, hospitals, the NRCS, the police department, the North Lafourche Levee District and 911.

The costs would be added to the projects and a rough cost effectiveness assessment performed and provided for the committee members to consider with the other criteria and develop a response prioritizing specific projects, goals, or categories of projects.

Public Evening Meeting No. 2 - December 19, 2019

The Terrebonne Parish Hazard Mitigation Plan Update Committee held the second public meeting in the evening at the Bayou Terrebonne Waterlife Museum in Houma, Louisiana, on Monday December 19, 2019. The purpose of the meeting was to provide an opportunity to review the information in the last three meetings of the steering committee, and allow attendees to provide further input on all aspects of the plan. The presentation included the data from the TLCDC and CPRA, the revised maps and risk assessment updates, and proposed projects intended for vetting and prioritization. The meeting is part of the preparedness portion of the disaster cycle planning for resilience.

The disaster risk management (DRM) cycle: Looking at the time element of resilience



Participation was low, and there were few comments about the material. The approach and projects were considered sound. A resident offered that buyouts would be good for people living with flooding conditions that are beyond their control. The presenter provided an update on the pump stations that are intended to reduce the nuisance flooding in yards in the area where the house is located. The first of the three pumps will be operational in January 2020, and any resident still experiencing flooding should report it to the parish.

The Steering Committee has several public representatives including Bayou Grace, which represents the Bayou Community residents. Through the planning process, it has become evident that some of the institutions that previously coordinated with community members not likely to participate in a public meeting are no longer in existence or are less active in planning activities. This will be a consideration as the Parish considers how to reach the general public with the extensive public education campaigns that the committee is calling for.

The low public turnout may also be related to the ten years that have passed since the parish has had a major weather event, or faith in the levee system that has been credited by some for the low damages from Hurricane Barry. Focus groups may be necessary to ascertain whether the general public understands that the levee system is not protection against the 100 year storm, or flooding like that seen from recent rainstorms of 40-60 inches in other jurisdictions. The LA SAFE program also has provided significant input that will be considered in this document.

The PowerPoint and accompanying notes for this meeting are found in Attachment c1-3.7C and Attachment c1-3.7D.

3.2 §201.6 (c)(2) A risk assessment that provides factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Risk Assessment is a four-step process: hazards are identified; hazard events are profiled; an inventory of assets within the community is conducted, and; the potential losses experienced by a community due to a hazard event are estimated. This section is divided into subsections that address each component of the risk assessment process. This section contains data from the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), Terrebonne Parish, and FEMA HAZUS software which is used to support the four-step risk assessment process. HAZUS is a software program that can estimate property losses that a community may experience as a result of a specific hazard event. In this HMPU, estimated losses resulting from flooding and hurricanes were calculated due to these storm events' high probability of occurrence in Terrebonne. The HAZUS data considered in this plan is primarily that from the 2015 plan with an additional Hurricane Model output from this year. The Parish does not have a digital elevation model that represents the actual conditions due to the continued delays of the LAMP process. The process is moving forward, but the consulting team was not able to provide data that could be incorporated into the HAZUS model to provide updated risk assessments.

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

The risk assessment shall include the following:

3.2.1 §201.6 (c)(2)(i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazards events.

The identification of hazards is in the risk assessment process. The planning team utilized a combination of sources such as the NOAA National Climatic Data Center (NCDC) information, the National Hurricane Center, the 2015 Terrebonne Parish HMPU, the State Hazard Mitigation Plan updated in 2019, and the HMPU Steering Committee input to identify hazards that may potentially impact Terrebonne Parish.

According to the National Climatic Data Center, there have been 310 recorded climatic events recorded in Terrebonne Parish within the 62-year period from 1957 to 2019. The following table 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.

**NOAA National Climatic Data Center
Recorded Climatic Events in Terrebonne Parish, 1957 – 2019**

Event	# of Events	Events/yr	Probability	Property Damage	Crop Damage	Damage /Event
Cold	10	0.16	16%	-	100,000	10,000
Cold/Wind Chill	5	0.08	8%	-		-
Heavy Snow	1	0.02	2%	-		-
Winter Storm	2	0.03	3%	-		-
Winter Weather	1	0.02	2%	-		-
Flood	40	0.65	65%	295,718,000	-	7,392,950
Flash Flood	16	0.26	26%	1,445,000		90,313
Storm Surge/Tide	15	0.24	24%	294,273,000		19,618,200
Coastal Flood	5	0.08	8%	-		-
Heavy Rain	2	0.03	3%	-		-
Flood	2	0.03	3%	-		-
Hurricane/Tropical Storm / Depression	41	0.66	66%	137,087,000	-	3,343,585
Hurricane	15	0.24	24%	109,520,000		7,301,333
Tropical Storm	24	0.39	39%	27,567,000		1,148,625
Tropical Depression	2	0.03	3%	-		-
Wind	167	2.69	269%	14,104,400	-	84,457
Thunderstorm Wind	121	1.95	195%	1,319,900		10,908
Tornado	31	0.50	50%	12,754,500		411,435
Funnel Cloud	10	0.16	16%	-		-
High Wind	3	0.05	5%	10,000		3,333
Waterspout	2	0.03	3%	20,000		10,000
Drought	6	0.10	10%	0		

					4,390,000	439,000
Hail	30	0.48	48%	0	0	0
Lightning	16	0.26	26%	679,500	0	679,500

Hazard Identification

Based on the combination of NOAA Climatic Data Center Recorded Climatic Events listed in the above table, the 2015 HMPU, and the HMPU Steering Committee, this section lists and describes potential hazard events that may impact the community.

During the HMPU Steering Committee kick-off meeting held on October 29, 2019 (meeting presentation is Attachment c1-3.1D), HMPU Steering Committee members were presented with a list of identified hazards. The worksheet was developed based on the abovementioned data sources, and was reviewed and revised based on HMPU Steering Committee comments. The HMPU Steering Committee recommended that the 2015 list of identified hazards was acceptable, but did not focus sufficiently on sea level rise as an independent variable. Flooding was also discussed reiterating the need to reflect multiple types of flooding in the plan as each may require different mitigation efforts. Extreme heat was submitted as requiring some level of attention, particularly regarding vulnerable populations.

For reference, the ten hazards listed in the 2015 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

The summary of the HMPU 2020 discussions is below in chart format for easy reference. Note that high winds and hail mitigation activities would be very similar to Hurricane and Tornado mitigation activities, and therefore will not be discussed independently. Similarly, due to the lack of risk of damage, Sink Holes and Drought will no longer be profiled hazards in this plan with specific mitigation activities. We also removed other hazards never profiled in the plan such as avalanche which would not naturally occur in Terrebonne Parish.

Identified Hazard	Comments	Hazards Profiled in Plan Update
Natural Hazards		
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. Coastal erosion is prevalent and will be combined with land subsidence, due to their interconnectedness, and treated as a single hazard in this plan.	Coastal Erosion
Coastal (Tropical) Storm	During the planning session, “coastal storm” was regarded as similar to hurricanes and therefore considered redundant. Impacts of coastal storms are similar to those generated by hurricanes. For purposes of this report, storm water and surge events created by tropical storms and tropical depressions and hurricanes are considered. However, storm water and surge events related to hurricanes are considered the most serious. Based upon historical events, coastal storms are often the cause of heavy rainfall events with less wind than hurricanes. The heaviest rainfalls in recent history resulted from tropical depressions.	Tropical Storm
Hurricane	Hurricane hazards are a primary concern regarding flooding from both storm water events and storm surge. Wind damage is also of significant concern. Storm water issues and surge issues are also addressed as flood concerns.	Hurricane

Flood	<p>Flooding is the second most prevalent hazard event type recorded by the NCDC in Terrebonne Parish. Forty flood events have been recorded since 1957. Flood concerns are addressed as the major hazard issue in the parish, and as such, will be detailed throughout this HMPU. Additionally, with high river stages and as a result of storm surge, flooding occurs in areas far removed from the source of the primary event. Locally, the term “backwater flooding” identifies this phenomenon. The issue is of such concern that the steering committee chose to identify flooding as a hazard independent of the riverine (including backwater), stormwater, and storm surge hazards.</p>	Flood
Saltwater Intrusion	<p>The parish has three freshwater intakes available for its supply of potable water. These intakes became increasingly vulnerable to saltwater intrusion. Steps have been taken to protect drinking water and to reduce environmental damage, but the HMPU Steering Committee agreed that saltwater intrusion should be recognized as a significant hazard within this HMPU.</p>	Saltwater Intrusion
Land Subsidence	<p>According to Terrebonne Parish’s 2015 HMP, land subsidence is likely to occur in the region. Two areas of concern for the Committee included the subsidence due to the removal of resources, and the potential of subsidence due to changing water infiltration patterns after forced drainage is in place. The hazard is thus identified as a prevalent hazard and coastal land subsidence will be combined with coastal erosion, due to their interconnectedness in that area, and treated as a single hazard in this plan. Land subsidence in forced drainage areas, natural or exacerbated by water management, will be separately developed to improve water storage in particular.</p>	Land Subsidence
Tornadoes	<p>Tornadoes are a function of high winds. They have occurred historically in the parish and are likely to occur in the future. Due to the limited impacts created by any single event upon the parish, the HMPU Steering Committee concluded that addressing mitigation measures relative to tornados as a stand-alone hazard should not be considered in this plan, but the tornado hazard will be profiled with other wind events due to the high probability of occurrence. Building to a Fortified standard may be advisable but would need to follow a benefit/cost assessment.</p>	Tornadoes

Man Made Hazards		
Levee/Dam Failure	Dams do not exist in Terrebonne Parish, but the Steering Committee was concerned with manmade releases or breaches of dams upstream of the Parish. This would cause riverine flooding or backwater flooding, so those risk reduction efforts are considered relevant to the dams. In Terrebonne Parish, the majority of the levees that existed prior to 2015 were not designed for hurricane protection, but were forced drainage mechanisms. All levees within the parish located south of the Intracoastal Canal reportedly topped and/or breached during Hurricane Rita in 2005 have now been elevated to 12 feet. The levees are not at the FEMA BFE or federally certified. Levee overtopping or failure is considered a highly significant hazard event in the area. A map of levees and pump stations, as well as, drainage areas are displayed in Attachment c2-3 at the end of this section. There is a data deficit regarding these threats as we do not yet have the data regarding the potential breaching of the dams external to the Parish or the completed maps and models to estimate the extent of the exposure should various segments of the levee system fail.	Levee/Dam Failure
Lightning	Lightning is a natural electrical discharge in the atmosphere that is a by-product of thunderstorms. Every thunderstorm produces lightning. There are three primary types of lightning: intra-cloud, cloud-to-ground, and cloud-to-cloud. Lightning will be profiled for the purposes of this plan though it does not cause a high dollar value of damage due to the high likelihood of occurrence.	Lightning

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/Dam failure
- (b) Flooding
 - i. Coastal Surge
 - ii. Rainfall
 - iii. Riverine/Backwater
- (c) Hurricanes and Coastal/Tropical Storms
- (d) Saltwater Intrusion
- (e) Tornadoes
- (f) Subsidence
 - i. Coastal

- ii. Within forced drainage areas
- (g) Coastal Erosion
- (h) Lightning

This list was confirmed by HMPU Steering Committee members in Meeting No. 1, 2 and 4 with consideration of the former HMP (2015). In a discussion of the Goals and Objectives, one member suggested removal of the salt domes from the list all together, but others thought that it did no harm to continue to monitor the natural condition of the domes and manmade disturbance of the same.

Additional Hazards of Concern

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

3.2.2 §201.6 (c)(2)(ii) *A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.*

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

Hazard Vulnerability

A Profile of Hazard Events and Hazard Impacts

As discussed in section §201.6 (c)(2)(i), levee failure, flooding, hurricanes, coastal/tropical storms, coastal erosion, and saltwater intrusion and sea level rise were identified as prevalent hazards to Terrebonne Parish. The State 2019 Hazard Mitigation Plan used a combined flood proxy of the 1% chance of flooding, and projected the following yearly losses for various hazards for Terrebonne Parish. Flooding and wind damage are consistently and by far the greatest threats to the community.

STATE 2019 HAZARD MITIGATION PLAN

Yearly Risk Projections - Terrebonne Parish Excerpt

Property Loss	\$75,648,246	Crop Losses	\$2,465
1% Flood Loss	\$ 41,496,891	Tornado	\$ 2,465
Wind Loss	\$ 33,650,164		
Tornado	\$ 501,191		

3.2.2.1 Flooding

Flooding is a broad term that can be used to describe inundation whether it causes damage or not. Flooding is defined by FEMA as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; or it could be the collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above. In coastal Louisiana, coastal storm surge is a common source of flood waters.

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. According to NOAA data, flooding has a 65 percent probability in 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 three categories based on the type of flooding: riverine/backwater, rain/storm water, and storm surge. By separating the types of flooding into these categories, the parish was able to identify specific portions of the parish that may be prone to each type of flooding or hazard event. This approach proved valid in defining both the varying causes of flooding hazards and in determining vulnerability.

In addition to damages from storm surge that would be expected near the coast, the Parish experiences flooding in the northern communities that may be caused by poor drainage, road improvements, or subsidence. These flood prone areas outside the SFHA are included in the repetitive loss map. The addresses of repetitive loss structures are not shown specifically due to privacy concerns, but are shown generally both within the SFHA and without. The data mapped is from NFIP claims and calls to the Department of Public Works, the Office of Emergency Preparedness, and the mitigation division of the planning department that are logged after every moderate to severe storm. NFIP claims are not reflective of the flooding in these areas. As much of the flooding is persistent pooling on land rather than in-home flooding, this may cause damage such as rotting floors or sinking foundations, which are more difficult to claim with flood insurance. Claims are also suppressed due to unfamiliarity with flood insurance rules or a desire to retain a preferred insurance rate. More specific education regarding flood insurance

details is needed rather than general information about the importance of getting flood insurance. The importance of flood insurance and the mitigation benefits of insurance have been the focus to this point.

Rainfall/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. This type of inundation is anticipated to be significantly reduced due to the implementation of the MTTG footprint and the series of floodgates and the planned lock system. Forced drainage systems with pumps accompanying the floodgates maintain levels of water in the marsh to avoid flooding from surge, southerly winds and high tides.

Riverine/Backwater

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 unless external threats are combined, such as dam failure.

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. The floodgate system has been designed in part to minimize flooding through the bayous from the south, and internal levees are being places to stop flow from the marshes. The Gibson/Bayou Black are is currently a focus due to flooding from the Atchafalaya. This phenomenon generally results in the flooding of areas of the parish located south of the City of Houma. Historically, flooding is generally widespread but shallow in these areas. Backwater flooding has occurred when the storm surge flowed through the pump station outfall pipes inhibiting drainage. The addition of pumps to the system dilutes that risk. Water flooding land and pooling in Gibson has prompted a similar response first identified by the U.S. Army Corps of Engineers and is now being implemented by the Parish.

Three pump stations are planned for the Gibson area; Hanson Canal, Bayou Black Pump Station, and the Elliot Jones pump station. Hanson Canal is online January 2020. Each

of the pump stations format and capacity are the same. The Hanson Canal Pump Station is currently under construction, and will be operable in December or early 2020. It includes 4 60” pumps, 900 horsepower electric motors, and 4,000 kilowatt backup generators. The pump station costs \$14.6 million, and will pump 1,000 cubic feet of water per second. This adds up to 1,000,000 gallons every 2 minutes and 15 seconds. It is anticipated that this group of pump stations and floodgates will reduce the flooding under and around Gibson homes.

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

Terrebonne Parish Historical Flood Events 1996-2019

• Date	• Type	• Property Damage	• Rainfall
4/5/1997	Coastal Flood	\$0	N/A
10/16/2006	Coastal Flood	\$0	1-2”
5/1/2010	Coastal Flood	\$0	N/A
10/25/2015	Coastal Flood	\$0	N/A
1/6/1998	Flash Flood	\$35,000	4-9”
6/26/1999	Flash Flood	\$500,000	3-10”
6/6/2001	Flash Flood	\$75,000	11-23”
6/6/2001	Flash Flood	\$500,000	11-23”
6/10/2001	Flash Flood	\$250,000	11-23”
10/9/2004	Flash Flood	\$50,000	N/A
10/22/2007	Flash Flood	\$0	3-10”
5/22/2008	Flash Flood	\$0	1-5”
8/17/2008	Flash Flood	\$0	1-3”
3/27/2009	Flash Flood	\$0	1-8”
12/14/2009	Flash Flood	\$0	1”
7/18/2011	Flash Flood	\$0	1-3”
9/4/2011	Flash Flood	\$25,000	1-4”
3/23/2012	Flash Flood	\$0	1-3”
7/20/2012	Flash Flood	\$10,000	1-4”
4/14/2015	Flash Flood	N/A	N/A
2/12/1997	Flood	N/A	N/A
9/10/1997	Flood	N/A	N/A
12/21/2006	Heavy Rain	N/A	1-6"
9/5/2014	Heavy Rain	N/A	
9/12/1998	Storm Surge/tide	N/A	N/A
6/30/2003	Storm Surge/tide	\$1,000,000	5-10”
9/15/2004	Storm Surge/tide	\$5,000	N/A
9/22/2004	Storm Surge/tide	\$5,000	N/A
10/9/2004	Storm Surge/tide	\$18,000	N/A
9/23/2005	Storm Surge/tide	\$34,560,000	1-2”

9/23/2005	Storm Surge/tide	\$138,240,000	1-2"
8/3/2008	Storm Surge/tide	\$0	1-4"
9/1/2008	Storm Surge/tide	\$9,400,000	1-5"
9/11/2008	Storm Surge/tide	\$100,000,000	<1"
9/2/2011	Storm Surge/tide	\$45,000	1-2"
8/28/2012	Storm Surge/tide	\$10,000,000	<1"
8/28/2012	Storm Surge/tide	\$1,000,000	<1"
6/21/2017	Storm Surge/tide		
7/12/2019	Storm Surge/tide		
	Terrebonne Total:	\$295,718,000	
<i>Source: NCDC</i>			

Based on previous occurrences the parish is susceptible to between one and 23 inches of rainfall in a flood event. Recent events such as Tropical Storm Imelda suggest that up to 40 inches is a realistic scenario. The pumping capacity in the Parish is developing not only robust pumping capacity, but storage for detention of these flows in natural systems such as the Shell property. This property provides over 4,139 acres of wetland which is sufficient to hold 1.8 billion gallons of water once the drainage levees are in place and pump station diversions connected. See page 105 for more information.

The most recent flood event to threaten Terrebonne Parish occurred in 2019 and is detailed below.

Year	FEMA #	Name	Parish Damages and Expenses
2016	EM 3376	Severe Storm and Flooding	\$11,539,617.43
2019	4462	May Flooding*	\$808,016.95
	*=estimated	Total:	\$12,347,634.38

Source: TPCG

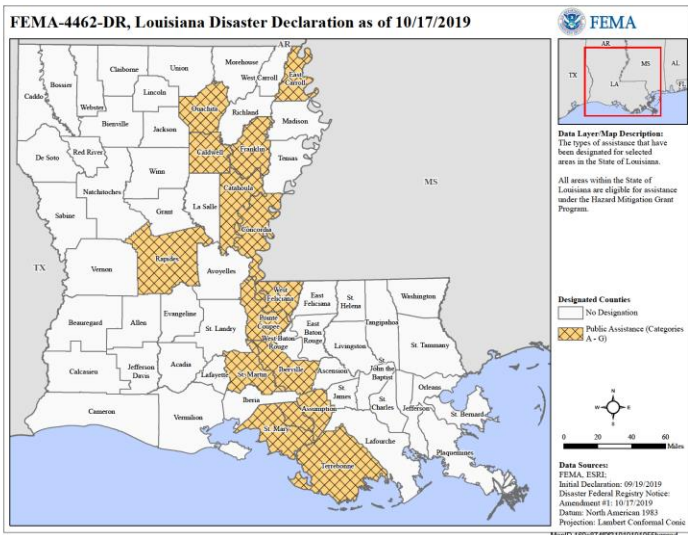
Flooding from Morganza Spillway (May 2019)

The threat of flooding from the spillway was met with the combined efforts of the Parish, the Army National Guard, to put portable pumps and two miles of flood tubes in place to move 500 million gallons per day from the area already saturated from months of backwater flooding from the Atchafalaya. Pumps moved water from above the floodgates to below to allow the water to flow to the Intracoastal Canal.



Source: TPCG

Pumps at Spanish Trail in Gibson with intake through temporary structures to draw down the bayou in anticipation of the spillway flooding. Three temporary installations at different gates were put in place for the same purpose. A temporary barge structure was put in place St. Mary Levee District as it had been before in Bayou Chene to provide more protection from the backwater flooding. A permanent structure will be constructed in 2020.

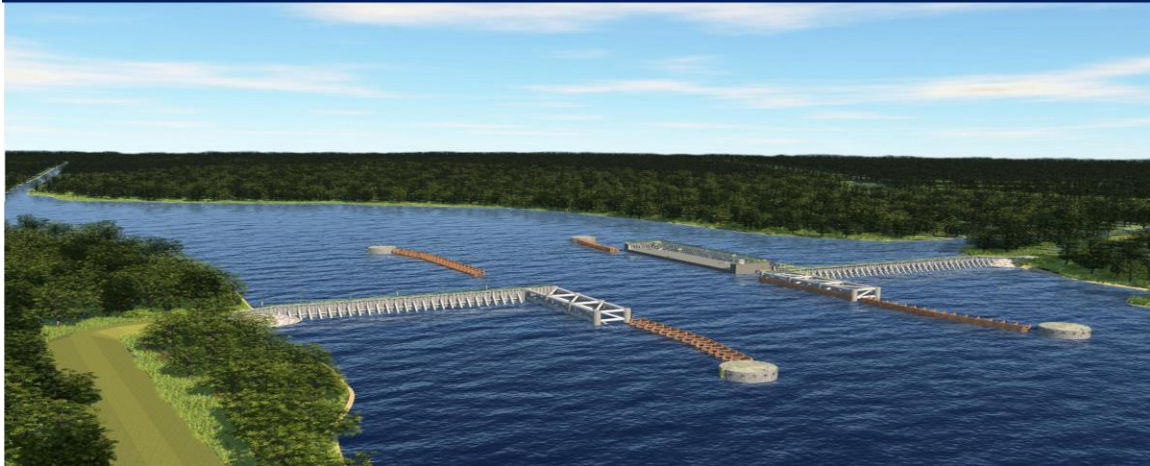


The Bayou Chene project is considered to be critical for Terrebonne Parish, and the TLCD and the TPCG are each authorized to expend \$400,000 towards construction of the structure. Terrebonne works with partner agencies and neighboring parishes as very effective projects may not be within our borders.

The May 2019 flooding was not declared a disaster until

September 19, 2019. Public Assistance was available to the Parish, but fortunately there was no need for significant Hazard Mitigation Grant Program funds for the parish or individuals.

W Bayou Chene Flood Control Structure - Open Position
In Design and Engineering Phase
Backwater flooding – Atchafalaya via Intracoastal to Terrebonne



Source: GIS - Conceptual Drawing



Lake Pontchartrain near the
Bonnet Carre Spillway, 2011

Source: nola.com

The Mississippi River Flood of 2011 (April – May)

This flood was retained in this plan to illustrate the repeated flood events from the Mississippi via the Atchafalaya. 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.¹ 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 \$3-\$4B.

The adjacent picture 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.

Bayou Cane - Flooding Frequency in Surrounding Areas

According to TPCG, Bayou Cane experiences flooding from rains more often than hurricanes. In particular, there is flooding on Douglas around the intersection of D Street.

¹ http://www.srh.noaa.gov/jan/?n=2011_05_ms_river_flood

The neighborhood occasionally ropes off the intersection to stop cars from driving through as the car traffic makes waves that in turn flood some of the homes along the street. Mire, Collins and Funderburk in Bayou Cane experience shallow flooding in rains as well. The intersection of Alma and Westside Boulevard was closed to traffic occasionally between 2013 and 2014 due to high waters from flooding caused by rain events. Projects have alleviated this to some extent and drainage improvements from Alma to St. Louis Canal road are pending final FEMA approval. Closer to Martin Luther King Boulevard, but still in Bayou Cane, Jean Street, Mike Street, and sometimes all the way to Duet Street residents experience flooding in rains. Some improvements have been made and buyouts executed, but the risk remains the same for the other structures. Westview and Louis Streets have experienced flooding. The structures at the end of Westview has been bought out or elevated at the election of the owners. Structures on Harding and Louis were also purchased due to shallow but repeated flooding. This level of participation may have been a result of the repetitive loss studies in the area.

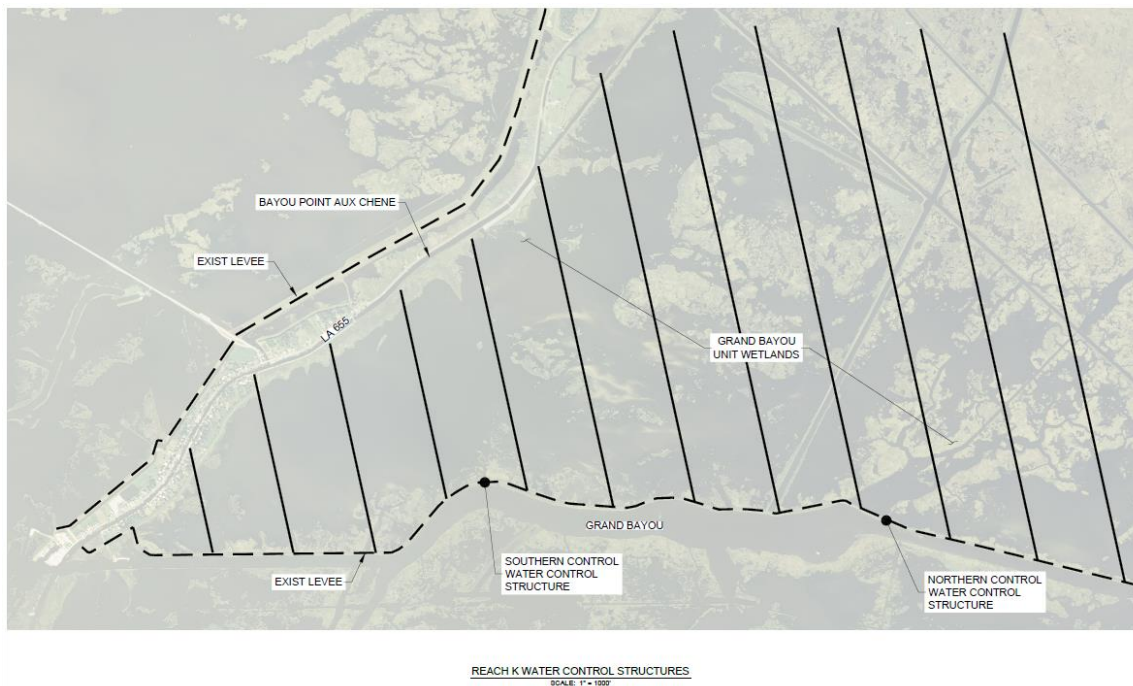
Prospect Street sees some flooding near the bridge in rains. This is nearer to the Roberta Grove area. This area is also targeted for elevations.

Flooding causes collateral damages beyond those to public and private structures. Roads can be impassible or washed away affecting the ability for people in discreet areas to lose access to work, schools, or medical care, for example. This can lead to economic loss and stress for all affected. Schools and businesses can be temporarily out of service. Ponding under houses can cause them to sink, floors to warp or mold to develop. All of these are difficult to collect flood insurance claims for due to the lack of an acute event, but they affect the owner and the economy.

3.2.2.2 *Hurricane and Tropical Storm Hazard Events*

Because of the proximity of the parish along the Gulf coast, the region is highly prone to hurricanes and tropical storms. According to the [National Oceanic and Atmospheric Administration](#) (NOAA) a tropical cyclone is a rotating low-pressure weather system that has organized thunderstorms and associated wind. Tropical cyclones with maximum sustained surface winds of less than 39 miles per hour (mph) are called tropical depressions. Those with maximum sustained winds of 39 mph or higher are called tropical storms. When a storm's maximum sustained winds reach 74 mph, it is called a hurricane. The parish has a history of damage linked to hurricanes and tropical storms that have occurred in the past. Nineteen presidentially declared disasters associated with hurricanes and tropical storms have occurred in the parish since 1965. Even more, hurricanes and tropical storms have a 66 percent probability in the parish. 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. Based on the storm events profiled later in this section and Terrebonne Parish's location in coastal Louisiana, it is estimated that Terrebonne Parish could experience between 2.5 and 15 feet storm surges, and between 1- 23' of rain related specifically to hurricanes, tropical storms, and tropical depressions.

The design of the Morganza to the Gulf Hurricane Protection Levee in Terrebonne Parish has been extended to provide protection for several communities, including Grand Caillou, Dulac, and portions of Bayou Dularge. Isle de Jean Charles and Point aux Chenes remain outside the MTTG. Lafourche Parish is pursuing an Eastern tie in for the MTTG expanding the footprint to Lockport, and replacing two environmental structures near the Ponte aux Chenes Wildlife Management Area. Each will provide protection from surge and backwater flooding from the east that otherwise could flow into the GIWW into the MTTG system. These projects are included in the list of priorities for this plan as they protect Terrebonne as well as Lafourche. The current weir structures will be replaced by three box culverts, slide gates, flood gates, and a wall. This new installation will account for flood risk by incorporating overbuild in the elevation by starting at 6-8 feet rather than 4 feet and moving up to 10 feet over 10 years. This will be accomplished with a partnership between Terrebonne and Lafourche, and will be managed in a partnership between the South Lafourche Levee District and the LA Dept. of Wildlife and Fisheries. This will shore up a weak point in the current system.



Source: TLCD All South Consulting Engineers

Local redundant levees with corresponding pump stations have been added to the system to protect the Bayou Dularge, Grand Caillou and Dulac communities. Point aux Chenes is outside the levee, but efforts by Terrebonne and Lafourche to increase the internal levee system are planned. Terraces to protect the marsh and the Wildlife Management Area are already implemented. The State has provided a \$48M relocation package to the residents of Isle de Jean Charles for all volunteers. A marsh restoration project is through engineering and will build a barrier to reduce the effect of wave action on Island Road (Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Island Road Marsh Creation and Nourishment Project (TE-117)). Further, five public parking areas

for fishing will be constructed on both sides of the road strengthening it in those locations. A buyout project has been funded through LA SAFE for primary residences outside the MTTG footprint. There was concern that the lower bayou communities might see increased surge heights as a result of the construction of the Morganza levees. The results of the LAMP process will inform whether this is projected or not. Preliminary results do not suggest any significant increase in vulnerability for these areas. Hazard mitigation strategies, including community relocation, may become necessary in order to reduce the vulnerability of these communities. The Parish is continuing to monitor the need for buyout programs that mirror the state program by providing sufficient funding for replacement housing rather than fair market value.

Numerous hurricanes and tropical storms have impacted the study area. A table summarizing the tropical storms, depressions, and hurricanes relevant to Terrebonne Parish is below.

Year	FEMA #	Name	Parish Damages and Expenses
2017	EM 3392	Tropical Storm	\$113,559.45
2019	4458	Hurricane Barry*	1,813,199.47
	*=estimated	Total:	\$1,926,758.92

Source: TPCG

These are the expenses from Emergency Measures or response and damage repair. Hurricane Barry is the only presidentially declared storm since 2012 that included Terrebonne Parish, and is profiled below. The profiles for the storms are below and newspaper accounts are available for review in Attachment c4-3.

Table 4-2: Terrebonne Parish Presidential Disaster Declarations (1965 to 2019)

Year	DR#	Storm Name	Impact	Damage (Billions)
1965	208	Hurricane Betsy	Storm surge, flooding, and destructive winds	\$21.90
1971	315	Hurricane Edith	Flooding and high winds	\$0.30
1973	374	Severe Storms, Flooding	Heavy rains and flooding	N/A
1974	448	Hurricane Carmen	High winds and tidal flooding	\$1.60
1980	616	Severe Storms, Flooding	Heavy rains and flooding	N/A
1985	752	Hurricane Juan	Storm surge, heavy rain, and flooding	\$4.10
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	\$56.00
1995	1049	Rainstorm/flood	Heavy rains and flooding	N/A
1998	1246	Tropical Storm Frances & Hurricane Georges	Destructive winds, storm surge, tornado, and flooding	\$4.60
2001	1380	Tropical Storm Allison	High winds, heavy rains, and flooding	\$6.50
2002	1435	Tropical Storm Isidore	High winds, heavy rains, and flooding	\$0.40
2002	1437	Hurricane Lili	High winds and storm surge	\$1.10

2004	1548	Hurricane Ivan	Winds	\$15.50
2005	1603 & 3212	Hurricane Katrina	high winds	\$81.00
2005	1607 & 3260	Hurricane Rita	Storm surge and flooding	\$10
2008	1792	Hurricane Ike	Heavy rains and high winds	Gustav & Ike
2008	1786	Hurricane Gustav	Heavy rains and high winds	\$8 to \$20B
2009	1863	Severe Storms, Flooding, Tornado	High winds, heavy rains, and flooding	N/A
2011	4015	Flooding	Mississippi River Flooding	\$4.00
2011	4041	Tropical Storm Lee	High winds, heavy rains, and flooding	\$1.60
2012	4080	Hurricane Isaac	Heavy rains, high winds	\$1.00
2013	4102	Severe storms and flooding	High winds, heavy rains, and flooding	N/A
2016	3376	Flooding	Heavy rains and flooding	\$0.014
2017	3392	Tropical Storm Nate	High winds, heavy rains, and flooding	\$0.007
2019	3413	Flooding	Heavy rains and flooding	N/A
2019	4458	Hurricane Barry	High winds, heavy rains, and flooding	\$0.60
2019	4462	Flooding	Heavy rains	\$0.008

Note ⁽¹⁾: Loss estimates for all affected areas and are not limited to Terrebonne Parish. Data obtained from *Normalized Hurricane Damage in the United States: 1900-2005*, R. Pielke, et. al. and the FEMA data visualization for 2016-2019.

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 is no longer being followed; however, it is used in this section due only to its previous use in describing past storm events.

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

Hurricane Betsy (1965)

Hurricane Betsy made landfall near the mouth of the Mississippi River in Louisiana on September 9, 1965. The hurricane was a category 3 storm with maximum winds of 140 miles per hour recorded in Terrebonne Parish. According to NOAA, Terrebonne

Hurricane Betsy's Storm Track



Source: noaa.gov

experienced approximately five inches of rainfall during this storm. Grand Isle, which is 70 miles southeast of Houma, experienced 15' storm surge. The event caused wide spread wind and water damage to area homes and businesses in Terrebonne. In addition, the area's agricultural crops (sugarcane) suffered significant losses. One fatality was reported. It should be noted that at this period in history there was not an extensive levee system in place. The level of damage experienced in Louisiana reflected that reality. Hurricane Betsy is often referred to as "Billion Dollar Betsy."

A map of the flood impact area of Hurricane Betsy is shown in Attachment c2-17. The storm's path is illustrated in the above 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 to the right).



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. NOAA records approximately 10 inches of rainfall parishwide. 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 104). Similar to Hurricane Betsy, there was not an extensive levee system in place. In addition, the 1970's marked a period of intensive land loss in coastal Louisiana as discussed previously. Accordingly, widespread damage reflected that reality.

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



Source: noaa.gov

Terrebonne Parish. Hurricane Andrew's path is illustrated in the adjacent graphic.

Terrebonne Parish was located on the eastern side of the storm's eye wall and therefore sustained widespread damage. The damage was caused by a combination of high winds and storm surge (9 feet recorded in Terrebonne Bay). In addition to storm surge, Terrebonne experienced between five and seven inches of rainfall (NOAA). 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 Chenes, 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. The following graphic illustrates the magnitude of the storm's surge on Louisiana's central coastline. At this point in time Terrebonne Parish was still protected by drainage levees that were less than 6 feet in height.

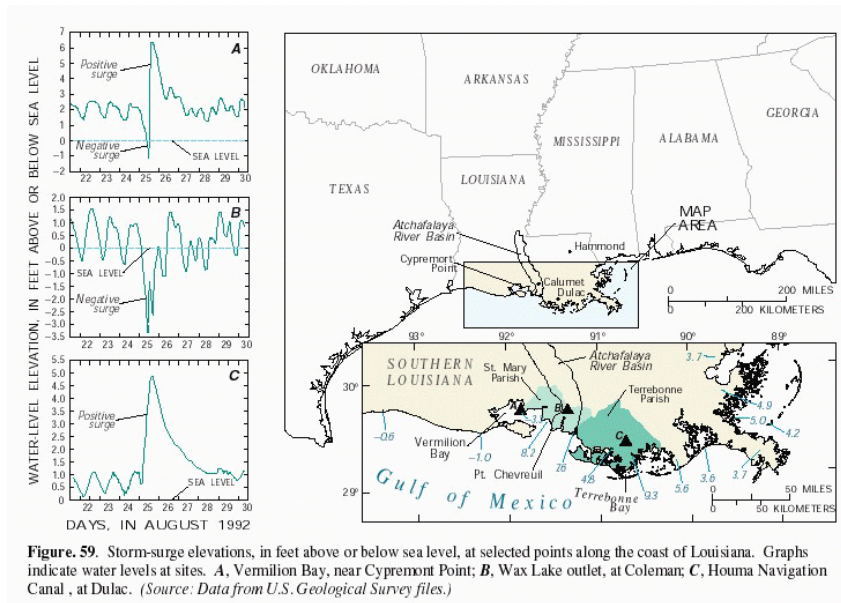
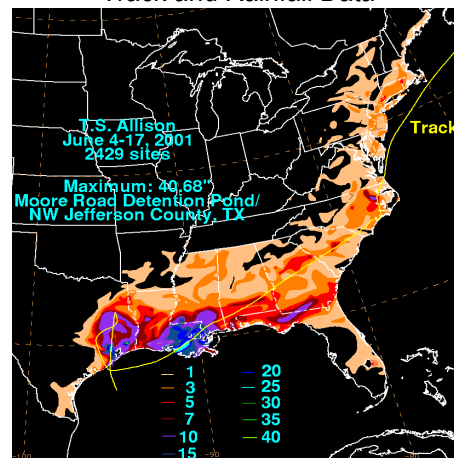


Illustration of Hurricane Andrew's Storm Surge

Tropical Storm Allison (2001)

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. The storm produced a 2.5' storm surge in Cameron,

Tropical Storm Allison's Storm Track and Rainfall Data



Louisiana and isolated areas 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. Generally, the parish experienced between 15 and 23 inches of rainfall. It is estimated that 131 homes in the parish were damaged or destroyed by flood waters and 25,000 residents were displaced due to high water. The accompanying graphic illustrates the storm's track as well as rainfall accumulations produced by the storm. Allison will be remembered as the costliest Tropical Storm in U.S. history with 41 deaths and a \$5 billion price tag associated with the damage. A map of the inundation caused by Tropical Storm Allison in Terrebonne Parish is included as Attachment c2-20

Hurricane Lili (2002)

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

Hurricane Lili's Storm Track



Source: noaa.gov

The storm was responsible for damages associated with both wind (greater than 78 miles per hour) and storm surge (6 to 8 feet) in Terrebonne Parish. NOAA also records that Terrebonne experienced up to five inches in rainfall from this storm event. 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 and substantial damage of more than 300 homes. The extent of parish inundation caused by the storm is displayed in Attachment c2-21 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

Hurricane Katrina's Storm Track



Source: noaa.gov

and was caused by high winds and large storm surge (estimated 14 feet in Plaquemines Parish, Louisiana). Between three and five inches of rain fell in Terrebonne. 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 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 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. Approximately one inch of rain fell in Terrebonne, and the impact and damages were largely a result of storm surge that caused extensive flooding, primarily south of Houma. An 8' storm surge was recorded in Calcasieu Parish. All levees located south of the Intracoastal Canal failed and more than 10,000 homes and business were flooded. The Rita inundation map is presented as Attachment c2-22.

Hurricane Rita's Storm Track



Source: noaa.gov

Cattle Round Up After a Levee Break in Chauvin, Louisiana



Source: TPCG

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



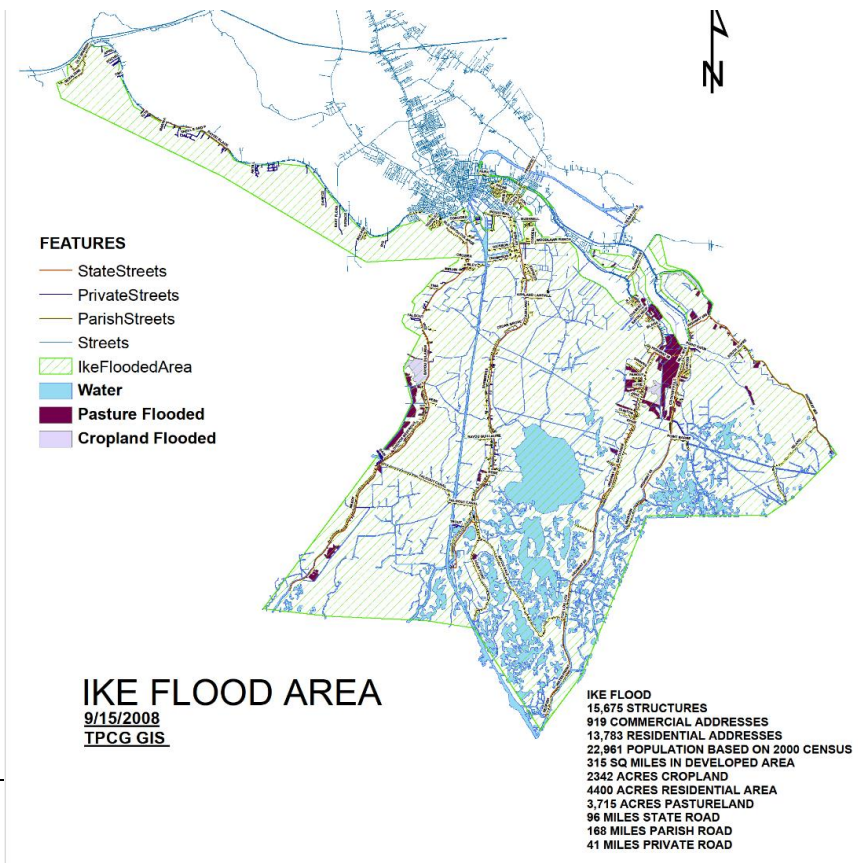
parishes.² Over two million people were evacuated from the region.

Hurricane Gustav 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.

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. According to NOAA, Hurricanes Gustav and Ike caused between one and two inches of rainfall in Terrebonne Parish. 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.



Extent of Hurricane Ike Inundation



Terrebonne Parish expended approximately \$1,973,953.05 on recovery projects that resulted from damages to parish properties from Hurricanes Gustav and Ike. The extent of the flooding for Hurricane Ike is on the next page.

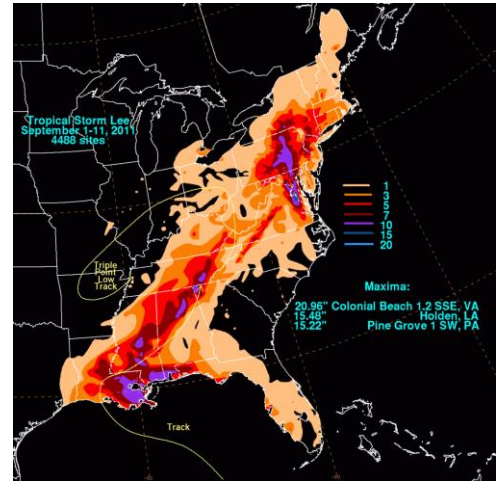
The projects funded with federal funding

from the 2008 storms are ongoing, though most projects are complete. A discussion of the projects completed since 2015 is included on pp. 22-26.

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 at the Montegut floodgate and up to five feet of flood waters into some areas. Between four and five inches of rain fell in the parish. Fortunately, there were no major road closures and no reports of house flooding in northern Terrebonne, although there were reports of homes flooding in the low portions of the Parish such as Cocodrie, Isle de Jean Charles, and Pointe aux Chenes.

Tropical Storm Lee Storm Track and Rainfall Data

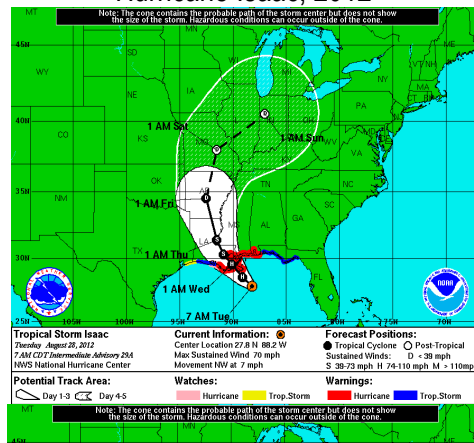


Source: NOAA

Hurricane Isaac Aug. 29, 2012

Hurricane Isaac was a Category 1 hurricane that reached Terrebonne Bay on August 29, 2012.³ The hurricane generated maximum sustained winds of 80 miles per hour along the coast but weakened to a tropical storm and then a tropical depression as it progressed over southeastern Louisiana. It reached winds of up to 60 miles per hour in Houma. Approximately one billion dollars in damage was caused by the hurricane. According to NOAA, approximately 1.5 and 6 inches of rain fell as a result of the storm.

Hurricane Isaac, 2012



Terrebonne Parish experienced extensive damage to barrier islands and marshland, especially those that were in the process of being restored by the Coastal Protection and Restoration Authority, including Whiskey Island Back Barrier Marsh and Timbalier Island Dune Marsh. Over the last century Louisiana's barrier islands have decreased in land mass, with some decreasing by more than 50%. This trend has significant impacts for future storm surge protection in coastal Louisiana, which is why CPRA endeavored to undertake the Whiskey and Timbalier Island projects. However, damage to these critical restoration projects only compounds the financial toll of resulting property damage on communities. It is estimated that damage to the restoration projects in Terrebonne

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

(\$18M) totaled more than the cost of property damage (\$16M) caused by the storm in the parish.

In Terrebonne, over 1,000 homes were damaged with approximately 20 homes with reported water inside. Damage in Terrebonne Parish represented a small fraction of the total 59,000 homes damaged statewide by the storm. Roads were inundated and fields of sugar cane were damaged.

Isle de Jean Charles, which is located in the coastal southeastern portion of the Parish has been repeatedly damaged with each storm event impacting coastal Louisiana, and Hurricane Isaac is the most recent incidence. Some homes on this island experienced between one and three feet of water from Isaac. Many homes have roof and interior damage. As a result, the Louisiana Native American community of Isle de Jean desires voluntary resettlement to a more secure inland Terrebonne Parish location. The Isle de Jean Charles Band of Biloxi-Chitimacha-Choctaw community is the first community in the lower 48 states to be so severely impacted by coastal erosion and sea level rise that permanent relocation is sought by the residents. Funding has been awarded for that purposes.

The Parish endured significant damage and received roughly \$1.5 million in HMGP funds for this storm, and \$678,000 Community Development Block grants for low to moderate income grant recipients.

Hurricane Barry (2019)

Hurricane Barry landed west of coastal Louisiana, and caused \$600 million in damages according to the National Weather Service. Terrebonne Parish was not heavily impacted compared to past events. Maximum 1-minute sustained winds of 75 mph

The surge created a brief overtopping of the levees under construction in Montegut and lower Dularge. There was a call for a mandatory evacuation of structures

National Hurricane Center – Hurricane Barry Track



on Highway 315 and Brady Road south of Falgout Canal while the levee was shored up and the overtopping stopped with a temporary work accomplished by local contractors. The Dularge levee is now at 9' and had it been at 9' or

completed to the final 12 feet it would not have been overtopped. The Montegut Levee is under construction with completion expected by 2021.

A voluntary evacuation notice was in effect, but the Coast Guard rescued four (4) people and a cat by helicopter from Isle de Jean Charles and eight (8) more by boat and taken to the Houma-Terrebonne Airport for a health evaluation. Many structures on the island are elevated, and each permanent resident has the opportunity through the State LA SAFE resettlement project to relocate to a new home and community in a safer location. Other mitigation efforts for Isle de Jean Charles are described below.



Two structures in Pointe aux Chenes in Terrebonne and eight in Lafourche flooded with reports of 2-4' in the homes. Elevated structures were above the water and no damage was reported (photo left). The Terrebonne residents were insured and have been advised of their nonstructural mitigation options. A temporary levee reach has been constructed to protect the area and further projects are discussed below.

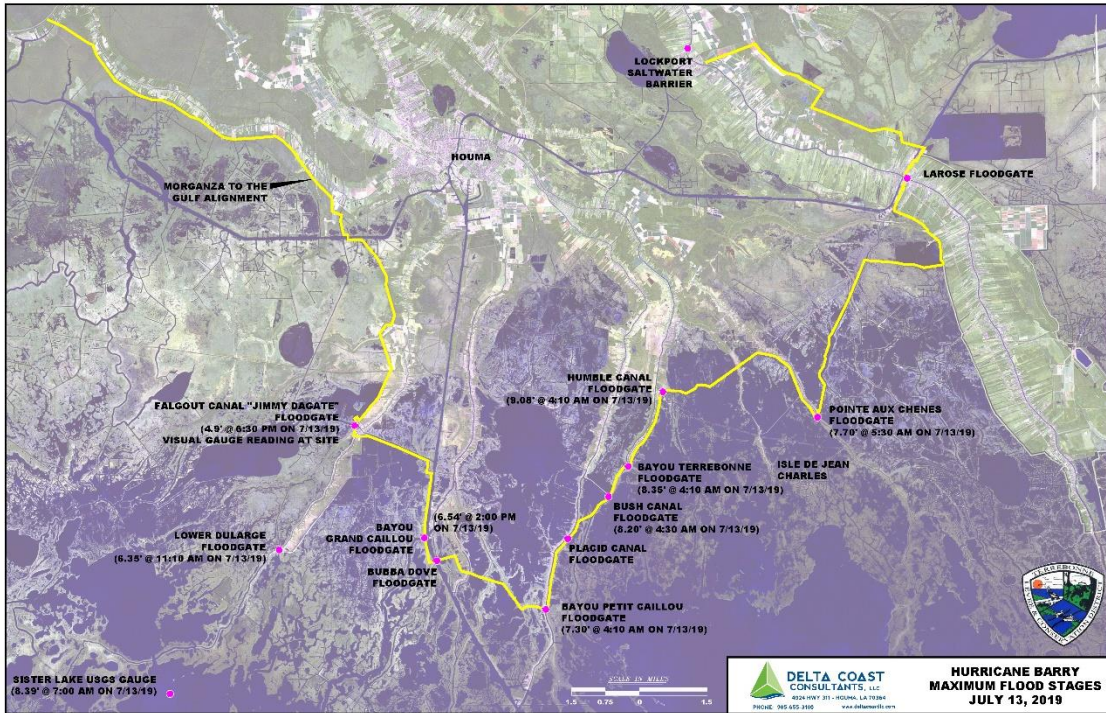
The water height at the Morganza Spillway led to discussions of levee and dam failure, and proposals that would both reduce the pressure on the spillway and provide sediment and freshwater to the marshes in western Terrebonne. These will be discussed in the project section of this plan.

The map below illustrates the protection level of the levee system and the series of gauges that captured high water marks in Terrebonne and Lafourche parish along the MTTG proposed alignment. Note that the current alignment is being proposed to extend beyond Larose to Lockport. Also interesting is that except for the 7.7' high water at the Point aux Chenes floodgate, the high water elevation readings dropped from east to west. The high water marks at the floodgates were captured as follows:

- Humble Canal – 9.08’;
- Bush Canal – 8.2’;
- Bayou Petit Caillou – 7.03’;
- Bayou Grand Caillou – 6.54’;
- Lower Dularge – 6.35’;
- Falgout Canal – 4.9’.

This supports the position of the levee district that the levee system may not require a consistent elevation, but one that varies based on the protection of each area.

Along that alignment, the two environmental structures discussed on page 51 will also provide protection in the Pointe aux Chenes area.

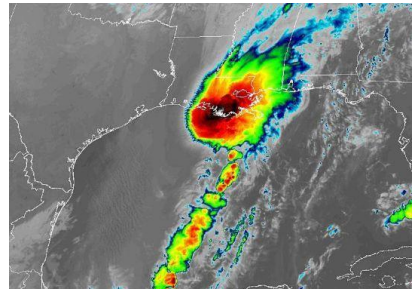


Source: TLCD

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

Tropical Depression Olga

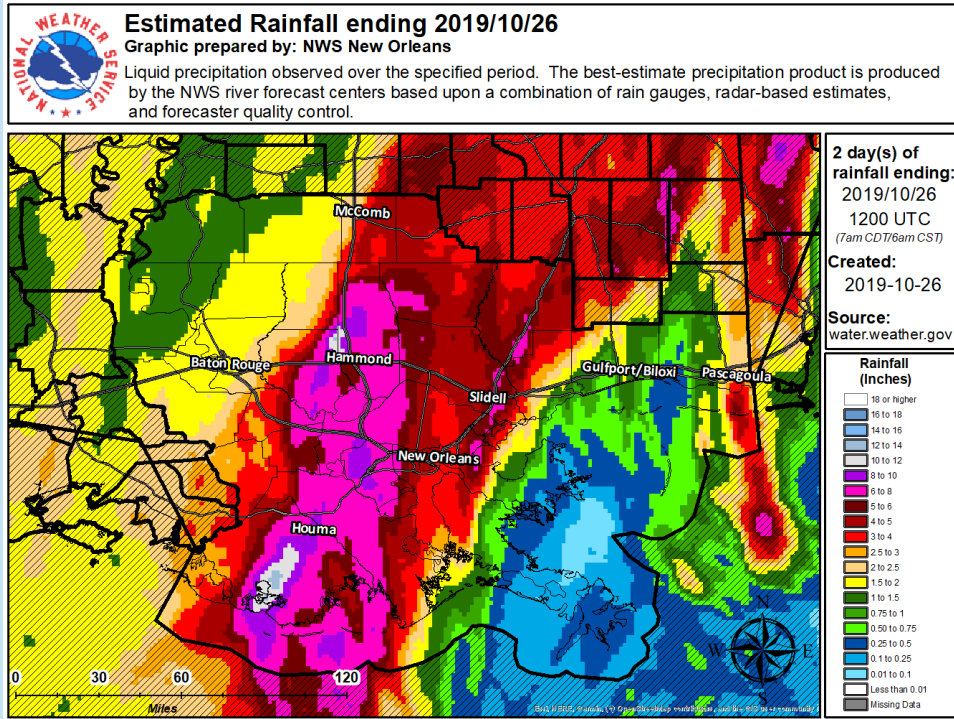
Though not a presidentially declared disaster, Tropical Depression Olga was fast moving, and tested the ne defenses of Terrebonne Parish October 25, 2019. The Parish closed the Bubba Dove Floodgate on the Houma Navigation Canal in anticipation of three (3) foot wave surges and closed all other floodgates and flood control structures in the MTTG levee system. Pump stations were operating in the forced drainage areas to control any flash floods from the predicted 4" rainfall.



Source: The Times; 10/26/2020

According to the National Weather Service, a swath of heavy rainfall of 6 to 8 inches occurred from Friday into early Saturday from Terrebonne and Lafourche Parishes traveling northeast. Parts of Terrebonne Parish experienced an estimated 10-14 inches. "Widespread and significant street flooding was reported in Houma and surrounding areas during the early morning Saturday. Due to dry soils conditions leading up to the event, only a few [bayous] reached flood stage, with mostly minor flooding reported."

The map below was created for the event using both rain gauges and radar to estimate the total rainfall from this storm.



Source: <https://www.weather.gov/lix/OlgaSummary> National Weather Service

Some flooding and damages were reported from properties outside the MTTG footprint or where the first lift and associated pump stations haven't been completed. The Louisiana Universities Marine Consortium, or LUMCON, is in Cocodrie outside all flood protections. Fortunately, the coastal laboratory was built elevated to 20 ft above sea level, so there are limited areas of the structure that have ever been inundated. However, experiments can be inundated and compromised, and the entry floor lobby took on water. This area has been floodproofed, and the upper floor has old but manually operated functional storm shutters against wind.

In Bayou Black, residents reported that there was backwater flooding from the closure of the Bayou Black Floodgate, and there was 10-12" in the houses by the time the pump station turned on according to area residents. This risk may be resolved when Hanson Canal Pump Station is online, and the other two pump stations in that area outlined in the Bayou Black Area Analysis in Attachment c3-2.

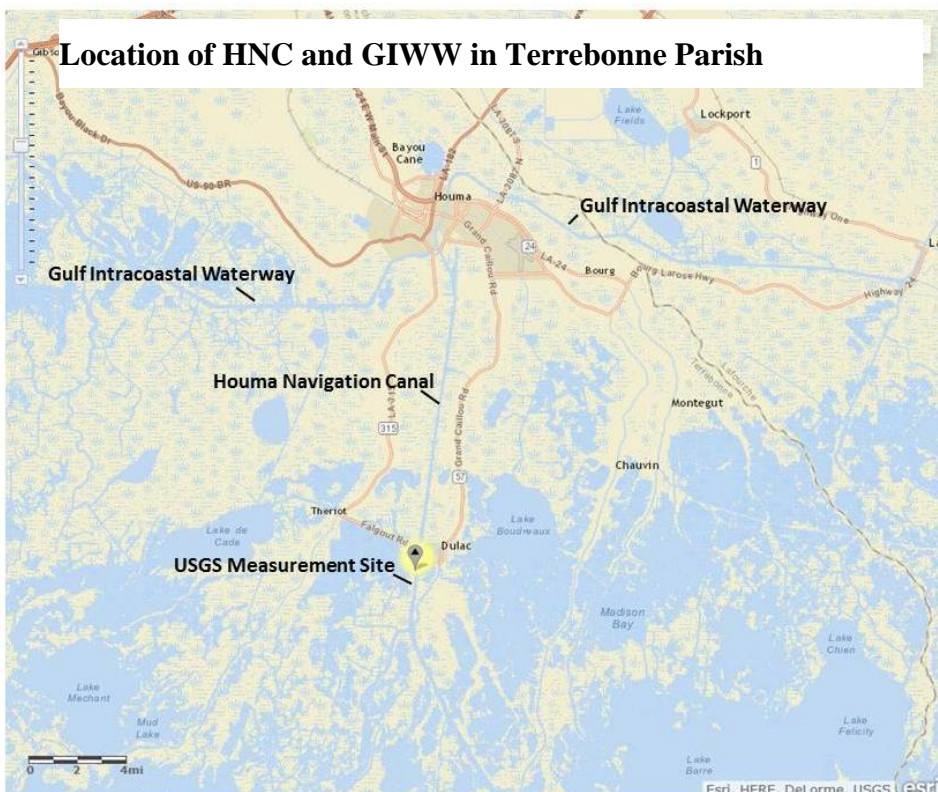
The most visible impacts of hurricanes are the losses due to wind and flood to structures and public infrastructure like roads and government and the private sector service interruptions. The Parish and our public and private partners seek to minimize damages and outages to the energy grid, communication systems, business and school closures, road integrity, the bridge operations, and other functions that could impede quick recovery from a hurricane event. If bridges are out or locked, either fishermen can't get in and out of the bayous, or car and foot traffic can't pass. A bridge outage can require a 60 mile detour due to the configuration of the bayou communities. The Parish focuses on generators, alternate and hardened transportation routes, and other redundancies to maintain resilient systems for roads, fire and police services, energy production and

delivery and private and civic activity to rebound quickly. Education of the community as to the type quality and extent of these protective measures is also important to nurture a sense of security and habit of safety in the community.

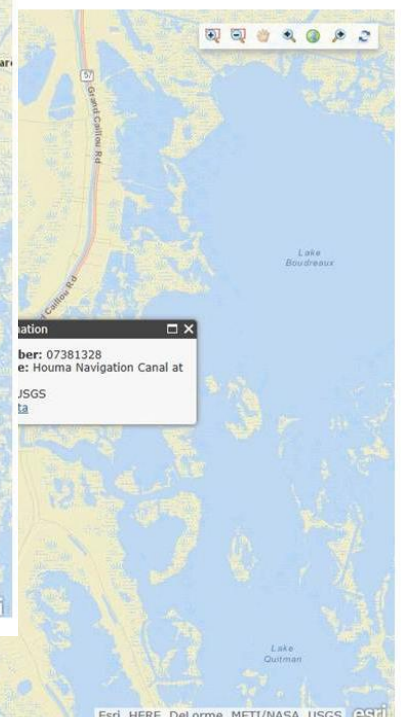
3.2.2.3 Saltwater Intrusion

Under natural conditions, the seaward movement of freshwater prevents saltwater from encroaching coastal fresh ground or surface waters, and the interface between freshwater and saltwater is maintained near the coast or far below land surface. The United States Geological Survey (USGS) states that reduced freshwater flows toward coastal discharge areas can cause saltwater to be drawn toward the freshwater in the ground. Saltwater intrusion occurs by many mechanisms, including encroachment from coastal waters daily through the bayous and at a greater scale during a storm surge. Saltwater can undermine marsh growth, fisheries productivity, and coastal stability as the vegetation and fauna do not thrive on saltwater. This can lead to loss of stability near roads and other built environment threatening their integrity as well as the changing flora resulting in lost coastal protection, habitat, and plants used for traditional medicines.

The Houma Navigation Canal is the primary waterway through which saltwater reaches Terrebonne Parish fresh waterways and marshes. At present, normal tide brings saltwater from the Gulf north into the parish by intruding the Gulf Intracoastal Waterway (GIWW). Due to the location of smaller waterways that feed into the HNC, when the saltwater travels north towards Houma, surrounding freshwater marshes are also destroyed. Saltwater intrusion in the GIWW also occurs in a similar manner from tidal influences from Bayou Lafourche. Furthermore, storm events exaggerate saltwater intrusion occurrences as storm surge push more saltwater further inland, reaching more fresh waterways and marshes than would occur during normal tidal events.



To alleviate saltwater intrusion's impacts on



the Parish, a lock for the Houma Navigation Canal currently being designed to assist in storm protection and resulting intrusion. The Parish has currently installed 10 floodgates and will be adding a lock component to the three bayous that support the most significant marine traffic.

The figure below illustrates the location of the Houma Navigation Canal and the GIWW in relation to Houma, as well as a USGS measurement station that records salinity levels in the channel. According to measurements taken at this station, daily mean salinity levels in the Houma Navigation Canal were recorded at 3.91 parts per thousand for the year 2009, 1.78 for 2010, and 4.89 for 2012 (USGS Water Information System).

As described previously, a marked harm of saltwater intrusion is the loss of marsh or wetland. This leads to further land subsidence, more open water, more erosion of soils, and higher winds over newly open water in a hurricane situation. In the case of a strong northward tidal push due to sustained south winds (as is the case in a tropical storm or hurricane event), saltwater intrusion significantly impacts the parish's potable water sources.

The parish's potable water intakes are jeopardized by saltwater 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.

Location of USGS Measurement Site along the HNC

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. 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. In May of 2013 the citizens of Terrebonne Parish voted to join the Bayou Lafourche Fresh Water District thereby guaranteeing an unlimited supply of raw fresh water from Bayou Lafourche. The reservoir at this plant can hold up to a five day supply at maximum production. In the forty eight years of operation of the Schriever facility there has never been a time when the raw water supply, Bayou Lafourche fed from the Mississippi River in Donaldsonville, has been unavailable for an extended amount of time.

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.

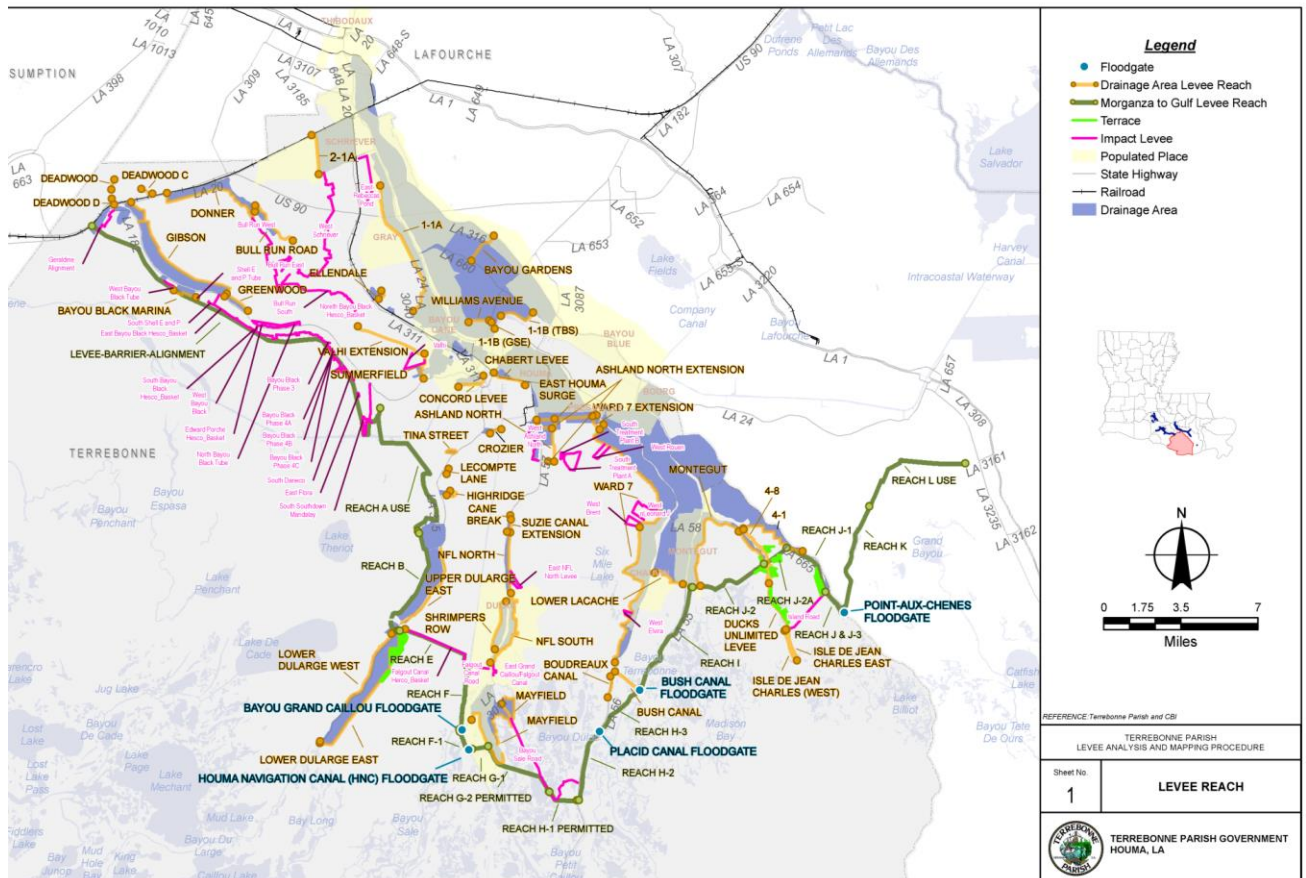
According to Terrebonne Parish Consolidated Waterworks (TPCW), the GIWW source has had problems with salinity for the last 40 plus years but with the proposed Houma Navigational Canal lock system in Dulac, they would expect for that to no longer be the case. During the last several years when the Bubba Dove barge has been closed, the salinity of the GIWW has remained acceptable for human consumption water. The plant has its own reservoir that can be supplied with water from either source and at maximum production/consumption has a 3 day supply of raw water.

TPCW has recorded a trend developing over the years, whereby salinity levels peak during hurricane season between August and November. 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 66%. However, this is not a concern to the provider or the Steering Committee at this time.

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

As previously discussed in Section II of this HMPU, a comprehensive system of hurricane protection levees has been constructed in Terrebonne Parish (Morganza-to-the-Gulf). The parish also relies on drainage levees to force water to drain in certain patterns. When confronted with hurricane storm surge of excessive height or velocity, the drainage levees in Terrebonne Parish have historically been overtopped. In addition, degradation of wetlands from storm events and manmade activity make the impacts of surge greater in Terrebonne. The parish's drainage levees were not constructed for tropical storm or hurricane induced surge waters. The MTTG is designed for a 12-foot surge, and if in place, would have been two feet higher than the surge for Hurricane Ike.

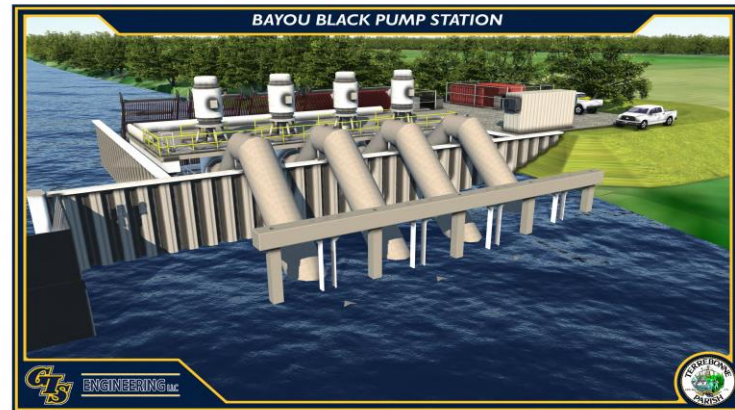
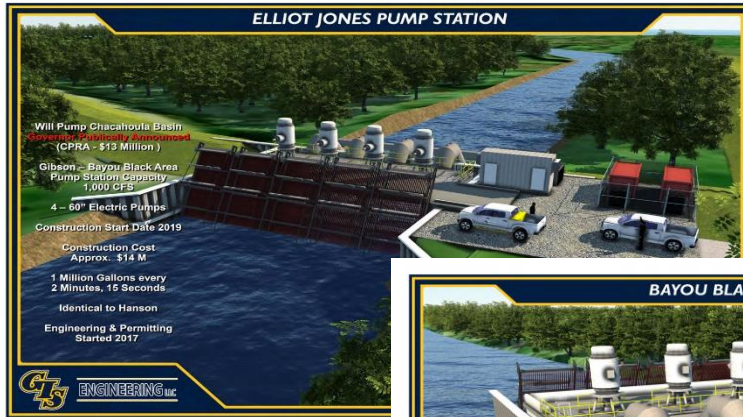
Considering the four hurricanes (Allison, Lili, Rita, and Ike) which have resulted in levee failure since the year 2000, the probability of levee failure in Terrebonne was estimated at 25% per year in 2015. The contiguous portions of the MTTG levee protection system that has been built to 12 feet will reduce the probability of levee failure in Terrebonne. It should be noted that the Hurricane Barry overtopping was of an incomplete levee that is now at 9' and will be 12' when complete, and is not considered a "failure." This yearly probability varies based on a storm's track in relation to parish levees, as well as the construction of new levees and upgrades to existing.



Source: APTIM

The LAMP Levee Reach map above illustrates the various levees and other mitigating structural installations in the Parish taken into account in the ongoing mapping process. 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 and drainage areas in the parish is provided in Attachment c2-3. There is a critical facilities map of the pump stations. The Parish is investing in power redundancy for these pump stations and slowly adding to the Supervisory Control and Data Acquisition (SCADA) remote management for enhanced operability and cameras to ward off vandalism and theft. All new pump stations are fitted with generator to ensure continuous power and operation.



The forced drainage levees and the drainage pumps combine to form individual drainage systems. These systems or areas are managed by the Terrebonne Parish Department of Public Works (DPW).

Inundation (Attachments c2-17 to c2-23) for hurricane events ranged from two to six feet. Future loss estimates for a levee overtopping failure are captured in the 2015 HAZUS model. The total structure use and function cost that would result from a hurricane and levee overtopping was estimated at \$157.3 million, according to HAZUS using the current data set available. This estimation is anticipated to be lower when run with the appropriate DEM based on the map above produced through the LAMP process.

3.2.2.5 Tornadoes

As previously stated, HMPU Steering Committee concluded that the tornado hazard will be profiled in this plan due to its high probability of occurrence although addressing mitigation measures relative to tornadoes 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. The entirety of the planning area is susceptible to tornadoes ranging between an F0 and F2, as recorded by historic NCDC information.

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.

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

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

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. There are 86 mobile home parks in Terrebonne Parish. They are listed in the following table.

Trailer Parks in Terrebonne Parish

Addie Authement
Al's Trailer Park
Alton James Jr. Mobile Home Park
Arthur Breaux
Azalea Trailer Park
Bayou View Trailer Park
Bayou Wind Mobile Home Park
Betty Desselle Dupre Street
Betty Desselle Trailer Park Peters Street
Biondo Trailer Park
Blue Bayou Trailer Park
Bon Villa Mobile Home Park
Bonvillain's Trailer Park
Callegan's Mobile Home Park
Capri Court Trailer Park
Carriage Cove Trailer Park
Charles Robinson Trailer Park
Clarence Matthews Mobile Home Park
Comet Mobile Home Park
Coteau Trailer Park (renamed Willow Wood Mobile Home Park)
Country Boy No. 1
Country Boy Trailer Park No.2
Creel's Mobile Home Park
Crestview Trailer Park
Crochet Trailer Park
Daniel Turner Mobile Home Park #1
Daniel Turner Mobile Home Park #2
David Gagneaux Mobile Home Park
Duplantis Trailer Park
Dupre Mobile Home Park
Faith Trailer Park

Family Mobile Home Park
Fanguy's Trailer Park
Gene's Mobile Home Park
Glover Mobile Home Park
Goodman's Trailer Park
Harris guidry Trailer Park
Hebert Brother Mobile Home Park
Hedgeford Trailer Court
Hope Street Mobile Home Village
Houma Mobile Home Park (bayou side)
Ingram Mobile Home Park
Ira Neil Mobile Home Park
Ja Mon Rentals Trailer Park
Jerry's Trailer Park
Jimmy Doirion Trailer Park
Johnson Mobile Home Park
Ken Rembert Trailer Park
Kim Burton Trailer Park
Knightshed Trailer Park
La Bonne Vie Mobile Home Park
Landry's Mobile Home Park
Le Visage Rouge Trailer Park
LeCompte Trailer Park
Levron Trailer Park
Memory Lane Trailer Park
Millers Trailer Court
Mott's Trailer Park
Mulligan Mobile Home Park
Myrna Mobile Home Park
Myrna Mobile Home Park

Nelo's Mobile Homes
North American Fabricators Mobile Home Park
O'Brien Mobile Home Park
Oakview Mobile Home Park
Patrick Duplantis Mobile Home Park
PHI Mobile Home Park
Pe'l's Mobile Home Park
Peltier Trailer Park
Poche Trailer Park
Porche Trailer Park
Quality Shipyard Mobile Home Park
Remwood Trailer Park
Robert Price Mobile Home Park
Rolands Trailer Park
Saadi Mobile Home Park
Slatter Street Mobile Home Park
SONOCO Mobile Home Park
South Van Trailer Park
Theriot Trailer Park
Victoria Mobile Home Park
Whitney's Trailer Park
Wilow Woods Mobile Home Park (See Coteau Trailer Park)
Wilson's Mobile Home Park
Wilson Gaidry Trailer Park

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. The Parish would discourage the use of mobile homes but for the limited availability of affordable housing without this option.

Terrebonne Parish Tornado History 1957-2019

Date	Type	Magnitude	Injury	Property Damage
3/21/1957	Tornado	N/A	0	\$25,000
5/11/1959	Tornado	F0	0	N/A
11/22/1961	Tornado	F2	0	\$2,500
9/6/1967	Tornado	F1	0	\$25,000
11/1/1977	Tornado	F1	0	\$25,000
11/8/1977	Tornado	F1	2	\$250,000
7/9/1982	Tornado	F0	0	\$2,500
2/12/1984	Tornado	F1	0	\$250,000
11/16/1987	Tornado	F1	0	\$250,000
7/24/1988	Tornado	F1	0	\$25,000
3/29/1990	Tornado	F1	7	\$250,000
5/28/1990	Tornado	F0	0	N/A
11/1/1991	Tornado	F1	0	\$250,000
11/20/1992	Tornado	F1	0	\$2,500
1/17/1994	Tornado	F0	0	\$5,000
1/18/1995	Tornado	F1	0	\$250,000
8/24/1998	Tornado	F0	0	N/A
1/2/1999	Tornado	F1	0	\$700,000
3/15/2000	Tornado	F2	36	\$10,000,000
8/31/2000	Tornado	F0	0	N/A
12/13/2001	Tornado	F1	0	\$100,000
3/31/2002	Tornado	F1	0	\$75,000
10/3/2002	Tornado	F1	0	\$25,000
7/6/2004	Tornado	F0	0	\$5,000
11/2/2004	Tornado	F0	0	\$2,000
11/27/2004	Tornado	F1	0	\$50,000
3/14/2007	Tornado	F0	0	\$5,000
12/26/2007	Tornado	F0	0	\$25,000
3/5/2011	Tornado	N/A	0	\$50,000
11/16/2011	Tornado	N/A	0	\$30,000
2/25/2013	Tornado	N/A	0	\$100,000
10/25/2015	Tornado	N/A	0	\$0
Total			45	\$12,779,500
<i>Source: NCDC</i>				

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 1957-2019 with an annual probability of fifty percent. All 45,327 structures in the parish are vulnerable to some sort of tornado damage at any given time. One can estimate that the average losses for a tornado event would average \$411,435, based on historical losses from the NOAA. For this reason, the steering committee agreed to assign the Terrebonne

Parish at a medium risk for tornadoes. All wind related mitigation actions can be found in Attachment c3-1.

3.2.2.6 Coastal Erosion and Land Subsidence

Coastal erosion and land subsidence are intricately connected in Louisiana, and as such, for the purpose of this plan they will be treated as one hazard in the coastal areas. Subsidence in forced drainage areas will be discussed in section 3.2.2.7. However, because coastal erosion and saltwater intrusion are always happening it can't be measured by individual events.

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

Land subsidence in Terrebonne Parish can be defined as the loss of surface elevation due to the loss of subsurface density. According to *Faulting, Subsidence and Land Loss in Coastal Louisiana* subsidence in Terrebonne Parish has been measured to be between 2.1' and 3.5' of loss of elevation every 100 years with the probability of continued subsidence at 100 percent.

In Terrebonne, the most concentrated land loss has occurred south of the Intracoastal Waterway near populated communities. West of Dulac and south of Theriot, significant land loss occurred in the period 1956-1973. Within the same time period, significant land loss occurred south of Montegut as well. Southeast of Morgan City, the period from 1932 to 1956 marked a period of concentrated land loss. More recently occurring land loss concentrations are located south of Amelia and the Gulf Intracoastal Waterway and west of Montegut.

It is assumed that subsidence has always occurred in Terrebonne, but because seasonal flooding and the sediment associated with it has been limited by water control structures, the natural balance has been adversely affected by man-made structures. Subsidence is caused by a diverse set of human activities and natural processes. Those two causes are profiled below.

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

found to be rich in oil and gas, and significant amounts of these resources were removed from the wetlands.

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

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.

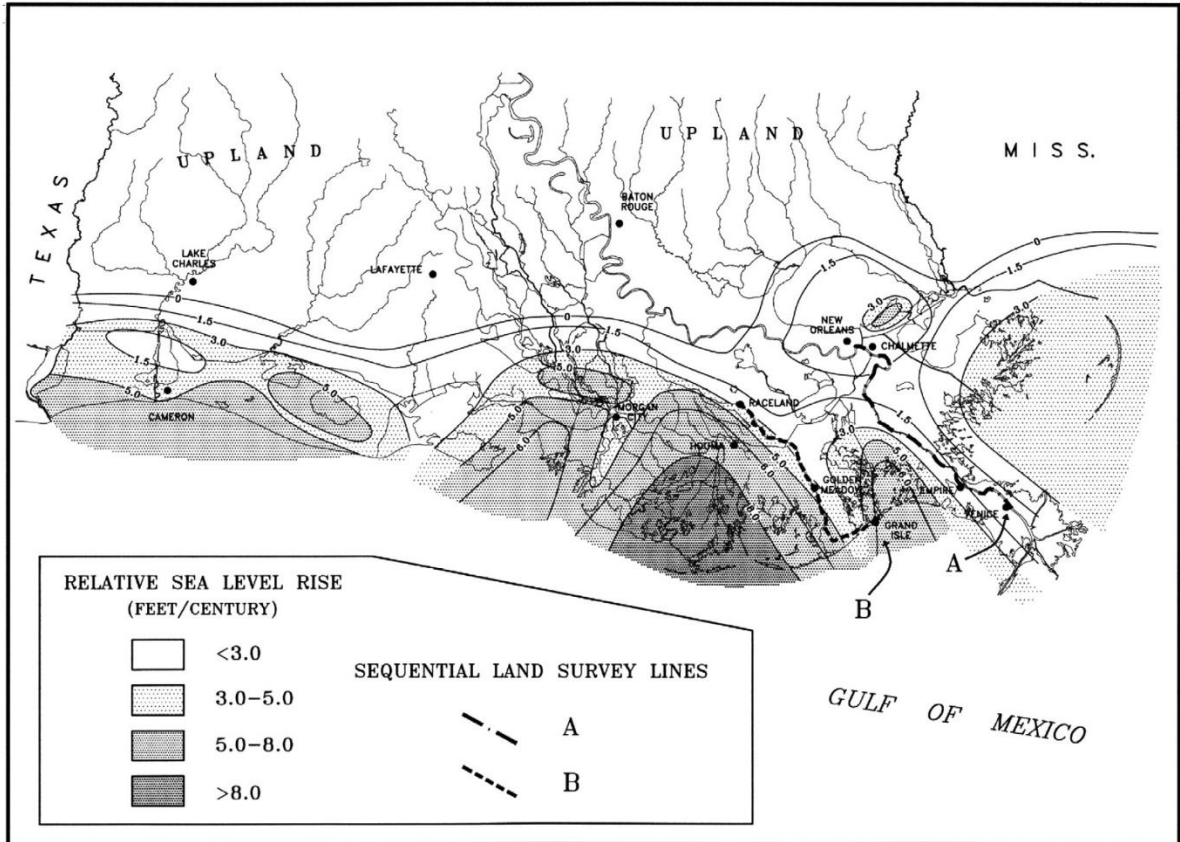
All states with low-lying coasts are vulnerable to accelerated sea-level rise, but Louisiana's coast is much more so because of the subsidence of the Mississippi River delta. Until humans intervened, the surface elevation of the broad delta complex had kept pace with rising sea level for several thousand 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 45,327 structures in the parish are vulnerable to the effects of subsidence, including agricultural, commercial, government, industrial, residential, religious/nonprofit, and school structures. There is no way to quantify per event loss estimates for strictly coastal erosion and land subsidence in this plan. However, since subsidence heightens the effects of flooding, one can assume subsidence increases flood losses by 0.01% per year.

Sea level rise is directly related to coastal 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 is

not profiled independently in this HMPU as the Parish does not have the capacity independently to mitigate sea level rise itself. However, the Parish is considering the impact on coastal erosion and potential land loss, and efforts to work with that eventuality in future coastal restoration projects and the built environment.

Relative Sea Level Rise in Coastal Louisiana















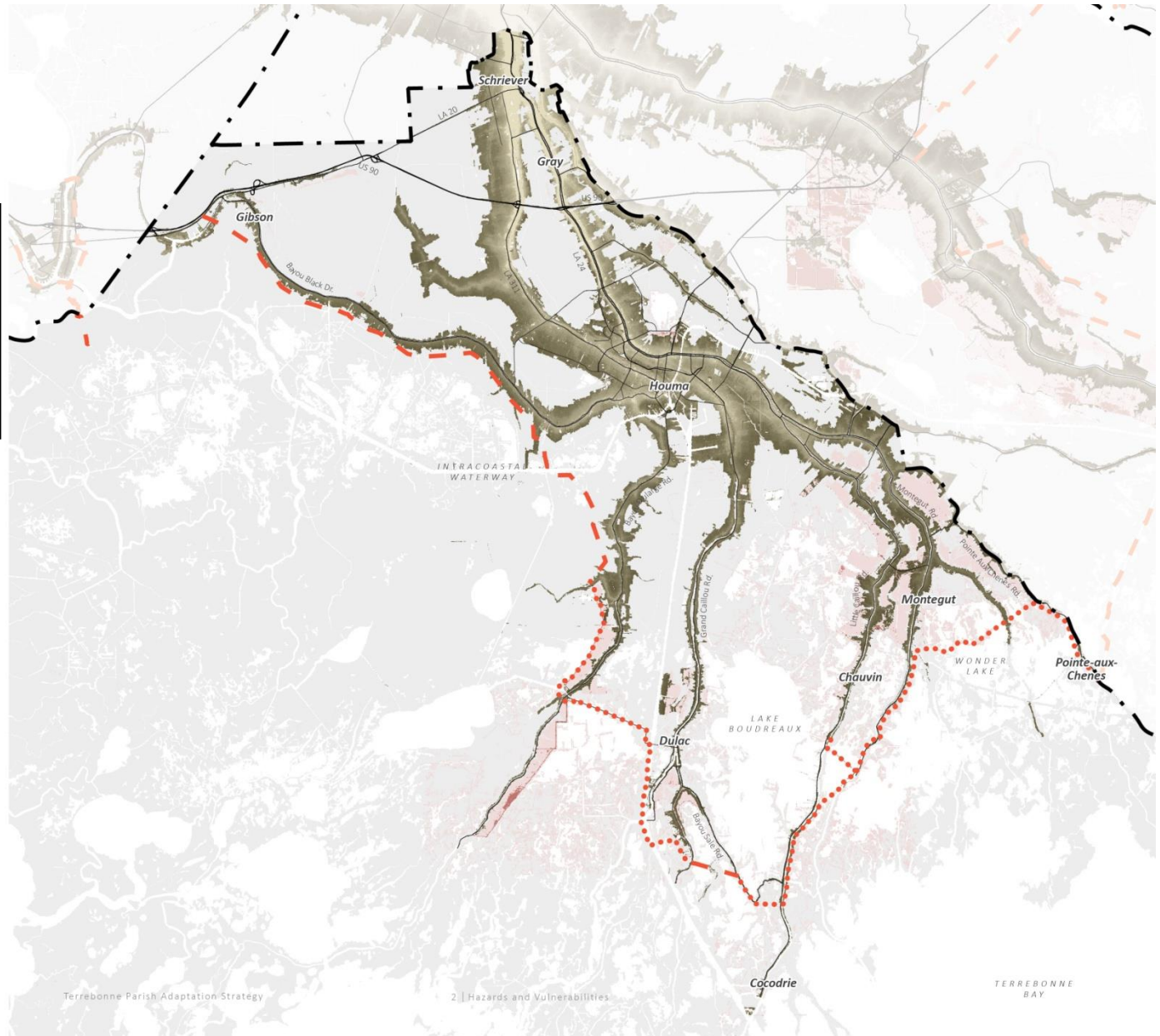
ELEVATION TODAY

Sources: NOAA Digital Elevation Map 2011; For all basemap data see References

The Parish must research and prioritize methods that are cost effective and will preserve the elevation of land in the Parish. Seasonal sediment deposits historically restoring the soils may be possible on a large scale to raise the wetlands through the sediment pipelines if funded.

Legend

-  > 13'
-  9' to 13'
-  5' to 9'
-  0' Sea Level
-  0' - 1' Wetlands
-  0' to -3'
-  Water
-  Non-Federal Levee (Morganza to the Gulf)
-  CPRA Proposed Levee (Morganza to the Gulf)
-  Parish Boundary



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

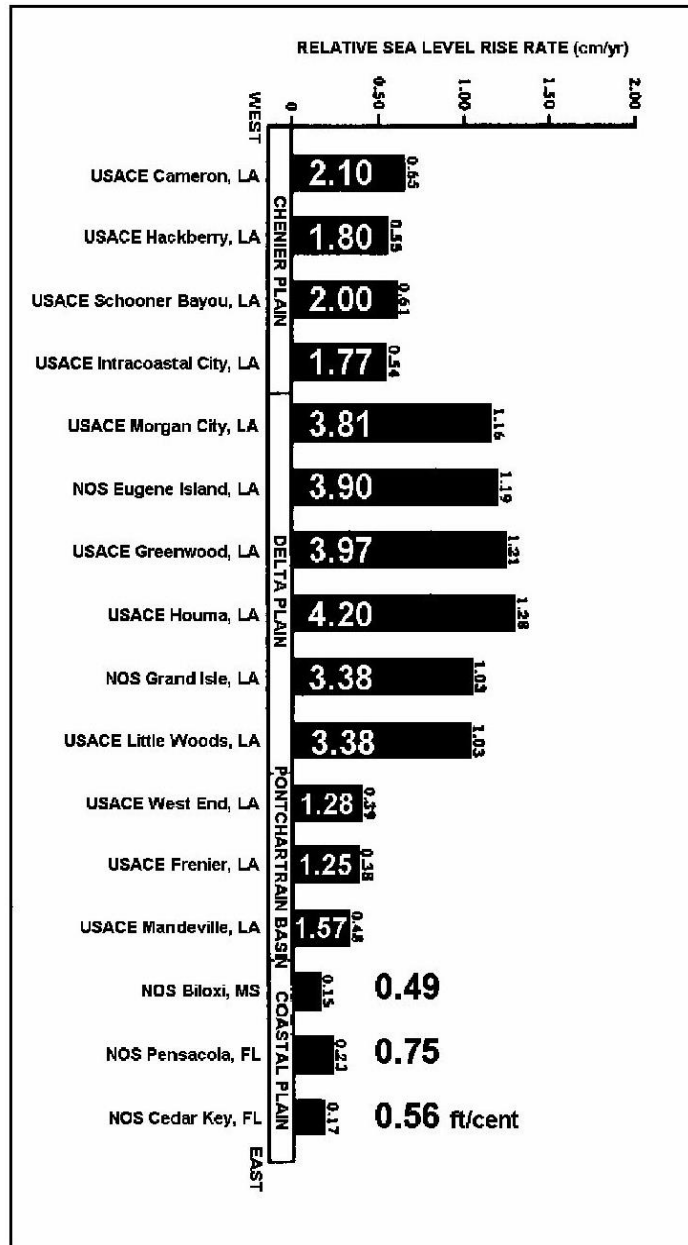


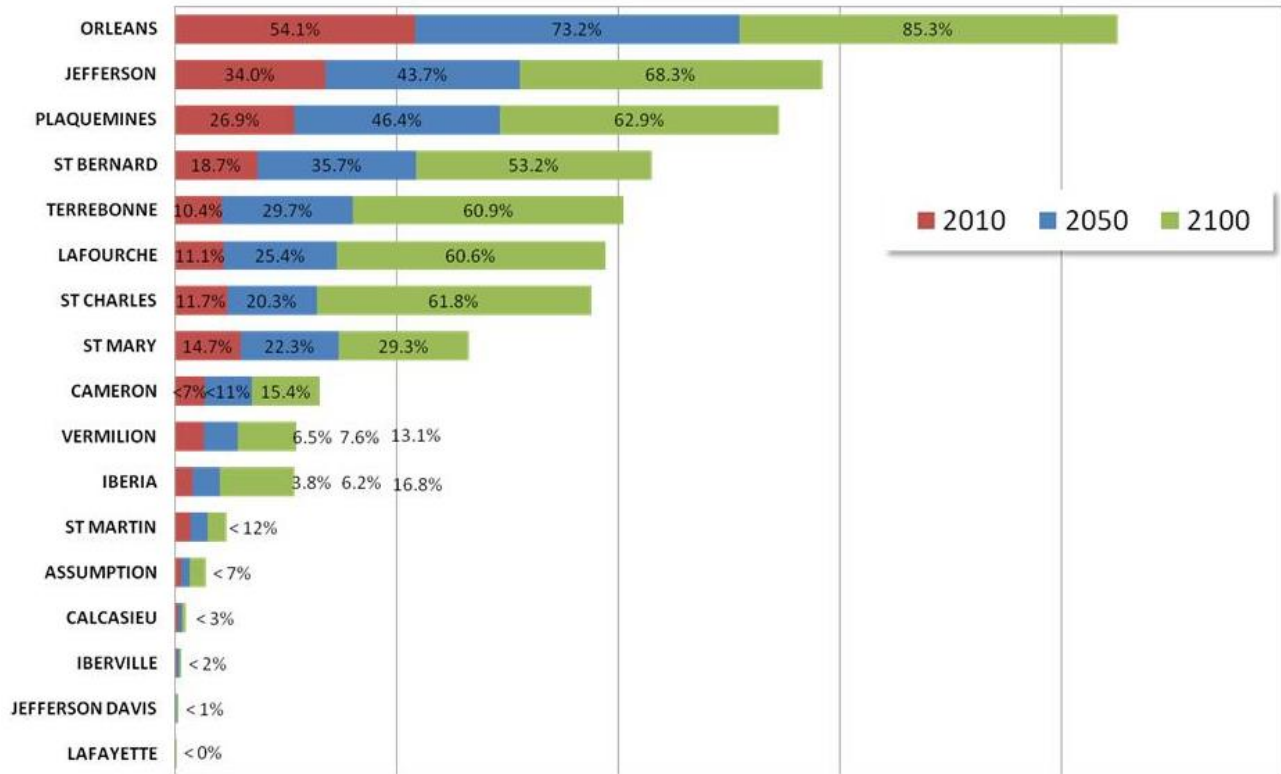
Figure 1-19. Rates of relative sea level rise across the northern Gulf of Mexico region from Cameron, LA to Cedar Key, FL based on records from the National Ocean Survey and U.S. Army Corps of Engineers tide gage stations. The Pensacola, FL gage land location is considered to be stable, and this gage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

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

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

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

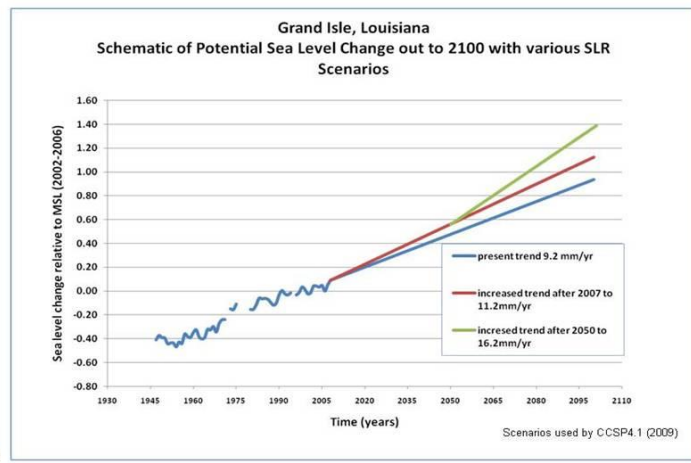
Percent Land Below Sea Level by Parish Through 2100



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

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

Climate models project acceleration in Sea Level Rise starting before 2100 due to climate change



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

The combination of coastal erosion and relative sea level rise poses a challenge to the community, the state and the country to maintain these areas for habitat and fisheries productivity as well as protection for the levee system. The Parish levee systems are earthen, and are not designed to bear ocean currents without the barrier of the islands and marshes outside the system. The vast oil infrastructure is protected by the marsh system that would otherwise expose the pipelines to ocean currents and the elements. Tourism and camps, docks, and leases for sports fishing and hunting are important to the economy. The loss of the coastline can damage this infrastructure as well as cultural and commercial assets that contribute to the quality of life and economic stability of the community.

3.2.2.7 Land Subsidence

Terrebonne Parish experiences shallow subsidence from compaction of soils both in the coastal areas, and the forced drainage areas. The subject was discussed at length in the LA SAFE meetings, and the following synopsis captures that discussion.

Shallow subsidence is the sinking of the ground that damages our buildings, our streets, and other infrastructure and makes the challenge of pumping stormwater out of the region more difficult. Subsidence is a result of dry soils, largely caused by current drainage practices that pump water out rather than maintaining a consistent water table.

The Parish and the state Adaptation Plan both propose engagement of an approach that uses gray and green infrastructure to meet a balance between keeping water on the land, and protecting the built environment.

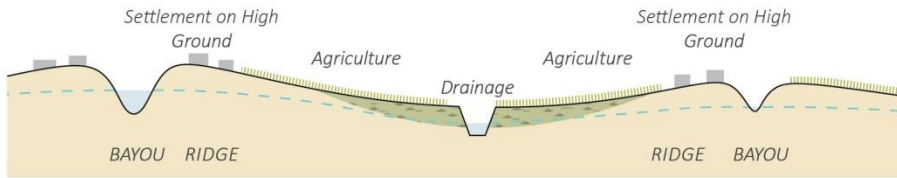
According to the state plan, the increased flood risk and infrastructure damage caused by subsidence across the region add millions of public dollars every year in preventable expenses. Subsidence also drastically raises the cost and frequency of repairs to levees, canals, and floodwalls that have been compromised by degradation or lowered elevations.

The graphic below illustrates how the change in pumping practices can encourage or exacerbate subsidence unintentionally. This is a critical point to understand now that such a large area of the Parish is in a forced drainage.



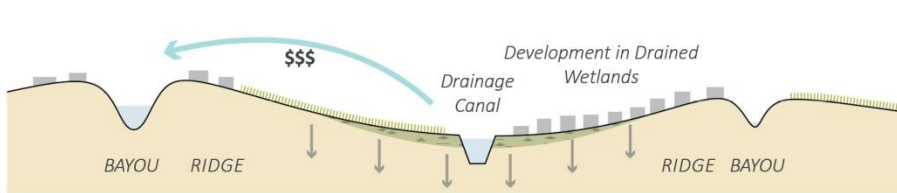
Pre-European Settlement—Natural Condition

Natural waterways form naturally high ridges.



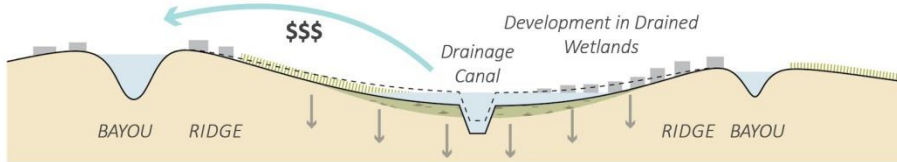
Early Development

Early development was on the highest ground adjacent to natural bayous and waterways.



Current Condition—Drain and Pump

Modern technologies have allowed development in the low-lying wetlands. Water is pumped out lowering the groundwater level and causing soils to dry and land to sink.



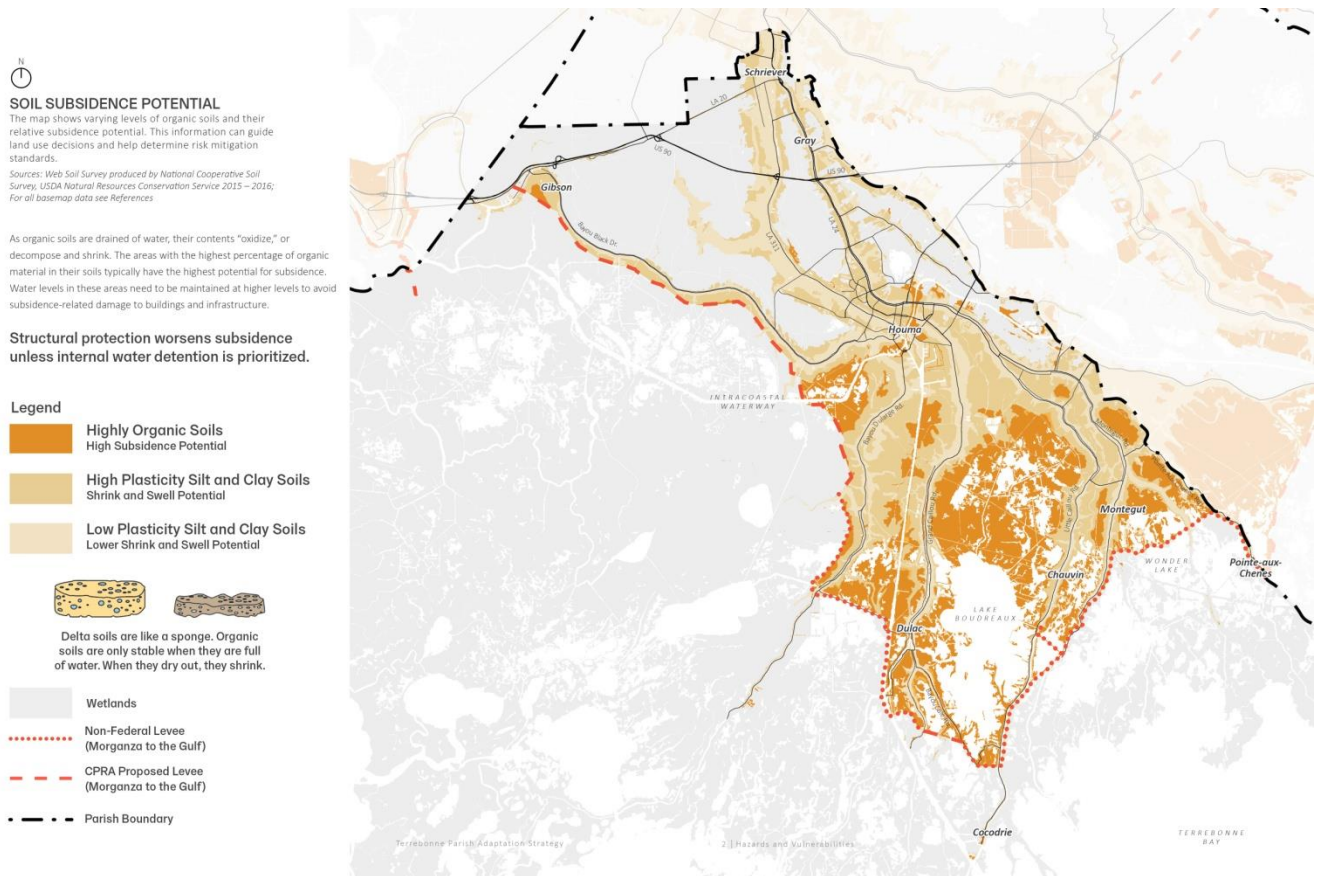
Future Subsidence without Action

Limited stormwater capacity in the bayous causes increased flood risk in low-lying areas. As land sinks and sea levels rise, pumping and levee maintenance costs increase further.

LA SAFE Terrebonne Parish Adaptation Strategy, p. 51.

The subcommittee has committed to review the actions that can be taken to ensure that the water can be pumped from the system to reduce flooding while retaining sufficient soil saturation to support the built and natural environments.

The subsidence potential of the area is in part due to the types of soils, each of which respond at different levels of subsidence when dry. The soils have been mapped and the level of risk that they will subside captured (see below).



LA SAFE Terrebonne Parish Adaptation Strategy, pp. 52-53.

Any increase in the rate of subsidence is relevant to the integrity of the foundations of the built environment, and could affect homes, businesses, roads, etc. as well as flood insurance rates for structures that have subsided sufficiently to no longer be compliant with those safety regulations. The Parish will have to seek additional data to have a sound understanding of the rates within the new and increasingly pumped forced drainage areas.

3.2.2.8 Lighting

Lightning is a natural electrical discharge in the atmosphere that is a by-product of thunderstorms. Every thunderstorm produces lightning. There are three primary types of lightning: intra-cloud, cloud-to-ground, and cloud-to-cloud. Cloud-to-ground lightning has the potential to cause the most damage to property and crops, while also posing as a health risk to the populace in the area of the strike.

Damage caused by lightning is usually to homes or businesses. These strikes have the ability to damage electrical equipment inside the home or business and can also ignite a fire that could destroy homes or crops.

Lightning continues to be one of the top three storm-related killers in the United States per FEMA, but it also has the ability to cause negative long-term health effects to the individual that is struck.

NOAA has developed a lightning activity level (LAL) to measure the number of lightning strikes per 15 minutes. Terrebonne can expect all levels (1-6) throughout all areas of the parish.

NOAA’s Lightning Activity Level (LAL)

LAL	Cloud and Storm Development	Lightning Strikes / 15 minutes
1	No thunderstorms.	-
2	Cumulus clouds are common but only a few reach the towering cumulus stage. A single thunderstorm must be confirmed in the observation area. The clouds produce mainly virga, but light rain will occasionally reach the ground. Lightning is very infrequent.	1-8
3	Towering cumulus covers less than two-tenths of the sky. Thunderstorms are few, but two to three must occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.	9-15
4	Towering cumulus covers two to three-tenths of the sky. Thunderstorms are scattered and more than three must occur within the observation area. Moderate rain is common and lightning is frequent.	16-25
5	Towering cumulus and thunderstorms are numerous. They cover more than three-tenths and occasionally obscure the sky. Rain is moderate to heavy and lightning is frequent and intense.	>25
6	Similar to LAL 3 except thunderstorms are dry.	

Lightning is a climatological based hazard and has the same probability of occurring throughout the entire planning area for Terrebonne Parish. An extensive search of lightning strikes to have any significant impact to property or people in the Terrebonne Parish planning area over the last 56 years returned sixteen incidents as shown in the table below with related loss estimates.

Terrebonne Parish Lightning History 1957-2019

Date	Type	Time	Property Damage
7/24/1999	Lightning	1100	-
9/8/1999	Lightning	1300	500,000
7/25/2002	Lightning	1230	20,000
6/2/2004	Lightning	550	500
7/18/2004	Lightning	645	2,000
8/5/2004	Lightning	2230	-
6/6/2005	Lightning	1800	-
6/16/2005	Lightning	1630	-
8/21/2005	Lightning	800	15,000
8/21/2005	Lightning	1530	65,000
7/1/2007	Lightning	1200	-
8/17/2008	Lightning	1700	15,000
7/9/2009	Lightning	834	-
8/21/2009	Lightning	1455	20,000
8/20/2010	Lightning	1300	40,000
6/25/2014	Lightning	1745	2,000

Lightning can strike anywhere and is produced by every thunderstorm, so the chance of lightning occurring in Terrebonne Parish is high. However, lightning that meets the definition that is used by NCDC that actually results in damages to property and injury or death to people is a less likely event. According to the State Hazard Mitigation Plan, a major lightning strike in Terrebonne Parish is likely to occur more than once a year. The annual probability of a lightning strike is 100%.

Since 1999, there have been 16 lightning events that have resulted in property damages according to the NCDC database. The total property damages associated with those events have totaled \$679,500. To estimate the potential losses of a lightning event on an annual basis, the total damages recorded for lightning events was divided by the total number of years of available major lightning strike data in NCDC (1957-2019). This provides an annual estimated potential loss of \$10,959. All 45,327 buildings in Terrebonne Parish are vulnerable to lightning strikes. There have been no reports of death due to lightning strike events. Since lightning is a common occurrence in Terrebonne Parish, development trends will not be affected. Recently constructed buildings are not more vulnerable to lightning than existing structures, however, critical facilities will be encouraged to be constructed with lightning rods in the future. See section 4.2 for mitigation action items relating to lightning.

3.2.3 Risk Assessments

The risk assessment process was developed using data from past hazard events, existing land use data, HAZUS, FEMA flood maps, and FEMA repetitive loss structures. The land use map used for this purpose is displayed in Attachment c2-6 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 at the end of this section. The Parish anticipated incorporating the LAMP process maps or final DFIRMs by this time, but the data was not ready for review and inclusion.

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, Hurricane Ike, and Hurricane Barry.

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 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 535).

FEMA Repetitive Loss Structures

The fourth independent vulnerability assessment mapping task was based on the FEMA repetitive loss structures inventory. Within the framework of NFIP the number and frequency of repetitive losses play critical roles in determining flood insurance premiums within a community. The National Flood Insurance Program is a system setup by Congress to provide property owners with protection from flooding damages related to hurricanes, tropical storms, heavy rains, etc., not covered by traditional homeowners insurance. A community must formally participate in the NFIP for residents within a jurisdiction to be eligible. Eligibility hinges on a community's success in becoming more resilient and mitigating potential impacts from hazard events. Persistent repetitive losses in a community with little mitigation typically yields higher flood insurance premiums. For those communities that are aggressive in mitigating impacts and reducing losses, the NFIP offers voluntary participation in the Community Ratings System (CRS) program. This program incentivizes communities to go beyond minimum NFIP standards by offering greater flood insurance premium rate discounts. Terrebonne Parish participates in both the NFIP and CRS. Though Terrebonne has a significant number of repetitive losses, the parish continues to engage in mitigation efforts to improve its rating, and it is currently engaged in the Levee Analysis and Mapping Procedures for Non-Accredited Levees process which will result in more accurate flooding forecasts which will inform future development patterns. Terrebonne's efforts to reduce losses are described in the Repetitive Loss Strategy section found in Section **3.2.5 §201.6 (c)(2)(ii)(B)**.

According to the parish, Terrebonne Parish has a total of 1,067 repetitive loss structures defined as structures flooded two times or more at a value of at least \$1,000 per occurrence. Of these, 141 are severe repetitive loss structures, 107 of which are residential. Of these only thirty-three are insured according to the latest record provided by FEMA. A Severe Repetitive Loss is defined as a one-to-four family residential property with at least four National Flood Insurance Program (NFIP) payments over \$5,000 and the cumulative amount exceeds \$20,000 or two to three separate claims payments have been made with the total payments exceeding the market value of the building (FEMA 2004).

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

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

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

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

3.2.4 §201.6 (c)(2)(ii)(A) *The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas*

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

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

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

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

In the determination of hazard area percentages, an inundation polygon file that represents a composite flood (i.e. a combination of all applicable storm inundations or gauge data for a particular storm) was used. The inundation polygon was overlaid with

HAZUS Census Block data and those blocks which intersected the inundation polygons had their building information included in the HAZUS estimates. The composite was necessary to account for differences in the data sets. The worksheets are represented as Attachment c2-28 (page 114-115). 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 in the 2015 HAZUS assessments. An estimated 26,373 of these with a value of \$4,407,015,000 are in the hazard area. The total residential population within Terrebonne Parish is 104,503, and 64,961 or 62% are in the composite risk area, which is the area within the 100-year floodplain, in addition to those areas that are at risk beyond the floodplain as evidenced by past storm events.

Residential

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

Commercial

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

Industrial

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

Agricultural

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

Religious/Nonprofit

The religious/nonprofit 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. This list was compiled according to the following pre-defined groups:

- Essential facilities
- Lifeline utility systems
- Other important facilities

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

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

In addition, an expanded list of critical facilities is provided in the attachments as “2014 Building Content Listing w-Flood Elevation.” The accompanying PDF’s list facilities included in the HAZUS analysis as well as those that hold importance to the parish

regarding its operations although they may not necessarily be included in a FEMA evaluation.

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 at the end of this section.

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

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

Worksheet #4

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

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

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

3.2.5 §201.6 (c)(2)(ii)(B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(a) of this section and a description of the methodology used to prepare the estimate

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

The repetitive loss structures map is displayed in Attachment c2-25. 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:

As previously stated, in Terrebonne, the lack of new mapping data has hindered the projections of loss. To be conservative, we are using the 2015 projections for the repetitive loss strategy. Terrebonne Parish has 297 residential and 24 non-residential repetitive loss properties following the definition for a flood mitigation assistance program. FEMA insurance paid a total average of \$102,315 per property for the 297 residential properties and \$207,232 per property for the 24 non- residential properties.

The repetitive loss property list shared by the Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP) shows 1,101 unmitigated repetitive loss structures. Of these, only 321 meet the Biggert Waters Definition of two storms averaging >25% damage, 47 of which are on the FEMA Severe Repetitive Loss list. Another 467 are 25% damaged or less. Also worth consideration is that 132 have **not** made a flood claim since 1999, 397 since 2005, and 1,030 since 2009. The Parish has focused predominantly on repetitive loss areas, and structures that can be funded through yearly Hazard Mitigation Assistance (HMA) or Hazard Mitigation Grant Program (HMGP) disaster funded projects.

Strategies to Reduce Repetitive Loss Properties in addition to Structural Installations

Outreach and Insurance

The Terrebonne Parish has been providing outreach to Severe Repetitive Loss and Substantially Damaged properties yearly to outline opportunities available for elevation, buyout or demolition as appropriate. The outreach includes invitations for open grant applications which are ongoing throughout the years. Each owner of uninsured properties receives additional outreach in letters and postcards to encourage them to insure the properties for the upcoming storm season and grant applications.

Of the 81 that flooded since 2009 (the last 10 years) 10 are in a funded program or are in an application, 5 meet the repetitive loss definition of BW2012 and 14 are verified SRL properties.

Repetitive Loss Studies

Due to the prevalence of repetitive loss properties and the number of severe repetitive loss properties, Terrebonne Parish has initiated a plan to address its repetitive loss problem as specified in Sections 501-504 of the *NFIP CRS Coordinator's Manual*. In the past, Terrebonne Parish has taken measures to identify concentrations of RL properties, better understand the causes of those losses, and develop recommendations for reducing those losses. During this plan development, the Parish performed a Bayou Black Area Analysis of repetitive loss properties. The study, which was initiated by Terrebonne Parish invited residents in three study areas to fill out surveys, and Parish staff went onsite and surveyed 326 structures. A detailed listing of recommendations for decreasing the number of repetitive loss and severe repetitive loss structures are disclosed in the *Bayou Black Repetitive Loss Area Analysis* found in Attachment C3-3. Improvement of the Parish's Community Rating System (CRS) Class is one key recommendation from the report.

The Parish, as mentioned above, is implementing a coordinated levee, flood gate and pump station system to protect the Bayou Black area in particular. Any outcomes of the new lock system in Bayou Chene may also protect this area. The residents are engaged, and the area will be revisited after each pump station is in place.

Barriers to Entry and Proposed Solutions

Some of the Parish's efforts to assist in the mitigation of repetitive loss properties has been frustrated in several ways. Applicants may be new owners, and not have increased cost of compliance available to help with matches, and the structure may have not been covered by flood insurance, so that is a barrier to entry into the Flood Mitigation Assistance grant program. The grant program itself is nationally competitive, and last year, the Parish application for repetitive loss properties was not selected for further review.

Many of the severe repetitive loss properties are camps and not primary residences, so the barrier to entry of the federal surcharges and high rates have limited our ability to recruit participants, even at 100% funding.

The Parish is considering funding group policies for potential applicants in an effort to increase participation and take advantage of elevation, which is one of the multiple lines of defense that protects the parish. In the event that the levee is overtopped by a 100 year storm, the elevated structures would still be above the projected flood level. The parish mitigation grant elevations include a foot of freeboard as well, so it is a conservative approach to flooding.

The Parish Predisaster Mitigation elevation grant project coincided with changes to the Increased Cost of Compliance program and the time available to make use of those funds. The insecurity of the applicants, and the lack of cooperation from the insurance sector created an incentive for the applicants to sell the homes. The new owners did not have access to the insurance benefit, and therefore could not take advantage of the program without significant investments due to the 25% match. We continue to propose PDM

elevation grant applications for applicants who agree to the 25% match at the application period. If history repeats itself, those elevations may not come to fruition either due to nonselection by the FEMA, or such a lag in time between the application and the approval that the finances of the applicants have changed and they won't be willing to pay for the match. The Parish may have to consider independently or with the assistance of the state, providing at least a portion of the nonfederal share.

Terrebonne Parish has engaged in a public outreach effort to inform the public and industry about flood damage prevention and to obtain their preferences regarding flood damage prevention issues.

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. Most of the Parish is insured based on 1985 maps. The regulatory standard is the Advisory Base Flood Elevation (ABFE) from 2006.

Insurance Overview Terrebonne
As of 08/31/2019
Community: TERREBONNE PARISH* State: LOUISIANA
County: TERREBONNE PARISH CID: 225206
Total by Community
Total Number of Policies: 11,048
Total Premiums: \$8,070,156
Insurance in Force: \$2,863,926,400
Total Number of Closed Paid Losses: 10,189
\$ of Closed Paid Losses: \$273,564,159
Group Flood Insurance
Total Number of Policies: 0
Total Premiums: \$0
Insurance in Force: \$0
Total Number of Closed Paid Losses: 484
\$ of Closed Paid Losses: \$7,068,068
Post Firm Minus Rated Policies
Total Number of Minus Rated Policies: 178
A Zone Minus Rated Policies: 178
V Zone Minus Rated Policies: 8
Manufactured Homes
Total Number of Policies: 534

Total Number of Closed Paid Losses: 607
\$ of Closed Paid Losses: \$6,281,679
ICC
Total Number of ICC Closed Paid Losses: 1,005
\$ of ICC Closed Paid Losses: \$26,605,530
1316
Number of Properties by Community: 1
Substantial Damage Losses
#of Substantial Damage Closed Paid Losses: 2,786
Data Courtesy of Region VI DHS/FEMA RVI-MT-FM&I
Insurance Overview Houma
As of 08/31/2019
Community: HOUMA, CITY OF State: LOUISIANA
County: TERREBONNE PARISH CID: 220220
Total by Community
Total Number of Policies: 4,561
Total Premiums: \$2,788,618
Insurance in Force: \$1,298,181,000
Total Number of Closed Paid Losses: 1,016
\$ of Closed Paid Losses: \$19,450,861
Group Flood Insurance
Total Number of Policies: 0

Total Premiums: \$0
Insurance in Force: \$0
Total Number of Closed Paid Losses: 102
\$ of Closed Paid Losses: \$1,190,269
Post Firm Minus Rated Policies
Total Number of Minus Rated Policies: 11
A Zone Minus Rated Policies: 11
V Zone Minus Rated Policies: 0
Manufactured Homes
Total Number of Policies: 57
Total Number of Closed Paid Losses: 5

\$ of Closed Paid Losses: \$29,515
ICC
Total Number of ICC Closed Paid Losses: 12
\$ of ICC Closed Paid Losses: \$298,038
1316
Number of Properties by Community: 0
Substantial Damage Losses
Number of Substantial Damage Closed Paid Losses: 56

Flood insurance is critical to the resilience and recovery of Terrebonne Parish from extraordinary and nuisance flooding alike. The Parish recommends flood insurance to all properties regardless of flood zone and is a net beneficiary of the program.

The Parish lost one class in the transition to the 2013 CRS Manual. Both Houma and Terrebonne are Class 7. Due to improvements in documentation and other efforts, the Parish is working to regain a Class six, or move to a Class 5 at the next recertification.

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	10/1/17	7	15	5	C

CRS Participation in Houma, Louisiana

Community Number	Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
220220	Houma, City of	10/1/92	10/1/09	7	15	5	C

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

Repetitive Loss Strategy

While insurance is important, the focus is on avoiding losses whenever feasible. The approach to repetitive loss structures is multifaceted. The Parish has approached high risk structures individually and by area. Terrebonne Parish has developed a strategy to approach, motivate, and fund owners of repetitive loss structures. Structures have been targeted for elevation, demolition, and acquisition. Communities have been targeted for education and improved drainage and continuous pumping station service. Where feasible, levee structures and floodgates have been constructed to limit water flow and assist nonstructural flood control efforts. As evidenced by the efforts described in this section, the parish has worked diligently to lower their class and will continue to do so in the future.

For example, since the last plan was adopted, the Parish embarked on a Repetitive Loss Strategy for three areas in a community that have approached the Parish concerned with repetitive flooding: Lower Bayou Black, Upper Bayou Black, and Deadwood. The community met with the parish to discuss their vulnerability and the resulting plan can be viewed in Attachment c3-3. The approach mirrors that for most of the Parish which is to elevate structures as funding becomes available, educate the community on the mitigation funds in insurance policies, and improve structural installations such as levees and improved drainage to avoid the need for individual nonstructural projects.



The table below lists the proposed projects. Some of these are duplicative of other projects and approached promoted by the Parish. The

report goes further to identify relatively inexpensive methods to avoid shallow flooding without elevation. The parish is opening a pump station an existing floodgate in January 2020 and two more are in design, and another two planned to alleviate some of the backwater flooding that has been reported to sit in the yards for months at a time. In the next event, this area is expected to have significantly lower losses. Efforts to educate and recruit participation will continue.

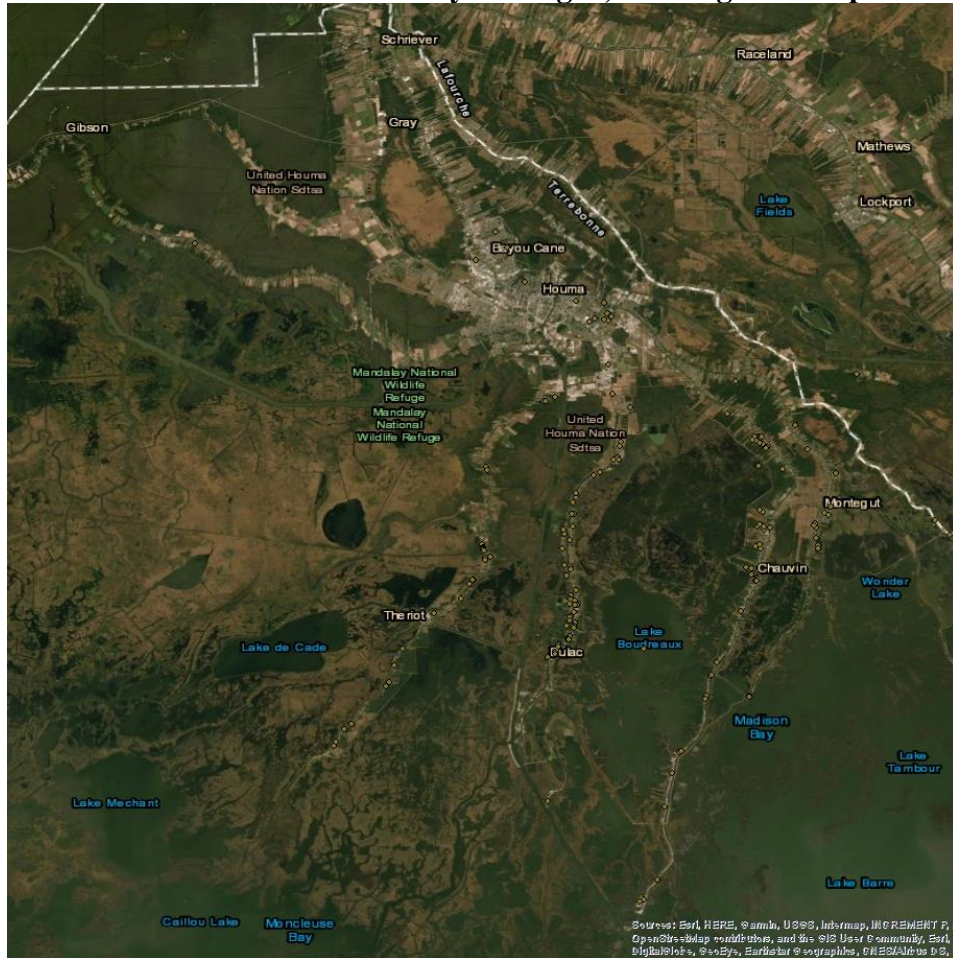
The report describes how these recommendations emerged out of the data, resident feedback, and current conditions of the study areas.

Recommendation	Responsibility	Funding
Levee and pump station improvements, combined with increased stormwater management	Terrebonne Parish	Public Works Terrebonne Levee & Conservation District CPRA
Elevation of low areas of the road along North Bayou Black	Terrebonne Parish	Public Works
Elevate utilities to at least the base flood elevation	Residents	Residents
Obtain flood insurance	Residents	Residents
Demolish and reconstruct building to at or above the base flood elevation	Terrebonne Parish Residents	FEMA CDBG
Elevate building to at or above the BFE	Terrebonne Parish Residents	FEMA CDBG NFIP - ICC
Acquire property	Terrebonne Parish	FEMA CDBG

Substantially Damaged Property Focus

On a broader scale, the Parish will continue to target funding to substantially damaged structures whether on the repetitive loss list (NFIP insured losses) or designated as substantially damaged through permitted activity not covered by insurance. This is broader than the NFIP focus, and includes the uninsured in the Parish risk reduction strategy. At this time the Hazard Mitigation Grant Program benefit cost assessments are based on risk and risk reduction rather than past NFIP damages. This is an opportunity to take advantage of that advance in approach to serve those who might not have been served in the past. This population is often of lower income, and highest vulnerability to disruption in the event of a disaster. Currently, the Parish has declared 166 properties to be substantially damaged and not yet mitigated. The Parish participation in NFIP insurance relies, in part, on the enforcement of this provision. Substantially damaged structures are also targets of significant insurance premium increases, which will burden homeowners and may require them to sell the structure if they can. Funding will be prioritized to mitigate these structures. A map showing substantially damaged structures is below.

Terrebonne Parish Substantially Damaged, Unmitigated Properties



Source: TPCG

Buyouts or Relocations

Due to the scarcity of buildable land, the success of elevation programs, and the high percentage of buyout participants in established neighborhoods, the Parish will only acquire structures if rebuilding is possible. The cost of maintaining lots, particularly in neighborhoods, is prohibitive, and the loss of property taxes and economically viable land is not sustainable. The Parish has been awarded a program through LA SAFE to pay greater than fair market value to owners of primary residences outside the MTTG footprint. There being no effective method to provide structural protection, the State and HUD are willing to pay a value based on the square footage of the structure to allow the residents to buy a replacement property outside the floodplain. Property outside the SFHA is more expensive and this has been a barrier to lower income residents in participating in buyout programs.

Grant Subsidies for Nonfederal Shares

Funding from HUD opened the door to recruitment for elevation from low to moderate income applicants. The parish participated in a pilot program to provide the homeowner match for FEMA funded projects. The programs generally require the homeowner to pay at least 25% of the cost of an elevation project. This is cost prohibitive, particularly for

the uninsured. This new program funded with CDBG grants as a result of Hurricane Isaac allowed 15 more structures to be elevated. These programs accessible to this previously underserved population reducing risk where it was not possible before.

Encouragement for Repetitive Loss and Severe Repetitive Loss Structure Owners

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

Community Based Standards

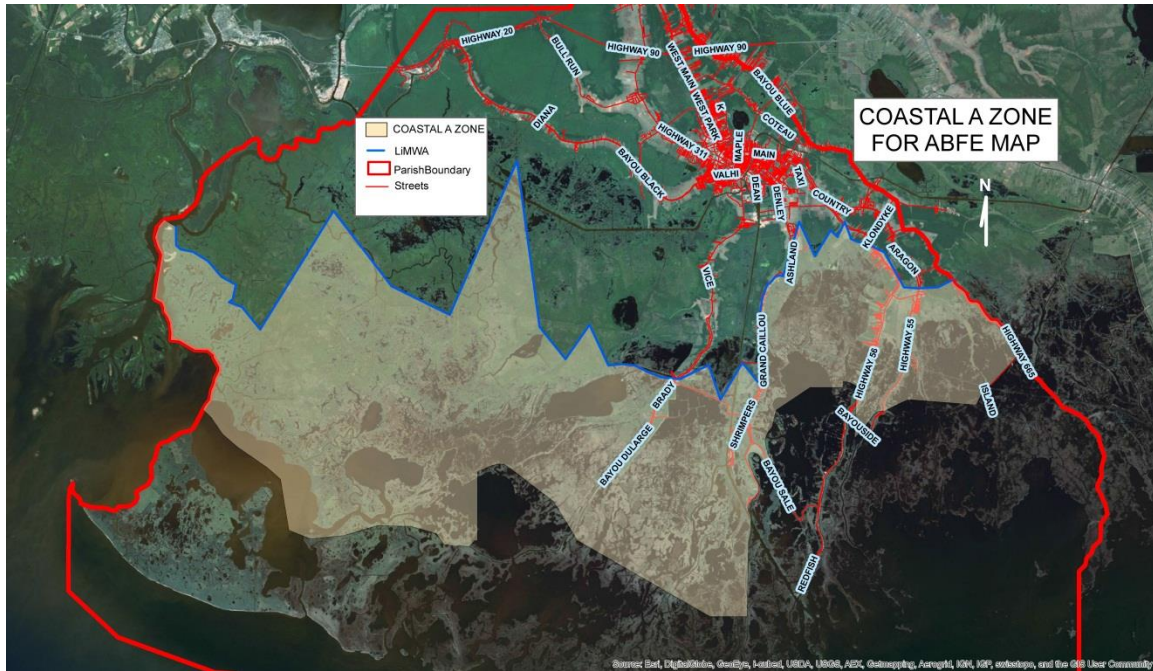
Terrebonne Parish is continuously implementing mitigation strategies and actions that improve its CRS rating. The Planning Department commissioned an engineering study of flood ordinance changes that could be adopted by the Council to decrease flood risk and keep flood insurance rates within reach. Two recommendations were adopted by the last HMP also employed by communities with good CRS ratings. During the HMPU meetings, several of the proposed flood ordinance amendments were discussed, and members supported various approaches to risk reduction. In order to provide better signals to the market about the needs or opportunities for mitigation, the real estate interests were very interested in greater disclosure requirements that included a listing from FEMA of all past claims. Greater regulatory standards across the board were not only considered, but were included as Goal 5 in this plan.

A similar discussion arose out of the proposed addition of some freeboard to new construction and substantially improved properties. The home builders explained that the mortgage banking industry did not value the additional flood safety, and therefore would not pay the incremental increase in the cost of construction. Educational efforts to bring banks, mortgage companies and appraisers up to speed on the value of safer homes, and the risks with properties with higher risk was supported by the steering committee.

In 2014, the Parish commissioned a study of the available data to develop a Coastal A Zone map, shown on the following page. In the Flood Ordinance Outreach effort, the public supported the extension of V zone floodplain requirement to the Coastal A Zone. The V zone is defined as an area with a risk of wave action three (3) feet or higher. The Coastal A Zone was defined as “the limited wave action zone,” which is the area that has a prediction of waves between 1 ½ and 3 feet. The Parish, rather than adopt a map based on the ABFE heights from 2006 has requested that FEMA provide in the Risk Map

process a nonregulatory product showing the 500-year floodplain and the LMWA. It is anticipated to be available in 2020 along with the new DFIRM maps. These additional data points will be available for the public and development communities to consider when building. As the Parish has little topographical variation, the 500-year projected safety level may be a marginal cost difference for construction for structures other than critical facilities.

Terrebonne Parish Draft Coastal A Zone



Status of Flood Maps

TPCG is currently engaged in the LAMP process which is anticipated to be complete in 2016. The parish’s flood maps have been in a D-FIRM appeals process since 2008. In addition, Terrebonne was selected as one of five pilots for the Levee Analysis and Mapping Procedures for Non-Accredited Levees (LAMP) program to include non-accredited levees into flood mapping along with other barriers such as raised roads and sugar cane fields. The draft data has been reviewed by the Parish, and in 2020, the final data will be provided to a separate FEMA consultant

LAMP

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

if the levee did not exist. The inclusion of non-accredited levees' flood reduction capabilities as inputs to flood modeling will result in more accurate forecasts.

3.2.6 §201.6 (c)(2)(ii)(C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions

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

From 1980 to 2000, the parish population increased from 94,393 to 104,503. In October of 2003, when the parish government completed its comprehensive master plan (CMP), it was anticipated that the population would continue to experience positive growth. According to the 2010 U.S. Census, Terrebonne's population grew to 111,860 over the ten year period from 2000 to 2010, exceeding previous growth projections, and in 2019 is has decreased by 4%.

Terrebonne Parish completed a Comprehensive Master Plan (CMP) in 2003, which was updated in 2009 and 2013. In that original planning document, for the purpose of evaluation the Parish was segregated into 18 development zones. A brief discussion of the anticipated population changes within each zone as well as existing influences or issues that impact population trends was provided. Though this discussion was last updated in 2003 and it is possible that population projections may have adjusted due to an increase of over 17,000 residents between the 2000 and 2010 Census, it still reflects the present push and pull factors influencing migration out of and into the development zones, and is relevant to the priorities that the Parish has carried forward into the present HMPU process. The discussion below provides an understanding of anticipated migration patterns within the Parish.

It is anticipated that residential areas that existed in the 1980s will accommodate expected growth. However, the subdivision of land holdings and resulting new home sites have continued to develop at a minimal rate in some areas and a more accelerated rate in others. As more impervious surfaces are constructed with increased development, runoff rates will increase and enhanced pumping capacity may become a concern. At this time, and in the foreseeable future, this is considered significant.

Development Zone 1 (Montegut)

The twenty-year projection for this zone is a 9.4 % decrease in population. This is consistent with current out migration trends due to increased risk of flooding, which limits the available land for development. Most current residents live there because of the commercial fishing, family heritage, or because of easy access to the vast amounts of wetlands in this area.

Development Zone 2 (Bourg)

The twenty-year population forecast for this zone is a 26.4 % increase in population. This is consistent with current trends of in migration. This area is attractive to residents because of availability of residential neighborhoods, and less risk of flooding.

Development Zone 3 (Chauvin)

A 7.9% decrease in population is predicted for this zone over the next twenty-years. It appears the out migration documented in this area will continue, based on flooding concerns, and available, protected property elsewhere.

Development Zone 4 (Grand Caillou)

Population is projected to increase in this zone by 30% over the next twenty years. This increase will most likely occur in the northern region of this development zone. The lower areas of this zone are vulnerable to the same flooding events that affect the previously discussed areas. However, the northern portion of this development zone includes a substantial mobile home community. This neighborhood was developed in the early 1980's, and when the economy declined the land was difficult to market and the development was entrenched in bankruptcy for many years. Although, the Federal Emergency Management Agency (FEMA) has stiffened elevation requirements in this zone, mobile homes are generally placed approximately 4 feet above the natural ground, which meets the FEMA requirements. This area will continue to develop.

Development Zone 5 (Dularge)

An 8.1% decrease in population is predicted in this zone during the next twenty years. This is a bayou community, and population changes will be affected by issues similar to Development Zones 1 and 3.

Development Zone 6 (East Houma)

A very small increase (0.6%) in population is projected in the next twenty years. This is because adequate housing exists and there is very little available space for further residential development.

Development Zone 7 (South Industrial)

The projection is for a 7.9% decrease in population for the next twenty years. This area is dominated by industrial development, and there is little are for residential development. It is anticipated that over years those few residents will either move or will not expand their households.

Development Zone 8 (North Industrial)

The projection is for an increase by 13.2% over the next twenty years in this zone. This increase can be attributed to the availability of developable land, and the recent conversion of agricultural areas to residential.

Development Zone 9 (Schriever)

This zone has witnessed considerable growth over the last ten years and population is expected to grow by 26.8% over the next twenty years. This area has vast amounts of

available land suitable for development, and has been positively impacted by the completion of Highway 90. This area offers residents the ability to locate in an urban setting while still enjoying a rural life.

Development Zone 10 (Upper Bayou Blue)

Population is projected to expand by 35.9% in the next twenty years in this zone. This area has been positively impacted by the opening of Bayou Gardens Boulevard which provides easier access to a major retail center (Southland Mall).

Development Zone 11 (Bayou Cane)

Population is expected to grow at a moderate 13.8% rate over the next twenty years. This area is presently well developed, but there are still a few large tracts of land that can be developed.

Development Zone 12 (Hwy. 311)

This is the fastest growing zone in the Parish with a projected 79.2% population increase in the next twenty years. Many reasons for the expected high growth are transportation accessibility, little flooding issues, and availability of land.

Development Zone 13 (Chacahoula)

The projection for this zone is a population decrease by 29.6% over the next twenty years. This percent change is somewhat misleading due to the relatively low present population in this area. This area will continue to be impacted negatively by flooding concerns. It appears residents are finding other areas of the parish more attractive for residential living.

Development Zone 14 (Gibson)

The projection for this area is for a decrease by almost 87.1% over the next twenty years. Similar to the Chacahoula area, flooding impacts and availability of land elsewhere in the parish affect residential development.

Development Zone 15 (Bayou Black)

Population in this zone is expected to grow at a rate of 19.7% over the next twenty years. This is due to the rural qualities of Old Bayou Black. There is a vast amount of agriculture land suitable for residential development, and the areas close to Houma will be developed first.

Development Zone 16 (Lower Bayou Blue)

Population in this zone is projected to grow at a rate of 51.1% over the next twenty years. There is suitable land available for development along Coteau Road and lower Bayou Blue and the completion Prospect Avenue to U.S. 182 provides easy access to Houma.

Development Zone 17 (West Houma)

This area is currently the most populous Development Zone and is projected to experience a 21.4% growth rate over the next twenty years. The area has currently many lots available with more anticipated for future development.

Development Zone 18 (Western Marsh)

This zone consists entirely of wetlands. There are no residences in this zone, and no population change is projected.

Based upon the past several decades of parish development and the management of that development, Terrebonne Parish Consolidated Government is fully aware of state and federal mandates regarding coastal zone management, flood zone and hazard management, and protecting the valuable coastal areas of the state.

The parish 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. The importance of orderly land development remains a concern for the parish and the CMP presented three land use projection scenarios for the parish based on past and current comprehensive plans. The population change between 2000 and 2010 is presented in the figure below, followed by the forecast population change between 1900 and 2030 and the three land use scenarios.

Forecast Land Use Scenarios

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

It should be noted that 90 percent of Terrebonne's land is considered environmentally sensitive. Therefore, the land that is available for development is generally related to farming, vacant, and open space uses. Regardless of the year of total consumption of available developable land, the increase in impervious surfaces related to development and the resulting reduction in agricultural, vacant, and open space land will undoubtedly increase pressure on environmentally sensitive lands within the parish. This concern reflects the 2003 CMP development zone discussion as it highlights the role of flooding concerns and protected developable land in projected population growth or decline. The 2013 Comprehensive Plan proposed action items to achieve a sustainable balance between development activities, preservation of natural resources, and open space.

The Parish has retained largely the same goals for approaching hazard mitigation as were adopted in the 2015 HMPU. In alignment with those goals, Terrebonne Parish Consolidated Government has instituted preventative measures to minimize repetitive losses resulting from hazard events since the last plan. The Parish's existing zoning ordinances and corresponding maps conform to FEMA guidelines, and the parish will update its zoning ordinances if and when needed to ensure compliance to FEMA regulations. There Parish proposed an open space zoning area that includes the environmentally sensitive marshland and wetlands as viewed in the figure below, but that was rejected by the landowners, which are predominantly mining and timber interests. The Parish has developed a voluntary participation procedure which will be provided to these landowners in 2020. Shell has donated a 4,139 acre property to the Parish which will be kept in open space and used as a stormwater sink and recreation area. The Parish also has adopted the International Building Codes (IBCs) and advisory base flood elevations (ABFEs) which dictate wind and flood related guidelines.

+/- 4,139 Acres of Land

Houma, Terrebonne Parish, LA

Shell Oil Donation

Project Area (+/-4,193 acs.)
Black Willow & Red Maple Swamp (+/-1,253 acs.)
Bottomland Hardwood Forest (+/-258 acs.)
Freshwater Marsh (+/-2,446 acs.)
R.O.W. (+/-64 acs.)
Bottomland Hardwood Cut-Over (+/-47 acs.)
Canal (+/-52 acs.)
Forested Spoil Bank (+/-35 acs.)
Terrebonne Parish Levee (+/-17 acs.)
Herbaceous (+/-6 acs.)

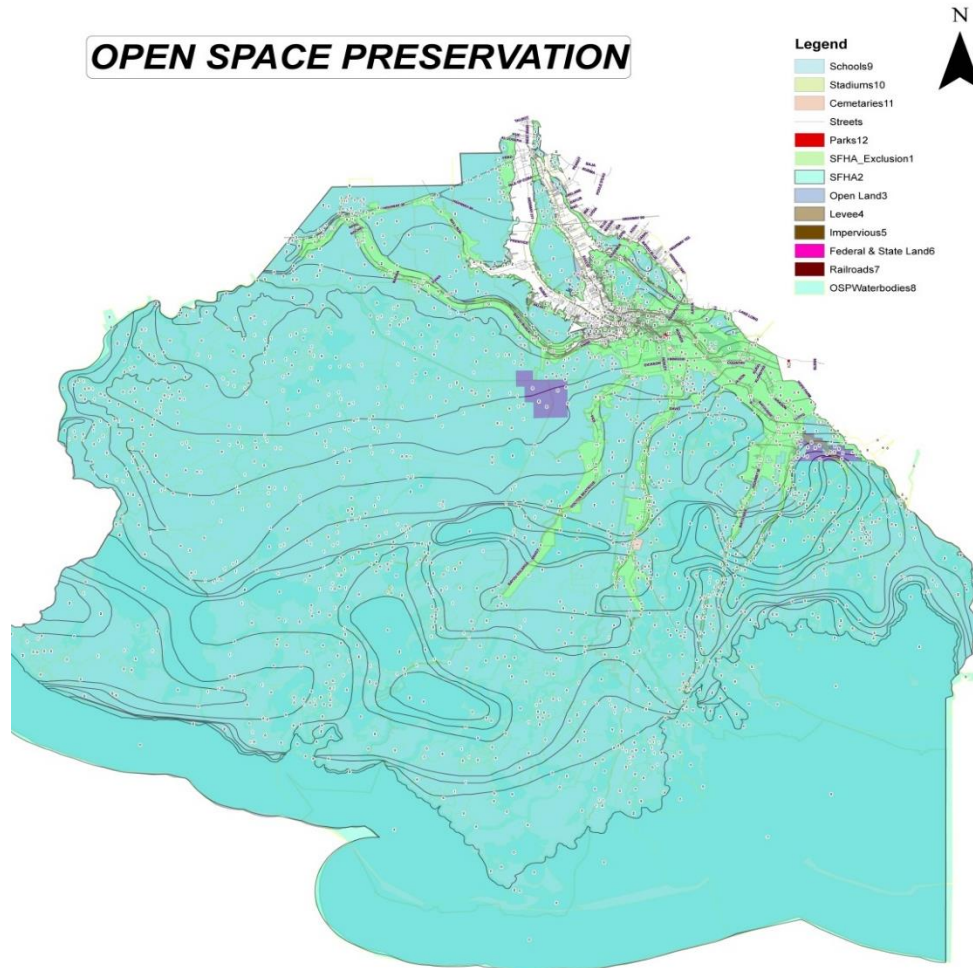
BENEFITS

- **Increased Storm Water Retention - 1.7801 billion gallons of storm water capacity**
- **Opportunity to make positive impact on FEMA's Community Rating System (CRS)**
- **Potential to reduce flood insurance rates**
- **Storm water filtered through wetlands should enhance water quality released back in to the environment while maintaining the natural habitat of Terrebonne Parish**

Source: GIS Engineering

Terrebonne Parish Open Space Preservation Map

OPEN SPACE PRESERVATION



SFHA Area = 1,309,147 Acres
 Open Land Area = 1,228,376 Acres
 Waterbodies = 605,020 Acres
 Levees = 709 Acres
 Impervious Surfaces = 152 Acres
 Federal & State Land = 9,591 Acres
 Railroad = 540 Acres
 SFHA not in Open Land = 80,540 Acres
 Net Open Land Area = 612,364 Acres

OTHER OPEN AREAS NOT IN SFHA:
 SCHOOLS = 517 ACRES
 STADIUMS = 179 ACRES
 PARKS = 213 ACRES
 CEMETARIES = 632 ACRES

Source: Terrebonne Parish

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

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

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

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

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

The Terrebonne Parish HMPU Steering Committee reviewed and analyzed the risk assessment evaluation performed for the parish as well as goals reflective of that risk assessment. Goals and action items that would have the greatest benefit in reducing or eliminating hazard damage to the parish were identified. The evaluation criteria used in determining these goals and action items followed the Zurich Flood Resilience Alliance Approach from page 34 of this plan.

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, *public education*, 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.

Goal 5: Assess the feasibility of setting a uniform standard of protection incorporated into all drainage, development and mitigation activities.

4.2 §201.6 (c)(3)(ii) The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

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

communications including committee meetings, telephone conversations, emails, and face-to-face meetings.

The projects and resulting action items relate to community goals which are presented immediately following the Project List attachment. Projects include those that may be eligible under the proposed Building Resilient Infrastructure and Communities that will be available starting in 2020. The Parish specifically reached out to entities that are responsible for the community lifelines in the Parish to capture the current conditions and projects that could increase the resilience of those critical infrastructure assets and service providers. A list of outreach efforts and meetings is included in Attachment c4-2.

The Parish will continue to focus on hardening of critical structures. The Parish has already wind hardened the Government Tower, the Generating Station, the Houma Police Department, and the Courthouse Annex, and has shutters on the Houma Fire Department. The TOHSEP office was moved to a Cat 5 building outside the SFHA as was the majority of the Public Works offices, the Juvenile Justice Facility and the Animal Shelter. Each of these buildings and the fire departments have redundant power and the span bridges and pump stations are funded for redundant power, which will be in place in 2020. Advances in communications and evacuation procedures and routes have also been accomplished along with an update to the Flood Response Plan.

Regardless of the topic, education was central to all activities reviewed. Ongoing efforts were applauded, but in most instances, increased education was identified as a necessary component of any resulting plan. For example, the evacuation routes have been developed, but are not widely known. The Parish is investing in a flood gate and lock system backed up by pump stations and retention basins. The general public should have access to training that explains how the system works together, and who is responsible for what element of the process. Educational initiatives are also necessary to bring industries a more detailed knowledge of the safety and resilience practices including insurance professionals, real estate interests, banks and builders. Without the education, support and enforcement would be frustrating, expensive, and less productive, it was decided, than to work toward a common goal. Action items and the proposed project list includes outreach initiatives from the Multijurisdictional Program for Public Information, Levee Safety, Safe Harbor, etc. The objectives for education are listed below Goal 3.

The established and agreed upon objectives and actions relative to the established goals are as follows. All projects are in Attachment c3-1.

- **Goal 1: Identify and pursue preventative measures that will reduce future damages from hazards**
 - **Objective 1.1:** Ensure existing structures are structurally sound to endure hurricane-force winds
 - Action 1.1.1: Wind harden structures*
 - Timeframe: 1-5 years, as funding permits
 - Funding: HMGP, local, regional, and other federal
 - Staff: Public Works, Planning and Zoning

- Hazard Event Mitigated: Hurricane
- **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 and assess whether new structures should include a category 5 area for employees*
 - Timeframe: 1-5 years, as funding permits
 - Funding: HMGP, local, regional, and federal
 - Staff: Public Works, Planning and Zoning, Public Safety
 - Hazard Event Mitigated: Hurricane/Tornado
 - Action 1.2.2: Expand the coverage and participation in the Parish's hazard early warning system.*
 - Timeframe: 1-5 years, as funding permits
 - Funding: BRIC, local, state and regional.
 - Staff: Office of Emergency Preparedness
 - Hazard Event Mitigated: Hurricane/Tornado
- **Objective 1.3:** Ensure all first responders are adequately equipped to respond to a storm event
 - Action 1.3.1: Purchase or upgrade communication devices as necessary to ensure interoperability among first responders and develop recurring cost funding source.*
 - Timeframe: 1-5 years, as funding permits
 - Funding: HMGP, local, regional, and federal
 - Staff: Parish, Public Safety, 9-1-1
 - Hazard Event Mitigated: Hurricane/Tornado/Flooding/Levee Failure
 - Action 1.3.2: Purchase generators for critical facilities (see Attachment c3-1 for locations) to ensure operation during and after a hazard event*
 - Timeframe: 1-5 years, as funding permits
 - Funding: HMGP, local, regional, and federal
 - Staff: Public Safety, Public Works
 - Hazard Event Mitigated: Hurricane/Tornado/Flooding/Levee Failure
- **Objective 1.4:** Protect citizens from saltwater intrusion
 - Action 1.4.3: Continue to construct Morganza to the Gulf storm surge protection levee and proposed lock system to reduce the effects of saltwater intrusion*
 - Timeframe: 1-5 years
 - Funding: local, federal
 - Staff: Public Works, Planning and Zoning
 - Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion

- **Objective 1.5:** Reduce the effects of Land Subsidence
 - Action 1.5.1: Pursue approvals and funding for coastal restoration projects such as sediment diversions to reduce land subsidence in coastal areas.*
 - Timeframe: Ongoing
 - Funding: Local
 - Staff: Planning and Zoning, Public Works
 - Hazard Event Mitigated: Coastal Erosion/Land Subsidence
 - Action 1.5.2: Study foreseeable subsidence that is often correlated with forced drainage areas under pump, and retention options if needed.*
 - Timeframe: Ongoing
 - Funding: local, federal
 - Staff: Existing parish administration, DCRP
 - Hazard Event Mitigated: Coastal Erosion/Land Subsidence
 - Action 1.5.3: Monitor agricultural activities and encourage smart farming practices to reduce soil compaction and acceleration of subsidence*
 - Timeframe: Ongoing
 - Funding: local, federal
 - Staff: Planning and Zoning
 - Hazard Event Mitigated: Land Subsidence

- **Objective 1.6:** Protect historic and cultural resources, such as cemeteries and gathering places from all hazards
 - Action 1.6.1: Identify vulnerable historic and cultural resources, and opportunities to protect and/or relocate historic assets threatened by sea level rise*
 - Timeframe: Ongoing
 - Funding: local, federal
 - Staff: Planning and Zoning
 - Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion/Land Subsidence

- **Objective 1.7:** Protect critical facilities from lightning strikes
 - Action 1.7.1: Install lightning rods on all critical facilities*
 - Timeframe: As needed
 - Funding: local, federal
 - Staff: Public Safety/Public Works
 - Hazard Event Mitigated: Lightning
 - Action 1.7.2: Install and maintain surge protection on all critical electronic equipment*
 - Timeframe: As needed
 - Funding: local, federal
 - Staff: All Parish Departments and Public Safety
 - Hazard Event Mitigated: Lightning

▪ **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 through existing channels and organizations and their memberships,
- **All Actions in this section will be approached as follows:**
 - Timeframe: 1-5 years
 - Funding: BRIC, Local and State
 - Staff: Planning and Zoning in coordination w/ TOHSEP, TSD, IT, etc.
 - Hazard Event Mitigated: All Hazards with a focus on Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion/ Tornado/Lightning.

Action 2.1.1: Continue to advertise public meetings during the hazard mitigation planning process and throughout the year

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

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

Action 2.1.4: Develop or identify and place pamphlets in the libraries and the Parish Robert “Bobby” Bergeron Government Tower regarding the risk of identified hazards.

Action 2.1.5 Increase social media to increase penetration of messaging

Action 2.1.6 Increase education regarding Law and Ordinance and Flood Insurance Claims to assist in elevation or other code compliance.

Action 2.1.7 Increase transparency on the website and links to useful material.

Action 2.1.8 Provide age appropriate materials for schools to support physical and mental health through knowledge of natural hazard preparation and recovery.

Action 2.1.9 Educate communities currently residing in at risk areas on the six (6) evacuation plans, access to shelter and transportation assistance as needed.

Action 2.1.10 Promote increased participation in the NFIP and continued participation in the Community Ratings System.

Action 2.1.11: Better promote the Multijurisdictional Program for Public Information to educate population on risk reduction strategies, their responsibilities, and the Parish’s responsibility for enforcement

Action 2.1.12 Gather and present information on subsidence and climate change as models mature and understanding improves.

Action 2.2.13 Increase understanding of public, real estate, banking and mortgage stakeholders regarding the value of flood and wind safety building alternatives.

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: Continue to upgrade current drainage infrastructure (see Attachment c3-1 for locations)

- Timeframe: 1-5 years
- Funding: HMA, BRIC, Local, State
- Staff: Public Works, Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion

Action 3.1.2:

Action 3.1.3: Elevate or acquire all RL and SRL structures in Terrebonne Parish (see Attachment c2-25 on page 111)

- Timeframe: 1-10 years, as funding permits
- Funding: HMA, FMA, PDM
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

Action 3.1.4: Develop new and more accurate models to project the impact of various activities.

Timeframe: 1-10 years, as funding permits

- Funding: CDBG, FMA, PDM, BRIC, Watershed Initiative
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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

- Timeframe: 1-5 years, as funding permits
- Funding: HMA, Local, State
- Staff: Public Works
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

Action 3.1.6: Flood proof public buildings vulnerable to flood damage that cannot be relocated if cost effective

- Timeframe: 1-5 years, as funding permits
- Funding: HMGP
- Staff: Public Works, Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Public Works, Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Planning and Zoning, Public Safety
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Public Works, Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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

- Timeframe: 1-10 years, as funding permits
- Funding: local, regional, and federal
- Staff: Public Works, Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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

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

***Action 4.1.1:** Enforce building codes to ensure that future development does not increase hazard losses.*

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

- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion/ Tornado

Action 4.1.2: *Guide future residential development away from hazard areas using zoning regulations or tax options while maintaining other parish priorities such as economic development and the quality of life*

- Timeframe: Ongoing
- Funding: Local/BRIC for outreach or modeling
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion/ Tornado.

Action 4.1.3: *Provide safe locations for files, records, and computer equipment*

- Timeframe: Ongoing
- Funding: CDBG/HMA/BRIC
- Staff: Finance Department, Information Technologies Division
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/ Tornado

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

- Timeframe: Ongoing
- Funding: Not additional funds required
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion/ Tornado

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

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

- Timeframe: Ongoing
- Funding: local, regional, and federal
- Staff: Planning and Zoning, Recreation, Parks, & Grounds, Coastal Restoration and Preservation
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion/ Tornado

Action 4.2.2: *Continue to participate in the NFIP (including Houma under the Consolidated Government) and incorporate Community Ratings System principles as appropriate.*

- Timeframe: Ongoing
- Funding: Local, BRIC
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

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: HMA, state
- Staff: Planning and Zoning, Housing and Human Services
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure

Action 4.2.4: Work with landowners in flood prone areas, particularly outside of the levee systems, and other stakeholders to identify flood mitigation and climate adaptation measures to reduce flood risk.

- Timeframe: Ongoing
- Funding: HMA, state
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion

Action 4.2.5: Work with communities currently residing in flood prone areas, particularly outside of the levee systems, on the identification of flood mitigation and climate adaptation measures to reduce flood risk.

- Timeframe: Ongoing
- Funding: HMA, state, CDBG, local
- Staff: Planning and Zoning
- Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Coastal Erosion

Action 4.2.5: Research partners and low tech or low cost alternatives for marsh, coastal or shoreline protection or restoration programs to reduce harm from all hazards.

- **Goal 5: Assess the feasibility of setting a uniform standard of protection incorporated into all drainage, development and mitigation activities.**
- **All actions under this goal will be approached as follows:**
 - Timeframe: 1-5 years
 - Funding: HMA, state, Watershed Initiative, BRIC
 - Staff: Planning and Zoning, Administration, Public Works
 - Hazard Event Mitigated: Hurricane/Flooding/Levee Failure/Saltwater Intrusion/ Subsidence

Action 5.1 Review the level of risk currently acceptable across all relevant plans or codes and compare to flood ordinance requirements.

Action 5.2 Develop a benefit cost assessment for the economic impact of higher standards including attracting high value businesses and insurance savings.

Action 5.3 Approach regional partners to coordinate stormwater management plan and uniform standard of protection for all drainage, development, and mitigation activities.

2020 HMPU Project List

The Terrebonne Parish Project List resulting from the HMPU 2020 planning process is presented in Attachment c3-1. Two truncated listings of projects based on projects' status and prioritization are provided in this section. The project list has been reduced both by completing projects since 2015, and by changing the format of the list to have each project shown once, and provide all of the projects and characteristics in the columns.

The HMPU Steering Committee in reviewing and evaluating the potential project list. Consideration was given to a variety of factors including the Zurich method, as previously noted, and the cost effectiveness. A project's eligibility for federal mitigation grants was not considered as the plan is focused on what needs to be done rather than what the federal government will fund. This process required evaluation of each project's engineering feasibility, cost effectiveness, and environmental and cultural factors.

4.3 §201.6 (c)(3)(iii) ...shall include an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The Hazard Mitigation Committee has identified several hazard mitigation projects to be included in the parish Hazard Mitigation Plan. The actions presented on the previous pages were categorized to organize priorities by HMGP grant eligibility. Projects not deemed eligible and/or covered in other programs can be located in the full project list in Attachment c3-1. Potential projects identified included properties and areas that have localized flooding or drainage problems as noted in the Terrebonne Parish Hazard Mitigation Plan (2010). Projects carried over from the HMP (2010) can also be found in Attachment c3-1. 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. Attachment c4-6 captures discussion of prioritization and feasibility based on several criteria.

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.

The mitigation efforts in this plan extend to wind losses, natural subsidence, and flooding beyond that to structures and public infrastructure. We focus on these elements of resilience as there are concrete steps and programs within FEMA and HUD to mitigate these events. Nonetheless, the Parish strives to be prepared to resolve challenges presented that can reduce the quality of life and property value in the Parish and has invested in internal staff resources and public and private partnerships to gain expertise and capacity for effective action.

The Parish has hired a grant writer to specifically seek funding for all departments and nonprofits in the area that do not have the capacity to search through all government and foundation grants effectively and efficiently with their staff. The grant writer is made available to assist in various levels of support including finding the opportunities, and drafting if necessary, depending on the capacity of the grant applicant. This is intended to broaden the capacity of the departments and the community at large to provide services or maintain services and programs that support resilience.

The GIS department has developed extensive inhouse mapping systems to illustrate the communications system in the Parish including all cell towers and their capacities, the gas infrastructure, water systems, fire hydrants, etc. to inform typical planning and response to events. For modeling of events and the impact of development on our natural and built systems, the Parish hires outside firms specializing in complex modeling. The Parish will soon be the beneficiary of models from the Governor's Watershed Initiative, which will model regional and local water movement in various scenarios. This would be very expensive for the Parish to do independently. It is a goal of the Parish to use these models and the support of the Governor's Watershed Initiative to reinvigorate a Parish effort to extend the Terrebonne Parish Stormwater Drainage and Detention Design Manual to the watershed rather than Terrebonne requiring development in the Parish to mitigate activity by those outside the Parish.

The coastal programs are coordinated by the Coastal Restoration and Protection department within the Parish. The director works closely with the state, federal programs, the levee district in Terrebonne and neighboring parishes, and nonprofits such as Ducks Unlimited to pool resources and develop projects that complement one another. As nearly 60% of the land in the Parish is owned by companies involved in mineral extraction, these relationships are also important, and the Parish is working with those companies to negotiate land conservation and maintenance. Apache Minerals and Conoco Phillips are particularly involved in these efforts offering land, trees, and money to

support coastal restoration. The tribes are also good partners in planning and development of projects to maintain or restore traditional hunting, fishing, and medicinal customs.

The Parish is sensitive to the need to balance the expenditures of the public and private sectors to build or retrofit to meet projected conditions that are uncertain. However, when action is necessary, a firm line has been established. After significant flooding in 1985 that flooded many structures that had successfully applied for a waiver of the flood height regulations, the Parish abolished the variance board for floodplain regulations, and has not entertained a request since that time. The Parish is considering freeboard for a greater margin of flood safety, and already requires freeboard and the use of the DFIRM maps that have not been adopted for all Parish managed mitigation projects. As a practice, the Parish is leading by example and including a step in the building or additions to all new Parish facilities to consider in the engineering development whether a safe room should be designed within the footprint. Several departments have requested a room within their facility that could protect the staff in the event of a tornado or terrorist event and a room is more cost effective than requiring the entire structure to meet category 4 or 5 standards.

Each event has some effect on the population, and in particular, vulnerable populations. Any closure of businesses and schools, which may be required for a high wind event, hurricane, tornado, flood or car running into a critical transformer, disrupts the social stability and productivity. The Parish has attempted to install redundant power systems to avoid outages that would result in losses of access to schools, loss of productivity at work, and the associated stress. Outside energy providers were invited to participate in the plan, and plan participants have suggested a negotiated maintenance plan to increase the likelihood that poles are replaced prior to an event rather than after. Perverse incentives reward delays in maintenance as costs can be more easily transferred to the rate payer only after an event, not for standard maintenance.

The Parish has partnered with South Central Planning and Development Corporation to provide additional expertise in this area to optimize our transportation infrastructure. Access to traffic is also important to the continuous operation of the Parish. Trees down, car accidents, fires, a boat accident with a bridge; all can cause losses of time and access. The Parish has invested in raised roads for evacuations and flood resilience, but also additional roads that allow for bypasses of other major thoroughfares to allow for continuous flows of traffic regardless of the functionality of any one route.

Working with the Parish Department of Housing and Human Services (HHS) and the Council on Aging, the Parish is seeking a facility to better serve meals to those that are food insecure. The school system is available for the children, but do not have the capacity to serve the elderly, incarcerated, or impoverished in the Parish regardless of the season or school operation. Disruptions can cause a loss of frozen food common to subsistence communities due to loss of refrigeration. The upgrades to the energy grid can minimize outages, but loss of income, buying power, or store availability is a need that may be best met through this facility to efficiently serve those without the capacity to buy

and prepare food in certain circumstances. The Covid 19 pandemic is indicative of the benefit of such a facility.

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

A plan maintenance process that includes:

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

Terrebonne Parish has developed a plan maintenance process to ensure that regular review and update of the Hazard Mitigation Plan occurs. The parish has formed a Hazard Mitigation Plan Evaluation Committee that consists of select members from the Parish staff, 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 Office of Homeland Security and Emergency Preparedness Director
7. Terrebonne Parish Sheriff
8. Houma Police Department Chief
9. Houma Fire Department Chief
10. Rachael Ellender, Bayou Board of Realtors

The Parish Planning and Zoning Director is responsible for contacting HMP Evaluation Committee members in the first quarter of the year on an annual basis. The Recovery Planner will survey the Departments and stakeholder partners and develop an inventory of progress on objectives and projects. All directors and the HMPU Steering Committee will be invited to a meeting to discuss the progress, any change to hazards or other conditions since the plan was adopted or the previous maintenance. The information will be sent to the committee members for comment or additions. If warranted, the revisions will be adopted by the Council. Maintenance updates may also include updates to maps or other materials to make them more accessible to the average member of the public.

In addition, starting January 1, members have a one-month period in which to respond to or initiate a meeting if any one member feels that issues need to be addressed. However, should a hazard event occur and the need for update analysis surface, a meeting can be

called by the Parish Planning and Zoning Director or requested by a committee member through the Parish Administration.

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

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

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

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

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

When appropriate, Parish Government, by way of the individuals who served on the HMPU Steering Committee and the HMP Evaluation Committee, will address the need to incorporate requirements of the mitigation plan into the respective zoning ordinances, comprehensive plans, and/or capital improvement plans if deemed necessary and if not previously included. An effort will be made by all HMPU Steering Committee members to ensure consistency in all future planning efforts with the mitigation goals and risk assessment presented in this plan. Consistency between all planning efforts will ensure a decrease in losses related to hazard events within future and existing developments. The former hazard mitigation plan's goals were incorporated into Goal 5 of *Vision 2030: Terrebonne's Plan for Its Future* and are anticipated to be updated in the next iteration currently in development. Attachment c4-1 illustrates the current integration of projects

and project types showing the various plans that include the projects or project types proposed.

If amendments to existing ordinances or new ordinances are required, the Parish Council will be responsible for its respective updates.

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

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

5.4. §201.6 (d)(3). Plan review, evaluation, and implementation based on changing conditions, future development, and mitigation efforts.

As is evident in the discussions, goals and objectives, and the proposed new projects for this plan update, a lot has changed in the last five years, and the parish is planning ahead for the next 50 years. This effort will be repeated to a large extent over the next one or two years as the maps are completed through the LAMP and Risk Mapping processes to develop the risk profile of the Parish including the levee system and other reductions to the parish vulnerability and risk of damages and disruption due to natural hazards. This plan provides a slight pivot in priorities as the first lift of the MTTG is either in place or funding identified as are the floodgates and pumping systems.

The Parish new construction is predominantly in the north and west quadrants of the Parish as captured above. There has been a slow and voluntary move of residents, and nonfunctionally water access commercial activity is also focused outside the special flood hazard area. This is not to say that the Parish is abandoning the fishing community and other industry that must be performed at the water's edge or in our marshes. The Parish is mitigating repetitive loss structures and the new maps will require safer building requirements for the future. The community is supportive as evidenced by their input to the LA SAFE process and the adaptation measures that align with this plan.

The risk assessments in the report are maintained largely from the last report as the Parish is on the cusp of receiving the new maps. The Parish has requested funding to revise the

HAZUS building surveys to reflect our updated property data and incorporate the new Digital Elevation Model and Flood Insurance Study from the resulting mapping effort. The Parish has worked with FEMA and their consultants for many years to develop this more accurate set of maps to best identify the risks and vulnerabilities we face and better provide cost benefit assessments of proposed activities.

The proposed direction for the future includes not only the updated mapping and risk assessments, but improved models for daily use in permitting, and to inform a uniform development standard of protection to be used in all drainage as well as building activities. Seeing gaps in the funding streams, the Parish is considering options for community support for flood insurance or other underfunded needs. The education initiatives will continue to pursue participation in insurance and mitigation programs, but also include campaigns to show the effect of our current progress, and the options that are available for the future. The Parish has made steps over the last four years to increase the regional focus of these efforts, and that partnership with our neighbors is reflected in the project list and the meetings that have been held during this process. Meetings will continue as we update this plan again with input from the ongoing subcommittees and our local and regional partners.

6.0 PREREQUISITES—COPY OF FORMAL PLAN ADOPTION

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

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

OFFERED BY: MR. G. MICHEL
SECONDED BY: MR. D. W. GUIDRY, SR.

RESOLUTION NO. 20-174

Resolution Requesting the Approval of the Hazard Mitigation Plan Update required by FEMA for Federal Funding.

WHEREAS, on October 30, 2000, the President signed into law the Disaster Mitigation Act of 2000 (DMA 2000), and

WHEREAS, DMA 2000 amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act by, among other things, adding a new section, 322—Mitigation Planning—places new emphasis on local mitigation planning; and

WHEREAS, Section 322 requires local governments to develop and submit mitigation plans as a condition of receiving Hazard Mitigation Grant Program (HMGP) and Hazard Mitigation Assistance project grants; and

WHEREAS, an Interim Final Rule (the Rule) for implementing Section 322 was published in the Federal Register, 44 CFR Parts 201 and 206, on February 26, 2002, with requirements for Local Plans found in Part 201.6 requiring an update of the plan every five (5) years; and

WHEREAS, the Parish's last plan expired March 27, 2020; and

WHEREAS, in Louisiana, the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) has approved this updated plan;

WHEREAS, Federal Emergency Management Agency (FEMA) has approved the plan pending adoption; and

WHEREAS, all FEMA and GOHSEP procedures have been adhered to and Attachment A provides a link to the Final Draft plan update and Attachments for review and approval by the Council; and

WHEREAS, the plan is a tool with no legally binding requirements for the Parish;

WHEREAS, the Terrebonne Parish Consolidated Government, nonprofits, state agencies, business interests, tribes, and elected officials and the general public participated in preparation of the plan update and the Terrebonne Parish Consolidated Government supports the plan as it pertains to the entire parish; and

NOW THEREFORE BE IT RESOLVED, by the Terrebonne Parish Council that the Parish President and council does hereby approve and adopt the overall Hazard Mitigation Plan Update attached.

THERE WAS RECORDED:

YEAS: C. Harding, G. Michel, J. Amedée, J. Domangue, D. W. Guidry, Sr., D. Babin, D. J. Guidry, S. Trosclair and J. Navy.

NAYS: None.

NOT VOTING: None.

ABSENT: None.

The Chairman declared this resolution adopted this 10th day of June 2020.

I, Suzette Thomas, Council Clerk, do hereby certify that the foregoing is a true and correct copy of a resolution adopted by the Assembled Council in Regular Session on June 10, 2020 at which meeting a quorum was present.

GIVEN UNDER MY OFFICIAL SIGNATURE AND SEAL OF OFFICE THIS
11th DAY OF JUNE 2020.


SUZETTE THOMAS, COUNCIL CLERK
TERREBONNE PARISH COUNCIL

Reserved for adoption resolution