Hazard Mitigation Plan

City of New Orleans, Louisiana

2015 Update

Orleans Parish, Louisiana

2015 Hazard Mitigation Plan Update

Submitted to:

GOHSEP
FEMA, Region VI

Submitted by:

City of New Orleans
Office of Homeland Security and Emergency Preparedness

Section 1. Executive Summary

The Executive Summary for the Orleans Parish 2015 Hazard Mitigation Plan Update provides an overview of the purpose of the plan, the planning process, identified hazards and vulnerability (risk) assessment, capability assessment, the mitigation strategy, and the procedure for maintaining and updating the plan.

Purpose of the Hazard Mitigation Plan and Plan Update

Hazard mitigation is defined as any sustained action to reduce or avoid long-term risk to life and property from a hazard event in order to: 1) save lives and reduce property damage, 2) reduce the cost of disasters to property owners and all levels of government, and 3) protect critical facilities and minimize community disruption.

More recent disaster events, including Hurricane Katrina in 2005 and the BP oil spill in 2010, point to the urgency and need for a strong Hazard Mitigation Plan that the City continues to fund and implement to reduce future potential risks and losses for the residents and businesses of New Orleans. The City has demonstrated its commitment to building resiliency by participating in the Rockefeller 100 Resilient Cities initiative and by releasing the Resilient New Orleans Strategy in 2015, which outlines the City's priorities for adapting to the changing natural environment, and to prepare for future shocks. The Hazard Mitigation Plan is a vehicle towards these objectives for a safer and more resilient New Orleans.

Hazard mitigation planning provides a mechanism for understanding the risks and vulnerabilities of the City, as well as identifying actions that can reduce the risks and potential impacts. Hazard mitigation planning is also a federal requirement based upon the Disaster Mitigation Act of 2000, which authorized pre-disaster mitigation planning to reduce and control the cost of disaster assistance. This Act includes a requirement that state and local governments have an approved hazard mitigation plan that is updated every five years in order to apply for and/or receive grant funds for any of the hazard mitigation assistance programs. Although the Act was written to respond to natural disasters, state and local governments are encouraged to expand the scope of hazard mitigation planning to also include manmade disasters.

Identified Hazards for the 2010 Orleans Parish Hazard Mitigation Plan and the Five Year Plan Update

The City of New Orleans adopted its first Hazard Mitigation Plan in December 2005 and updated the plan in 2010. The 2010 plan update was developed through a public planning process and adopted after its review and approval by the Governor's Office of Homeland Security Emergency Preparedness (GOHSEP) and the Federal Emergency Management Agency (FEMA). The City's 2010 Plan Update included 12 identified natural hazards and 2 man-made hazards. For the 2015 five-year Plan Update, the City reviewed the list of hazards, considered additional hazards and prioritized the updated list of hazards for the 2015 Plan Update. The following table shows the 9 natural hazards and the 8 man-made hazards identified for the 2015 Plan Update and shows those hazards included in the 2010 Plan. The table includes notations on which hazards were dropped, added, and amended from the 2010 plan, based on input from the City's Working Group and the Advisory Committee.

Identified Hazards, 2015 Plan Update

Natural Hazards, 2010 Plan	**Natural Hazards, 2015 Plan**
Floods	Floods
Hurricanes/Tropical Cyclones	Tropical Cyclones (Amended)
Tornadoes	Storm Surge
Thunderstorms (Dropped in 2015 Plan)	Coastal Erosion
Lightning (Dropped in 2015 Plan)	Tornadoes
Subsidence	Subsidence
Hail – (Dropped in 2015 Plan)	Winter Storms
Winter Storms	Drought
Drought	Extreme Temperatures (New)
Storm Surge	**Man-Made Hazards, 2015 Plan**
Coastal Erosion	Dam & Levee Failure
High Winds, part of Hurricanes - (Dropped in 2015 Plan)	Hazardous Materials Spills/Contamination, Fixed Site and Transportation (Amended)
Man-Made Hazards, 2010 Plan	Power Outages (New)
Dam & Levee Failure	Terrorism (New)
Hazardous Materials Spills/Contamination	Infrastructure Failure (New)
	Building Collapse (New)
	Civil Unrest (New)
	Pandemic (New)

Overview of the 2015 Five-Year Plan Update

FEMA requires that all local governments update their Hazard Mitigation Plan every five years in order to remain eligible to receive federal hazard mitigation assistance funds. In 2015, Orleans Parish reviewed and updated each section of its 2010 Hazard Mitigation Plan using a comprehensive planning process described below. Critical information updated in the 2015 Plan includes the following:

- The mission statement was reaffirmed and updated: To promote, implement, and sustain mitigation measures in Orleans Parish in order to reduce and manage risks to human life, the environment, and property. To protect Orleans Parish and the surrounding region from the effects of natural and manmade hazards, ensuring community continuity in the event of such hazards.

- Hazards included in the 2010 Plan were reviewed and a new list of prioritized hazards was prepared for the 2015 Plan Update

- The goals and objectives included in the 2010 Plan were reviewed and a new list of goals was prepared for the 2015 Plan Update.

- Each of the 17 prioritized hazards were identified and profiled to include: a description of the hazard, the location and extent of the hazard within the Parish, the severity of the hazard, and occurrences of the hazard in Orleans Parish.

- The risk assessment of potential losses with future hazard events was also updated using the most recent available data.

- The evaluation of land use, development and redevelopment trends was reviewed and updated to reflect changes underway since Hurricane Katrina and anticipated changes for the near future. The focus of this evaluation was on the potential impact of redevelopment trends on hazard mitigation planning.

- An updated and expanded planning process was used to review and update the plan to ensure broad representation from the community.

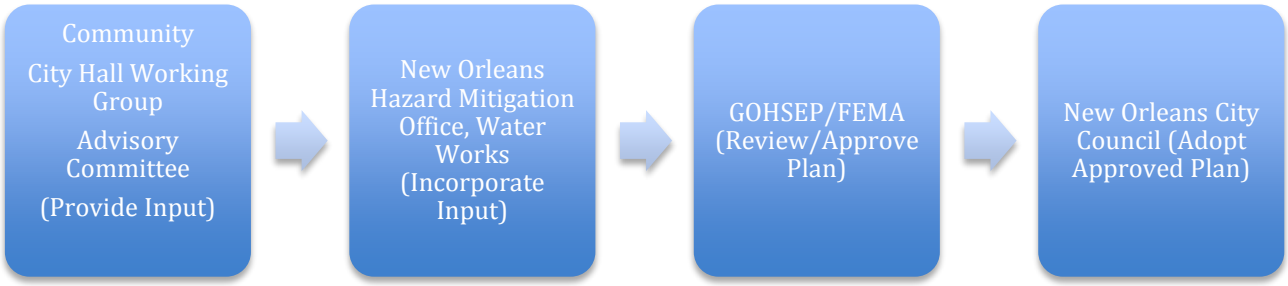
- The ability of Orleans Parish to implement the mitigation actions proposed in the Plan was updated following a thorough review of all agencies and departments that support hazard mitigation activities. The updated Capability Assessment also includes a review of federal and state programs available to support Orleans Parish in implementing the 2015 Plan Update.

- The updated and expanded Mitigation Strategy includes updated goals, a review of the 2010 Plan and accomplishments over the past five years, an updated mitigation action plan that addresses the updated hazards and risk assessment, and a discussion of the Parish's compliance with the National Flood Insurance Program (NFIP) and participation in the NFIP's Community Rating System (CRS).

- The Plan Maintenance procedure has been rewritten and expanded to provide more detail on how the process will be implemented, how the community will be kept informed of progress in implementing the plan, and how changes will be incorporated into the plan.

Hazard Mitigation Planning Organization

The diagram below shows the various groups involved in the planning effort to update the Orleans Parish Hazard Mitigation Plan. The Hazard Mitigation Office received guidance and recommendations from the community, City Hall Working Group, and Advisory Committee to prepare the updated plan. Once the plan was reviewed by the City, it was sent to the Governor's Office of Homeland Security Emergency Preparedness (GOHSEP) and the Federal Emergency Management Agency (FEMA) for approval before being submitted to the City Council for final adoption.



Community stakeholders for the hazard mitigation planning effort included non-profit organizations, community organizations, environmental groups, and regional governmental agencies with an interest in hazard mitigation planning. The Advisory Committee included representatives from a cross section of the community, including community members, university representatives, and governmental and non-governmental organizations. The City Hall Working Group included representatives from the City of New Orleans departments that worked on the 2010 approved Hazard Mitigation Plan and other organizations that work closely with hazard mitigation planning efforts for Orleans Parish.

Planning Process for the 5 Year Plan Update

The Hazard Mitigation Office began the 2015 Plan Update process in February 2014 by convening advisors and initiating conversations with relevant City departments. Beginning in May 2015, the City accelerated the Plan Update process, with the assistance of Water Works, L3C. The planning team held convened a formal Advisory Committee and City Hall Working Group beginning in June 2015. The City Hall Working Group met eight times between June and October 2015. The purpose of each meeting was as follows:

- June 26, 2015 – Overview/Hazards: overview of the hazard mitigation planning process; review the 2010 Plan; hazards activity to rank hazards and discuss correlation to 2010 risk assessment
- July 13, 2015 –Assets and Goals: shared draft maps and discussed data sources; exercise to develop updated goals for 2015 Plan
- July 31, 2015 – History of Impacts: update on risk assessment; discussion of proposed goals; hazards exercise to discuss what could have been done to reduce impacts of different hazards in past 5 years
- August 13, 2015 – Risk Assessment: update on risk assessment; overview of hazard impacts
- September 14, 2015 – Mitigation Strategies: mitigation actions activity to determine how actions fit under updated goals
- September 25, 2015 – Capabilities/Implementation: capability assessment and mitigation action implementation activities to determine process for city departments to implement mitigations strategies
- October 9, 2015 – Hazards Ranking/Draft Review: activity to rank hazards; review draft of 2015 Plan Update
- October 23, 2015 – Final Draft Review: review of final 2015 Plan Update prior to submittal to GOHSEP

The Advisory Committee met four times between July and October 2015. The purpose of each meeting was as follows:

- July 8, 2015: Assets, Goals, Capabilities
- August 5, 2015: Risk Assessment
- September 18, 2015: Mitigation Strategies
- October 7, 2015: Implementation and Draft Review

In addition to the City Hall Working Group and the Advisory Committee, two additional groups were convened for the purpose of holding a discussion specific to their sectors. These two groups included a Public Safety Group and a Non-Profits and Community Organizations Group. The Public Safety Group was convened to discuss the alignment of the risk assessments across the various relevant plans, as well as to discuss hazard vulnerability and mitigation actions.

The Non-Profit and Community Organizations Group was convened in order to facilitate a discussion with local organizations regarding their concerns and needs regarding hazards; as well as how they can best interact with the City in support of risk reduction.

The City also reached out to representatives from the neighboring parishes responsible for hazard mitigation planning, including Jefferson Parish, St. Bernard Parish, and Plaquemines Parish. Following the invitation to participate, there were two meetings that allowed the City's Hazard Mitigation Office to receive Regional input to the 2015 Plan Update. These included a presentation at a meeting of the regional Community Rating System (CRS) Users Group, Flood Loss Outreach and Awareness Taskforce (FLOAT) and an additional meeting sponsored by the South Louisiana Flood Protection Authority-East, which brought together the Planners and Emergency Managers from various neighboring jurisdictions.

Community members were informed of the planning process through a press release, as well as the City's Hazard Mitigation website (http://www.nola.gov/hazard-mitigation/). A survey was circulated to the general public in August and September of 2015 and received over 130 responses and a public comment form was posted on the City's Hazard Mitigation website. Due to the many other public engagement processes ongoing in the City of New Orleans in 2015, such as the Resilient New Orleans Strategy, a public meeting for the Update was not held until October of 2015. This meeting was publicized in the Times-Picayune. Comments from this survey were used in the update of the plan's demographics, perceived hazard frequency, perceived hazard risk, mitigation actions taken and mitigation actions which might be considered.

Once GOHSEP and FEMA review and approve the 2015 Plan Update, a final Progress and Coordination meeting will be held to review the final plan with the Planning Team and Steering Committee before submitting the Plan to the New Orleans City Council for final adoption, Hazard Identification, Profiles and Ranking.

Each of the 18 prioritized hazards were identified and profiled to include: a description of the hazard, the location and extent of the hazard within the Parish, the severity of the hazard, and occurrences of the hazard in Orleans Parish. The Orleans Parish 2015 Plan Update includes a complete review and update of the Orleans Parish 2010 Plan, as well as the State of Louisiana's 2014 Hazard Mitigation Plan. The 18 hazards were identified and prioritized by the 2015 Orleans Parish Hazard Mitigation Planning Team and presented to the community for their review. One new natural hazard not included in the 2010 Plan was added to the 2015 Plan Update: extreme temperatures; six new man-made hazards were added to the 2015 Plan Update: power outages, terrorism, infrastructure failure, building collapse, civil unrest, and pandemic.

Vulnerability (Risk) Assessment and Loss Estimation

The 2015 Plan Update includes an overview and analysis of Orleans Parish's vulnerability to hazards. This vulnerability assessment includes a review of physical assets that could potentially be damaged by the hazards identified in the plan. The vulnerability assessment also includes the potential for physical injury or death from the identified hazards, as well as the potential for interruption of operations. The assessment examines the potential for loss of buildings by type (commercial, residential, government, etc.) and the potential monetary damage by types and number of structures. The vulnerability assessment focuses on levee vulnerabilities, flood and surge vulnerabilities, and hurricane wind vulnerabilities.

The estimates of potential losses focuses on four general categories of risk, including: 1) structure – direct damage to buildings or infrastructure, 2) contents – direct damage to contents of buildings, 3) loss of function – the value of services interrupted or lost during hazard events, and 4) injuries and fatalities – damage related to deaths and a range of injuries. Although Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence have the potential to cause damage in all of these four categories, the hazards with the greatest potential for losses occurs with hurricane winds, storm surge, flooding, and levee failure. For this reason, the 2015 Plan Update focuses on potential losses from these four identified hazards. The loss estimates also include a review of the loss of property by National Flood Insurance Program flood insurance claims by planning area in Orleans Parish, as well as the repetitive loss properties.

This section of the plan concludes with an overview of land uses, development and redevelopment trends. Careful land use planning offers opportunities to mitigate vulnerabilities and potential losses from hazard events. Understanding risks associated with different types of development in Orleans Parish and mitigation planning is an essential part of comprehensive planning. For this reason the City's Master Plan includes a chapter on Resilience: Living with Water and Natural Hazards. Since the 2010 Plan, the City has also updated its Comprehensive Zoning Ordinance and released its Resilient New Orleans Strategy.

Capability Assessment

The 2015 Plan Update includes a review of all City departments, boards, commissions, as well as other organizations involved in activities related to hazard mitigation planning. The Hazard Mitigation Office will serve as the lead agency and will coordinate with other agencies as needed to implement the Mitigation Strategy of the 2015 Plan Update.

The Hazard Mitigation Office will also work with federal and state agencies and programs to implement the 2015 Plan Update. The capability assessment section of the plan highlights the federal and state programs that provide financial assistance for hazard mitigation planning.

Mitigation Strategy

The Mitigation Strategy included in the 2015 Plan Update provides a long-term plan to reduce potential losses identified in the Vulnerability (Risk) Assessment. This strategy has been updated, expanded, and completely rewritten from the 2010 Plan to include updated goals and objectives, a review of the 2010 Mitigation Action Plan and accomplishments, and an updated Mitigation Action Plan that addresses the updated hazards and risk assessment. The Mitigation Strategy also includes a discussion of the Parish's compliance with the National Flood Insurance Program (NFIP) and participation in the NFIP's Community

Rating System (CRS).

The Mitigation Action Plan outlined in Table 9.1 includes projects that address the identified risks to protect lives, infrastructure, and the economy. There are a total of 92 actions designed to reduce or eliminate risks from the hazards identified in the plan. The actions were prioritized using a modified STAPLEE methodology. STAPLEE is an acronym for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. This methodology was used to examine opportunities (benefits) and constraints (costs) of implementing each action from the perspective of all seven of the STAPLEE criteria.

The actions included in the Mitigation Strategy provide a full range of actions, some of which are underway and will remain ongoing. Some can be implemented quickly over a couple of years, while others will require more planning and will be implemented over the next 10 years. The mitigation actions are organized by foundational principles and goals, including:

Foundational Principles: The following foundational principles are key to all of the Goals and Objectives:

1. Consider the principles of equity in risk reduction decisions, including land use, zoning, and the allotment of funds and resources
2. Plan for future conditions, including development and climate change
3. Plan for minimizing damage and maximizing disaster recovery
4. Treat risk reduction and hazard mitigation as part of an integrated system, with an emphasis on safety.

Goal #1: Reduce risk and vulnerability to the human environment including cultural resources, homeowners, renters, visitors, and transient populations.

Goal #2: Reduce risk and vulnerability to the built environment including current and future structures; critical facilities; historic structures; and infrastructure, including communications infrastructure.

Goal #3: Reduce risk and vulnerability to the natural environment including wetland restoration and recognition of New Orleans as a coastal city.

Goal #4: Maximize the involvement of individuals, businesses, and groups in risk reduction measures through education/outreach on hazard mitigation appropriate to all groups, particularly vulnerable populations.

Goal #5: Promote coordination locally, regionally, and nationally including all levels of government, private sector entities, as well as nonprofits and community based organizations.

Goal # 6: Ensure continuity of operations for local government and businesses, including protection of critical functions, records and cultural assets.

The actions will be implemented in a variety of ways. Some will be implemented through ongoing organization and routine assignments of City staff, while others will be implemented through strengthening City policies, programs, building codes, and other planning tools. Still others will be implemented through the new Master Plan and the new City Zoning Ordinance. Many actions are FEMA-funded projects and will require these federal funds before they can be implemented. Implementation of the Mitigation Strategy will require a combination of local, federal, and state funds. Projected time frames are given for each mitigation action.

Plan Maintenance Procedures

Once the Plan is approved by GOHSEP and FEMA and is formally adopted by the City Council, the Plan must be implemented and maintained. The 2015 Plan Update includes an overall process that Orleans Parish will use to update the plan and to keep the community informed of progress in implementing the plan. The Hazard Mitigation Office will be responsible for monitoring and updating the plan annually.

Because the annual monitoring and updating process will require extensive coordination between numerous agencies, both within City Hall and outside City Hall, a Disaster Risk Reduction Subcommittee of the Local Emergency Planning Committee (LEPC) will be convened within the first quarter following adoption of the 2015 Plan Update. This LEPC subcommittee will be responsible for producing an annual progress report of all action items. The report should be complete within 30 days of the end of the third quarter each year. This will necessitate tracking of progress on any action items underway as well as the strategic implementation of subsequent action items. In order to accomplish this, the subcommittee will need to continue to meet at least quarterly.

The 2015 Plan Update will also be reviewed, revised, and updated in 2020. The City should begin the 2020 update cycle no later than 2018 to ensure that proper attention can be brought to bear on the this comprehensive update. The 2020 Update will require GOHSEP and FEMA approvals, as well as Council adoption before the expiration of the 2015 Plan Update.

The public will be notified when the plan implementation process begins and will be given an opportunity to participate in the plan maintenance process. Public meetings should be held annually following the release of the progress report. The community will be given opportunities to comment on the progress in implementing the plan and on any proposed plan revisions or updates.

Plan Contact

Hazard Mitigation Office
City Hall Room 9E06
1300 Perdido Street
New Orleans, LA 70112

Section 2. Introduction

Contents of this Section

2.1 Interim Final Rule (IFR) Requirements for Plan Updates

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

2.2 Overview

New Orleans is one of the most important cities in the United States for historical, cultural, and economic contributions. It is also one of the most vulnerable cities to natural and man-made disasters. Hurricane Katrina and the subsequent levee system failure in 2005 and the 2010 BP oil spill are examples of recent catastrophes, but the city also faces ongoing risk from other hazards.

Hazard Mitigation is a vital piece of the City of New Orleans' resilience and emergency management/preparedness efforts. Hazard Mitigation is defined as the sustained action to reduce or avoid long-term risk to life and property from a hazard event in order to: 1) save lives and reduce property damage, 2) reduce the cost of disasters to property owners and all levels of government, 3) protect critical facilities and minimize community disruption.

Disaster Mitigation Act 2000 and Interim Final Rule (IFR)

To reinforce the importance of hazard mitigation planning the federal government amended the Stafford Act with the Disaster Mitigation Act of 2000 (DMA 2000), Public Law 106-390. The provisions of this law are governed by the FEMA regulations published under 44 Code of Federal Regulations (CFR) 201.6, as the Interim Final Rule. The February 26, 2002 Interim Final Rule was subsequently amended in October 2002, September 2004, October 2007, September 2009, April 2014, and most recently on December 19, 2014. The regulations require that a local government must have an approved plan that is updated every five years in order to apply for and/or receive grant funds for any of the hazard mitigation assistance programs. These programs include funds from the 1) Hazard Mitigation Grant Program (HMGP), 2) Pre-Disaster Mitigation (PDM), and 3) Flood Mitigation Assistance (FMA). Mitigation plans must demonstrate that

mitigating actions were developed through a sound planning process that accounts for risk to and capabilities of the community.

Benefits of Mitigation Planning

Hazard mitigation plans help communities reduce their risk from hazards by identifying vulnerabilities and developing strategies to lessen and sometimes avoid the effects of the hazard. Benefits of mitigation planning include:

- Reducing risks to human life and property.
- Improving ability to recover after a disaster.
- Long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage.
- Ensuring that resources are committed to reduce identified hazards.

2.3 Purpose of Plan

This hazard mitigation plan outlines New Orleans' strategy to reduce the effects of hazards on people and property. In accordance with the requirements of the Disaster Mitigation Act of 2000 and the Interim Final Rule, this Plan examines Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence that might affect New Orleans and focuses on those hazards that are most prevalent. It estimates the location and the extent of possible losses to life and property, identifies and prioritizes mitigation strategies, proposes ways of implementing these strategies, and establishes a method to monitor and maintain the plan. The purpose of the 2015 Plan is to review and update all sections of the 2010 Orleans Parish Hazard Mitigation Plan.

Hazard mitigation planning is important to all communities. Every year, local governments and individuals across the U.S. must spend time, energy, and money to recover from natural and man-made disasters. The costs of disaster recovery are high and frequently state and federal aid is insufficient to cover the full extent of damages. Hazard mitigation planning can help reduce the risks from hazards, lowering the overall damage costs from disasters and hastening the response and recovery process.

With its location in southeastern Louisiana, New Orleans is vulnerable to many natural hazards (e.g., tropical cyclones and coastal erosion), as well as many man-made hazards (e.g., dam and levee failure and hazardous materials spills). The information in this plan provides a detailed picture of the risks that face New Orleans. Based on this information, mitigation strategies specifically tailored to New Orleans have been created. By implementing these strategies, New Orleans will improve its ability to cope with the hazards is faces.

The 2010 Orleans Parish Hazard Mitigation Plan was approved by GOHSEP and FEMA, and subsequently adopted by the New Orleans City Council in March 2010. The Orleans Parish 2015 Hazard Mitigation Plan is an update to the 2010 Plan. The planning team for the 2015 Plan has reaffirmed and updated its 2010 Mission Statement as follows:

To *promote, implement, and sustain* mitigation measures in Orleans Parish in order to reduce and manage risks to human life, the environment, and property in order to protect New Orleans and the surrounding region from the effects of natural and manmade hazards while ensuring community continuity when such hazards do occur.

In addition to the Mission Statement, the planning team developed the following Foundational Principles as key to all the Goals and Actions in the 2015 Hazard Mitigation Plan:

- Consider the principles of equity in risk reduction decisions, including land use, zoning, and the allocation of funds and resources;
- Plan for future conditions, including development and climate change;
- Plan for minimizing damage and maximizing disaster recovery; and
- Treat risk reduction and hazard mitigation as part of an integrated system, with an emphasis on safety.

It is important to note that this hazard mitigation plan is not an emergency operations plan. The City of New Orleans Comprehensive Emergency Management Plan establishes the framework to prepare for, respond to, and recover from a wide variety of emergencies and disasters. Instead, the Hazard Mitigation Plan is dedicated to reducing risk and vulnerability to the human, built, and natural environment, including cultural resources, Parish infrastructure, critical facilities, and the surrounding ecosystems.

2.4 Organization of Plan

The Orleans Parish 2015 Hazard Mitigation Plan Update contains ten (10) sections.

Because the boundaries of the City of New Orleans and Orleans Parish are coterminous, the names “New Orleans,” “City of New Orleans,” and “Orleans Parish” are used interchangeably throughout the Plan. Where appropriate, sections have been updated to reflect current conditions and new development, and also to review and summarize what has been accomplished between 2010 and 2015.

Section I: Executive Summary

The Executive Summary provides highlights of the plan, including an overview of the planning process, identified hazards and risks, a summary of the mitigation strategy and implementation process, and a method to monitor and update the plan.

Section II: Introduction

The Introduction section provides an overview of the plan purpose and organization.

Section III: Plan Adoption

The Plan Adoption section identifies all requirements for approval of the plan by the City of New Orleans, Governor’s Office of Homeland Security & Emergency Preparedness (GOHSEP), and Federal Emergency Management Agency (FEMA).

Section IV: Community Profile
For context, the Community Profile section provides a brief illustration of the community of New Orleans. Descriptions of the geography and climate, the economy past and present, transportation, and the community's assets are included. Additionally, trends in population and land use are discussed.

Section V: Planning Process
The Planning Process section outlines the manner in which 2015 Plan Update was created. It identifies all participating parties, agencies, and organizations involved in the overall process. How the community was engaged and included in the process is also described in this section.

Section VI: Hazard Identification, Profiling, and Ranking
The Hazard Identification and Profile section includes an analysis of the hazards identified as a risk to the City of New Orleans and a detailed profile of each hazard.

Section VII: Vulnerability Assessment and Loss Estimation
The Risk Assessment section includes an assessment of risks associated with each hazard identified in the plan. This section provides a scientific and technical basis to guide the Mitigation Strategy.

Section VIII: Capability Assessment
The Capability Assessment section includes a review of the planning tools, as well as administrative, technical, and financial resources available to implement the plan. The assessment will include capabilities of the City of New Orleans, GOHSEP, and FEMA as they relate to supporting mitigation activities in the Plan.

Section IX: Mitigation Strategy
The Mitigation Strategy describes how the City of New Orleans intends to reduce losses identified in the Risk Assessment. It includes goals and objectives to guide the selection of actions to mitigate and reduce potential losses. The section contains a prioritized list of cost-effective, environmentally sound, and technically feasible mitigation actions. It identifies current and potential sources of funding and other resources needed to implement the mitigation actions.

Section X: Plan Maintenance
The Plan Maintenance section describes how New Orleans will monitor, evaluate, and update its mitigation plan. It establishes a process for review and a method for measuring progress. FEMA requires mitigation plan updates every five years.

2.5 Plan Contact

If you have any questions or comments on the Orleans Parish Hazard Mitigation Plan or require additional information, please contact:

Hazard Mitigation Office
City Hall Room 9E06
1300 Perdido Street
New Orleans, LA 70112

2.6 Acronyms

Following is a list of acronyms used throughout the Plan Update.

ABFE	Advisory Base Flood Elevation
ASCE	American Society of Civil Engineers
BFE	Base Flood Elevation
CAEP	City Assisted Evacuation Plan
CEMP	Comprehensive Emergency Management Plan
CFR	Code of Federal Regulations
CPRA	Coastal Protection & Restoration Authority
CRS	Community Rating System
CZO	Comprehensive Zoning Ordinance
DEQ	Department of Environmental Quality
DMA	Disaster Mitigation Act of 2000
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GOHSEP	Governor's Office of Homeland Security & Emergency Preparedness
HIRA	Hazard Identification & Risk Assessment
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HPS	Hurricane Protection System
HSDRRS	Hurricane Storm Damage Risk Reduction System
IFR	Interim Final Rule
IHNC	Inner Harbor Navigation Canal
IW	Intercoastal Waterway
LACPR	Louisiana Coastal Protection and Restoration
LANOIA	Louis Armstrong New Orleans International Airport
LRA	Louisiana Recovery Authority
MAT	Mitigation Assessment Team
MRGO	Mississippi River Gulf Outlet

NCDC	National Climatic Data Center
NEPA	National Environmental Protection Act
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NIST	National Institute of Standards and Technology
NOAA	National Oceanic & Atmospheric Administration
NOHSEP	New Orleans Office of Homeland Security & Emergency Preparedness
NWS	National Weather Service
PDM	Pre-Disaster Mitigation Program
RFC	Repetitive Flood Claims Program
RL	Repetitive Loss
SRL	Severe Repetitive Loss
STAPLEE	Social, Technical, Administration, Political, Legal, Economic, Environmental
TPC	Tropical Prediction Center
UNO-CHART	University of New Orleans Center Hazards Assessment Response
UNOP	Unified New Orleans Plan
USACE	U.S. Army Corps of Engineers

Section 3. Plan Adoption

Contents of this Section

3.1 Interim Final Rule (IFR) Requirements for Plan Adoption

IFR §201.6(c)(5): [The local hazard mitigation plan ***shall*** include] 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).

FEMA requires a formal plan adoption to be a part of the planning process. Adoption included in the overall planning process indicates that the City of New Orleans is committed to fulfilling the mitigation goals and objectives outlined in the Plan. The following steps as required by GOSHEP and FEMA have been completed as shown in the following table:

Action	Date
LA GOHSEP Approval Pending City Council Adoption	
FEMA Approval Pending City Council Adoption	
City Council Adoption of Orleans Parish 2015 Hazard Mitigation Plan Update	

3.2 Official Record of Adoption

New Orleans City Council adopted the 2010 Orleans Parish Hazard Mitigation Plan (Resolution No. R-11-115) on March 3, 2011; the plan was approved by GOHSEP and FEMA in March of 2011. Plan adoption and approval documents will be included as Appendix A.

Section 4. Community Profile

Contents of this Section

4.1 History

The City of New Orleans was founded in 1718 by Jean-Baptiste Le Moyne, Sieur de Bienville, and in 1722 became the capital of the French colony. The original settlement was in the area now known as the Vieux Carre, or French Quarter. In 1763, New Orleans became a Spanish colony under the Treaty of Paris, and soon after, became the capital of Spanish Louisiana. After being returned secretly to France in 1800, New Orleans was sold to the United States in 1803 as part of the Louisiana Purchase.

New Orleans grew in size and prominence during the 19th Century. By 1852, New Orleans was the third largest city in the U.S. The growing population fueled development upriver and downriver from the French Quarter. Already a major port for many decades, New Orleans became a railroad hub in the late 1800s.

In the early 20th Century, many of the swampy areas of New Orleans were drained. This allowed development to continue towards Lake Pontchartrain, establishing the neighborhoods of Gentilly and Lakeview. Further increasing development in parts of town not along the Mississippi River, was the addition of 2,000 acres of reclaimed land, created by the Levee Board after building a seawall that extended 3,000 feet into Lake Pontchartrain in 1927. Later developments extended further east, and also on the west bank of the Mississippi River. Starting in the 1960s and continuing into the 1980s, new neighborhoods were established in New Orleans East and Algiers. In the 1990s, new development was confined to smaller infill projects within the urban core, including condominiums in downtown New Orleans, and the redevelopment of public housing.

Like many major U.S. cities, New Orleans' growth was outpaced by the growth of its surrounding suburbs during the last half of the 20th Century. Commerce and industry followed the population movement to the suburbs. New Orleans's economy was further weakened by the oil bust of the late 1970s and early 1980s. Between 1960 and 1980, New Orleans population decreased 21 percent. Starting in the early 1990s and continuing through 2005, the rate at which New Orleans lost population slowed, and City officials worked to diversify New Orleans' economy.

In August of 2005, New Orleans experienced one of the worst disasters in the history of the United States when Hurricane Katrina made landfall. Katrina caused almost a total evacuation of the city, flooded approximately eighty percent of the area, and generated an estimated $17 billion in damages. Many areas of the City with the worst damage included neighborhoods developed on drained land that was originally low-lying swampy areas. Since the hurricane, the population recovery has exceeded expectations. Ten years after Katrina, more than half (40) of New

Orleans' 72 neighborhoods have recovered over 90 percent of the population they had before the levees failed.

On April 20, 2010, an explosion occurred at the Deepwater Horizon oil rig, located approximately 41 miles off the southeast coast of Louisiana. This oil spill was the largest in US history, causing devastating environmental and economic impacts for New Orleans. In June of 2015, the city accepted a $45 million settlement for losses incurred from the event. The city has pledged to use the funds for resilience initiatives, including water management, and coastal and ecosystem restoration.

4.2 Geography

Orleans Parish is located in Southeast Louisiana at 30.07 degrees North latitude and 89.93 degrees West longitude. The City sits between the Mississippi River to the south and Lake Pontchartrain to the north. It is bordered by Jefferson, Plaquemines, St. Bernard, and St. Tammany Parishes. The land area of the Parish is 180.6 square miles.

The boundaries of the City of New Orleans and Orleans Parish are coterminous. Because of this, the names New Orleans, City of New Orleans, and Orleans Parish, are used interchangeably throughout the Plan.

The topography of New Orleans consists of mostly flat land with elevations across the Parish close to, or below, sea level. Although there are a few ridges in New Orleans, such as the Metairie Ridge and the Gentilly Ridge, the highest spots in the City are still only a few feet above sea level and nearer the Mississippi River. With the exception of the easternmost section of the Parish, all of Orleans Parish is surrounded by levees. These levees along the Mississippi River and Lake Pontchartrain result in a topography that is similar to a saucer. As a result of this topography, all rain that falls in New Orleans must be pumped out of the city by New Orleans' extensive network of pumps.

Water figures prominently in the topography of New Orleans. In addition to being located between the Mississippi River and Lake Pontchartrain, New Orleans also contains a large area of marshland. Twenty-five percent of the Parish is marshland. While most of this area is uninhabited, the marshes provide recreation areas for people and habitat areas for wildlife. The marshes also help protect Southeast Louisiana from the effects of coastal storms.

4.3 Climate

New Orleans is located in a humid subtropical climate zone, characterized by hot, usually humid summers and mild to cool winters. The monthly daily average temperature ranges from 54.4 °F in January to 82.9 °F in July and August. The lowest recorded temperature was 6 °F on February 13, 1899. The highest recorded temperature was 104 °F on June 24, 2009.

The average precipitation is 62.7 inches (1,590 mm) annually; the summer months are the wettest, while October is the driest month. On average, there are 77 days of 90 °F + highs, 8.1 days per winter where the high does not exceed 50 °F, and 8.0 nights with freezing lows annually. In a typical year the coldest night is around 30 °F. It is rare for the temperature to reach 100 °F or dip below 25 °F.
New Orleans experiences snowfall only on rare occasions. The most recent three snowfall events occurred in 2008, 2004, and 1989.

Monthly Temperature Data in degrees Fahrenheit

Month	Avg. Temp	Ave. Max Temp	Avg. Min Temp
January	54.4	67.6	43.3
February	56.9	65.9	44.1
March	63.0	70.9	54.7
April	69.5	75.1	63.6
May	76.0	81.7	71.4
June	81.4	85.9	76.9
July	82.9	87.5	79.7
August	82.9	88.7	76.4
September	79.5	85.4	74.9
October	71.0	80.5	56.2
November	62.1	68.7	53.0
December	56.0	65.0	48.3
Annual Averages	69.6	74.2	60.9

Source: National Oceanic and Atmospheric Association; Audubon Weather Station; 1893-2015

4.4 Economy

Since World War II, New Orleans' economy has been largely based on trade, energy, tourism, and to a smaller extent, industry and manufacturing. The New Orleans economy remained diversified and strong until the 1980s with the decline in the oil sector. Since the 1980s, the New Orleans economy has relied more heavily on trade and tourism.

Today, New Orleans is still home to one of the major U.S. ports and an extensive network of ground transportation routes in and out of the city. Some of the major imports that pass through New Orleans include coffee, sugar, bananas, and bauxite. Exports include oil, petroleum products, grains, and textiles.

The following table indicates the city's workforce distribution by sector. As the table indicate, more than a quarter of the workforce is employed in the education services, health care, or social assistance sector.

Workforce Employment by Sector

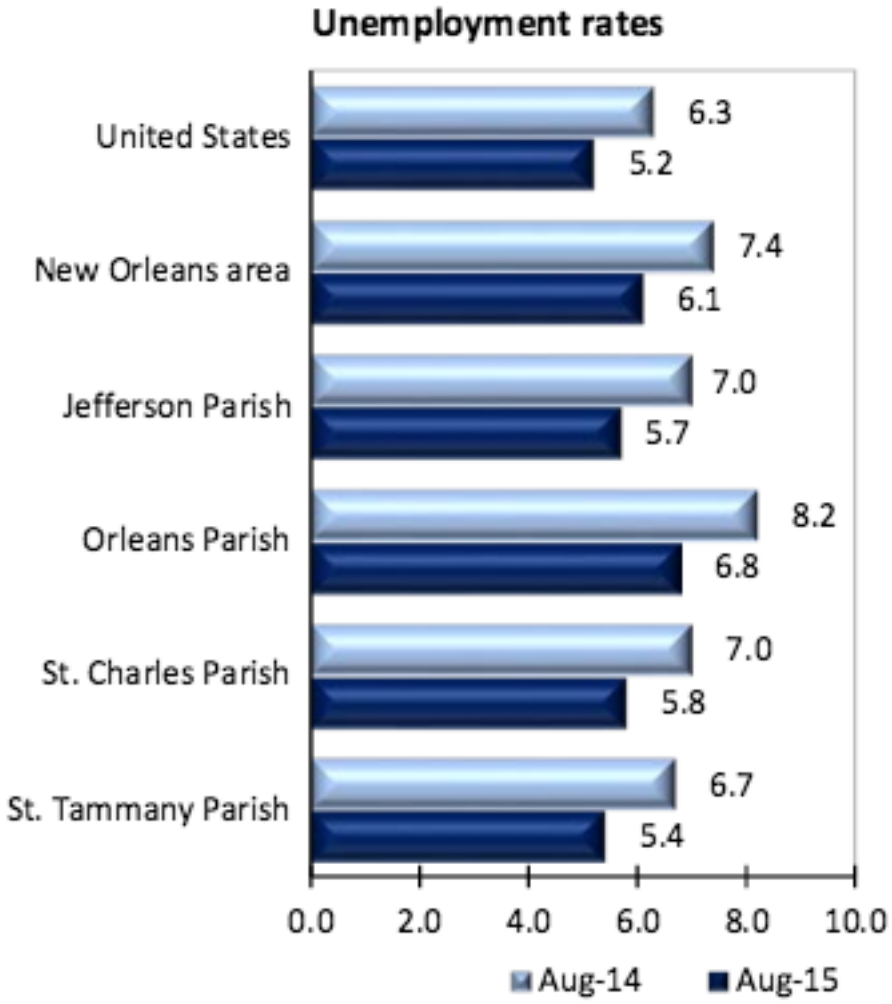
Sector	Percent of Workforce Employed
Educational services, and health care and social assistance	26.5%
Arts, entertainment, and recreation, and accommodation and food services	17.0%
Professional, scientific, and management, and administrative and waste management services	12.0%
Retail trade	9.3%
Construction	6.0%
Finance and insurance, and real estate and rental and leasing	5.4%
Public administration	5.3%
Other services, except public administration	4.6%

Transportation and warehousing, and utilities	4.9%
Manufacturing	4.1
Wholesale Trade	1.9%
Information	1.8%
Agriculture, forestry, fishing and hunting, and mining	1.3

Source: ACS 2009-2013 5-year estimates

In 2014, the city's median household income was $37,146, well below the national average of $51,939. The city's unemployment rate is almost on par with national levels: In August 2015 New Orleans' unemployment rate was 6.8 percent, versus the national average of 5.2 percent.

Figure 4-1 Orleans Parish Employment Rates Compared to the National Average

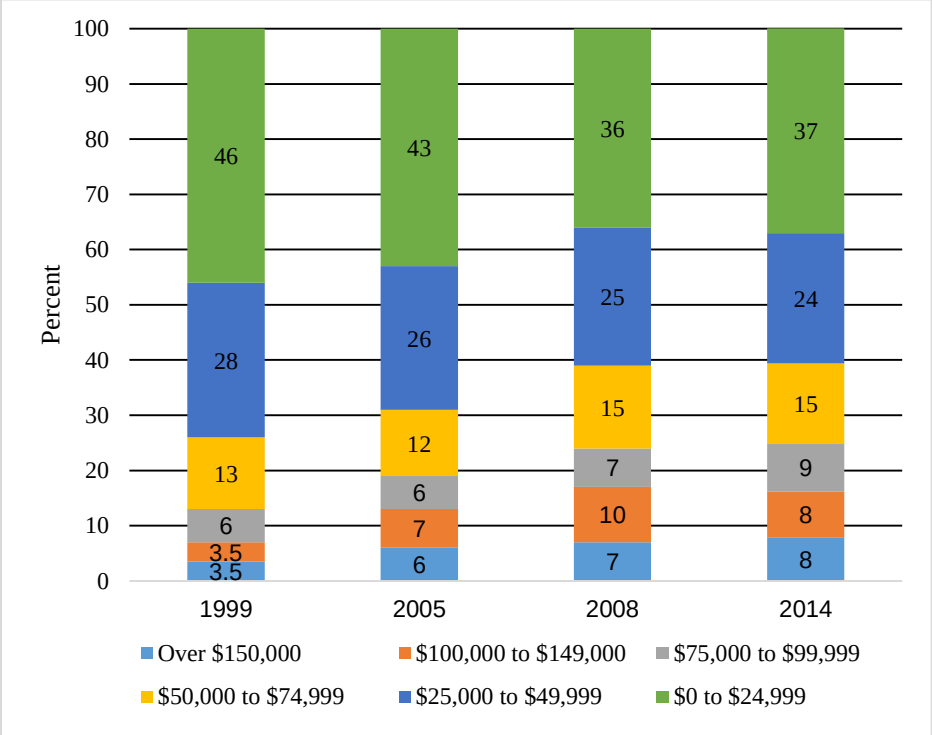


Source: U.S. BLS, Local Area Unemployment Statistics

Prior to 2005, New Orleans experienced a slow increase in household incomes. Due to Hurricane Katrina, which caused a significant shift in the city's demographics, household incomes increased significantly. In 1999, only 26

percent of Orleans Parish households earned incomes exceeding $50,000. By 2008, that same group of households earning incomes of $50,000 or greater, expanded to 39 percent. As of 2014, that number stands at 40 percent.

Figure 4-2 Household Incomes by Percentage of Total Population



Source: U.S. Census Bureau; 2005; 2008; 2014 ACS-5 year Estimates

4.5 Transportation

New Orleans has an extensive transportation network. It is served by air, rail, water, and ground transportation systems.

Aviation
The Louis Armstrong New Orleans International Airport (LANOIA), the largest airport in the region, is owned and operated by the City of New Orleans. However, the LANOIA is located in Jefferson Parish, the Parish directly west of Orleans Parish. LANOIA is considered a medium-sized hub airport, and as of January 2015, has surpassed its pre-Katrina passenger levels.

The New Orleans lakefront Airport is located in Orleans Parish on the southern shore of Lake Pontchartrain. The airport has three runways that serve mostly private and military aircraft. The largest of the three runways is nearly seven thousand feet in length, allowing it to service large aircraft.

Rail
Amtrak provides passenger rail service to New Orleans. Amtrak routes connect New Orleans to the Northeast, the Southeast, the Midwest, and Southern California. New Orleans is also served by six Class 1 freight railroads: Union

Pacific, Kansas City Southern, Burlington Northern Santa Fe, Canadian National, Norfolk Southern, and CSX Transportation. In addition, the City owns a non-profit switching railroad, the New Orleans Public Belt Railroad (NOPBRR). The NOPBRR interchanges with all Class 1 railroads serving New Orleans.

Ports and Waterways

New Orleans is located in the heart of the world's busiest port complex – Louisiana's Lower Mississippi River. The Port of New Orleans is one of America's leading general cargo ports, and is ranked number one in the country for import steel, natural rubber, plywood, and coffee. The Port of New Orleans is also the only deep water port in the U.S. served by six Class 1 railroads. As of 2014, the Port of New Orleans handles more than 1,000,000 cruise ship passengers per year.

Important navigable waterways in Orleans Parish include the Inner Harbor Navigation Canal (IHNC, or the Industrial Canal) and the Mississippi River. The IHNC connects the Mississippi River and Lake Pontchartrain. From 1968 until 2008, the Mississippi River Gulf Outlet (MRGO) provided a shortcut from the Gulf of Mexico to the Port of New Orleans. Following Hurricane Katrina, U.S. Congress de-authorized MRGO, closing it to all ship travel in 2008. MRGO was closed because of its magnifying effect of the storm surge from Hurricane Katrina. To permanently close MRGO, the USACE constructed a rock closure across MRGO at Bayou la Loutre in 2009. In 2010, the USACE constructed a floodwall with navigational gates at Bayou Bienvenue and Gulf Intercoastal Water Way (GIWW) to reduce the risk of damage from future storm surges from the Gulf of Mexico and Lake Borgne.

Roads, Highways, and Bridges

Several major highways pass through New Orleans. The largest is Interstate 10, which handles over 131,000 vehicles per day. New Orleans also includes the spur routes I-510 and I-610. Louisiana Highways 11 and 90 pass through New Orleans. While New Orleans has many major corridors, it also has an extensive network of small streets. Many of the streets in the older sections of the city are very narrow, and driving space for cars is further limited by the lack of off-street parking.

Traffic congestion is a major problem during an evacuation. The number of routes out of New Orleans is restricted by the bodies of water surrounding the City. The major route out of New Orleans is Interstate 10, which runs east-west, crossing Lake Pontchartrain to the east, and the Bonne Carre Spillway to the west. Highway 90, which runs east-west, and is the only other possible evacuation route, crosses the Mississippi River.

These limited evacuation routes for New Orleans are the same routes used to evacuate the lower-lying parishes that border the City, compounding congestion during evacuation. The only routes out of St. Bernard and Plaquemines Parishes pass through Orleans Parish. Similarly, residents in west Parishes evacuating east, must travel through New Orleans on I-10, creating more congestion overall. As a result, Louisiana Department of Transportation and Development (LADOTD) has developed a contraflow map for emergency evacuation. When the contraflow plan is in effect, all travel lanes on the interstates move evacuees east, west, and north out of New Orleans.

Transit

Public transportation in New Orleans is operated by the New Orleans Regional Transit Authority (RTA). RTA operates bus lines throughout the Parish, as well as three streetcar routes. New Orleans' famous street cars currently operate along St. Charles Avenue, Canal Street, Loyola Ave, Carrollton Ave, and along the riverfront through the French Quarter and Central Business District. A new streetcar line along Rampart, just north of the French Quarter, in scheduled for completion in 2015.

4.6 Community Assets

New Orleans maintains its unique cultural heritage. Residents and new-comers take pride in the City's historic neighborhoods, food, music, art, and its diversity of lifestyles. New Orleans is perhaps best known for the French Quarter Historic District and the historic architecture throughout the city. In all, New Orleans has 154 properties and districts listed on the National Register in the parish, including 26 National Historic Landmarks. During the planning process, the Planning Team also identified Critical Facilities.

The Riverfront, along the Mississippi River, is the location of the Convention Center, the Riverwalk, the Moonwalk, the Aquarium of the Americas, and Woldenberg Park. Other main attractions downtown include the Superdome and the New Orleans Arena. Although the downtown New Orleans Medical Center, home to several hospitals and clinics, was heavily damaged by flooding from Hurricane Katrina, progress has been made to reopen some hospitals and construct new facilities. A new bio-sciences district is nearing the completion phase, with some buildings already completed, effectively expanding downtown to the northwest. This district will house the new Veterans Affairs (VA) and Louisiana State University (LSU)/Tulane Teaching Hospitals.

New Orleans also offers many opportunities for recreation. Lake Pontchartrain and Bayou Savage National Wildlife Refuge provide access to outdoor and wildlife recreation. New Orleans' major parks include City Park, Audubon Park, the Audubon Zoo, and the National Jazz Historical Park (Louis Armstrong Park). Following Hurricane Katrina, the City lost two important recreational assets – Six Flags New Orleans and the Louisiana Nature Center, both located in the eastern portion of New Orleans.

New Orleans has many colleges and universities. Major institutions of higher learning include the University of New Orleans, Tulane University, Loyola University, Xavier University, Southern University at New Orleans, Dillard University, Our Lady of Holy Cross College, and Delgado Community College.

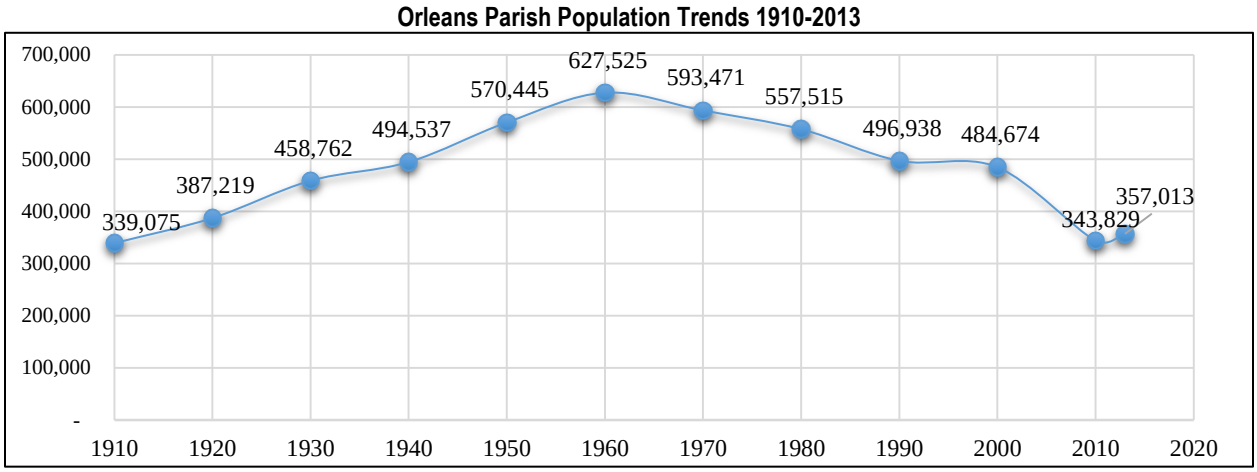
Culturally, New Orleans is a very rich city. It has a unique history, many community assets, and an advantageous location for commerce. Through hazard mitigation planning, the citizens and officials of New Orleans can help protect the city that they call home.

4.7 Population & Housing

Similar to most urban cities across the country, New Orleans experienced a slow decline in population beginning in 1960. Although New Orleans lost over 130,000 people between 1960 and 1990, the decline was not as pronounced as in other U.S. cities (e.g., Cleveland, Pittsburgh, and St. Louis) whose local economies were tied closely to manufacturing. However, during the 1980s New Orleans experienced a sharper decline in population as a result of the slowdown in the oil industry. Between 1960 and 1990, the population of New Orleans decreased 21 percent (from 627,625 in 1960 to 496,938 in 1990). However, from the 1990s through mid 2005, prior to Hurricane Katrina, New Orleans population began to stabilize.[1] In July 2005, New Orleans had an estimated population of 455,188. In August 2005, Hurricane Katrina flooded the City of New Orleans, and nearly 100% of the population was temporarily displaced. The population has continued to increase between 2006 and 2015, from 208,548 in July 2006

[1] "Plan For The 21st Century: New Orleans 2030, Volume 3, Chapter 2; —New Orleans Yesterday and Today: Population and Land Use Trends, pages 2.2 - 2.3, Draft January 2010. Source: GNO Data Center

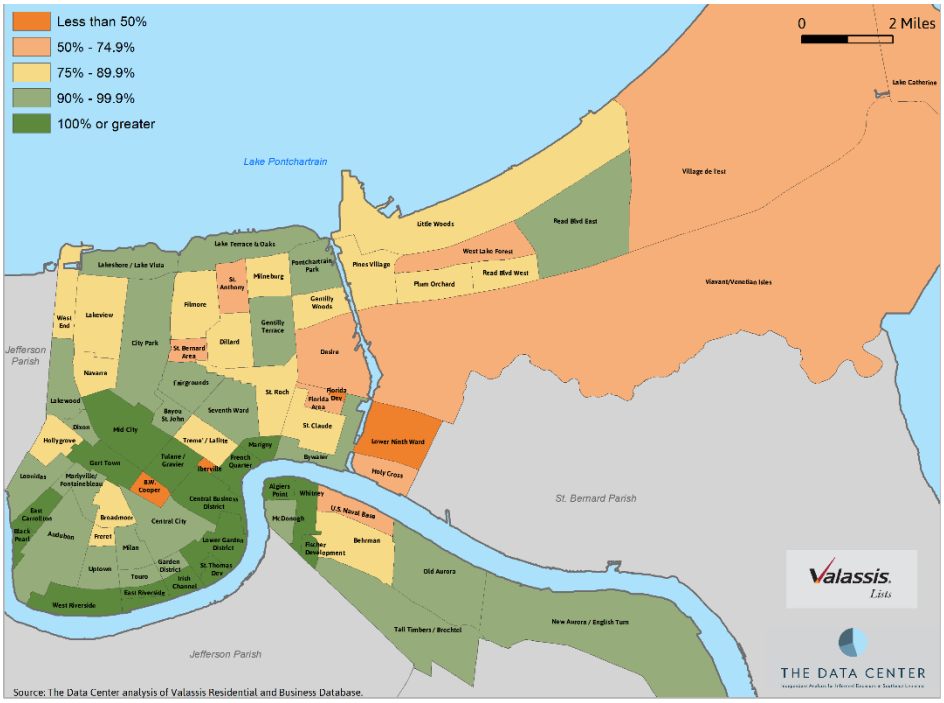
to 357,013 in 2014.



Source: U.S. Census Bureau, 2010, Table DP-1; ACS 2009-2013 5 year Estimates, Table DP05

This recovery in population has exceeded most projections. As shown in the map below, by June 2015 most areas of the city had recovered to at least 75% of their pre-Katrina population.

Figure 4-3 Percent of June 2003 residential address that were actively receiving mail in June 2015



The following table indicates the distribution of residents by age cohorts. Orleans parish has over 60,000 people, or 17.6 percent of its population, under the age of 5 or over the age of 64. This is relevant to hazard mitigation insofar as the very young and elderly populations may be at greater risk from certain hazards over others. For a more elaborate discussion of this vulnerability, please see *Section Five: Risk Assessment*.

Orleans Age Cohorts

Indicator	Total	% of Total
Total Population	357,013	100.0%
Under 5 years of age	22,709	6.4%
Age 6 to 64	294,210	82.4%
65 and over	40,094	11.2%

Source: ACS 2009-2013 5 year estimates Table DP05

The following table highlights certain populations that may be more at risk to hazardous events than others. For example, there are over 16,000 female headed households, with children, that have no husband present. Over 13,000 householders over the age of 65 are living alone. Variables in this table may indicate certain components of vulnerability in the city. For a more elaborate discussion of this vulnerability, please see *Section Five: Risk Assessment.*

Orleans Socio-Housing Variables

Indicator	Total	% of Total
Total Occupied Households	148,398	100.0%
Female householder, no husband present, family	29,828	15.7%
Female householder, no husband present, family With own children under 18 years	16,432	8.6%
Householder living alone	57,330	30.2%
Householder living alone, 65 years and over	13,298	7.0%
Households with one or more people 65 years and over	30,626	16.1%
Number of grandparents living with and responsible for own grandchildren under 18 years	4,639	2.4%
Households With Food Stamp/SNAP in the past 12 months	30,179	15.9%

Source: ACS 2009-2013 5 year estimates Table DP02; DP03

The following table highlights ethnic cohorts in the city. Race and ethnicity correlate with social vulnerability. This vulnerability translates to a lack of access to resources, cultural differences, and the social, economic, and political marginalization that is often associated with these disparities. Language and cultural barriers can also affect access to post-disaster funding in high hazard residential locations.

Orleans Parish Ethnicity

Indicator	Total	% of Total
% White	120,087	33.6%
% Black	213,632	59.8%
% Vietnamese	6,750	1.9%
% Latino	18,984	5.3%

Source: ACS 2009-2013 5 year estimates Table DP05

The following tables indicate a series of miscellaneous demographic variables that may indicate different types of vulnerabilities in the city. Over 12,000 people speak English less than very well. As such, communicating with these populations for disaster preparation, mitigation, response, and recovery may be challenging. The city also has over 16,000 residents that may be new to the city. This population may have less developed local social networks, and may be unaware of disaster preparedness activities, such as those related to hurricane preparedness and evacuation procedures.

Nearly one sixth of the city has no health insurance. This is relevant for public health pandemics, which is a hazard profiled in this plan. This population may be less inclined to seek medical assistance during a pandemic event, which

could pose challenges for effective outbreak control. Finally, the city has over 48,000 residents with a disability. Caring for these populations during hazardous events is critical, as they may require assistance to effectively prepare, evacuate, or manage hazardous situations.

Orleans Miscellaneous Resilience Variables

Indicator	Total	% of Total
Speak English less than "very well"	12,539	3.5%
Resided outside LA 1 year ago	16,101	4.5%
No health insurance	66,867	18.7%
Total Civilian Noninstitutionalized Population With a disability	48,105	13.7%

Source: ACS 2009-2013 5 year estimates Table DP02; DP03

The following page, indicates selected housing variables, including housing occupancy and date of construction. According to the Department of Housing and Urban Development (HUD), older homes are at greater risk of poor repair and dilapidation, resulting in blighted or substandard properties. This is significant in assessing hazard vulnerability because these housing units may result in living quarters that are prone to higher damages during disaster events, which include high winds, tornados, hail, severe thunderstorms, and hurricanes. Almost one third of the city's housing was built prior to 1939.

Approximately 1.0-percent of all housing units in the planning area are mobile homes. Mobile homes are at a higher risk of sustaining damages during high wind events, tornados, severe thunderstorms, and hurricanes. Mobile homes that are either not anchored or are anchored incorrectly can be overturned by 60 mph winds.

78.1-percent of the city's housing is occupied. Less than half of these units are owner occupied. Occupied housing units may often be better maintained and less likely to contribute to dangerous or hazardous situations. Owner occupied units are generally better maintained and updated. Rental housing often does not receive many of the updates and retrofits required for hazard resilience. Multi-family rental units may present specific concerns (such as lack of wind resistant building practices or storm shelters). It should be noted that almost 1/6 of occupied housing has no vehicle available. This population may be dependent on public services during mandatory evacuations for hazardous events.

21.9-percent of the city's housing is vacant. Vacant homes are more likely to become derelict or fall into disrepair over time. This tendency can result in higher levels of vulnerability for communities. If vacant homes deteriorate they can be easily damaged or destroyed during hazard events (specifically high winds, thunderstorms, and hurricanes), which can result in homes becoming projectiles and wind-borne debris. Wind-borne debris can injure people, damage vehicles and other structures, as well as creating a post-impact environment where debris management is intensified.

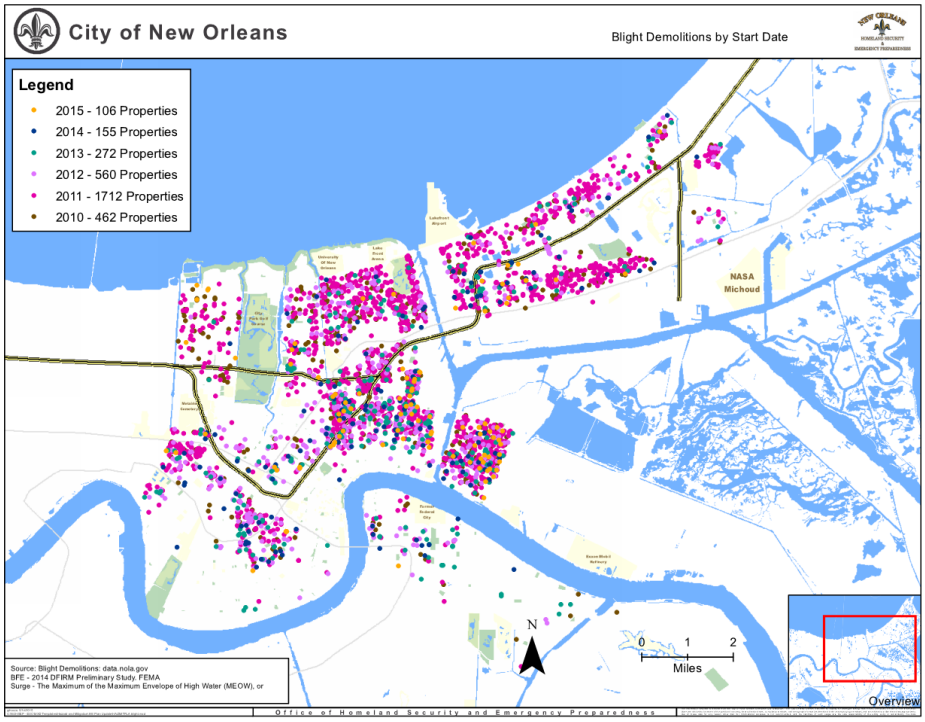
Orleans Parish Housing Variables

Indicator	Total	% of Total
Total housing units	190,127	100%
Occupied housing units	148,398	78.1%
Owner-occupied	70,175	47.3%
Renter-occupied	78,223	52.7%
Occupied - No vehicles avail.	27,396	18.5%
Vacant housing units	41,729	21.9%
Mobile homes	1,810	1.0%
Built 2010 or later	1,735	0.9%
Built 2000 to 2009	15,105	7.9%
Built 1990 to 1999	7,028	3.7%
Built 1980 to 1989	14,476	7.6%
Built 1970 to 1979	27,533	14.5%
Built 1960 to 1969	21,660	11.4%
Built 1950 to 1959	23,598	12.4%
Built 1940 to 1949	19,498	10.3%
Built 1939 or earlier	59,494	31.3%

Source: ACS 2009-2013 5 year estimates Table DP04

Figure 4-4 indicates that the city was highly productive in demolishing blighted properties in 2011. The city still has a high number of blighted properties impacting the housing makeup of the city, which will continue to be addressed over the next five years.

Figure 4-4 Blight Demolitions by Start Date



4.8 Land Use & Development Trends

Overview of Land Use and Changes, 2010 to 2015
New Orleans is divided into thirteen planning districts. Land use in most of these districts is mixed. Residential land use differs based on the time of construction. Neighborhoods built prior to World War II contain, in addition to single family homes and apartment buildings, pedestrian oriented mixed use commercial corridors. Neighborhoods constructed post World War II are predominantly suburban type single family subdivisions, strip malls, or large multi-family developments. With the exception of the planning districts in far eastern Orleans Parish, and the planning district that comprises downtown, land use is a mix of residential, commercial, and light industrial in all sections of town. Density of land use is also fairly consistent throughout the City, with the same exceptions noted above. The planning districts in the eastern sections of the Parish are less densely developed and contain more green space.

Few major changes to the land use patterns in New Orleans were expected up until the occurrence of Hurricane Katrina when over 70 percent of residences were flooded. As expected, there has been an increase in the number of vacant properties. In 2009, the Parish had an estimated 41,729 vacant housing units. Still, much of Orleans Parish is developed, and most of the undeveloped land lies outside of the hurricane levee protection system. The parts of the Parish within the levee system that are undeveloped lie in far eastern New Orleans.

City of New Orleans Master Plan
The City of New Orleans approved the Plan for the 21st Century: New Orleans 2030 in August 2010. The City's New Master Plan provides a comprehensive revision to the previously adopted Land Use Plan in 1999. The City's new Land Use Plan, included in the Master Plan, sets forth the policy and framework for the physical development of New Orleans, providing a guide for the City's decision makers in directing the pattern, distribution, density, and intensity of land uses that will, over time, achieve the goals for livability, opportunity, and sustainability expressed throughout the Master Plan, and provide sufficient land to meet demand for various land uses in the future.[2]

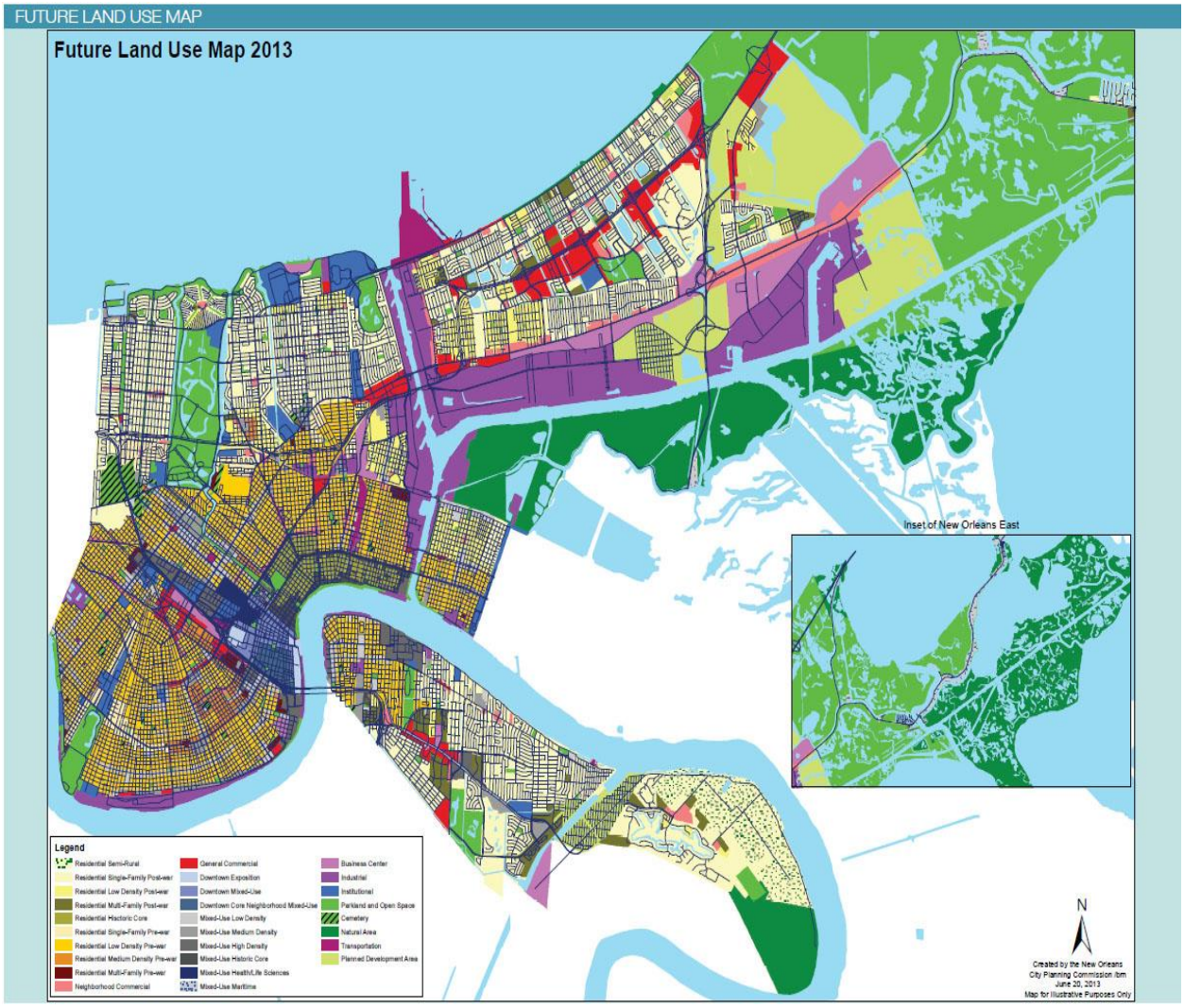
Highlights of the Future Land Use Map include:

- *No change in the overall existing footprint of the city.*
- *Preservation of neighborhood residential character.*
- *Mixed-use land use designations for greater flexibility in areas that would benefit from this.*

The future land map for the city is depicted on the following page.

[2] Plan for The 21st Century: New Orleans 2030, Executive Summary.

Figure 4-5 New Orleans Future Land Use Map



Section 5. Planning Process

Contents of this Section

Changes between the 2010 Plan and the 2015 Plan Update.

This section of the Plan has been completely revised to reflect the planning process utilized for the 2015 Plan Update. The NOHSEP Mitigation Office provided oversight and direction in setting up the new City Hall Working Group and Advisory Committee for the 2015 Plan Update, and also worked closely with Water Works LA, the firm responsible for planning and outreach for the 2015 Plan Update. All stakeholder lists were reviewed and updated as part of the Update. The plans, ordinances, and codes reviewed in 2010 were examined again along with many new ones to identify all opportunities to integrate other plans into the 2015 Plan Update. Section 5 describes the planning process conducted in 2015 and summarizes all Planning Team and community meetings held to develop and update each section of the 2015 Hazard Mitigation Plan Update.

5.1 Interim Final Rule (IFR) Requirements for Planning Process

IFR §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

IFR §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

5.2 Overview of the Planning Process

An effective planning process identifies all stakeholders, integrates their input and builds consensus in the development of the plan. An inclusive process, like the one utilized to develop the City of New Orleans Hazard Mitigation Plan Update, reaches out to other governmental agencies, the public, and the business community. All parties involved gain understanding of the challenges and issues and are involved in developing solutions. Transparency and inclusivity add validity to the plan. This section explains the integral pieces of the planning process and how the Hazard Mitigation Plan Update was created.

The planning process was divided into four phases as follows:

1) Organize Resources

During the first phase of the planning process, Water Works LA worked with the Hazard Mitigation Office to review the 2010 Plan, establish the City Hall Working Group and Advisory Committee, develop a community engagement/outreach strategy, conduct interviews to update the capability assessment, and coordinate with regional, state and other agencies.

2) Assess Risks

During the second phase, Water Works LA worked with the Hazard Mitigation Office, the City Hall Working Group, and Advisory Committee to identify hazards to be profiled in the plan. Using the identified list of hazards, the Hazard Mitigation Office conducted a thorough risk assessment, which included identifying critical public and private facilities, identifying repetitive loss properties, estimating potential losses, and analyzing development trends.

3) Develop the 2015 Plan

During the third phase Water Works LA worked with the Hazard Mitigation Office, the City Hall Working Group and Advisory Committee, to update 2010 goals and objectives, select/prioritize mitigation actions, and submit an initial draft and final plan for City, GOHSEP and FEMA approval.

4) Implement and Monitor Progress

The final phase started after GOHSEP (Louisiana Governor's Office of Homeland Security & Emergency Preparedness) and FEMA approved the updated plan. During this phase, the Hazard Mitigation Office worked to ensure adoption by the New Orleans City Council, and also developed an implementation strategy and process to monitor progress and to maintain the plan.

5.3 Mitigation Planning Organization

The New Orleans Homeland Security Emergency Preparedness (NOHSEP) Hazard Mitigation Office working with its consultant, Water Works LA, received guidance and recommendations from the community, City Hall Working Group, and Advisory Committee to prepare the updated plan. Once the plan was reviewed by the City, it was sent to GOHSEP and FEMA for approval before being submitted to the City Council for final adoption. The following sections provide additional details about the roles and responsibilities of each group.

Lead Agency and Planning Group

The Lead Agency for the development of the Orleans Parish Hazard Mitigation Plan Update, 2015, is the NOHSEP Hazard Mitigation Office. The Planning Group consisted of a City Hall Working Group, an Advisory Committee, and several other stakeholders involved throughout the process. All meeting documentation is included in Appendices.

City Hall Working Group

The City Hall Working Group included representatives from various City departments. The departments and participants are listed below and included representation from City of New Orleans departments that worked on the 2015 approved Hazard Mitigation Plan and other organizations that work closely with hazard mitigation planning efforts for Orleans Parish.

The City Hall Working Group members were tasked with:

- Providing leadership and support
- Overseeing the planning process
- Helping to develop specific details for the
    - Risk assessment
    - Mitigation strategies
    - Implementation plan
- Attending several meetings
- Ensuring that the perspectives of the community were considered and incorporated into the Plan
- Ensuring that all recommendations were realistic given anticipated funding levels and human resources available within the City.
- Recommending the Plan to the City Council for adoption.

City Hall Working Group		
Organization	**Participants**	**Title**
New Orleans Office of Homeland Secuirty & Emergency Preparedness (NOHSEP)	Gregory Reese	Public Safety GIS Coordinator/WebEOC Administrator
NOHSEP Office of Emergency Preparedness (OEP)	Dev Jani	Chief, Planning & Preparedness
NOHSEP Hazard Mitigation Office	Brad Case	Hazard Mitigation Director
City of New Orleans Office of Performance and Accountability	Oliver Wise	Director
City of New Orleans Department of Public Works	Jennifer Larmeu	Green Infrastructure Program Manager
City of New Orleans Office of Coastal and Environmental Affairs	Ron Harper	Program Coordinator
Louisiana Public Health Institute Advisor to the City of New Orleans	Jennifer Ruley	Active Transportation Engineer
New Orleans City Planning Commission	Tyler Hevlin	Board Member
City of New Orleans Department of Parks and Parways	Tica Hartman	Advisor
City of New Orleans Floodplain Management	Jerome Landry	Floodplain Administrator
City of New Orleans Office of Information Technology & Innovation	Ishmael Amin	Service Desk Administrator
City of New Orleans Stormwater Manager	Prisca Weems	Stormwater Manager
New Orleans Redevelopment Authority	David Lessinger	Director of Planning and Strategy
New Orleans Redevelopment Authority	Jerry Graves	Director of Land Stewardship

City of New Orleans Office of Place-Based Planning	William Gilchrist	Director
City of New Orleans Department of Public Health	Sarah Babcock	Healthy Populations and Planning Manager

Advisory Committee

The Planning Group included the City Hall Working Group (described above) and an Advisory Committee that brought input from various additional organizations.

The Advisory Committee responsibilities included:

- Sharing specific knowledge
- Commenting on interim and final versions of the plan
- Participating in all stages of the planning process
- Assisting in disseminating information to the community.

Advisory Committee		
Organization	**Participants**	**Title**
UNO/CHART	Monica Farris	Director
Lowlander Center	Shirley Laska	Board Member
Tulane Institute on Water Resources Law Policy	Mark Davis	Director
New Orleans Redevelopment Authority	Jerry Graves	Director of Land Stewardship
Sewerage & Water Board	Jason Higginbotham	Director of Emergency Management
Regional Planning Commission	Meredith Soniat	Sustainability Planner
City of New Orleans Stormwater Manager	Prisca Weems	Storm Water Manager
New Orleans Redevelopment Authority	David Lessenger	Director of Planning and Strategy
South Louisiana Flood Protection Authority East	Robert Turner	Regional Director
NOHSEP Office of Emergency Preparedness (OEP)	Dev Jani	Chief, Planning & Preparedness

Louisiana Public Health Institute Advisor to the City of New Orleans	Jennifer Ruley	Advisor to the City of New Orleans
South Louisiana Flood Protection Authority East	Steven Spencer	Chief Engineer
UNO/CHART	Tara Lambeth	Assistant Director
Governor's Office of Homeland Security and Emergency Preparedness	Nicolette English	Hazard Mitigation Planner
Governor's Office of Homeland Security and Emergency Preparedness	Jeffrey Giering	State Hazard Mitigation Officer

Additional Meetings

In addition to the City Hall Working Group and the Advisory Committee, two additional groups were convened for the purpose of holding a discussion specific to their sectors. These two groups included a Public Safety Group and a Non-Profits and Community Organizations Group.

The Public Safety Group was convened by the New Orleans Office of Homeland Secuirty & Emergency Preparedness to discuss the alignment of the risk assessments across the various relevant plans, as well as to discuss hazard vulnerability and mitigation actions. Representatives from the New Orleans Fire Department, New Orleans Police Department, and New Orleans Emergency Medical Services were all invited. The meeting was attended by NOHSEP, as well as the Chief of Plans for the New Orleans Fire Department and the Head of Planning for New Orleans Emergency Medical Services.

The Non-Profit and Community Organizations Group was convened by NOHSEP in order to facilitate a discussion with local organizations regarding their concerns and needs regarding hazards; as well as how they can best interact with NOHSEP in support of risk reduction. Invitations were sent out to an extensive listing of local non-profit and community organizations, based upon the lists maintained by NOHSEP, the New Orleans Department of Public Health and the University of New Orleans' Center for Hazard Assessment, Response and Technology.

Participants at Non-Profits and Community Organizations Meeting	
Organization	**Name/Title**
UNO/CHART	Monica Farris/Director
UNO/CHART	Tara Lambeth/Assistant Director
Louisiana Emergency Management Disability & Aging Coalition	Joan Guillory/Project Coordinator
New Orleans Americans with Disablitlities Act Administrator	Page McCranie/Administator
Evacuteer	Kali Rapp Roy/Executive Director
New Orleans Health Department/New Oleans Medical Reserve Corps (NOHD/NOMRC)	Bijal Patel/Emergency Preparedness Analyst
Friends of Lafitte Greenway	Sophie Harris/Executive Director
Friends of Lafitte Greenway	Nellie Catzen/Coordinator
Oxfam / Latino Forum	Rosa Herrin/Gulf Coast Policy Officer
La. Appleseed	Tara Richard/Program Director
Sierra Club	Darryl Malek-Wiley/Environmental Justice Associate Representative
Common Ground Relief	Thom Pepper/Operations Director
CNO - Hazard Mitigation Office	Brad Case/Director
Louisiana Department of Health and Hospitals (LA DHH)	Cynthia Davidson/ Public Health Emergency Regional Coordinator (PHERC)
Puentes New Orleans	Kenneth Roubon/Grant Writer, Development Coordinator
Water Works LA	Alessandra Jerolleman/Vice President
Water Works LA	Miriam Belblidia/ Chief Executive Officer

Regional Coordination

In addition to the meetings held with City of New Orleans stakeholders, an effort was made to reach out to representatives from the neighboring parishes responsible for hazard mitigation planning. These representatives were notified by letter of the Orleans Parish 2015 Hazard Mitigation Plan Update and given the opportunity to participate. These neighboring parishes included Jefferson Parish, St. Bernard Parish, and Plaquemines Parish.

In addition to the invitation to participate, there were two meetings that allowed NOHSEP to receive Regional input to the 2015 Plan Update. These included a presentation at a meeting of the regional Community Rating System (CRS) Users Group, Flood Loss Outreach and Awareness Taskforce (FLOAT). Water Works LA, on behalf of NOHSEP, gave a presentation describing the CRS credit for planning processes and requesting specific input for the City's Update. FLOAT members gave feedback regarding both mitigation actions and the planning process. Attendees represented St. John the Baptist Parish, the City of Mandeville, Tangipahoa Parish, LSU Ag Center, LA DOTD, GOHSEP and UNO CHART.

The second additional meeting was sponsored by the South Louisiana Flood Protection Authority-East (SLFPA-E) and brought together the planners and emergency managers from various neighboring jurisdictions. The meeting included representatives from St. Bernard Parish, Jefferson Parish, the South Louisiana Flood Protection Authority-West, the Louisiana Coastal Protection and Restoration Authority, and the United States Army Corps of Engineers. Meeting participants provided feedback to the City's Plan Update as well as discussing what their respective jurisdictions do to address levees and levee failures in their hazard mitigation plans. The meeting also included a Risk Awareness Exercise and a Levee Failure Due to High River Events Discussion.

Community

Community members were initially informed of the planning process through a press release, as well as the NOHSEP Hazard Mitigation website. A survey was circulated to the general public in August and September of 2015 and received over 130 responses. The survey was circulated by members of the Planning Group, on the NOHSEP website, utilizing social media, and by community groups, such as the Greater New Orleans Water Collaborative. Comments from this survey were used in the update of the plan's demographics, perceived hazard frequency, perceived hazard risk, mitigation actions taken and mitigation actions which might be considered.

The survey asked a total of nine questions, including questions on demographics, perceived hazard frequency, perceived hazard risk, mitigation actions taken and mitigation actions which might be considered.

The following bullet list provides a brief overview of findings:

- The vast majority of respondents perceived coastal erosion, subsidence, thunderstorms and flooding as the highest frequency hazards.
- The vast majority of respondents perceived flooding, coastal erosion, tropical cyclones, storm surge, dam/levee failure, and infrastructure failure as the hazards with the highest potential impacts.

- Over half of the respondents were concerned about street flooding during heavy rain and one quarter were concerned about house flooding.

- Many respondents had taken steps to protect their property. The most frequently cited measures were: purchasing flood insurance, making an emergency plan, clearing debris, elevating utilities, clearing tree limbs, and installing gutters or yard drains.

- Many respondents indicated that they would take measures to protect their property if they could. The most frequently cited potential measures were: rain barrels, rain gardens, and clearing debris.

Due to the many other public engagement processes ongoing in the City of New Orleans in 2015, such as the Resilient New Orleans Strategy, a public meeting for the Plan Update was not held until October of 2015. This meeting was publicized in the *Times-Picayune*.

Community responsibilities included:

- Receiving information about the hazard mitigation planning process
- Sharing specific concerns about each phase of the planning effort
- Reviewing the recommendations from the Planning Group
- Identifying community priorities for hazard mitigation planning

5.4 Hazard Mitigation Plan Development

Planning and Organization

The NOHSEP Hazard Mitigation Office began the 2015 Plan Update process in February 2014 by convening advisors and initiating conversations with relevant City departments. Beginning in May 2015, the City accelerated the Plan Update process, with the assistance of Water Works LA.

The planning team convened a formal Advisory Committee and City Hall Working Group beginning in June 2015, as described above. Water Works LA established a schedule of meetings for City Hall Working Group and the Advisory Committee.

The City Hall Working Group met eight times between June and October 2015. The purpose of each meeting was as follows:

- June 26, 2015 – Overview/Hazards: overview of the hazard mitigation planning process; review the 2010 Plan; hazards activity to rank hazards and discuss correlation to 2010 risk assessment

- July 13, 2015 –Assets and Goals: shared draft maps and discussed data sources; goal exercise to develop updated goals for 2015 Plan

- July 31, 2015 – History of Impacts: update on risk assessment; discussion of proposed goals; hazards exercise to discuss what could have been done to reduce impacts of different hazards in past 5 years

- August 13, 2015 – Risk Assessment: update on risk assessment; overview of hazard impacts
- September 14, 2015 – Mitigation Strategies: mitigation actions activity to determine how actions fit under updated goals
- September 25, 2015 – Capabilities/Implementation: capability assessment and mitigation action implementation activities to determine process for city departments to implement mitigations strategies
- October 9, 2015 – Hazards Ranking/Draft Review: activity to rank hazards; review draft of 2015 Plan Update
- October 23, 2015 – Final Draft Review: review of final 2015 Plan Update prior to submittal to GOHSEP.

The Advisory Committee met four times between July and October 2015. The purpose of each meeting was as follows:

- July 8, 2015: Assets, Goals, Capabilities
- August 5, 2015: Risk Assessment
- September 18, 2015: Mitigation Strategies
- October 7, 2015: Implementation and Draft Review

A Public Meeting was held on the below dates and times. Draft documents were posted on the web at nola.gov/hazard-mitigation with a comment and feedback form, allowing for additional public comments throughout the update period.

- October 19, 2015: Community meeting at Lake Area High School to gather input from the public on draft documents.

Comments from the public were cataloged and noted. Comments were used to inform mitigation action strategy rankings and revise threat and vulnerability analysis.

Review of Existing Plans and Integration with 2015 Plan

To begin development of the Hazard Mitigation Plan several plans, ordinances, and codes were reviewed. Coordination of existing and future plans is imperative to generating a plan that is capable of being implemented throughout its life. The following existing Plans and Programs were evaluated for integration into the New Orleans Hazard Mitigation Plan:

Resilient New Orleans Strategy. The *Resilient New Orleans Strategy* identifies the resilience gaps in New Orleans' infrastructure and identifies potential actions to increase resilience through effective planning and cross-sector collaboration. The document builds upon a multitude of sources, ranging from locally developed plans to globally accepted practices, and addresses three overarching components for improving the city's resilience. First, it

advocates for the regional Urban Water Plan that favors adaptation to the current and future environment as opposed to fighting the existing natural systems. The plan also stresses the necessity of social equity in order to strengthen and stabilize New Orleans communities while fostering resilience through numerous initiatives to grant access, support, and training to disenfranchised populations. Finally, the strategy recommends developing a plan of sufficient capacity to prepare for potential risks, including key investments into communication initiatives, infrastructure, and community outreach.

In the development of this plan, various stakeholders in New Orleans were consulted for their expertise and insight on the city's weaknesses and strengths in an effort to create new approaches and improve existing ones. The Office of Neighborhood Engagement had carried out a summit with prominent community leaders to help gather research and develop focus areas for the strategy to serve as the foundation for initiatives and priorities. With the information gathered from the summit and research from global approaches, the strategy developed a "series of short-term actions with long-term goals that provide a road map for implantation." The newly created department of Resilience and Sustainability in the Mayor's office, predominantly led by the chief resilience officer, will implement the strategy by "coordinating with partners and agencies." The goal is to ultimately ensure the execution of these actions in congruence with the City's existing Master Plan and Hazard Mitigation Plan.

City of New Orleans Comprehensive Emergency Management Plan (CEMP). The New Orleans Office of Emergency Preparedness is responsible for producing and maintaining the City's Comprehensive Emergency Management Plan. The CEMP addresses mitigation of, preparation for, and recovery from a wide variety of emergencies and disasters.

City of New Orleans Master Plan. The Plan for the 21st Century: New Orleans 2030 was approved by the City Council in August 2010. This plan outlines a structure for the City's development potential for the next twenty years. Significant changes are recommended in the future development pattern to support and encourage the City's future growth toward a more sustainable, livable community. The plan includes a chapter on "Resilience: Living with Water and Natural Hazards." The City's new master plan now includes a significant discussion of strategies to reduce risks and vulnerabilities. When the 2015 Plan Update is approved and adopted, it will become a part of the master plan. The master plan will have the "force of law."

Briefly, the master plan seeks greater levels of flood protection through myriad policy/program recommendations, including: comprehensive wetlands restoration, enhanced storm water management, better building codes/regulations/techniques, additional funding for residents to elevate and storm proof structures, and development of a public office to oversee mitigation/resilience activities.

City of New Orleans Master Land Use Element. The Plan for the 21st Century: New Orleans 2030 Master Plan also includes a revised future land use plan that will serve as a guide in directing future development to achieve the goals for a sustainable, livable community. The new land use plan was approved by the City Council as part of the new master plan in August 2010. The new land use plan will be used to implement the "force of law" provisions. This provision will ensure that all future land use decisions are consistent with the land use element of the master plan and any future amendments to the plan.

City of New Orleans Comprehensive Zoning Ordinance. The Zoning Ordinance was reviewed for land use regulations and hazard identification. The Zoning Ordinance controls the uses and densities of various land uses

throughout the Parish. The current zoning ordinance was approved in the 2015, including a revised Article 23 which addresses landscape and storm water management to create a more sustainable city by conserving resources such as water, decreasing storm water runoff, reducing heat island effects, subsidence, and creating a more amiable space for the public.

In order to enforce these restrictions, the city will issue a certificate of occupancy only once landscaping and storm water management restrictions are met. All developments require a landscape plan, except for single-family dwellings and residences under six units. A storm water management plan is required for all new development that exceeds 5,000 square feet of impervious surface.

Storm water management is addressed through on site detention with measures such as infiltration through pervious pavement and surfaces, vegetation, green roofs, blue roofs, and other methods that allow rainfall to reenter the ground water. Buildings that exceed 5,000 square feet of impervious surface are in charge of their own storm water runoff and must either detain or allow for infiltration the first one and one quarter (1.25) inch of storm water runoff back into the groundwater.

Some of the storm water management strategies outlined as a best management practices are listed in Article 23 as follows: bioswells, circular depressions, constructed wetlands, detention/ retention basins, disconnected roof tops, recycling, and irrigation, ditch gardens, flow diffusers, french drains, infiltration trenches, and dry wells, grassed swales, habitat preservation and protection areas, permeable pavers, porous surfaces, grass paving, and structural soils, planted storm water buffers, preserved forest floors, preserved wetlands, rain gardens, rain groves, rooftop runoff management, sand filters, stream bank or riparian buffers, tree protection areas, cisterns and underground storm water chambers.

City of New Orleans Building Code. The Building Code of City of New Orleans was amended to read as set forth in the International Building Code, 2006 Edition. This latest edition of the International Building Code was reviewed for assessment in hazard mitigation analysis.

State of Louisiana Hazard Mitigation Plan. The purpose of this hazard mitigation plan is to implement actions that eliminate the risk from hazards, or reduce the severity of the effects of hazards on people and property. Mitigation actions are both short-term and long-term activities that reduce the cause or occurrence of hazards; reduce exposure to hazards; or reduce effects of hazards through various means to include preparedness, response, and recovery measures. The State's updated 2014 Plan was reviewed to ensure consistency between the Orleans Parish plan and the State plan regarding hazard identification, as well as other sections of the plan.

Flood Loss Outreach & Awareness Task Force (FLOAT) Plan for Public Information (PPI). FLOAT is comprised of a group of communities across several parishes and municipalities that work towards lowering flood risk and subsequently, insurance policies through a Community Rating System (CRS) program. The group is user driven, meaning that the actual members of the community work towards hazard mitigation. The premise behind FLOAT is to give communities incentives to increase mitigation by allowing insurance rates to be lowered through the use of points. Activities taken on by the FLOAT group in each community help homeowners lower their insurance rates while making the community more resilient, and thus helping the NFIP. The purpose of the Program for Public Information (PPI) document is to give concrete actions to each community and the goals for the group are as follows:

The goals of the PPI are: "1) To make the public aware of the flood threat their community may be susceptible to; 2) To promote an all-hazard approach to public outreach; 3) To educate local officials about the importance of making the public aware of flood threats and other hazards; 4) To provide the most comprehensive coverage for public outreach using the most cost effective means, including the pooling of resources by seeking private sector sponsors; 5) To provide a level of consistency in the public message disseminated from the various public entities participating in this strategy; and, 6)To promote public awareness of their community's Flood Insurance Rate Map."

The PPI document specifically outlines each parish's hazards and risks by stating the overall geography of the parish, the flood zones, and the associated flood risks. The FLOAT group is comprised of Orleans Parish, St. Bernard Parish, Tangipahoa Parish, St. Tammany Parish, City of Slidell, City of Mandeville, City of Covington, Terrebonne Parish, City of Houma, and St. John the Baptist Parish.

While it is up to each community to take on the recommendations provided by the group, and incorporate each action, Orleans parish lists specific actions that include enforcing building codes, land use regulations, outreach, education, and mitigation. Each community has its own list of actions and it is up to each community to fulfill these tasks.

Resilience and Resistance: Addressing Acute and Chronic Adversity in Communities of Color. This white paper by the Institute of Women and Ethnic Studies provides a sociological approach to disaster resilience and highlights the shortcomings in the realm of emergency management. The document suggests that individuals who frequently deal with social disadvantages in their everyday lives are more susceptible to enduring trauma after a hazard, which highlights the importance of understanding the factors that contribute to successful coping mechanisms in the face of a disaster. The institute emphasizes the emotional and physical recovery of individuals before and after disasters, offering services and information ranging from mental health to job training to availability of public transit. By thinking about these factors in the context of resilience, we are better able to understand the complex interactions that exist between social factors and adverse environmental factors.

Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report, Building Performance Observations, Recommendations, and Technical Guidance, FEMA 549 / July 2006. The findings from the MAT report concluded that structures should be built to better withstand wind and flooding events common to the Gulf Coast. To accomplish this goal, the MAT report recommended that the City adopt and enforce modern building codes, develop more accurate floodplain maps, and encourage building beyond code with the expectation of severe weather events. The report further stated that critical structures should be located, when possible, in areas likely to be unaffected by severe weather, and plans should be in place to ensure these facilities remain operational in such an event.

Flood Risk in New Orleans, Implications for Future Management and Insurability. Briefly, this report illustrates how the risk analysis involved in assessing insurability can be a useful tool for policy makers concerned with determining acceptable levels of risk. Specifically, the use of catastrophe modeling is used to quantify the individual components of risk (hazard, exposure, vulnerability). The report finds that flood risk in New Orleans will continue to rise and therefore flood risks should be continually assessed, so that preparations are equal to the level of threat.

Polderize New Orleans. This proposal calls for a system of internal levees that would compartmentalize Orleans Parish to mitigate flooding within the parish. The proposal is based on the Dutch polder system and identifies 4 major areas to be addressed: street cuts, underpasses, Bayou St. John and drainage culverts.

Unified Plan for New Orleans (UNOP). The UNOP plan was developed in 2006 and 2007. Briefly, this post-Katrina plan outlines priorities for flood protection policy and projects at the citywide level. Strategies include, taking measures to flood-proof individual structures and critical equipment from rising water and hurricane-force winds, clustering residents and businesses in less populated areas, and developing incentives for areas with more population/less flood risk to attract residents and businesses. Policies and projects are generally centered on two concepts: moving the population to higher ground and elevating structures, which would be accomplished through a series of incentives and code changes/enforcement.

City of New Orleans Floodplain Ordinance. The City's floodplain ordinance was amended post-Katrina to include FEMA recommendations. The purpose of the floodplain ordinance is to set forth minimum land use requirements and control measures for flood prone areas within the city, as determined by FEMA. Regulations are based on parish specific storm data and were developed by the U. S. Army Corps of Engineers (USACE) and the National Academy of Sciences. The floodplain ordinance is to be applied uniformly to land within flood prone areas. Methods include: restriction/prohibition of uses, increased hardening of vulnerable structures, controlling the alteration of natural flood protection elements, controlling developments which may increase flood damage, prevention/regulation of barriers which unnaturally divert floodwaters or increase flood hazards to other areas. Additionally, the City's participation in FEMA's Community Rating System Program CRS) is to create incentives that reduce flood losses and support the sale of flood insurance.

City Assisted Evacuation Plan (CAEP). The purpose of the City Assisted Evacuation Plan is to help evacuate residents and visitors that are unable to self-evacuate during an emergency. The plan lists relevant agencies that will participate and identifies staging and debarkation facilities, such as local hotels, Morial Convention Center, Union Passenger Terminal, and Louis Armstrong Airport.

Individual Agency Hazard Mitigation Plans within Orleans Parish. All individual agency plans approved or in draft form were reviewed to coordinate proposed mitigation strategies. Individual plans reviewed include 1) Louis Armstrong New Orleans International Airport (LANOIA) Hazard Mitigation Plan; 2) the University of New Orleans (UNO) Hazard Mitigation Plan; 3) the Sewerage and Water Board Plan; 4) the Port of New Orleans Plan; 5) the Audubon Institute Plan; 6) Dillard University Hazard Mitigation Plan; and 7) the Public Belt Railroad Plan.

Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast. This plan, adopted in 2012 and currently being updated, aims to achieve long term and comprehensive coastal protection and restoration in coordination with federal, state, and local agencies. The plan presents hurricane protection (both structural and non-structural) and coastal restoration measures. In addressing hurricane protection the plan takes a whole system approach, with a goal of built hurricane protection structures that allow the natural ecosystem to be dynamic and functional. Non-structural hurricane protection tools include: flood insurance, structure elevation, and building codes. Structural hurricane protection planning is recommended for the

following areas: Lake Pontchartrain, Barataria Basin and West Bank, Plaquemines Parish, Terrebonne Parish and Atchafalaya Delta, LA 1 Highway Corridor, Acadiana, and the Chenier Plain.

Louisiana Coastal Protection and Restoration (LACPR) Final Technical Report (USACE). This report seeks to develop plans for hurricane risk reduction and coastal restoration in Louisiana and Mississippi. It accomplishes through comprehensive hurricane protection analysis and design, development of a full range of flood control, coastal restoration, and hurricane protection measures, and consideration of Category 5 hurricane protection. The report does not contain construction recommendations, NEPA alternatives, feasibility designs, real-estate planning, or cost estimates. The report was developed in conjunction with Louisiana's Coastal Protection and Restoration Authority and similar themes, goals, and recommendations are seen in both documents, specifically the multiple lines of defense strategy: coastal restoration, structural, and nonstructural measures.

Risk Assessment

The NOHSEP Hazard Mitigation Office prepared the Hazard Identification/Risk Assessment (HIRA). The ongoing results of the HIRA were discussed with the City Hall Working Group and Advisory Committee throughout the series of meetings, with their input requested at several points. The update included the following:

- Hazard Identification and Profiles. An update to those included in the 2010 Plan and a complete identification and profiles for new hazards included for the 2015 Plan.
- Loss Estimates of anticipated losses with each hazard
- Risk Estimates for each hazard, and
- Funding Matrix to identify potential funding opportunities to support mitigation actions
- Preliminary Review and Update of Goals and Objectives in the 2010 Plan

Mitigation Strategy

In developing the mitigation strategy, the City Hall Working Group and the Advisory Committee reviewed the 2010 goals and objectives for the 2015 Orleans Parish Hazard Mitigation Plan Update. In updating the goals, the planning groups also decided to add foundational principles as key to the goals of the Plan Update, including:

1. Consider the principles of equity in risk reduction decisions, including land use, zoning, and the allotment of funds and resources

2. Plan for future conditions, including development and climate change

3. Plan for minimizing damage and maximizing disaster recovery

4. Treat risk reduction and hazard mitigation as part of an integrated system, with an emphasis on safety.

Once the foundational principles and goals were established, the Planning Team reviewed an update of mitigation actions from the 2010 Plan and a list of new preliminary mitigation actions for the 2015 Plan Update.

A number of plans were reviewed to develop the list of mitigation actions for the 2015 Plan Update, including the Resilient New Orleans Strategy, Chapter 12: Resilience of the New Orleans Master Plan, the Unified New Orleans Plan (UNOP), the Louisiana Coastal Protection Restoration Technical Report and the Louisiana Coastal Protection Restoration Authority Comprehensive Plan, the City's Emergency Operations Plan, the Mitigation Assessment Team Report, and others. The updated goals and a preliminary list of mitigation actions were reviewed by the City Hall Working Group and the Advisory Committee. At the September meetings of the City Hall Working Group and the Advisory Committee, the groups participated in the mitigation actions activities, organizing the actions under the corresponding Goals and Objectives and developing a process for city departments to implement mitigations strategies.

Implementation Strategy

The fourth set of meetings for the 2010 Hazard Mitigation Plan Update, were held in June and July. The Progress and Coordination Meeting was held at the Homeland Security Conference Room in New Orleans City Hall on June 29, 2010. At this meeting the Planning Team reviewed the results of the STAPLEE evaluations of the mitigation actions. The members were asked to evaluate all of the actions by considering the benefits and costs of implementing each action. The seven (7) criteria used to evaluate the actions included social, technical, administrative, political, legal, economic, and environmental. GCR assessed the STAPLEE evaluation forms that were completed by the Planning Team members and summarized the results in a number of different ways: a) identified the number of criteria with positive responses, b) overall total number of positive/negative responses for each action, and 3) benefit-cost review. The Planning Team reviewed the STAPLEE results and approved the overall priority ranking of each mitigation action.

The Planning Team members also reviewed the Implementation Strategy at this meeting. The Implementation Strategy handout reviewed at this meeting listed all mitigation actions by goal and identified the specific objectives that are met with each action, and further explained the content of the table, and pointed out the key components of the Implementation Strategy which includes:

- Lead agency/support agencies to implement the action
- Preliminary cost estimates (including ongoing maintenance costs)
- Funding sources
- Time frame for implementing action
- Priority ranking based on the benefit-cost review

The Planning Team reviewed the handout and the detail of the Implementation Strategy and recommended some changes to the key components of the strategy. Once all actions had been reviewed and changes noted, the members voted unanimously to approve the Implementation Strategy.

On July 1, 2010, the 4th Community Meeting was held for the 2010 Hazard Mitigation Plan Update at the Latter Library on St. Charles Avenue. At this meeting, the community was presented with a review of planning efforts underway since the May 11, 2010 meeting, including a review of the updated list of identified hazards, goals and objectives, mitigation actions, and implementation strategy for the updated plan. The community was given an opportunity to ask questions and provide comments on the work completed.

5.5 Community Engagement/Outreach Strategy

Community involvement in the development of the Plan Update was coordinated with ongoing public engagement processes through the City of New Orleans for the Resilient New Orleans Strategy and National Disaster Resiliency Competition (NDRC).

Goals and Objectives

The goals and objectives of the engagement strategy were to educate the community, hear community concerns, gain public support, and engage Orleans Parish residents in the decision making process.

Identify the Community

Stakeholders include active organizations representing neighborhoods, civic organizations, churches, businesses, environmental groups, governmental agencies, and non-profit organizations as well as elected officials that have an interest in hazard mitigation planning.

Organize Community Events/Meetings

One community meeting was organized and held in conjunction with the NDRC public engagement process. The community engagement meeting, held on October 19, 2015 included public presentations of the risks, hazards, strategies, and implementation. Also discussed was alignment with the City's Resilience Strategy. Comments from the public were cataloged and noted. Comments were used to inform mitigation action strategy rankings and revise threat and vulnerability analysis. .

The planning group also hosted a meeting for nonprofits and community organizations, to present these groups with an overview of the process and how they can participate to support the populations they serve.

Distribute Information to the Community

To make sure that the community remained well informed of the planning process and the community events/meetings, the City of New Orleans utilized the following techniques to distribute information.

- Hazard Mitigation Website - The City posted information on the hazard mitigation planning effort on its website http://www.nola.gov/hazard-mitigation/
- Press releases – A press release was issued to inform the community of the planning process and before the community meeting.
- Community Survey -- A survey was circulated to the general public in August and September of 2015 and received over 130 responses. The survey was circulated by members of the Planning Group, on the NOHSEP website, utilizing social media, and by community groups such as the Greater New Orleans Water Collaborative.

5.6 Plan Development Meeting Summary

June 26, 2015: City Hall Working Group Meeting - Overview and Discussion of Hazards

The kickoff meeting for the City Hall Working Group provided an opportunity to present the department representatives with an overview of the hazard mitigation planning process, including the timeline and integration with other planning processes, such as the Resilient New Orleans initiative. The planning team presented an overview the 2010 Plan, including a discussion on the hazards included, risk assessment, capability assessment, and the mitigation strategy. A discussion on the importance of the process and the need for the Hazard Mitigation Plan allowed City Hall Working Group representatives to understand their role in the update and how it related to their departments' work. A hazards exercise asked attendees to consider hazards according to greatest negative impact, ability of the City to reduce impact, hazards that would require external assistance to reduce risk, and hazards of least concern. Based upon the hazard exercise results, the following hazards were raised for consideration: power outages, terrorism, fire, infrastructure failure, building collapse, civil unrest, and pandemic. The meeting closed with sharing the meeting schedule and responsibilities of the City Hall Working Group.

Accomplishments:

- Established meeting schedule and responsibilities for City Hall Working Group
- Developed additional hazards for consideration

July 8, 2015: Advisory Committee Meeting - Assets, Goals, Capabilities

The Advisory Committee meeting provided an update on the Hazard Mitigation Plan Update, including progress to date and the planning process timeline. Advisors participated in a Hazard Mitigation Goals exercise, in which they were asked to provide three primary goals for the plan update. Following the exercise, the 2010 Goals were shared and attendees discussed changes in priorities, including adding goals to focus on equity, renters, and risk communication. Advisors shared suggestions for engaging stakeholders in City departments and regionally, and the use of a survey tool to gather input. The meeting closed with sharing the meeting schedule and responsibilities of the Advisory Committee.

Accomplishments:

- Established meeting schedule and responsibilities for Advisory Committee
- Developed additional goals for the Hazard Mitigation Plan
- Robert Turner from SFLPAE offered to host a regional meeting

July 13, 2015: **City Hall Working Group Meeting - Assets and Goals**

The City Hall Working Group received an update on progress to date, including an overview of the Advisory Committee recommendations. NOHSEP shared GIS data, including draft maps showing storm surge impacts and Digital Flood Insurance Rate Maps, and the group discussed the need for additional data sources. Attendees participated in a goal setting exercise to update the goals for the 2015 Plan, and the 2010 Plan goals were shared.

Accomplishments:

- Developed additional goals for the Hazard Mitigation Plan
- Ron Harper from the Office of Coastal and Environmental Affairs offered to assist with public outreach

July 31, 2015: City Hall Working Group Meeting - History of Impacts

The City Hall Working Group received an update on the risk assessment and a proposed final list of hazards to include in the 2015 Plan Update, based on previous meeting exercises. The group received a copy of the proposed goals, based on previous meeting exercises, including foundational principles to guide the goals and actions. The group then conducted a hazards exercise, asking participants to provide input on what can be done to reduce impacts of the hazards in past five years for the 2015 Plan.

Accomplishments:

- City Planning Commission will assist with timeline for Plan Update adoption and incorporation into Master Plan.
- City Hall Working Group to share community outreach list
- Data requests made to City Hall Working Group

August 5, 2015: Advisory Committee Meeting - Risk Assessment

The Advisory Committee received an update on the planning process and was provided with the draft 2015 goals. Advisors provided feedback on the goals, and received an update on the revised list of hazards. GOHSEP reminded that the State would not review any man-made or technological hazards; however, advisors expressed interest in pursuing an Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence approach. An update on the risk assessment was shared with attendees, including draft maps. Advisors were also asked to provide input on the outreach plan.

Accomplishments:

- SWBNO agreed to send out a public notice regarding the 2015 Plan in the water bill
- Additional planning for regional meeting hosted by SLFPAE

August 13, 2015: City Hall Working Group – Risk Assessment

The City Hall Working Group received update on the planning process, including individual meetings held with city departments, SLFPAE, CHART, SWBNO, NORA, and Evacuteer. The group discussed the final hazard list and the Goals and Objectives, and requested addition of several goals relating to protection of records, consideration of cultural resources, and continuity of operations. The group also discussed vulnerable populations related to different hazards, and members of the group agreed to provide information on vulnerabilities for hazards relating to their departments.

Accomplishments:

- Review of final hazard list
- Addition of goals relating to protection of records, consideration of cultural resources, and continuity of operations

September 9, 2015: Public Safety Meeting

September 14, 2015: City Hall Working Group – Mitigation Strategies

The City Hall Working Group received an update on work to progress, including presentations at the FLOAT users group and a meeting with public safety officials, plan integration efforts, data gathering completion, and an update on the risk assessment. The group participated in the mitigation actions activity, in which they were asked to organize the actions under the corresponding Goals and Objectives.

Accomplishments:

- Mitigation actions organized under Goals and Objectives

September 15, 2015: Regional Stakeholders Meeting

Based on previous discussion during the Advisory Committee on the need to engage regional stakeholders, SLFPA-E hosted a meeting that convened representatives from Jefferson, Orleans, and St. Bernard Parish, CPRA, USACE, and SLFPA-W. The attendees received an overview of the Hazard Mitigation Plan Update process, and discussed how levees and levee failure are handled in mitigation plans. Attendees took part in an exercise on communicating residual risk to residents, and an exercise focused on a scenario of levee failure due to a high river event.

Accomplishments:

- Regional stakeholders engaged and received information on 2015 Hazard Mitigation Plan Update
- Regional stakeholders shared information on procedures for handling a levee failure hazard event

September 18, 2015: Advisory Committee - Mitigation Strategies

The Advisory Committee received an update on the planning process, including presentations at the FLOAT users group and a meeting with public safety officials, plan integration efforts, data gathering completion, and an update on the risk assessment. The committee participated in a capability assessment activity and a mitigation action implementation activity. The committee provided feedback on potential implementation mechanisms, including the Local Emergency Planning Committee (LEPC).

Accomplishments:

- NOHSEP exploring establishing a mitigation subcommittee on the LEPC for plan implementation

September 21, 2015: Nonprofits and Community Organizations Meeting

This meeting provided nonprofits and community organizations an opportunity to learn about the 2015 Hazard Mitigation Plan Update and to better understand how their organizations can participate to address the needs of the communities they serve. Attendees were asked to provide information on their experience with hazards and how they have taken steps to reduce risk. An overview of the planning process was provided, along with copies of the hazards being addressed by the Update. The attendees then participated in a tabletop exercise, including a

train derailment, heavy rainfall, and hurricane evacuation scenarios, and were prompted to determine impacts to their organizations and the populations they serve.

Accomplishments:

- Nonprofits and community organizations identified potential impacts from different hazards considered in the 2015 Plan Update
- Nonprofits and community organizations shared information on how they currently interact with the City in responding to hazards and provided recommendations on how the City can best support their efforts

September 25, 2015: **City Hall Working Group** - **Capabilities/Implementation**

The City Hall Working Group received an update on the planning process. The group discussed the capability assessment, and conducted an activity to come up with options for a process for engagement. The group demonstrated an interest in continuing to meet, but questioned whether ongoing implementation could be tied to other efforts. The group conducted a mitigation action implementation activity to determine process for city departments to implement mitigations strategies.

Accomplishments:

- Group developed options for Plan implementation and ongoing engagement
- Group developed process for implementing mitigation strategies

October 7, 2015: Advisory Committee - Implementation and Draft Review

The Advisory Committee received an update on the partial draft and the community engagement process, in coordination with NDRC. The planning team presented the STAPLEE and asked advisors to provide feedback on it as a method of ranking mitigation actions.

Accomplishments:

- Advisors recommended use of STAPLEE for ranking mitigation actions

October 13, 2015 – Hazards Ranking/Draft Review: activity to rank hazards; review draft of 2015 Plan Update

October 19, 2015 – Community Meeting

Community meeting at Lake Area High School to gather input from the public on draft documents.

Accomplishments:

- Comments from the public were cataloged and noted. Comments were used to inform mitigation action strategy rankings and revise threat and vulnerability analysis

Section 6. Hazard Identification, Profiling, and Ranking

Contents of this Section

One of the first steps in developing the 2015 City of New Orleans Hazard Mitigation Plan (HMP) update was to complete a comprehensive evaluation of the existing document, completed in 2010, to determine (a) specific areas that required updates, such as incorporation of data about recent hazards or documenting the 2015 update process, (b) where recent City, State, or FEMA guidance require new elements in the plan, and (c) where there are opportunities to incorporate technical data and studies that have been completed since the original plan was written and approved.

Portions of the 2015 Plan were retained from the original December 2010 HMP, as appropriate, including portions of the historical hazard data. As part of the update, the list of hazards profiled in the 2010 Plan was modified to better align with the State of Louisiana Hazard Mitigation Plan.

Table 6-1 Identified Hazards, 2015 Plan Update

Natural Hazards, 2010 Plan	Natural Hazards, 2015 Plan
Floods	Floods
Hurricanes/Tropical Cyclones	Tropical Cyclones (Amended)
Tornadoes	Storm Surge
Thunderstorms (Dropped in 2015 Plan)	Coastal Erosion
Lightning (Dropped in 2015 Plan)	Tornadoes
Subsidence	Subsidence
Hail – Dropped	Winter Storms
Winter Storms	Drought
Drought	Extreme Temperatures (New)
Storm Surge	Thunderstorms (Hail & Lightning)
Coastal Erosion	**Man-Made Hazards, 2015 Plan**
High Winds, part of Hurricanes - (Dropped in 2015 Plan)	Dam & Levee Failure
Man-Made Hazards, 2010 Plan	Hazardous Materials Spills/Contamination, Fixed Site and Transportation (Amended)
Dam & Levee Failure	Power Outages (New)
Hazardous Materials Spills/Contamination	Terrorism (New)
	Infrastructure Failure (New)
	Building Collapse (New)
	Civil Unrest (New)
	Pandemic (New)

6.1 FEMA IFR (Interim Final Rule) Requirement for Hazard Identification and Profiling

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

6.2 Hazard Identification

In accordance with IFR requirements, and as part of its efforts to support and encourage hazard mitigation initiatives, the following subsections provide an overview of past hazard events in Orleans Parish and brief descriptions of the potential

for future losses. Section 7 (Vulnerability Assessment and Loss Estimation) includes detailed loss estimates for a subset

of the most significant hazards in Orleans Parish. The term "planning area" is used frequently in this section. This term refers to the geographic limits of the Parish.

6.3 Overview of Orleans Parish's Natural Hazards History

According to the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database, the following natural hazards impacted Orleans Parish between 1950 and 2014.

Table 6-2 NCDC Database of Hazard Impact on Orleans Parish (1950-2014)

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							
Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
130 LAZ038 - 040 - 050 - 058 - 060>062 - 064 - 066>070	10/5/1996	7:00 AM	Coastal Flooding	N/A	0	5.5M	0
241 LAZ062	1/3/2008	12:00 AM	Cold/wind Chill	N/A	0	0K	0K
148 LAZ034>040 - 046>050 - 056>070	7/1/1998	12:00 AM	Drought	N/A	0	0	0
149 LAZ034>040 - 046>050 - 056>070	8/1/1998	12:00 AM	Drought	N/A	0	0	77.5M
131 LAZ034>040 - 046>050 - 056>070	12/18/1996	6:00 PM	Excessive Cold	N/A	0	0	0
158 LAZ062	8/14/1999	10:00 AM	Excessive Heat	N/A	2	0K	0
164 LAZ062	7/16/2000	3:32 PM	Excessive Heat	N/A	0	0	0
165 LAZ062	7/16/2000	3:49 PM	Excessive Heat	N/A	0	0	0
124 LAZ034>040 - 046>050 - 056>070	2/2/1996	4:00 PM	Extreme Cold	N/A	0	0	20.0M
115 ORLEANS	5/8/1995	20:30	Flash Flood	N/A	0	0	0
109 New Orleans	5/9/1994	16:00	Flash Flood	N/A	0	500K	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							
Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
48 ORLEANS	7/1/1977	13:47	Hail	1.75 in.	0	0	0

61 ORLEANS	4/18/1980	11:09	Hail	1.00 in.	0	0	0
152 Countywide	9/11/1998	10:00 AM	Flash Flood	N/A	0	0	0
176 Algiers	6/7/2001	2:00 PM	Flash Flood	N/A	0	25K	0
177 New Orleans	6/11/2001	1:00 AM	Flash Flood	N/A	0	50K	0
192 Countywide	9/25/2002	2:30 PM	Flash Flood	N/A	0	0	0
197 New Orleans	6/19/2003	11:30 AM	Flash Flood	N/A	0	150K	0
201 Countywide	6/30/2003	10:00 AM	Flash Flood	N/A	0	130K	0
233 New Orleans	12/21/2006	8:30 AM	Flash Flood	N/A	0	0K	0K
240 Vieux Carre	10/22/2007	11:15 AM	Flash Flood	N/A	0	0K	0K
245 Algiers	4/26/2008	3:00 AM	Flash Flood	N/A	0	0K	0K
247 Algiers	6/15/2008	8:30 AM	Flash Flood	N/A	0	0K	0K
251 Algiers	3/27/2009	4:45 AM	Flash Flood	N/A	0	0K	0K
255 Lee	9/13/2009	11:30 AM	Flash Flood	N/A	0	0K	0K
256 Little Woods	12/12/2009	16:45 PM	Flash Flood	N/A	0	0K	0K
259 New Orleans	4/23/2010	13:58 PM	Flash Flood	N/A	0	0K	0K
260 New Orleans	5/16/2010	9:47 AM	Flash Flood	N/A	0	10K	0K
248 Vieux Carre	6/29/2008	16:00 PM	Flood	N/A	0	0K	0K
132 LAZ062	12/31/1996	8:00 AM	Fog	N/A	0	0	0
108 LAZ001>070	3/14/1993	0	Freeze	N/A	0	0	50.0M
216 New Orleans	11/2/2004	10:25 AM	Funnel Cloud	N/A	0	0	0
239 New Orleans	9/11/2007	10:45 AM	Funnel Cloud	N/A	0	0K	0K
8 ORLEANS	2/5/1962	15:50	Hail	1.75 in.	0	0	0
12 ORLEANS	4/26/1964	1:25	Hail	1.75 in.	0	0	0
30 ORLEANS	3/30/1972	13:00	Hail	1.75 in.	0	0	0
35 ORLEANS	6/17/1973	13:30	Hail	0.75 in.	0	0	0
37 ORLEANS	9/1/1974	13:50	Hail	1.00 in.	0	0	0
42 ORLEANS	5/7/1975	22:00	Hail	1.50 in.	0	0	0
48 ORLEANS	7/1/1977	13:47	Hail	1.75 in.	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
72 ORLEANS	4/26/1982	16:30	Hail	1.75 in.	0	0	0
61 ORLEANS	4/18/1980	11:09	Hail	1.00 in.	0	0	0
85 ORLEANS	7/5/1984	14:20	Hail	0.75 in.	0	0	0

89 ORLEANS	5/21/1985	12:35	Hail	0.75 in.	0	0	0
102 ORLEANS	3/2/1991	19:05	Hail	0.75 in.	0	0	0
103 ORLEANS	4/9/1991	17:30	Hail	1.00 in.	0	0	0
106 ORLEANS	2/17/1992	1:45	Hail	1.00 in.	0	0	0
107 ORLEANS	6/4/1992	13:20	Hail	1.00 in.	0	0	0
111 New Orleans	4/10/1995	19:51	Hail	0.75 in.	0	0	0
121 Newellton	10/27/1995	16:45	Hail	1.75 in.	0	0	0
127 (new)lkfrnt Arpt New	4/14/1996	12:06 PM	Hail	0.75 in.	0	0	0
129 (new)lkfrnt Arpt New	7/28/1996	12:00 PM	Hail	0.75 in.	0	0K	0K
133 New Orleans	1/24/1997	12:45 PM	Hail	0.88 in.	0	0	0
135 New Orleans	3/29/1997	3:55 PM	Hail	1.50 in.	0	0	0
145 (new)lkfrnt Arpt New	6/21/1998	4:15 PM	Hail	0.75 in.	0	0	0
160 New Orleans	1/23/2000	11:03 PM	Hail	0.75 in.	0	0	0
161 Algiers	1/23/2000	11:12 PM	Hail	1.00 in.	0	0	0
179 New Orleans	6/21/2001	2:23 PM	Hail	0.88 in.	0	0	0
184 New Orleans	5/30/2002	11:35 AM	Hail	0.75 in.	0	0	0
207 New Orleans	2/4/2004	10:30 PM	Hail	1.75 in.	0	0	0
211 New Orleans	7/8/2004	1:36 PM	Hail	0.75 in.	0	0	0
198 New Orleans	6/24/2003	12:00 PM	Heavy Rain	N/A	0	0	0
203 Countywide	7/3/2003	10:30 AM	Heavy Rain	N/A	0	0	0
204 New Orleans	7/11/2003	3:30 PM	Heavy Rain	N/A	0	0	0
236 New Orleans	5/4/2007	12:00 PM	Heavy Rain	N/A	0	0K	0K

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
125 LAZ040 - 056>070	3/18/1996	3:00 PM	High Wind	40 kts.	0	250K	0
195 LAZ061>062	12/12/2002	6:30 PM	High Wind	0 kts.	0	3K	0
196 LAZ062	12/12/2002	6:34 PM	High Wind	45 kts.	0	0	0
258 LAZ062	3/1/2010	18:56 PM	High Wind	52 kts.	0	10K	0K

139 LAZ061>064 - 066>070	7/17/1997	9:00 AM	Hurricane	N/A	0	5.0M	0
155 LAZ038>040 - 058>070	9/27/1998	12:00 PM	Hurricane	N/A	0	30.1M	0
194 LAZ034>040 - 046>050 - 056>070	10/2/2002	6:00 PM	Hurricane	N/A	0	149.6M	0
120 Southeast Louisiana	10/4/1995	24:00	Hurricane Opal	N/A	0	200K	0
213 LAZ040 - 058>070	9/15/2004	10:00 AM	Hurricane/ typhoon	N/A	0	11.8M	0
223 LAZ038>040 - 050 - 058>070	7/5/2005	3:00 PM	Hurricane/ typhoon	N/A	0	47.5M	0
226 LAZ034>040 - 046>050 - 056>070	8/28/2005	11:00 AM	Hurricane/ typhoon	N/A	0	16.9B	0
110 Algiers	6/17/1994	2:00	Lightning	N/A	0	50K	0
119 Algiers	5/30/1995	14:55	Lightning	N/A	2	0	0
126 New Orleans Lakefron	4/14/1996	2:00 PM	Lightning	N/A	0	0	0
128 New Orleans Lakefron	4/17/1996	3:45 PM	Lightning	N/A	0	0	0
146 New Orleans	6/21/1998	5:20 PM	Lightning	N/A	0	120K	0
159 Algiers	9/6/1999	7:15 PM	Lightning	N/A	0	50K	0
162 New Orleans	6/4/2000	11:00 AM	Lightning	N/A	0	0	0
220 New Orleans	5/30/2005	6:30 AM	Lightning	N/A	0	0	0
221 New Orleans	6/6/2005	12:00 PM	Lightning	N/A	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							
Location or County	**Date**	**Time**	**Type**	**Mag-nitude**	**Injury**	**Property Damage**	**Crop Damage**
238 New Orleans	6/4/2007	10:30 AM	Lightning	N/A	0	50K	0K
142 Chef Menteur	2/15/1998	2:00 PM	Storm Surge	N/A	0	0	0
153 Countywide	9/12/1998	11:00 AM	Storm Surge	N/A	0	0	0

199 LAZ038 - 040 - 058 - 060>063 - 066>070	6/30/2003	2:00 PM	Storm Surge	N/A	0	4.1M	0
212 LAZ040 - 058 - 060>062 - 066>070	9/15/2004	10:00 AM	Storm Surge	N/A	0	4.0M	0
214 LAZ038 - 040 - 050 - 058 - 060>062 - 066>070	10/9/2004	3:00 PM	Storm Surge	N/A	0	100K	0
224 LAZ061>062 - 064 - 067>070	7/5/2005	3:00 PM	Storm Surge	N/A	0	2.5M	0
227 LAZ040 - 059 - 061>064 - 067>070	8/29/2005	2:00 AM	Storm Surge	N/A	0	31.3B	0
229 LAZ038 - 040 - 050 - 058>070	9/23/2005	7:00 AM	Storm Surge	N/A	0	432.0M	0
249 LAZ038 - 040 - 049 - 057>058 - 060 - 062 - 066	9/11/2008	12:00 PM	Storm Surge/tide	N/A	0	0K	0K
257 LAZ062	3/1/2010	18:45 PM	Strong Wind	45 kts.	0	5K	0K
113 New Orleans	4/11/1995	6:30	Thunderstorm Wind	0 kts.	0	0	0
112 New Orleans	4/11/1995	5:56	Thunderstorm Wind	60 kts.	0	0	0
114 Lake Catherine	4/11/1995	6:42	Thunderstorm Wind	60 kts.	0	0	0
232 (new)lkfrnt Arpt New	11/6/2006	15:18 PM	Thunderstorm Wind	50 kts.	0	1K	0K

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
237 New Orleans	5/4/2007	12:05 PM	Thunderstorm Wind	50 kts.	0	1K	0K
242 (new)lkfrnt Arpt New	2/6/2008	3:38 AM	Thunderstorm Wind	63 kts.	0	0K	0K
244 New Orleans Lakefron	2/12/2008	14:45 PM	Thunderstorm Wind	50 kts.	0	2K	0K
243 (new)lkfrnt Arpt New	2/12/2008	14:42 PM	Thunderstorm Wind	59 kts.	0	0K	0K

246 New Orleans	5/15/2008	8:00 AM	Thunderstorm Wind	50 kts.	0	2K	0K
250 (new)lkfrnt Arpt New	3/27/2009	12:00 AM	Thunderstorm Wind	50 kts.	0	1K	0K
252 South Pt	4/2/2009	12:33 PM	Thunderstorm Wind	50 kts.	0	4K	0K
253 Gentilly	5/16/2009	13:30 PM	Thunderstorm Wind	50 kts.	0	3K	0K
254 (new)lkfrnt Arpt New	7/2/2009	18:26 PM	Thunderstorm Wind	52 kts.	0	0K	0K
261 New Orleans	6/4/2010	13:00 PM	Thunderstorm Wind	52 kts.	0	2K	0K
116 New Orleans	5/8/1995	21:25	Thunderstorm Winds	0 kts.	0	750K	0
117 Lakefront Airport (ne	5/8/1995	21:33	Thunderstorm Winds	50 kts.	0	250K	0
118 Lake Catherine	5/9/1995	22:35	Thunderstorm Winds	70 kts.	0	0	0
122 New Orleans	11/11/1995	6:05	Thunderstorm Winds	52 kts.	0	0	0
1 ORLEANS	11/1/1951	7:00	Tornado	F1	0	25K	0
2 ORLEANS	7/17/1953	11:20	Tornado	F2	2	250K	0
3 ORLEANS	6/27/1957	6:00	Tornado	F0	0	25K	0
4 ORLEANS	7/13/1957	12:50	Tornado	F0	0	3K	0
9 ORLEANS	3/31/1962	7:00	Tornado	F1	0	3K	0
13 ORLEANS	10/3/1964	9:00	Tornado	F2	2	2.5M	0
26 ORLEANS	3/10/1971	2:00	Tornado	F2	0	2.5M	0
28 ORLEANS	12/6/1971	13:30	Tornado	F1	0	25K	0
50 ORLEANS	7/29/1977	11:50	Tornado	F1	3	25K	0
67 ORLEANS	6/22/1981	13:45	Tornado	F2	0	25K	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
105 ORLEANS	4/19/1991	13:30	Tornado	F1	0	25K	0
167 New Orleans	8/10/2000	4:12 PM	Tornado	F0	0	0	0
202 Lake Catherine	6/30/2003	11:45 AM	Tornado	F0	0	5K	0
230 New Orleans	2/2/2006	2:42 AM	Tornado	F2	0	500K	0
234 New Orleans	2/13/2007	3:03 AM	Tornado	F2	15	2.0M	0K
235 Gentilly	2/13/2007	3:10 AM	Tornado	F2	10	1.0M	0K

262 Gentilly	7/6/2010	8:44 AM	Tornado	F0	0	10K	0K
151 LAZ038 - 040 - 058>070	9/10/1998	3:00 PM	Tropical Storm	N/A	0	31.5M	0
154 LAZ040 - 058 - 060 - 062 - 066>070	9/19/1998	12:00 PM	Tropical Storm	N/A	0	0K	0
188 LAZ038 - 040 - 058 - 060>064 - 069>070	8/4/2002	6:00 PM	Tropical Storm	N/A	0	50K	0
191 LAZ040 - 058 - 060>064 - 068>070	9/14/2002	12:00 AM	Tropical Storm	N/A	0	0	0
193 LAZ038 - 040 - 049>050 - 057>060 - 062>070	9/25/2002	10:00 AM	Tropical Storm	N/A	0	108.6M	0
200 LAZ038>040 - 050 - 058>070	6/30/2003	6:00 AM	Tropical Storm	N/A	0	34.0M	0
215 LAZ038 - 040 - 050 - 058>070	10/9/2004	3:00 PM	Tropical Storm	N/A	0	50K	0
225 LAZ040 - 061>064 - 068>070	7/10/2005	4:00 AM	Tropical Storm	N/A	0	0	0
228 LAZ034>038 - 040 - 046>050 - 056>070	9/23/2005	7:00 AM	Tropical Storm	N/A	0	48.0M	0
5 ORLEANS	4/28/1958	1:00	Tstm Wind	0 kts.	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							
Location or County	**Date**	**Time**	**Type**	**Mag-nitude**	**Injury**	**Property Damage**	**Crop Damage**
6 ORLEANS	12/31/1960	7:30	Tstm Wind	63 kts.	0	0	0
7 ORLEANS	6/10/1961	13:40	Tstm Wind	50 kts.	0	0	0
10 ORLEANS	2/25/1964	0	Tstm Wind	50 kts.	0	0	0
11 ORLEANS	4/25/1964	18:00	Tstm Wind	55 kts.	0	0	0
14 ORLEANS	7/8/1965	14:00	Tstm Wind	50 kts.	0	0	0
15 ORLEANS	1/28/1966	21:30	Tstm Wind	0 kts.	0	0	0
16 ORLEANS	4/21/1966	10:00	Tstm Wind	0 kts.	0	0	0
17 ORLEANS	4/28/1966	13:40	Tstm Wind	50 kts.	0	0	0
18 ORLEANS	6/17/1966	18:30	Tstm Wind	0 kts.	0	0	0
19 ORLEANS	7/3/1967	20:27	Tstm Wind	60 kts.	0	0	0
20 ORLEANS	5/24/1968	16:45	Tstm Wind	0 kts.	0	0	0

21 ORLEANS	7/12/1968	10:30	Tstm Wind	50 kts.	0	0	0
23 ORLEANS	2/1/1970	14:45	Tstm Wind	0 kts.	0	0	0
22 ORLEANS	2/1/1970	14:39	Tstm Wind	90 kts.	0	0	0
24 ORLEANS	7/4/1970	15:08	Tstm Wind	75 kts.	0	0	0
25 ORLEANS	11/13/1970	22:00	Tstm Wind	0 kts.	0	0	0
27 ORLEANS	4/2/1971	40	Tstm Wind	58 kts.	0	0	0
29 ORLEANS	3/2/1972	5:25	Tstm Wind	51 kts.	0	0	0
31 ORLEANS	5/12/1972	17:48	Tstm Wind	50 kts.	0	0	0
32 ORLEANS	6/22/1972	12:30	Tstm Wind	52 kts.	0	0	0
33 ORLEANS	12/30/1972	22:27	Tstm Wind	50 kts.	0	0	0
34 ORLEANS	4/26/1973	6:03	Tstm Wind	60 kts.	0	0	0
36 ORLEANS	5/11/1974	1:30	Tstm Wind	0 kts.	0	0	0
38 ORLEANS	1/10/1975	12:30	Tstm Wind	70 kts.	0	0	0
39 ORLEANS	3/18/1975	6:28	Tstm Wind	52 kts.	0	0	0
40 ORLEANS	4/30/1975	11:40	Tstm Wind	53 kts.	0	0	0
41 ORLEANS	4/30/1975	17:51	Tstm Wind	71 kts.	0	0	0
43 ORLEANS	8/26/1975	13:12	Tstm Wind	52 kts.	0	0	0
44 ORLEANS	5/10/1976	11:45	Tstm Wind	64 kts.	0	0	0
45 ORLEANS	5/24/1976	17:11	Tstm Wind	55 kts.	0	0	0
46 ORLEANS	5/31/1976	15:51	Tstm Wind	55 kts.	0	0	0
47 ORLEANS	7/31/1976	7:04	Tstm Wind	0 kts.	0	0	0
49 ORLEANS	7/2/1977	19:00	Tstm Wind	60 kts.	0	0	0
51 ORLEANS	12/13/1977	17:45	Tstm Wind	68 kts.	0	0	0
52 ORLEANS	6/29/1978	9:02	Tstm Wind	50 kts.	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
53 ORLEANS	6/29/1978	22:02	Tstm Wind	50 kts.	0	0	0
54 ORLEANS	8/20/1978	16:30	Tstm Wind	0 kts.	0	0	0
55 ORLEANS	4/11/1979	13:00	Tstm Wind	0 kts.	0	0	0
56 ORLEANS	5/4/1979	10:57	Tstm Wind	52 kts.	0	0	0
57 ORLEANS	5/29/1979	17:10	Tstm Wind	52 kts.	0	0	0
58 ORLEANS	7/1/1979	17:00	Tstm Wind	0 kts.	0	0	0
59 ORLEANS	7/16/1979	17:53	Tstm Wind	50 kts.	0	0	0
60 ORLEANS	8/6/1979	19:36	Tstm Wind	58 kts.	0	0	0
62 ORLEANS	6/24/1980	12:14	Tstm Wind	65 kts.	0	0	0
63 ORLEANS	7/7/1980	16:38	Tstm Wind	55 kts.	0	0	0
64 ORLEANS	2/10/1981	5:40	Tstm Wind	65 kts.	0	0	0
65 ORLEANS	4/30/1981	15:40	Tstm Wind	0 kts.	0	0	0
66 ORLEANS	6/1/1981	6:00	Tstm Wind	0 kts.	0	0	0

68 ORLEANS	6/22/1981	14:05	Tstm Wind	0 kts.	0	0	0
69 ORLEANS	7/10/1981	19:20	Tstm Wind	0 kts.	0	0	0
70 ORLEANS	7/30/1981	18:18	Tstm Wind	0 kts.	0	0	0
71 ORLEANS	1/31/1982	2:00	Tstm Wind	0 kts.	0	0	0
73 ORLEANS	6/16/1982	20:00	Tstm Wind	0 kts.	0	0	0
74 ORLEANS	8/8/1982	13:42	Tstm Wind	0 kts.	0	0	0
75 ORLEANS	8/9/1982	13:42	Tstm Wind	50 kts.	0	0	0
76 ORLEANS	9/24/1982	20:30	Tstm Wind	0 kts.	0	0	0
77 ORLEANS	2/21/1983	11:17	Tstm Wind	68 kts.	0	0	0
78 ORLEANS	8/10/1983	14:20	Tstm Wind	50 kts.	0	0	0
79 ORLEANS	12/11/1983	4:45	Tstm Wind	0 kts.	0	0	0
80 ORLEANS	12/27/1983	23:02	Tstm Wind	0 kts.	0	0	0
84 ORLEANS	2/12/1984	13:50	Tstm Wind	53 kts.	0	0	0
83 ORLEANS	2/12/1984	13:45	Tstm Wind	61 kts.	0	0	0
81 ORLEANS	2/12/1984	13:20	Tstm Wind	74 kts.	0	0	0
82 ORLEANS	2/12/1984	13:20	Tstm Wind	75 kts.	0	0	0
86 ORLEANS	7/25/1984	13:30	Tstm Wind	0 kts.	0	0	0
87 ORLEANS	2/11/1985	1:55	Tstm Wind	52 kts.	0	0	0
88 ORLEANS	2/23/1985	0	Tstm Wind	0 kts.	0	0	0
90 ORLEANS	5/21/1985	12:35	Tstm Wind	0 kts.	0	0	0
91 ORLEANS	8/1/1985	14:30	Tstm Wind	50 kts.	0	0	0
92 ORLEANS	7/13/1986	16:40	Tstm Wind	0 kts.	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
93 ORLEANS	7/16/1986	16:45	Tstm Wind	0 kts.	0	0	0
94 ORLEANS	5/6/1987	20:50	Tstm Wind	0 kts.	0	0	0
95 ORLEANS	5/21/1988	11:40	Tstm Wind	0 kts.	0	0	0
96 ORLEANS	5/4/1989	18:30	Tstm Wind	0 kts.	0	0	0
97 ORLEANS	11/15/1989	16:07	Tstm Wind	55 kts.	0	0	0
98 ORLEANS	5/27/1990	18:00	Tstm Wind	0 kts.	0	0	0
99 ORLEANS	5/27/1990	18:25	Tstm Wind	0 kts.	1	0	0
100 ORLEANS	9/4/1990	19:00	Tstm Wind	54 kts.	0	0	0
101 ORLEANS	9/4/1990	19:43	Tstm Wind	72 kts.	0	0	0
104 ORLEANS	4/18/1991	3:45	Tstm Wind	0 kts.	0	0	0
123 (new)lkfrnt Arpt New	1/24/1996	2:19 AM	Tstm Wind	53 kts.	0	0	0
134 New Orleans	2/13/1997	1:10 AM	Tstm Wind	0 kts.	0	1K	0
137 Ft Pike	4/26/1997	4:10 AM	Tstm Wind	54 kts.	0	0	0

136 (new)lkfrnt Arpt	4/26/1997	3:04 AM	Tstm Wind	57 kts.	0	50K	0
141 New Orleans	2/10/1998	9:33 PM	Tstm Wind	50 kts.	0	0	0
147 New Orleans	6/21/1998	5:30 PM	Tstm Wind	0 kts.	0	1K	0
156 Lake Catherine	1/2/1999	7:30 AM	Tstm Wind	0 kts.	0	1K	0
163 New Orleans	7/14/2000	4:30 PM	Tstm Wind	0 kts.	0	1K	0
166 New Orleans	7/22/2000	7:30 PM	Tstm Wind	0 kts.	0	10K	0
169 Algiers	8/20/2000	7:40 PM	Tstm Wind	0 kts.	0	5K	0
168 New Orleans Lakefron	8/20/2000	7:02 PM	Tstm Wind	59 kts.	0	0	0
170 New Orleans Lakefron	8/31/2000	5:28 PM	Tstm Wind	53 kts.	0	0	0
171 New Orleans Lakefron	9/1/2000	8:00 PM	Tstm Wind	0 kts.	0	1K	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							
Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
172 New Orleans	9/1/2000	8:06 PM	Tstm Wind	0 kts.	0	5K	0
173 New Orleans	11/6/2000	1:45 PM	Tstm Wind	0 kts.	0	50K	0
175 New Orleans	6/5/2001	2:45 PM	Tstm Wind	0 kts.	0	15K	0
178 (new)lkfrnt Arpt New	6/19/2001	10:28 AM	Tstm Wind	51 kts.	0	0	0
181 Countywide	4/8/2002	1:15 PM	Tstm Wind	0 kts.	0	15K	0
183 Lake Catherine	4/8/2002	1:55 PM	Tstm Wind	0 kts.	0	10K	0
182 (new)lkfrnt Arpt New	4/8/2002	1:34 PM	Tstm Wind	57 kts.	0	0	0
185 New Orleans	7/7/2002	5:05 PM	Tstm Wind	0 kts.	0	4K	0
187 New Orleans	7/13/2002	12:50 PM	Tstm Wind	0 kts.	0	0K	0
186 New Orleans Lakefron	7/13/2002	12:38 PM	Tstm Wind	56 kts.	0	0	0
205 New Orleans	7/17/2003	2:20 PM	Tstm Wind	50 kts.	0	3K	0
206 New Orleans	11/18/2003	9:45 AM	Tstm Wind	50 kts.	0	8K	0
208 (new)lkfrnt Arpt New	4/11/2004	4:20 AM	Tstm Wind	52 kts.	0	0	0
209 (new)lkfrnt Arpt New	6/3/2004	2:22 PM	Tstm Wind	53 kts.	0	0	0
210 New Orleans	7/6/2004	1:00 PM	Tstm Wind	50 kts.	0	15K	0
217 Algiers	11/24/2004	5:00 AM	Tstm Wind	50 kts.	0	2K	0
219 New Orleans	1/13/2005	9:10 AM	Tstm Wind	50 kts.	0	2K	0
222 Algiers	7/3/2005	3:00 PM	Tstm Wind	50 kts.	0	2K	0
231 Little Woods	8/15/2006	4:15 PM	Tstm Wind	50 kts.	0	0K	0
138 New Orleans	5/19/1997	4:00 PM	Urban/sml Stream Fld	N/A	0	0	0
CDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							

Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
140 New Orleans	1/5/1998	7:00 AM	Urban/sml Stream Fld	N/A	0	0	0
143 New Orleans	3/7/1998	8:30 AM	Urban/sml Stream Fld	N/A	0	0	0
144 Countywide	4/29/1998	5:00 AM	Urban/sml Stream Fld	N/A	0	0	0
150 New Orleans	8/21/1998	10:00 AM	Urban/sml Stream Fld	N/A	0	0	0
157 Countywide	8/9/1999	4:30 PM	Urban/sml Stream Fld	N/A	0	0K	0
174 New Orleans	6/5/2001	1:00 PM	Urban/sml Stream Fld	N/A	0	0	0
180 New Orleans	6/21/2001	2:30 PM	Urban/sml Stream Fld	N/A	0	0	0
189 New Orleans	8/17/2002	12:25 PM	Urban/sml Stream Fld	N/A	0	0	0
190 New Orleans	8/22/2002	11:48 AM	Urban/sml Stream Fld	N/A	0	0	0
218 LAZ038 - 040 - 056>070	12/25/2004	7:00 AM	Winter Storm	N/A	0	0	0
ORLEANS (ZONE)	03/01/2010	6:45 PM	Strong Wind	45 EG	0	5000K	0
ORLEANS (ZONE)	03/01/2010	6:56 PM	High wind	52 kts	0	10000K	0
ORLEANS PAR./ NEW ORLEANS	4/23/2010	1:58 PM	Flash Fld/ Heavy Rain	0	0	0	0
ORLEANS PAR./ NEW ORLEANS	5/16/2010	9:47 AM	Flash Fld/ Heavy Rain	0	0	10000K	0
ORLEANS PAR./ NEW ORLEANS	6/4/2010	1:00 PM	Tstm Wind	52 kts	0	2000K	0
ORLEANS PAR./ GENTILLY	7/6/2010	8:44 AM	Tornado	EF0	0	10000K	0
ORLEANS PAR./ GENTILLY	11/30/2010	7:10 AM	Tstm Wind	61 kts	0	5000K	0
ORLEANS PAR./ LKFRNT APT	4/4/2011	6:44 PM	Tstm Wind	51 kts	0	0	0
ORLEANS PAR./ SOUTH PT	5/26/2011	5:58 PM	Hail	1 in.	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2015)							
Location or County	Date	Time	Type	Mag-nitude	Injury	Property Damage	Crop Damage
ORLEANS (ZONE)	9/2/2011	4:00 PM	Tropical Storm	N/A	0	350000K	0
ORLEANS PAR.	04/03/2012	11:00 PM	Tstm Wind Flash Flood	60 kts N/A	0	20000K	0
ORLEANS PAR.	04/04/2012	11:00 PM	Flash Flood	N/A	0	10000K	0
ORLEANS PAR./ GENTILLY	7/3/2012	5:44 PM	Tstm Wind	55 kts	0	5000K	0
ORLEANS PAR./ NEW ORLEANS	7/20/2012	10:20 AM	Flash Flood	N/A	0	20000K	0
ORLEANS PAR./ LKFNT APT	7/2/2012	2:45 PM	Flash Flood	N/A	0	0	0
ORLEANS PAR./ NEW ORLEANS	8/9/2012	12:50 PM	Flash Flood	N/A	0	0	0
ORLEANS (ZONE)	8/28/2012	4:00 AM	Hurricane	N/A	0	26.8M	0
ORLEANS (ZONE)	8/28/2012	6:00 AM	Storm Surge	N/A	0	62.5M	0
ORLEANS PAR./ NEW ORLEANS	8/29/2012	2:00 AM	Flash Flood	N/A	0	5000K	0
ORLEANS PAR./ NEW ORLEANS	2/24/2013	9:15 PM	Hail	1 in.	0	0	0
ORLEANS (ZONE)	4/3/2013	10:05 AM	High Wind	73 kts	0	20000K	0
ORLEANS PAR./ NEW ORLEANS	4/24/2013	11:00 AM	Tstm Wind/ High Wind	56 kts	0	11000K	0
ORLEANS PAR./ NEW ORLEANS	5/2/2013	3:24 PM	Flash Flood	N/A	0	50000K	0
ORLEANS PAR./ GREENS DITCH	5/10/2013	6:34 AM	Tstm Wind	70 kts	0	60000K	0
ORLEANS (ZONE)	11/26/2013	8:00 AM	Coastal Flood	N/A	0	0	0

A number of these events caused property damage, injuries, and deaths. According to the NCDC database, Orleans Parish experienced 647 deaths and 35 injuries from natural hazards in the period from 1950 to 2014. Review of the 255 events listed in the NCDC database indicates that this total does not include all of the injuries or loss of life from Hurricane Katrina in August 2005. Although the injuries and deaths from Katrina are not provided in the summary listing, the detailed description for Katrina from the NCDC database estimated that fatalities occurring in Louisiana as a result of the event numbered approximately 1,097 people as of late June 2006. An estimated 800 of the victims were in the New Orleans area.

Table 6-3 SHELDUS Database of Hazard Impact on Orleans Parish (1960-2013)

The Spatial Hazard Events and Losses Database for the United States (SHELDUS) U.S. version 14.1 includes county (parish) level hazard loss data from 1960 to 2014. Aggregated data, showing hazard occurrences from 1960 to 2014 by hazard types is listed below. Damage is also adjusted for 2014 dollars.

County Name	Hazard	Year	Crop Dmg	CropDmg(ADJ 2014)	CropDmgPerCapita(ADJ 2014)	Property Dmg	Property Dmg (ADJ 2014)	Property Dmg PerCapita (ADJ 2014)	Injuries	Inj PerCapita	Fatalities	Fatalities Per Capita	Occurences
Orleans	Hail	1960	$0	$0.00	0.00E+00	$25,000	$199,945.95	0.318626262	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1960	$0	$0.00	0.00E+00	$125,000	$999,729.73	1.593131317	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1960	$0	$0.00	0.00E+00	$35,000	$279,924.33	0.44607677	0	0.00E+00	0	0.00E+00	3
Orleans	Hurricane/Tropical Storm	1961	$78,125	$618,561.87	0.991094453	$78,125	$618,561.87	0.991094453	7	1.12158E-05	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1961	$0	$0.00	0.00E+00	$5,000	$39,587.96	0.063430046	0	0.00E+00	0	0.00E+00	1
Orleans	Tornado	1961	$0	$0.00	0.00E+00	$500	$3,958.80	0.006343011	0	0.00E+00	1	1.60226E-06	1
Orleans	Hail	1962	$391	$3,062.09	0.004933158	$5,391	$42,256.79	0.068077596	0	0.00E+00	0	0.00E+00	2
Orleans	Lightning	1962	$0	$0.00	0.00E+00	$98	$768.53	0.001238137	0	0.00E+00	0	0.00E+00	1
Orleans	Tornado	1962	$0	$0.00	0.00E+00	$598	$4,688.00	0.00755258	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1962	$391	$3,062.09	0.004933158	$489	$3,830.62	0.006171294	0	0.00E+00	0	0.00E+00	2
Orleans	Winter Weather	1962	$78,125	$612,417.22	0.9866319	$781,251	$6,124,178.29	9.866328814	0	0.00E+00	0	0.00E+00	2
Orleans	Hail	1963	$26	$201.48	0.00032639	$260	$2,014.71	0.003263692	0	0.00E+00	0	0.00E+00	1
Orleans	Heat	1963	$78,125	$604,411.77	0.979107335	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1963	$91	$705.19	0.001142364	$560	$4,331.64	0.007016969	1	1.61993E-06	0	0.00E+00	4
Orleans	Severe Storm/Thunder Storm	1963	$26	$201.48	0.00032639	$273	$2,111.41	0.003420348	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1963	$91	$705.19	0.001142364	$5,963	$46,132.75	0.074732028	0	0.00E+00	0	0.00E+00	6

Orleans	Winter Weather	1963	$781	$6,044.12	0.009791077	$1,172	$9,066.18	0.014686616	0	0.00E+00	0	0.00E+00	3
Orleans	Hail	1964	$195	$1,491.53	0.002429586	$27,203	$207,740.61	0.338392668	0	0.00E+00	0	0.00E+00	3
Orleans	Lightning	1964	$195	$1,491.53	0.002429586	$1,953	$14,915.32	0.024295855	0	0.00E+00	1	1.62892E-06	2
Orleans	Severe Storm/Thunder Storm	1964	$195	$1,491.53	0.002429586	$1,953	$14,915.32	0.024295855	0	0.00E+00	0	0.00E+00	1
Orleans	Tornado	1964	$0	$0.00	0.00E+00	$250,000	$1,909,161.29	3.109869442	2	4.88676E-06	0	0.00E+00	1
Orleans	Wind	1964	$195	$1,491.53	0.002429586	$2,536	$19,370.00	0.031552168	0	0.00E+00	0	0.00E+00	3
Orleans	Hail	1965	$1,000	$7,515.43	0.012310327	$10,000	$75,154.29	0.123103253	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1965	$78,125	$587,142.86	0.961744117	$7,812,500	$58,714,285.81	96.1744114	273	0.000447176	41	6.71583E-05	1
Orleans	Lightning	1965	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	1	1.63801E-06	1
Orleans	Severe Storm/Thunder Storm	1965	$0	$0.00	0.00E+00	$391	$2,935.72	0.004808722	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1965	$0	$0.00	0.00E+00	$391	$2,935.72	0.004808722	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1965	$781	$5,871.43	0.009617443	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1966	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	3	4.94158E-06	1	1.64719E-06	1
Orleans	Severe Storm/Thunder Storm	1966	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	5	8.23597E-06	0	0.00E+00	1
Orleans	Wind	1966	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	1	1.64719E-06	1
Orleans	Flooding	1967	$0	$0.00	0.00E+00	$260	$1,845.81	0.003057556	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1967	$260	$1,845.81	0.003057556	$456	$3,230.17	0.005350723	0	0.00E+00	0	0.00E+00	2
Orleans	Lightning	1967	$0	$0.00	0.00E+00	$195	$1,384.36	0.002293167	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1967	$260	$1,845.81	0.003057556	$755	$5,352.87	0.008866944	0	0.00E+00	0	0.00E+00	4
Orleans	Wind	1967	$260	$1,845.81	0.003057556	$755	$5,352.87	0.008866944	0	0.00E+00	0	0.00E+00	4

Orleans	Hail	1968	$0	$0.00	0.00E+00	$3	$17.71	2.95028E-05	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1968	$0	$0.00	0.00E+00	$643	$4,375.73	0.007289457	0	8.33E-07	0	0.00E+00	3
Orleans	Wind	1968	$0	$0.00	0.00E+00	$643	$4,375.73	0.007289457	0	8.33E-07	0	0.00E+00	3
Orleans	Winter Weather	1968	$12,500	$85,034.48	0.141657554	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	2
Orleans	Coastal	1969	$0	$0.00	0.00E+00	$98	$632.41	0.001059537	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1969	$172,414	$1,112,167.60	1.863311201	$1,724,138	$11,121,676.24	18.63311242	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1969	$0	$0.00	0.00E+00	$5,000	$32,252.86	0.054036024	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1969	$0	$0.00	0.00E+00	$98	$632.41	0.001059537	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1969	$0	$0.00	0.00E+00	$98	$632.41	0.001059537	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1970	$0	$0.00	0.00E+00	$33,333	$203,381.44	0.3426982	0	0.00E+00	0	5.62E-07	1
Orleans	Severe Storm/Thunder Storm	1970	$0	$0.00	0.00E+00	$39,912	$243,522.50	0.410335978	0	8.43E-07	0	5.62E-07	2
Orleans	Wind	1970	$0	$0.00	0.00E+00	$39,912	$243,522.50	0.410335978	0	8.43E-07	0	5.62E-07	2
Orleans	Hail	1971	$0	$0.00	0.00E+00	$1,953	$11,416.67	0.019187676	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1971	$0	$0.00	0.00E+00	$50,000	$292,266.67	0.491204487	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1971	$0	$0.00	0.00E+00	$1,953	$11,416.67	0.019187676	0	0.00E+00	0	0.00E+00	1
Orleans	Tornado	1971	$0	$0.00	0.00E+00	$6,953	$40,643.34	0.068308133	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1971	$0	$0.00	0.00E+00	$2,453	$14,339.34	0.024099727	0	0.00E+00	0	0.00E+00	2
Orleans	Winter Weather	1971	$0	$0.00	0.00E+00	$781	$4,566.67	0.007675076	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1972	$0	$0.00	0.00E+00	$823	$4,659.18	0.007830536	0	0.00E+00	0	0.00E+00	3
Orleans	Lightning	1972	$0	$0.00	0.00E+00	$195	$1,106.16	0.001859092	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1972	$7,813	$44,246.41	0.074363714	$2,045	$11,581.58	0.019464846	0	0.00E+00	0	0.00E+00	4

Orleans	Wind	1972	$0	$0.00	0.00E+00	$26,264	$148,745.46	0.249992375	0	0.00E+00	0	0.00E+00	4
Orleans	Wind	1973	$0	$0.00	0.00E+00	$7,813	$41,655.41	0.071745453	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1973	$781	$4,165.54	0.007174544	$7,813	$41,655.41	0.071745453	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1974	$0	$0.00	0.00E+00	$67	$320.13	0.000558886	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1974	$0	$0.00	0.00E+00	$5,000	$24,009.74	0.041916446	2	3.49162E-06	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1974	$0	$0.00	0.00E+00	$67	$320.13	0.000558886	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1974	$0	$0.00	0.00E+00	$67	$320.13	0.000558886	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1975	$26	$114.60	0.00020169	$2,604	$11,459.11	0.020167382	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1975	$0	$0.00	0.00E+00	$714	$3,143.09	0.005531661	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1975	$26	$114.60	0.00020169	$2,604	$11,459.11	0.020167382	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1975	$26	$114.60	0.00020169	$61,176	$269,190.82	0.473760677	2	3.51989E-06	1	1.75994E-06	4
Orleans	Tornado	1976	$0	$0.00	0.00E+00	$50	$208.03	0.0003662	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1976	$0	$0.00	0.00E+00	$7,500	$31,204.22	0.054937007	0	0.00E+00	0	0.00E+00	2
Orleans	Winter Weather	1976	$781	$3,250.44	0.005722606	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1977	$0	$0.00	0.00E+00	$500	$1,953.27	0.003464473	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1977	$0	$0.00	0.00E+00	$8,333	$32,554.46	0.057741149	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1977	$0	$0.00	0.00E+00	$6,906	$26,979.51	0.047852978	0	0.00E+00	0	0.00E+00	3
Orleans	Tornado	1977	$156	$610.40	0.001082653	$158,750	$620,162.38	1.099968748	1	3.54736E-06	0	0.00E+00	2
Orleans	Wind	1977	$0	$0.00	0.00E+00	$12,240	$47,814.36	0.084807308	0	0.00E+00	0	0.00E+00	2
Orleans	Winter Weather	1977	$806	$3,150.42	0.005587833	$80,723	$315,348.33	0.559326587	0	0.00E+00	0	0.00E+00	2

Orleans	Hurricane/Tropical Storm	1978	$78	$283.68	0.000505939	$781	$2,836.66	0.00505914	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1978	$0	$0.00	0.00E+00	$2,000,000	$7,261,840.49	12.95138307	2	3.56697E-06	0	0.00E+00	2
Orleans	Hurricane/Tropical Storm	1979	$0	$0.00	0.00E+00	$34,167	$111,411.45	0.200092403	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1979	$0	$0.00	0.00E+00	$250	$815.21	0.001464098	1	1.79598E-06	0	0.00E+00	2
Orleans	Flooding	1980	$0	$0.00	0.00E+00	$2,268,517	$6,517,470.42	11.68158275	0	0.00E+00	2	3.5847E-06	2
Orleans	Hail	1980	$0	$0.00	0.00E+00	$1,667	$4,788.36	0.008582413	0	0.00E+00	0	0.00E+00	1
Orleans	Heat	1980	$7,813	$22,445.39	0.040229976	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1980	$0	$0.00	0.00E+00	$20,833	$59,854.36	0.107279913	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1980	$0	$0.00	0.00E+00	$5,000	$14,365.05	0.025747186	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1980	$0	$0.00	0.00E+00	$5,000	$14,365.05	0.025747186	2	3.5847E-06	0	0.00E+00	1
Orleans	Flooding	1981	$0	$0.00	0.00E+00	$67	$173.62	0.000310111	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1981	$0	$0.00	0.00E+00	$833	$2,170.30	0.003876395	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1981	$0	$0.00	0.00E+00	$6,193	$16,129.38	0.028808894	1	2.67917E-06	0	8.93E-07	9
Orleans	Severe Storm/Thunder Storm	1981	$208	$542.57	0.000969091	$21,146	$55,071.27	0.098363518	0	8.93E-07	0	8.93E-07	6
Orleans	Tornado	1981	$0	$0.00	0.00E+00	$833	$2,170.30	0.003876395	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1981	$0	$0.00	0.00E+00	$235	$611.76	0.001092669	0	0.00E+00	0	0.00E+00	5
Orleans	Flooding	1982	$78,125	$191,658.03	0.341273852	$2,097,039	$5,144,505.04	9.160508693	3	5.34192E-06	0	0.00E+00	3
Orleans	Lightning	1982	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	3	5.34192E-06	1	1.78064E-06	2
Orleans	Severe Storm/Thunder Storm	1982	$0	$0.00	0.00E+00	$66,789	$163,849.46	0.291756814	0	0.00E+00	0	0.00E+00	3

Orleans	Wind	1982	$50	$122.66	0.000218413	$5,050	$12,388.77	0.022059933	1	1.78064E-06	0	0.00E+00	2
Orleans	Winter Weather	1982	$0	$0.00	0.00E+00	$7,812	$19,164.58	0.034125207	0	0.00E+00	0	0.00E+00	1
Orleans	Flooding	1983	$0	$0.00	0.00E+00	$1,250,000	$2,971,084.34	5.308465324	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1983	$0	$0.00	0.00E+00	$2,430,833	$5,777,768.70	10.32319559	0	0.00E+00	0	0.00E+00	5
Orleans	Wind	1983	$0	$0.00	0.00E+00	$12,500	$29,710.85	0.053084656	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1983	$7,813	$18,569.28	0.033177913	$78,125	$185,692.77	0.331779078	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1984	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	1	1.80805E-06	1
Orleans	Severe Storm/Thunder Storm	1984	$0	$0.00	0.00E+00	$14,583	$33,228.09	0.060078053	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1984	$0	$0.00	0.00E+00	$12,500	$28,481.23	0.051495493	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1985	$0	$0.00	0.00E+00	$714	$1,571.54	0.002860728	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1985	$7,406,015	$16,294,334.33	29.66122445	$8,948,872	$19,688,849.48	35.840395 3	38	7.09933E-05	0	0.00E+00	2
Orleans	Lightning	1985	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	0	9.10E-07	1
Orleans	Severe Storm/Thunder Storm	1985	$0	$0.00	0.00E+00	$194,444	$427,806.68	0.778753504	5	9.1017E-06	0	9.10E-07	3
Orleans	Wind	1985	$0	$0.00	0.00E+00	$714	$1,571.54	0.002860728	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1985	$0	$0.00	0.00E+00	$781	$1,718.87	0.003128927	0	0.00E+00	2	3.64068E-06	1
Orleans	Heat	1986	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	4	7.36656E-06	3
Orleans	Severe Storm/Thunder Storm	1986	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	9.21E-07	0	0.00E+00	1
Orleans	Wind	1986	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	9.21E-07	0	0.00E+00	1
Orleans	Fog	1987	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	17	3.39768E-05	2	3.77519E-06	1

Orleans	Heat	1987	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	60	0.000113256	0	0.00E+00	1
Orleans	Flooding	1988	$0	$0.00	0.00E+00	$500,000	$1,000,574.81	1.928937901	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1988	$0	$0.00	0.00E+00	$26,563	$53,155.54	0.102474832	0	0.00E+00	0	0.00E+00	2
Orleans	Flooding	1989	$0	$0.00	0.00E+00	$50,000	$95,458.06	0.188316226	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1989	$0	$0.00	0.00E+00	$278	$530.33	0.001046216	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1989	$0	$0.00	0.00E+00	$2,500	$4,772.91	0.009415815	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1989	$0	$0.00	0.00E+00	$2,500	$4,772.91	0.009415815	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1989	$0	$0.00	0.00E+00	$7,813	$14,915.32	0.029424407	0	0.00E+00	2	3.94553E-06	1
Orleans	Flooding	1990	$0	$0.00	0.00E+00	$5,000	$9,056.47	0.018292943	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1990	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	3	6.05963E-06	1	2.01988E-06	1
Orleans	Severe Storm/Thunder Storm	1990	$0	$0.00	0.00E+00	$2,550	$4,618.80	0.009329391	0	1.00994E-06	0	0.00E+00	4
Orleans	Wind	1990	$0	$0.00	0.00E+00	$2,550	$4,618.80	0.009329391	0	1.00994E-06	0	0.00E+00	4
Orleans	Hail	1991	$0	$0.00	0.00E+00	$100	$173.82	0.000353792	0	0.00E+00	0	0.00E+00	2
Orleans	Severe Storm/Thunder Storm	1991	$0	$0.00	0.00E+00	$25	$43.46	8.84479E-05	0	0.00E+00	0	0.00E+00	1
Orleans	Tornado	1991	$0	$0.00	0.00E+00	$5,000	$8,690.75	0.017689078	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1991	$0	$0.00	0.00E+00	$25	$43.46	8.84479E-05	0	0.00E+00	0	0.00E+00	1
Orleans	Hail	1992	$0	$0.00	0.00E+00	$16,667	$28,122.59	0.057413201	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1992	$16,666,667	$28,122,594.45	57.4132031	$16,666,667	$28,122,594.45	57.4132031	2	4.08307E-06	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1992	$0	$0.00	0.00E+00	$21,667	$36,559.37	0.074637165	0	0.00E+00	0	0.00E+00	2

Orleans	Wind	1992	$0	$0.00	0.00E+00	$16,667	$28,122.59	0.057413201	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1993	$0	$0.00	0.00E+00	$1,667	$2,730.52	0.005599619	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1993	$139,063	$227,827.68	0.467218073	$0	$0.00	0.00E+00	0	0.00E+00	1	2.05075E-06	1
Orleans	Flooding	1994	$0	$0.00	0.00E+00	$50,000	$79,870.45	0.164799248	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1994	$0	$0.00	0.00E+00	$10,000	$15,974.09	0.032959855	0	0.00E+00	0	0.00E+00	1
Orleans	Flooding	1995	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	4	8.31729E-06	1
Orleans	Hurricane/Tropical Storm	1995	$0	$0.00	0.00E+00	$15,385	$23,898.25	0.049692156	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1995	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	2	4.15864E-06	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1995	$0	$0.00	0.00E+00	$100,875,000	$156,697,795.23	325.825169	0	0.00E+00	0	0.00E+00	3
Orleans	Wind	1995	$0	$0.00	0.00E+00	$125,000	$194,173.23	0.403748664	0	0.00E+00	0	0.00E+00	1
Orleans	Flooding	1996	$0	$0.00	0.00E+00	$500,000	$754,416.83	1.591267691	0	0.00E+00	0	0.00E+00	1
Orleans	Lightning	1996	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	1	2.10927E-06	1
Orleans	Wind	1996	$0	$0.00	0.00E+00	$22,727	$34,291.67	0.072330341	0	0.00E+00	0	0.00E+00	1
Orleans	Winter Weather	1996	$909,091	$1,371,666.96	2.893213977	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1997	$0	$0.00	0.00E+00	$833,333	$1,229,158.87	2.620511691	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1997	$0	$0.00	0.00E+00	$25,250	$37,243.52	0.079401507	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	1997	$0	$0.00	0.00E+00	$25,250	$37,243.52	0.079401507	0	0.00E+00	0	0.00E+00	2
Orleans	Drought	1998	$3,522,727	$5,116,296.70	11.012783	$0	$0.00	0.00E+00	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	1998	$0	$0.00	0.00E+00	$5,886,364	$8,549,166.76	18.40200517	0	0.00E+00	0	0.00E+00	2
Orleans	Lightning	1998	$0	$0.00	0.00E+00	$120,000	$174,284.17	0.375145121	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1998	$0	$0.00	0.00E+00	$500	$726.19	0.001563107	0	0.00E+00	0	0.00E+00	1

Orleans	Wind	1998	$0	$0.00	0.00E+00	$500	$726.19	0.001563107	0	0.00E+00	0	0.00E+00	1
Orleans	Heat	1999	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	2	4.33921E-06	0	0.00E+00	1
Orleans	Lightning	1999	$0	$0.00	0.00E+00	$50,000	$71,049.22	0.154148874	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	1999	$0	$0.00	0.00E+00	$500	$710.49	0.001541484	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	1999	$0	$0.00	0.00E+00	$500	$710.49	0.001541484	0	0.00E+00	0	0.00E+00	1
Orleans	Heat	2000	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	2	4.13511E-06	1
Orleans	Lightning	2000	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	2	4.13511E-06	1
Orleans	Severe Storm/Thunder Storm	2000	$0	$0.00	0.00E+00	$35,750	$49,148.16	0.101616539	0	0.00E+00	0	0.00E+00	5
Orleans	Wind	2000	$0	$0.00	0.00E+00	$35,750	$49,148.16	0.101616539	0	0.00E+00	0	0.00E+00	5
Orleans	Flooding	2001	$0	$0.00	0.00E+00	$75,000	$100,255.23	0.209768816	0	0.00E+00	0	0.00E+00	2
Orleans	Severe Storm/Thunder Storm	2001	$0	$0.00	0.00E+00	$7,500	$10,025.52	0.020976875	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	2001	$0	$0.00	0.00E+00	$7,500	$10,025.52	0.020976875	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	2002	$0	$0.00	0.00E+00	$15,160,096	$19,949,641.58	42.19967166	0	0.00E+00	0	0.00E+00	3
Orleans	Severe Storm/Thunder Storm	2002	$0	$0.00	0.00E+00	$14,625	$19,245.49	0.040710173	0	0.00E+00	0	0.00E+00	4
Orleans	Wind	2002	$0	$0.00	0.00E+00	$16,125	$21,219.39	0.044885583	0	0.00E+00	0	0.00E+00	5
Orleans	Coastal	2003	$0	$0.00	0.00E+00	$205,000	$263,754.79	0.563866558	0	0.00E+00	0	0.00E+00	1
Orleans	Flooding	2003	$0	$0.00	0.00E+00	$280,000	$360,250.43	0.770159184	0	0.00E+00	0	0.00E+00	2
Orleans	Hurricane/Tropical Storm	2003	$0	$0.00	0.00E+00	$2,833,333	$3,645,391.30	7.793277555	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	2003	$0	$0.00	0.00E+00	$5,500	$7,076.35	0.015128132	0	0.00E+00	0	0.00E+00	2
Orleans	Tornado	2003	$0	$0.00	0.00E+00	$5,000	$6,433.04	0.013752835	0	0.00E+00	0	0.00E+00	1

Orleans	Wind	2003	$0	$0.00	0.00E+00	$210,500	$270,831.14	0.57899469	0	0.00E+00	0	0.00E+00	3
Orleans	Hurricane/Tropical Storm	2004	$0	$0.00	0.00E+00	$1,769,192	$2,217,212.35	4.800044056	0	0.00E+00	0	0.00E+00	4
Orleans	Severe Storm/Thunder Storm	2004	$0	$0.00	0.00E+00	$8,250	$10,339.19	0.022383306	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	2004	$0	$0.00	0.00E+00	$8,250	$10,339.19	0.022383306	0	0.00E+00	0	0.00E+00	2
Orleans	Hurricane/Tropical Storm	2005	$0	$0.00	0.00E+00	$6,031,365,260	$7,311,015,283.70	16061.52905	0	0.00E+00	510	0.001120416	7
Orleans	Severe Storm/Thunder Storm	2005	$0	$0.00	0.00E+00	$1,500	$1,818.25	0.003994503	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	2005	$0	$0.00	0.00E+00	$1,500	$1,818.25	0.003994503	0	0.00E+00	0	0.00E+00	2
Orleans	Severe Storm/Thunder Storm	2006	$0	$0.00	0.00E+00	$650	$763.29	0.003660021	0	0.00E+00	0	0.00E+00	2
Orleans	Tornado	2006	$0	$0.00	0.00E+00	$500,000	$587,142.86	2.815384756	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	2006	$0	$0.00	0.00E+00	$650	$763.29	0.003660021	0	0.00E+00	0	0.00E+00	2
Orleans	Lightning	2007	$0	$0.00	0.00E+00	$50,000	$57,088.29	0.198145485	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	2007	$0	$0.00	0.00E+00	$500	$570.89	0.001981462	0	0.00E+00	0	0.00E+00	1
Orleans	Tornado	2007	$0	$0.00	0.00E+00	$3,000,000	$3,425,297.33	11.88872883	25	8.67715E-05	1	3.47086E-06	2
Orleans	Wind	2007	$0	$0.00	0.00E+00	$500	$570.89	0.001981462	0	0.00E+00	0	0.00E+00	1
Orleans	Coastal	2008	$0	$0.00	0.00E+00	$2,327,273	$2,558,948.26	7.601348119	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	2008	$0	$0.00	0.00E+00	$5,912,825	$6,501,435.28	19.31249415	0	0.00E+00	0	0.00E+00	2
Orleans	Severe Storm/Thunder Storm	2008	$0	$0.00	0.00E+00	$1,750	$1,924.21	0.005715866	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	2008	$0	$0.00	0.00E+00	$1,750	$1,924.21	0.005715866	0	0.00E+00	1	2.9705E-06	3
Orleans	Winter Weather	2008	$0	$0.00	0.00E+00	$0	$0.00	0.00E+00	0	0.00E+00	1	2.9705E-06	1
Orleans	Severe Storm/Thunder Storm	2009	$0	$0.00	0.00E+00	$4,000	$4,413.90	0.012438763	0	0.00E+00	0	0.00E+00	3

Orleans	Wind	2009	$0	$0.00	0.00E+00	$4,000	$4,413.90	0.012438763	0	0.00E+00	0	0.00E+00	3
Orleans	Flooding	2010	$0	$0.00	0.00E+00	$10,000	$10,856.66	0.031198464	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	2010	$0	$0.00	0.00E+00	$26,000	$28,227.32	0.081116004	0	0.00E+00	0	0.00E+00	2
Orleans	Tornado	2010	$0	$0.00	0.00E+00	$10,000	$10,856.66	0.031198464	0	0.00E+00	0	0.00E+00	1
Orleans	Wind	2010	$0	$0.00	0.00E+00	$41,000	$44,512.31	0.127913701	0	0.00E+00	0	0.00E+00	4
Orleans	Flooding	2011	$0	$0.00	0.00E+00	$15,000	$15,786.68	0.043745332	0	0.00E+00	0	0.00E+00	1
Orleans	Hurricane/Tropical Storm	2011	$0	$0.00	0.00E+00	$10,000	$10,524.45	0.029163538	0	0.00E+00	0	0.00E+00	1
Orleans	Flooding	2012	$0	$0.00	0.00E+00	$62,585,000	$64,531,836.88	174.3316851	0	0.00E+00	0	0.00E+00	5
Orleans	Hurricane/Tropical Storm	2012	$0	$0.00	0.00E+00	$26,800,000	$27,633,669.86	74.65189998	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	2012	$0	$0.00	0.00E+00	$10,000	$10,311.08	0.027855198	0	0.00E+00	0	0.00E+00	2
Orleans	Wind	2012	$0	$0.00	0.00E+00	$10,000	$10,311.08	0.027855198	0	0.00E+00	0	0.00E+00	2
Orleans	Flooding	2013	$0	$0.00	0.00E+00	$50,000	$50,811.09	0.134064078	0	0.00E+00	0	0.00E+00	1
Orleans	Severe Storm/Thunder Storm	2013	$0	$0.00	0.00E+00	$35,500	$36,075.88	0.095185498	0	0.00E+00	0	0.00E+00	3
Orleans	Wind	2013	$0	$0.00	0.00E+00	$55,500	$56,400.32	0.14881114	0	0.00E+00	0	0.00E+00	4

Using the data from the NCDC database, SHELDUS, and other sources explained in each subsequent section, the number of events, period of record, and probability of the occurrence of these events in the future can be estimated.

Table 6-3 Hazard Recurrence Probability of Future Events

Hazard	Number of Events	Period of Record	Annual Probability	Probability
Floods	17	47	36%	Medium
Tropical Cyclones	37	53	100%	High
Storm Surge	11	17	65%	Medium
Coastal Erosion*	16 sq mi / year	-	100%	High
Tornadoes	17	59	28%	Low
Subsidence**	5 mm/year	50	100%	High
Winter Storms	20	52	40%	Medium
Drought	2	65	3%	Low
Extreme Temperature	56	56	100%	High
Dam Failure	>1%	100	0.01%	Low
Levee Failure	4	96	.04%	Low
Hazardous Materials***	7,254	5	100%	High
Power Outages****	10	1	100%	High
Terrorism	0	5	-	Low
Infrastructure Failure	15	5	100%	High
Building Collapse	199	15	100%	High
Civil Unrest	0	50	Less than 1%	Low
Pandemic	3	160	1%	Low
Hail	5	6	83%	High
Lightning	8	20	40%	Medium

* There is insufficient data available on erosion incidence to calculate Orleans land loss and coastal erosion probability of occurrence. According to USGS, the state of Louisiana has experienced 100,000,000 acres of coastal erosion over the past 80 years.

**According to *Seal-Level Rise and Subsidence Implications for Flooding in New Orleans, LA.* Insufficient data from National Geodetic Survey to calculate annual probabilities.

*** Defined as days in which temperatures were so high or low as to necessitate emergency action- freeze or cooling shelters and public warnings.

****While it is technically correct to say that based on past incidence there is a 100% probability of at least one of these events occurring in a given year, it cannot be said with absolute certainty that occurrence of this event at any one point in the future is guaranteed. This is due to variance of occurrence over time that is not explicated here.

*****High = 100 - 76%, Medium = 75-31%, Low = >30%

Numerous federal agencies maintain a variety of records about losses associated with natural hazards. However, no single source offers a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The U.S. Army Corps of Engineers (USACE) and the Natural Resources Conservation Service collect data on losses during the course of some of their ongoing projects and studies. Additionally, NOAA and the NCDC collect and maintain data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and costs.

In the absence of definitive data on some of the natural hazards that are likely to occur in Orleans Parish, illustrative examples are useful. In 1965, the federal government began to maintain records of events deemed significant enough to warrant declaration of a major disaster by the U.S. President. Since 1965, Orleans Parish has received 26 Presidential Disaster Declarations. These are summarized below in Table 6-4. This list is not meant to capture every event that has affected the area, but to highlight past significant events. A number of these events caused property damage and injuries. These figures and events are discussed in more detail in the hazard-specific subsections that follow.

Table 6-4 Natural Hazards and Declared Major Disasters in Orleans Parish, Louisiana (1965 to 2015)
(Sources: Public Entity Risk Institute (PERI) website, FEMA, NCDC database)

Disaster & Date	Nature of Event	Description
FEMA-DR-208 9/10/1965	HURRICANE BETSY	Category 3 Hurricane with landfall west of New Orleans. Estimated $1.4 billion in damage, 75 deaths, 800 injuries,164,000 homes flooded.
FEMA-DR-272 8/14/1969	HURRICANE CAMILLE	One of only two Category 5 hurricanes to make landfall on a US coastline. Hurricane Camille made landfall along the Mississippi coast near Bay St. Louis, MS, causing an estimated $1.4 billion in total damages and 259 deaths.
FEMA-DR-374 4/27/1973	SEVERE STORM, FLOOD	Spring rains caused flooding in large areas of Louisiana and along the Mississippi River for more than 1,500 miles.
FEMA-DR-448 9/23/1974	HURRICANE CARMEN	Category 4 Hurricane made landfall ten miles west of Grand Isle; six-foot storm surge. Orleans Parish damage estimates were reported at slightly less than $20 million.
FEMA-DR-556 5/9/1978	SEVERE STORM, FLOOD	Torrential rains in excess of 10 inches, with rates of two inches per hour at times. Nearly all main arteries were flooded or inaccessible well into the evening hours.
FEMA-DR-616 4/9/1980	SEVERE STORM, FLOOD	Severe storms resulted in 10 inches of rain over several days. Drainage pumps throughout the Parish were overwhelmed and most shut down during the event. Flooding occurred in low-lying areas.
FEMA-DR-679 4/20/1983	SEVERE STORM, FLOOD	Heavy rain overwhelmed drainage pumps throughout the Parish, with resulting moderate flooding in the low-lying areas.
FEMA-DR-752 11/1/1985	HURRICANE JUAN	Category 1 storm made landfall in south-central Louisiana. Storm stalled over Louisiana for several days causing an estimated $38 million in damages in Orleans Parish.
FEMA-DR-849 11/19/1989	SEVERE STORM, FLOOD	Heavy rain flooded residences and businesses.
FEMA-DR-956 8/26/1992	HURRICANE ANDREW	Category 3 Hurricane, with winds of more than 100 miles per hour (mph) at the time it made landfall for the second time in Louisiana. Grand Isle and coastal areas were completely evacuated.
FEMA-DR-1049 5/10/1995	SEVERE STORM, FLOOD	Widespread rainfall of 8 to 12 inches in less than four hours overwhelmed the capacity of drainage pumps, with some of the most widespread and severe flooding reported in the City in the past 50 years. New Orleans damage estimated at $388 million.
FEMA-DR-1246 9/13/1998	TROPICAL STORM FRANCES & HURRICANE GEORGE	Category 3 hurricane that made landfall to the east of New Orleans. Widespread and deep flooding in the streets of the New Orleans metropolitan area.
FEMA-DR-1380 6/11/2001	TROPICAL STORM ALLISON, FLOOD	Slow-moving tropical storm caused widespread flooding; some locations received ten to 18 inches of rain.

FEMA-DR-1437 10/03/2002	HURRICANE LILI	Hurricane Lili made landfall on the central Louisiana coast as a category one hurricane. Property damages in Louisiana were estimated at $415 million.
FEMA-DR-1548 9/15/2004	HURRICANE IVAN	Impacted Orleans Parish as a hurricane on September 16, 2004 and then cycled back into the Gulf and came ashore again as a tropical depression on September 26, 2004.
FEMA-DR-1601 7/5/2005	TROPICAL STORM CINDY	The tropical storm came ashore just southwest of Grand Isle. Surge flooded low-lying coastal areas and high winds caused power outages across to an estimated 300,000 homes and businesses.
FEMA-DR-1603 8/29/2005	HURRICANE KATRINA	Made landfall as a Category 3 storm. Catastrophic flooding from storm surge and levee failures caused unprecedented flooding throughout New Orleans and the surrounding areas. A much longer discussion of the effects of Katrina can be found later in this section.
FEMA-DR-1603 9/24/2005	HURRICANE RITA	Made landfall as a strong Category 3 hurricane in extreme southwestern Louisiana. Rita made landfall less than a month after Hurricane Katrina while sections of the City of New Orleans were still being drained of floodwaters. An estimated 10,000 structures were flooded.
FEMA-DR-1685 2/13/2007	SEVERE STORMS AND TORNADOES	Tornadoes and severe storms impacted Jefferson, Orleans, and St. Martins Parishes. An EF2 Tornado moved through the City of Westwego and the Carrollton area of New Orleans. A total of 295 houses in New Orleans were damaged. A total of 79 houses were destroyed.
FEMA-DR-1786 9/2/2008	HURRICANE GUSTAV	Made landfall along the Louisiana coast with 105 mph winds near Cocodrie, Louisiana. Surges of 12-13 feet occurred along the Louisiana coast southeast of New Orleans, with surges of 9-10 feet in other portions of southeastern Louisiana. The storm surge overtopped the levees and floodwalls in a few parts of the New Orleans metropolitan area.
FEMA-DR-1792 9/13/2008	HURRICANE IKE	Landfall as a Category 2 hurricane. A storm surge ranging from four to nearly eight feet above normal occurred along the southeast Louisiana coast with a storm surge around five feet above normal in Lake Pontchartrain.
FEMA-DR-4015 8/18/2011	FLOODING	The historic Mississippi River Flood of 2011 resulted from above-normal snowfall over the Upper Mississippi Valley, elevated river levels from heavy rain events from February to April, and a very heavy rain event in the Mississippi watershed from the end of April to the beginning of May.
FEMA-DR-4041 10/28/2011	TROPICAL STORM LEE	Lee made landfall in S. Louisiana on Sept. 4, 2011. The large, slow moving system produced heavy rainfall with over 12.5 inches reported at New Orleans Lake Front Airport. Lee also generated strong winds and tornados.
FEMA-DR-4080 8/29/2012	HURRICANE ISAAC	Isaac, a slow moving system, made landfall twice in S. Louisiana, with sustained winds of 80 miles per hour. Storm surge in Orleans Parish was recorded at 4-8' and up to 17' in Plaquesmines Parish. Over 20" of rain was recorded in New Orleans.

6.3 Overview of the Type and Location of Natural Hazards that can affect Orleans Parish

In the initial identification process, the Office of Homeland Security and Emergency Preparedness (NOHSEP) catalogued potential hazards to identify those with the most potential to significantly affect the Parish. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used in the investigation. These included national, regional, and local sources such as websites, published documents, newspapers, databases, and maps, as well as discussion with the NOHSEP staff.
The Hazard Mitigation Plan update Advisory Committee and the City Hall Working Group reviewed the complete list of natural hazards as outlined in the current State Plan, the 2010 Orleans Plan, as well as any and all potential natural hazards which could affect the City/Parish. Following the review and discussion, the planning team recommended that those hazards viewed as not having any significant potential to affect Orleans Parish life and property would be deleted and focus would be placed on the most significant ones historically affecting the Parish.

It was recommended that the Plan update include **hazard identification** for the following 18 hazards:

- ✶ Floods
- ✶ Tropical Cyclones
- ✶ Storm surge
- ✶ Dam and levee failure
- ✶ Coastal Erosion
- ✶ Hazardous Materials Spills/Contamination Fixed Site & Transport
- ✶ Tornadoes
- ✶ Subsidence
- ✶ Winter Storms
- ✶ Drought
- ✶ Extreme Temperatures
- ✶ Power Outages
- ✶ Pandemic
- ✶ Terrorism
- ✶ Infrastructure Failure
- ✶ Building Collapse
- ✶ Civil Unrest
- ✶ Thunderstorm (Hail & Lightning)

The following section profiles the 18 hazards listed above, and includes a description of the hazard, location, and extent of the hazard, severity of the hazard, impact on life and property, past occurrences, and general probability of future occurrences.

6.3.1 Floods

Description of the Flood Hazard

Flooding is defined as the accumulation of water within a water body and the overflow of excess water onto the adjacent floodplain. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding. Flooding is a natural event for rivers and streams (often called "overbank" flooding, and also can be the result of ponding or overland ("sheet") flow when rainfall rates temporarily exceed the drainage capacity of an area. In overbank events, excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto banks and adjacent floodplains. In ponding events, water temporarily accumulates in an area until normal drainage allows it to flow away. Overland or sheet flow floods occur when intense rainfall occurs, and water simply runs across the ground, in extreme cases at depths of more than a foot and at relatively high velocities. Floodplains are lowlands, adjacent to rivers, lakes, and oceans that are subject to recurring floods. Hundreds of floods occur each year, making them one of the most common hazards in all 50 States and U.S. territories. Floods are also the most widespread of all natural disasters except fire. Flooding typically results from large-scale weather systems generating prolonged rainfall. Most communities in the United States have experienced some kind of flooding after spring rains, heavy thunderstorms, or winter snow thaws.

Flooding in Orleans Parish can be the result of the weather events such as hurricanes, thunderstorms (convectional and frontal), storm surge, and winter storms. Convectional rain, or showery precipitation, occurs from convective clouds and falls as showers with rapidly changing intensity. Frontal precipitation occurs when the leading edge of a warm air mass meets a cool air mass. The warmer air is forced over the cool air. As it rises, the warm air cools, moisture in the air condenses, and clouds and precipitation result. In Orleans Parish, heavy rains can occur at any time of the year, although the rainiest months are June, July, and August, when tropical moisture is plentiful along the Gulf Coast. This section addresses flooding from rain events, including those that are the result of hurricanes, tropical storms, thunderstorms, and winter storms. Flooding from storm surge is also summarized in this section, but addressed in detail in Section 6.3.3.

Location and Extent of the Flood Hazard

As described in Section 4, Orleans Parish lies in southeastern Louisiana and is bordered by Lake Pontchartrain to the north, Jefferson Parish to the west and southwest, and Plaquemines and St. Bernard Parishes and Lake Borgne to the east. Across most of the Parish, elevations vary by only a few feet. Most of Orleans Parish is below sea level and/or surrounded by flood levees. As such, the entire City is at risk from flood events, particularly those caused by excessive rains. Figure 6-1 displays the topography of New Orleans, showing elevations below and above sea level in cross section looking west. The map shows that the highest areas of the City border portions of the natural levee of the Mississippi River, particularly the area near the Garden District and Central Business District. The topography of New Orleans has been particularly influenced by the natural levee of the Mississippi River. With each Mississippi River flood, water spilled out of the river, depositing its sediment to raise the natural levee to an original average of 10 to 15 feet above sea level, and one to two miles in width, sloping very gently into the back swamp. In the New Orleans area today, the Mississippi River flows 10 feet to 15 feet above sea level. The map also shows that the lowest elevations of the City are located in the areas of Lakeview, Gentilly, and New Orleans East.

Figure 6-1 Topography of New Orleans Showing Base Flood Elevation Above Ground – All Parcels

As a result of this minimal elevation change, when heavy rainfall events occur, water tends to pool rather than run off rapidly. Elevations below sea level combined with little slope in topography and an extensive levee system mean that rainwater cannot flow out of the Parish, but must be pumped out. The greater New Orleans metropolitan area is served by over 80 pumping stations in four Parishes (Orleans, Jefferson, St. Bernard, and Plaquemines) with a combined capacity of over 30 billion gallons per day. All stations are equipped with pumps that are either directly driven by diesel engines or by electric motors that receive their power from diesel-electric generators. The main metropolitan area (Orleans Parish) is drained by 24 pump stations with total design capacity of 50,891 cubic per second, and 11 underpass stations. Because the river levees are higher than the lake levees, most rainwater is pumped into Lake Pontchartrain. Exceptions are the two (2) West Bank pumping stations and two (2) stations in Eastern New Orleans that pump rainwater into the Intracoastal Waterway or the Industrial Canal. Rainfall amounts of greater than 1-2 inches an hour cause flooding of 6-10 inches in some low lying areas, particularly those listed as being below ground elevation in the above map. Greater rainfall amounts can cause flooding of 1-10 feet in areas across the entire parish.

The most recent Flood Insurance Study (FIS) for Orleans Parish was published as a preliminary FIS by FEMA in December of 2014. An FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS. The Orleans Parish FIS characterizes flooding in the City and the surrounding area, describes

its causes, and identifies flood protection measures. The FIS indicates that the past history of flooding within the City suggests that flooding may occur during any season of the year. In the cooler months, the area is subject to heavy rainfalls resulting from fontal passages. In the summer months, heavy rainfalls result from convective thundershowers. In the late summer, hurricanes accompanied by rainfall and super-elevated water-surface elevations (storm surge) pose the largest threat of flooding in the area.

The FIS indicates that the principal sources of flooding in the Parish are rainfall ponding, or hurricane or tropical storm surges from Lake Pontchartrain and Lake Borgne.

The FIS produced for the Parish is also supported by a Flood Insurance Rate Map (FIRM), usually divided into individual FIRM panels. The FIRM is the official map of a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs are the areas subject to inundation by the base (1-percent-annual-chance) flood. Heavy rains are common in New Orleans, and since a large portion of the City lies within the SFHA, a major flood will result in significant property damage to residential and non-residential structures and disruption to the lives of people who live and work in the City.

Flood vulnerabilities and potential losses are discussed in much more detail in the following section of this Plan. Seventy-two percent of all parcels in Orleans Parish (109,231 structures) lie within the currently adopted SFHA. The City of New Orleans is in the process of adopting a revised FIRM. Figure 6-2 shows the change in SFHAs (Zone A and V) in Orleans Parish, based upon the proposed SFHA once the new maps are adopted. The flood risk zones are described immediately following Figure 6-2.

Figure 6-2 Orleans Parish Flood Zones
(Source: FEMA, Flood Insurance Rate Map)

The flood zone designations are defined as follows:

Zone AE (1 percent- annual-chance flooding). BFEs are shown for these zones.
Zone VE. Coastal areas with a 1-percent or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage.
Zone 0.2%. Areas of moderate flood hazard, with a 0.2-percent-annual-chance flood.
Zone X These areas are protected by the levees.

After Hurricanes Katrina and Rita in 2005, to minimize the flood impacts of future events, FEMA provided advisory information concerning coastal flood elevations and interior levee ponding elevations that can be used to guide recovery efforts. The document, *FEMA Flood Recovery Guidance, Advisory Base Flood Elevations for Orleans Parish, Louisiana,* was published by FEMA on April 12, 2006, and included new floodplain guidance for substantially damaged structures and new construction inside and outside of the levee protected areas in Orleans Parish. See the Vulnerability and Loss Estimation section of the Plan update for a more detailed discussion and maps related to the advisory base flood elevations.

Severity of the Flood Hazard

Several factors determine the severity of floods, including depth, velocity, duration, and the presence of debris or contaminants. A large amount of rainfall over a short time span can result in flash flood conditions. A small amount of rain can also result in floods in locations where the soil is saturated from a previous wet period, or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs in a particular season each year, or in regions where annual flooding is derived principally from snowmelt, the floodplains may be inundated nearly every year. In areas where flooding is caused by melting snow, and occasionally compounded by rainfall, the flood season is spring or early summer.

Orleans Parish is protected from flooding by a complex system of levees, drainage canals, and storm water pumps. As mentioned previously, New Orleans has a total of 24 drainage pumping stations and 11 underpass pumping stations that pump water out of the City and into Lake Pontchartrain or into canals, where the water is then pumped outside the levee and canal system. The system's pumping capacity is over 29 billion gallons a day, enough to empty a lake 10 square miles by 13.5 feet deep every 24 hours. That flow rate (over 45,000 cubic feet per second) is more than the flow rate of the Ohio River, the nation's fifth largest river. However, when heavy rain falls for an extended period, the pumps are sometimes unable to keep up. Orleans Parish is also vulnerable to flooding due to clogged storm drains. Catch basins often become clogged with leaves, mud, trash and other debris, preventing the storm water from flowing into the large, underground collection boxes that are part of the storm water system. Big rain events are fairly common in Orleans Parish and have caused significant property damage in the area. Note that a detailed discussion about flooding that occurs as result of storm surge, such as Hurricane Katrina in 2005, is addressed in detail in Section 6.3.3, Storm Surge.

Impact on Life and Property

Floods have been and continue to be the most frequent, destructive, and costly natural hazard facing Orleans Parish. As of July 2015, Orleans Parish was ranked number one in the State with $7,215,720,337 in total flood insurance payments since 1978. Louisiana has the largest number of repetitive loss properties of any State, and, since the inception of the NFIP in 1968, has the largest numbers of claims and total amounts of claims nationally.

Occurrences of the Flood Hazard

As part of this plan update, a variety of sources were reviewed to identify past flood events that have impacted the City of New Orleans. Past floods in New Orleans have ranged from catastrophic flooding from large surge events to minor localized flooding from heavy rainfall events. Review of the flood category within NCDC, SHELDUS and others shows a total of 4 flood events over the last five years. NCDC data does not appear to include flooding from storm surge associated with recent events such as Hurricanes Katrina and Rita in 2005. The flood category of the NCDC database provides only data statistics associated with rainfall and riverine flooding events that typically result in minor property damage from localized flooding; hurricane (and associated surge) damage is listed separately. SHELDUS data includes flood events from heavy rainfall. Figure 6-3 shows some of the flooding experienced by the City from Hurricane Katrina.

Figure 6-3 Aerial Photo of New Orleans Flooding on August 31, 2005 after Hurricane Katrina
(Source: NOAA, News Online)

A wide variety of information is available related to significant floods that have caused serious loss of life, major property and infrastructure damage, or public utilities failure in Orleans Parish. Since the beginning of the 20th century, while the southern Louisiana coastline has been flooded by hurricane storm surges numerous times, the four most significant flooding events in New Orleans occurred in 1915, 1947, 1965, and 2005. All four of these events were the result of storm surge associated with major hurricanes. Each of these events prompted significant changes and development of the New Orleans Levee Protection System. These four events are briefly noted in Table 6-5, which also includes short descriptions

of the improvements and modifications to the Levee Protection System. The events themselves are described in detail in other parts of this section.

Table 6-5 Orleans Parish: Significant Flood Events and Resulting Improvements in the HPS, 1915 - 2015
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability, NOAA, NCDC Database)

Date	Event	Changes to Flood Protection
1915	Unnamed Hurricane (Category 4) Hurricane	This event spurred investment in new pump stations and the raising of the levees along the drainage canals (17th Street, Orleans Avenue, and London Avenue canals) and the Pontchartrain shoreline.
1947	Unnamed Hurricane (Category 3) Hurricane	The City invested in improvements to flood defenses and land reclamation along the shores of Lake Pontchartrain, which sparked a major expansion of the City to the north. The levees were heightened along the south shore of Lake Pontchartrain bordering the City and extended westward across Jefferson Parish.
9/10/1965 FEMA-DR-208	Hurricane Betsy (Category 3)	Event led to new initiatives for flood protection with the passage of the Flood Control Act of 1965 by the U.S. Congress. The enhancements to the levee system surrounding New Orleans following Hurricane Betsy have their origins in the 1955 Congressional act that authorized the investigation of the coastal areas of the southern and eastern United States susceptible to hurricane hazard.
8/29/05 FEMA-DR-1603	Hurricane Katrina (Category 3)	Numerous upgrades and improvements to pump stations, levees and floodwalls throughout Southeastern Louisiana, including New Orleans component. The USACE anticipates base flood elevation level flood protection by 2011. Since Hurricane Katrina, local, state and federal agencies and organizations have initiated a range of actions to improve flood protection in Orleans Parish and surrounding communities. These are discussed in more detail in the present section of the HMP, and in Section 7 (the Vulnerability Assessment and Loss Estimation).

In addition to the events described above, Orleans Parish has experienced numerous other flood events, many of which have resulted in Presidential Disaster Declarations. All of the 26 Presidential Disaster Declarations in Orleans Parish were associated with flooding either as a result of severe storms (thunderstorms, tornadoes, etc.) or from hurricanes and tropical storms. In addition to the declared events, Orleans Parish has also experienced less severe floods that may have caused moderate damage, but were not widespread or severe enough to warrant a Declaration.

Details of the Presidential Disaster Declarations and significant non-declared flood events for Orleans Parish since 1970 are summarized below. Declared events are indicated by the Disaster Number:

- **FEMA DR-374: April 27, 1973.** Six inches of rain fell. Several homes and businesses were flooded.
- **FEMA DR-556: May 9, 1978.** Over 10 inches of rain fell in one night. A squall line approached the Greater New Orleans area from the west, intersecting a stationary front that was settled over the City. The result was a morning of torrential rains in excess of 10 inches, with rates of 2 inches per hour at times. Coffins were lifted from ground level tombs, along with empty gasoline tanks at service stations in the New Orleans area. The City's population was at a virtual standstill as nearly all main arteries were flooded or inaccessible well into the evening hours.[36]
- **FEMA DR-616: April 12, 1980.** More than 10 inches of rain fell in a few days" time. All low-lying streets were

completely flooded. As a result, thousands of homes were flooded in Jefferson and Orleans Parishes. Drainage pumps were overworked and most of them shut down during the storm.

- **FEMA DR-679: April 20, 1983.** Many neighborhoods and low-lying areas were flooded. About 90 percent of the area roads were closed (including Interstate 10) due to street flooding. Some areas received 10 inches of rain in an 8-hour period exceeding the capacity of the pump stations.
- **May 9, 1994.** A band of thunderstorms passed over the Parish dumping 4 to 8 inches of rain. Damages totaled $500,000.
- **FEMA DR-1049: May 8, 1995.** One of the heaviest rain events in Orleans Parish in recent history. Widespread rainfall of 8 to 12 inches in less than 4 hours overwhelmed the capacity of drainage pumps with some of the most widespread and severe flooding reported in the city in the past 50 years. During this storm, as much as 17 inches of rain fell in parts of Orleans Parish over a 48-hour period. Four people drowned in this flood and one person died of a heart attack as a result of pushing his flooded car. Although no property damage was reported in the NCDC database, an estimated $388 million in damages were documented in New Orleans.[37] Actual damages likely exceeded this amount. A breakdown of damages shows how wide-spread the devastation from the May 8, 1995, flood event was.
    - City buildings suffered an estimated $1 million in damages
    - Touro Hospital closed temporarily on May 8 as a result of the flooding
    - Charity Hospital, Mercy + Baptist Medical Center, and United Medical Center each suffered damages ranging from $50,000 to $250 million
    - Orleans Parish Prison had to move 750 inmates to the Louisiana State Penitentiary
    - Public schools suffered an estimated $9 million in damages
    - 46 of 124 schools incurred some damage
    - 11 public schools remained closed through at least May 12
    - Early estimates showed that between 10,000 and 30,000 housing units were damaged.
- **September 11, 1998.** Storms associated with Tropical Storm Frances produced heavy rainfall over the Parish. Rainfall amounts were 5 to 7 inches in 2 to 3 hours. Rainfall runoff overwhelmed drainage pumping capacity, with resulting widespread and deep flooding in the streets of the New Orleans metropolitan area. In Orleans Parish, at least 290 single family homes and 124 apartments and businesses were flooded.
- **June 7, 2001.** Severe street flooding occurred and several houses were flooded as a result of the outer rain bands on the eastern periphery of Tropical Storm Allison. Many locations received ten to 18 inches of rain. Periods of torrential rain overwhelmed local drainage and created severe ponding of water, which flooded numerous roadways and low lying areas, with many houses and some businesses flooded.
- **June 19, 2003.** Rainfall amounts of up to 6 inches in a 90-minute time period resulted in flooding of numerous streets and a few homes and businesses in areas of New Orleans. The French Quarter, the Central Business District, and the Uptown area were particularly hard hit. Numerous cars were flooded.

National Flood Insurance Program

The NFIP was established by the U.S. Congress in 1968 to provide an insurance mechanism to protect homes and businesses from the flood hazard. To participate in the NFIP, the community must make a commitment to regulate the location and design of future floodplain construction to increase safety from flood hazards. The Federal government established a series of building and development standards for floodplain construction to serve as minimum requirements for participation in the program.

The NFIP maintains a very large database of claims information for millions of policies nationwide. As of 07/31/2015, a total of 86,034 polices were in force with annual premiums totaling $82,482,093. The total coverage value of these policies is approximately $21.1 billion.

FEMA and the NFIP categorize policies as Repetitive Loss (RL) or Severe Repetitive Loss (SRL), as part of their effort to focus mitigation program resources on properties with the highest risk.

Repetitive loss structures are structures covered by a contract for flood insurance made available under the NFIP that:

a. Have incurred flood-related damage on two occasions, in which the cost of the repair, on average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and
b. At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

Severe repetitive loss is defined by the Flood Insurance Reform Act of 2004 and updated in the Biggert-Waters Flood Insurance Reform Act of 2012. For a property to be designated SRL, the following criteria must be met:

a. It is covered under a contract for flood insurance made available under the NFIP; and
b. It has incurred flood related damage –
    1) For which four or more separate claims payments have been made under flood insurance coverage with the amount of each claim exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or
    2) For which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

As of January 2016 the City had 6,117 RL properties, based on a query of the FEMA BureauNet NFIP interface. 5,502 are residential and 615 are non-residential.

6.3.2 Tropical Cyclones

Description of the Tropical Cyclone Hazard

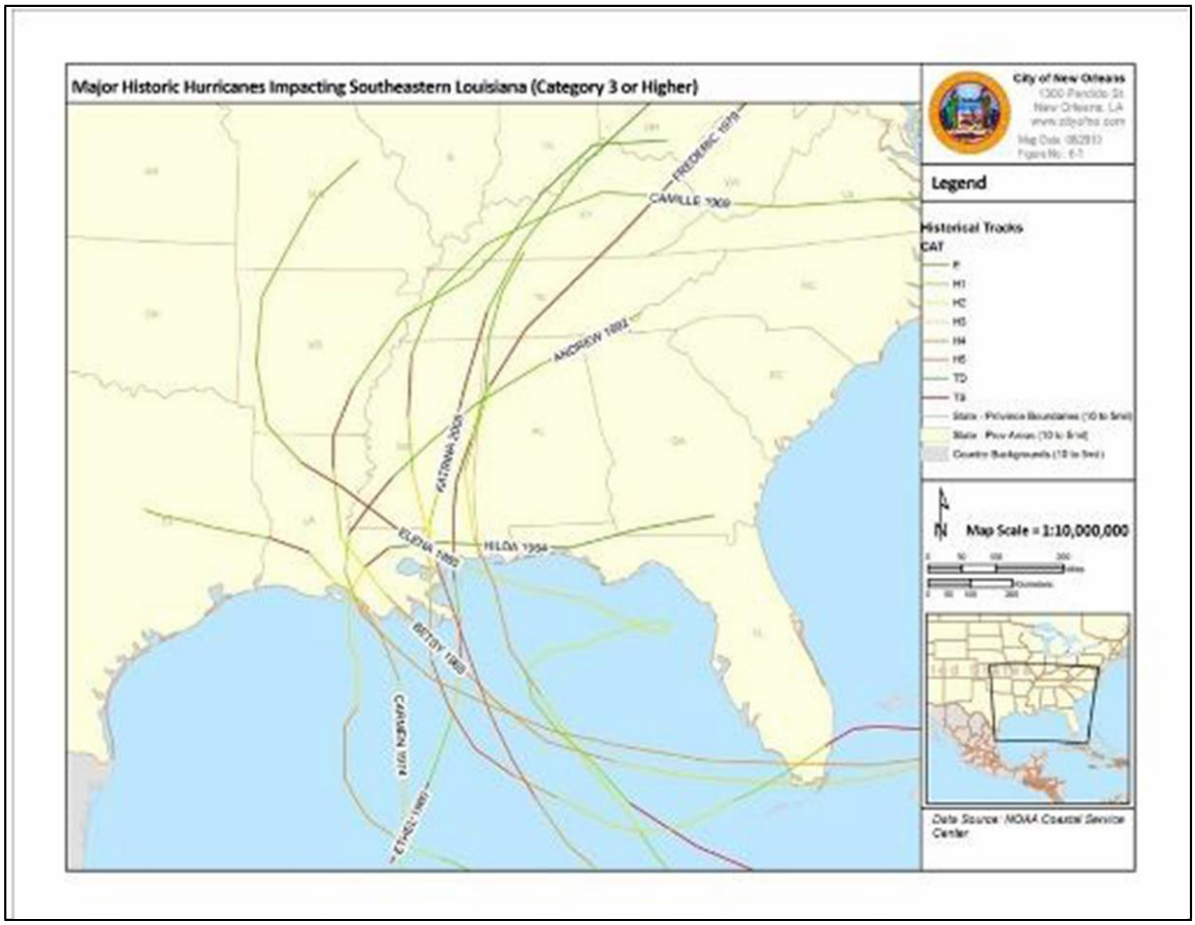
Hurricanes, tropical storms, and typhoons, collectively known as tropical cyclones, are among the most devastating naturally occurring hazards in the United States. Hurricanes generate several hazards that can cause extensive damage. High winds, heavy rainfall, tornadoes, and storm surge are all associated hazards. This subsection focuses on the effects from high winds associated with hurricanes. Storm surge is often the greatest hurricane-related threat to property and human life. In Orleans Parish, the area's low elevations and network of levees make it especially vulnerable to the surge of a hurricane. The effects of a strong hurricane can be catastrophic to any location; however, New Orleans is especially vulnerable because of the threat to a system of levees that channel and hold the waters of canals, Lake Pontchartrain, and the Mississippi River. See Section6.3.3 for a detailed discussion of the storm surge hazard associated with hurricanes. The risks associated with Levee Failure from storm surge can be found in Section 6.3.4.

A hurricane is defined as a low-pressure area of closed circulation winds that originates over tropical waters. A hurricane begins as a tropical depression with wind speeds below 39 mph. As it intensifies, it may develop into a tropical storm, with further development producing a hurricane. A tropical cyclone is a storm system characterized by a large low pressure center and numerous thunderstorms that produce strong winds and flooding rain. The wind speeds from a tropical storm range between 39 and 74 mph. In most of the world, a storm is given a name when it reaches tropical storm intensity.

Location and Extent of the Hurricane and Tropical Storm Hazard

Hurricane risk in the United States extends along the entire east coast from Maine to Florida, the Gulf Coast (including Florida, Alabama, Louisiana, and Texas), and Hawaii. The southeastern United States and Gulf Coast are at greatest risk based on historical storm tracks and the warmer waters of the Gulf of Mexico and Atlantic Ocean. Orleans Parish is threatened by hurricanes that develop in the Atlantic Ocean and the Gulf of Mexico, and the entire Parish is susceptible to hurricanes and tropical storms. The greatest threat to Orleans Parish comes during the Atlantic Ocean/Gulf Hurricane season, which runs from June 1 to November 30. Figure 6-4 shows all major historical hurricanes (Category 3 or higher) that impacted southeastern Louisiana within 100 miles of Orleans Parish from 1950 to 2015. The database was queried and the map developed using NOAA's Historic Hurricane Tracks database. Due to the great variation in size, strength and other variables in tropical cyclones, the entire New Orleans area is at risk for up to a Category 5 hurricane.

Figure 6-4 Major Historic Hurricanes Impacting Southeastern Louisiana (Category 3 or Higher)
(Source: NOAA Coastal Service Center – Historic Hurricane Tracks database)



Severity of the Tropical Cyclone Hazard

The severity of hurricanes and tropical storms is measured primarily by wind velocity, flooding, central pressure, and storm surge. For the period 1886 – 1994, an average of five hurricanes per year has occurred in the North Atlantic basin. This region is particularly vulnerable because hurricanes occur frequently, the areas are prone to storm surge and coastal riverine flooding, and the population has climbed to an estimated 36 million people.

As shown in Table 6-6, the Saffir-Simpson Hurricane Scale is used to classify storms by numbered categories. Hurricanes are classified as Categories 1 through 5 based on central pressure, wind speed, storm surge height, and damage potential.

Table 6-6 Saffir-Simpson Hurricane Scale

(Source: NOAA)

Storm Category	Central Pressure	Sustained Winds	Storm Surge	Potential Damage
1	> 980 mbar	74 - 95 mph	4 – 5 ft	Minimal
2	965 – 979 mbar	96 - 110 mph	6 – 8 ft	Moderate
3	945 – 964 mbar	111 – 130 mph	9 – 12 ft	Extensive
4	920 – 944 mbar	131 – 155 mph	13 – 18 ft	Extreme
5	< 920 mbar	> 155 mph	> 18 ft	Catastrophic

The winds associated with a hurricane cause many devastating effects. Property damage associated with hurricane force winds increases greatly with the wind strength of the hurricane. A Category 1 storm may cause little or no damage to permanent buildings. Most damage will be to mobile homes, trees, shrubs, and signs. A Category 3 storm will cause some structural damage to homes, down trees, and destroy signs. Winds from a Category 5 storm will be devastating to buildings. There will be complete roof failure on many residences and commercial buildings. In addition to causing wind-blown related structural damage, winds increase the storm surge as they grow stronger.

In addition to the Saffir-Simpson Hurricane Scale, the Beaufort Wind Scale (developed in 1805 by Sir Francis Beaufort) is sometimes used to indicate the force of wind. As shown in Table 6-7 below, the scale includes a Beaufort Number (or force), related wind speeds (in miles per hour and knots), and empirical descriptions of the effects of the various wind forces on both land and sea. The scale is primarily used at sea, but has some applicability to land on occasion.

Table 6-7 Beaufort Wind Scale

Beaufort Wind Scale						
# or Force	Wind Speed			Description	Effects	
	Mph	Km/hr	Knots		Land	Sea
0	<1	<1	<1	Calm	Still, calm air, smoke will rise vertically	Water is mirror-like.
1	1-3 mph	1-5 kph	1-3 knots	Light Air	Rising smoke drifts, wind vane is inactive	Small ripples appear on water surface
2	4-7 mph	6-11 kph	4-6 knots	Light Breeze	Leaves rustle, can feel wind on your face, wind vanes begin to move	Small wavelets develop, crests are glassy
3	8-12 mph	12-19 kph	7-10 knots	Gentle Breeze	Leaves & small twigs move, light weight flags extend.	Large wavelets, crests start to break, some whitecaps
4	13-18 mph	20-28 kph	11-16 knots	Moderate Breeze	Small branches move, raises dust, leaves & paper	Small waves develop, becoming longer, whitecaps
5	19-24 mph	29-38 kph	17-21 knots	Fresh Breeze	Small trees sway	White crested wavelets (whitecaps) form, some spray
6	25-31 mph	39-49 kph	22-27 knots	Strong Breeze	Large trees branches move, telephone wires begin to “whistle”, Umbrellas are difficult to keep under control.	Large waves form, whitecaps prevalent, spray
7	32-38 mph	50-61 kph	28-33 knots	Moderate or Near Gale	Large trees sway, becoming difficult to walk	Larger waves develop, white foam from breaking waves begins to be blown
8	39-46 mph	62-74 kph	34-40 knots	Gale or Fresh Gale	Twigs and small branches are broken from trees, walking is difficult.	Moderately large waves with blown foam.
9	47-54 mph	75-88 kph	41-47 knots	Strong Gale	Slight damage occurs to buildings, shingles are blown off of roofs	High waves (6 meters), rolling seas, dense foam, blowing spray reduces visibility

10	55-63 mph	89-102 kph	48-55 knots	Whole Gale or Storm	Trees are broken or uprooted, building damage is considerable.	Large waves (6-9 meters), overhanging crests, sea becomes white with foam, heavy rolling, reduced visibility
11	64-72 mph	103-117 kph	56-63 knots	Violent Storm	Extensive widespread damage	Large waves (9-14 meters), white foam, visibility further reduced
12	73+ mph	118+ kph	64+ knots	Hurricane	Extreme destruction, devastation.	Large waves over 14 meters, air filled with foam, sea white with foam and driving spray, little visibility.

Impact on Life and Property

Past hurricanes and tropical storms have had a major, and in some cases devastating, impact on life and property in Orleans Parish. Events such as Hurricane Betsy in 1965, and more recently Hurricane Katrina in 2005, have resulted in many hundreds of deaths and thousands of injuries.

Table 6-8 summarizes the number of residential structures in Orleans Parish that sustained damage exclusively from high winds as a result of Hurricanes Katrina and Rita in 2005. As noted in Section 6.3.3, the storm surge associated with Hurricane Katrina overtopped or breached numerous levees protecting the City of New Orleans. The widespread flooding damaged or destroyed thousands of residential properties in the Parish, many of which also experienced wind-related damage. Note that Table 6-8 below summarizes the residential structures that experienced wind damage only. The table indicates that 26,965 residential structures experienced only wind- related damage (no flood damage) from Hurricanes Katrina and Rita. This total represents approximately 14.3% of the 188,251 residential structures in the Parish based on 2000 US Census data. Post-Katrina, the number of housing units has increased to an estimated 190,127 as of the 2013 US Census American Community Survey estimates.

Table 6-8 Orleans Parish Residential Structures Damaged by High Winds from Hurricanes Katrina and Rita
(Source: FEMA, Housing Unit Damage Estimates: Katrina, Rita, Wilma, April 2006)

Occupancy	Minor	Major	Destroyed	Total
Owner-Occupied	10,944	1,635	122	12,701
Renter-Occupied	10,855	3,037	372	14,264
Grand Total	**21,799**	**4,672**	**494**	**26,965**

A more detailed discussion related to the impacts on life and property from storm surge can be found in Section 6.3.3. The Vulnerability and Loss Estimation section of this plan includes a much more detailed discussion of the impacts on the Parish associated with high winds from hurricanes.

Occurrences of the Hurricane and Tropical Storm Hazard

Table 6-9 below summarizes the most recent 12 events that caused property damage within Orleans Parish. Within the past five years there has only been one occurrence of a tropical cyclone. This occurrence is listed below.

Table 6-9 Hurricane and Tropical Storm Events Causing Property Damage, Orleans Parish, 1/1/1996 – 4/1/2015
(Source: NOAA/NCDC and SHELDUS)

YearMonth	Day	Type	Property Damage
200410	9	Tropical Storm	$ 3,000
200809	11	Tropical Storm	$ 100,000
200409	15	Hurricane (Typhoon)	$ 240,000
200306	30	Tropical Storm	$ 2,000,000
199809	10	Tropical Storm	$ 4,300,000
200210	2	Hurricane (Typhoon)	$ 5,540,000
199809	27	Hurricane (Typhoon)	$ 6,000,000
200809	1	Hurricane (Typhoon)	$ 6,170,000
200209	25	Tropical Storm	$ 6,390,000
200507	5	Hurricane (Typhoon)	$ 17,000,000
201208	28	Hurricane (Typhoon)	$ 26,800,000
200508	28	Hurricane (Typhoon)	$ 3,560,000,000
		Grand Total	**$3,634,543,000**

In addition to the NCDC database, the National Weather Service's (NWS) Tropical Prediction Center (TPC) was also reviewed to identify past hurricane events that have impacted Louisiana. According to the TPC, from 1900 to 1996, Louisiana experienced 12 direct hits from major hurricanes (Categories 3, 4, and 5). During the same time period, Louisiana experienced 13 direct hits from other hurricanes (Category 1 and 2). Based on approximately 100 years of historical data from the TPC, the probability of future hurricanes impacting Louisiana is high.

In addition to the numerous hurricanes over the last century, Orleans Parish has also experienced numerous tropical storms. Based on approximately 60 years of historical data from the NHC, the probability of future tropical storms impacting Orleans Parish is considered high, averaging one event approximately every four years. The 15 events have occurred over a period of 59 years. The entire planning area is subject to the effects of hurricanes and tropical storms.

Hurricane Katrina

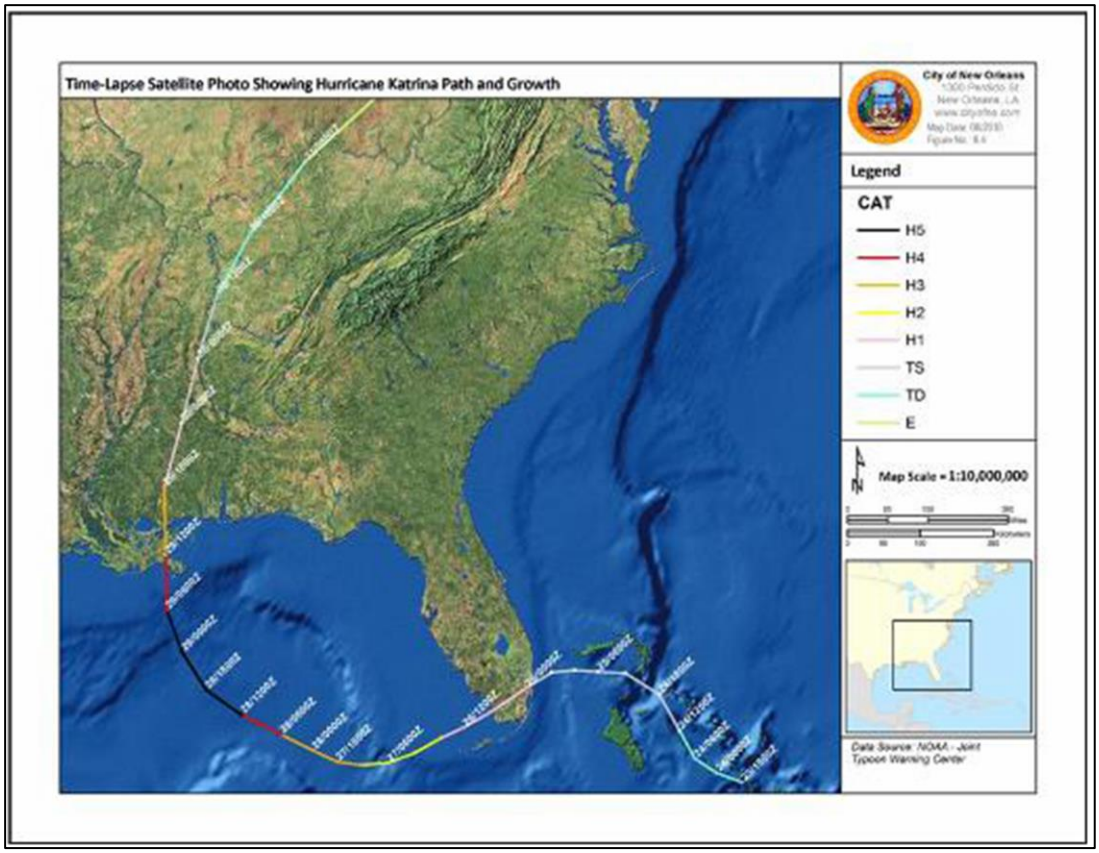
Hurricane Katrina made landfall as a powerful Category 3 Hurricane that had a devastating impact on the New Orleans area and the entire Gulf Coast region. The storm initially formed over the southeastern Bahamas on August 23, 2005, as Tropical Storm 12. As the cyclone moved north and eventually west of the Bahamas, it continued to strengthen reaching Category 1 hurricane status on August 25 shortly before making landfall on the southeast coast near Miami, Florida. Once back over open water, the storm quickly gained strength and briefly reached Category 5 intensity over the central Gulf of Mexico before making landfall near Buras, Louisiana, as a Category 3 hurricane. Damage and loss of life inflicted by this massive hurricane in Louisiana and Mississippi were staggering, with significant effects extending into the Florida

Panhandle, Georgia, and Alabama.[15] Figure 6-4 displays the storm track of Hurricane Katrina from August 23-30, 2005.

The morning of August 28, the mayor of New Orleans issued a mandatory evacuation for residents. It is estimated that 1 million residents evacuated inland from the New Orleans metropolitan area to escape the devastation that would be caused by Katrina. For those that stayed behind, the New Orleans Superdome was opened as a temporary shelter. Several thousand residents also sought shelter at the New Orleans Convention Center.

On August 29, 2005, Hurricane Katrina made landfall with maximum sustained winds of 130 mph and a massive storm surge of up to 28 feet that devastated parts of the Gulf Coast. The NHC attributed the catastrophic storm surge to several factors including the size of the storm and the vast area of hurricane force winds. See Section 6.3.3 for additional details about the storm surge associated with Hurricane Katrina. The day of the event, Federal Disaster Declarations were issued in the States of Louisiana, Mississippi, Alabama, and Florida. Subsequently a total of 22 parishes in the southern part of Louisiana were eligible for Public Assistance through FEMA. Figure 6-7 shows Katrina's storm path and growth using time-lapsed satellite photos.

Figure 6-7 Time-Lapse Satellite Photo Showing Hurricane Katrina Storm Path and Growth
(Source: NOAA - Joint Typhoon Warning Center)



Although storm surge and flooding from levee breaches were the dominant cause of damage, high winds from Hurricane Katrina caused considerable damage to certain areas of the City of New Orleans and the Gulf Coast. As the eye of the storm passed to the east of New Orleans, wind speeds near the center and to the east of the storm were near Category 3 intensity on the Saffir-Simpson scale. To the west of the eye, the NHC estimates that sustained winds throughout the New Orleans metropolitan area were less than Category 3 intensity. At the surface, the New Orleans area most likely

experienced maximum sustained winds between 96 -110 mph (Category 2).

As shown in Figure 6-8, the Wind Gust Analysis performed by NOAA indicates that the strongest winds from the storm occurred between Slidell, Louisiana, and Gulfport, Mississippi. The wind speed analysis depicts 3-second wind gusts and was derived from measured gusts, ground surveys, and estimates from aerial imagery. As the storm moved inland, near Category 3 strength winds were felt as far inland as Laurel, Mississippi.Figure 6-8 Hurricane Katrina Wind Gust Analysis (MPH)

(Source: NOAA)

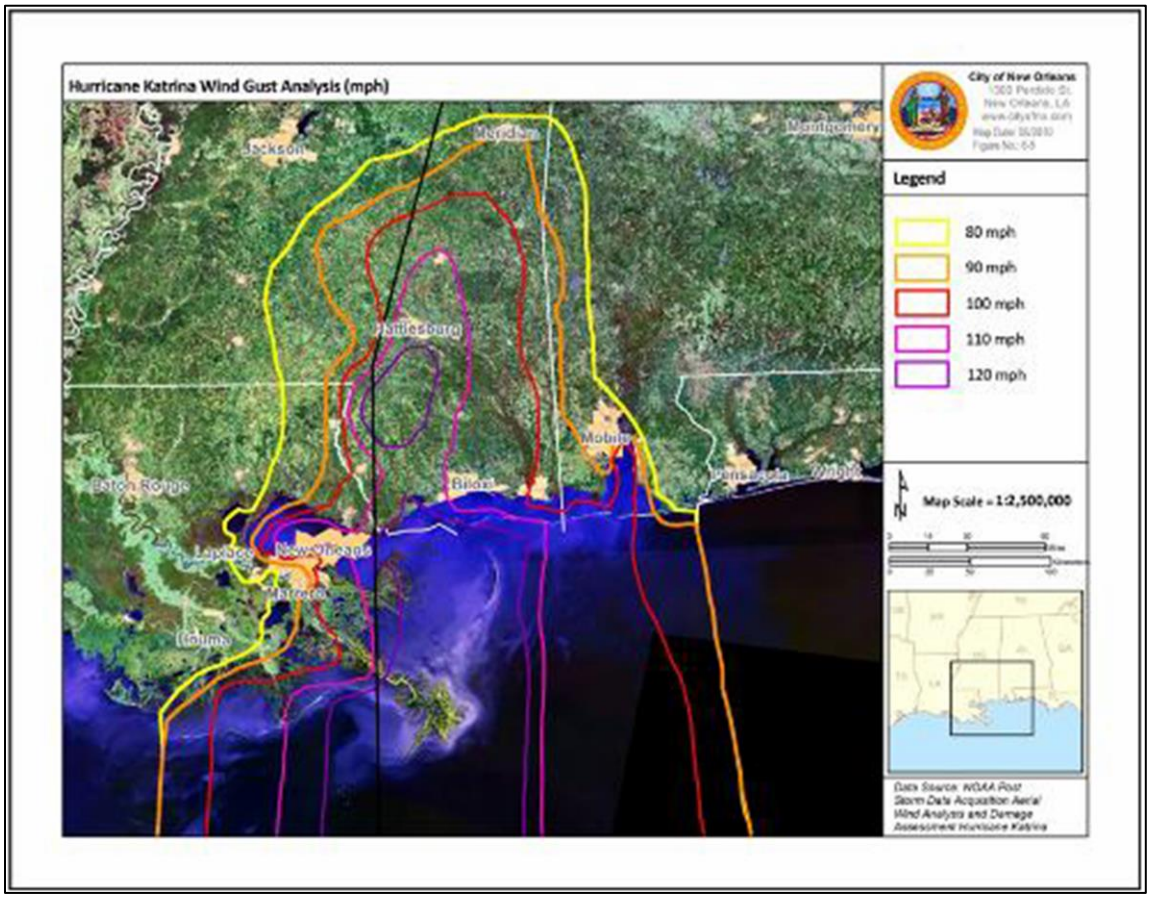


Table 6-10 shows where Hurricane Katrina's characteristics fall within the Saffir-Simpson Hurricane Scale (the shaded blocks represent Hurricane Katrina). Note that based on three physical characteristics, wind speed, central pressure and surge height, Hurricane Katrina displayed attributes from three different categories on the Saffir-Simpson Hurricane Scale. As noted, the wind speeds from Katrina ranged from 111 to 130 mph; the speeds were slightly lower inland, in Orleans Parish.

Table 6-10 How Katrina Fits within the Saffir-Simpson Hurricane Scale
(Source: USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008)

Scale Number (Category)	Winds (miles per hour)	Pressure (millibars)	Approximate Surge (feet)	Damage
1	74-95	980	4 to 5	Minor
2	96-110	965 – 979	6 to 8	Considerable
3	111 – 130	945 – 964	9 to 12	Extensive
4	131 - 155	920 - 944	13 to 18	Extreme
5	> 155	< 920	> 18	Catastrophic

Along the Gulf Coast, inland from the storm surge areas, the main causes of damage were high winds and wind- borne debris. After Katrina, FEMA studied the performance of buildings from New Orleans to Mobile, Alabama. The results were published in the July 2006 report titled "Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report" (FEMA 549). This report included the assessment of wind-induced envelope damage to residential, commercial, and critical facilities. It concluded that high winds and wind-borne debris from Katrina caused significant damage to roof systems, windows, exterior-mounted electrical, mechanical, and communication equipment.[16] Blow-off of building envelope components and rooftop equipment also caused damage to adjacent buildings, as well as to the building themselves. Common windborne building envelope debris during Hurricane Katrina included roof coverings (particularly aggregate surfaces and asphalt shingles) and vinyl siding.

Although wind speeds in the New Orleans area were approximately 100 mph, slightly higher wind speeds were most likely experienced at elevations above the surface, as evidenced from the damages that occurred to many of the downtown high-rise buildings.[18] Many of the high-rises experienced extensive window damage, which then allowed wind-driven rain into the interior. As noted in FEMA 549:

> Several buildings in downtown New Orleans had isolated window breakage. These windows may have been broken by windborne debris or they may have been weakened by scratches and failed when over-stressed by wind pressure. However, nine buildings along or near Poydras Street had extensive glazing damage that was indicative of damage caused by windborne roof aggregate. Except for two of these buildings, virtually all of the glazing damage occurred on the windward facades.

Figure 6-9 identifies two general locations where buildings along or near Poydras Street (shown with red line) experienced extensive window damage from high winds. FEMA 549 indicates that the damages to the buildings within Cluster A were generally more significantly damaged than in Cluster B. This figure is followed by a sample of the type of window glazing damage that was experienced due to windborne debris from the high winds. Window glazing is considered the glass on the exterior of the building.

Figure 6-9 General Locations of Buildings in Downtown New Orleans with Extensive Glazing Damage
(Source: Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report Hurricane, FEMA 549, July 2006)

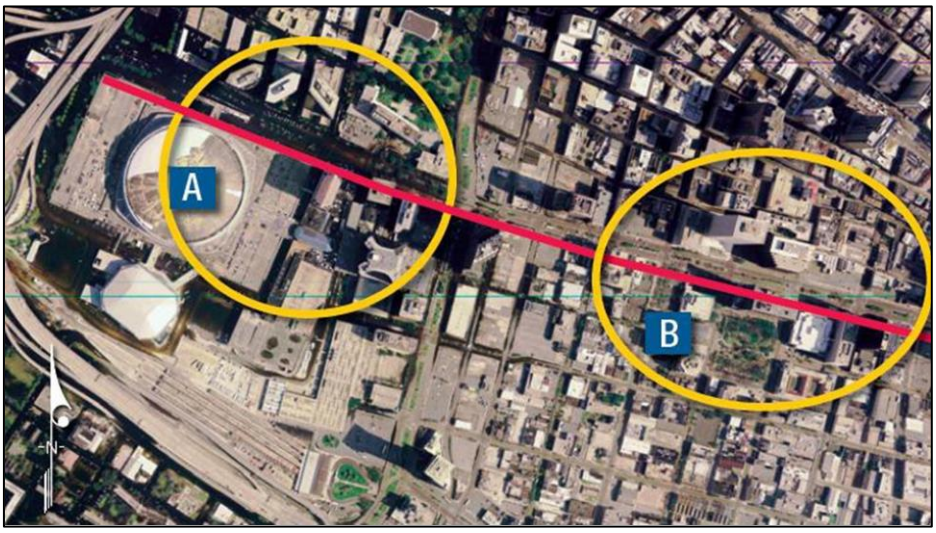


Figure 6-10 is a sample of the window glazing damage that occurred to the Hyatt Regency Hotel, one of the most heavily damaged buildings. The figure shows a close-up view of the north façade with broken windows and spandrel panels: the non-structural metal panels that cover the exterior façade of a building in the area between floors.

Figure 6-10 Hyatt Regency Hotel - Extensive Window Glazing Damage from Hurricane Katrina
(Source: Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report Hurricane, FEMA 549, July 2006)

As mentioned earlier, Katrina's winds also caused damage to rooftops and exterior windows and doors allowing wind-driven rain to penetrate into the interior of both residential and commercial structures. After the hurricane, the National Institute of Standards and Technology (NIST) also studied the performance of structures and found that roof failures on buildings and residential structures were evident throughout the area. Typical roof damage included failure of roof coverings, loss of roof decking and, in some cases, the support structure. This is consistent with the conclusions found within FEMA 549. Figure 6-11 shows typical roof damage to residential structures in New Orleans. Most of the residential structures inspected by the MAT had asphalt shingle roof coverings. The vast majority of the observed roofs experienced damage, ranging from loss of a few hip trim shingles or tabs to loss of a large number of shingles and underlayment. FEMA 549 indicates that the house in the lower right hand corner is circled to highlight that the roof

damage was most likely initiated by blow off of a deck panel from the corner.

Figure 6-11 Hurricane Katrina: Typical Wind Damage to Residential Structures
(Source: Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report Hurricane, FEMA 549, July 2006)

In Louisiana, an estimated 273,000 residential structures were damaged by wind and wind-driven rain. This estimate was derived using FEMA"s HAZUS - Multi-Hazard Hurricane Wind Model, a risk assessment program for estimating losses.

In the days and weeks after the event, one of the largest search and rescue operations in U.S. history was mobilized by FEMA to locate trapped or stranded survivors who rode out the storm. As the magnitude of the event was realized, search and rescue operations grew to include more than 3,000 urban search and rescue personnel in 51 task forces, 8 swift water teams, and 108 incident support team command staff. Teams from 15 States were part of the Katrina Unified Search and Rescue Command. Numerous agencies also participated in the effort, including the Louisiana Department of Wildlife and Fisheries, U.S. Coast Guard, Federal Law Enforcement Agencies, the Louisiana State Police, the New Orleans Fire Department, and the New Orleans Police Department. The search and rescue teams rescued 6,582 people in the early days after Katrina.

The Air Force Reserves and U.S. Coast Guard helicopters and boats were critical in assisting residents stranded on rooftops by the floodwater. The Coast Guard deployed over 5,000 Guardsmen and hundreds of air and boat crews to rescue more than 24,135 people mainly from the rooftops of their homes. The Guard also assisted with the evacuation of 9,409 patients and medical personnel from hospitals and nursing homes. A total of 76 Coast Guard aircraft, 42 cutters (ships over 65 feet in length), and 131 small boats assisted with the rescue operations.

Figure 6-12 Air Force Reserve Helicopter over the City of New Orleans
(Source: US Air Force)

Figure 6-13 FEMA Search and Rescue Team Searches for Survivors
(Source: The Times Picayune)

The search and rescue teams later entered 22,313 structures in New Orleans and other Louisiana Parishes to search for trapped and stranded survivors. The teams completed operations on September 30, 2005. Thousands of National Guard troops from numerous States were deployed to New Orleans and other parts of the Gulf Coast to assist with security in the region. Guard members assisted with a variety of tasks that included providing support for law enforcement agencies, conducting search and rescue operations, transporting and distributing food, and protecting life and property. The National Guard was also responsible for the security and screening for the temporary shelter set up at the New Orleans Superdome. The Coast Guard assisted with this effort by providing Maritime Safety and Security Teams to protect critical infrastructure as well as provide security for numerous agencies during the height of the emergency response after the storm.

Hurricane Katrina was the costliest disaster in U.S. history, causing approximately $81 billion dollars in damage to the Gulf Coast region including Louisiana, Mississippi, and Alabama. By September of 2006, the USACE had repaired and restored 220 miles of floodwalls and levees restoring the hurricane protection system (HPS) to equal or better condition than prior to Katrina. The repair work consisted of 59 separate construction projects to strengthen the flood protection system against future storm surge and flooding events. The flooding and high winds also created an extraordinary amount of debris from damaged and destroyed structures. FEMA has funded the removal of 100 million cubic yards of debris from Alabama, Mississippi, and Louisiana. Table 6-11 below summarizes the damages from Hurricane Katrina for Orleans Parish, the State of Louisiana, and the Gulf Coast.

Table 6-11 Summary of Damages and Deaths from Hurricane Katrina

	Orleans Parish, LA	Louisiana	Louisiana, Alabama, & Mississippi
Total damages	$16.9 Billion	$38.8 Billion	$81 Billion
Number of structures damaged or destroyed by flood, storm surge, and wind	134,344	205,000	275,000
NFIP estimated paid claims ($)	$7.9 Billion[1]	$12.6 Billion	$15.3 Billion
Schools damaged	124[2]	875	1,154
Deaths	800	1,464	1,810

Note 1: Estimate of $7.9 billion for Orleans Parish based on 83,500 claims in the New Orleans area with an average claim of $94,803.
Note 2: Estimate is for public schools only. All Orleans Parish School Board (OPSB) schools experienced at least minor damage. Approximately 33 were severely damaged.

Sources include: General Accounting Office: NFIP, New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight should be Improved. NOAA – NCDC; LA Department of Health and Hospitals; AIR Worldwide – Insurance Information Institute; US Department of Commerce – Gulf Coast Recovery; Louisiana Recovery Authority; National Association of Home Builders - American Red Cross; Louisiana Long-Term Community Recovery Planning; FEMA Federal Insurance Administration.

Hurricane Rita

On September 24, 2005, Hurricane Rita made landfall as a strong Category 3 hurricane in extreme southwestern Louisiana just west of Johnson's Bayou in Cameron Parish. The storm occurred only three weeks after Hurricane Katrina had a devastating impact on Louisiana and the Gulf Coast. Similar to Katrina, Rita was also an intense hurricane that at one point in the Gulf of Mexico was a Category 5 on the Saffir-Simpson scale.

Approximately 48 hours prior to reaching the Gulf Coast, the storm began to weaken and made landfall as a Category 3 hurricane near the Texas/Louisiana border. With the exception of a small portion of western Louisiana, most of the southern part of the State experienced wind speeds ranging between 80-100 mph, the equivalent of a Category 1 or 2 hurricane.[25]

The highest observed wind gusts from Hurricane Rita were reported in Port Arthur, Texas, and Calcasieu Pass, Louisiana. Table 6-12 below provides a summary of the peak wind gusts.

Table 6-12 Observed Peak Wind Gusts – Hurricane Rita
(Source: NOAA – Hurricane Research Division)

Location	Peak Gust	Direction
Port Arthur, Texas	116	N
Calcasieu Pass, LA	112	E
New Orleans	42	NE
Marsh Island, LA	93	S
Lake Charles, LA	74	NE

On the day the storm made landfall, a Presidential Disaster Declaration (DR-1607) was declared for parts of southern Louisiana. In Orleans Parish, the disaster assistance from FEMA included emergency work (Categories A and B) for public assistance. The NHC estimated the storm caused an estimated $11.3 billion in damages to the Gulf Coast. In Orleans Parish, the maximum sustained winds were estimated at 45 mph.

Other Events

Half of the most costly hurricanes in U.S. history occurred in the past 25 years. Five recent hurricane events revealed consequences in densely populated areas: Hurricane Katrina (2005), Hurricane Andrew (1992), Tropical Storm Alberto (1994), Tropical Storm Allison (2001), and Tropical Storm Isidore / Hurricane Lili (2002). Hurricane Katrina was the most costly hurricane to strike the United States with total damages currently estimated at $81 billion. Hurricane Andrew resulted in total damages estimated at $25 billion for southeastern Florida and $1 billion for southeastern Louisiana.[8] Tropical Storm Allison, which caused widespread flooding in Texas, Louisiana, and several other Gulf and Atlantic Coast States was the second most costly event in National Flood Insurance Program (NFIP) history, resulting in $1.1 billion in flood insurance claims paid to policyholders – $90 million in Louisiana.

- In September of 1965, Hurricane Betsy made landfall with maximum winds of up to 140 mph and caused extensive damage to the Gulf Coast. Betsy made its most intense landfall near the mouth of the Mississippi River causing significant flooding of the water of Lake Pontchartrain into New Orleans. Levees for the Mississippi River Gulf Outlet along Florida Avenue in the Lower Ninth Ward and on both sides of the Industrial Canal failed. The floodwater reached the eaves of houses in some places and over some one- story roofs in the Lower Ninth Ward. The NHC estimated that in the United States the storm caused an estimated $1.4 billion dollars in damages and was responsible for 75 deaths and approximately 800 injuries. An estimated 164,000 homes were flooded. Betsy was recognized as the first hurricane to cause over a billion dollars in damages. The USACE Hurricane Protection Program came into existence as a result of Betsy.
- On September 8, 1974, Hurricane Carmen made landfall near Morgan City, Louisiana, as a Category 3 hurricane with winds of 120 mph. The storm caused an estimated $150 million in damages to Texas and Louisiana. Hurricane Carmen caused severe flooding in several outlying parishes; however, Carmen caused only minor flood damage in New Orleans.
- On October 29, 1985, Hurricane Juan made landfall in south-central Louisiana as a Category 1 hurricane. Juan looped across southern Louisiana for several days dropping 5-10 inches of rain and causing extensive flood damage in Texas and Louisiana. The storm stalled over Louisiana for several days causing an estimated $38 million in damages within Orleans Parish. In neighboring Jefferson Parish, an estimated $46.5 million in damages was reported with over 2,200 homes and business flooded. A breach in the Harvey Canal levee caused extensive flooding.
- In August 1992, Hurricane Andrew hit southern Florida as a Category 5 hurricane with maximum sustained winds of 150 mph. The intense winds caused catastrophic damages to south Dade County, Florida, and overall caused an estimated $25 billion dollars in damages. The storm weakened after landfall, but then redeveloped over the warm waters of the Gulf and struck near Morgan City, Louisiana, as a Category 3 hurricane and caused an estimated $1 billion dollars in damages. In Orleans Parish, damage was minimal relative to other Parishes in south central Louisiana.

- In early September of 1998, Tropical Storm Frances hit Louisiana. Tornadoes and severe flooding were the primary weather disasters resulting from Frances. Peak wind gusts of 60 mph were recorded at Grand Isle. Significant tidal flooding occurred during the event with tides averaging 2 to 4 feet above normal along the southeast Jefferson coastline and in Lakes Pontchartrain and Maurepas. The persistent strong winds and resulting high tides pushed a considerable volume of water into the tidal lakes of Jefferson Parish and well

inland along marshes, bayous, and other low-lying areas. This resulted in a number of homes outside of the levee protection systems being flooded and caused the flooding of many roadways. In addition, very heavy rainfall occurred with most locations of southeast Louisiana receiving a minimum of 5 inches during the storm, and some areas south of Lake Pontchartrain receiving 15 to 30 inches of rain. The heavy rainfall resulted in widespread flash flooding south of Lake Pontchartrain. The flash flooding peaked on September 11 when intense rainfall in amounts of 5 to 7 inches within 2 to 3 hours over portions of the greater New Orleans area. Rainfall runoff overwhelmed drainage pumping capacity, producing widespread and deep flooding in the streets of the New Orleans metropolitan area. In Orleans Parish, at least 290 single family homes and 124 apartments and businesses were flooded.

- In late September of 1998, Hurricane Georges struck the Mississippi coast as a Category 2 Hurricane. The storm produced rainfall amounts of 20 to possibly 30 inches along parts of the Gulf Coast. The extreme rainfall totals produced severe flooding particularly along coastal regions of Alabama and Mississippi. The event caused thousands of people to evacuate and consequently was one of the largest evacuations in Louisiana's history. Along the Mississippi River, the hurricane storm surge created a 5- to 6-foot rise in the river in the New Orleans area. The main affect to Orleans Parish was storm surge flooding outside of the hurricane protection levees, and wind damage to trees and downed power lines.
- On June 10, 2001, the remnants of Tropical Storm Allison moved inland near Morgan City, Louisiana. Outer rain bands on the eastern periphery of Allison affected southeast Louisiana beginning late on June 5, producing heavy rainfall over much of southeast Louisiana. The event caused minimal damage in Orleans Parish. In neighboring Jefferson Parish, the highest rainfall total was in the City of Gretna where the NWS recorded 21.30 inches of rain between June 5 and June 11. Rainfall totals on the East and West Bank averaged between 15 and 16 inches. The worst flooding occurred on June 6 and 7, when an estimated 59 homes and 2 businesses were flooded in Jefferson Parish.
- On October 3, 2004, Hurricane Lili made landfall as a Category 1 hurricane near Intercoastal City. The day before making *US* landfall, Hurricane Lili was a Category 4 storm in the Gulf of Mexico and expected to impact southeastern Louisiana as a major hurricane. The storm rapidly weakened just prior to landfall, impacting Louisiana as a Category 1 hurricane with wind speeds estimated at 90 mph. Rainfall across south-central and southeastern Louisiana ranged from 4 to 8 inches, with the highest amount of 8.57 inches in Perry just north of Intracoastal City.[12] The event also produced a storm surge of approximately *ten*10 feet, impacting the southeastern Louisiana Parishes. The combination of storm surge and heavy rains caused levees to fail in Montegut and Franklin, Louisiana. Lili produced significant damage to sugar cane fields, homes and businesses. The storm also disrupted oil production in the Gulf of Mexico. The NHC estimated total damages from the Lili were $860 million, with damages in Louisiana approximately $415 million.
- Near the end of June of 2003, Tropical Storm Bill moved into southeast Louisiana. Storm surge of 3 to 5 feet above normal was reported along the southern Jefferson Parish coast and Lake Pontchartrain. Sustained winds of 35 to 45 mph were common across the area. Storm total rainfall (approximately 48 hours) was 6 to 10 inches. The collective effects of Tropical Storm Bill in southeast Louisiana resulted in 4 injuries and approximately $44 million in property damage in Southeastern Louisiana. Storm surge flooding along the coast and tidal lakes caused $4.0 million in damage and heavy rainfall, river flooding, and flash flooding caused $7.0 million in damage.
- In September of 2004, Hurricane Ivan grazed southeastern Louisiana. Many inhabitants of coastal Louisiana, including Orleans Parish, evacuated to higher ground causing massive traffic jams statewide. Hurricane Ivan passed within 70 miles (to the east) of the mouth of the Mississippi River, and within 125 miles of the City of New Orleans. Storm surge flooded low-lying property and roadways outside of the hurricane protection levees in Orleans, St. Bernard, and Plaquemines Parishes. Southwest Pass, at the mouth of the Mississippi River, recorded the highest winds in the State with a peak gust of 89 mph and sustained winds of 79 mph. Composite radar indicated that between 3 and 4 inches were common in Orleans Parish.

- In October of 2004, Tropical Storm Matthew made landfall near Houma, Louisiana, on the morning of October 10, 2004, producing rain for 2 days. The region hardest hit was the south-central and southeastern portion of the State. Storm totals from this event exceeded double digit inches. Wind damage, in the form of downed trees and power lines, was reported. Flash flooding was problematic in low-lying areas, both from high rains and from the storm surge induced by the storm's persistent easterly winds. Many roads were closed due to storm tide flooding in extreme eastern Orleans Parish.
- On July 5, 2005, Hurricane Cindy made landfall southwest of Grand Isle with maximum sustained winds of 75 mph and a storm surge of 4-6 feet. The storm was initially categorized as a strong tropical storm, but later analysis by the NHC determined the storm to be a Category 1 Hurricane. Hurricane Cindy quickly weakened back into a tropical storm as it crossed over extreme southeastern Louisiana and Breton Sound before making a second landfall near Waveland, Mississippi**,** with 50 mph winds on July 6.[13] At the New Orleans lakefront tropical storm force winds were recorded for a period of five and a half hours. The storm flooded low-lying coastal areas, and high winds caused power outages across an estimated 300,000 homes and business.
- August 29, 2005. Hurricane Katrina (see subsection below).
- September 23, 2005 Hurricane Rita (see subsection following Katrina, below).
- On September 2, 2008, Hurricane Gustav made US landfall near Cocodrie, Louisiana, as a Category 2 hurricane with 105 mph winds. The NHC Tropical Cyclone Report for Gustav indicated that surges of 12-13 feet occurred along the Louisiana coast in the Mississippi River Delta southeast of New Orleans, with surges of 9-10 feet in other portions of southeastern Louisiana. The storm surge overtopped the levees and floodwalls in a few parts of the New Orleans metropolitan area. However, it did not cause widespread inundation of the city and its suburbs.[14] Floodwater reportedly splashed over the top of the Industrial Canal, but the walls were not breached. Minor street flooding occurred in the upper Ninth Ward of New Orleans. High winds from Gustav downed numerous trees in Orleans Parish, particularly along St. Charles Street. In Louisiana, the highest rainfall total from the event occurred in Larto Lake, located in the southeastern part of the State. Rainfall totals in the Larto Lake region were estimated at 21 inches. Hurricane Gustav was declared a Presidential Disaster Declaration on September 2, 2008, for 34 parishes in Louisiana, including Orleans. The storm caused an estimated $2.15 billion in damages to insured property, of which $2.045 billion occurred in Louisiana.

- In Mid–August 2010, Tropical Depression Five made landfall in southeast Louisiana. Upon issuing the first advisory on Tropical Depression Five, the NHC issued a tropical storm warning from Destin, Florida to Intracoastal City, Louisiana, including Lake Pontchartrain and New Orleans.https://en.wikipedia.org/wiki/Tropical_Depression_Five_(2010) - cite_note-23 Louisiana governor Bobby Jindal issued a state of emergency due to the threat from the depression. While the depression moved through the region, it dropped heavy rainfall of up to 8 in (20 cm) around the New Orleans area, flooding streets as well as entering one apartment complex.

- On September 4, 2011, Tropical Storm Lee was the first subtropical or tropical storm to make landfall in Louisiana since Hurricane Gustav in 2008. In preparation for this event Mayor Mitch Landrieu declared a state of emergency for all of New Orleans; officials accordingly ordered the closure of floodgates and the preparation of rescue boats across the city. The extent of impacts in Orleans parish involved about 38,000 residences in New Orleans which were left without power at one point, though only minor flooding occurred around the city

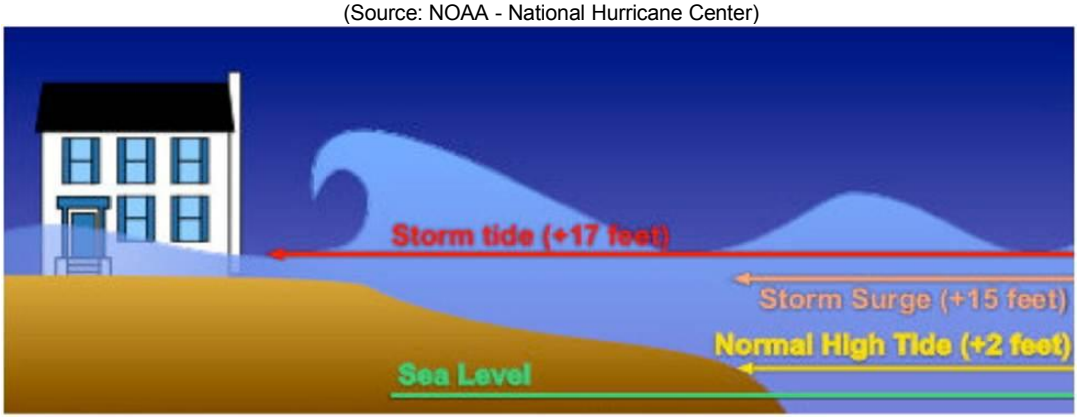
- On August 29, 2012, Hurricane Isaac made landfall just southwest of the mouth of the Mississippi River with winds of 80 mph (130 km/h). Louisiana Governor Bobby Jindal declared a state of emergency for Louisiana on August 26. Later that day, reports of exposed levees in Louisiana began surfacing from local

news outlets. The US Army Corps of Engineers closed the Seabrook Floodgate and the IHNC Lake Borgne Surge Barrier to protect the New Orleans area from a storm surge. The closure of all schools and Universities in South East Louisiana, including Louisiana State University followed Gov. Jindal's State of Emergency declaration. As of Wednesday afternoon (Aug. 29), over 600,000 customers were body of water increases above the normal high tide. They are nearly always associated with massive low-pressure systems with cyclonic flows that are typical of hurricanes. Storm surges are particularly damaging when they occur at the time of a high tide, combining the effects of the surge and the tide. This increases the difficulty of predicting the magnitude of a storm surge, since it requires weather forecasts to be accurate to within a few hours.

Storm surges inundate coastal floodplains by tidal elevation rise in inland bays and ports, and backwater flooding through coastal river mouths. Severe winds associated with low-pressure systems cause increase in tide levels and water surface elevations. Storm systems also generate large waves that run up and flood coastal areas. The combined effects create storm surges that affect the beach, marsh, and low-lying floodplains. Shallow offshore depths can cause storm driven waves and tides to pile up against the shoreline and inside bays.

The level and severity of surge in a particular area is also determined by the slope of the continental shelf. As shown in Figure 6-14, a shallow slope off the coast, as is found off the coast of Louisiana, will allow a greater surge to inundate coastal communities. Communities with a steeper continental shelf will not see as much surge inundation, although large breaking waves can still present major problems. Storm tides, waves, and currents in confined harbors have the potential to severely damage ships, marinas, and pleasure boats.

Figure 6-14 Storm Surge
(Source: NOAA - National Hurricane Center)



Location and Extent of the Storm Surge Hazard

The storm surge hazard associated with hurricanes and other severe storms is responsible for most coastal flooding and erosion along the Louisiana Gulf Coast. In addition to flooding coastal areas, storm surge can also reach farther inland, impacting lakes and rivers. Storm surge in Orleans Parish is primarily the result of hurricanes that approach land from the Gulf of Mexico. The effects of storm surge can be felt in the Parish from hurricanes that make landfall as far away as Texas, Mississippi, or Alabama. The extent of the storm surge hazard covers the entire planning area, and is made worse in some areas based on such factors as elevation and proximity to flood sources (which are in turn related to potential levee failures). Based on historical events and future projections, storm surge up to 15 feet can be expected in

some areas of the City.

The storm surge threat in Orleans Parish has increased over the past 150 years due to a variety of factors such as coastal erosion, loss of wetlands, sea level rise, and the construction of drainage canals. A significant factor that has increased the threat from storm surge in the City has been the construction of a series of drainage canals to remove storm water from the City to Lake Pontchartrain through a network of pump stations. Three of the canals were completed in the mid-1800s so that storm water could be pumped into the canals to keep the City from flooding. In 1923, a shipping channel named the Industrial Canal was constructed along the eastern edge of the City. This canal connected with the varying height of the river through locks of the Inner Harbor Navigation Canal (IHNC). Figure 6-16 displays the drainage canals and the year or timeframe completed.

Figure 6-15 Main Canals in New Orleans
17th Street, Orleans Avenue, London Avenue Canals, the Industrial Harbor Navigation Canals, and the Mississippi River Gulf Outlet

In 1965, as the Port of New Orleans expanded, the USACE completed construction of the Mississippi River Gulf Outlet (MRGO) shipping channel, providing a shorter route from New Orleans to the Gulf of Mexico. The MRGO entered the City from the east, halfway down the Industrial Canal. Over time the profile of MRGO has become more than twice as wide as originally designed (approximately 1,000 feet) due to erosion and collapse of the unconsolidated sidewalls. With no flood gates, the MRGO has inadvertently increased the opportunity for storm surge floods to penetrate into the city.

New Orleans presents two fronts along which storm surges have the potential to flood the City. The weakest link is in the southeast of the City, where the expanded MRGO shipping channel leads directly into the IHNC from the open sea of Lake Borgne. This was evident when Hurricane Betsy in 1965, the year that the MRGO was completed, resulted in a strong storm surge that provided a funnel up which the storm surge from Lake Borgne to the east was directed towards the City. It was the first time the City had been flooded from this route. The earth embankments along the Industrial Canal were breached at numerous locations, flooding the entire eastern part of the City on either side of the canal. As a result, 13,000 houses were flooded, leaving 60,000 homeless. The surge reached up to 12 feet above sea level and left water

levels of up to 9 feet deep in parts of the city. There were 58 deaths in New Orleans with a total of 81 people killed by the storm across all affected regions. It was the first U.S. natural disaster to exceed $1 billion in damages, and led to new initiatives for flood protection with the passage of the Flood Control Act of 1965 by the U.S. Congress.

The City is also vulnerable to surges from Lake Pontchartrain to the north, although in general there is a strong correlation between water levels in Lake Borgne, fully open to the Gulf of Mexico, and those in the partially confined Lake Pontchartrain. Only for slow moving storm tracks located close to the City would the surge in Lake Pontchartrain be higher than in Lake Borgne. Following Hurricane Katrina, the USACE applied protective remedies by blocking off the northern ends of the three drainage canals passing south from Lake Pontchartrain, thus reducing the potential for floodwater to enter the City from this direction. As of January 2010, nothing had been done to resist the arrival of surges from Lake Borgne via the MRGO.43 Notably, in 2006 the U.S. Congress authorized funding for the construction of the Inner Harbor Navigation Canal (IHNC) Lake Borgne Surge Barrier, which is located near the confluence of the MRGO and the Gulf Intracoastal Waterway (GIWW). The purpose of the barrier is to protect vulnerable areas such as New Orleans East, metro New Orleans, the Ninth Ward and St. Bernard Parish.

As mentioned elsewhere in this section of the Plan update, in addition to the canals described above, the City of New Orleans is also protected from storm surge flooding by a complex network of levee systems. There are three USACE levee systems in Southern Louisiana: the Lake Pontchartrain and Vicinity, the West Bank and Vicinity, and the New Orleans to Venice hurricane protection projects. The system that is of most importance to the flood defense of New Orleans is the Lake Pontchartrain and Vicinity project, which covers St. Bernard, Orleans, Jefferson, and St. Charles parishes, generally between Lake Pontchartrain and the Mississippi River. It also includes flood defenses around the 17th Street, Orleans Avenue, London Avenue, and Industrial canals, as well as the IHNC.[44] The levee system protecting New Orleans is described in much greater detail in the Dam and Levee Failure section of this Plan. (Section 6.3.4).

In February 2008, the USACE completed a draft version of the *Louisiana Coastal Protection and Restoration Technical Report (LACPR)*. The purpose of the report is to describe the LACPR effort that is being undertaken in response to the following congressional acts passed after Hurricane Katrina in August of 2005.

- Energy and Water Development Appropriation Act of 2006 passed in November 2005
- Department of Defense, Emergency Supplemental Appropriations to address hurricanes in the Gulf of Mexico
- Pandemic and Influenza Act, 2006 passed on December 30, 2005, as part of the Defense Appropriations Act, P.L 109-148

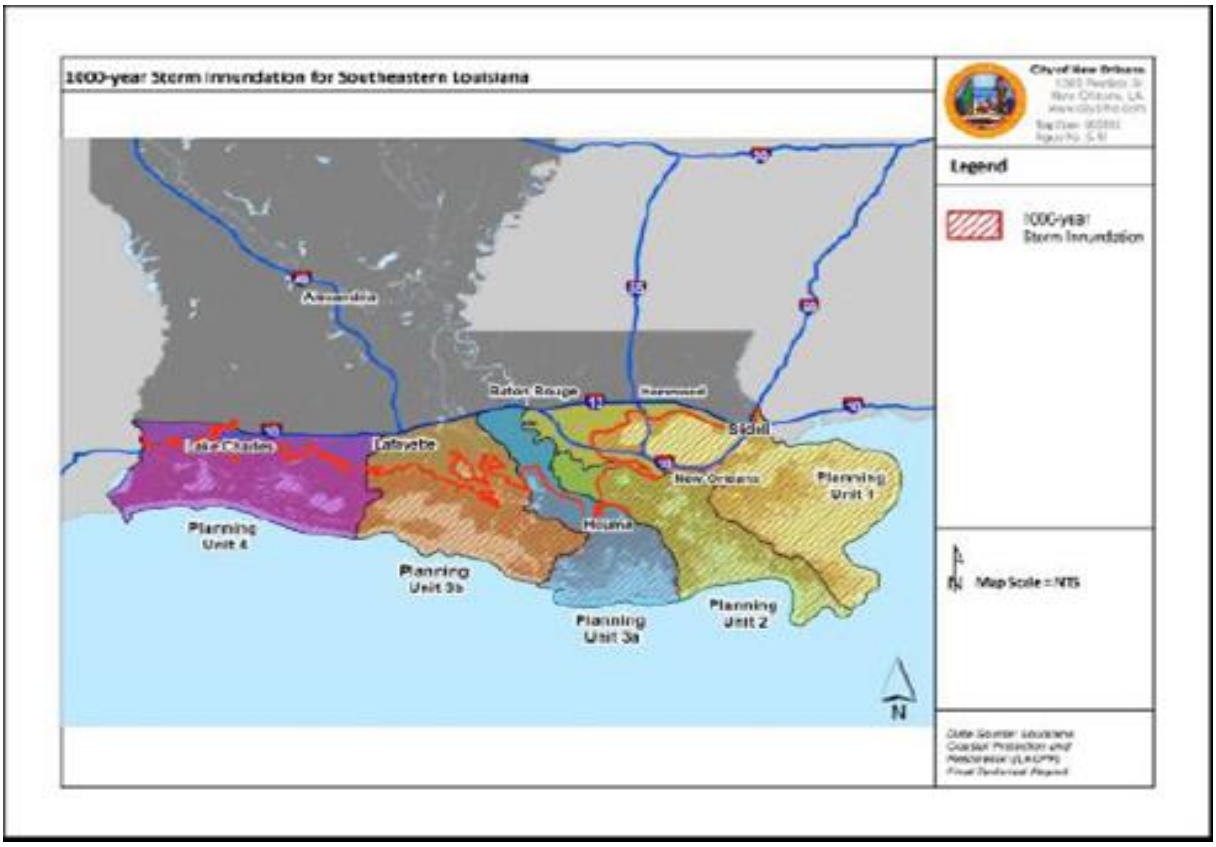
Under these acts, Congress and the President directed the Secretary of the Army, acting through the Chief of Engineers to conduct a comprehensive hurricane protection analysis and design; to develop a full range of flood control, coastal restoration, and hurricane protection measures exclusive of normal policy considerations for South Louisiana; and to submit a final technical report for Category 5 protection within 24 months.

The LACPR technical report included advanced computer storm simulation software to evaluate a full range of hurricanes that could make landfall in coastal Louisiana. The USACE used a state of the art, physics-based computer model named ADCIRC (ADvanced CIRCulation) that can simulate a powerful storm once it forms in the Atlantic and guide it to a coastal landfall. The computer simulations allow planners to evaluate different storm tracks, landfall speeds, and wind fields. Coupling this program with wave generation software and other tools enables technical planners to develop assessments of hurricane impacts, which can then be used to evaluate different risk reduction strategies and alternatives.[45]

The USACE report also included a set of baseline conditions that assumed improvements to the hurricane risk reduction system as authorized in Public Laws described above. These laws provided funds to raise levee heights or otherwise

enhance the West Bank and Vicinity and the Lake Pontchartrain and Vicinity projects to a BFE design level. Implementation of the 1-percent annual chance flood standard will be accomplished through improvements to levees, floodwalls, armoring, and associated structures in Jefferson, Orleans, portions of Plaquemines, St. Charles, and St. Bernard Parishes. Appropriations were also provided to accelerate completion of previously authorized hurricane and storm damage reduction and flood risk management projects in South Louisiana. The analysis completed by the USACE assumed that funds provided by these laws are sufficient to complete the authorized improvements.

Figure 6-16 1,000-year Storm Inundation Limit for Southeastern Louisiana
(Source: USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008)



Risk in Orleans Parish associated with storm surge is described in much greater detail in the Vulnerability Assessment and Loss Estimation section of this Plan. The storm surge risk assessment section also includes more detailed surge inundation maps and estimates of future losses.

Severity of the Storm Surge Hazard

According to most sources, storm surges in Louisiana are deeper and travel further inland than in other Gulf Coast States. In coastal areas such as southern Louisiana, storm surge is the most dangerous aspect of hurricanes, although wind is clearly a very significant hazard as well. Storm surge causes nine out of every ten hurricane-related deaths, according to the NWS. The severity of storm surge is determined by a variety of factors such as the path of a hurricane, wind speeds, shape of the coastline, and the forward speed. The forward motion of a storm complements the counterclockwise rotation of the wind field, which usually results in the highest surges from hurricanes occurring on the

right-front (northeast) quadrant of the storm's track. Table 6-13 identifies the factors that can influence the severity of storm surge.

Table 6-13 Factors that Influence the Severity of Storm Surge

(Sources: NOAA – National Hurricane Center, New Scientist Magazine, April, 2009)

Factor	Effect
Wind Velocity	The higher the wind velocity the greater the damage.
Storm Surge Height	The higher the storm surge the farther inland the inundation area and the greater the damage.
Coastal Shape	Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.
Storm Center Velocity	The slower the storm moves, the greater potential for damage along the immediate coastline. The worst possible situation is a storm that stalls along a coast, through several high tides.
Nature of Coast	Damage is most severe on low-lying island barrier shorelines because they are easily over washed by wave action.
Previous Storm Damage	A coast weakened by even a minor previous storm will be subject to greater damage in a subsequent storm.
Storm Size	The size of a storm and extent of hurricane force winds can influence the area of coastline impacted by storm surge. Larger hurricanes with expansive hurricane force winds can create significant surge over a large section of coastline.
Central Pressure	The lower a hurricane's central pressure the greater the wind speeds and potential for stronger storm surge.
Storm Track (or Path)	The right-front (northeast) quadrant of the storm track typically experiences the most severe surge as a hurricane eye makes landfall.
Forward Speed	The forward speed of a hurricane can influence the peak height and how far inland a surge will reach.
Human Activity	With increased development, property damage increases and more floating debris becomes available to knock down other structures.

Impact on Life and Property

Storm surge is considered one of the most deadly and destructive components of a hurricane. As described in more detail below in the Occurrences of the Storm Surge Hazard, numerous past storm surge events associated with major Hurricanes (Category 3 or stronger) have caused considerable, sometimes catastrophic, damage to portions of Orleans Parish. These surge events have also been accompanied by considerable injuries and loss of life within the planning area.

Although data limitations limit the ability to identify figures relating to the specific causes of death, it is widely accepted based on review of numerous reports and studies that the majority of deaths associated with these events were the result of storm surge and levee failure. The number of deaths and injuries for Hurricane Katrina in August 2005 was estimated at 800 and 7,500, respectively, based on a study completed by the Louisiana Department of Health and Hospitals (LDHH) from September 9-25, 2005. The LDHH in coordination with the Center for Disease Control (CDC) established an active surveillance system during this time period to detect outbreaks of disease and characterize post-hurricane injuries and illnesses.

Occurrences of the Storm Surge Hazard

As part of the 2015 Plan update, the planning team examined a variety of sources to identify past storm surge events that have impacted Orleans Parish. As indicated elsewhere in this section, one source for identifying past storm surge events is NOAA"s NCDC database. The NCDC indicates eleven storm surge events impacted Orleans Parish between 1950 and 2015. Table 6-14 summarizes the storm surge events reported by the NCDC that have impacted southern Louisiana and Orleans Parish between 1998 and 2015. The events are summarized following Table 6-14.

Table 6-14 Storm Surge Events, Orleans Parish, 1998 – 2015
(Source: NOAA/NCDC, NWS)

Date	Time	Type	Property Damage ($)	Estimated Surge Depth
02/15/1998	02:00 PM	Storm Surge	0	unknown
09/12/1998	11:00 AM	Storm Surge	0	Unknown
06/30/2003	02:00 PM	Storm Surge	4.1M	0-6 feet
09/15/2004	10:00 AM	Storm Surge	4.0M	0-10 feet
10/09/2004	03:00 PM	Storm Surge	100K	0-5 feet
07/05/2005	03:00 PM	Storm Surge	2.5M	4-6 feet
08/29/2005	02:00 AM	Storm Surge	31.3B	15-20 feet
09/23/2003	07:00 AM	Storm Surge	432.0M	0-14 feet
09/11/2008	12:00 PM	Storm Surge/tide	0	5-15 feet
09/02/2011	04:00 PM	Storm Surge	15K	3.5 to 5 feet
08/28/2012	06:00 AM	Storm Surge	62.5M	11 feet
	Grand Total		**$31.8B**	

The NCDC database appears not to include some large events that impacted the Parish prior to 1998. The major events *missing* from this database are summarized in Table 6-15 below.

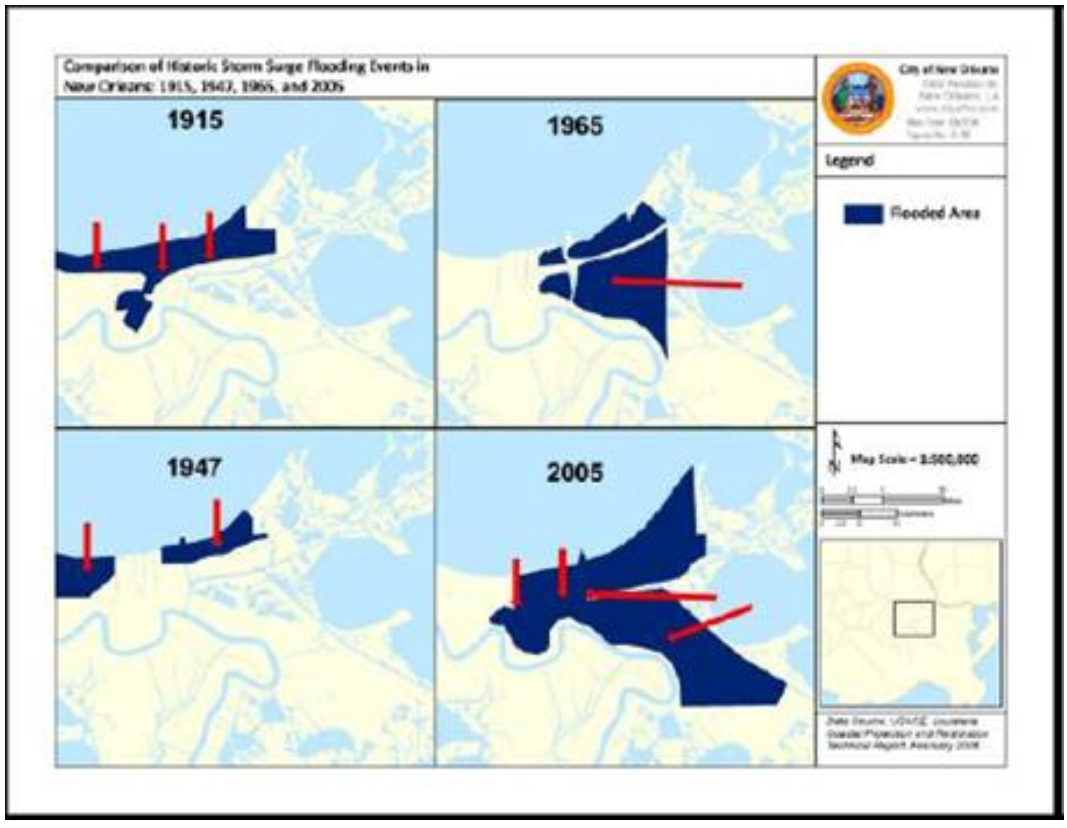
Table 6-15 Major Storm Surge Events Impacting Orleans Parish between 1965 and October 1998
(Sources: NOAA – National Hurricane Center; NWS - New Orleans / Baton Rouge Service Area, USGS)

Event	Date	Description of Storm Surge	Estimated Damages in LA	Estimated Surge Depth
Hurricane Betsy	September 10, 1965	A storm surge of15.5 feet was reported at Grand Isle, LA. Surge caused 75 deaths and approximately 800 injuries.	$1.4 billion	10 feet
Hurricane Camille	August 17, 1969	Storm surge estimated at 25 feet was most severe along the Mississippi Coast, inundating everything within two miles of the beach from Henderson Point to Biloxi. A 15-foot storm surge occurred near Boothville, LA.	$350 million	22 feet
Hurricane Carmen	September 23, 1974	Category 4 hurricane made landfall 10 miles west of Grand Isle. Maximum storm surge of 6 feet in southeastern LA.	$150 million	4-6 feet
Hurricane Andrew	August 23, 1992	An 8-foot storm surge caused flooding from Lake	$1 billion	8 feet

		Borgne westward to Vermillion Bay, LA.		
Hurricane Georges	September 23, 1998	Strong Category 3 hurricane that made landfall to the east of New Orleans near Ocean-Springs-Biloxi, MS. Storm produced a 9-foot storm surge at Point a la Hache, LA. The storm surge at Lake Pontchartrain was estimated at 7 feet.	$25 million	5.81 feet

Examining historical storm surge events prior to 1965 indicates that Orleans Parish has experienced four catastrophic flood events from storm surge between 1900 and 2015. After each flood, modest investments were made in improved defenses that reduced the immediate risk of flooding. However, each investment in improved flood defenses prompted additional development in the partially protected floodplain and thus increased the number of people and structures at risk. These events occurred in 1915, 1947, 1965 (Hurricane Betsy), and 2005 (Hurricane Katrina). Figure 6-18 identifies the geographic extent of the storm surge flooding in New Orleans from these historic storm surge events.

Figure 6-17 Comparison of Historic Storm Surge Flooding Events in New Orleans: 1915, 1947, 1965, and 2005
(Source: USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008)



As mentioned in Section 6.3.2, Hurricane Katrina made landfall in September of 2005 as a powerful Category 3 hurricane that had a devastating impact on the New Orleans area and the entire Gulf Coast region. Hurricane force winds from Katrina produced the greatest recorded storm surge in the United States. Data collected by FEMA shortly after the event indicated a 24-28-foot storm surge along a 20-mile section of Mississippi centered somewhere near Bay St. Louis Bay (Figure 6-20 for Katrina SLOSH model). The surge crossed Interstate 10 in many locations penetrating as far inland as 6 miles in parts of coastal Mississippi.

A significant storm surge also occurred west of Katrina's path. As the level of Lake Pontchartrain rose, several feet of water were pushed into communities along its northeastern shore in St. Tammany Parish, from Slidell to Mandeville, Louisiana. High water mark data indicate the storm surge was 12 to 16 feet MSL (mean sea level) in those areas. The data also indicate a storm surge of 15 to 19 feet occurred in eastern New Orleans, St. Bernard Parish, and Plaquemines Parish, while the surge was 10 to 14 feet in western New Orleans along the southern shores of Lake Pontchartrain. Farther west, observations indicate a storm surge of 5 to 10 feet along the shores of western Lake Pontchartrain.

The storm surge on August 29 severely strained the levee system in the New Orleans area. Several of the levees and floodwalls were overtopped and/or breached at different times on the day of landfall. Most of the floodwall and levee breaches were due to erosion on the backside caused by overtopping, but a few breaches occurred before the waters reached the tops of the floodwalls. The surge overtopped large sections of the levees east of New Orleans, in Orleans Parish and St. Bernard Parish, and it also pushed water up the Intracoastal Waterway and into the Industrial Canal. The water rise in Lake Pontchartrain strained the floodwalls along the canals adjacent to its southern shore, including the 17th Street Canal and the London Avenue Canal. See Section 6.3.4 for additional details about the New Orleans levee protection system and the breaches that resulted from Katrina.

Again, Table 6-16 shows where Hurricane Katrina's characteristics fall within the Saffir-Simpson Hurricane Scale (shaded blocks represent Hurricane Katrina). This figure is repeated from Section 6.3.1, Hurricanes and Tropical Storms, to identify how the storm surge fits within the Saffir-Simpson Scale. The table shows that although Katrina was a Category 3 Hurricane at landfall, the storm surge in excess of 18 feet falls within the characteristics of a Category 5 storm.

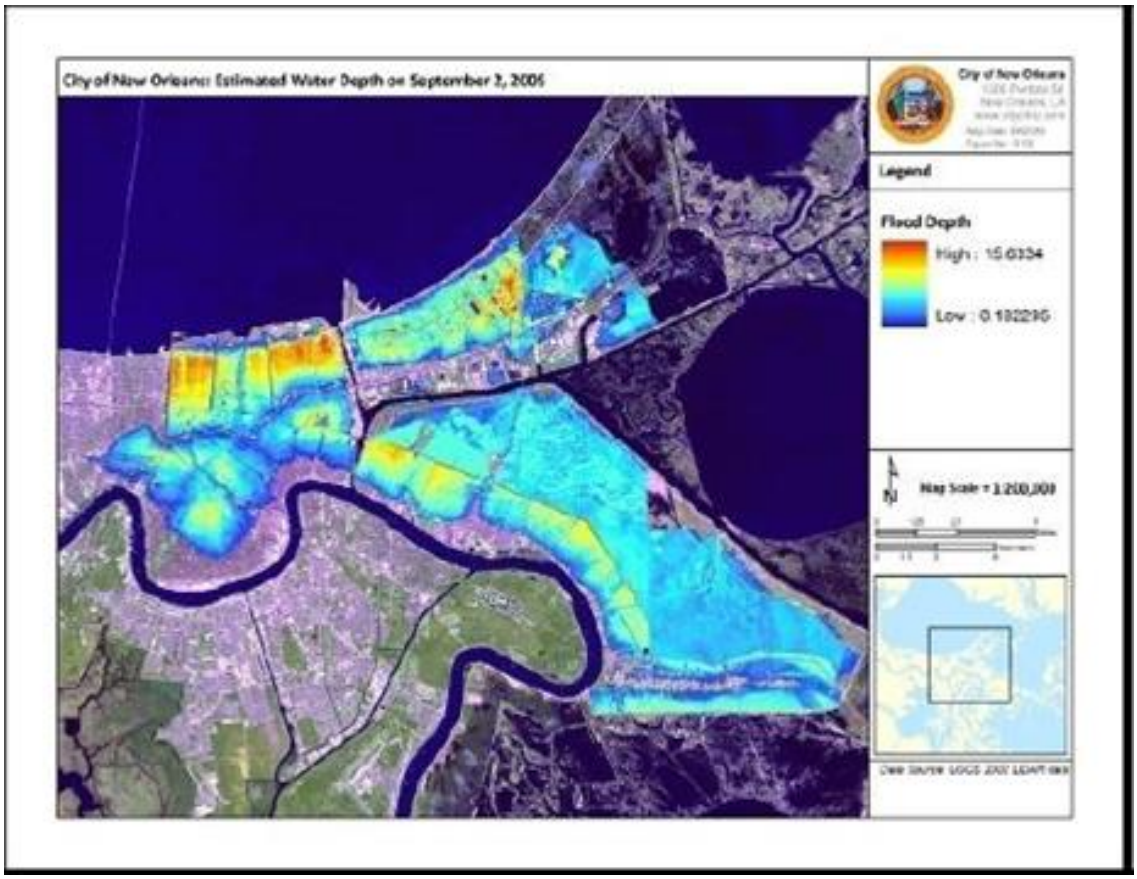
Table 6-16 How Katrina fits within the Saffir-Simpson Hurricane Scale
(Source: USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008)

Scale Number (Category)	Winds (miles per hour)	Pressure (millibars)	Approximate Surge (feet)	Damage
1	74-95	980	4 to 5	Minor
2	96-110	965 – 979	6 to 8	Considerable
3	111 – 130	945 – 964	9 to 12	Extensive
4	131 - 155	920 - 944	13 to 18	Extreme
5	> 155	< 920	> 18	Catastrophic

The volume of water entering the City when the levees failed immediately overwhelmed the 23 major pump stations throughout Orleans Parish, which are designed to remove surface runoff during rain events. The levee breaches or overtopping of floodwalls caused electrical and structural damage to all of the major pump stations preventing them from operating during and immediately after the event.

The massive amount of water released into large sections of the city flooded an estimated 147,000 residential homes.[50] As the floodwaters rose, thousands of residents who were unable to evacuate became trapped, many on rooftops and some in their attics. Figure 6-20 below identifies the location and flood depths throughout the City on September 2, 2005. Within about 24 hours of Katrina's landfall, about 80 percent of the City of New Orleans flooded, to varying depths up to about 20 feet.

Figure 6-18 City of New Orleans: Estimated Water Depths on September 2, 2005
(Source: USGS 2002 LiDAR data)



The following link provides a detailed interactive graphic including a timeline of how and where the flooding occurred as Hurricane Katrina approached the City of New Orleans.

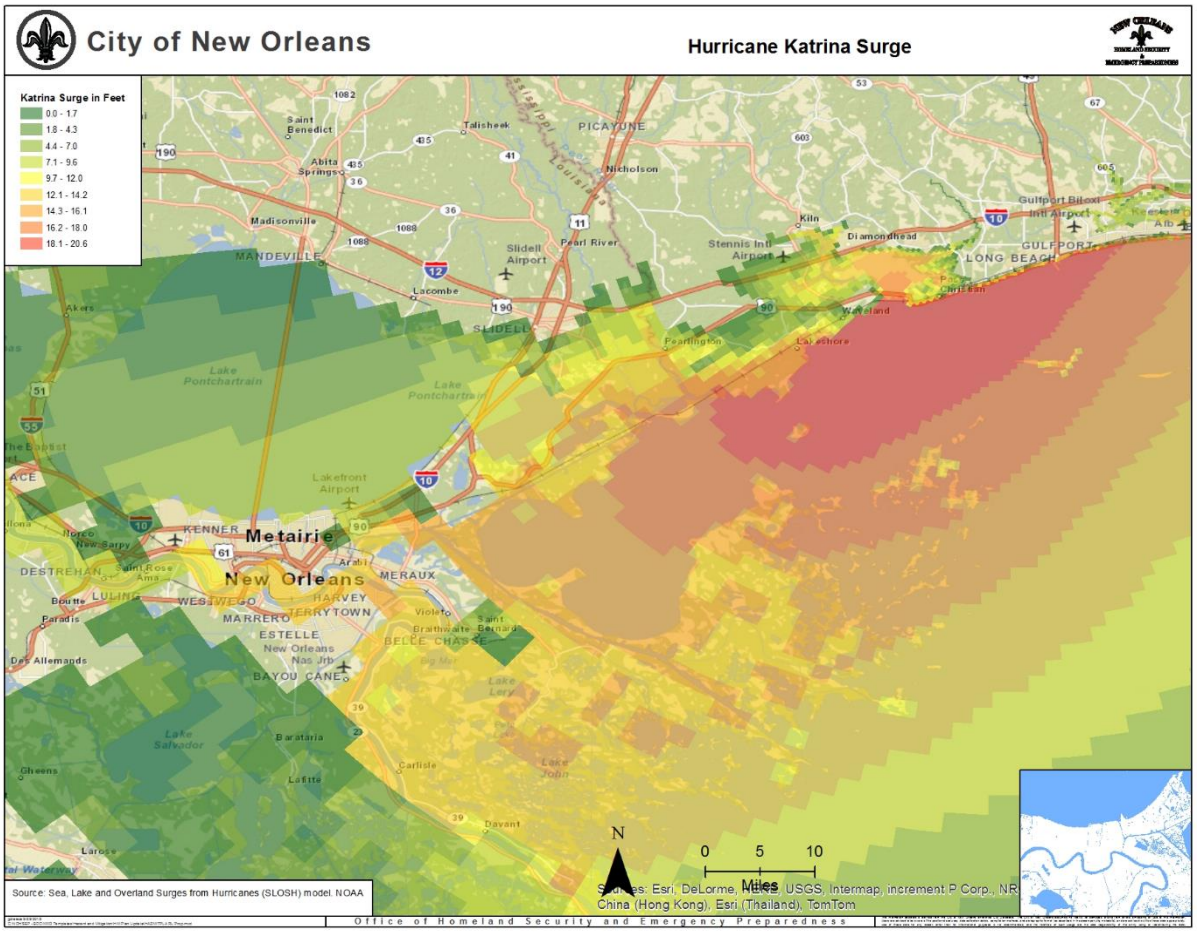
http://www.nola.com/katrina/graphics/flashflood.swf

The consequences of the flooding were catastrophic for the City of New Orleans. Large developed areas were inundated with floodwater for extended periods of time before repairs could be made to the levees and pump stations and the water drained out of the City. The USACE was tasked to drain the floodwater from the City and repair all pump stations damaged by the event.

The USACE"s first priority after the event was to complete emergency temporary repairs to all levee breaches so that floodwater could be drained. The USACE completed the process of draining floodwater from New Orleans on October 11, 2005, 43 days after Hurricane Katrina made landfall.

After Katrina, the NHC used the SLOSH (sea, lake, and overland surges from hurricanes) model to develop a computerized model of the storm surge. The SLOSH model is used to estimate storm surge heights and winds by considering the pressure, size, forward speed, track, and winds. Figure 6-20 below shows the storm surge estimated by the NHC.

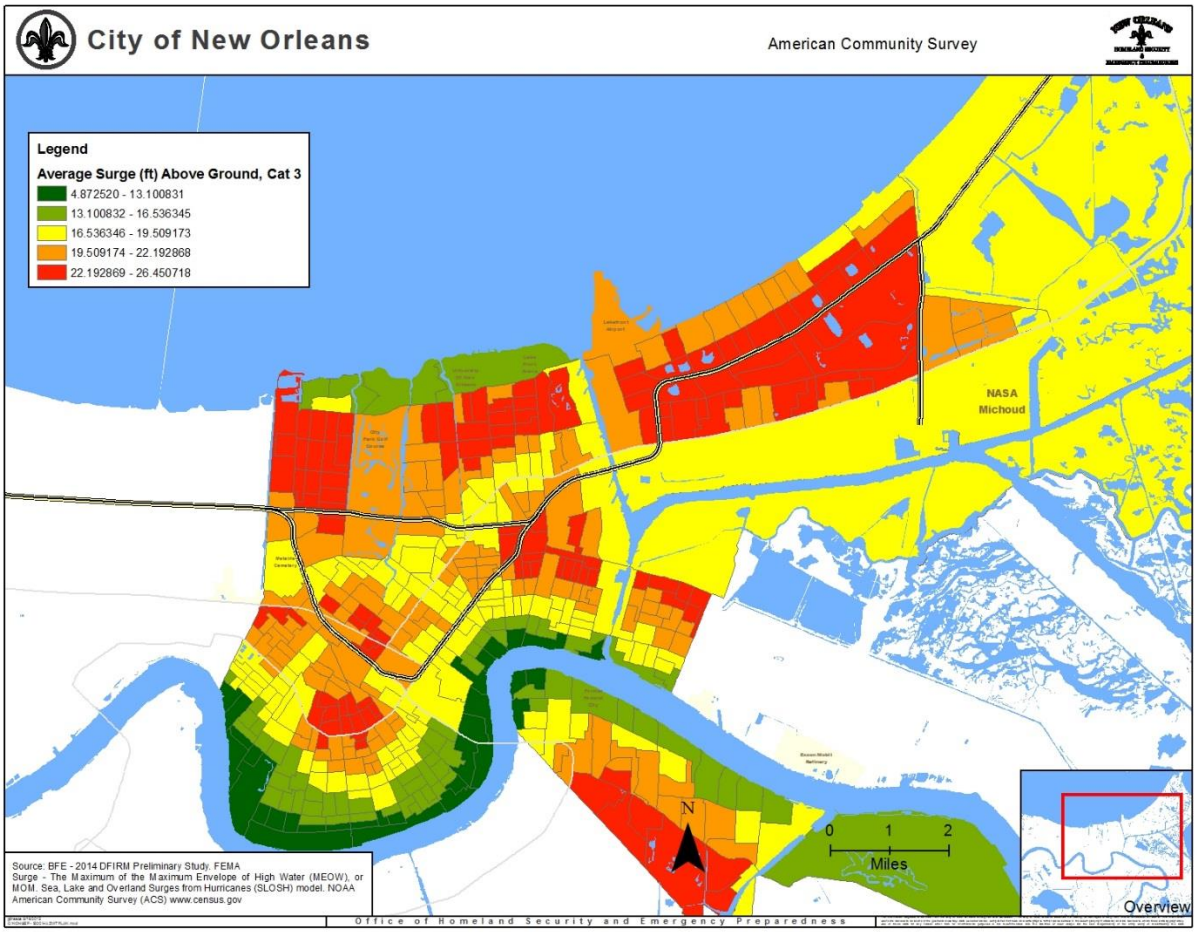
Figure 6-19 Storm Surge for Hurricane Katrina
(Source: NOAA – National Hurricane Center)



Prior to Katrina, SLOSH models developed for the Louisiana coastline estimated storm surge flooding inland up to 18 feet above sea level. The damages caused by Hurricane Katrina demonstrate that storm surge-related flooding can reach depths of up to 30 feet above sea level, with ability to reach either the north shore of Lake Pontchartrain, just north of New Orleans or the south shore in Jefferson and Orleans Parishes. After Katrina, the NFIP paid a total of $15.3 billion in flood insurance claims to more than 162,000 policyholders across the States of Alabama, Florida, Louisiana, and Mississippi. This total is more than all other claims combined since the program began in 1968. In Louisiana, total payout was nearly $12.6 billion.

The most currently available data regarding storm surge is based upon a recent SLOSH model. Utilizing the Maximum of Maximums (MoM) for a Category 3 storm, which compiles the worst case inundations based upon hundreds of possible tracks, the scenario shows overtopping of the levees and significant inundation throughout the city can result from a Category 3 storm. Figure 6-22 shows the project flood depths above ground level based upon that model.

Figure 6-20 SLOSH Model for New Orleans



The relatively frequent occurrence of the storm surge hazard suggests that this will continue to be a significant problem for Orleans Parish. The *Flood Risk in New Orleans* report indicates that over the next several decades, a number of factors related to storm surge hazard can be expected to change the risk of flooding in New Orleans.

These include increases in the mean sea level of the region due to geological subsidence and global sea level rise and increases in hurricane activity in the Gulf of Mexico. As mentioned, the Vulnerability and Loss Estimation section of this Plan includes a much more detailed discussion of the impacts on the Parish associated with storm surge.

6.3.4 Dam and Levee Failure

Dam Failure

A **dam** is defined as any artificial dike, levee, or other barrier that is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of-dam. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (also known as dikes) are used to manage or prevent water flow into specific land regions.

Dams are typically ranked by hazard classification, which is determined by the potential for infrastructure and property damages downstream if a dam failure were to occur. The three hazard classifications include high hazard (H), significant (S), and low (L) and are defined as follows:

- **High Hazard Dams.** Probable loss of life; major increases in existing flood levels at houses, buildings, major interstates, and state roads with more than six lives in jeopardy.
- **Significant Hazard Dams.** Possible loss of life, significant increased flood risks to roads and buildings with no more than two houses or six lives in jeopardy.
- **Low Hazard Dams.** Unlikely loss of life; minor increases to existing flood levels at road and buildings.

Dam failures are not themselves natural hazards, but are often caused by natural hazards such as floods and earthquakes, and their failure can then result in floods. Dam failures can result from a variety of causes including lack of maintenance, seismic activity, improper design or construction, or the effects of large storms. Significant rainfall can quickly inundate an area and cause floodwater to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows and failure may occur.

There is only one dam in the planning are, located at the Carrollton Water Purification Plan at 8800 S. Claiborne Avenue, New Orleans, Louisiana. The dam is classified by the State of Louisiana as a significant hazard dam. The dam is owned and operated by the Sewerage and Water Board of New Orleans. Any flooding caused by a sudden breach of the dam at the Carrollton Water Plant would be localized and temporary. Some temporary minor street flooding may occur, however the drainage system would quickly consume the small volume of water contained by this structure. Residents and businesses in the immediate area surrounding the plant may experience minor flooding to any surface or subsurface elevation property. It is estimated that the total volume of water in the flood area would not be more than approximately an area 1-foot deep with a radius of approximately 1,200 feet. The majority of the flooding would be contained within the grounds of the Carrollton Plant. There have been no occurrences of dam failure in Orleans parish in the last five years. The probability of the dam failure with in Orleans parish is less than one percent.

The Parish's vulnerability and impact to dam failure is minimal and will not be carried forward into a vulnerability and impact assessment.

Description Levee Failure

Man-made levees can fail in a number of ways. The most frequent (and dangerous) form of levee failure is a breach. A levee breach is when part of the levee actually breaks away, leaving a large opening for water to flood the land protected by the levee. A breach can be a sudden or gradual failure that is caused either by surface erosion or by a subsurface failure of the levee. Levee breaches are often accompanied by levee boils, or sand boils. A sand boil occurs when the upward pressure of water flowing through soil pores under the levee (under seepage) exceeds the downward pressure from the weight of the soil above it. The under seepage resurfaces on the landside, in the form of a volcano-like cone of sand. Boils signal a condition of incipient instability which may lead to erosion of the levee toe or foundation or result in sinking of the levee into the liquefied foundation below. Complete breach of the levee may quickly follow. Sometimes levees are said to fail when water overtops the crest of the levee. Levee overtopping can be caused when flood waters simply exceed the lowest crest of the levee system or if high winds begin to generate significant swells in the ocean or river water to bring waves crashing over the levee.

Levees play a vital role in protecting New Orleans. A failure of any of these levees will dump water into the City and endanger not only property, but human and animal life. New Orleans sits in a shallow "saucer" with much of the area below sea level, thus incoming water would rise as the "saucer" fills.

Some background about how New Orleans was founded and expanded will help explain the City's levee system. New Orleans was founded by the French in 1718 at the natural levee embankment on a tight outer bend of the lower Mississippi River. After the Louisiana Settlement of 1803, the town quickly became the largest U.S. city in the South, expanding its footprint along the flanks of the levees as they followed the meandering river east and west to become the Crescent City. Undeveloped marshland areas remained north of the City.

Developers in the 19th century, interested in expanding the City to the north, recognized that pumps would be required to keep the marshland areas from flooding. In 1928 a 14-foot electricity-powered screw siphon pump was developed by a City of New Orleans engineer to remove floodwater from the City. Increases in pumping capacity at the beginning of the 20th Century saw the city expand across the swamplands right up to the lake's shore. From 1900 through 1930, the population of Orleans Parish grew over 60 percent, to 460,000 people. As described in detail in the Storm Surge subsection (Section 6.3.3), a series of drainage canals was also constructed around this time to convey storm water from the City into Lake Pontchartrain.

The majority of the perimeter floodwall and levee system was designed and constructed after Hurricane Betsy in 1965. The flood protection system was built to withstand an event roughly equivalent to a typical Category 3 hurricane.

The levee system protecting New Orleans consists of over 350 miles of levees, which 133 miles have been newly strengthen after Hurricane Katrina. Much of the system protecting the New Orleans region has been constructed with a combination of earthen and concrete materials including the following

- **Sheet Pile** – A row of piles driven side-by-side to retain earth or prevent seepage.
- **Concrete I-Walls** – Concrete floodwalls are mainly "I-walls" with the concrete wall section cast atop a row of sheet piles driven through the crest of an earthen embankment.
- **Concrete T-Walls** – These wall sections also cap a sheet pile curtain, but they get additional rotational and lateral stability by nature of their broad concrete base (which forms an inverted "T").
- **Earthen levee** – A low ridge of earthen embankment built along the edges of a stream or river channel to prevent flooding of the adjacent land.

Figure 6-22 Typical Floodwall Construction along the 17th Street Canal in New Orleans

(Source; Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005)

Southeast Louisiana is currently protected from storm surge by an extensive network of levees and flood control structures.

As mentioned in the Storm Surge subsection, the City of New Orleans is currently protected from storm surge flooding by a complex network of levee systems. There are three USACE levee systems in the New Orleans and surrounding area: the Lake Pontchartrain and Vicinity, the West Bank and Vicinity, and the New Orleans to Venice hurricane protection projects. The system that is of most importance to the flood defense of New Orleans is the Lake Pontchartrain and Vicinity project, which covers St. Bernard, Orleans, Jefferson, and St. Charles parishes, generally between Lake Pontchartrain and the Mississippi River. It also includes flood defenses around the 17th Street, Orleans Avenue, London Avenue, and Industrial canals, as well as the Inner Harbor Navigation Canal (IHNC).

A portion of the Lake Pontchartrain and Vicinity Levee system, also known as the New Orleans Flood Protection System, can be further broken down into a series of protected basins or "polders," each protected by its own perimeter levee system. The New Orleans Flood Protection System is also supported by a series of pumps to remove surface runoff from within the City. There are four main polders (or protected units) that comprise the City of New Orleans flood protection system. The four polders include the following

- Orleans East Bank
- New Orleans East
- St. Bernard Parish - Contains the Lower Ninth Ward and St. Bernard Parish
- Plaquemines Parish Protection Zone

Three of the four polders are described in detail below. The Plaquemines Parish Protection zone contains a thin protected strip along the Mississippi River heading south from St. Bernard Parish to the north of the river at the Gulf of Mexico. This levee system predominately provides protection for communities and infrastructure within the Plaquemines and St. Bernardo Parish region and, therefore, is not described in detail as part of the New Orleans HMP update.

The location of the Orleans East Bank protected section (shown in Figure 6-23) encompasses the main downtown area of New Orleans, as well as a number of historic districts including the French Quarter and the Garden District.

Figure 6-23 shows an enlarged view of the principal levees protecting the northern portion of this polder, in the "Canal" district. The small numbers indicate the approximate elevations of the tops of the levees along the lakefront, and the tops of the floodwalls at the crests of the earthen levees along the three main drainage canals. As shown in this figure, the tops of the lakefront levees were generally on the order of elevation +17.5 to +18 feet, while the tops of the floodwalls along the sides of the three drainage canals were typically at elevations of about +13 to +15 feet.

Figure 6-23 Orleans East Bank Levee Protection System

The region known as New Orleans East is bordered by distinctively different hydraulic boundaries: Lake Pontchartrain borders it to the north and east; the Inner Harbor Navigational Canal (IHNC), also known as the "Industrial Canal," borders it to the west; to the south and southeast is the Intracoastal Waterway (IW)/Mississippi River Gulf Outlet (MRGO) and Lake Borgne, respectively.

The Lower Ninth Ward of New Orleans and neighboring St. Bernard Parish together form an 81 square mile polder located across the IHNC from central New Orleans. Elevations within the polder range from approximately -4 feet to 12 feet, with the higher elevation reaches situated near its southern edge, which is bordered by the Mississippi River. The Gulf Intracoastal Waterway (GIWW) and MRGO are located north of the polder. system surrounding the polder. The primary levee system, which includes earthen, I-wall, T-wall, and sheet pile sections, was designed and constructed by the USACE.

Location of Levee Failure

The complex system of levees hold back waters that are designed to keep the city safe from Lake Ponchartrain, the Mississippi River and a network of canals that are used for drainage and industrial purposes. A breach of one or more levees would cause massive flooding in the entire city. Due to the scale and scope of possible flooding from a levee failure the entire planning area is subject to the impact of this hazard. Additionally, much of New Orleans is below sea level and once a breach of a levee occurs, it becomes very difficult, time consuming and costly to remove the water from the affected area. Effected structures and infrastructure may remain submerged in flood waters for lengthy periods of time until the breach can be repaired and the water pumped from flooded areas. A breach in any levee is possible at any time from either natural or manmade causes and the resulting flooding would be catastrophic to the Parish.

Extent of Levee Failure

Levee failure has the potential to be a catastrophic hazard event for the City and all properties and assets in the planning area. A re-occurrence of this hazard would likely create many of the same consequences as seen after Katrina. Thousands of homes and businesses would be severely damaged, or destroyed, and much of the Parish's infrastructure would be devastated. The monetary loss to the Federal, State and Local government would be staggering. Lives would be disrupted and some citizens would more than likely die. The economic and tax structure of the Parish would be severely negatively impacted and cause significant damage to Orleans Parish's ability to meet its payroll and other governmental financial obligations. Furthermore, the Parish's vital role as an import and export port for the nation would be affected as seen with the levee breaks related to Hurricane Katrina.

After Hurricane Katrina in 2005, almost 80% of the city incurred damage either from floodwaters or wind driven rain. The Katrina flood damages are directly related to the levee failure. The "worst case" extent of potential flooding is best illustrated by the flood depths from Hurricane Katrina in 2005 where 80% of the city flooded with some areas under 8 ft of water.

Previous Occurrences of Levee Failure

Since the early 1900s, four significant storm surge flood events (1915, 1947, 1965, and 2005) either overtopped or breached a portion of the levee system in New Orleans. Each of the events prompted an investment in improvements to flood defenses (levees, floodwalls, etc.).

On August 29, 2005, Hurricane Katrina, a powerful category 3 storm at landfall, hit the Gulf Coast near the border of Louisiana and Mississippi. It initiated what has been called the greatest disaster in U.S. history due to a series of catastrophic effects. One effect was that the City of New Orleans flooded as a result of several levee breaks that occurred during or soon after the storm hit. The powerful storm surge, strong winds and excess water contributed to the levee failures. Additionally, once the water dumped into the planning area, there was no expeditious way for it to be removed other than by pumping it out. As a result, the flood waters remained in the City, as well as neighboring parishes, for several weeks causing catastrophic damage to businesses, residences, vehicles and infrastructure. Over one thousand persons died in Louisiana as a result of the effects created by Katrina and a large number of them perished in Orleans Parish as a direct result of rising water from the levee breaks.

As the storm passed through the New Orleans area, the first levee break was reported on the Industrial Canal near the Orleans and St. Bernard Parish Line. This break permitted the waters from the canal to pour into the 9th Ward. Following the report of a break on the Industrial Canal, it was reported that the 17th Street Canal had been compromised and that a levee wall had failed. The 17th Street Canal connects to Lake Ponchartrain and is on the border between Orleans and Jefferson Parishes. The break on this canal was on the Orleans Parish side. Then in addition to the 9th Ward, water was dumping into Orleans Parish from the west and flooding homes, businesses, vehicles, infrastructure and endangering lives of humans and animals. Water from the 17th Street Canal moved into portions of Lakeview, Mid-City, Carrollton, Uptown, the Central Business District and the French Quarter. There were more than 50 breaches of the levee system including the London Avenue Canal and water moved into most parts of the planning area. Generally, only the areas nearest the Mississippi River where there were some elevated areas near or above sea level were spared.

The levee breaches stranded survivors on roof tops and in attics who had to be rescued by helicopters and boats. Many citizens, who were trapped in attics and unable to escape, died from drowning or other disaster related causes. The Orleans Parish infrastructure was devastated. Roads and bridges were damaged, electricity and gas lines destroyed and water mains disrupted. It was estimated that 75-80% of the properties in the City, over 100,000, received some flood damage from the compromised levees. The monetary cost to taxpayers, insurance companies and citizens has been estimated to be between $50-100 billion. Hundreds of thousands residents had to abandon their flooded homes and relocate to other areas of the country that were then in turn impacted by the homeless New Orleans residents. Some citizens will never return to Orleans Parish. The economic and social climate of city was severely altered. Revenue sources were devastated and will take a long time to recover. Following the levee breaks and subsequent flooding, civil unrest broke out and looting became rampant. The New Orleans Police Department and other public service departments were devastated with the loss of vehicles and other equipment items needed to perform their duties.

Hurricane Rita

Shortly after Hurricane Katrina, Orleans Parish again suffered the effects of water pouring through a levee break. On September 23, 2005, as powerful Hurricane Rita prepared to make landfall at the border of Texas and Louisiana, surging water began pouring through the previously damaged Industrial Canal wall. Once again, the 9th Ward flooded with some areas receiving as much as 8 feet of water. The additional flooding from Rita was generally considered not to be as extensive as during Katrina, however, it contributed to prolonging the efforts (which lasted until October 2005) to remove all floodwater from the New Orleans area.

There have been no levee failures in Orleans parish within the last 5 years. The annual probability of levee failure within the parish is 4%.

6.3.5 Coastal Erosion

Description of the Coastal Erosion Hazard

Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. The physical processes that cause barrier island erosion and wetland loss throughout the Louisiana delta plain are complex and varied. Coastal erosion along the Louisiana Gulf Coast is an ongoing process that continues to threaten the wetlands and barrier islands. The erosion process has been accelerated by strong storms and hurricanes, which can erode large sections of coastline with a single event. The creation of canals by the shipping and oil industries have also contributed to this erosion.

Location and Extent of Coastal Erosion

The Louisiana coast is unique among the Gulf Coast States in that its coastal population centers are all buffered from the Gulf of Mexico by an expansive, although rapidly eroding, coastal wetland system.[86] Coastal erosion is a significant problem along the entire Louisiana Gulf Coast. The barrier islands and marshes of Louisiana provide protection for inland development during hurricanes. These islands act as a buffer and help to reduce the intensity of hurricanes as they make landfall prior to reaching more densely populated areas such as New Orleans. For example, Hurricane Lili in 2002, went from a Category 4 to a Category 2 as it encountered Louisiana coastal waters. Figure 6-28 below identifies areas of coastal erosion that have occurred between 1932 and 1990 in southeastern Louisiana.

The extent of Orleans Parish that is susceptible to Coastal Erosion in the areas outside of the levees, i.e. the eastern and southern portions of the parish. Approximately 25 percent of the total land mass is susceptible. The maps below illustrate this. In 6-28, the planning area is approximately outlined in a blue dotted line.

Figure 6-27 Geomorphic Classification of Coastal Land Loss between 1932 and 1990 in Southeastern Louisiana

(Source: USGS – Coastal Erosion and Wetland Change in Louisiana)

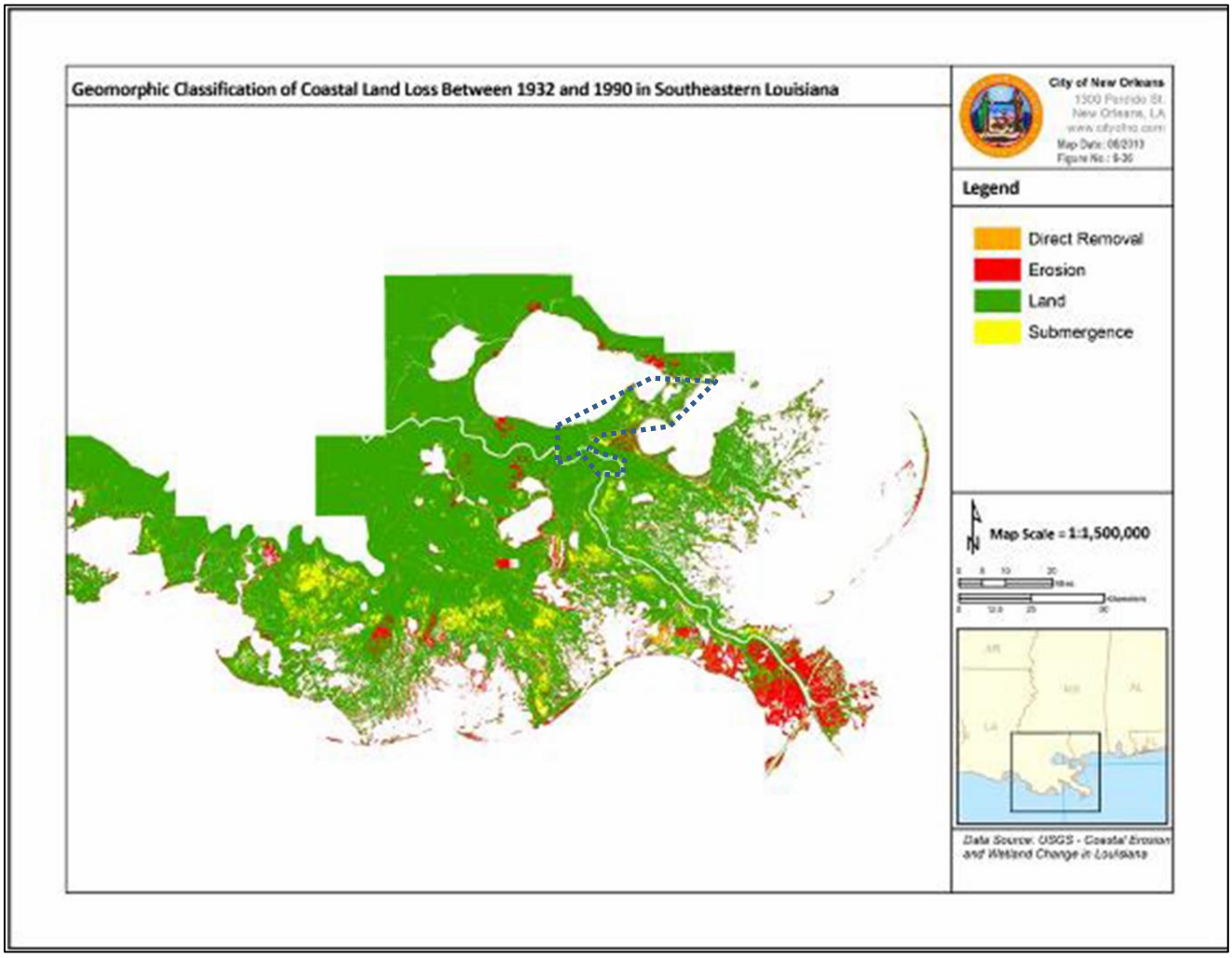
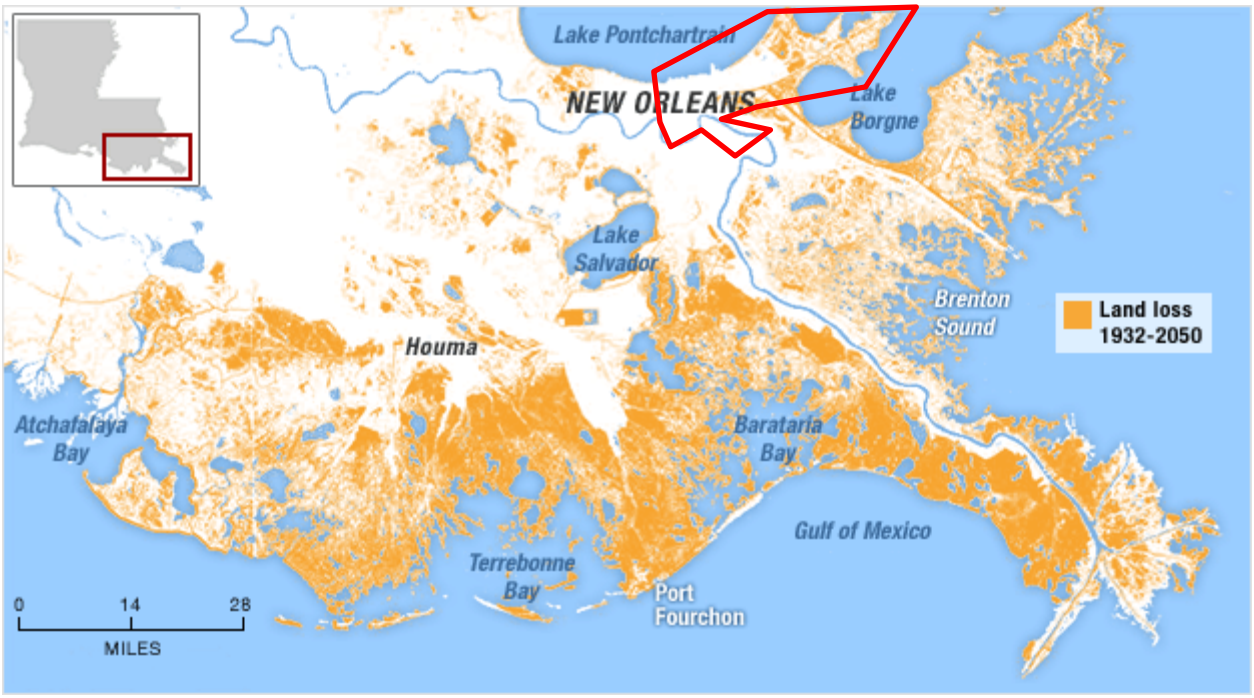


Figure 6-28 Projected Coastal Land Loss, 1932 to 2050
(Source: Louisiana Coastal Wetlands Planning Protection and Restoration Act Program)
Approximate Planning Area Outlined in Red



***The area denoted as "Land Loss" on the above map is the location where Coastal Erosion will occur.**

Severity of the Coastal Erosion hazard

Tides and strong storms moving onshore from the Gulf of Mexico are rapidly eroding Louisiana's marshy coastline. Erosion of several of the barrier islands, which lie offshore of the estuaries and wetlands that buffer and protect these important ecosystems from the open marine environment, exceeds 65 feet/year. The average rate of shoreline erosion is over 33 feet/year. Within the past 100 years, Louisiana's barrier islands have decreased in area by more than 40 percent, and some islands have lost more than 75 percent of their land area. If these loss rates continue, several of the barriers are expected to erode completely within the next 3 decades. Their disappearance will contribute to further loss and deterioration of wetlands and back-barrier estuaries and increase the risk to infrastructure.

Coastal wetlands in southern Louisiana are also being lost due to erosion. Louisiana has the highest rate of wetlands loss in the Country with the State accounting for 80 percent of the nation's total wetland loss. The U.S. Geological Survey (USGS) estimates wetland loss in the entire Mississippi River Delta Plain to be 43.5 square miles per year - the equivalent of a football field every 20 minutes. In total, the USGS estimates that Louisiana has lost approximately 1,900 square miles of its coast since 1932. The planning area is estimated to loose approximately 4 square miles every year, approximately 20 square miles in the past five years.

Impact on Life and Property

The slow movement and advancement of coastal erosion is not in itself life threatening; however, the continued loss

of wetlands along the Louisiana coastline can have a direct effect on the severity of hurricanes and tropical storms. The wetlands act as a buffer to reduce hurricane wind speeds and storm surge heights, thus reducing the severity of these events. Without the protection from coastal wetlands, areas such as New Orleans are at greater risk from major hurricane events.

Coastal erosion also has the potential to cause substantial property damage and negative impacts to the Louisiana economy. If losses continue at the current rate, coastal erosion has the potential to have direct implications on the nation's energy supplies, economic security, and environmental integrity.[87] Numerous studies have been conducted to identify the major contributing factors that have caused such extensive land loss in southeastern Louisiana. Most studies agree that land loss and the degradation of the coastal ecosystem are the result of both natural and human-induced factors, producing conditions where wetland vegetation can no longer survive or is directly extracted and wetlands are lost.

Louisiana's coastal system, including Orleans Parish, has also been heavily impacted by channels excavated 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. Both the coastal areas and the Parish itself are clearly highly vulnerable to the continued effects of erosion. Not only are there direct impacts associated with the hazard, i.e. the loss of land, marshes and wildlife, but the loss of coastal mass results in a significant increase in potential damages from storm surge because of the loss of attenuation capacity. Although Orleans Parish is not at immediate physical risk from coastal erosion, the loss of land and marsh represents a severe vulnerability for nearly all facilities, populations and operations in the area. There are numerous studies that include projections of potential losses from storm surges under various future coastal erosion scenarios. In the case of storm surge (which is the primary threat), vulnerabilities to flooding and surge are closely related, although the surge hazard the additional components of velocity and debris that serve to exacerbate risk. There is an extensive discussion of the flooding and storm surge risk in Section 7 of this Parish Hazard Mitigation Plan.

Louisiana is clearly a State at risk from further sea-level rise. Absent major intervention, a continuation of current trends is projected to cause loss of more than 400,000 acres over the next 50 years. This is a conservative estimate since it presumes a continuation of what has been observed over the past 50 years, without factoring in acceleration of sea level rise from potential climate change.[89] Over the long term, the loss of coastal land masses that provide some protection for the City of New Orleans from hurricanes is vitally important. The loss of this important natural barrier will have a tremendous impact on all of New Orleans and surrounding parishes by making them more vulnerable, especially to powerful hurricanes.

In terms of specific, present-day coastal erosion in Orleans Parish, much of the vulnerability is related to the increased potential for storm surges to inflict significant damages on the area because of the loss of the buffering capacity of the coast line, in particular the many barrier islands. Most surge and flood risk studies are based on statistical models that consider such factors as coastal erosion and sea level rise in estimating potential impacts of future events. Because of the inherent variability in erosion rates, and the fact that erosion is partly driven by weather events, there is uncertainty in any prediction of the effects of this hazard. However, given the trend in coastal losses over a period of time, it is clear that erosion is a significant problem that has several related but different negative effects on the area and its people. As noted, much of coastal Southern Louisiana is at higher risk from the impacts of hurricanes and tropical storms because of the loss of coastal buffering capacity, this in addition to direct impacts such as the loss of wetlands (and related damages to the fishing and tourism industries) and direct physical impacts to communities on the coast and islands.

Occurrences of Coastal Erosion

As mentioned above, the rate at which Louisiana is losing coastline and wetlands is faster than any place in the United States or perhaps even the world. It is estimated that since 1932, the State of Louisiana has lost an estimated 1,900 square miles of coastal land, an area the size of Delaware.[90] Although there are specific areas of more severe coastal erosion that can be identified along the Louisiana coastline, this is an ongoing process that impacts the entire coastal region of Louisiana. Although there will be yearly variations in the amount of coastal erosion, there is a 100% statistical probability of additional erosion in the future, based on extensive and ongoing studies of the Louisiana coastline. It is estimated that the planning area loses 4 square miles of coastal area every year, and has lost 20 square miles over the past five years.

It is difficult to track specific losses of coastal area, with sea level rises and other natural and manmade factors. However, there are specific cases in southern Louisiana which typify what is seen in the planning area and are summarized below:

Chandeleur Islands – This chain of barrier islands is located in St. Bernard Parish, Louisiana, about 60 miles east of New Orleans and is part of the Breton National Wildlife Refuge. The USGS analyzed a section of the islands with aerial photographs taken 2 days after Hurricane Katrina. The photos were compared with those taken in 2001 prior to Hurricanes Lili and Ivan. Figure 6-29 identifies the USGS study areas and sections photographed as part of the analysis. Figure 6-30 and 6-31 compare the location of the study area in 2001 and 2005. The photo taken in 2001 shows low vegetation and marshes behind narrow sand beaches. In 2005, this section of the barrier island is almost submerged from erosion and wave action from Hurricane Katrina and other hurricanes.

Figure 6-29, Chandeleur Islands Study Area,
(Source: USGS)

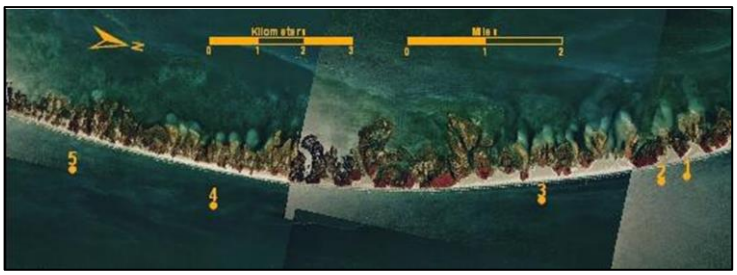


Figure 6-30 Location 2; Photo of Barrier Islands in 2001

Figure 6-31 Location 2; Photo of Barrier Islands in 2005

Grand Isle – Grand Isle is a 6-square-mile barrier island located in southern Jefferson Parish. The island lies

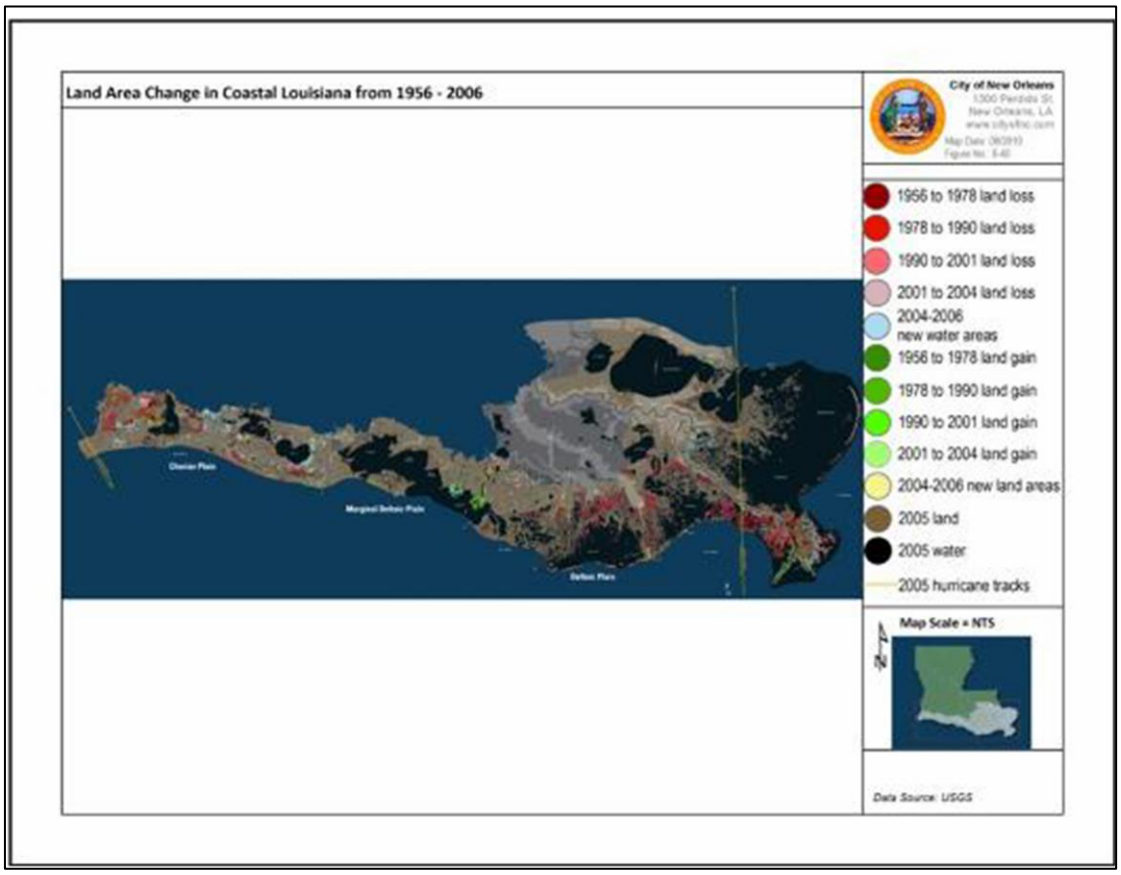
between marshes on the inland side and the Gulf of Mexico. Saltwater intrusion has been a major source of coastal erosion around the area of Grand Isle. Construction of canals allows saltwater to infiltrate into the fresh and brackish marshes, which weakens and kills many of the marsh grasses.

Coastal Erosion from Hurricanes Katrina and Rita in 2005

The 2008 *Louisiana Coastal Protection and Restoration Technical Report* (February 2008 Draft) indicates that Hurricanes Katrina and Rita resulted in the destruction of more than 217 square miles of coastal wetlands during their landfalls. The loss attributed to these storms exceeds the wetland losses that had been projected to occur in the entire State over the next 20 years. All of the wetlands that were expected to erode in the New Orleans area over the next 50 years were lost in a single day during the landfall of Hurricane Katrina. In addition, Hurricane Katrina destroyed or substantially damaged about one half of the State's barrier islands along the Gulf of Mexico.

Figure 6-32 identifies the land area change (shown in red) in coastal Louisiana from 1956 – 2005. The graphic shows that in Orleans Parish significant erosion has occurred in or near the far eastern and southern part of East New Orleans.

Figure 6-32 Land Area Change in Coastal Louisiana from 1956 – 2005
(Source: USGS)



6.3.6 Hazardous Materials Spills/Contamination

Description of the Hazardous Materials Spills/Contamination Hazard

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials, airborne carcinogens and industrial/petrochemical byproducts. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health impacts, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section focuses on incidents that relate to hazardous materials that occur at facilities and along transportation routes.

Location and Extent of the Hazardous Materials Spills/Contamination Hazard

Orleans Parish faces the threat of a hazardous material spill/accident from a variety of sources. The Parish has many facilities that use or store toxic chemicals. A leak at one of these facilities could cause health problems for residents, property damage, and economic losses due to downtime at businesses that are evacuated. New Orleans also faces threats from chemicals transported through the City on highways, railways, and waterways. Interstate 10, a major east-west corridor, runs through New Orleans. Because of its proximity to several major ports (including Jacksonville, New Orleans, and Houston), I-10 serves as a major transportation route for many freight trucks. Six major freight rail companies operate in the New Orleans area, including Illinois Central, CSX, Norfolk Southern, Kansas City Southern, BNSF, and Union Pacific. Many toxic chemicals are transported by rail through New Orleans routinely. The area is also home to several of the nation’s largest petrochemical refineries, which process and ship vast quantities of hazardous materials on a daily basis.

New Orleans also has an extensive system of navigable waterways, including the Mississippi River and the Industrial Canal. More than one third of all industrial chemicals transported on the nation’s inland waterway system pass through the New Orleans Industrial Canal. Also, because of the many modes of transportation that can be found in New Orleans, there is reason to believe that chemicals are traveling on the City’s streets as part of the intermodal transportation of these products.

The Emergency Planning and Community Right-to-Know Act of 1986 requires certain facilities, known as Tier II facilities, to submit reports detailing the type and amount of certain chemicals to the State Emergency Response Commission, the Local Emergency Planning Committee, and the local fire department. Figure 6-45 shows the location of Tier II facilities in New Orleans. As of 1999, companies of all sizes that use certain flammable and toxic substances are required to submit a Risk Management Plan (RMP) to the EPA. Each RMP must include a description of the “worst-case” scenario for the facility. Due to security concerns following September 11, 2001, these reports are not readily available. However, the extent of the damage from a chemical accident will depend on factors that cannot be predicted: the specific chemical involved in the accident, the amount of chemical involved, and the meteorological conditions at the time of the accident. Furthermore, the effects of a chemical spill will vary depending on which chemical is involved and which environmental medium the chemical is emitted into (i.e., land, air, water, or underground injection).

The US EPA maintains the Toxic Release Inventory (TRI) database. This contains information reported annually by some industry groups as well as federal facilities. Each year, companies across a wide range of industries (including chemical, mining, paper, oil and gas industries) that produce more than 25,000 pounds or handle more than 10,000 pounds of a

listed toxic chemical must report it to the TRI. As on 2015, Orleans Parish had the following four TRI facilities.

Table 6-18 TRI Facilities in New Orleans

(Source: EPA TRI Database, 2015)

Facility	Address	Chemical Released	Total Onsite Releases	Total Offsite Transfers
Southern Foods Group LLC DBA Browns Dairy	1300 Baronne St, New Orleans, LA 70113	Ammonia, Nitrate Compounds, Nitrate Acid, Sodium Nitrate	0	18629
Us Gypsum Co	5701 Lewis Road, New Orleans, LA 70126	Lead, Mercury	0	29
Lafarge MidAtlantic New Orleans East RMX	11900 Chef Menteur Hwy, New Orleans, LA 70129	Led, Lead Compounds, Mercury Compounds	1	0
Air Products Chemicals Inc.	14700 Intracoastal Dr, New Orleans, LA 70129	Aluminum Oxide, Ammonia, Chlorine, Copper, Copper Compounds, Dichlorodifluoromethane, Ethylene Glycol, Hydrochloric Acid, Methanol, Nickel, Nickel Compounds, Propylene, Sodium Hydroxide, Sulfuric Acid, Zinc, Zinc Compounds	3,238	21,054

New Orleans vulnerability to chemical accidents along transportation routes is more difficult to gauge because hazardous chemicals are not located at a fixed site and because many different chemicals are transported through New Orleans. A recent study analyzed the potential effects of a chemical leak along the southern Mississippi River rail corridors using the Area Locations of Hazardous Atmospheres (ALOHA) model available from the EPA. The researchers modeled two leaks from a railcar, a large breach and a small hole, for five different meteorological conditions. Simulations were run on 46 "extremely hazardous substances," as defined by the EPA that are transported along the Mississippi River corridor. The researchers identified vulnerability zones for each chemical under each set of meteorological conditions. A vulnerability zone is defined as the "total area where any time following an accident the concentration of a given chemical meets or exceeds the level which is „Immediately Dangerous to Life and health.'" The results of the model showed that 15 chemicals that are transported along rail lines in the region have vulnerability zones of less than 1 mile, 6 chemicals have vulnerability zones of between 1 mile and fewer than 6 miles, and 5 chemicals have vulnerability zones of 6 miles or more under some conditions.

Severity of the Hazardous Materials Spills/Contamination Hazard

The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment.

Threat to Human Safety and Welfare

- Poisoning of water or food sources and/or supply
- Introduction and dispersion of airborne toxins and irritants
- Presence of toxic fumes or explosive conditions

- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Threat to the Environment

- Injury or loss of animals or plants or habitats that are of economic or ecological importance, such as: commercial, recreational, or subsistence fisheries (marine plants, crustaceans, shellfish, aquaculture facilities) or livestock; seal haul outs; and marine bird rookeries
- Direct damage and contamination of private property
- Impact to recreational areas such as public beaches
- Impact to ecological reserves, forests, parks, and archaeological and cultural sites

One method of classifying incident severity is by ranking from 1 to 4, with a Level 1 incident considered minor; a Level 2 moderate; a Level 3 major; and a Level 4 severe. Thresholds depend on the type of incident and hazards. Incidents categorized as minor or moderate are often associated with known hazardous materials and limited in the area impacted. Incidents categorized as major or severe are typically associated with a fire, explosion, or toxic cloud that impacts a large area, possibly disrupting essential services. Events of this magnitude present an immediate danger to the public, potentially causing deaths and injuries and may require the evacuation of large numbers of the population. Emergency response by local agencies will require assistance from outside resources to adequately respond to the incident.

Impact on Life and Property

Hazardous material incidents (fixed sites) refer to uncontrollable releases of hazardous materials at a facility that pose a risk to the health, safety, property, and the environment (MSP/EMD). The most well-known example of a large-scale fixed-site hazardous material incident is that which occurred at the Union Carbide plant in Bhopal, India, in 1984. This incident caused 2,500 deaths and injuries to many others. Although incidents of this scale are fairly rare, smaller-scale incidents - those requiring a response and evacuation or other protective measures - are relatively common. Table 6-20 below illustrates the relatively small number of Hazardous Material-related incidents that led to a Presidential Disaster Declaration.

Table 6-20 Hazmat Related Federal Disaster Declarations (1953-2015)
(Source: FEMA)

DR - Number	Declared	State	Description
3366	1/10/2014	West Virginia	Chemical Spills
3126	06/10/1998	Kansas	Kansas Grain Elevator Explosion
3094	09/16/1992	Rhode Island	Water Contamination
3092	09/04/1987	Wyoming	Methane Gas Seepage
636	03/17/1981	Kentucky	Sewer Explosion, Toxic Waste
3080	05/21/1980	New York	Chemical Waste, Love Canal
3066	08/07/1978	New York	Chemical Waste, Love Canal
139	11/05/1962	Louisiana	Chlorine Barge Accident
135	10/10/1962	Mississippi	Chlorine Barge Accident

The declared incident in Louisiana occurred in 1961 about 125 miles from New Orleans after a barge carrying 2.2 million

pounds of liquid chlorine sank while being pushed in the Mississippi River near Vidalia, Louisiana. After the incident, the Federal Government studied the risk posed by such a substantial load of chlorine at the bottom of the Mississippi River.

The study concluded that if any lethal chlorine gas escaped from the barge, it could potentially result in a large number of casualties. In November 1962, a Presidential Disaster Declaration (DR-139) was declared, and the barge was eventually raised safely.

Although there is clearly some vulnerability to widespread contamination during significant flood events in Orleans Parish, vulnerability to hazardous materials spills and contamination is most often site- and material-specific. Thus, as a practical matter, it is impossible to characterize the vulnerability of the entire Parish, as associated with spills or releases from events unrelated to major disasters or floods. In most cases vulnerability is a function of the proximity to the spill or air-release event, as well as the type of material involved. Vulnerability is increased with proximity to hazmat transportation routes (including water routes), and by being downwind of areas where air releases are likely.

Occurrences of the Hazardous Materials Spills/Contamination Hazard

Like most cities its size, New Orleans has a history of small chemical spills and accidents. The New Orleans Fire Department (NOFD) HazMat unit responds to all hazardous materials calls, whether from a fixed-site or on a transportation route. Table 6-21 details the number of fixed site and transportation incidents responded to by the New Orleans Fire Department between 2010 and 2014.

Table 6-21 Orleans Parish: Number of Transportation & Fixed Site Incidents Per Year, 2010-2014
(Source: New Orleans Fire Department HazMat Unit)

HazMat Category	2010-2014
Fixed-sites	6401
Transportation	853
Grand Total	7254

The data in Table 6-22 below breaks down hazardous materials incidents in Orleans Parish by Transportation category.

Table 6-22 Orleans Parish: Number of Transportation Incidents Per Year, 2010-2014
(Source: New Orleans Fire Department HazMat Unit)

Incident Type	2010	2011	2012	2013	2014	Total
Highway	163	149	138	167	144	761
Railroad	10	20	12	9	5	56
Wharf/Vessel	4	7	3	6	13	33
Airport/Aircraft	1	2	0	0	0	3
Grand Total						853

Table 6-23 Orleans Parish: Number of Fixed Site Incidents per Year, 2010-2014

(Source: New Orleans Fire Department HazMat Unit)

Incident Type	2010	2011	2012	2013	2014	Total
Explosions (no fire), other	1	3	3	1	1	**9**
Hazardous Condition, other	142	141	133	185	157	**758**
Flammable gas or liquid condition, other	30	20	15	43	22	**130**
Gasoline or other flammable liquid spill	186	182	198	189	189	**944**
Gas leak (natural gas or LPG)	325	333	350	304	310	**1,622**
Oil or other combustible liquid spill	192	221	165	198	208	**984**
Toxic condition, other	1	4	3	4	2	**14**
Chemical hazard (no spill or leak)	8	13	4	6	5	**36**
Chemical spill or leak	11	29	22	14	14	**90**
Carbon monoxide incident	27	21	17	19	24	**108**
Radioactive condition, other	0	2	0	0	0	**2**
Radiation leak, radioactive material	0	1	0	0	0	**1**
Biological hazard, confirmed or suspected	13	19	12	13	10	**67**
Building or structure weakened or collapsed	8	14	23	13	10	**68**
Explosive, bomb removal	1	0	3	1	0	**5**
Hazmat release investigation with no hazmat	19	11	16	18	16	**80**
Bomb scare, no bomb	3	2	1	15	1	**40**
Fumigations	100	297	330	334	382	**1,443**
Grand Total						**6401**

Table 6-23 summarizes Fixed Site incidents per year between 2010 and 2014.

The statistical probability of a hazmat spill or contamination annually somewhere in the Parish is 100%, although the extent and severity are highly variable, and as a practical matter impossible to predict except very generally.
Although not included in the HazMat data reported in the tables above, the City of New Orleans has experienced at least one major chemical spill. In 1987, a railcar filled with butadiene spilled, ignited, and exploded in a Gentilly neighborhood. A total of 19,000 residents were evacuated from their homes for 3 days as the fire burned. No one was killed in the incident, but many residents complained of respiratory ailments and other health problems.

Spills and Contamination Related to Hurricane Katrina

As previously described in detail within several of the hazard sections (Flood, Hurricanes and Tropical Storms, Storm Surge, Levee Failure), in addition to the direct structural damages from Katrina's floodwater, contamination was a significant problem after the event. Floodwater within the City of New Orleans and surrounding areas was contaminated from a variety of sources, including leaking oil and gas from automobiles, rotting animal carcasses, leaking appliances, raw sewage, and household and commercial chemicals.

Throughout the flooded areas of Orleans Parish, contamination occurred from the flooding of potential sources of toxic chemicals such as hydrocarbon fuel storage, distribution facilities, and commercial chemical storage.

Contamination was also caused when floods affected several large chemical and petroleum production facilities operating in and around New Orleans, and old contaminated sites that have undergone or were currently undergoing remediation at the time of the disaster.[108] Figure 6-33 from the National Institute of Environmental Health Sciences shows the flooded areas of Orleans Parish and potential petroleum-related release points, including refineries, oil and gas wells, and service stations near the City. As a result of the floodwater from Katrina, an estimated 565 oil spills were noted (these were the result of failures in petroleum production and refining infrastructure). Figure 6-34 shows the major hazardous-material storage locations, Superfund sites, and Toxics Release Inventory reporting facilities.

The July 2006 Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report (FEMA 549) studied the effects of long-term flood impacts on contamination.

Figure 6-33 Orleans Parish: Flooded Areas and Petroleum and Natural Gas Extraction, Refining, and Distribution Facilities

(Source: Hurricane Katrina: Environmental Hazards in the Disaster Area, National Institute of Environmental Health Sciences, 2005)

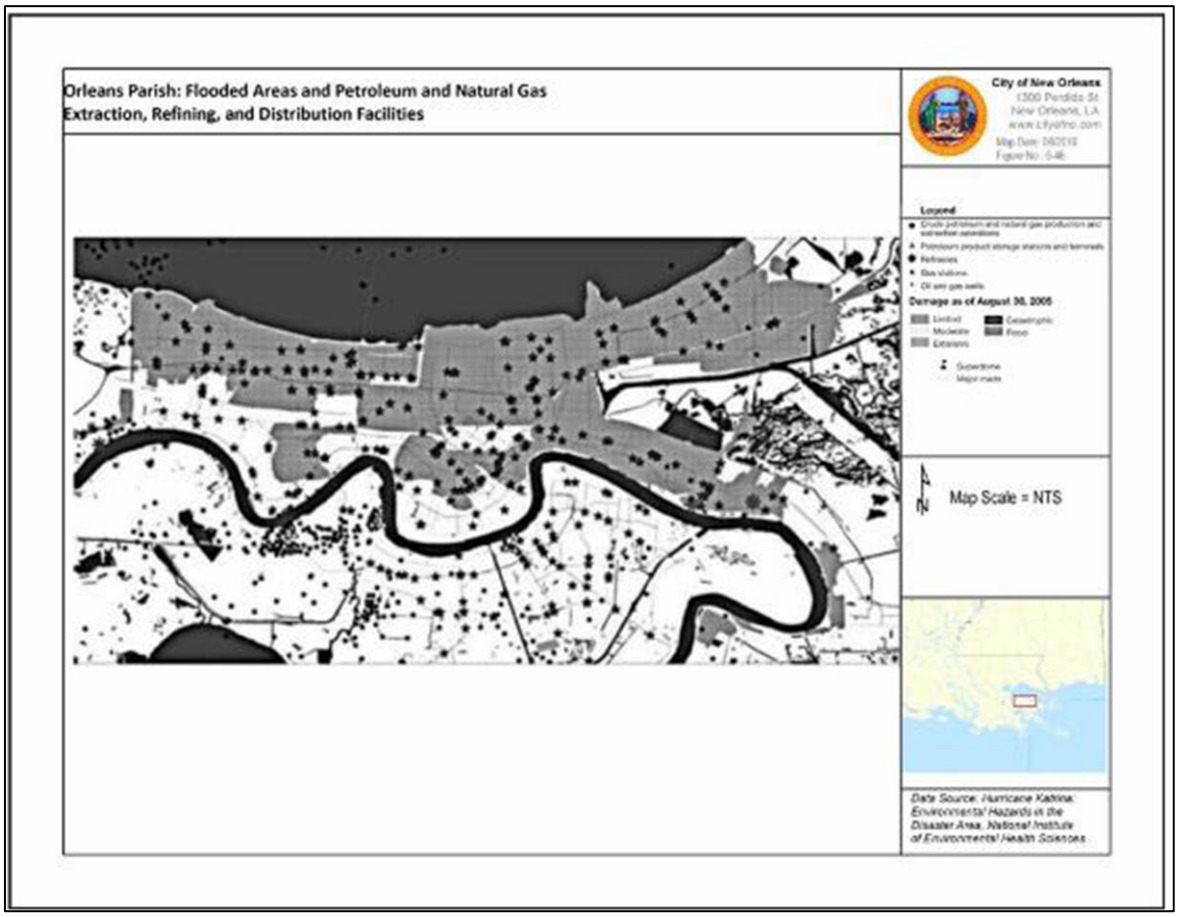
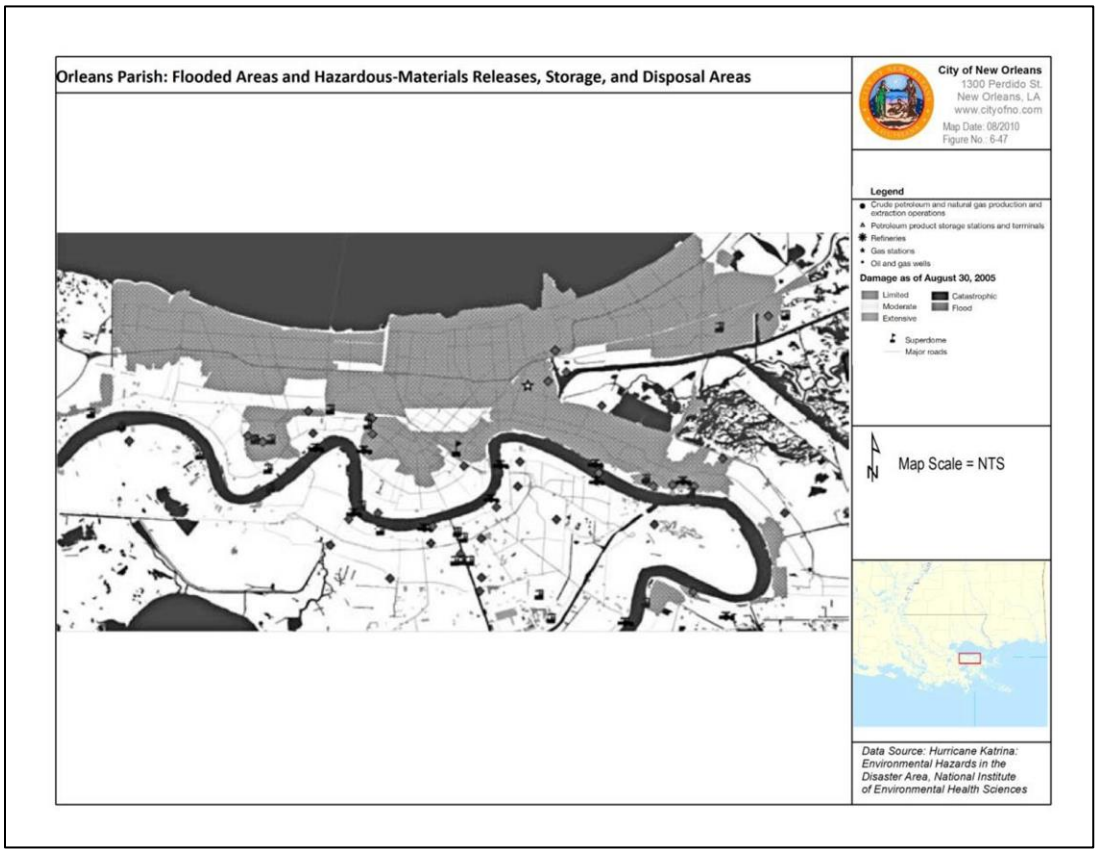


Figure 6-34 Orleans Parish: Flooded Areas and Hazardous-Material Releases, Storage, and Disposal Areas
(Source: Hurricane Katrina: Environmental Hazards in the Disaster Area, National Institute of Environmental Health Sciences, 2005)



In addition to the possible contamination from the fixed sites described above, a study completed in 2009 by the University of Texas titled Hurricane Katrina: Environmental and Engineering Concerns identified numerous possible contaminates released into the floodwater of Katrina.

Hundreds of commercial establishments, such as service stations, pest control businesses, and dry cleaners, use potentially hazardous chemicals that may have been released into the environment by the floodwater. The potential sources of toxics and environmental contaminants included metal-contaminated soils typical of old urban areas and construction lumber preserved with creosote, pentachlorophenol, and arsenic. Compounding these concerns is the presence of hazardous chemicals commonly stored in households and the fuel and motor oil in approximately 400,000 flooded automobiles. Uncontrolled biological wastes from both human and animal sources also contributed to the pollutant burden in the City.

Figure 6-35 Cars Flooded after Hurricane Katrina

There are more than 3,500 oil rigs/platforms located in the Gulf of Mexico with roughly 700 off the coast of Louisiana. Today, the offshore oil and gas industry has an economic impact of $44.3 billion for the state of Louisiana.

Figure 6-36 Oil and Gas Extraction Infrastructure in HIB Region

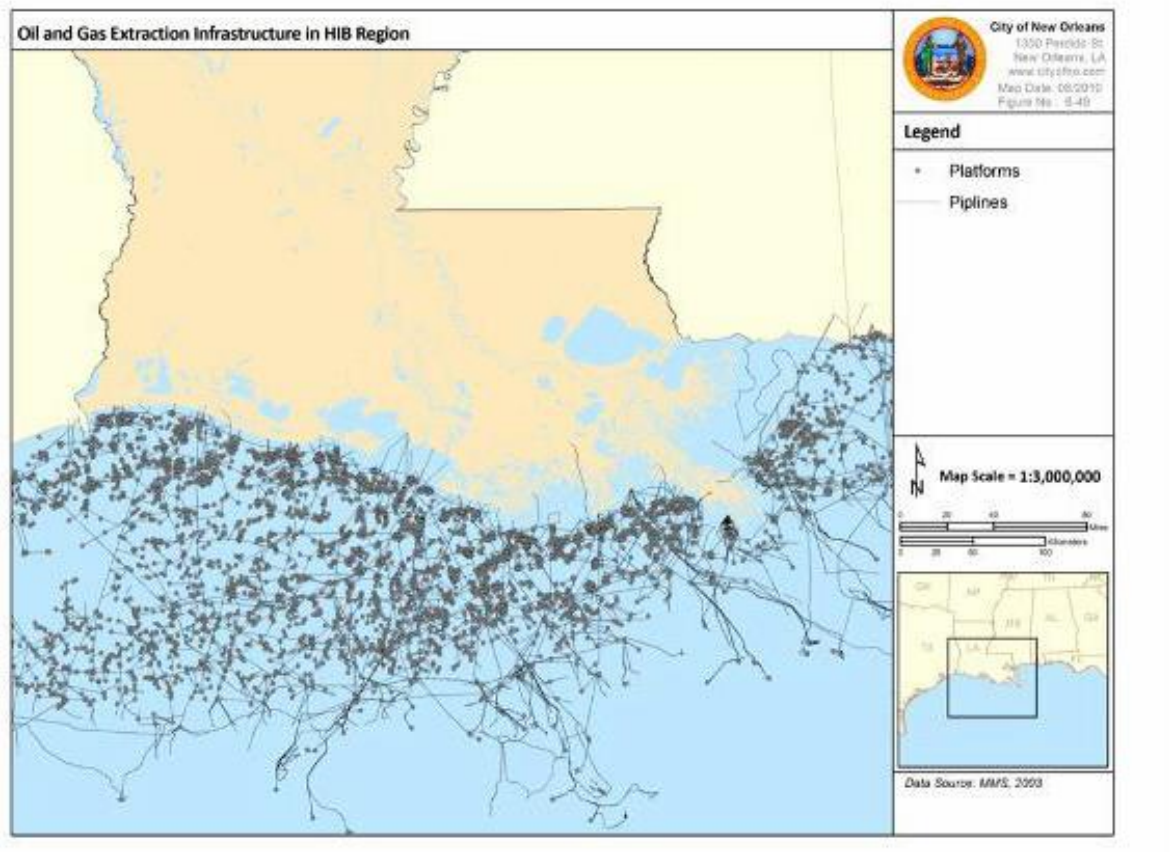
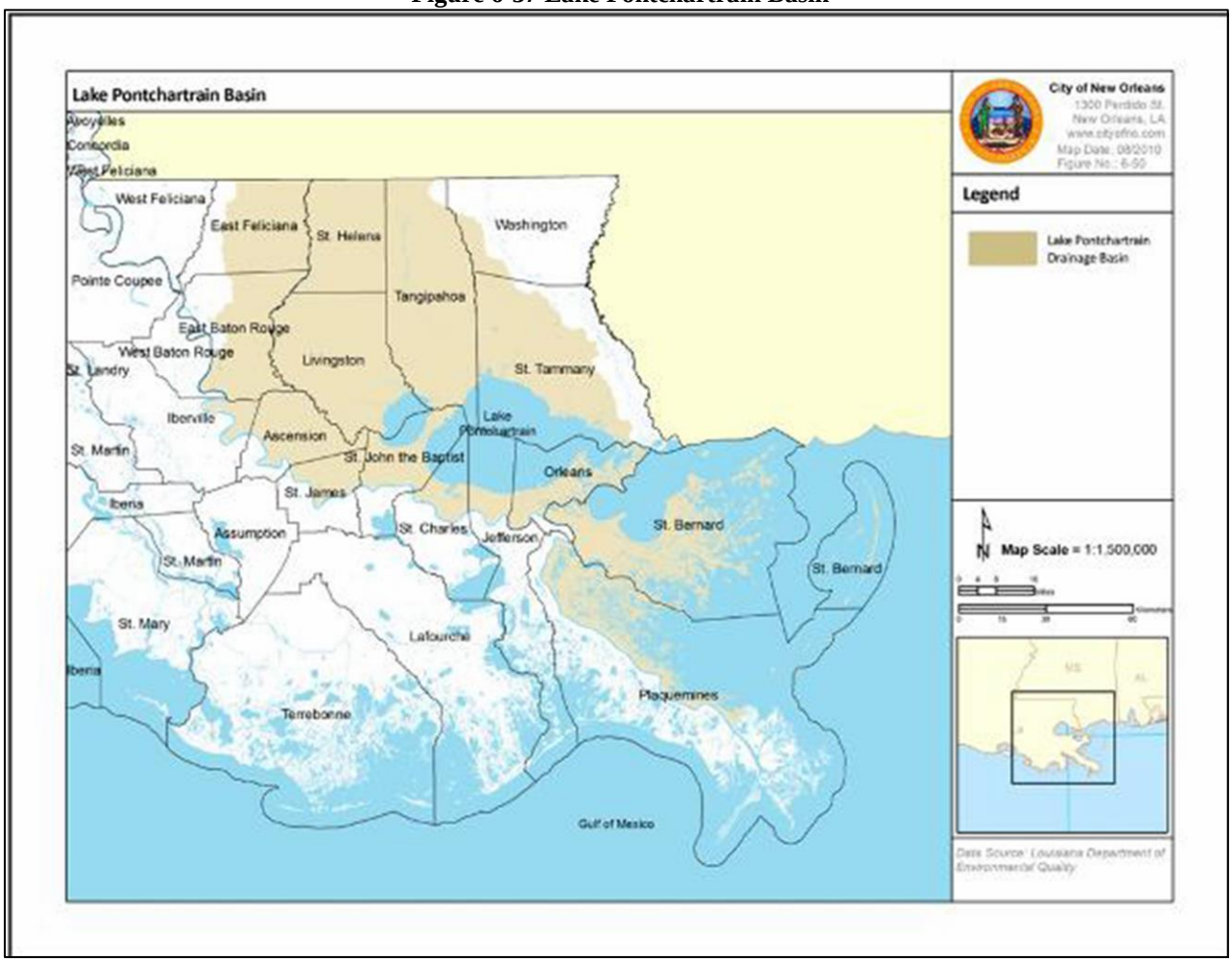


Figure 6-37 Lake Pontchartrain Basin



While there are multiple safety measures built into the various stages of the process, spills are real possibilities. On April 20, 2010 the Deepwater Horizon drilling rig exploded, killing 11 people and leaking oil into the Gulf of Mexico. An April 27, 2010, Times Picayune newspaper article stated: "Advocates for preserving Louisiana's battered coastal ecosystem are sometimes accused of hyperbole in assessing its diversity and productivity. But that criticism may end after the list of species coastal scientists said are threatened by the oil spill moving toward the coast reached more than 400.[109] From whales and tuna to shrimp and neo-tropical songbirds, the array of life that depends on a clean Gulf of Mexico and functioning coastal estuaries can stun even those who make a living studying the area. The economic impacts of the oil spill are still being determined.

While Orleans Parish is not located directly on the Gulf of Mexico, Orleans Parish, Lake Pontchartrain, and the Mississippi are directly affected by the Gulf of Mexico water. Water flows in and out of Lake Pontchartrain in an area known as the East Orleans Land Bridge via either the Rigolets or the Chef Menteur Pass - both located on the far east end of the lake and via the Mississippi River. Preservation of Orleans Parish water is important to the quality of life for Orleans Parish residents both recreationally as well as economically via water-related tourism and the fishing industry. Commercial fishing in Orleans Parish brings approximately $1,500,000 into the Parish economy every year; this represents dockside values not the seafood in local restaurants. The overall economic impact is several times this. Commercial fishing includes (but is not

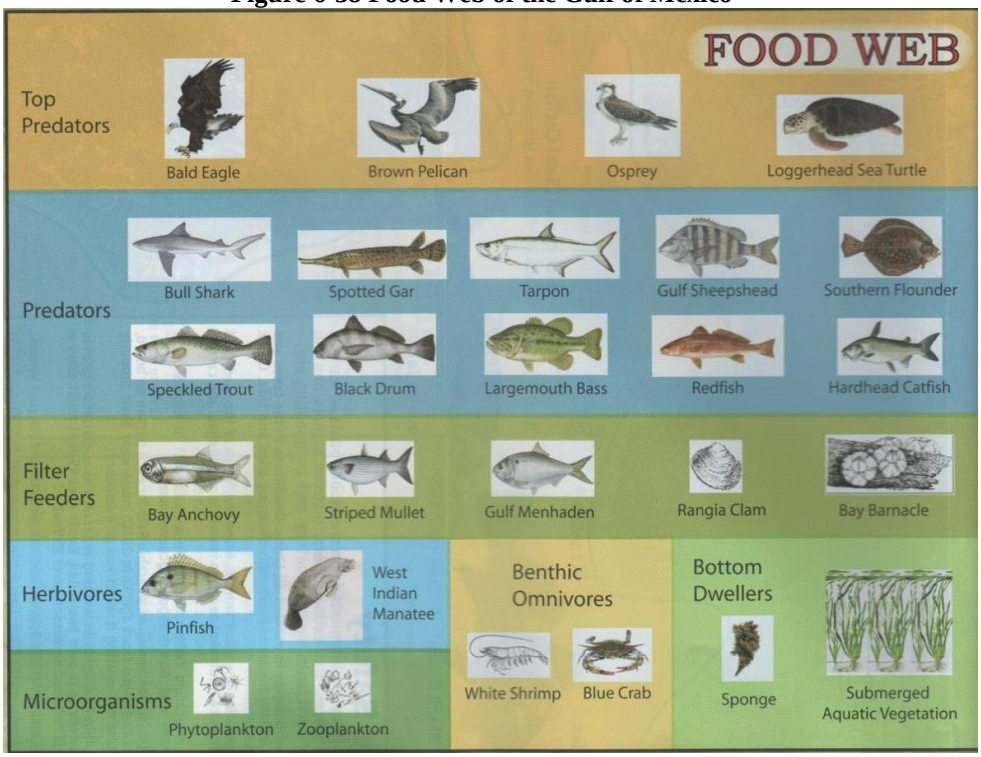
limited to) shrimp, crab, and oysters. Recreational fishing is common in Orleans Parish water as well.

The Bayou Sauvage National Wildlife Refuge is located in eastern Orleans Parish at the south end of the Lake Pontchartrain Sanctuary, and Fort Pike State Park is found at its north end. According to the U. S. Fish & Wildlife Service "Bayou Savage National Wildlife Refuge" was established in 1990. Its 24,293 acres of fresh and brackish marshes, all within the city limits of New Orleans, make it the nation's largest urban wildlife refuge. Bayou Sauvage is only 15 minutes from the French Quarter. Most of the refuge is inside massive hurricane protection levees, built to hold back storm surges and maintain water levels in the low-lying city."

The U.S. Fish and Wildlife Service states:

> An enormous wading bird rookery can be found in the swamps of the refuge from May until July, while tens of thousands of waterfowl winter in its bountiful marshes. The refuge contains a variety of different habitats, including freshwater and brackish marshes, bottomland hardwood forests, lagoons, canals, borrow pits, chenieres (former beach fronts) and natural bayous. The marshes along Lakes Pontchartrain and Borgne serve as estuarine nurseries for various fish species, crabs and shrimp. Freshwater lagoons, bayous and ponds serve as production areas for largemouth bass, crappie, bluegill and catfish. The diverse habitats meet the needs of 340 bird species during various seasons of the year. Peak waterfowl populations of 75,000 use the wetland areas during the fall, winter, and early spring months.

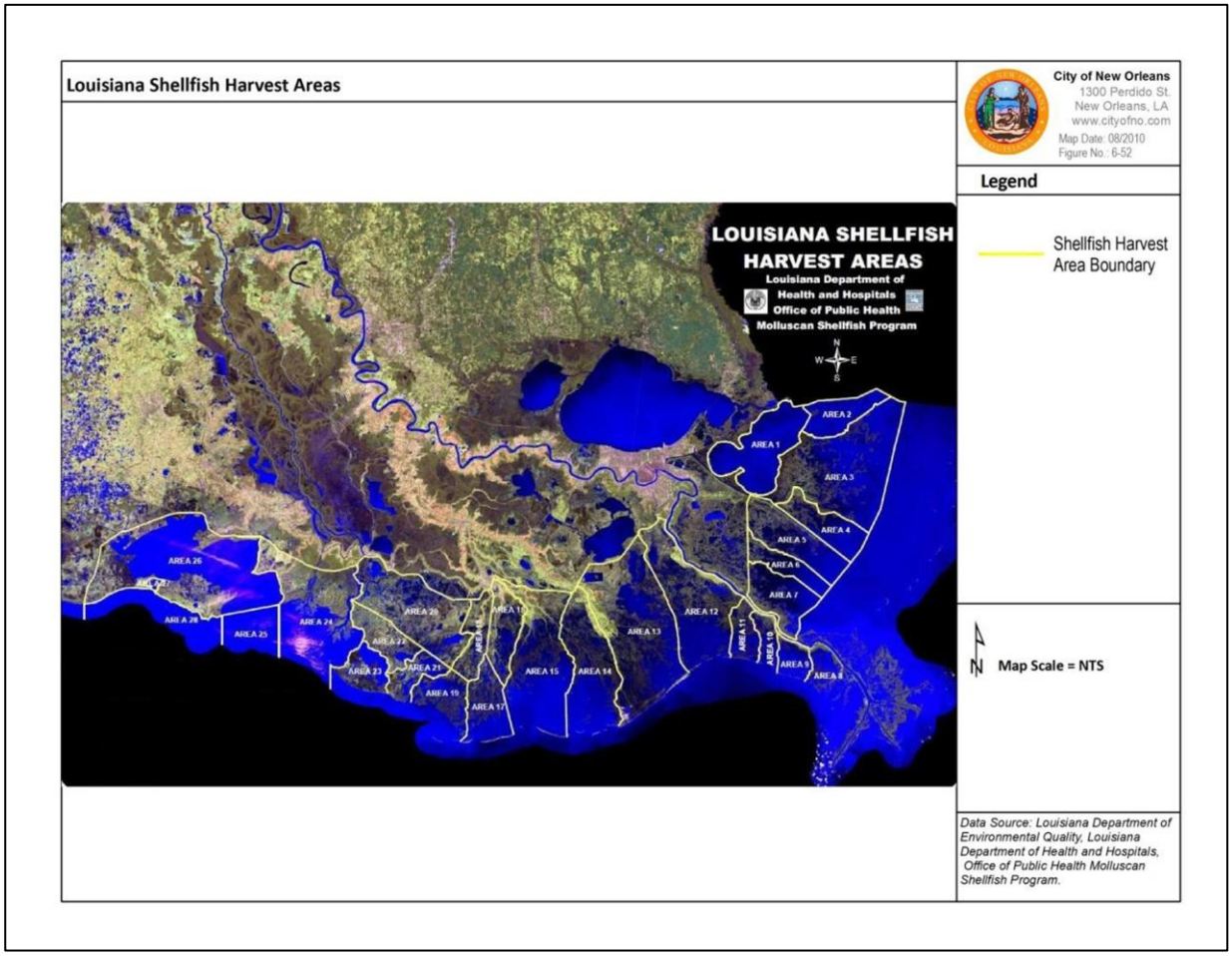
Figure 6-38 Food Web of the Gulf of Mexico



While shrimp are primarily taken in the Gulf, they are also harvested in Lake Pontchartrain and the surrounding wetlands and brought into stations within the Parish. There are no commercial oyster harvest areas within the Parish (see map below); however, there are numerous oyster and shrimp processing facilities that depend directly on these harvests, not to mention the restaurants and other value-added processing. Any spill/contamination to the Gulf water in and around southeast Louisiana will have a deleterious effect on the economy of Louisiana including Orleans Parish.

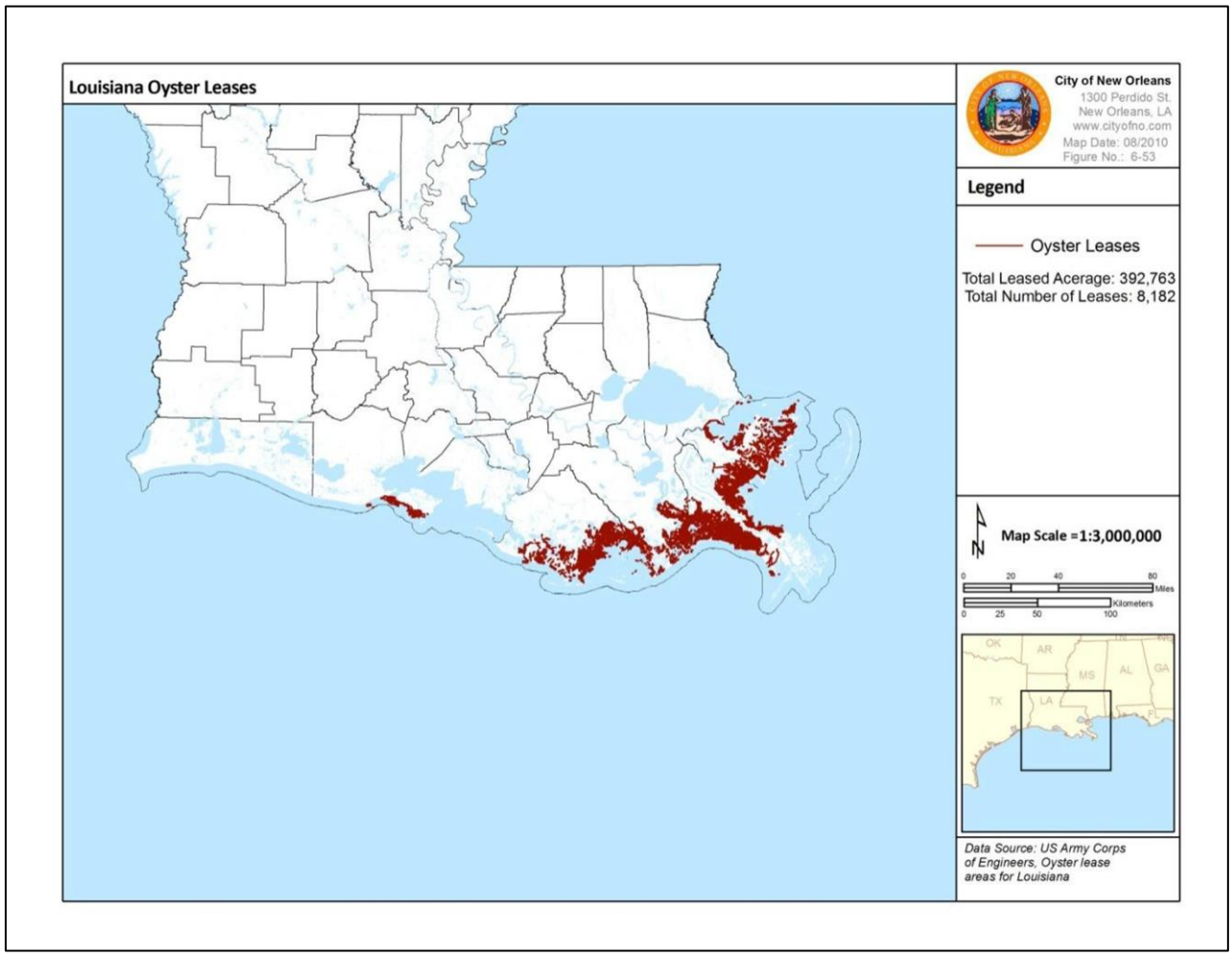
Crabs are found in many water areas throughout the Parish and the harvesting of crab is legal throughout these waters. Recreational crabbing is an important activity to many families in New Orleans. Hundreds of families own camps on the "Land Bridge" between the Rigolets and Chef Pass. This land bridge and its health are a critical storm surge barrier that protects the entire Greater New Orleans region.

Figure 6-39 Louisiana Shellfish Harvest Areas



There are no oysters in Lake Pontchartrain, and no commercial or private oyster lease areas are located in Orleans Parish. However, the oldest oyster house in America (P&J Oysters in the French Quarter) and many restaurants depend on fresh Louisiana Oysters and their signature dish. The closest lease area is immediately east offshore of the area called the Rigolets. Figure 6-40 shows the locations of the oyster leases.

Figure 6-40 Louisiana Oyster Leases



Procedures must be in place to protect Lake Pontchartrain and the Mississippi River from oil spills in the Gulf of Mexico. While winds and water currents greatly affect where and how oil spills move in the Gulf, the areas at which contaminated water can enter Orleans Parish should be protected. Measures like hard and soft booms, skimmer equipment, etc., should be positioned near locations like the Rigolets, Chef Menteur and Ft. Pike to protect Lake Pontchartrain from Gulf of Mexico oil spills.

6.3.7 Tornadoes

Description of the Tornado Hazard

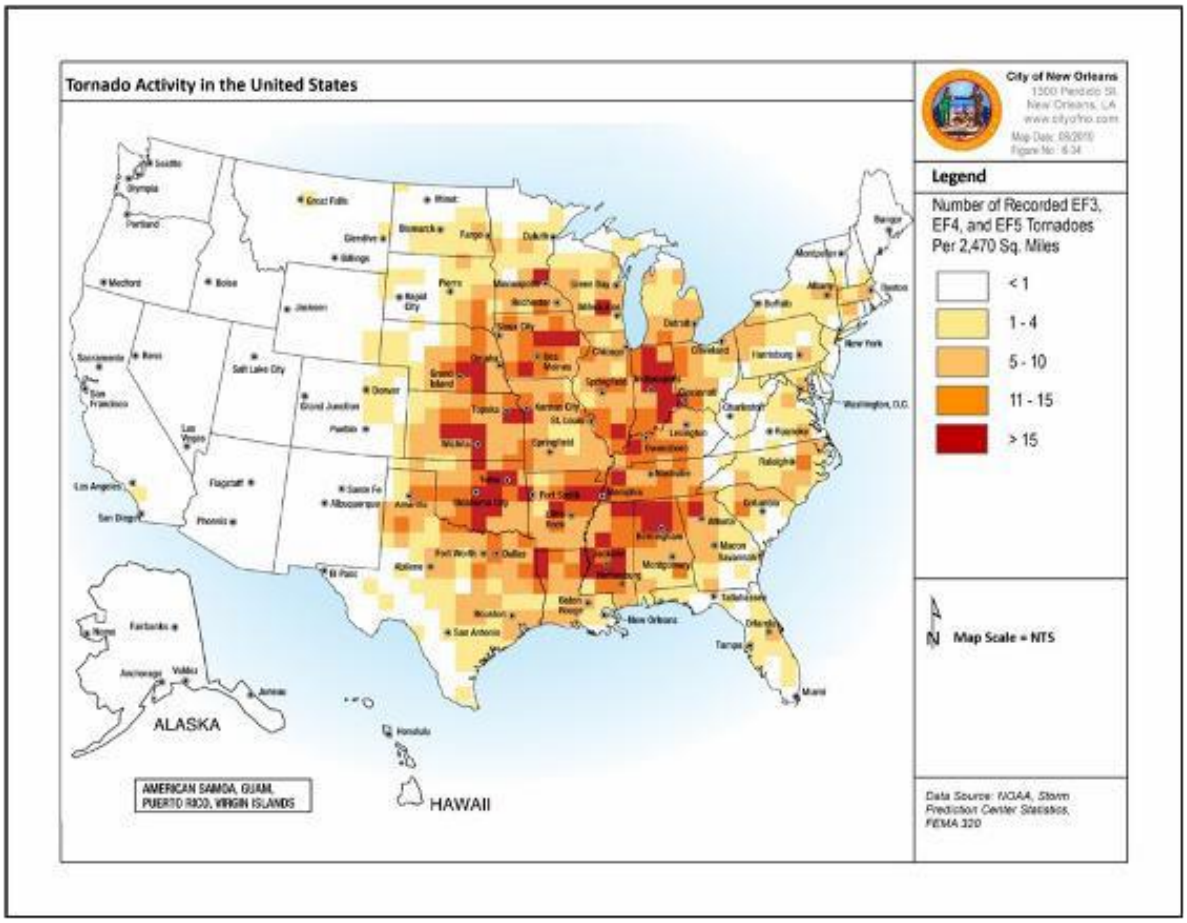
A tornado is a rapidly rotating vortex or funnel of air extending ground ward from a cumulonimbus cloud. Most of the time, vortices remain suspended in the atmosphere. When the lower tip of a vortex touches the ground, the tornado becomes a force of destruction. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. In extreme cases, winds may approach 300 mph. Damage paths can be in excess of 1 mile wide and 50 miles long. Tornado statistics from the NWS indicated that the United States averaged 2,733 tornadoes between 2012 and 2014. The highest monthly average during this time period occurred in May and June with an average of 173 tornadoes each.

Tornadoes are most hazardous when they occur in populated areas. Tornadoes can topple mobile homes, lift cars, snap trees, and turn objects into destructive missiles. Among the most unpredictable of weather phenomena, tornadoes can occur at any time of day, almost anywhere in the country, and in any season. In Louisiana, tornadoes have a higher frequency in the spring months of March, April, and May. While the majority of tornadoes cause little or no damage, some are capable of tremendous destruction. Additionally, tornadoes are often generated from hurricanes, so the entire hurricane season has to be viewed as a risk period for this hazard.

Location and Extent of the Tornado Hazard

From 1953 to 2004, NOAA indicates that Texas experienced the highest average annual number of tornadoes with 139, followed by Oklahoma (57), Kansas and Florida (55 each), and Nebraska (45). Louisiana ranked tied for 10th (with Alabama) in the United States during this time period, averaging approximately 27 tornadoes per year. In Louisiana, peak tornado occurrence is in March through May, and in November. Figure 6.41 shows tornado activity in the United States. The map indicates that NOAA has recorded 1-5 tornadoes per 1,000 square miles in eastern Louisiana, including Orleans Parish. Because there is no defined geographic boundary, all people and property within the planning area are exposed to the risk of damage from tornados. All buildings, facilities and above ground infrastructure of the entire parish is at risk. In short, the entire Parish is vulnerable to Tornadoes.

Figure 6-41 Tornado Activity in the United States



(Source: FEMA 320)

An area covering portions of Texas, Oklahoma, Arkansas, Missouri, and Kansas is known as Tornado Alley, where the average annual number of tornadoes is the highest in the United States. Cold air from the north collides with warm air from the Gulf of Mexico, creating a temperature differential on the order of 20 – 30 degrees centigrade.
Most tornadoes in this area occur in the spring.

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

Severity of Tornado Hazard

Tornado damage severity was previously measured by the Fujita Tornado Scale. The Fujita Scale assigned numerical values based on wind speeds and categorized tornadoes from 0 to 5. The letter "F" often preceded the numerical value. Tornadoes are related to larger vortex formations and, therefore, often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. See Table 6.24 for the Enhanced Fujita tornado Measurement Scale. The period of record for the table is 1/1/1950 to 4/1/2015.

Table 6-24 Enhanced Fujita Tornado Measurement Scale

(Source: NOAA)

Category	Wind Speed (mph)	Examples of Possible Damage
EF0	65-85	Light damage. Some damage to chimneys; break branches of trees; push over shallow rooted trees; damage to sign boards.
EF1	86-110	Moderate damage. Peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
EF2	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
EF3	136-136	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
EF4	166-200)	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	>200	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through air in excess of 100 yards; trees debarked; incredible phenomena will occur.

In February of 2007, the F-Scale was replaced with the more accurate Enhanced Fujita Scale (EF-scale). It was the Jarrell, Texas, tornado of May 27, 1997, and the Oklahoma City/Moore tornado of May 3, 1999, that brought to the forefront the problem that perhaps the wind estimates were too high in the original F-Scale. The changes to the original scale were proposed by a committee of meteorologists and engineers searching for a more accurate method of assessing the magnitude of tornadoes. Changes to the original Fujita scale were designed to ensure compatibility with the existing databases of tornado hazards, including the one maintained by the NCDC.

The EF scale has the same basic design as the original Fujita scale, six categories from 0 to five representing increasing degrees of damage. It was revised to reflect better examinations of tornado damage surveys, so as to align wind speeds more closely with associated storm damage. The new scale also considers damages to a wider variety of structures and better accounts for variables such as differences in construction quality. Table 6.25 displays the wind speed ranges for the original Fujita Scale, the derived wind speeds (EF-scale), and the new Enhanced Fujita scale, in wide use since February of 2007.

Table 6-25 Wind Speed Comparison of the Fujita Scale and Enhanced Fujita Scale
(Source: NOAA – National Weather Service)

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**

2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-206	162-209	3	138-167	**3**	**136-165**
4	207-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

Tornadoes have potential impact on Orleans Parish equally and uniformly. Based on tornadoes identified in the NCDC database for Orleans Parish ranged in severity from an F0 to an F2 can be expected. See Table 6.26 for Louisiana's ranking nationwide for tornadoes between years 1950 and 1994. The table lists how Louisiana ranks in the nation for number of tornadoes, fatalities, and injuries caused by tornado events, and accumulated dollar damages. Louisiana ranks within the top 20 States in the nation for all four categories, as seen by the ranking, indicating that it has a relatively high probability for occurrences and damages. As part of the 2015 Plan update, open sources were reviewed in search of more recent tornado ranking statistics, but no updated data was identified.

Table 6-26 Louisiana National Ranking for Tornadoes, Fatalities, Injuries, and Damages from 1950-1994
(Source: NOAA)

Tornadoes							
Rank	Number	Rank	Number	Rank	Number	Rank	Dollar
10	1,086	13	134	16	2,169	15	$593,237,248

Another useful gauge of how intense tornadoes are likely to be in an area is the design wind speeds for community shelters recommended by the ASCE. The ASCE divides the country into Wind Zones based on 40 years of tornado history and 100 years of hurricane history. Orleans Parish is in Wind Zone III, meaning community shelters should be designed to withstand 200 mph winds. This corresponds approximately to the highest wind speed of an EF-5 tornado or a strong Category 5 hurricane.

Impact on Life and Property

The NCDC reports that 17 tornadoes, including water spouts, have occurred in Orleans Parish between 1/11950 and 4/1/2015. The tornadoes caused an estimated $8.9 million in property damage. For all 17 tornadoes, there was 1 death and 32 injuries. The injuries and deaths occurred from 2 tornadoes that occurred on the same day, February 13, 2007. The tornado in the Carrollton area resulted in 15 injuries, while the Gentilly tornado resulted in 1 fatality and 10 injuries. Both tornadoes are summarized in the following subsection.

With a total of 17 tornadoes between 1950 and 2015, Orleans Parish experiences a tornado event on average about once every 3.8 years. The 17 events have occurred over a period of 65.25 years which calculates to a 28 percent annual probability of future tornado occurrences.

Effective January 2004, New Orleans adopted the International Building Code, which requires new structures to be able to withstand winds up to 140 mph. Previously, New Orleans had followed the Standard Building Codes created by the Southern Building Code Congress International, which was established in 1940. This building code requires buildings to withstand 110-mph winds. Buildings constructed to fit these guidelines would be able to withstand an EF-0 or an EF-1 tornado. However, structures built before 1940 were built under a different building code or no code at all.

Approximately 31.3 percent of the housing units in Orleans Parish, or 59,494 units, were built before 1939. Most of the housing units south of I-610 and west of the Industrial Canal were built before 1939. It is difficult to know how vulnerable older houses are to tornadoes. Many older houses were built with heavier materials, such as plaster and larger timbers,

which allow them to withstand higher winds than many newer houses can withstand.

The major commercial and government buildings in Orleans Parish are newer than the housing stock. The original Parish Hazard Mitigation Plan indicated that 14 of the 18 Class A office buildings in the New Orleans Central Business District were built after 1980. Many other major structures, such as the University of New Orleans and the Superdome, also date from the second half of the last century. Because much of the stock of major commercial and governmental buildings was built under modern building codes, the typical tornado in Orleans Parish should cause minimal damage to these structures and result in little functional downtime for businesses.

Although Orleans Parish is not especially prone to tornadoes compared to other parts of the country, much of the building stock is vulnerable to damage from this hazard. This is particularly true of older, wood-frame structures that were built prior to the inception of modern building codes and construction practices in the Parish. Although nearly any structure would fail under the wind loads related to tornadoes of EF-3+ winds, less robust structures are likely to experience envelope and roof connection failures at much lower wind speeds. It is worth noting that hurricane and thunderstorm-related winds are much more likely to occur in the Parish, and the vulnerabilities are substantially the same. Most recently-constructed facilities are much less vulnerable to wind damage than older ones, although accurately characterizing wind vulnerabilities for specific structures and populations requires engineering study on a case-by-case basis, which is outside the scope of this HMP update.

Although there are clear differences between winds generated by tornadoes versus hurricanes and thunderstorms, as noted in the high-wind subsection above, it may be possible to prioritize areas of Orleans Parish or structural classes for further wind (including tornado) vulnerability studies bases on percent expected damage or the dollar amount of damage. Section 7 of the HMP update (specifically the subsection called Hurricane Wind Risk in Orleans

Parish), presents a series of tables with this information. It should be recognized that most of the potential risk from tornadoes is related to life safety, so high population-density areas are at somewhat greater risk that others.

Occurrences of the Tornado Hazard

Of the 17 tornadoes identified in the NCDC and SHELDUS database, 4 were an F-0, 5 were an F-1, and 7 were an F2. Note that the NCDC database does not report the tornadoes using the Enhanced Fujita scale, but instead uses the earlier Fujita scale. As such, it is not practical nor would it be technically accurate to convert the data to the Enhanced Fujita scale.

Table 6-26 Tornado Events, Orleans Parish, 1950 – 2015
(Source: NOAA/NCDC/SHELDUS)

Date	Time	Type	Magnitude	Property Damage ($)
11/01/1951	07:00 AM	Tornado	F1	25K
07/17/1953	12:20 PM	Tornado	F2	250K
06/27/1957	06:00 AM	Tornado	F0	25K
07/13/1957	12:50 PM	Tornado	F0	2K
03/31/1962	07:00 AM	Tornado	F1	3K
10/03/1964	09:00 AM	Tornado	F2	2.5M
03/10/1971	02:00 AM	Tornado	F2	2.5M
12/06/1971	01:20 PM	Tornado	F1	25K
07/29/1977	11:50 PM	Tornado	F1	25K
06/22/1981	01:45 PM	Tornado	F2	25K

04/19/1991	01:30 PM	Tornado	F1	25K
08/10/2000	04:12 PM	Tornado	F0	0
06/30/2003	11:45 AM	Tornado	F0	5K
02/02/2006	02:42 AM	Tornado	F2	500K
02/13/2007	03:03 AM	Tornado	F2	2.0M
02/13/2007	03:10 AM	Tornado	F2	1.0M
7/6/2010	04:00 AM	Tornado	F0	10k
Grand Total		I		**8.910M**

The last occurrence was in July of 2010. There have been no other occurrences since that time. There has not been a tornado stronger than an EF2 in Orleans Parish in at least 60 years. Since 1950, Orleans Parish has experienced 17 tornadoes, 14 of which caused $25,000 or more in reported damages. Only three tornadoes in Orleans Parish have caused more than $25,000 in damage. In 1953, an F2 tornado caused $250,000 in damage.
In 1964, Orleans Parish had an F2 tornado that caused $2.5 million in property damage (no detailed description is provided by the NCDC). In 1971, Orleans Parish had two tornadoes – one (F1) causing $25,000 in damage and another (F2) causing $2.5 million in property damage. It should be noted that tornadoes (in particular, low-magnitude events in unpopulated areas) are often not reported, and in many cases the NCDC data does not fully capture all damages from reported events because insurance payments through private-sector companies covers repairs, and data about payments is proprietary.

Significant events are summarized below from the details of the NCDC database:

- **February 2, 2006.** The tornado, which initially moved through the east portions of Metairie, continued to move northeast through the Lakeview and Lakefront neighborhoods of New Orleans. The same areas had previously been flooded by Hurricane Katrina in 2005, and most homes were unoccupied. Several homes suffered substantial damage to roofs, windows were blown out, and power poles were toppled. Several two-story homes suffered substantial damage to the second floor. A large communication tower was toppled at a former State police building. Damage estimates from the event totaled $500,000.
- **February 13, 2007.** An EF-2 Tornado (Enhanced Fujita Scale) moved through the City of Westwego and the Carrollton area of New Orleans. The damage observed indicated an intensity in the mid-to- upper range of an EF-2 tornado on the Enhanced Fujita Scale with winds estimated to be in the 125- 130 mph range. A total of 295 houses in New Orleans and 231 in Jefferson Parish were damaged. A total of 79 houses were destroyed in both Jefferson and Orleans Parishes. One woman was killed and 25 people were injured. A Federal Disaster Declaration (DR-1685) was declared for three Parishes including Orleans. Damage estimates from the event totaled approximately $2 million. A second EF-2 tornado touched down just south of the intersections of Franklin Avenue and Prentiss Street and moved east northeast across the southern portion of Pontchartrain Park to the Industrial Canal. Roofs were blown off of several homes and the upper portions of two-story houses were partially collapsed. One fatality occurred when a travel trailer was destroyed, killing the 86-year old occupant[84].

Although Orleans Parish is subject to occasional tornadoes, this area of the country is not a high probability location for these events. Also, given the relatively small physical area being considered, the statistical likelihood of a significant tornado impacting the Parish is very low, calculated at approximately 28% annually.

6.3.8 Subsidence

Description of the Subsidence Hazard

Subsidence is the motion of the Earth's surface as it shifts downward, relative to sea-level. Land subsidence, the loss of surface elevation due to the removal of subsurface support, ranges from broad, regional lowering of the land surface to localized collapse. Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of years.

The single most important factor that has contributed to subsidence in the region is the change to the hydrology of southeast Louisiana, including Orleans Parish. River deltas naturally undergo accretion and subsidence. Accretion is the process by which sediments accumulate through flooding of the banks and natural levees. Subsidence occurs as these sediments compact over time. Prior to the 20th Century, the accretion process equaled or exceeded the subsidence process in the Mississippi River Delta. However, the creation of flood-protection levees along the Mississippi River has stopped the accretion process in recent decades. Thus, there is nothing to counteract the natural subsidence that occurs in this area.

In the United States, the average annual damage from all types of subsidence is estimated conservatively to be at least $125 million. Cities where cumulative damage from subsidence that exceeds $100 million include Long Beach, California; Houston, Texas; and Orleans and Jefferson Parishes, Louisiana. Louisiana's coastal system has also been heavily impacted by channels dug for navigation and mineral extraction, which have allowed high-salinity Gulf water to migrate inland. Over 1 million acres of coastal land have been lost since the 1930s, and the USGS estimates that approximately 44 square miles of Mississippi River Delta plain are lost to erosion annually.

Location and Extent of the Subsidence Hazard

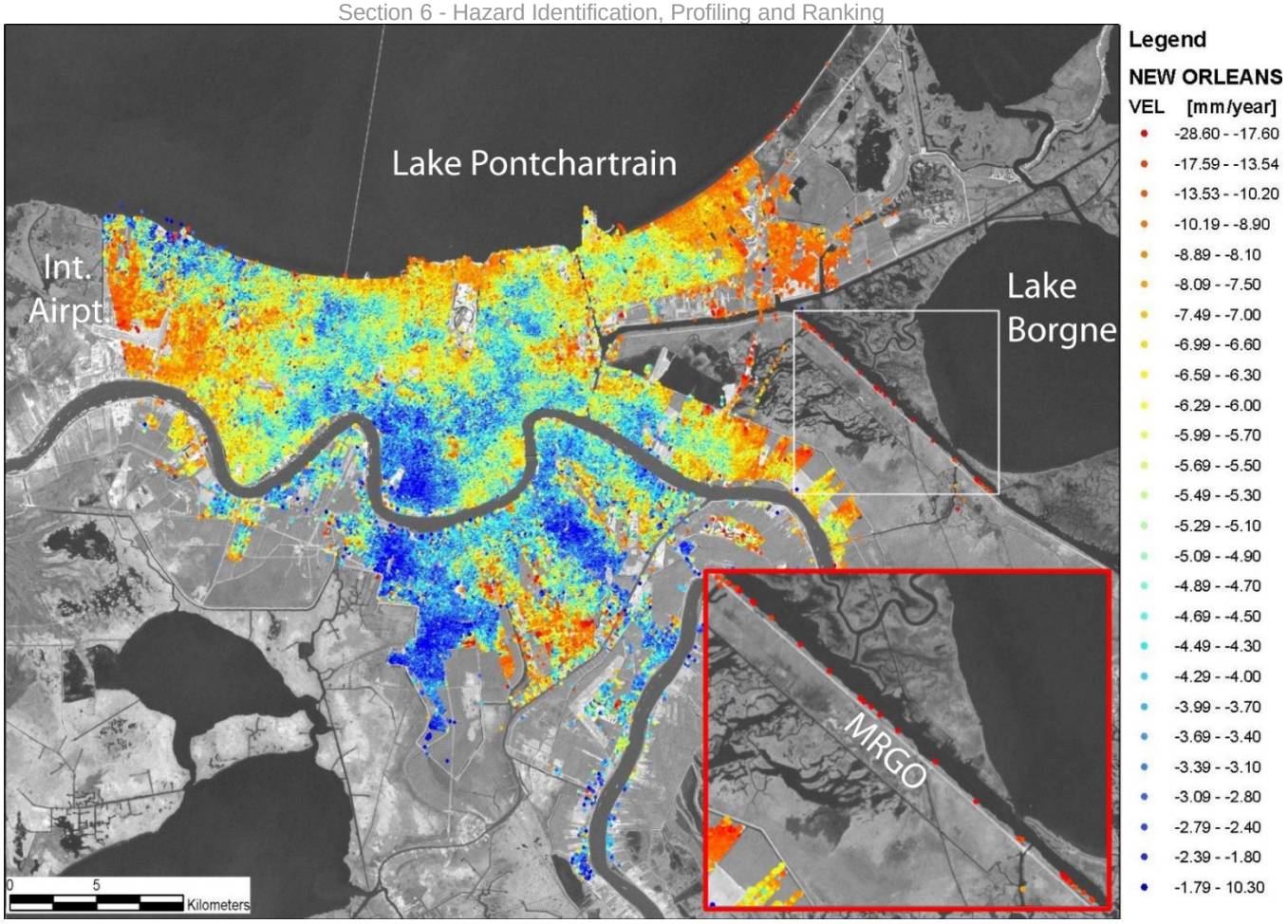
The Mississippi River Delta Basin in southeastern Louisiana is particularly vulnerable to erosion and inundation due to the rapid deterioration of coastal barriers combined with relatively high rates of land subsidence. Subsidence of the land surface in the New Orleans region is mainly attributable to the drainage and oxidation of organic soils, aquifer- system compaction related to groundwater withdrawals, natural compaction and dewatering of surface sediments. As mentioned above, the problem is exacerbated as a result of flood-protection measures and disruption of natural drainage paths that reduce sediment deposition in the New Orleans area.

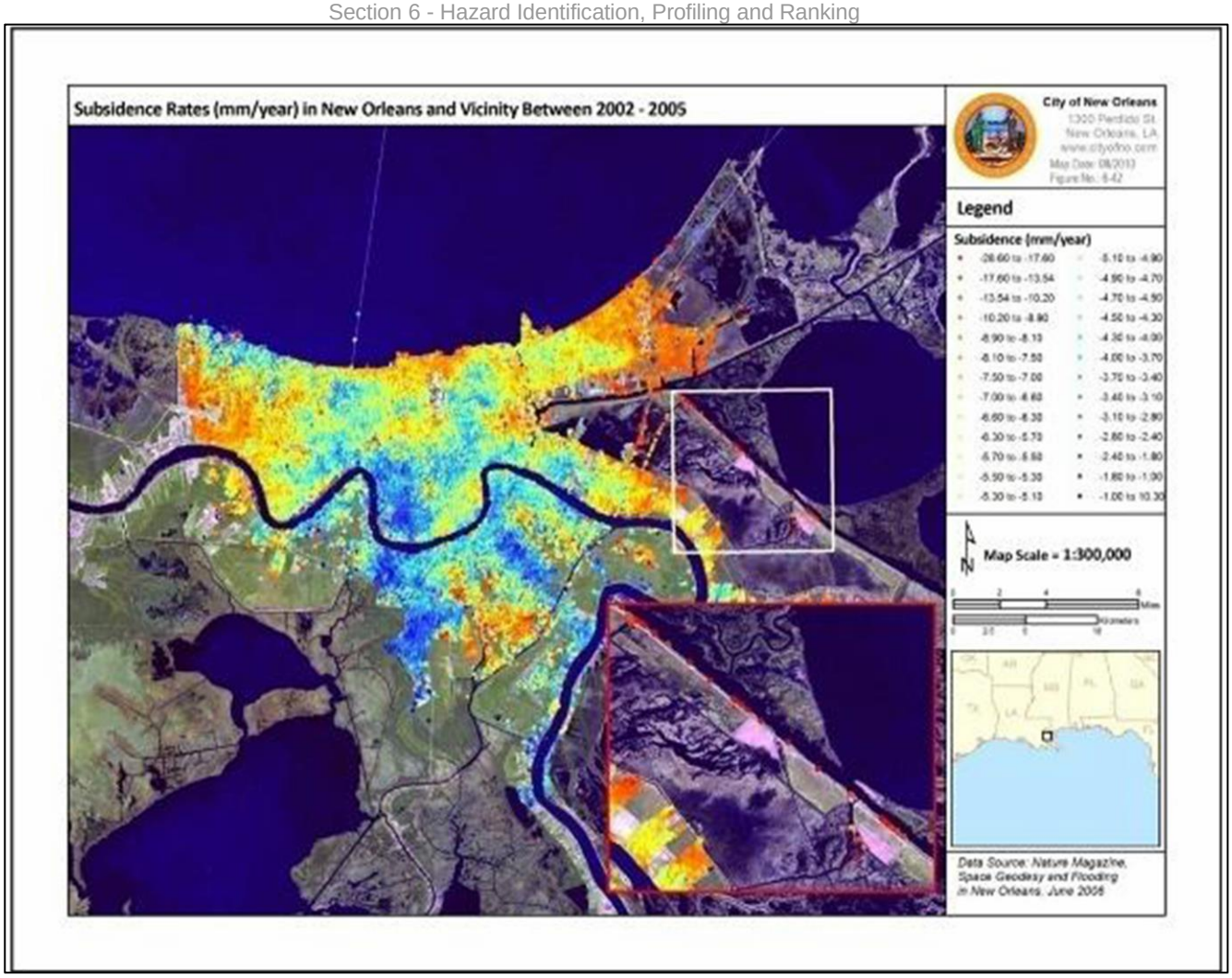
A variety of sources and technical reports were reviewed to determine the extent of subsidence in New Orleans. Review of the *Flood Risk in New Orleans* report indicates that the most comprehensive perspective on subsidence in the City of New Orleans has come from the analysis of satellite radar (interferometry) data published in the journal *Nature* in June of 2006. An international team of scientists determined the subsidence rates in New Orleans in the 3-year period prior to Hurricane Katrina. The research team measured subsidence by examining data collected by RADARSAT, a satellite that can measure surface-height changes within millimeters. Measurements between April 2002 and July 2005 determined the average rate of absolute subsidence across the city of New Orleans to be 0.2 inches +/- 0.1 inches (5.6 mm +/- 2.5 mm) per year. Higher rates of subsidence were found in the Lakeview region along the southern shores of Lake Pontchartrain, while in parts of St. Bernard and Orleans parishes land was subsiding at more than 0.8 inches (20 mm) per year, including locations along the levee system that bounds the MRGO. The study also determined that a number of the levee breaches that occurred as a result of Katrina corresponded with the locations of some of the highest rates of subsidence.

The radar study confirmed what had already been learned from studies of the elevation changes of individual benchmarks -- that higher rates of subsidence were found where the former marshland had been loaded by buildings, roads, and levee causeways. However, loading does not explain the background geologically rapid subsidence found across the whole of southern Louisiana, which has to have some broad tectonic origin, on which is superimposed some local and superficial effects related to peat shrinkage and the compaction of recent sediments. One of the scientists from the 2006 study published in *Nature* (Roy Dokka, 2006) has proposed that the primary subsidence of southeast Louisiana is related to slow slumping, along underlying listric faults of a major section of the continental margin almost 200 miles (320 km) across towards the Gulf of Mexico. Listric faults are curved normal faults, in which the fault surface is shaped in a concave, upwards direction. Whatever the cause, it is reasonable to assume that subsidence rates observed today can be projected into the future; therefore, it is possible to extrapolate how much subsidence will occur by a given date through the coming century. Subsidence rate projections over the next 50 years are presented later in this subsection.

Figure 6-43 shows subsidence rates in New Orleans as measured by NASA. Values are given in millimeters per year as range change in the direction of radar illumination. Negative values indicate motion away from the satellite, consistent with subsidence. Red indicates the areas of highest subsidence rates, up to over an inch (28.6 millimeters) each year. Blue indicates the areas of least subsidence**.** Historically, eastern New Orleans has seen the greatest subsidence in southern Louisiana. This part of the city was 10 to 16 feet below sea level when Hurricane Katrina made landfall in 2005 and consequently saw some of the worst flooding. For example, the line of red dots along the MRGO (which failed in many locations during Hurricane Katrina) indicates that the area experienced some of the highest subsidence rates during the study period. Historical subsidence rates from 1951 to 1995 can be found in the Occurrences of Land Subsidence subsection. This graphic shows that the extent of the subsidence hazard is across the entire planning area.

Figure 6-42 Subsidence Rates (mm/year) in New Orleans and Vicinity
(Source: National Aeronautics and Space Administration, 2006)


Lake Pontchartrain
Int.
Airpt
Lake
Borgne
MRGO
0
5
Kilometers
Legend
NEW ORLEANS
VEL [mm/year]
-28.60 - -17.60
-17.59 - -13.54
-13.53 - -10.20
-10.19 - -8.90
-8.89 - -8.10
-8.09 - -7.50
-7.49 - -7.00
-6.99 - -6.60
-6.59 - -6.30
-6.29 - -6.00
-5.99 - -5.70
-5.69 - -5.50
-5.49 - -5.30
-5.29 - -5.10
-5.09 - -4.90
-4.89 - -4.70
-4.69 - -4.50
-4.49 - -4.30
-4.29 - -4.00
-3.99 - -3.70
-3.69 - -3.40
-3.39 - -3.10
-3.09 - -2.80
-2.79 - -2.40
-2.39 - -1.80
-1.79 - 10.30



Severity of Subsidence

The severity of land subsidence has no generally established measure, except that it can be described in terms of change in ground elevation relative to sea level. Subsidence is generally permanent, although it can be abated with proper management methods. Land subsidence occurs slowly and continuously over time or on abrupt occasions, as in the case of sudden formation of sinkholes. Procedures for determining the probability or frequency of land subsidence have not been established.

The sinking problem in Louisiana, as a result of subsidence, has been estimated anywhere from 6 to 20 inches over the past 20 years, depending on location. This necessitates maintenance to address resulting infrastructure problems. Subsidence continues to be a problem for the Greater New Orleans area, including all of Orleans Parish. Most of these areas are built on Mississippi River silt, and the silt is slowly settling and compacting. Houses not built on deep pilings are experiencing differential settlement and cracking. Subsidence is also responsible for infrastructure problems, including ruptured water and sewer lines. However, it is coastal subsidence that poses the

greatest threat to New Orleans. Loss of land mass makes the City more vulnerable to the effects of hurricanes,

including high winds and storm surge. See Section 6.3.5 for a detailed description of the coastal erosion hazard.

Impact on Life and Property

The costs associated with structural damage due to differential subsidence caused by drainage of organic soils appear to be high. Increased flooding is the most serious problem associated with organic soil subsidence. The cumulative damage caused by drainage of organic soils exceeds $100 million in California, Louisiana, and Florida.

Losses from natural sediment compaction, particularly in the Mississippi River Delta, are difficult to estimate because of the uncertain value of coastal wetlands. Increased flooding potential is the principal impact because affected areas commonly are low lying and naturally subject to flooding. Annual revenue losses are estimated on the order of millions of dollars. For example, collapsible soils added more than $2.5 million in mitigation costs to interstate highway construction in Louisiana. The two States with the highest damage caused from land subsidence are California and Louisiana.

Land subsidence can undermine the integrity of the levee system, potentially leading to levee failure. In Orleans Parish, land subsidence has caused extensive damage to roads and drainage systems, which can cause increased flooding. Land subsidence will most likely continue to be an ongoing problem in Orleans Parish. While the effects on property in the New Orleans metropolitan area can be significant, subsidence is a creeping hazard event, one with chronic, not acute impacts. Subsidence is a constant process that cannot be easily mitigated through comprehensive mitigation actions. Subsidence problems are normally addressed on an individual basis as problems are discovered.

The entire Parish is at risk from land subsidence. However, higher land subsidence rates in the Parish can be found where former marshland has been built upon by buildings, roads, and levee causeways. Figure 6-43 also shows that higher subsidence rates are found along the Mississippi River levee area and the south shoreline of Lake Pontchartrain. Considering subsidence as a separate and distinct natural hazard, Orleans Parish can be considered at overall low vulnerability to its effects. It is important to note, however, that although subsidence itself does not pose a high threat to the Parish, the fact that the hazard is lowering ground elevations relative to sea level significantly exacerbates flood and storm vulnerabilities when events do occur. Areas that are experiencing higher rates of subsidence are necessarily more vulnerable, although high subsidence areas are not the only indicator of risk. Many studies of flood risk and vulnerabilities in southern Louisiana incorporate various scenarios of coastal erosion, subsidence and storm surge to characterize potential losses. Section 7 of this Hazard Mitigation Plan includes detailed discussions of some of these studies.

Occurrences of Subsidence

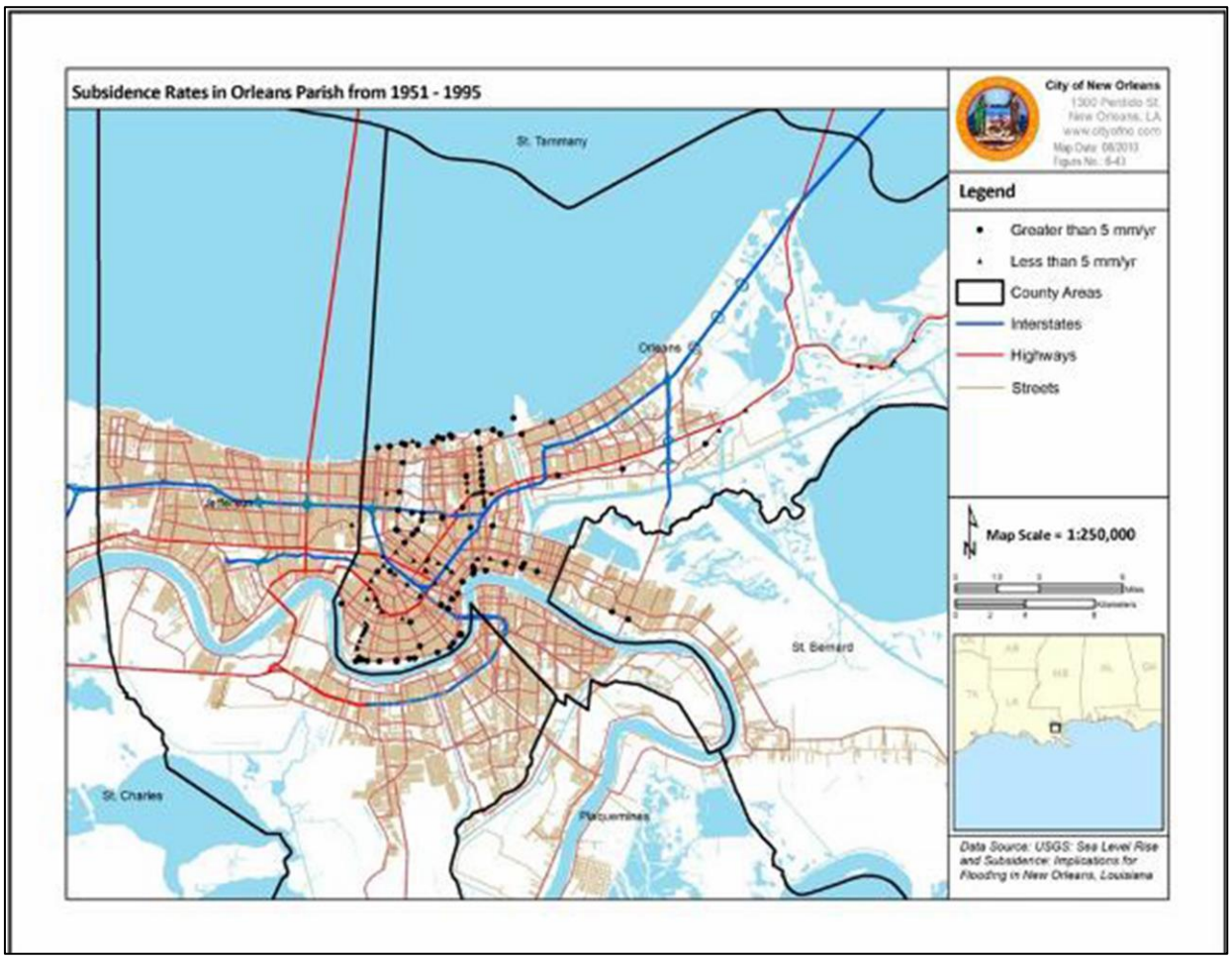
Most of the land surface within the New Orleans Metropolitan Statistical Area, a region that includes all or parts of seven parishes, is sinking or “subsiding” relative to mean sea level. This is an ongoing occurrence, and, therefore, it is difficult to identify specific occurrences of the land subsidence hazard. Although no specific cases are presented in this subsection, it is possible to characterize subsidence rates over a period of years. Given the virtually continuous nature of this hazard, there is assumed to be a 100% annual statistical probability of occurrence, although there are variations from year to year in the exact degree of subsidence.

As part of the 2010 Plan update, the planning team completed a thorough review of various studies and reports to identify past and future subsidence rates for Orleans Parish. One report, titled *Sea-Level Rise and Subsidence: Implications for Flooding in New Orleans, Louisiana,* analyzes past subsidence rates in comparison to future sea level rise. The report indicates land-surface altitude data collected in the levee-protected areas of the New Orleans

metropolitan region during five survey periods between 1951 and 1995 had a mean annual subsidence rate of 5 millimeters per year. Observations of local subsidence in the New Orleans region were derived from precise leveling data collected by the National Geodetic Survey (NGS) during periods 1951–55, 1964, 1984–85, 1990–91, and 1995.

Figure 6-44 shows subsidence rates for 165 benchmarks that were consistently surveyed during the period from 1951 to 1995. The average rate of subsidence among soil types was between 0.15 and 0.25 inches/yr for all but one of the soil classifications.

Figure 6-43 Subsidence Rates in Orleans Parish from 1951 – 1995
(Source: USGS: Sea Level Rise and Subsidence: Implications for Flooding in New Orleans, Louisiana)



The report titled *Exploration of Subsidence and Elevation in Orleans Parish*, prepared by the Department of Regional Planning at the University of Wisconsin-Madison and published in May 2006 after Hurricane Katrina, provides subsidence rate predictions in the New Orleans area over the next 50 years. The report identified possible relationships between subsidence and other factors such as geology, the location of pumping stations, land use, soil types, water wells, levees, and roads. In order to identify patterns, maps were created using Geographic Information Systems that show predicted subsidence in 50 years layered with the other factors listed above to discover patterns.

Figure 6-44 shows the predicted subsidence rates over the next 50 years in relation to the soil types found in Orleans

Parish. The map indicates that the areas along the natural levee of the Mississippi River will experience the greatest level of subsidence over the next 50 years. This is consistent with past areas of subsidence shown above in Figure 6-43. Note that the list of soils (referenced in the legend) is provided following the map.

The subsidence and soils map indicates a moderate correlation between soil type and subsidence rates. The highest subsidence rates are on Urban land, followed by Aquents and Allemands soils. Westwego clay is also in many of the intermediate- to high-subsidence rate areas. The slowest subsidence rates are found in Harahan clay, Commerce, and Sharkey soils.

Figure 6-44 Expected Subsidence Rates Over the Next 50 Years in Orleans Parish
(Source: Exploration of Subsidence and Elevation in Orleans Parish, May 2006)

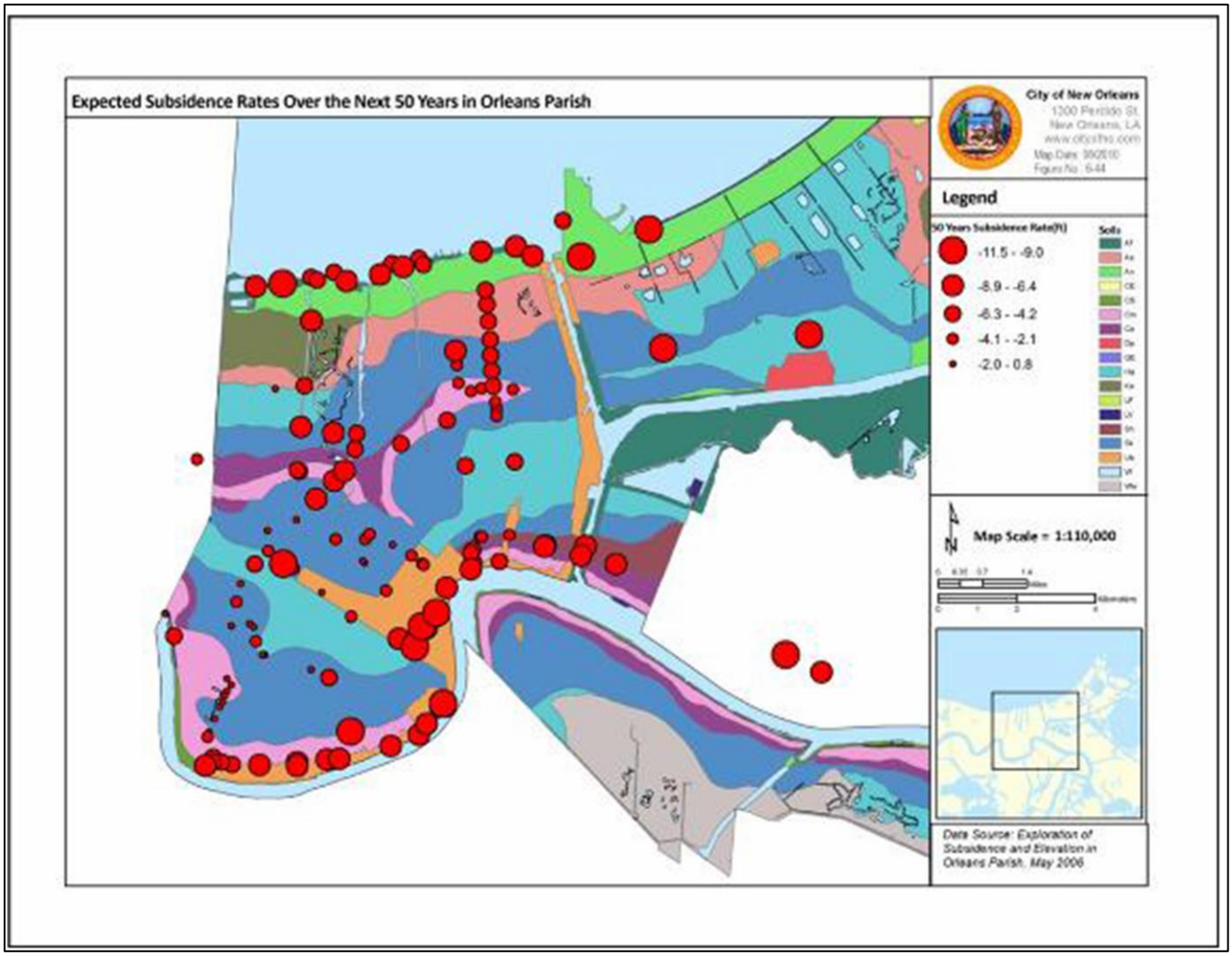


Table 6-32 provides a list of soil types located in Orleans Parish. Note that cells with an asterisk were fields left blank and omitted from the source table.

Table 6-32 Orleans Parish Soil Types
(Source: Exploration of Subsidence and Elevation in Orleans Parish, May 2006)

Map Symbol	Soil Name	Depth (inches)	% Clay	% Organic Matter
Ae	Allemands Muck, drained * *	0-6 6-30 30-46 46-60	-- -- 60-95 20-95	30-85 for Surface layer Only *
An, AT	Aquents dredged	* *	* *	* *
CE	Clovelly muck *	0-31 31-72 *	-- 50-90 *	30-60 surface… * *
Cm	(Commerce) Cancienne silt loam	0-5 5-33 33-60	14-27 14-39 14-39	.5-4 surface… * *
Co	(Commerce) Cancienne silty clay loam	0-4 4-32 32-60	27-39 14-39 14-39	.5-4 surface… * *
CS	(Commerce) Cancienne and Schriever	0-5 5-29 29-60	14-27 14-39 14-39	.5-4 surface… * *
GE	Gentilly muck *	0-10 10-40 40-80	45-90 60-95 60-95	-- * *
Ha	Harahan clay *	0-6 6-36 36-72	50-95 60-95 60-95	2-25 surface… * *
Ke	Kenner muck drained *	0-36 36-40 40-75	-- 45-85 --	30-60 surface… * *
LF	Lafitte muck	0-75 75-90	-- 60-90	30-70 surface…
Sh	(Sharkey) Schriever silty	0-5 5-24	27-35 60-90	.5-4 surface --

As noted, land subsidence will continue to occur in Orleans Parish. Historical subsidence rates (and future projections) indicate that risk from subsidence will continue to threaten property in Orleans Parish. Since subsidence is an ongoing occurrence, it has a 100% annual probability. Although subsidence by itself has the potential to negatively affect infrastructure, operations, and the general population of the Parish, a more significant effect of subsidence is that it potentially exacerbates the effects of other hazards. Subsidence not only results in lower ground elevations (and hence more damage when floods occur), but can: (a) damage elements in the Hurricane Protection System; (b) reduce the elevations of levees and other flood control structures, making it more likely surge will overtop them; and (c) lower coastal elevations, with a resulting loss of some of surge attenuation effects, meaning that surges may be more likely to reach farther inland.

6.3.9 Winter Storms

Description of the Winter Storm Hazard

Winter months in Louisiana (December, January, and February) have average seasonal temperatures ranging from the mid-40s over northern Louisiana to the low 50s across southern parishes. While average seasonal temperatures remain above the freezing mark statewide, cold fronts extending from Canada through the state occur at least once during most winters. Severe winter weather in Louisiana consists of freezing temperatures and heavy precipitation, usually in the form of rain, freezing rain, or sleet, but sometimes in the form of snow. Severe winter weather affects all but the extreme coastal margins of the state.

Because severe winter storm events are relatively rare in Louisiana, compared to more northern states where winter events are expected and states tend to be better equipped to handle them, occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; collapsed roofs from fallen trees and limbs and heavy ice and snow loads; and felled trees, telephone poles and lines, electrical wires, and communication towers. As a result of severe ice storms, telecommunications and power can be disrupted for days.

Severe winter weather within the City, as indicated by activation of the City of New Orleans Freeze Plan, can be defined as when the outside temperature or wind chill reaches 38 degrees or below. Severe winter weather in New Orleans may also consist of freezing temperatures and heavy precipitation in the form of rain, freezing rain, or sleet, but rarely in the form of snow. Severe winter storm events are relatively rare in Louisiana and New Orleans.

As a state situated in the southern United States and near the Gulf of Mexico, winter weather is not typically thought of as a frequent weather hazard in Louisiana. But, winter weather, ranging from extreme cold to freezing rain, snow and dense fog, can move across Louisiana.

The wind chill temperature is how cold people and animals feel when outside. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually lowering the internal body temperature. The updated Wind Chill Formula was implemented in 2001. The new formula uses advances in science, technology, and computer modeling to provide a more accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures.

Other hazards created by winter cold include the improper use of space heaters and poorly maintained heating systems. These can create a fire and/or carbon monoxide hazard potentially resulting in injuries and fatalities.

Because of its temperate climate, the city is rarely affected by winter storms. The average low temperature during the month of January is 43° F.

During summer months, the average temperatures are around 81° F. Extended periods of extreme heat are not typical for the area.

Table 6-33 Average Temperatures in Planning Area
(Source: National Weather Service)

	Temp.			Extreme	Temperature	Rain		Cloudiness	

	(°F)	Relative	Humidity	(Days Per	Month)	Inches	(Days	Per	Month)
	Average	A.M.	P.M.	Below 32°	Above 90°	Average	Clear	Partly Cloudy	Cloudy
January	51.3	85%	68%	5	0	5.1	7	7	17
February	54.3	84%	65%	3	0	6.0	8	6	14
March	61.6	85%	63%	0	0	4.9	8	8	15
April	68.5	87%	61%	n/a	n/a	4.5	8	10	12
May	74.8	89%	62%	0	4	4.6	9	11	11
June	80.0	90%	64%	0	16	5.8	8	13	9
July	81.9	91%	67%	0	21	6.1	5	15	12
August	81.5	91%	67%	0	21	6.2	7	14	10
September	78.1	89%	66%	0	9	5.5	10	11	10
October	69.1	87%	61%	0	1	3.1	14	8	9
November	61.1	86%	63%	1	0	4.4	10	8	12
December	54.5	85%	67%	3	0	5.8	8	7	16
Annual	68.1	87%	65%	13	72	61.9	101	118	146

Location and Extent of the Winter Storm Hazard

Nearly the entire United States is considered at some risk for severe winter storms. When these storms occur in the South, unprotected pipes are especially vulnerable. Disruption in water service and decreases in water pressure cause a cascading problem for emergency responders. Heavily populated areas are particularly impacted when severe winter storms disrupt communication and power due to downed lines from high winds and icing. Debris associated with heavy icing may impact utility systems and transportation routes.

While Louisiana is far less likely to have heavy snow and ice accumulation than most other states in the United States, winter storms or conditions of ice, snow, or dangerous wind-chill factors occur at least once a year.
According to data from the NCDC, Louisiana is in the lowest category of probable snow depth of any State with 0 – 1 inch snow depth, with a 5-percent chance of being equaled or exceeded in any given year. Louisiana winter storms that have had severe consequences for the State have generally delivered between 1 and 3 inches of ice accumulations.

Because there is no defined geographic boundary for winter storms, all people and property in New Orleans are exposed to the risk of damage from these severe weather hazards. Winters in the planning area are mild and the risk of winter storms is medium. The annual probability assigned is 40%. Temperatures in Orleans Parish usually dip to the mid-teens in any given year. The maximum depth of snow that Orleans Parish would expect would be about 2 inches.

The potential for winter storms is uniform for the entire Parish. All people and assets are considered to have the same degree of exposure. Certain populations – mainly the homeless and those with poor access to heat or utilities – are at additional risk, as are some types of infrastructure, such as pipes, and to a lesser degree electrical services.
Overall, however, the risk in southern Louisiana is low compared to most other parts of the country.

Severity of Winter Storms

Because severe winter storms are relatively rare in Louisiana, occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice making even small accumulations of ice an extreme hazard to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways, collapsed roofs from fallen trees, and downed telephone poles and lines, electrical wires, and

communication towers. As a result of severe winter storms, telecommunications and power can be disrupted for days.

Impact on Life and Property

In Orleans Parish, where the climate is subtropical, severe winter storms are rare and pose a minimal threat to life and property. The NCDC database shows no injuries, deaths, or property damage from winter storms between 1950 and 2015 in Orleans Parish. There are occasional highway accidents and broken pipes related to freezing and ice, but these are not reported in any public database, and cannot be readily related to specific events.

The Parish is not particularly vulnerable to the winter storm hazard. Although clearly there is always the potential for traffic accidents and interruptions to functions throughout the area, the most significant vulnerabilities to the winter storm hazards are typically failures of structures and infrastructure due to snow and ice loads. New Orleans is not subject to heavy snow or ice loads and there is very little history of damages from this hazard and thus the Parish‟s vulnerability to this hazard should be considered relatively low. If in the future there appears a trend toward more (or more severe) winter storms, it may be in the Parish's interest to study this issue further.

Occurrences of the Winter Storm Hazard

The NCDC and SHELDUA databases indicates that there have been 20 winter storm event in Orleans Parish between 1/11962 and 1 / 1 / 2015, over 52 years. Table 6.34 summarizes the winter storm events for Orleans Parish. There has been one winter weather event in the last 5 years- January 2014 saw freezing rain and sleet in the city which made roads, bridges and highways impassable. This event was not included in the NOAA/NCDC and SHELDUS data. The event closed schools and workplaces. There were no injuries, deaths or reported damage from the January 2014 event.

Table 6-34 Winter Storm Events, Orleans Parish, 1962 – 2015
(Source: NOAA/NCDC, SHELDUS)

Hazard	Year	Property Damage Amount	Occurences
Winter Weather	1962	$781,251	2
Winter Weather	1963	$1,172	3
Winter Weather	1965	$0	1
Winter Weather	1968	$0	2
Winter Weather	1971	$781	1
Winter Weather	1973	$7,813	1
Winter Weather	1976	$0	1
Winter Weather	1977	$80,723	2
Winter Weather	1982	$7,812	1
Winter Weather	1983	$78,125	1
Winter Weather	1985	$781	1
Winter Weather	1989	$7,813	1
Winter Weather	1993	$0	1
Winter Weather	1996	$0	1
Winter Weather	2008	$0	1

In another historical event, on December 31, 1963, a low pressure system that developed in the southern Gulf of Mexico and moved towards the Florida peninsula interacted with intruding cold air across the Deep South to produce heavy snow along the Gulf Coast. New Orleans Audubon Park measured 4.5 inches of snow while the Slidell area measured 9 inches. This was the greatest snowfall to occur in the Greater New Orleans area in the last century.

Figure 6.45 shows a street-car traveling along snow-covered tracks on St. Charles Street. Portions of the region became snowbound due to a lack of snow removal equipment.

Figure 6-45 December 31, 1963 Snowstorm: Snow-covered Streetcar along St. Charles Street
(Source: NWS – New Orleans / Baton Rouge Office)

On January 12, 1997, a record ice storm hit southern Louisiana and Orleans Parish. Thousands of customers were without electric power for up to six days due to downed trees and power lines from wind. Numerous traffic accidents were attributed to icy roadways. Tons of debris were removed and numerous homes received minor roof damage due to trees and tree limbs falling on them.

In addition to these more severe events, the City experienced a snow event on December 11, 2008, when about two inches of snow fell, with accumulations mainly in grassy areas. There were about 7,000 power outages Statewide, but the New Orleans area was spared any significant effects, except school, office and some road/bridge closures. After the snowfall, the weather changed to freezing rain and sleet, which compounded the traffic and driving problems. Fortunately, the weather warmed up significantly the following day, so there were few lasting effects from the event.

The probability of severe winter storms occurring in the future is medium, based on previous data. Due to its geographic location in the southeastern part of the State, Orleans Parish is at medium risk to severe winter storms- estimated to be about 40%. This hazard has a very low probability of significant impacts on the Parish, and therefore the mitigation strategy does not include actions to address the effects of winter storms.

6.3.10 Drought

Description of the Drought Hazard

A drought is an extended dry climate condition when there is not enough water to support urban, agricultural, human, or environmental water needs. It usually refers to a period of below-normal rainfall, but can also be caused by drying lakes or anything that reduces the amount of liquid water available. Drought is a recurring feature of nearly all the world's climatic regions. Its impact is far reaching, including potential for fires, destruction of agricultural crops, and reduction of surface and subsurface water supplies. Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) and the demand people place on water supply. Human beings often exacerbate the impact of drought. Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this "natural" hazard.

Location and Extent of the Drought Hazard

Droughts may occur anywhere in the United States. Effects seen in different regions vary depending on normal meteorological conditions such as precipitation and temperature, as well as geological conditions such as soil type and subsurface water levels.

The extent of drought is possible throughout the Orleans Parish planning area and the southeastern Louisiana region in general. Because there is no defined geographic boundary for this hazard, all property in Orleans Parish is exposed to the risk of drought. The probability of a drought occurring in any specific region depends on certain atmospheric and climatic conditions. Duration and frequency can be used as indicators of potential severity. Effects seen in different regions vary depending on normal meteorological conditions such as precipitation and temperature, as well as geological conditions such as soil type and subsurface moisture. Drought events affect Orleans Parish equally and uniformly.

Severity of the Drought Hazard

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent, as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

Drought is an insidious hazard by nature, and even areas such as Orleans Parish, with 57 inches of average rainfall and a normally humid subtropical climate, can be severely impacted. Climatic factors such as high temperatures, high wind, and low humidity can significantly aggravate the severity. Even though droughts in Louisiana are more common in the northern parishes, the southern parishes, including Orleans, can be negatively impacted during periods of low rainfall amounts. Drought can cause extensive damage to commercial and residential structure foundations, framing and walls, agricultural crops, roads, bridges, pipelines, utilities, and railroads.

Impact on Life and Property

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. Drought impacts are commonly referred to as "direct" or "indirect." Reduced crop productivity, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat are a few examples of direct impacts. Drought can cause extensive damage to commercial and residential structure foundations, framing and walls, levees, roads, bridges, pipelines, and other integral infrastructure. Indirect impacts of drought include increased prices for food, unemployment, and reduced tax revenues because of reduced supplies of agriculture products dependent upon rainfall. In Orleans Parish, droughts requiring the population to undergo water restrictions are rare.

The NCDC database indicated no deaths or injuries from droughts in the planning area. The most significant threat presented by drought is the potential for agricultural losses. The planning area can expect to experience extreme drought but it is not considered vulnerable to the effects of drought because of the medium- to high-density character of Orleans Parish.

Occurrences of the Drought Hazard

There have been no occurrences of drought in the last five years. The NCDC database recorded two droughts in Orleans Parish from 1950 to 2009. The database provides no indication as to why there are no additional events other than the two events in 1998. Drought events in the NCDC and SHELDUS are listed by month. For example, if a drought lasts several continuous months, it is listed in the database as a single event. If the continuous months are combined into single events, the number of events is reduced from two to one. Table 6-34 below summarizes the drought event for Orleans Parish.

Table 6-34 Drought Events, Orleans Parish, 1950 – 2009
(Source: NOAA/NCDC and SHELDUS)

Date	Time	Type	Magnitude	Crop Damage
07/01/1998	12:00 AM	Drought	N/A	0
08/01/1998	10:00 AM	Drought	N/A	77.5M
Grand Total				**77.480M**

In addition to the single drought event identified in the NCDC database for Orleans Parish, three additional drought events were identified for neighboring Jefferson Parish. The drought events in Jefferson Parish most likely had similar impacts in Orleans Parish. These droughts for the New Orleans area are summarized below:

- **Spring / Summer 1998.** In the spring and summer of 1998, Orleans Parish experienced severe drought conditions (Palmer Index -3.22, NCDC.NOAA.gov). In May, June, and July total precipitation was only 2.29 inches. Only the fall of 1924 (1.39 inches) and the summer of 1934 (2.09 inches) were drier. Area rivers and lakes fell to well below normal levels with water users urged to conserve. August of 1998 was one of the hottest months in the history of the area. Drought conditions were in full force by mid May across the Parish. Most places saw less than half an inch of rain, dating back to the last half of April. The most significant impact in May was the drying up of shallow wells, with many farmers resorting to deeper wells

for irrigation purposes. Some crops were beginning to see the effects of the drought, but significant losses occur in June. It was estimated that $77.5 million in crop damages occurred across southeast United States during this drought.

- **February 2000.** Much of southeast Louisiana, including Orleans Parish, was impacted by an extreme drought rated at -4.45 on the Palmer Index (NCDC.NOAA.gov). Less than one inch of rain fell across the region. This was one of the five driest Februarys on record.
- **October 2005.** The State of Louisiana had its second lowest amount of monthly rainfall total since 1895 with very little measurable precipitation. The Palmer Drought index for the event was -2.25 (NCDC.NOAA.gov).
- **June 2009.** Drought conditions across the Gulf States contributed to a very hot June in the region. New Orleans averaged 83.3 degrees for the fifth warmest June ever; 2.13 inches of monthly rain was the eighth driest June. The Palmer Drought index for the event was -1.67(NCDC.NOAA.gov).

The historical record indicates a drought in the planning area every few years, so the statistical probability is presumed to approximate this recurrence, although it is very difficult to assess this except over a very long period of time because of the direct influence of the weather on the hazard. The Palmer Drought Severity Index (PDSI) mentioned above in the February 2000 event is an indication of the relative dryness or wetness affecting water sensitive economies. The PDSI indicates the prolonged and abnormal moisture deficiency or excess and indicates general conditions, not local variations caused by isolated rain. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather.

The equation for the PDSI was empirically derived from the monthly temperature and precipitation scenarios of 13 instances of extreme drought in western Kansas and central Iowa and by assigning an index value of -4 for these cases. Conversely, a +4 represents extremely wet conditions. From these values, seven categories of wet and dry conditions can be defined. Table 6-34 identifies the values used to define the PDSI.

Table 6-35 Palmer Drought Severity Index
(Source: NOAA, National Weather Service - Climate Prediction Center)

Palmer Drought Severity Index
-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 or above (Extremely Moist)

No Presidential Disaster Declarations from drought have occurred in the Parish. However, the 1988 drought in the upper Midwest and High Plains resulted in record low river stages in the lower Mississippi River, even though rainfall in Louisiana was above normal for that year. River traffic along the Mississippi River was brought to a near standstill for several weeks, and water supplies for several river-dependent parishes were threatened by low flows and salt water intrusion. A drought event of this nature and magnitude would greatly impact the Port of New Orleans, which is dependent on the water flow of the Mississippi River for international imports and exports. This would also greatly impact the United States, which is greatly dependent on the Mississippi River and its ports for commercial shipping.

Various sources indicate there have been a total of four moderate to severe droughts between 1950 and 2009 in Orleans Parish. Based on the historical data provided by the NCDC, the probability of future droughts in Orleans is considered low. An analysis of the Palmer Index statistics reveals that long- and short-term dry spells are normally followed with wet periods.

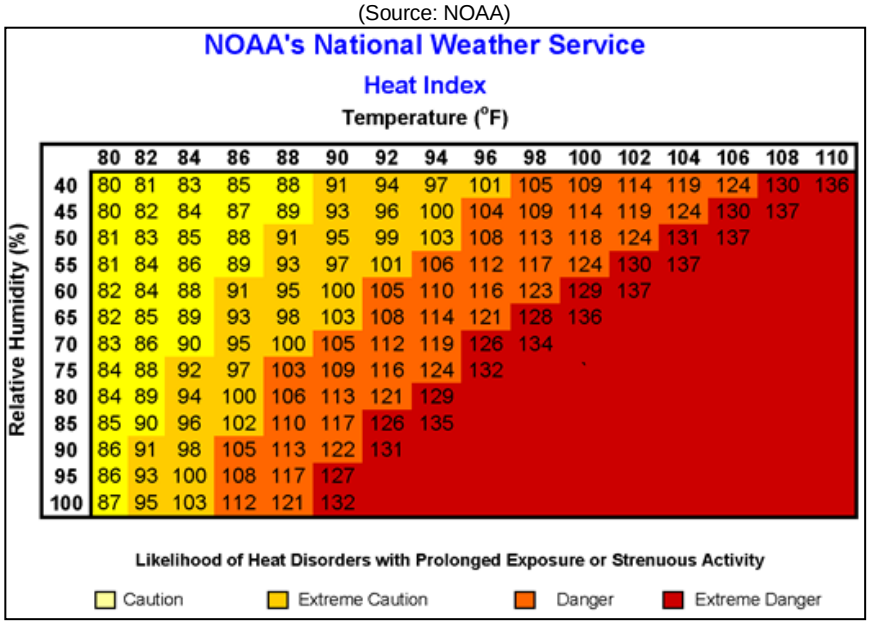
This hazard has a very low probability of significant impacts on the Parish, calculated at an annual probability of 3%, and therefore the mitigation strategy does not include actions to address the effects of drought.

6.3.11 Extreme Heat

Extreme heat is often be characterized by long periods of high temperatures in combination with high humidity. During these conditions, the human body has difficulties cooling through the normal method of the evaporation of perspiration. Health risks arise when a person is overexposed to heat. Extreme heat can also cause people to overuse air conditioners, which can lead to power failures. For the planning area, the months with the highest temperatures are May, June, July, August, and September. The National Weather Service is responsible for issuing excessive heat outlooks, excessive heat watches, and excessive heat warnings. Excessive heat outlooks are issued when potential exists for an excessive heat event in the next 3 to 7 days. Excessive heat outlooks can be utilized by public utility staffs, emergency managers, and public health officials to plan for extreme heat events. Excessive heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. An excessive heat watch should provide local officials and residents in the area enough time to take appropriate actions to mitigate the effects of extreme heat. Finally, excessive heat warnings are issued when an excessive heat event is expected in the next 36 hours. Excessive heat warnings are issued when an extreme heat event is occurring, is imminent, or has a very high probability of occurring.

Another factor to consider in extreme heat situations is the humidity level relative to the temperature. As is indicated in the following figure, as the relative humidity increases, the temperature needed to cause a dangerous situation decreases. For example, for 100 percent relative humidity, dangerous levels of heat begin at 86°F where as a relative humidity of 50 percent, require 94°F. The combination of relative humidity and temperature result in a heat index: 100 percent relative humidity + 86°F = 112° heat index.

Table 6-36 NOAA Heat Index
(Source: NOAA)



Source: NOAA

Location and Extent of the Extreme Temperatures Hazard

Extreme Heat

Based on historical records from the Audubon Weather Station as reported by NOAA, the extreme maximum temperature is approximately 102° Fahrenheit for the Parish. For the purposes of this plan, extreme heat events are quantified as days with temperatures exceeding 90° Fahrenheit. It should be noted that when combined with humidity, heat index warnings of 125 are not uncommon in for Orleans Parish during summer months. Given their zonal nature, extreme heat events have the potential to impact the entire Parish.

Severity of the Extreme Temperatures Hazard

Extreme Heat

The months of July and August are when most extreme heat events occur. Periods of high temperatures can make people vulnerable to heatstroke, heat cramps, heat exhaustion, and pose a threat to human life. Most heat disorders occur because the victim has been overexposed to hear or has over-exercised for his or her age and physical condition. Older adults, young children and these who are sick or overweight are more likely to succumb to extreme heat. Persons that are homeless or living without air conditioning are more susceptible to extreme heat as they do not have a way to avoid heat exposure. Building stock, such as critical facilities, are not at risk; however periods of extreme heat place a significant demand on utilities, such as water and electricity, which can cause a failure in the system. Power loss could occur with the high demand on energy, making an extreme heat event even more dangerous.

The following table indicates historical max temperature by day, month, and year in degrees Fahrenheit. A record high of 102 degrees Fahrenheit occurred on 8/22/1980.

Tables 6-39 Highest Max Temperature by Day for New Orleans Area, LA
Period of record: 1946-05-01 to 2015-09-26

Day	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
1	81	2006	82	1957	83	2012	86	2012	91	1978	98	2011	99	1980	100	2010	97	2000	94	1998	87	1997	83	1991
2	81	1952	81	1969	83	2012	85	2012	92	2002	98	2011	100	2011	100	2010	100	2000	92	1952	85	2004	83	2007
3	80	2000	83	1957	83	1955	86	2015	90	2002	95	2011	98	2009	97	2011	97	1947	92	2004	85	2003	84	1978
4	80	1952	81	1957	83	1955	85	2001	92	1952	100	2011	98	1970	98	1951	99	2000	92	1986	85	1946	82	1995
5	78	2009	79	2008	83	1955	86	1982	92	1952	97	1991	97	1979	100	1990	97	2000	92	1986	86	2003	84	1995
6	79	1989	79	1974	84	1955	89	1955	92	1952	95	2011	99	1998	98	1990	93	2015	91	2009	85	2005	82	2013
7	83	1982	80	1999	83	1974	86	1986	91	1952	95	1980	100	1980	97	2015	94	1980	92	1990	86	1986	83	1951
8	79	2012	81	1999	84	1980	88	1948	91	1998	96	1980	98	2000	97	1962	96	1980	91	1962	85	1986	82	1978
9	80	1974	82	1957	83	2000	86	1999	91	1986	95	2006	98	1995	97	2007	98	1980	92	1990	87	1986	82	2007
10	81	1974	83	1994	82	2000	88	1963	90	2009	96	1953	97	1998	98	2015	101	1980	91	1981	85	1946	81	2007
11	79	1989	81	1999	85	1955	87	1999	91	2003	96	2007	98	1995	100	2007	98	1980	91	1980	83	2003	82	1949
12	80	1989	81	2000	86	1974	86	2001	91	2000	96	2006	99	1995	99	2007	94	2010	91	1991	86	2003	82	1971
13	82	1972	81	1959	85	1982	87	2001	90	2007	96	1998	98	1991	99	1951	95	1991	89	2014	83	2005	80	1991
14	80	1971	82	1989	84	1982	87	2001	91	1991	97	1963	99	1980	100	1951	97	1980	90	2009	84	2011	80	1971
15	82	1947	82	1989	87	1982	87	2012	92	1995	97	2011	100	1980	98	1995	96	1980	90	2009	86	2011	83	1971
16	80	1947	82	2001	87	1955	87	2012	90	2003	97	2011	101	1980	98	1995	96	1990	90	1980	85	2011	84	1971
17	79	1974	80	2000	87	1982	91	2006	92	1988	96	2011	97	2000	99	1995	95	1995	91	1980	85	2003	79	1990
18	79	1974	81	2000	89	1982	91	1987	94	1962	96	2011	97	2015	98	2011	94	1954	88	1979	85	1986	79	2008
19	80	1982	81	1956	87	1982	90	1987	92	1998	99	1990	99	1951	98	1995	94	2005	89	1993	85	1981	82	1967
20	82	1982	82	1971	88	1982	90	1987	94	1998	97	1990	98	2000	100	1995	96	2015	90	2004	84	1986	80	1978
21	82	1982	80	2011	87	1982	92	1987	92	2012	96	2010	97	2008	99	1980	95	2005	90	1979	83	1996	80	1990
22	81	2012	82	2006	83	1991	89	1955	93	1996	96	2009	99	1981	102	1980	95	1997	88	1991	86	1973	83	1970
23	81	2002	81	1982	84	1995	88	1971	93	2005	99	2009	101	1981	99	2011	94	1993	87	1995	85	1973	81	1970
24	81	2002	83	2011	84	1994	90	1988	94	2005	101	2009	98	1981	97	2011	93	1980	88	2004	83	1973	81	2008
25	81	1970	82	1972	84	2005	88	2006	94	2010	97	2012	98	2005	97	1990	93	1993	88	2010	83	1973	79	2008
26	81	1962	85	1972	84	2011	88	1967	93	2012	98	2012	96	1981	99	1990	93	2005	89	2010	84	1985	80	2008
27	81	1952	83	1962	85	2011	89	1987	94	2012	98	1967	99	1995	99	1989	93	1955	88	1995	85	1981	80	2008
28	82	1957	84	2011	84	1972	91	1987	96	1953	97	2009	98	1993	99	1998	96	1953	87	2014	82	1960	82	1974
29	82	1957	83	2012	83	2012	90	2002	94	2000	97	2009	99	2015	97	2011	94	1980	85	2009	83	1949	81	1974
30	82	1957	-	-	86	1974	89	2002	95	1977	100	1954	100	1986	101	2000	92	1981	87	2004	84	1981	81	1990
31	83	1957	-	-	86	1974	-	-	96	1951	-	-	98	1993	98	1947	-	-	86	1951	-	-	81	1973

Period of record: 1946-05-01 to 2015-09-26

Impact on Life and Property

Extreme Heat

The direct and indirect effects of extreme heat are difficult to quantify. There is no way to place a value on the loss of human life. Potential losses such as power outages could affect businesses, homes, and critical facilities. High demand and intense use of air conditioning can overload the electrical systems and cause damages to infrastructure.

According to the FEMA publication "What is a Benefit: Guidance on Benefit-Cost Analysis of Hazard Mitigation Project (June 2009)", if an extreme heat event occurred within the planning area, the following table assumes the event could potentially cause a loss of electricity for ten percent of the population at a cost of $126 per person per day. At 2015 population levels, this would result in $4,498,351 of assumed damage per day.

Occurrences of the Extreme Temperature Hazard

Extreme Heat

Based on data provided by National Climatic Data Center and SHELDUS for the period of record between 1981 – 2015, there are on average 56 days each year in which the temperature is at least 90 degree Fahrenheit in Orleans Parish.

NOAA's NCDC and SHELDUS database also records extreme heat events. For the time period between 1/1/1996 and 4/1/2015, there have been two extreme heat events recorded in this database for Orleans Parish causing two injuries and one death. A narrative of these events are included below.

- **August 14, 1999.** At an outdoor rally for public schools in New Orleans, 25 people were treated for heat related illness with 2 people sent to the hospital for treatment
- **July 16, 2000.** A New Orleans man was discovered dead in his home as a result of excessive heat.

The statistical probability of extreme heat impacting Orleans Parish is 100% on an annual basis, with an average of 56 days per year with temperature over 90 degrees Fahrenheit. Most of these events, however, do not result in injuries or death.

6.3.12 Power Outages

Description of the Power Outage Hazard

A power outage occurs when there is a short or long-term loss of electrical power to an area.

These outages occur when there are damages to distribution or transmission systems and can be caused by severe weather, such as hurricanes or thunderstorms. They can also be caused by the overloading of the system.

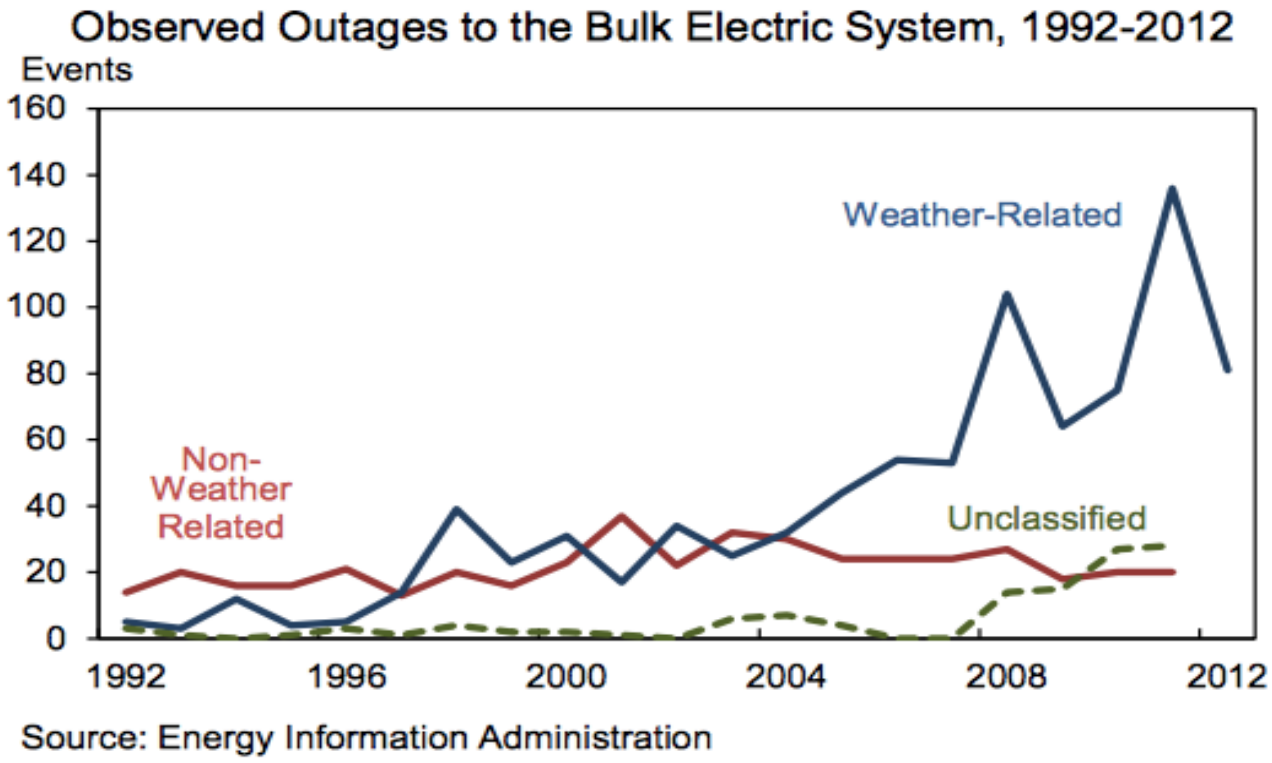
However, severe weather is the leading cause of outages in the United States.

Location and Extent of the Power Outage Hazard

According to a 2013 report by the Office of the President:

> "Outages caused by severe weather such as thunderstorms, hurricanes and blizzards account for 58 percent of outages observed since 2002 and 87 percent of outages affecting 50,000 or more customers (U.S. DOE, Form OE-417). In all, 679 widespread outages occurred between 2003 and 2012 due to severe weather. Data from the U.S. Energy Information Administration show that weather-related outages have increased significantly since 1992."

Figure 6-46 Observed Outages to Bulk Electrical System Nationwide
Period of record: 1992-2012



Severity of Power Outages

The majority of power outages in New Orleans have isolated impacts to various streets, blocks, and grids.

Impact on Life and Property

The direct and indirect effects of power outages are difficult to quantify. The loss of power does negatively affect businesses, homes, and critical facilities – with serious consequences from long-term outages. However, the majority of outages are limited in scale and do not present long-term impacts. Populations that are dependent upon access to electricity can be disproportionately impacted. Additionally, power outages can lead to cascading events such as the closure of critical facilities and the implementation of boil water orders.

Occurrences of Power Outages

Some recent outages are described below:

- The failure of an underground cable led to an outage for around 2,570 customers in Mid-City on January 20, 2015.
- An equipment failure led to an outage which impacted around 2,800 homes and businesses in New Orleans' Uptown on August 31, 2015.
- Thunderstorms on October 25, 2015 caused power outages for over 22,800 customers in New Orleans

6.3.13 Pandemic

Description of the Pandemic Hazard

An infectious disease is a viral, bacterial, parasitic or fungal disorder that can be transmitted between people. An outbreak is an increased number of cases of a particular disease and can include epidemics and pandemics. Infectious Disease Outbreaks require more public health and medical resources than day to day operations and may include responses such as infection control, contact tracing, quarantine, isolation, prophylaxis and social distancing.

For pandemics, communicable diseases are often of high concern. The Center for Disease Control (CDC) defines communicable disease as, "illnesses due to infectious agents or their toxic products, which may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment.

Communicable diseases are typically spread through direct contact. The following are three of the most common ways of direct contact transmission:

- Person to person. This involves direct transfer of bacteria, viruses or other germs from person to person. This may involve blood transfusion, coughing, kissing, sexual contact, touching etc.
- Animal to person. Infected animals can transfer communicable diseases to humans via biting and scratching. Coming in contact with an infected animal's waste may also transmit diseases.
- Mother to fetus. Infected pregnant women can pass bacteria, germs, and viruses through the placenta, such as AIDS. Bacteria, germs and viruses can also be spread during labor, such as with group B streptococcus.

Communicable diseases are also transmitted indirectly, such as a touching a germ infected door handle. Other ways that communicable diseases are spread is through particle transmission through the air (such as tuberculosis or SARS), through bites and stings from insects (such as West Nile Virus or Lyme Disease), and through food contamination (such as E. Coli).

The following communicable diseases have been targeted for this hazard mitigation plan update:

Chlamydia - A common STD that can infect both men and women. It can cause serious, permanent damage to a woman's reproductive system, making it difficult or impossible for her to get pregnant later on. Chlamydia can also cause a potentially fatal ectopic pregnancy (pregnancy that occurs outside the womb).

Gonorrhea - A sexually transmitted disease (STD) that can infect both men and women. It can cause infections in the genitals, rectum, and throat. It is a very common infection, especially among young people ages 15-24 years.

Primary and Secondary Syphilis - An STD that can cause long-term complications if not treated correctly. Symptoms in adults are divided into stages. These stages are primary, secondary, latent, and late syphilis.

Influenza - There are two main types of influenza (flu) virus: Types A and B. The influenza A and B viruses that routinely spread in people (human influenza viruses) are responsible for seasonal flu epidemics each year. Influenza A viruses can be broken down into sub-types depending on the genes that make up the surface proteins. Over the course of a flu season, different types (A & B) and subtypes (influenza A) of influenza circulate and cause illness.

Viral Meningitis - An inflammation of the tissue that covers the brain and spinal cord. Infants younger than 1 month old and people with weakened immune systems are more likely to have severe illness related to meningitis.

HIV - A virus spread through body fluids that affects specific cells of the immune system, called CD4 cells, or T cells. Over time, HIV can destroy so many of these cells that the body can't fight off infections and disease. When this happens, HIV infection leads to AIDS.

Acute Hepatitis B - A short term liver infection caused by the Hepatitis B virus. Hepatitis B is transmitted when blood, semen, or another body fluid from a person infected with the Hepatitis B virus enters the body of someone who is not infected.

Chronic Hepatitis B - A chronic, long term liver infection caused by the Hepatitis B virus, which can lead to cirrhosis or liver cancer. Hepatitis B is transmitted when blood, semen, or another body fluid from a person infected with the Hepatitis B virus enters the body of someone who is not infected.

It should also be noted that bioterrorism can also involve communicable diseases. The CDC has identified high priority biological agents that have the potential for major public health impact. These include:

- Anthrax (Bacillus anthracis)
- Botulism (Clostridium botulinum toxin)
- Plague (Yersinia pestis)
- Smallpox (variola major)
- Tularemia (Francisella tularensis)
- Viral hemorrhagic fevers (filoviruses [e.g., Ebola, Marburg] and arenaviruses [e.g., Lassa, Machupo])

Location and Extent of the Pandemic Hazard

Nearly the entire United States is considered at some risk for pandemics. Within the planning area, the entire population is subject to communicable diseases. Locations with higher population density may be exposed to higher numbers of the aforementioned diseases than less dense areas.

Severity of Pandemics

The severity of outbreaks are expected to change annually depending on variables such as weather patterns and trends in disease outbreaks. While there have been historically severe impacts of pandemic in Orleans Parish, modern public health and disease prevention it capable of treating most communicable disease outbreaks. Communicable diseases do, however, have potential to be catastrophic, especially in associated with terrorist activity.

Impact on Life and Property

The severity of outbreaks are likely to change annually depending on variables such as weather patterns and trends in disease outbreaks. The overall impact of this hazard is likely limited, with the majority of illnesses treatable and likelihood of fatalities low. If large scale outbreaks were to occur, strain on existing healthcare facilities is likely to occur.

Occurrences of the Pandemic Hazard

New Orleans has had few communicable disease pandemics, all of which occurred nearly 100 years ago. The first pandemic reported in New Orleans occurred in the 1830s, in which cholera killed 3,000 people in New Orleans. A subsequent cholera event in New Orleans during the 1870s claimed the lives of thousands more. In 1847 and 1852, over 40,000 people died from yellow fever. The most well documented pandemic in Orleans parish involved the 1918 flu epidemic, also known as the Spanish Flu, which caused 15,494 cases of influenza state wide in September of 1918, with approximately 7,000 of those cases located in New Orleans. Between October 1918 and April 1919, the city experienced a staggering 54,089 cases of influenza. Of these, 3,489 died – a case fatality rate of 6.5%, and an excess death rate of 734 per 100,000. Only Pittsburgh (806) and Philadelphia (748) - the two cities with the worst epidemics in the nation – had higher death rates. Cases gradually lessened during the winter and spring. By the summer, the disease had disappeared from the state, without the aid of vaccination.

New Orleans also experienced heightened awareness to communicable / infectious diseases following Hurricane Katrina. As each phase of the Katrina disaster unfolded in 2005, nearly every element of CDC was involved in supporting the Department of Health and Human Services response. CDC helped with health issues that involved:

- infectious disease detection, prevention, and outbreak control in shelters and in affected communities,
- injury prevention for displaced people and rescue workers
- environmental health and safety monitoring of homes, water quality, and shelters
- rebuilding public health infrastructure,
- school health, and
- worker and responder safety recommendations and monitoring.

Through this effort, infectious disease outbreaks were averted or quickly controlled, hospitals were resupplied with critical medicines and medical staff, evacuees had better health monitoring and vaccinations, dedicated rescue workers and volunteers had environmental health guidance they needed, and affected community members, who remained or returned, were warned about potential rebuilding injuries, dangers of mold, and carbon monoxide poisoning. Only one known outbreak of communicable disease (norovirus) requiring unusual mobilization of public health resources had been reported as of September 23, 2005.

According to the Louisiana Department of Health and Hospital, it is estimated that between 450,000 and 900,000 Louisiana residents become infected with influenza each year. The CDC has also reported the following statistics for communicable diseases in Orleans Parish.

Table 6-40 Communicable and Infectious Diseases in Orleans Parish in 2013
(Source: CDC)

Disease	Cases	Rate per 100,000
Chlamydia	4,064	1,100.60
Gonorrhea	1,485	402.2
Primary and Secondary Syphilis	65	17.6

Table 6-41 Viral Meningitis rates per 100,000 population in Orleans Parish (2002-2010)
(Source: Louisiana Department of Health and Hospitals)

2002	2003	2004	2005	2006	2007	2008	2009	2010
0	0	6	3	5	2	0	3	2

According to the CDC, the Orleans-Metairie-Kenner Metropolitan Statistical Area ranks second in the county in the number of new HIV cases diagnosed each year.

Table 6-42 Diagnoses of HIV Infection in Orleans Parish in 2013
(Source: CDC)

Number of new cases diagnosed	Rate per 100,000
521	43.4

For the time period between 2010-2012, the CDC reported and average of 5.7 new acute hepatitis B cases and 168.3 Chronic hepatitis B cases per year.

Based on historical record, there is a 100% probability that infectious disease outbreaks will occur annually. The likelihood that these in infectious disease outbreaks will lead to large scale epidemics or pandemic, however, is highly unlikely based on historical record and modern public health practices.

6.3.14 Terrorism

Description of the Terrorism Hazard

Terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 C.F.R. Section 0.85).

The FBI further describes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. For the purpose of this report, the FBI will use the following definitions:

- Domestic terrorism is the unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or Puerto Rico without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.

- International terrorism involves violent acts or acts dangerous to human life that are a violation of the criminal laws of the United States or any state, or that would be a criminal violation if committed within the jurisdiction of the Unite-d States or any state. These acts appear to be intended to intimidate or coerce a civilian population, influence the policy of a government by intimidation or coercion, or affect the conduct of a government by assassination or kidnapping. International terrorist acts occur outside the United States or transcend national boundaries in terms of the means by which they are accomplished, the persons they appear intended to coerce or intimidate, or the locale in which their perpetrators operate or seek asylum.

There are different types of terrorism depending on the target of attack, which are:

- Political Terrorism
- Bio-Terrorism
- Cyber-Terrorism
- Eco-Terrorism
- Nuclear-Terrorism
- Narco-terrorism

Terrorist activities are also classified based on motivation behind the event such as ideology (i.e. religious fundamentalism, national separatist movements, and social revolutionary movements). Terrorism can also be random with no ties to ideological reasoning.

The FBI also provides clear definitions of a terrorist incident and prevention:

- A terrorist incident is a violent act or an act dangerous to human life, in violation of the criminal laws of the United States, or of any state, to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

- Terrorism prevention is a documented instance in which a violent act by a known or suspected terrorist group or individual with the means and a proven propensity for violence is successfully interdicted through investigative activity.

The Department of Homeland Security and its affiliated agencies are responsible for disseminating any information regarding terrorist activities in the country. The system in place is the National Terrorism Advisory System (NTAS). NTAS replaced the Homeland Security Advisory System (HSAS) which was the color coded system put in place after the September 11th attacks by Presidential Directive 5 and 8 in March of 2002. NTAS replaced HSAS in 2011.

NTAS is based on a system of analyzing threat levels and providing either an imminent threat alert or an elevated threat alert.

An Imminent Threat Alert warns of a credible, specific and impending terrorist threat against the United States.

An Elevated Threat Alert warns of a credible terrorist threat against the United States.

The Department of Homeland Security, in conjunction with other federal agencies, will decide whether a threat alert of one kind or the other should be issued should credible information be available.

Each alert provides a statement summarizing the potential threat and what, if anything should be done to ensure public safety.

The NTAS Alerts will be based on the nature of the threat: in some cases, alerts will be sent directly to law enforcement or affected areas of the private sector, while in others, alerts will be issued more broadly to the American people through both official and media channels.

An individual threat alert is issued for a specific time period and then automatically expires. It may be extended if new information becomes available or the threat evolves. The sunset provision contains a specific date when the alert expires as there will not be a constant NTAS Alert or blanket warning that there is an overreaching threat. If threat information changes for an alert, the Secretary of Homeland Security may announce an updated NTAS Alert. All changes, including the announcement that cancels an NTAS Alert, will be distributed the same way as the original alert.

Location and Extent of the Terrorism Hazard

The location and extent of this hazard is unknown. Terrorist attacks can vary greatly in scale and magnitude. Historically, incidents have occurred near abortion facilities, the Louis Armstrong airport, hotels, and and law enforcement facilities.

Severity of the Terrorism hazard

The unpredictable nature of terrorism is such that severity can range from very isolated occurrences of property damage with limited injuries to large scale events with catastrophic impacts to lives and property.

Impact on Life and Property

The unpredictable nature of terrorism is such that impacts can range from very isolated occurrences of property damage with limited injuries to large scale events with catastrophic impacts to lives and property.

Occurrences of the Terrorism Hazard

The Planning team utilized the Global Terrorism Database, maintained by the University of Maryland and National Consortium for the Study of Terrorism and Responses to Terrorism. This database contains information for over 140,000 terrorist attacks. According to this database, there have been five terrorist attacks in the planning area since 1970. These events are listed below. There have been no events in the last five years.

Table 6-43 Terrorism Event Orleans Parish, 1970 – 2015

(Source: University of Maryland)

Date	City	Perpetrator Group	Fatalities	Injuries	Target Type
12/18/1996	New Orleans	Individual	0	1	Abortion Related
02/28/1984	New Orleans	Black Liberation Army	0	0	Airports and Aircraft
09/26/1973	New Orleans	Individual	0	0	Private Citizens & Property
01/07/1973	New Orleans	Republic of New Africa	8	20	Police, Private Citizens & Property, Business
12/31/1972	New Orleans	Republic of New Africa	2	2	Police

Three of these events have narrative available, and are included below:

09/26/1973: Byron de la Beckwith was arrested on Interstate 10 on his way into New Orleans in the United States, for transporting a ticking bomb, which was allegedly meant to kill the regional director of the Anti-Defamation League, A.I. Botnick. Allegedly, Beckwith was headed for Botnick's house at the time he was stopped at a roadblock by police.

1/7/1973: Mark Essex, a Black Revolutionary, broke into the Downtown Howard Johnson Hotel in New Orleans, Louisiana in the United States. He proceeded to shoot and kill Robert and Elizabeth Steagall, a White couple staying in the hotel. Essex then doused a telephone book with lighter fluid and set the Steagalls' room on fire. Noticing the commotion, Essex was approached by Frank Schneider and Sherwood Collins, the assistant manager and general manager of the hotel respectively. Essex shot and killed both managers in two separate incidents. Essex then lit more hotel rooms on fire. At this point, Essex began shooting at the policemen and firemen that approached the hotel. He shot and killed Deputy Super Intendent Louis Sirgo, Patrolman Pail Persigo and Patrolman Philip J. Coleman Sr. Twenty others were wounded as well. Finally, the police were able to force Essex to the roof of the building. The incident did not end until Essex was shot and killed by sharpshooters positioned in a military helicopter hovering above the hotel.

12/31/1972: Mark Essex, a member of the Republic of New Africa, indiscriminately fired shots into the Central Lockup area of the Police Headquarters in New Orleans, Louisiana, United States. Cadet Alfred E. Harrell was killed and lieutenant Horatio Perez was wounded in the initial barrage of bullets. Essex ignited firecrackers to distract police and fled from the scene escaping into the Burkant Building, however, Essex inadvertently set off the building's alarm system. Police officers, Edwin Hosli and Kenneth Blapper, responding to the alarm were ambushed by Essex at the warehouse. Officer Hosli was wounded

and died from his injuries three months later. Essex was able to escape from the police once more. It is believed that Essex was injured in the incident because his blood was scattered throughout the warehouse.

Given five events between 1/1/1970 and 1/1/2015, Orleans Parish averages one terrorist incident every 15 years, 1 death every five years, and 1 injury every two years.

6.3.15 Infrastructure Failure

Description of the Infrastructure Failure Hazard

Infrastructure failure is an undesirable or unintended event, occurrence or situation involving the city's infrastructure or the discontinuation or significant disruption of a service that could seriously compromise public safety. This infrastructure could be public or private utility infrastructure and would result in a temporary loss of essential function and/or services.

Location and Extent of the Infrastructure Failure Hazard

Miles of water, sewerage and gas pipes, as well as a vast network of generators, transformers, and treatment and distribution facilities means that an infrastructure failure can happen virtually anywhere in the City of New Orleans. Often these incidents are not limited to a small localized region, but instead affect large areas of the City, with up to tens of thousands of people at a time.

Severity of Infrastructure Failure

The severity of infrastructure failure can range from very isolated occurrences with limited impacts to the City to large-scale events with catastrophic impacts to lives, property and operations. Since all citizens and businesses are depended on the public infrastructure, especially the provision of sewerage and water services, these are essential services and failure is severe. When one or more of these independent, yet interrelated systems fail due to disaster or other cause, even for a short period of time, it can have devastating consequences. When the water or wastewater treatment systems in a community are inoperable, serious public health problems arise that must be addressed immediately to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur.

Impact on Life and Property

The direct and indirect effects of infrastructure failure are difficult to quantify. The loss of water utility for example does negatively affect businesses, homes, and critical facilities – with serious consequences from long-term outages. Hotels and restaurants, for example, may have to provide bottled water for guests and diners in the event of a water utility failure, and this can be extremely costly. However, the majority of infrastructure failures are limited in scale and do not present long-term impacts. Populations, businesses or residents that are dependent upon access to clean water or stable infrastructure can be disproportionately impacted.

Occurrences of Infrastructure Failure

Table 6-43 Water Utility Infrastructure Failures, 2010 – 2015

Some recent water utility outages are listed below

DATE	IMPACT AREA	CAUSE
11/20/2010	east bank	Carrollton power plant shut down
12/22/2010	east bank	commercial power failed at Carrollton power plant
3/29/2011	east bank	commercial power failed at Carrollton power plant
5/6/2011	east bank	thunderstorms knocked out power twice at Carrollton plant
6/9/2011	east bank	power failed at Carrollton power plant
6/26/2011	east bank	power failed at Carrollton power plant
5/2/2012	eastern New Orleans	major water main break
10/8/2012	east bank	mechanical failure in boilers at Carrollton power plant
3/3/2013	east bank	natural gas flare at the Carrollton power plant
7/23/2013	Uptown	water main break
12/18/2013	Venetian Isles	water main break
7/13/2014	Uptown	major water main break around 5:30 a.m.
6/1/2015	English Turn, Lower Algiers	water main break
7/24/2015	east bank	A power surge at the Carrollton power plant
9/24/2015	east bank	A power surge at the Carrollton power plant

6.3.16 Building Collapse

Description of the Building Collapse Hazard

A building collapse is the sudden structural failing, partially or fully, of a building, threatening human life and health. When internal load-bearing structural elements fail, a building will collapse into itself and exterior walls pulled into the falling structure. This scenario may be caused by construction activity, an earthquake or fire, and may result in a dense debris field with a small footprint. Alternatively, if an explosion or natural forces such as weather cause the structural failure, the building may collapse in an outward direction, resulting in a less dense and more scattered debris field.

Location and Extent of the Building Collapse Hazard

The potential for this threat exists throughout the City in all settings. Building inspectors and Code Enforcement officials are most familiar with this hazard.

Severity of Building Collapse

The scope and size of buildings and the exact cause of the collapse means that there are varying degrees of severity in this emergency. In the worst case scenario, a large, multistory, mixed use commercial and residential building collapses in a densely populated area of the city, such as the French Quarter. This could be due to age of the building, impact from other hazards, or manmade action. In the smaller scale, there have been collapses of single story uninhabited dwellings that were blighted or severely damaged from storm activity.

Impact on Life and Property

The monetary loss can be on property owners, the private-sector and/or the public (taxpayers). Estimates can range from insurance deductibles associated with insured losses to millions of dollars that may burden taxpayers if property owners are unable to cover the debris removal and disposal. Monetary losses may or may not be recoverable from insurance or federal disaster resources.

Occurrences of Building Collapse

Building collapses are frequently the result of another incident or event, such as resulting from a fire or tornadic activity. It is considered a regular event, occurring between once a year and once every three years.

September, 2013- a house in the 100 block of Mound Avenue was being elevated to mitigate against flood losses. Contractors for the property had lifted the home about six feet in the air when it collapsed, severely injuring two construction workers. Due to the extensive structural damage to the house, it was declared a total loss and demolished.

October, 2014- a three story building in the 800 block of Royal in the French Quarter collapsed. The result of deteriorating brick and mortar, the building was over 200 years old. It housed three apartments and commercial space. There were no injuries. The building was a complete loss.

July, 2015- a blighted property, slated for demolition, collapsed after a storm. The city was pursuing blight judgment against the property, located at 3516 Delachaise, which had been vacant since Hurricane Katrina. There were no injuries.

6.3.17 Civil Unrest

Description of the Civil Unrest Hazard

Civil Unrest is defined as a public demonstration, gathering, or a uprising, that results in a disruption of essential functions, by rioting, looting, arson, or other unlawful behavior. Large-scale civil disturbances rarely occur, but when they do they are usually an offshoot or result of one or more of the following events: 1) Labor disputes where there is a high degree of animosity between the participating parties. 2) High profile/controversial judicial proceedings. 3) The implementation of controversial laws or other governmental actions. 4) Resource shortages caused by a catastrophic event. 5) Disagreements between special interest groups over a particular issue or cause. 6) A perceived unjust death or injury to a person held in high esteem or regard by a particular segment of society. Prison uprisings are normally the result of perceived injustice by inmates regarding facility rules, operating policies and/or living conditions, or insurrections started by rival groups or gangs within the facility.

Location and Extent of the Civil Unrest Hazard

Several locations have been identified as sites for past or potential civil disturbances. Several major university campuses have been the site of protests and political activity in recent years. Additionally, New Orleans is home to several prominent sites in American history. These sites, including graveyards, battlefields, monuments, and various sites of historical, cultural and religious significance are throughout the entire City. Jackson Barracks, the Louisiana National Guard, and several other government sites or contract sites are among some of the installations that have potential for political unrest.

Severity of Civil Unrest

The magnitude of this hazard is relatively low. In most instances a civil disturbance would be limited to a localized area. Based on the historical data, resulting deaths are a possibility, but typically for only a riot or prison uprising. Civil disturbances have also historically monopolized law enforcement forces and possessed a moderate property damage risk.

Impact on Life and Property

Since the City of New Orleans has not had a full-fledged civil uprising in its history, historical numbers on the economic impact cannot be gathered. There are many corollary effects from a civil disturbance that are not a direct result of the event. The incident may deter future development in an area and threaten future and existing businesses. The severity of the economic loss is related to the severity of the incident. Economic value of property damage, recovery costs, and loss of business can range from tens of thousands of dollars to millions of dollars, depending on the seriousness of the incident.

Occurrences of Civil Unrest

Civil unrest is infrequent in large scale occurrences. The majority of civil unrest occurrences take place in smaller, localized formats, and include forms of civil disobedience.

6.3.18 Thunderstorms (Hail and Lightning)

The term "thunderstorm" is usually used as a catch-all term for several kinds of storms. Here "thunderstorm" is defined to include any precipitation event in which thunder is heard or lightning is seen. Thunderstorms are often accompanied by heavy rain and strong winds and, depending on conditions, occasionally by hail or snow. Thunderstorms form when humid air masses are heated, which causes them to become convectively unstable and therefore rise. Upon rising, the air masses' water vapor condenses into liquid water and/or deposits directly into ice when they rise sufficiently to cool to the dew-point temperature.

Thunderstorms occur throughout Louisiana at all times of the year, although the types and severity of those storms vary greatly, depending on a wide variety of atmospheric conditions. Thunderstorms generally occur more frequently during the late spring and early summer when extreme variations exist between ground surface temperatures and upper atmospheric temperatures.

Thunderstorms are classified into four main types (single cell, multi-cell, squall line, and supercell), depending on the degree of atmospheric instability, the change in wind speed with height (called wind shear), and the degree to which the storm's internal dynamics are coordinated with those of adjacent storms. There is no such interaction for single-cell thunderstorms, but there is significant interaction with clusters of adjacent thunderstorms in multi-cell thunderstorms and with a linear "chain" of adjacent storms in squall line thunderstorms. Though supercell storms have no significant interactions with other storms, they have very well-organized and self-sustaining internal dynamics, which allows them to be the longest-lived and most severe of all thunderstorms.

The life of a thunderstorm proceeds through three stages: the developing (or cumulus) stage, the mature stage, and the dissipation stage. During the developing stage, the unstable air mass is lifted as an updraft into the atmosphere. This sudden lift rapidly cools the moisture in the air mass, releasing latent heat as condensation and/or deposition occurs, and warming the surrounding environment, thus making it less dense than the surrounding air. This process intensifies the updraft and creates a localized lateral rush of air from all directions into the area beneath the thunderstorm to feed continued updrafts.
At the mature stage, the rising air is accompanied by downdrafts caused by the shear of falling rain (if melted completely), or hail, freezing rain, sleet, or snow (if not melted completely). The dissipation stage is characterized by the dominating presence of the downdraft as the hot surface that gave the updrafts their buoyancy is cooled by precipitation. During the dissipation stage, the moisture in the air mass largely empties out.

The Storm Prediction Center in conjunction with the National Weather Service (NWS) has the ability to issue advisory messages based on forecasts and observations. The following are the advisory messages that may be issued with definitions of each:

• ***Severe Thunderstorm Watch***: Issued to alert people to the possibility of a severe thunderstorm developing in the area. Expected time frame for these storms is three to six hours.
• ***Severe Thunderstorm Warning****:* Issued when severe thunderstorms are imminent. This warning is highly localized and covers parts of one to several counties (parishes).
A variety of hazards might be produced by thunderstorms, including lightning, hail, tornadoes or waterspouts, flash floods, and high-speed winds called downbursts. Nevertheless, given all of these criteria, the National Oceanic and Atmospheric Administration (NOAA) characterizes a thunderstorm as severe when it produces one or more of the following:

- Hail of 1 inch in diameter or larger

- Wind gusts to 58 mph or greater
- One or more tornadoes

Tornadoes and flooding hazards have been profiled within this report; therefore, for the purpose of thunderstorms, the sub hazards of hail, and lightning will be profiled. High winds are addressed within the Tropical Cyclone section of this Plan.

Hail

Hailstorms are severe thunderstorms in which balls or chunks of ice fall along with rain. Hail develops in the upper atmosphere initially as ice crystals that are bounced about by high-velocity updraft winds.
The ice crystals grow through deposition of water vapor onto their surface, fall partially to a level in the cloud where the temperature exceeds the freezing point, melt partially, get caught in another updraft whereupon re-freezing and deposition grows another concentric layer of ice, and fall after developing enough weight, sometimes after several trips up and down the cloud. The size of hailstones varies depending on the severity and size of the thunderstorm. Higher surface temperatures generally mean stronger updrafts, which allows more massive hailstones to be supported by updrafts, leaving them suspended longer. This longer time means larger hailstone sizes. Table 2-47 displays a spectrum of hailstone diameters and their everyday equivalents.

Spectrum of hailstone diameters and their everyday description.
(Source: National Weather Service)

1/4” Pea
1/2” Plain M&M
3/4” Penny
7/8” Nickle
1” (severe) Quarter
1 1/4” Half Dollar
1 1/2” Ping Pong Ball / Walnut
1 3/4” Golf Ball
2” Hen Egg / Lime
2 1/2" Tennis Ball
2 3/4" Baseball
3” Teacup / Large Apple
4” Softball
4 1/2" Grapefruit
4 3/4” – 5” Computer CD-DVD

Hailstorms can cause widespread damage to homes and other structures, automobiles, and crops. While the damage to individual structures or vehicles is often minor, the cumulative cost to communities, especially across large metropolitan areas, can be quite significant. Hailstorms can also be devastating to crops. Thus, the severity of hailstorms depends on the size of the hailstones, the length of time the storm lasts, and where it occurs. Hail rarely causes loss of life, although large hailstones can cause bodily injury.

Location/Extent

Because hailstorms is a climatological based hazard and has the same probability of occurring in Orleans Parish as all of the adjacent parishes, the entire planning area for Orleans Parish is equally at risk for hailstorms. Orleans Parish can expect to see hail up to 2 inches.

Previous Occurrences

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	0.00K	0.00K
SOUTH PT	ORLEANS PAR.	LA	05/26/2011	17:58	CST-6	Hail	1.00 in.	0	0	0.00K	0.00K
GENTILLY	ORLEANS PAR.	LA	06/07/2011	13:36	CST-6	Hail	1.00 in.	0	0	0.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	02/24/2013	21:15	CST-6	Hail	1.00 in.	0	0	0.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	04/08/2014	14:03	CST-6	Hail	0.75 in.	0	0	0.00K	0.00K
VIEUX CARRE	ORLEANS PAR.	LA	04/15/2015	16:03	CST-6	Hail	1.75 in.	0	0	0.00K	0.00K
MICHEND	ORLEANS PAR.	LA	04/15/2015	16:10	CST-6	Hail	1.50 in.	0	0	0.00K	0.00K

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. 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.

Location

Like hail, lightning is a climatological based hazard and has the same probability of occurring throughout the entire planning area for Orleans Parish, making all jurisdictions equally at risk for lightning.

Previous Occurrences / Extent

Typically only lightning events that cause death, injuries, and/or property damage are reported. These records do not accurately reflect the number of lightning events in Orleans Parish which occur on a nearly monthly basis but are rarely reported.

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								3	0	220.00K	0.00K
NEW ORLEANS LAKEFRON	ORLEANS PAR.	LA	04/14/1996	14:00	CST	Lightning		0	0	0.00K	0.00K

NEW ORLEANS LAKEFRON	ORLEANS PAR.	LA	04/17/1996	15:45	CST	Lightning		1	0	0.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	06/21/1998	17:20	CST	Lightning		0	0	120.00K	0.00K
ALGIERS	ORLEANS PAR.	LA	09/06/1999	19:15	CST	Lightning		0	0	50.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	06/04/2000	11:00	CST	Lightning		2	0	0.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	05/30/2005	06:30	CST	Lightning		0	0	0.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	06/06/2005	12:00	CST	Lightning		0	0	0.00K	0.00K
NEW ORLEANS	ORLEANS PAR.	LA	06/04/2007	10:30	CST-6	Lightning		0	0	50.00K	0.00K

There have been no recordable lightning events producing damage in the past five years. Orleans Parish can expect to experience Lightning Density up to 9-10 flash/sq/mi/year.

Frequency
Lightning can strike anywhere and is produced by every thunderstorm. However, lightning that meets the definition that is used by SHELDUS and the NCDC that actually results in damages to property and injury or to people is a less likely event. A major lightning strike, which produces recordable damage in Orleans Parish is medium.

Section 7

Vulnerability Assessment and Loss Estimation

Contents of this Section

One of the first steps in developing the 2015 City of New Orleans HMP update was to complete a comprehensive evaluation of the existing document, completed in 2010, to determine (a) specific areas that required updates, such as incorporation of data about recent hazards or documenting the update process, (b) where recent City, State or FEMA guidance (such as the Blue Book) require new elements in the plan, and (c) where there are opportunities to incorporate technical data and studies that have been completed since the original plan was written and approved.

7.1 Interim Final Rule Requirement for Risk Assessments

IFR §201.6(c)(2): *[T he risk assessment shall include 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 the probability of future hazard events.*

IFR §201.6(c)(2)(ii): *[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approves after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:*

IFR §201.6(c)(2)(ii)(A): *The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;*

IFR §201.6(c)(2)(ii)(B): *An estimate of the potential dollar losses to vulnerable structures identified in…this section and a description of the methodology used to prepare the estimate.*

IFR §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.*

7.2 Overview of Orleans Parish's Vulnerability and Impact to Hazards

Estimated Annualized Property Damages Due to Hazards

Flooding	Tropical Cyclones	Storm Surge	Coastal Erosion	Tornado	Subsidence
$122,348,161	$122,326,142	$29,411,764	$10,341,300	$156,127	$1,223,481

Hail	Lightning	Winter Storm	Drought	Extreme Heat
$11,055	$17,435	$124,376	$0	$0

Levee Failure would destroy 80% of the building inventory in the City of New Orleans at an estimated cost of $2,809,397,280. The area of Orleans Parish that is outside of the levee protection system, the neighborhood of Venetian Isles, contains the population that would be vulnerable to storm surge. The houses in Venetian Isles would be vulnerable to coastal erosion and storm surge.

The vulnerability to flooding remains a concern. While the Mississippi River Levee and Hurricane Storm Damage Risk Reduction System provides mitigation in these hazards, there are structures that are vulnerable to a flood. As depicted previously in figure 6-1, large portions of the City have negative BFEs. As a result, these areas are more vulnerable to flood of any source, including but not limited to heavy rainfall, ponding, sheeting, and bank overtopping. The most recent Flood Insurance Study (FIS) for Orleans Parish was published as a preliminary FIS by FEMA in December of 2014. An FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS. The FIS characterizes flooding in the City and the surrounding area, describes its causes, and identifies flood protection measures. The FIS indicates that the past history of flooding within the City suggests that flooding may occur during any season of the year. In the cooler months, the area is subject to heavy rainfalls resulting from fontal passages. In the summer months, heavy rainfalls result from convective thundershowers. In the late summer, hurricanes accompanied by rainfall and super-elevated water-surface elevations (storm surge) pose the largest threat of flooding in the area.The FIS indicates that the principal sources of flooding in the Parish are rainfall ponding, or hurricane or tropical storm surges from Lake Pontchartrain and Lake Borgne.The FIS produced for the Parish is also supported by a Flood Insurance Rate Map (FIRM), usually divided into individual FIRM panels. The FIRM is the official map of a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs are the areas subject to inundation by the base (1-percent-annual-chance) flood. Heavy rains are common in New Orleans, and since a large portion of the City lies within the SFHA, a major flood will result in significant property damage to residential and non-residential structures and disruption to the lives of people who live and work in the City. Seventy-two percent of all parcels in Orleans Parish (109,231 structures) lie within the currently adopted SFHA and represent the greatest vulnerability to the flood hazard.

The total population within the Parish that is susceptible to hazards are shown in the tables below. Subsidence, hail and lightning could potentially affect every structure within the Parish.

Number of People Exposed to Flood Hazards		
# in Community	# in Hazard Area	%in Hazard Area
389,617	389,617	100%

*Population estimate as of July 1, 2015, U.S Census Bureau.

Number of People Exposed to Tropical Cyclones		
	Total Numbers	%in Hazard Area
Number in Hazard Area	343,829	100%
Persons Under 5 years	22,005	6.4%
Persons Under 18 years	73,235	21.3%
Persons 65 and Older	37,477	10.9%
Population in Poverty	95,240	27.7%

*Population total as of April 1, 2010, U.S Census Bureau. The data for 2015 was not available.

Number of People Exposed to Tornadoes		
	Total Numbers	%in Hazard Area
Number in Hazard Area	343,829	100%
Persons 65 and Older	37,477	10.9%
Population in Poverty	95,240	27.7%

*Population total as of April 1, 2010, U.S Census Bureau. The data for 2015 was not available.

Number of People Exposed to Winter Weather		
	Total Numbers	%in Hazard Area
Number in Hazard Area	343,829	100%
Persons Under 5 years	22,005	6.4%
Persons Under 18 years	73,235	21.3%
Persons 65 and Older	37,477	10.9%
Population in Poverty	95,240	27.7%

*Population total as of April 1, 2010, U.S Census Bureau. The data for 2015 was not available.

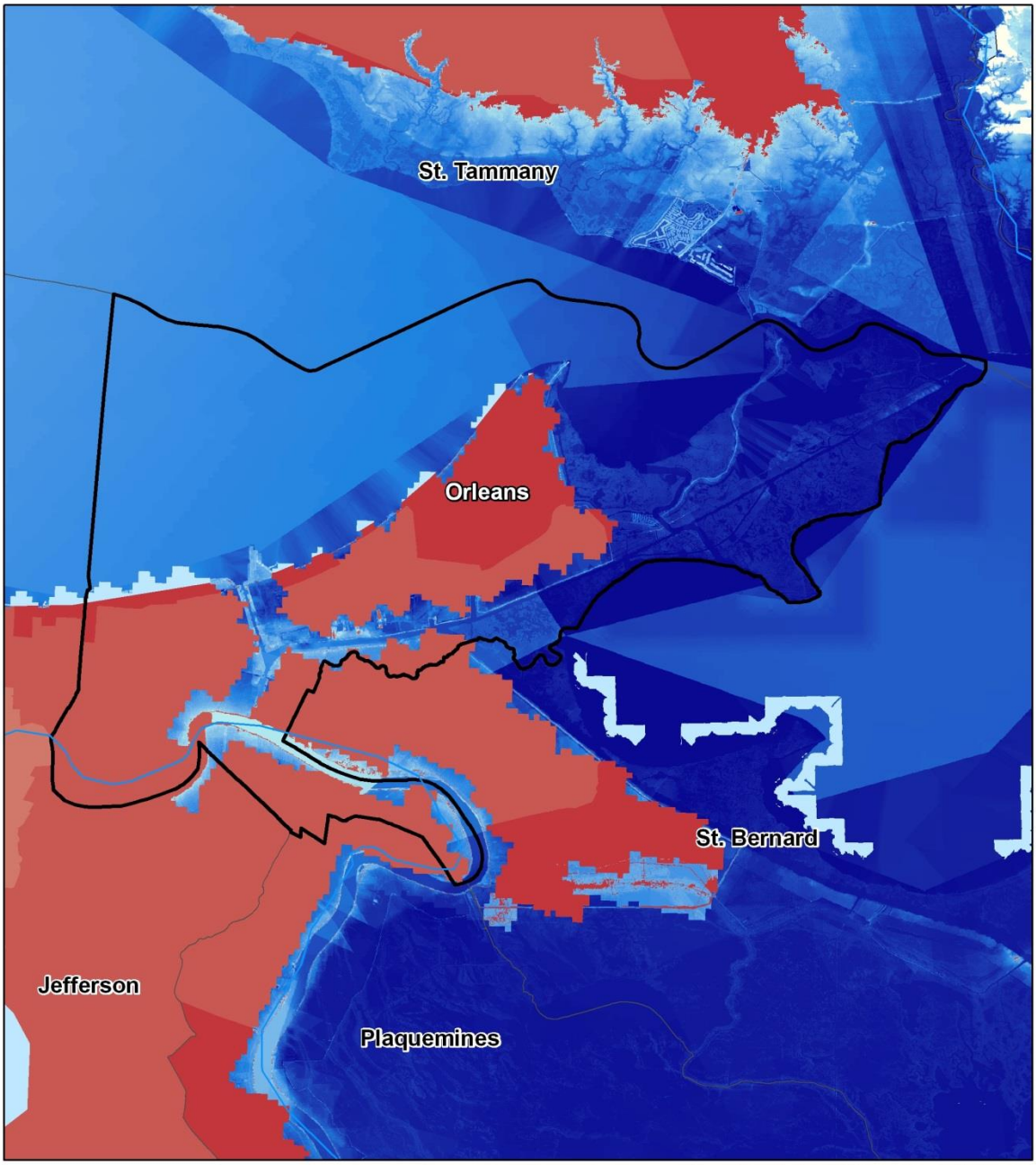
Number of People Exposed to Drought		
# in Community	# in Hazard Area	%in Hazard Area
389,617	389,617	100%

*Population estimate as of July 1, 2015, U.S Census Bureau.

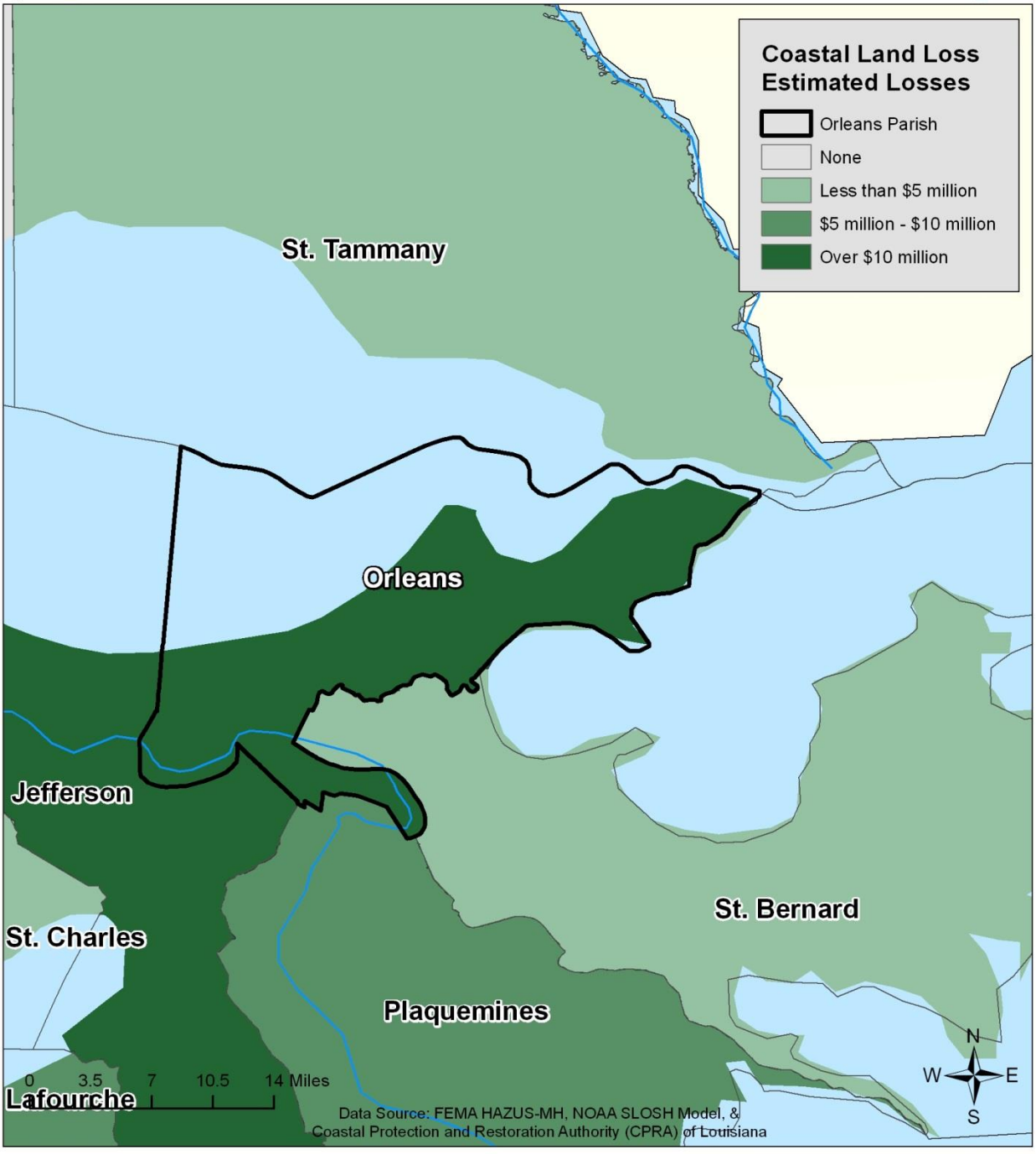
Number of People Exposed to Extreme Heat		
	Total Numbers	%in Hazard Area
Number in Hazard Area	343,829	100%
Persons Under 5 years	22,005	6.4%
Persons Under 18 years	73,235	21.3%
Persons 65 and Older	37,477	10.9%
Population in Poverty	95,240	27.7%

*Population total as of April 1, 2010, U.S Census Bureau. The data for 2015 was not available.

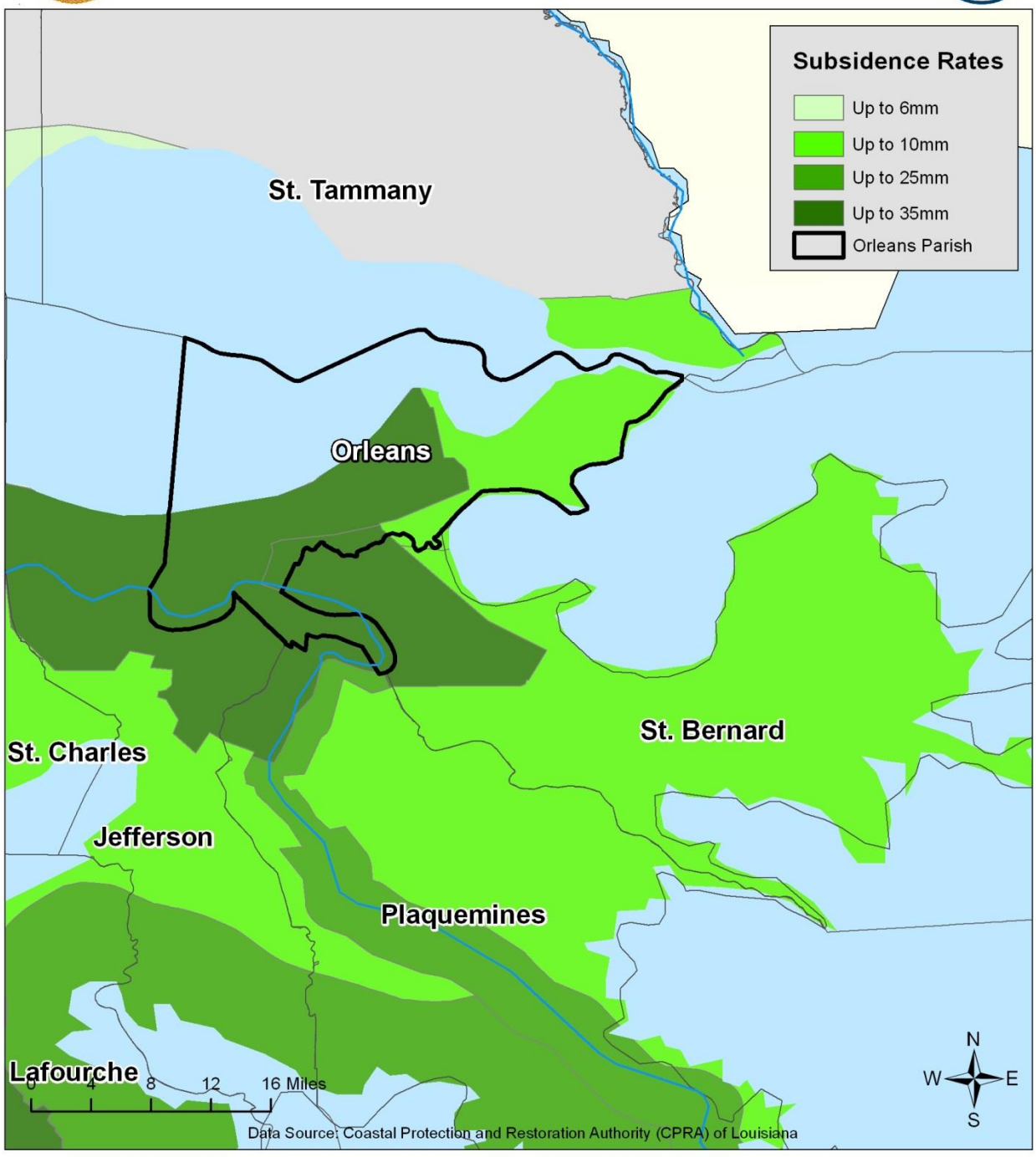
Hurricane Katrina - Wind Speed and Surge Depth



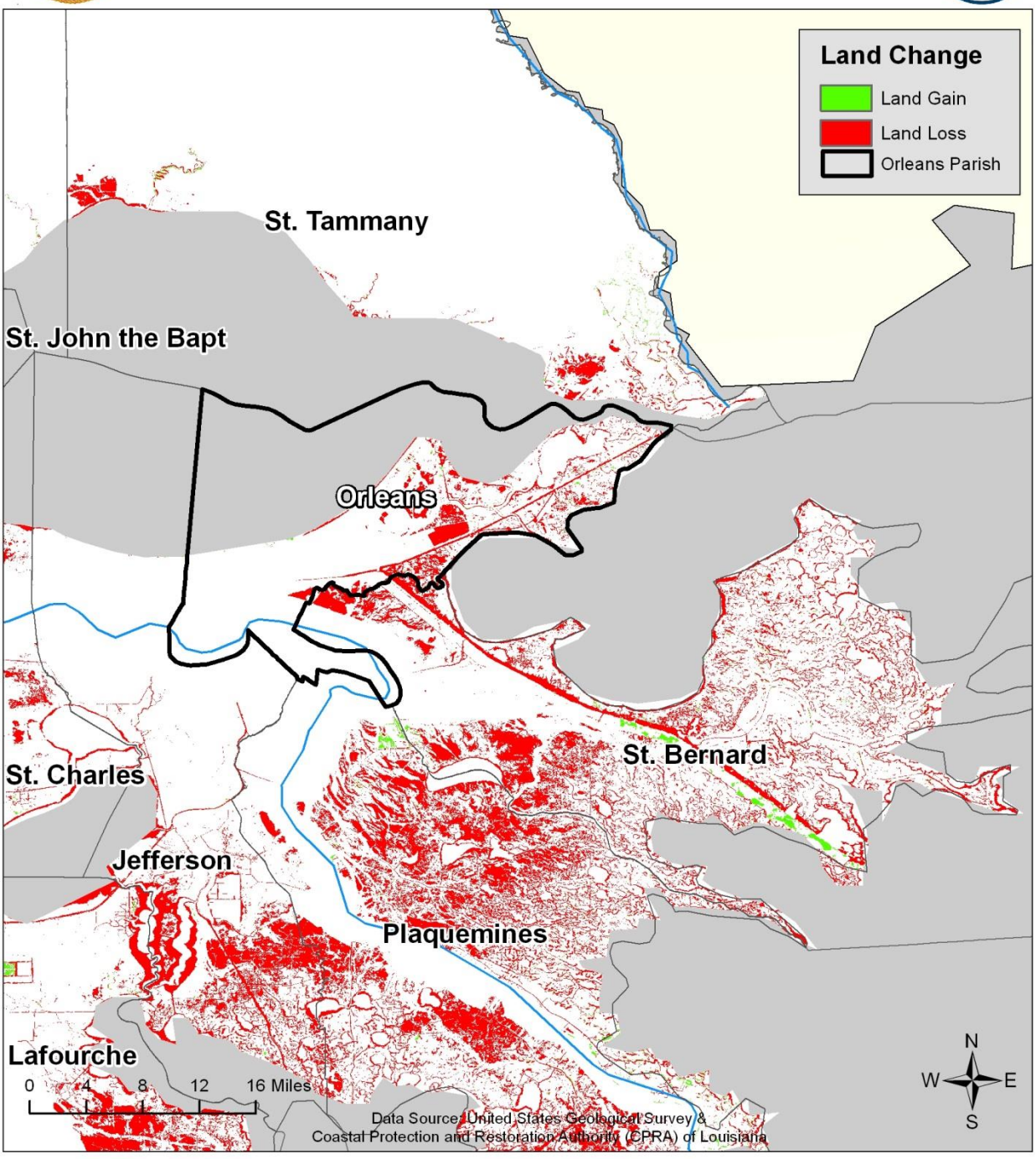
Jurisdictional Annualized Losses: Coastal Land Loss



Annualized Rates of Subsidence



Land Loss/Gain: 1932-2010



7.3 Land Uses, Development and Re-development Trends

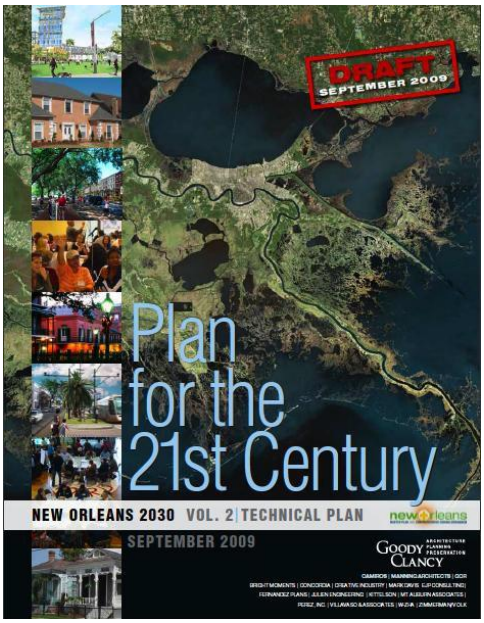
The FEMA Interim Final Rule (IFR) and "Blue Book" guidance states the HMP "should provide a general overview of land uses and types of development occurring within each community participating in the plan." and notes that "a land use map would be useful to depict the descriptive information". The guidance offers several considerations in analyzing development trends, including:

- Describing trends in terms of the amount of change over time
- Differentiating land uses of similar types that have distinctly different densities
- Where future land uses are likely to occur
- The expected growth and redevelopment over a reasonable time frame.

An analysis of development trends helps to provide a basis for making decisions on the type of mitigation approaches to consider, and the location where these approaches can be implemented. When properly coordinated, the information from Hazard Mitigation Plans and Land Use and Comprehensive Plans can be utilized to influence decisions regarding future development in hazard areas.

Background

Like most jurisdictions of its size, Orleans Parish has a well-established planning apparatus in place. Much of the land use planning is based on and organized by neighborhoods. There are presently 73 neighborhoods officially designated by the planning department in New Orleans. For planning purposes, the City is also organized into 13 Planning Districts.



Historic Development

From its origins in French Colonial times to its suburban expansion in the 1960s and 70s, New Orleans' growth has been determined by the constraints of water. Natural levees formed from sedimentation around the Mississippi River determined the earliest areas of settlement, with the higher ground in the area developing first in the 18th and 19th centuries. With the advent of electrical power and dewatering technologies, expansion to lower lying ground occurred. This expansion accelerated after World War II, with suburban neighborhoods filling in many of the areas that had existed as wetlands for centuries. This expansion paralleled the construction of levee and canal systems specifically designed to protect the newly claimed developments.

Some important characteristics of the City's historic development include:

- Neighborhoods built before World War II characteristically contain a mixture of small- to medium scale residential types, from single-family homes to small apartment buildings, and often include pedestrian-oriented mixed-use commercial corridors.

- Neighborhoods built after World War II are predominantly composed of suburban style single family subdivisions separated by strip malls and other retail areas and by large-scale multifamily developments. This generally marked the transition from residential construction on crawlspace foundations, to slab-on-grade configurations. This was a significant change because typical finished floor elevations were generally lower (by the amount of crawlspace elevation, on the order of 2-feet, usually). They are typically vehicle-oriented areas.

- The draining of wetlands after 1913 allowed the city to expand beyond the riverfront and the ridges, increasing the urbanized area of the city by more than 40 square miles or 100 percent between 1913 and 2000.

- By 2000, 40 percent of the city's housing units had been built after 1960, mostly in the form of suburban-style single-family houses.

- In 2000, New Orleans had some 26,000 vacant dwelling units, which included some non-blighted (areas of significant decay, vacancy and disrepair) units such as those for sale or rent and unoccupied second homes

Current Land Use

For current land use information, the Summary of Findings in **City of New Orleans Plan for the 21st Century, Volume 2** provides a concise picture of historic development and land use trends in the City, where development issues currently exist, and the relationship of Katrina and land use trends. Relevant findings include:

- The overall distribution of land use in New Orleans has not changed significantly since Hurricane Katrina, although the amount of blight and vacant or underutilized property has increased.
- In 2009, the number of unoccupied residential addresses was estimated at 65,888, 31 percent of all addresses.
- Changes in residential land use following Hurricane Katrina are overwhelmingly the result of flood impact and a diminished residential population rather than any intentional effort to alter the residential character of neighborhoods' pre-storm condition.
- Office uses continue to cluster in the Central Business District, with a good supply of well-priced Class A office space.

- Many of the City's industrial areas are underutilized.

Numerous studies and reports note that in New Orleans, the older neighborhoods experienced less flood damage from Katrina flooding than newer ones. This is partly because older neighborhoods tend to be on higher ground, and because newer (post WWII) construction shifted to slab-on-grade foundations.. The residential density of most areas of the City is generally lower than before the hurricane. The focus of recovery in these areas has been repair and renovation. Some infill occurs in these neighborhoods, but it is generally sensitive to the scale and design of the surrounding structures.

As described in Section 2.18, "the only way in which New Orleans has seen the introduction of new densities and building types since Hurricane Katrina is in the form of new infill development on formerly commercial parcels." The Plan goes on to describe several such areas, including the Tulane Avenue corridor in mid-City and underused "commercial parcels at the edges of lower density residential areas." One example of this is the proposed relocation/reconstruction of the Medical Center of Louisiana at New Orleans, also known as Charity Hospital, in an approximately 15 block area in mid-City. This proposed project would occur on land that is currently mixed residential and commercial use.

Because, as the Plan notes, most office uses were (and remain) concentrated in the downtown business district, these were not subjected to the most severe flooding (most did not flood at all), and hence were among the fastest types of operations to recover. Notably, no real estate development project announced since Katrina has included a major office component, in spite of consistently high occupancy rates in existing office space.

Repopulation since Hurricane Katrina

Demographics and population trends are key components of a City"s health, generating tax revenue for services and determining the character of a place. In addition, on the Risk Assessment side of planning, one of the key factors studied is the location of population density within areas of risk. Many cities in the United States have suffered from an exodus of middle-class professionals from their populations to the suburbs and exurbs over the past five decades, and New Orleans was among these. This exodus was exacerbated by Hurricane Katrina, which forced a large portion of the population (of all classes) out of the City. The study of the returning population is a key component of future land use and development decisions.

The 21st Century Plan discusses the effects of Hurricane Katrina on the population. During Katrina, 71 percent of the City"s occupied housing units were flooded, with over 55 percent of the housing stock experiencing "major or "severe" damage. The graphic on page 2.8 of the document shows the percentage of residences "active" (meaning occupied) in September, 2008 compared with June, 2005, 2-months prior to Katrina. The City has actually exceeded some estimates for repopulation – the RAND Corporation estimated that by September 2008, the City would have a population of 272,000, but in fact it was 328,758.

Future Land Use Strategies

The New Orleans Land Use Plan sets forth the policy framework for the physical development of the city, providing a guide for city decision makers in directing the pattern, distribution, density and intensity of land uses that will, over time, best achieve the goals for livability, opportunity, and sustainability expressed throughout the Master Plan and provide sufficient land to meet demand for various land uses in the future.

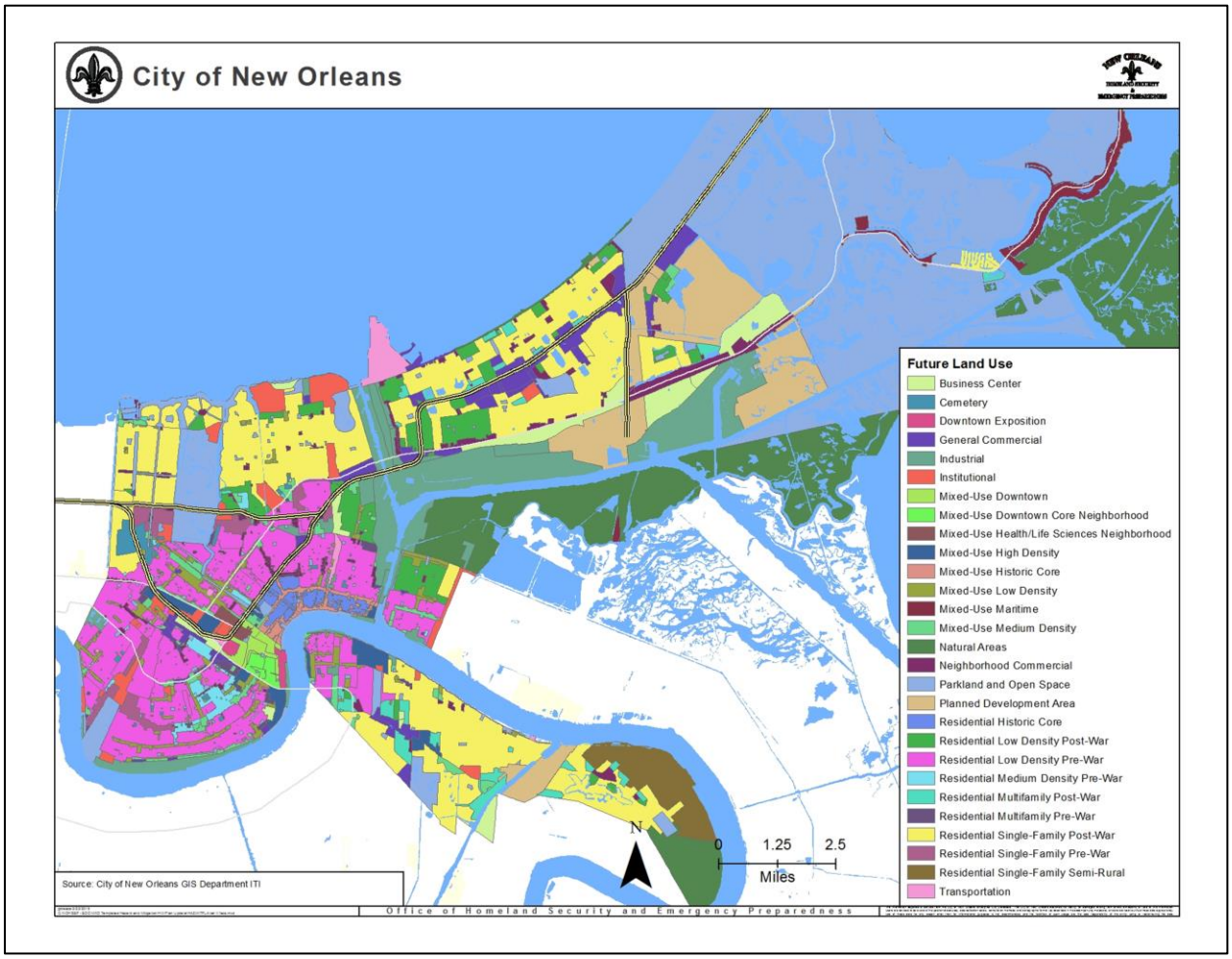
The focus of this part of the Master Plan is the Future Land Use Map, which shows the categories of land uses desired over time, and their densities and intensities. The map reflects the land uses that correspond to the long-term vision, goals and policies expressed elsewhere in the plan, and it constitutes the most direct link between the Master Plan and the Comprehensive Zoning Ordinance. Highlights of the Future Land Use Map include:

• **No change in the overall existing footprint of the city.** New Orleans represents the heart of a much larger region, and focusing regional growth in the city makes sense from the perspective of environmental efficiency and smart growth.

• **Preservation of neighborhood residential character.** Prevailing character, in terms of scale, massing and density, are reinforced so that infill development must be compatible with existing patterns. Community facilities, such as schools and houses of worship, are included within residential neighborhoods, and corner businesses that meet criteria can continue to operate.

• **Mixed-use land use designations for greater flexibility in areas that would benefit.**
Underutilized commercial and industrial areas and similar sites are designated as neighborhood centers and main street corridors for medium- to higher-density mixed-use areas that encourage compact, pedestrian-oriented, and transit-oriented development. A downtown mixed-use category sets the stage for tailoring future zoning to preserve and enhance the unique character of different parts of downtown. Larger parcels would require a site master plan, design guidelines and community process to ensure high quality development

Figure 7-49 Future Land Use Map for City of New Orleans
(Source: City of New Orleans, GIS Department, 2015)



Consequently, the Plan lays out specific goals in future development to meet the future land use designations, including:

- Create an efficient residential land use pattern that addresses the location and intensity of residential development while ensuring housing affordability and choice.
- Revise zoning districts to better reflect the city's established development patterns. Development patterns in areas built before World War II differ from those in areas developed after the war.
- Integrate development standards into district regulations that preserve established building character in terms of scale, massing, and placement.
- Revitalize challenged neighborhoods with new development that contributes to character and new vitality.
- Promote infill development on vacant lots in existing neighborhoods.
- Ensure that infill buildings fit in harmoniously in existing neighborhoods, but do not require them to copy existing architecture.
- Ensure that new housing built within established neighborhoods is compatible with the scale and character of existing development.
- Establish appropriate transitions between high-impact, medium-impact, and low-impact development.
- Ensure that multifamily housing is sensitive to neighborhood context.
- Create design and development standards for multifamily districts to assure compatibility with larger residential neighborhood around them.
- Respect the scale and massing of buildings in historic areas and other areas where existing scale should be preserved.
- Coordinate zoning districts with local historic designations in order to eliminate conflicts and inconsistencies.
- In revitalization areas, extend the positive qualities of existing adjacent neighborhoods into new development.

Implications of Redevelopment vs. Hazard Mitigation

As discussed in the introduction of this section, the relevance of this section is to connect the trends of physical and demographic growth and changes with the underlying risk identified within a geographic area. Consequently, the City"s Plan did include an entire section on risk and resilience.

One of the interesting aspects to the City of New Orleans, perhaps even more so than most metropolitan areas, is that future development and growth focuses on infill and redevelopment of existing commercial and residential areas. This provides a different emphasis than many other studies which serve to connect mitigation planning and comprehensive planning primarily through the avoidance of particular areas in which the municipality may be expanding and annexing.

Consequently, the following goals related to the City's resilience were included in the Plan and should be considered when developing the goals of the Mitigation Plan Update:

Figure 7-50 Excerpt from Goals and Policies for Chapter 12 – Resilience: Living with Water and Natural Hazards
(Source: City of New Orleans, Plan for the 21st Century, Volume 2, page 12.1)

GOAL		POLICIES FOR DECISION MAKERS
1	***A holistic community standard of resilience from flooding and other hazards***	• Develop mitigation standards to the level of a 1-in-500-year storm, with a longer-term goal of mitigating to a 1-in-1,000-year standard. • Create the community standard through community dialogue. • Pursue a multiple lines of defense flood protection strategy. • Enhance the amenity value of drainage canals and better integrate them into the urban landscape. • Enhance urban green spaces as water-storage assets.
2	***A resilient city working toward a future in which evacuation would rarely be necessary***	• Bring planning for resilience into an expanded city Environmental Affairs agency, and strengthen existing capacity in hazard mitigation, floodplain management, and stormwater management. • Expand community awareness about hazard risk. • Expand the coordination and implementation of coastal restoration efforts in Orleans Parish. • Design new public facilities and retrofit existing public facilities to withstand hazards and serve as storm shelters for emergency personnel and for the public (less than category 3 storms).

Within the Master Plan, the City discusses the fact that storms and floods are the most significant hazards facing New Orleans. The City"s commitments to expand its technical expertise in the area resilience and hazard mitigation must be combined with broad community dialogue and understanding about probabilities, managing risks, and the interrelated responsibilities of individual households, city government, and state and federal governments.

With the current influx of funding through the federal and state government in programs such as the Hazard Mitigation Grant Program (HMGP) and the Road Home and other similar mechanisms to provide funding for rebuilding, it is important to ensure these mitigation activities are consistent with the goals for development, renewal, and growth within the City. The HMGP is FEMA"s flagship hazard mitigation program, and is designed to provide funding for a range of mitigation projects, with the State administering the program. The Road Home program was established by the U.S. Department of Housing and Urban Development as a means for residents to return to their homes as soon as possible after Katrina, using grants to return to a pre-existing home, purchase another home in the area, or sell a home and leave the area. Additional information can be obtained at http://road2LA.org.

Section 8. Capability Assessment

Contents of this Section

Changes between the 2010 Plan and the 2015 Plan Update
The Capability Assessment section of the 2010 Plan has been updated. In the 2010 Plan, a capability assessment survey was sent to key departments and agencies to gather self-assessments. However, responses to that survey were not numerous enough to be uniformly helpful in the Plan update. For the 2015 Plan Update, the City's Hazard Mitigation Office updated the capability assessment from their own knowledge and experiences for those agencies that are most likely to serve as lead agencies in the implementation of the Mitigation Strategy in the 2015 Plan Update. The Capability Assessment section for the 2015 Plan Update also includes an updated discussion of federal and state capabilities to support Orleans Parish as well as a new funding source matrix.

8.1 Interim Final Rule (IFR) Requirements for Capability Assessment

IFR §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

The capability assessment contains an analysis of local, state and federal agencies and departments that support hazard mitigation activities. Agency missions, programs, and policies were reviewed to gauge the capacity of each to contribute in the implementation of the Hazard Mitigation Plan. Additionally, funding opportunities were examined at local, State and Federal levels.

The following capability assessment provides the basis for developing a mitigation strategy that fulfills the requirement of FEMA 44 CFR Part 201.6 (c) (3).

8.2 Local Capability Assessment

This section describes the City's capacity to implement the mitigation actions proposed in this Plan. The City of New Orleans is a Home Rule City, as defined by the Louisiana Constitution. Among other things, the City has the power to adopt and implement regulations for land use, zoning, and historic preservation and to adopt standards for the construction, demolition, use and modification of land and structures.

Since the 2010 Plan Update, the City updated many of the regulations that govern its application of these powers. One important milestone is the City's Master Plan for the 21st Century: New Orleans 2030, which was adopted by

the City Council August 12, 2010 (Ordinance Calendar No. 28,069). The new Master Plan also includes an approved Land Use Plan. The Master Plan establishes the policies and vision to guide future development that will encourage economic development and investment, support New Orleans neighborhoods and communities and help move New Orleans towards becoming a more resilient city. Elected officials, as well as city departments, boards and commissions are charged with implementing the policies of the Master Plan. The 2010 Hazard Mitigation Plan was adopted as an appendix to the Master Plan. As part of the Master Plan, elected officials, as well as city departments, boards, and commissions, will also be charged with implementing the 2010 Hazard Mitigation Plan Update. In the next round of Master Plan amendments following the adoption of the 2015 Plan Update, inclusion of the 2015 Plan within the Master Plan will be requested.

On August 12, 2015, the City adopted a new Comprehensive Zoning Ordinance (Ordinance Calendar 30,637) which establishes the regulatory tools to implement the policies of the Master Plan, including the Hazard Mitigation Plan.

Departments, Boards, and Commissions

Many City departments, boards, and commissions perform functions related to hazard mitigation. The organizations listed below are those that are most likely to be involved in mitigation activities or to support other organizations in that capacity.

New Orleans City Departments and Offices

Chief Administrative Office – Serving as the administrative arm of the Mayor, this office oversees other city departments and the city budget.

Office of Homeland Security and Emergency Preparedness (NOHSEP) – This office is responsible for emergency planning and response to disasters. This includes preparation for and coordination of the actions needed to protect the lives and property of the citizens of New Orleans from natural or man-made disasters. Requests for federal disaster assistance and federal funding subsequent to disaster declarations have historically been made through this office. NOHSEP also encompasses the Hazard Mitigation Office. The Hazard Mitigation Office is responsible for the maintenance and implementation of the City's Hazard Mitigation Plan as well as for the management of the City's disaster risk reduction efforts, including FEMA's Unified Hazard Mitigation Assistance programs. The office is responsible for gathering knowledge about local hazards and risks, and incorporating this knowledge into project planning and development. The Hazard Mitigation Office also communicates hazard and risk information to New Orleans residents, coordinates with city, state, and federal agencies, and builds capacity outside city government for disaster risk reduction.

Capital Projects Administration – Capital Projects Administration is responsible for the implementation of the City's Capital Improvements Plan and for projects funded by FEMA's Public Assistance program.

Office of Coastal & Environmental Affairs (OCEA) – The OCEA was established to enhance and protect the New Orleans environment for current and future generations. OCEA strives to deliver on a vision for creating a truly sustainable community through energy efficient housing, green economic development, sustainable coastal zone management, and soil/land remediation, as well as public education and information to further amplify the message of a green, sustainable New Orleans.

Department of Code Enforcement – This department enforces a broad set of housing standards in the City Code. The department's main functions include inspecting houses, prosecuting code violations, and initiating the

expropriation process when needed. This department seeks to make sure that neighborhoods are vibrant and safe through: a) Removing blighted property and getting the property back into commerce; b) Making sure that properties do not pose health threats to the community; and c) Making sure that properties are structurally sound.

Office of Communications – The Office of Communications is responsible for coordinating all external communications.

New Orleans Fire Department (NOFD) – The NOFD responds to all emergency situations in the City of New Orleans to protect and save life and property. The Department also strives to reduce the incidence of fire and the loss of life and injuries due to those incidents.

Department of Health – The New Orleans Department of Health is responsible for adopting and enforcing local health and sanitary regulations, making health inspections, and operating and providing emergency medical services. The Health Department also provides other services including disease mapping, prevention, and health maintenance. The Health Department is also in charge of implementation of the evacuation plan for special needs citizens.

Department of Information Technology & Innovation – The Office of Information Technology and Innovation facilitates effective, cost efficient use of technology by spearheading the assessment and deployment of technology-based business management solutions, and service delivery strategies. They strive to maximize the City's IT value by providing a stable technology and network infrastructure; drive innovation and performance improvement to enhance the delivery of all City services; increase the availability of information to improve decision making for City employees and residents.

Office of Intergovernmental Relations (IGR) – This office oversees many federal and state programs and monitoring of those programs. IGR works with federal, state and local agencies to secure funding for the City. This office also coordinates between the Administration and the City Council.

Mayor's Office of Resilience – The Mayor's Office of Resilience was established in 2015 through the City's participation in 100 Resilient Cities. This office is headed by the Chief Resilience Officer and is responsible for the City's Resilience Strategy.

Department of Parks & Parkways – The Department of Parks & Parkways is responsible for maintenance of neutral grounds, the tree canopy on public property, and City-owned parks.

Department of Public Works (DPW) – This department is responsible for designing, constructing, paving, and maintaining streets, bridges, the local storm sewer, and related structures. They have the responsibility for parking enforcement, towing abandoned cars and vehicles, and clearing catch basins.

Department of Safety and Permits – The Safety and Permits Department is responsible for issuing the permits needed for all new construction, renovations, additions, use, and special events. The Building Division of Safety and Permits is responsible for inspecting buildings to ensure that new construction or alterations to existing structures are done according to the minimum standards provided in the Building Code. The Building Division also conducts flood compliance reviews and inspections. The Director of Safety and Permits also serves as the Floodplain Manager.

Department of Sanitation – This department is responsible for keeping city streets clean and for the collection of refuse.

New Orleans City Council

City Council – The City Council serves as the legislative body of the City and consists of seven members – five council members representing each district and two at-large council members. They enact laws to protect the safety and welfare of the citizens of New Orleans. The Council has the authority to levy taxes (subject to state law) and to adopt the City's annual capital and operating budgets. Ordinances of the Council may be vetoed by the Mayor, and vetoes may be overridden by a two-thirds vote of the Council. The Hazard Mitigation Plan must be adopted by the City Council for it to become effective.

Boards and Commissions

New Orleans Sewerage and Water Board – The mission of the Sewerage and Water Board is to provide New Orleans with drinking water, drainage, water for fire protection, and wastewater service. The Board is responsible for operating pumping stations throughout the City to pump out storm water.

City Planning Commission – The City Planning Commission is responsible for developing the City's zoning ordinance, land use plan, Master Plan, and subdivision regulations. It is also in charge of plans for the "re-planning, improvement, and reconstruction of neighborhood and community centers, and of areas or districts destroyed or seriously damaged by fire, earthquake, flood, or other disaster."

New Orleans Redevelopment Authority (NORA) – NORA was created by state statute to eliminate and prevent the spread of slums and blight in the City of New Orleans in accordance with Community Improvement Plans. Its powers include acquiring real property through acquisition or expropriation; disposing of said property by sale or lease; and providing security to support slum clearance and neighborhood development. NORA's redevelopment policies are critical for the City's future sustainable growth and development, especially regarding development policies that mitigate future hazards. NORA coordinates with other departments within the City as well as outside agencies, such as the U.S. Department of Housing and Urban Development (HUD), to bring a better quality of life to Orleans Parish residents.

Historic District Landmarks Commission (HDLC) – The HDLC is responsible for preserving and protecting the architectural character of New Orleans through the regulation of thirteen designated historic districts and separate landmark structures. The HDLC must issue a Certificate of Appropriateness for alterations to any private structure within a district under their control.

Vieux Carre Commission – The Vieux Carre Commission is responsible for preserving the buildings in the Vieux Carre. Specifically, the Commission reviews all plans for the erection of any new building or alteration, addition to, painting, or demolishing of any building in the Vieux Carre.

Mosquito, Termite & Rodent Control Board – This board is responsible for administering and evaluating mosquito and termite activities, and for monitoring the population of disease and virus transmitting mosquitoes.

Regional Transit Authority (RTA) – The RTA operates public buses and streetcars in New Orleans. The RTA plays a major role during evacuations of the city.

The ability to expand on and improve the existing programs and policies will be accomplished by coordinating efforts of the Capital Improvement Plan and the Hazard Mitigation Plan. The City of New Orleans Master Plan and the

Resilient New Orleans Strategy direct departments and agencies listed in this section to coordinate mitigation projects identified in this plan with projects identified in the Capital Improvement Plan. In the future, we will be looking for opportunities to leverage hazard mitigation projects with larger redevelopment. For example, by making water management strategies a requirement of all new developments and commercial projects, we expand the hazard mitigation activities beyond this plan and into the other companion plans.

Other Organizations

Evacuteer – Evacuteer is a non-profit organization with an emphasis on community relations in the New Orleans area. Their mission is predominantly to recruit, train, and manage volunteers. Evacuteer is comprised primarily of volunteers who provide assistance to New Orleans residents who may have accessibility issues during a mandatory evacuation. They provide neighborhood pick-up points known as Evacuspots. They train volunteers from neighboring communities to staff these locations, as well as provide assistance at City Hall with the 3-1-1 hotline. The authority of Evacuteer stems from an existing agreement with NOHSEP. Evacuteer trains approximately 500 volunteers each hurricane season to assist with potential activation of the City-wide Assisted Evacuation Plan (CAEP).

In addition, Evacuteer encourages the use of community partnerships to assist during mandatory evacuations. Community organizations that participate are provided with training to fully understand their expected responsibilities and roles within Evacuteer. They must commit a certain number of Evacuteers during an activation of the CAE. Volunteers provided by these organizations receive twenty five hours of training, drills, etc. throughout the calendar year. Volunteers may also be asked to be present during the re-entry phase of the CAEP.

Southeast Louisiana Flood Protection Authority-East (SLFPAE) – The SLFPA-East covers three consolidated districts: East Jefferson Levee District, Orleans Levee District, and Lake Borgne Basin Levee District. The Authority's mission is to ensure the physical and operational integrity of the regional flood risk management system, and to work with local, regional, state, and federal partners to plan, design, and construct projects that will reduce the probability and risk of flooding for the residents within the Authority's jurisdiction. SLFPA-East is one of two authorities serving Orleans Parish and the surrounding metropolitan area, and it is the successor to the Orleans Levee District for the east bank of Orleans Parish.

Orleans Levee District – The Orleans Levee District is responsible for maintaining the levee system and associated drainage. It must also issue a permit or "letter of no objection" to any work or structures proposed in the vicinity of the levee system. As part of the maintenance program for the levees, a joint inspection of the hurricane levees is conducted each May by the U.S. Army Corps of Engineers, the Louisiana State Department of Transportation and Development, NOHSEP, and the Orleans Levee District. Each October or November, the same parties conduct an inspection of the Mississippi River levee system. Furthermore, the Operations and Maintenance Director for the Orleans Levee District is required to make bi-weekly checks of all levees for unusual conditions. (Also see Southeast Louisiana Flood Protection Authority-East and –West).

The Southeast Louisiana Flood Protection Authority-West (SLFPA-West) – The SLFPA-West is the levee authority serving the West Bank of the City of New Orleans and its surrounding metropolitan area. It is the successor of the Orleans Levee District on the west bank of Orleans Parish. It provides flood protection for nearly all land on the west bank of the Mississippi River in Jefferson and Orleans parishes by building, operating and maintaining flood control systems. The Authority is made up of two levee districts: the West Jefferson Levee District, which serves the west bank portions of Jefferson Parish, and the Algiers Levee District, which serves the west bank portions of Orleans Parish. Its jurisdiction covers approximately 67 miles of hurricane flood protection levees, floodwalls and floodgates and approximately 33 miles of Mississippi River levees and floodwalls.

Regional Planning Commission (RPC) – The RPC includes Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, and St. Tammany Parishes. Its mission is to promote the general welfare and prosperity of the entire region by harmonizing the activities of federal, state, parish, municipal, and other governmental agencies in the region.

U.S. Army Corps of Engineers (USACE) – The USACE's New Orleans division provides comprehensive water resources management to include navigation, hurricane and storm damage risk reduction, and environmental stewardship for south Louisiana to ensure public safety and benefit the nation. The local USACE district conducts contingency operations and supports the national response plan.

Lake Pontchartrain Basin Foundation (LPBF) – The LPBF is a non-profit organization that works to restore and preserve the water quality, coast, and habitats of the Lake Pontchartrain Basin, a 10,000 square mile watershed encompassing 16 Louisiana parishes. The Foundation, consisting of a 14-member board of directors representing parishes located within the Basin, as well as regulatory agencies, works in partnership with all segments of the community to coordinate restoration activities, educate citizens and stakeholders, advocate, and monitor regulatory processes. Over the last decade LPBF has worked with numerous federal, state, and local agencies to create comprehensive strategies for coastal restoration and hurricane protection in the Basin.

Entergy New Orleans (ENO) – ENO, a subsidiary of Entergy Corporation, is the electric and gas utility serving Orleans Parish. Until late 2015, customers on the west bank of Orleans Parish were served by Entergy Louisiana. However, all of Orleans Parish is now served by Entergy New Orleans.

Survey of Local Capabilities

An assessment of agencies that provide services which directly or indirectly support hazard mitigation planning activities was conducted by the Hazard Mitigation Office. During the first year following adoption of this plan, each of these agencies will be asked to update and expand upon any information about their operations or authority that may further support implementation of the plan. The Hazard Mitigation Office will use this information to fill capability gaps and to identify additional gaps, conflicts, and or weaknesses to be addressed through the maintenance cycle of the Mitigation Plan.

The results of the Mitigation Office's Capability Assessment are shown in the following tables. This assessment is intended to identify current capabilities to implement hazard mitigation activities. In particular, the information below reflects: 1) planning and regulatory tools currently in place; 2) administrative and technical authority and resources; and 3) funding resources.

STAFF/PERSONNEL RESOURCES	Staff with knowledge of land devleopment and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Staff having specialized experience with natural and/or human-caused disasters	Emergency Manager	Certified Floodplain Manager®	Land Surveyors	Scientists familiar with the hazards of the community	Staff with education or expertise to assess the community's vulnerability to hazards	Personnel skilled in Geographic Information Systems (GIS) and/or FEMA's HAZUS program	Resource development staff or grant writers
New Orleans City Departments and Offices										
Chief Administrative Office (CAO)	✓							✓		
Office of Homeland Security and Emergency Preparedness (including Hazard Mitigation Office)	✓		✓	✓	✓		✓	✓	✓	✓
Capital Projects Administration	✓	✓	✓					✓	✓	✓
Office of Coastal & Environmental Affairs (OCEA)	✓		✓				✓	✓		✓
Department of Code Enforcement	✓	✓	✓					□		
Office of Communication			✓							

New Orleans Fire Department (NOFD)			✓	✓				✓		✓
Department of Health			✓	✓			✓	✓		✓
Department of Information Technology and Innovation			✓					✓	✓	✓
Office of Intergovernmental Relations										✓
Mayor's Office of Resilience	✓	✓	✓				✓	✓		✓
Department of Parks and Parkways	✓	✓	✓				✓	✓		✓
Department of Public Works (DPW)	✓	✓	✓		✓			✓	✓	✓
Department of Safety and Permits	✓	✓	✓		✓			✓	✓	✓
Department of Sanitation			✓				✓	✓		
New Orleans City Council	✓									
Boards and Commissions										
Sewerage & Water Board	✓	✓	✓		✓		✓	✓	✓	✓
City Planning Commission	✓	✓	✓		✓			✓	✓	✓

New Orleans Redevelopment Authority (NORA)	✓	✓	✓		✓			✓	✓	✓
Historic Districts Landmarks Commission (HDLC)	✓	✓	✓							
Vieux Carre Commission	✓	✓	✓							
Mosquito, Termite, & Rodent Control Board			✓				✓	✓		✓
Regional Transit Authority	✓	✓	✓					✓	□	
Other Organizations										
UNO - CHART	✓	✓	✓		✓		✓	✓	✓	✓
Evacuteer	□		✓					✓		✓
Southeast Louisiana Flood Protection Authority - East (SLFPAE)	✓	✓	✓		✓		✓	✓	✓	✓
Orleans Levee District	✓	✓	✓		✓		✓	✓	✓	✓
Southeast Louisiana Flood Protection Authority - West (SLFPAW)	✓	✓	✓				✓	✓		✓
Regional Planning Commission (RPC)	✓	✓	✓					✓	✓	✓
U.S. Army Corps of Engineers (USACE)	✓	✓	✓		✓	✓	✓	✓	✓	✓

Lake Pontchartrain Basin Foundation (LPBF)	✓		✓				✓	✓	✓	✓
Entergy, New Orleans	✓	✓	✓			✓		✓	✓	✓

Local Funding Sources

The City of New Orleans has the capacity to fund some mitigation activities from City revenues. The City adopts two different budgets every year, the Operating Budget and the Capital Budget. Funds in both the Operating Budget and the Capital Budget can be used to support mitigation activities.

In the case of the Operating Budget, some revenues must be used for predetermined purposes while other revenues are unrestricted. Tax revenues make up slightly less than half of the City's total operating revenues in most years. All sales tax revenue and approximately one-third of property tax revenue goes into the City's unrestricted General Fund and may be used at the City's discretion to provide public services. Of the restricted sources of revenue, the Economic Development Trust Fund and the Housing Trust Fund could possibly be used to fund mitigation activities.

8.3 Federal and State Capability Assessment

The Federal government and the State of Louisiana have an abundance of resources that the City of New Orleans can access in order to support the Orleans Parish 2010 Hazard Mitigation Plan Update. Federal agencies provide mitigation assistance through various programs that conduct studies, develop, and fund projects for ecosystem restoration, flood control and hurricane protection, as well as indirectly provide mitigation assistance through disaster recovery. The federal government has several programs to support hazard mitigation through the Federal Emergency Management Agency (FEMA). These programs are federally-funded but typically administered by the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP).

FEMA-funded programs

- **FEMA Pre-Disaster Mitigation Program (PDM)**: The Pre-Disaster Mitigation program is designed to implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program. These include planning, acquisition, retrofitting, flood control projects, generators, and other projects. All applicants must participate in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area. Only governments are eligible. The PDM covers up to 75% of costs.

- **FEMA Flood Mitigation Assistance Program (FMA)**: The Flood Mitigation Assistance program's goal is to reduce or eliminate claims under the NFIP. This program provides funding to assist states and NFIP-participating communities in implementing plans, projects, and programs to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. This includes acquisition, elevation, and other methods of flood mitigation. The FMA program covers up to 75% of costs unless the subject property meets the definition of Severe Repetitive Loss, in which case up to 90% of eligible costs may be reimbursed by the FMA program.

- **FEMA Repetitive Flood Claims Program (RFC)**: This program provides funding to reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP that have had one or more claim payment(s) for flood damages. Repetitive Flood Claims (RFC) funds may only be used for structures in NFIP participating communities that cannot meet the requirements of the FMA program due to lack of cost share

funds or capacity to manage the activities. The RFC grants provide up to 100% of state/local match for FMA property acquisitions, as well as other flood-related mitigation measures.

- **FEMA Hazard Mitigation Grant Program (HMGP):** Authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program is administered by FEMA and provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Eligible projects include drainage systems, structure elevation, landscape alteration, floodwalls, road elevation, property acquisition, development of mitigation plans, development of land-use regulations, and more. Governments and selected non-profits are eligible. The HMGP covers up to 75% of costs. The majority of hurricanes Katrina and Rita-related funds came through FEMA's Public Assistance (PA) and HMGP.

- **FEMA Public Assistance (PA):** The Public Assistance Program provides supplemental federal disaster grant assistance under Section 406 of the Stafford Act for the repair, replacement, or restoration of disaster-damaged publicly owned facilities, and the facilities of certain private, non-profit organizations. Eligible projects include: debris removal, emergency protective measures, repair of transportation and utility infrastructure, and more. The PA covers up to 75% of costs. Rather than simply repairing a facility to its pre-damage level of safety, the Public Assistance program can provide additional funding, where cost-effective and technically feasible, to bring a facility to a higher safety standard.

- **FEMA Unmet Needs:** FEMA's Unmet Needs program is authorized by Congress for specific major disaster related events where the needs of the citizens are not met through existing services. The Unmet Needs program is implemented only when deemed appropriate by Congress. Project eligibility is also determined by Congress, but will usually conform to the existing criteria under the HMGP unless specifically waived.

For many of these federal grants, the "non-federal" share can be borne by the state as the "grantee", the recipient community as the "subgrantee" or the property owner who benefits from the project. In most states, the non-federal share is typically borne by the community or the property owner.

Other Federal Mitigation-Related Programs

The following other federal programs represent only some of the federal programs related to mitigation with may be available to support the Orleans Parish 2015 Hazard Mitigation Plan. A more comprehensive listing of potential funding sources to support this Update is included in Section 8.

- **National Disaster Resilience Competition (NDRC):** NDRC is a HUD program intended to help communities become more resilient. The National Disaster Resilience Competition (NDRC) is a two-phase process that will competitively award nearly $1 billion in HUD Disaster Recovery funds to eligible communities. Orleans Parish is an eligible community. The competition will help communities recover from prior disasters and improve their ability to withstand and recover more quickly from future disasters, hazards, and shocks. This support will help applicants consider future risks and vulnerabilities in planning and decision-making. The competition encourages communities to not only consider how they can recover from a past disaster but also how to avoid future disaster losses.

- **Non-Structural Alternatives to Structural Rehabilitation of Damaged Flood Control Works:** The USACE, New Orleans District Office provides planning and construction grants for non-structural alternatives to structural rehabilitation of damaged flood control works.

- **Beneficial Uses of Dredge Material Program:** The USACE, New Orleans District Office provides funding to use dredged materials from navigable waterways to create wetlands, protect eroding shorelines, and more.

- **Flood Control Act Funds:** The USACE, New Orleans District Office provides funding through federal appropriations in support of flood control infrastructure projects.

- **Project Modification for Improvement of the Environment:** The USACE New Orleans District Office provides ecosystem restoration by modifying structures and/or operations of water resource projects constructed by the USACE, or restoring areas where USACE projects degraded an area.

- **Water Resources Development Act:** The USACE New Orleans District Office provides funding to support federal projects including flood control and coastal restoration.

- **Community Development Block Grants (CDBG) Supplemental Appropriations:** The Housing and Urban Development (HUD) provides CDBG grants to help cities, parishes, and states recover from disasters, especially in low-income areas.

- **CDBG, State-Administered Program:** HUD provides financial assistance to promote development and economic opportunities for low and moderate-income persons, including mitigation actions.

- **CDBG Entitlement Communities Program:** HUD provides financial assistance to larger cities and urban parishes to promote development and economic opportunities for low and moderate-income persons, including mitigation actions.

- **HOME Investment Partnership Program:** HUD provides grants and loans to states, local governments, and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low–income persons.

State of Louisiana

A number of mitigation-specific acts, plans, executive orders, and policies exist in the State. Among them are several targeted planning and policy documents, and several multi-agency attempts at integrating the various hazard mitigation activities in the State. Many of these plans and policies hold significant promise for hazard mitigation, particularly because they are ongoing and take an integrated, strategic look at the whole hazard-mitigation landscape in Louisiana and propose ways to continually improve hazard mitigation.

The largest number of the mitigation policies, programs, and activities undertaken by Louisiana State agencies occur within the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP). However, the Department of Transportation and Development (DOTD), the Department of Natural Resources (DNR), the Department of Environmental Quality (DEQ), the Coastal Protection Restoration Authority (CPRA), the Division of Administration, and the Office of Community Development (OCD) all have policies, programs, and activities specific

to mitigation or that actively support hazard mitigation. Additional agencies and entities have programs that further support hazard mitigation activities in the State. In many cases, these programs' full potential for effective mitigation is not realized. Thorough and systematic policy/program evaluations and organizational reviews of hazard mitigation efforts are needed both within the State and among federal partners.

GOHSEP, DNR, OCD and DOTD all have significant numbers of staff devoted specifically to hazard mitigation, or whose activities actively support hazard mitigation. GOHSEP is the programmatic lead on hazard mitigation activities.

Finally, to provide a sound basis for ongoing and future hazard mitigation planning, a better GIS and other data creation, consistency, management, and distribution systems are needed. The 2010 Plan concluded that the most viable option was likely one that involves partnerships between GOHSEP, Louisiana universities, and other state agencies, as well as local and regional entities. While this would also facilitate better integration between local and state planning, the City itself has taken great steps forward to establish a level of capacity to manage and use data in the years since the previous plan update. The City should continue this positive momentum to establish a continuous and deliberate decision-making process that can be based on, and supported by, this capacity to analyze data. Additionally, efforts to collaborate with respect to this effort, as suggested in the 2010 Plan, should be continued.

FINANCIAL RESOURCES	Capital Improvement Programming	Community Development Block Grants (CDBG)	Special Purposes Taxes (or taxing districts)	Fees for Water, Sewer, Gas, Electric, or other Utility Services	Stormwater Utility Fees	Development Impact Fees	General Obligation, Revenue and/or Special Tax Bonds	Partnering arrangements or intergovernmental agreements	Impact fees for homebuyers or developers of new developments	Ability to withhold spending in hazard-prone areas
New Orleans City Departments and Offices										
Chief Administrative Office (CAO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Office of Homeland Security and Emergency Preparedness (including Hazard Mitigation Office)								✓		
Capital Projects Administration	✓	✓					✓	✓		✓
Office of Coastal & Environmental Affairs (OCEA)								✓		
Department of Code Enforcement							✓			
Office of Communication										
New Orleans Fire Department (NOFD)	✓		✓	✓		✓		✓	✓	✓
Department of Health							✓	✓		

Department of Information Technology and Innovation										
Office of Intergovernmental Relations								✓		
Mayor's Office of Resilience	✓	✓						✓		✓
Department of Parks and Parkways	✓	✓							✓	✓
Department of Public Works (DPW)	✓	✓			✓	✓			✓	✓
Department of Safety and Permits		✓				✓	✓		✓	✓
Department of Sanitation	✓	✓		✓		✓	✓		✓	
New Orleans City Council	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Boards and Commissions										
Sewerage & Water Board	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
City Planning Commission	✓	✓			✓	✓	✓		✓	✓
New Orleans Redevelopment Authority (NORA)		✓						✓		✓
Historic Districts Landmarks Commission (HDLC)										✓
Vieux Carre Commission			✓							

Mosquito, Termite, & Rodent Control Board			✓	✓			✓	✓		✓
Regional Transit Authority			✓	✓		✓	✓	✓	✓	✓
Other Organizations										
UNO - CHART								✓		
Evacuteer								✓		
Southeast Louisiana Flood Protection Authority - East (SLFPAE)			✓					✓		✓
Orleans Levee District			✓					✓		✓
Southeast Louisiana Flood Protection Authority - West (SLFPAW)			✓					✓		✓
Regional Planning Commission (RPC)								✓		✓
U.S. Army Corps of Engineers (USACE)			✓					✓		✓
Lake Pontchartrain Basin Foundation (LPBF)								✓		
Entergy, New Orleans				✓			✓			

Section 9. Mitigation Strategy

Contents of this Section

Changes between the 2010 Plan and the 2015 Plan Update.
The Mitigation Strategy section of the 2010 Plan has been updated, expanded, and completely rewritten to include updated goals. Objectives have been removed for the purposes of this update and the updated Mitigation Action Plan is organized solely by goals. The updated Mitigation Action Plan incorporates all prior mitigation actions, provides their status, and notes those actions that are being removed at this time. This Plan Update also includes an updated Implementation Strategy that identifies the hazards that are addressed with each action, the lead agency/support agencies that will implement the action, preliminary cost estimates, funding sources, and time frame for implementing the action.

9.1 Interim Final Rule (IFR) Requirements for Mitigation Strategy

IFR §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

IFR §201.6(c)(3)(i):[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

IFR §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 mitigation strategy] must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.

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

9.2 Overview of Mitigation Strategy

The Mitigation Strategy is a long-term plan to reduce potential losses identified in the risk assessment. The Mitigation Strategy includes the 1) Goals, 2) Mitigation Action Plan, 3) Prioritized Mitigation Actions, and 4) Implementation strategy developed by the Planning Team and the community. The strategy was developed following a review of the capabilities of the Parish, including its authorities, policies, programs, resources, and ability to use these tools to reduce losses and vulnerabilities from profiled hazards. The goals provide the vision, the objectives identify measurable steps to achieve the vision, and the mitigation actions are specific projects that can be implemented to achieve specific goals and objectives. A comprehensive range of mitigation actions are included in the updated plan that will allow the Parish to reduce losses and vulnerabilities in a variety of ways. For example, the mitigation strategy includes specific capital improvement projects, as well as regulatory changes, public education efforts, and coordination with other entities to improve hazard mitigation planning intended to reduce losses and vulnerabilities. The mitigation strategy includes actions that can be implemented easily with current resources, others that will require long range planning and significant local resources, and still other actions that cannot be implemented until after a disaster event.

9.3 Goals

The Orleans Parish Hazard Mitigation Planning Team reviewed the findings of the updated local and state risk assessments, as well as the goals and objectives in the 2010 approved plan. Over the course of several meetings the City Hall Working Group and Advisory Committee reviewed and discussed the following set of questions in order to update goals and objectives for the 2015 Hazard Mitigation Plan Update.

Do the goals and objectives identified in the 2010 plan:

a) reflect the updated risk assessment?
b) lead to mitigation projects and/or changes in policy that help reduce the Parish's vulnerability?
c) support changes in mitigation priorities?
d) reflect current State goals?

After a detailed discussion of the 2010 goals and objectives, the City Hall Working Group and Advisory Committee determined that objectives would not be included in this update and decided upon a final list of goals for the 2015 Update. Foundational principles were also determined.

Foundational Principles: The following foundational principles are key to all of the Goals:

1. Consider the principles of equity in risk reduction decisions, including land use, zoning, and the allotment of funds and resources
2. Plan for future conditions, including development and climate change
3. Plan for minimizing damage and maximizing disaster recovery
4. Treat risk reduction and hazard mitigation as part of an integrated system, with an emphasis on safety.

The following goals were the result of this update process. The goals were updated to simplify and bring clarity to mitigation actions, reflect the updated risk assessment, support changes in mitigation priorities, and support the broad range of efforts underway in the City, including Resilient New Orleans. This ensured that the plan was revised to reflect the changes in mitigation priorities.

Goal #1: Reduce Risk and Vulnerability to the Human Environment including cultural resources, homeowners, renters, visitors, and transient populations.

Goal #2: Reduce Risk and Vulnerability to the Built Environment including current and future structures; critical facilities; historical structures; and, infrastructure including communications.

Goal #3: Reduce Risk and Vulnerability to the Natural Environment including wetland restoration and recognition of New Orleans as a coastal city.

Goal #4: Maximize the Involvement of Individuals, Businesses, and Groups in Risk Reduction Measures through Education/Outreach on Hazard Mitigation Appropriate to all Groups, Particularly Vulnerable Populations

Goal #5: Promote Coordination Locally, Regionally, and nationally including all levels of government, private sector entities, as well as nonprofits and community based organizations.

Goal # 6: Ensure Continuity of Operations for local government and businesses, including protection of Critical Functions, Records, and Cultural Assets

9.4 Mitigation Action Plan

Review of 2010 Mitigation Action Plan and Accomplishments
The Hazard Mitigation Office, along with other City departments, have made significant progress towards several of the actions identified in the 2010 Plan. Highlights of accomplishments since 2010 include:

- Work to restore the damaged levee system to withstand at least a 1% annual chance of a hurricane event (formerly known as a Category 3 Hurricane) and to enhance the levee system to withstand a 0.2% annual chance of a hurricane event (formerly known as a Category 5 Hurricane).
- Improved pumping capacity
- Updated Comprehensive City Zoning Ordinance with greater requirements for on-site detention.
- Programs for Severe and Repetitive Loss Structures have been developed and are underway to reduce flood losses through implementation of mitigation actions to include elevation, relocation, demolition/rebuild, retrofitting and flood proofing.
- Geographic Information Systems (GIS) developed for all properties/parcels located in hazard areas and properties that sustain damaged during a hazard event.
- Public meetings held to present the FEMA Flood Insurance Rate Maps and to encourage homeowners and business owners to upgrade flood protection.
- Contra flow evacuation maps and a Citizen Assisted Evacuation Brochure produced and updated annually.
- Generators installed for some critical facilities.

- Creation of the Resilient New Orleans Strategy

There have been no changes in the priorities of the Plan, which reflects the current conditions of the City, including financial, legal, and political realities as well as post-disaster conditions.

2015 Mitigation Action Plan

In addition to reviewing and updating the 2010 mitigation actions for the 2015 updated plan, the planning consultant reviewed a number of recent planning documents to identify other potential mitigation actions to reduce risks from the identified hazards as discussed in Sections 6 and 7. Plans reviewed included: the Resilient New Orleans Strategy, various reports from The Data Center, reports from the Institute for Women & Ethnic Studies, and other documents.

In reviewing the area-wide plans, the planning consultant identified new potential actions that would achieve the following:

- Reduce or eliminate the long term-risk to human life and property from one or more of the hazards profiled, identified, and ranked in Section 6 and assessed for vulnerabilities in Section 7 of the updated plan.
- Meet one or more of the FEMA mitigation action categories (listed below)
- Fulfill one or more of the updated mitigation goals and objectives for the updated plan (described in Section 9.3)

A preliminary list of mitigation actions, including 2010 mitigation actions that are ongoing and new potential mitigations actions, was presented to the Hazard Mitigation staff for its review and then to the City Hall Working Group and Advisory Committee. The City Hall Working Group and Advisory Committee provided feedback on the proposed actions, including their input regarding the placement of the actions relative to the goals.

The list of actions was made available to the community in October and recommendations were reviewed by Hazard Mitigation staff. The Mitigation Action Plan includes 91 mitigation actions that meet the goals established by the City, meet one or more of the FEMA mitigation action categories, and will reduce or eliminate risks to human life and property from one or more of the identified hazards. The final list of mitigation actions is shown in Table 9-1.

FEMA Mitigation Action Categories

All of the mitigation actions included in the Plan fall within one of the following six FEMA mitigation action categories:

1. Prevention (P): Preventative measures are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or where capital improvements have not been substantial. Examples of prevention measures include:
   - (a) Comprehensive land use planning
   - (b) Zoning regulations
   - (c) Subdivision regulations
   - (d) Building code
   - (e) Floodplain development regulations

2. Property Protection (PP): Property protection measures protect existing structures by modifying the

building to withstand hazardous events, or removing structures from hazardous locations. Examples of property protection measure include:

(a) Building relocation
(b) Acquisition and clearance
(c) Building elevation
(d) Building retrofit

3. Natural Resource (NR) Protection: Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their mitigating functions. Such areas include floodplains, wetlands, and dunes. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

(a) Wetland protection
(b) Habitat protection
(c) Erosion and sedimentation control
(d) Best Management Practices (BMPs)

4. Emergency Services (ES): Although not typically considered a mitigation technique, emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event. Examples include:

(a) Hazard warning system
(b) Emergency response plan
(c) Critical facilities protection
(d) Health and safety maintenance
(e) Post-disaster mitigation

5. Structural (S) Projects: Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event. The projects are usually designed by engineers and managed or maintained by public works staff. Examples include:

(a) Reservoirs, retention, and detention basins
(b) Levees and floodwalls
(c) Channel modifications
(d) Channel maintenance

6. Public Education and Awareness (PE): Public education and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques that the public can use to protect themselves and their property. Examples of measures to educate and inform the public include:

(a) Map information
(b) Outreach projects
(c) Library
(d) Technical assistance
(e) Real estate disclosure
(f) Environmental education

9.5 National Flood Insurance Program (NFIP) Compliance

FEMA incorporated mitigation planning requirements for the Flood Mitigation Assistance (FMA) program on October 31, 2007 with published amendments to the 44 CFR Part 201. These amendments created a new requirement that all Local Mitigation Plans must address the jurisdiction's participation in the National Flood Insurance Program (NFIP). Orleans Parish participates in the National Flood Insurance Program as indicated below:

Adoption and enforcement of the floodplain management requirements. Orleans Parish adopted the Floodplain Management Ordinance as part of the City Zoning Ordinance in 2008 to meet the NFIP minimum standards. The new ordinance includes regulating all new and substantially improved construction in Special Flood Hazard Areas. The Hazard Mitigation Plan Update includes a mitigation action to keep City ordinances consistent with FEMA's Grant and Assistance Guidelines, as well as with state and local priorities.

Floodplain identification and mapping. The City of New Orleans, in coordination with FEMA, USACE, the LaMP Team, and others, held a series of open house public meetings in the Spring of 2009 to present the preliminary digital Flood Insurance Rate Maps (DFIRMs) to business and home owners. These meetings were advertised in local newspapers, radio and television announcements and well attended. The City is currently in the process of adopting the new preliminary FIRMs for Orleans Parish.

City's participation in the NFIP's Community Rating System (CRS). The City also participates in the NFIP's Community Rating System. This program rewards participating communities that go beyond the minimum standard requirements of the NFIP. New Orleans is currently rated as a Class 8 community, which gives policy holders in the Parish a 10% discount on flood insurance premiums. Class 10 is the lowest (no discount) and 1 is the highest, with a 5% discount added at each level. The Department of Safety and Permits administers and enforces the NFIP and participates in the CRS.

As part of the planning process to update the Orleans Parish Hazard Mitigation Plan, the Hazard Mitigation Planning Team identified, analyzed and prioritized actions related to continued compliance with the NFIP and participation in the CRS. The updated Orleans Parish 2015 Hazard Mitigation Plan includes the following mitigation actions that will improve the Parish's participation in the NFIP and CRS:

1. Increase the City's preparedness by remaining in the StormReady program and by pursuing No Adverse Impact.

2. Develop a warning and notification system in the event of sudden river flooding.

3. Install rain gardens and storm water runoff filtration and water retention systems along streets to reduce subsidence and flooding. Develop and advocate the necessary site design and landscape standards for streets, neighborhoods, and building sites.

4. Pursue an acquisition/buy-out program wherein property owners could elect to move out of high risk area to a lower risk area.

5. Adopt freeboard and other higher regulatory standards such as cumulative substantial damage and requiring non-enclosure agreements. These are adopted through updates to the CZO and the Floodplain Management Ordinance

6. Develop a program to promote the purchase of flood insurance.

7. Implement a public education campaign about the Community Rating Systems and ways in which to reduce flood insurance premiums.

8. Utilize informational brochures, hold educational events, and utilize social networks to inform the public about risk levels, historic impacts, and hazard mitigation - including non-structural measures and alternatives to elevation.

9. Educate the community about risk through the use of high water markers.

10. Require mandatory training in floodplain regulations for all building officials.

11. Continue compliance with the NFIP and adopt the revised flood insurance rate maps currently expected to arrive in 2016.

9.6 Prioritized Mitigation Actions

Once the final list of hazard mitigation actions was established, the City Hall Working Group and Advisory Committee used the same STAPLEE methodology from the 2010 Plan to evaluate and prioritize the mitigation actions for the 2015 Plan. STAPLEE is an acronym for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. This methodology was used to examine opportunities (benefits) and constraints (costs) of implementing each action from the perspective of all seven of the STAPLEE criteria. By using the STAPLEE methodology, the City was able to evaluate and prioritize mitigation actions to determine whether the actions addressed specific goals and objectives and where the actions are appropriate for Orleans Parish. The City Hall Working Group and Advisory Committee considered each of the following seven (7) STAPLEE criteria in evaluating each action.

STAPLEE Methodology

STAPLEE	Criteria Explanation
S – Social	Is the action acceptable to the community? Will the action achieve a social goal? If yes, it is a *benefit*. Does the action adversely affect one segment of the population? If yes, it is a *cost*. Or, will it negatively impact historical/cultural resources? If yes, this is a *cost.*
T – Technical	Is the action technically feasible? Does it provide long term solutions? If yes, these are *benefits*. Does it create new problems? If yes, there are *costs*.
A – Administrative	Does the Parish have the capability to implement the project? If yes, this is a *benefit*. Is there sufficient staffing and funding to implement and maintain the proposed action? If no, this is a *cost*.
P – Political	Is there political support for the action? Is there a local champion willing to promote the action? If yes, this is a *benefit.* Is there public support to ensure success? If no, this is a *cost.*

L – Legal	Is there legal authority to implement the action? Do the State and local governments have authority to implement it? If yes, this is a *benefit*. Is there a possibility that the action will be legally challenged? If yes, this is a *cost*.
E – Economic	Are there economic benefits for the action? Does the action contribute to other community economic goals? If yes, this is a *benefit*. Is there sufficient funding for the project? If no, this is a *cost*. Will the action create a financial burden? Does the action require other funding beyond what is available locally? If yes, this is a *cost*.
E - Environmental	Does the action comply with local, state, federal laws? Is the action consistent with community environmental goals? If yes, this is a *benefit*. Will the action adversely affect the environment? If yes, this is a *cost*.

Source: Adapted from STAPLEE Criteria, Lewis County, New York, URS, April 2010.

The Advisory Committee and City Hall Working Group considered the benefits (positive effects) and costs (negative effects) of each STAPLEE criteria as they completed their evaluations of the mitigation actions. Planning Team/Steering Committee members assigned a –+‖ for each criterion that was considered a benefit and a –-‖ for each criterion considered a cost. All mitigation actions were evaluated and prioritized, including the 2010 actions that were revised and carried forward to the updated plan.

The STAPLEE summary results were utilized to rank the Mitigation Actions. Adjustments were made to increase the priority ranking based on the critical need of certain actions or when there was a misunderstanding of the scope of the action. For example, the priority rankings for two actions that address compliance with the National Flood Insurance Program (NFIP) and participation in the Community Rating System (CRS) were moved from Medium to High to reflect the critical nature of these actions. The final priority ranking is shown in Table 9.1.

Benefit-Cost Review Methodology. The STAPLEE evaluation was used to perform a qualitative benefit-cost review based on Method B – Relative Rating as discussed in the FEMA 386-5 Guidance. The qualitative review was completed for the seven STAPLEE criteria -- social, technical, administrative, political, legal, economic, and environmental -- for each mitigation action. For each criterion, the total number of values received for benefits (+) was summed, reviewed, and an appropriate range of values was assigned for High, Medium, and Low. This procedure was then repeated for costs (-). Each action was assigned a High, Medium, or Low ranking for *Benefits* and a second ranking for *Costs* based on the number of –+‖ and –-‖ values for each criteria.

After evaluating benefits and costs for each of the seven criteria, an overall net benefit and net cost was determined for each action. Since each of the 7 criteria had between three and five measures, there were a total of 24 measures evaluated for each action to determine the net benefit and the net cost. The net benefit (+) range of values was determined by summing the benefit (+) values from each criteria ranked High, calculating the average value for all 7 criteria, and establishing the average value as the mid-point for the Low ranking. This procedure was repeated to determine the net benefit range for Medium and Low. Next, this same procedure was repeated for the net cost (-) range of values.

The overall net benefit and net cost for each action was reviewed to assign a priority ranking for the action. If the net benefit exceeded the net cost, the priority ranking was based on the net benefit. However, if the net cost exceeded the net benefit, the priority ranking was based on the net cost. For example, one mitigation action had a net benefit

of –High and a net cost of –Low. This action was given an overall ranking of –High. However another action had a net benefit of –Medium, but the net cost was –High. Because the net cost exceeded the net benefits, the action was assigned an overall ranking of –Low.

9.7 Implementation Strategy

The Hazard Mitigation Office in the New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP) will oversee the implementation of the Mitigation Action Plan shown in Table 9.1. The Action Plan identifies the information for each action that will guide the City of New Orleans in the implementation and administration of the actions. Table 9.1 identifies the lead and supporting agencies that will implement the actions, preliminary cost projections, funding sources, time frame for implementing, and priority ranking. This Action Plan will assist the City in coordinating mitigation activities among various agencies in order to avoid duplication or conflicts.

The Mitigation Plan lists all mitigation actions by goal and shows the specific hazards for which risks will be reduced or eliminated as specific mitigation actions are implemented. Specific mitigation actions supported by the community and identified in other plans also meet the requirements for hazard mitigation actions in the Orleans Parish 2015 Hazard Mitigation Plan Update. All of the 91 actions included in the updated plan will reduce or eliminate risks from the hazards identified in the plan. As shown, some actions are already underway and will remain ongoing. Others can be implemented quickly in the next year or two, while some will require more planning and are projected to be implemented over the next 10 years. The projected costs for the actions are preliminary and will require a more detailed cost projection before implementation. The following description of the column headings provides a key of the information provided in the Mitigation Action Plan table.

Column Header	Description
Action Item/Benefits	Contains a description of the action and potential benefits.
Goals	Identifies the hazard mitigation goals addressed by the mitigation action.
Hazards	Lists Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence for which risks will
Lead Agency/Support Agency	Lists the agency that has primary jurisdiction over the mitigation action. The listed agency will be the primary point of contact for the mitigation action. Supporting agencies will assist in implementation, funding, or maintenance of the mitigation action.
Potential Partners	Lists possible partners from outside of government.
Preliminary Costs	General projected costs associated with implementing each mitigation action. Projected costs also include ongoing maintenance costs, where applicable.
Funding Sources	Identifies possible sources of funding including the City's capital improvement budget, the City's operating budget, staff time, grants (federal, state, other), and other types of funding.
Timeframe for Implementing Action	Estimates when the project will begin and approximately how long it will take to complete. "Ongoing" refers to actions that are either underway or have no definitive end date.
Priority Ranking	Lists the results of the mitigation action prioritization.

Before implementing any action, the Hazard Mitigation Office will work with the lead agency to conduct a benefit-cost review. Such review will ensure that the City is optimizing the benefits to the community. For actions that require grant funding, a full benefit-cost analysis will be prepared to comply with FEMA requirements. For mitigation

actions that call for a study to be completed, it is assumed that the costs and benefits of the actions being studied will be calculated as part of the study. For those strategies that call for an action (including public outreach) to be undertaken, a cost-benefit review will be completed by

the agency or department responsible for implementation of the strategy prior to implementation. Projects with a benefit-cost ratio of greater than one will be considered appropriate for implementation; projects with a benefit-cost ratio of equal to or less than one will not be considered appropriate for implementation. As Project Scoping Reports are completed for specific mitigation actions, these reports will be added to the 2015 Hazard mitigation Plan Update and the Plan amended accordingly.

The Hazard Mitigation Office of the NOHSEP will be responsible for general management of the implementation of the mitigation strategies in the Plan. Accordingly, the Hazard Mitigation Office of the NOHSEP will have the authority to divide projects into phases to facilitate implementation. The Hazard Mitigation Office will also contact local universities and colleges for assistance with mitigation activities when appropriate.

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In addition, NOHSEP will be responsible for preparing a strategy to implement the mitigation actions in the Plan as part of a disaster recovery process. Frequently, a disaster is followed by a very large infusion of Federal and State development capital for local jurisdictions. Combining mitigation actions with the recovery process can achieve many of a community's mitigation goals; however, communities often have difficulty combining mitigation and recovery actions if they have not prepared to do so in advance. Following final approval of the Plan, NOHSEP will identify the mitigation actions in the Plan that would be most appropriate to implement as part of a disaster recovery process. For example, mitigation actions that require a large amount of capital and are eligible activities under the major flood recovery programs are good candidates to be combined with recovery activities.

2010 Orleans Parish Hazard Mitigation Action Items Status by 2010 Goals		
No.	**Action Item/Benefits**	**Status of Action: In Progress, Completed, Deleted, Carried Over, Carried Over with Updates, Not Started**
Goal 1 - Identify and pursue preventative measures to reduce losses of life, properties (existing and future), and ecosystems due to hazards.		
1	Install rain gardens and storm water runoff Filtration and water retention systems along streets to reduce subsidence and flooding. Develop and advocate the necessary site design and landscape standards for streets, neighborhoods, and building sites.	In progress; Carried Over

2	Harden/retrofit all critical and non-critical existing public facilities and construct future public facilities that are resilient to wind and flooding. Wind hardening projects can include but are not limited to shutters, roof tie downs, etc.	In progress; Carried Over
3	Locate electrical and other critical building-system hubs and sensitive equipment, along with files and documents, on upper floors; design buildings to minimize threats to people and property. Pursue hardening of power grid infrastructure to minimize impact of power outages.	In progress; Carried Over
4	Pursue an acquisition/buy- out/relocation program (including land-swaps) wherein property owners could elect to move out of a high risk area to a lower risk area.	Carried Over
5	Pursue programs to mitigate at- risk structures by physically elevating buildings to or above the Base Flood Elevation (BFE), wet flood proofing, and/or dry flood proofing where appropriate.	Carried Over
6	Recommend to City Council to adopt freeboard requirements.	Carried Over
7	Promote use of building methods that are flood resilient and built to the latest building code or standard.	Updated- to include Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence, not just floods
8	Limit increased exposure to risk by discouraging new and/or further development in flood prone areas through updates to the zoning ordinance and the floodplain management ordinance. This could include, but is not limited to, tracking cumulative development and/or improvements and pursuing a policy that requires homeowners to sign a non- enclosure agreement when receiving permits.	Deleted- action encompassed in new action item
9	Continue compliance with the NFIP and adopt revised flood insurance rate maps that account for completed improvements to the City's hurricane protection system, currently expected in 2011.	Updated- to include that flood maps should arrive in 2015
10	Pursue measures to improve the City's Community Rating System (CRS) credit, allowing for a reduction in NFIP insurance premiums. Improve the City's CRS rating to become a Class 7 community by 2012 by implementing measures including, but not limited to, installing rain gardens and adopting a freeboard requirement.	Updated- action has been made more inclusive by combining
11	Improve drainage infrastructure through measures in high flood risk areas including, but not limited to, the upgrade and improvement of culvert design and construction, retention and detention areas.	Carried Over

12	Restore coastal wetlands.	Updated- action is more specific with targeted wetlands areas
13	Restore Bayou Bienvenue. Use methods including, but not limited to, the use of treated municipal effluent to restore approximately 10,000 acres of critical cypress wetlands and provide improved storm surge and flood hurricane protection.	Updated- action is more specific and references the specific project
14	Restore Protective Wetlands near Fort Pike. Use methods including, but not limited to, pumping sand from the adjacent water bottoms to an elevation where marsh grass could be planted and stabilized to recreate protection that was lost.	Updated- action revised to reflect all available options
15	Maintain current information on known hazards present in facilities such as refineries, power plants, and other public or commercial businesses in a centrally located, accessible location or by other possible methods.	Carried Over
16	Implement pilot reconstruction projects in hazard prone areas to mitigate structures against future damage.	Carried Over
17	Restore Bayou Sauvage using methods including but not limited to reuse of I-10 Twin Spans debris, to improve storm surge and hurricane flood protection. . Use methods including, but not limited to, processing and placing debris to construct 3.5 miles of breakwaters along 3 reaches around the Bayou Sauvage National Wildlife Refuge (Irish Bayou Lagoon, Bayou Chevee Marsh, and Brazalier Marsh).	Updated- reflects the Golden Triangle Marsh Creation Project
18	Lake Pontchartrain Fringe marsh & shoreline stabilization Orleans Parish. Use methods including, but not limited to, the placement of wave dampening structures such as reef balls or I-10 demolition concrete to encourage natural accretion and re- vegetation of shoreline & provide buffer for levee.	Carried Over
19	Implement methods to avoid damage caused by un-tethered ships during storms, including, but not limited to, stronger tie down structures in the Industrial Canal or MRGO.	Updated- action item updated to apply to all waterways
20	Support levee maintenance in Orleans Parish**.** Implement a program to deal with invasive species, such as nutria, as a means of preventing wetlands/levee destruction.	Carried Over
21	Support efforts to raise ICC funding cap above $30K or expand the availability of ICC to Repetitive Loss properties.	Carried Over
22	Mitigate contamination resulting from illegal dumpsites, including but not limited to those sites in New Orleans East	Carried Over

23	Continue to coordinate with the USACE and Southeast Louisiana Flood Protection Authority-East to restore the damaged levee system to withstand at least a 1% hurricane event.	Completed
24	Continue to coordinate with the USACE and Southeast Louisiana Flood Protection Authority (East and West) to enhance the levee system to withstand at least a 0.2% hurricane event.	Completed
25	Establish a Parish capability to review the maintenance and strength levels of the levee system.	Carried Over
26	Keep City ordinances consistent with FEMA Grant and Assistance Guidelines, as well as with state and local priorities.	Carried Over
27	Strengthen existing programs for severe and repetitive loss structures, as well as substantially damaged structures to seek funding to support and enforce building requirements to reduce future flood losses through the implementation of mitigation actions to include elevation, relocation, demolition/-rebuild, retrofitting or flood proofing. Encourage and promote mitigation actions when building requirements cannot be enforced.	Carried Over
28	Continue to maintain a comprehensive Geographic Information System with data including but not limited to all properties/parcels in the City, hazard areas, service districts, public works facilities, transportation infrastructure, and special needs residents.	Carried Over
29	Continue to maintain a database of all properties that sustain damage as a result of a hazard. Include information about the nature and extent of the damage. Continue to incorporate database into the City's Geographic Information System.	Updated- includes specific reference to critical facilities
30	Adopt new Master Plan, which contains the guiding principles for both public and private development in the Parish, to include the hazard mitigation goals and action plan.	Carried Over
31	Conduct feasibility study regarding the use of polders, ring levees, or stepped levees as part of the City's internal flood protection system. Where feasible, pursue implementation, focusing on using existing natural features, manmade structures, and creating berms around individual or multiple parcels or smaller areas, to compartmentalize. The intent of these measures is be to achieve a higher level of structural protection across the city without requiring an increase in the height or footprint of the existing levees.	Carried Over

Goal 2 - Develop a culture of preparedness. Enhance public awareness and understanding of disaster preparedness in order to protect the economic infrastructure and the health and well being of people in Orleans Parish from the negative effects of hazards.		
1	Conduct hazard mitigation education programs for the public using a variety of methods including but not limited to distributing information brochures to and holding education events with community groups (e.g., neighborhood associations, civic associations, parent-teacher organizations at public schools, church groups, etc.). Use Social Networks (i.e., Twitter, Facebook, etc.) to get the message out. Document and publicize local mitigation success stories.	Updated- Goal 4 now creates overarching priority for education programs
2	Provide training in floodplain management principles for local officials and increase the number of Certified Floodplain Managers on City staff. The training would ensure that officials are able to consider flood risk and floodplain management in their decision making.	Carried Over
3	Provide comprehensive, ongoing education and outreach to the community about risk levels from identified hazards, such as installing historical storm/BFE markers around the City to indicate past flood depths and current risk. Encourage citizens to take greater advantage of the many non-structural measures available for reducing risks from identified hazards to make homes safer and to reduce insurance premiums. Use Social Networks (i.e., Twitter, Facebook, etc.) to get the message out.	Carried Over
4	Require mandatory training in floodplain regulations for building officials responsible for enforcing the new statewide building codes. The training would ensure that officials are informed about flood elevation requirements as they conduct their day-to-day responsibilities.	Carried Over
5	Implement a public education campaign to inform citizens about the Community Rating System and the many ways in which citizens can reduce their flood insurance premiums.	Carried Over
6	Create and conduct a Citywide Safe Growth Audit of post-Katrina redevelopment in order to assess and guide future renovation of existing buildings and development of new buildings to promote more resilient building practices.	Carried Over
7	Partner with non-profit organizations, universities, and professional associations to build a strong broad support base to promote non-structural hazard mitigation practices within the City.	Carried Over
8	Coordinate the annual reviews of the Orleans Parish Hazard Mitigation Plan and the City's Master Plan to ensure that the documents are compatible and support each other with regards to hazard mitigation planning. Ensure that the risk area maps included	Updated- actions now reflect specific items, such as incorporating hazard

	in the Hazard Mitigation Plan are added to the City's Master Plan during its first year review. Add standards to City ordinances as applicable (City Zoning Ordinance, Subdivision Regulations, Floodplain Ordinance, etc.) to promote hazard mitigation planning and ensure that these documents are compatible with the Hazard Mitigation Plan.	mitigation projects into the Capital Improvement Plan
9	Support and strengthen the City's professional Hazard Mitigation Staff in the Hazard Mitigation Unit of the New Orleans Office of Homeland Security Preparedness and also support staffing for the City's Environmental Affairs Office and the Department of Safety and Permits to support hazard mitigation planning efforts.	Updated- Several departments involved in hazard mitigation and resilience issues. Action item is now to strengthen City's capacity in general
10	Encourage policy initiatives that promote best practices, especially regarding Capital Improvements Projects in order to support hazard mitigation actions in the Orleans Parish Hazard Mitigation Plan.	In progress; Carried Over
11	Develop Parish wetlands regulations that provide the “intent” of the regulations for flood storage (available for CRS credit).	Carried Over
12	Encourage adoption of higher regulatory standards to increase Community Rating System (CRS) and enforce NFIP regulations.	Updated- action was reworded to include larger mitigation actions
13	Educate the public about storm water management, such as the importance of keeping drains and culverts clear, using handouts and community events.	Carried Over
14	Pursue other measures to increase the city's preparedness, including but not limited to, becoming a StormReady community (through NOAA) and pursuing ASFPM's "No Adverse Impact" initiative to increase cooperation with other parishes in the watershed.	Carried Over
15	Continue public education campaign for owners of non- conforming properties until the non-conformities are phased out and/or redeveloped.	Carried Over
16	Develop a program to promote, by public service announcements the purchase of flood insurance. Advertise the availability, cost, and coverage of flood Insurance through the National Flood Insurance Program (NFIP).	Carried Over

17	Annually update, produce, and distribute a hurricane awareness brochure that includes hazard information, evacuation information, and mitigation information and distribute to residents and visitors at facilities throughout the City.	In progress; Carried Over
18	Develop educational campaigns utilizing public access TV, the internet, and print media to notify the public of information regarding hazard mitigation and for the dissemination of hazard information.	Updated- action updated to reflect also informing public about risk
19	Provide hazard mitigation information to resource centers throughout the City, by distributing handouts on topics such as types of natural and manmade disasters, how to develop a family disaster plan, how to develop a business continuity plan, and simple types of mitigation projects for homeowners. Conduct presentations to civic groups, church groups, business groups, and others throughout the Parish to discuss information provided in handouts.	Carried Over
20	Evaluate the implementation of a voluntary incentive and reward programs that encourages builders and contractors to go beyond adopted minimum building code requirements to make buildings better able to withstand the forces of natural hazards.	Carried Over
Goal 3 - Ensure the ability of emergency services providers and facilities, including essential facilities, to continue operating during hazard events.		
1	Identify and harden all critical emergency management facilities. Locate electrical and other critical building-system hubs and sensitive equipment on upper floors; renovate existing buildings and design new buildings to ensure the facilities remain operational during hazard events.	Updated- action split into separate actions
2	Harden utility services and street infrastructure. Harden all flood protection infrastructure including pump support with alternative energy sources. Establish an implementation plan giving priority to emergency evacuation routes and primary arterial streets	Carried Over
3	Upgrade and install Management Information Systems equipment to ensure communication system remains operational during hazard events.	Carried Over
4	Construct shelters and/or safe rooms for emergency services and emergency service personnel to ensure continued operation of critical services during hazard events.	Carried Over

5	Continue to implement improvements for a comprehensive program to protect vital records maintained by the Parish, to include removing records from low areas, installing protection devices, and developing backup data systems. Establish standard operating procedures and controls for these improvements.	Carried Over
6	Continue to upgrade the Parish EOC to permit operations to continue during and after disaster events, including but not limited to, hardening the structure to withstand high winds, flood proofing City Hall building, enhancing communications system, and adding self containment equipment and supplies.	In progress; Carried Over- hardening for wind completed
7	Install emergency generators at all emergency shelters and critical facilities.	In progress; Carried Over- police, fire and EMS critical facilities have generators
Goal 4 - Promote regional, federal, and state cooperation between parishes with regard to hazard mitigation activities.		
1	Coordinate and assist in implementing actions from other hazard mitigation plans for specific agencies located within Orleans Parish (including New Orleans Sewerage and Water Board, Port of New Orleans, New Orleans International Airport, Audubon Institute, University of New Orleans, etc.)	Updated- action made wider to include any other local agency, instead of specific agencies
2	Coordinate local jurisdictions' planning and implementation to ensure that local plans are consistent with each other and meet regional goals. Review and coordinate mitigation actions between parishes to ensure that actions are mutually beneficial and collectively supported.	Deleted
3	Promote Stafford Act and other regulatory changes to strengthen hazard mitigation planning.	Carried Over
4	Ensure effective coordination regarding wetlands policy among State, US Army Corps of Engineers, and Local governments.	Updated- wetlands policy is included in engaging on protection of all coastal wetlands
5	Participate and contribute in all regional and statewide efforts for continued funding of Coastal Wetlands Planning, Protection and Restoration Act projects, as well as others.	Updated- action for engaging with regional and statewide partners for protection of coastal wetlands now encompasses this action

Table 9.1, Orleans Parish Hazard Mitigation New Action Plan 2016

No.	Action Item/Benefits	Hazards	Status	Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
Goal 1 Reduce Risk and Vulnerability to the Human Environment including cultural resources, homeowners, renters, visitors, and transient populations.								
1	Increase the City's preparedness by becoming StormReady and by pursuing No Adverse Impact.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP)	$50,000	City of New Orleans General Fund, Private Sector	1-5 years	High
2	Improve pediatric surge capacity	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHD, NOEMS) , State of Louisiana (DHH), Hospitals	Unknown	FEMA (HSGP), Private Sector	5-10 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
3	Purchase equipment and provide "warm zone" training to protect first responders in the event that they are a target.	Hazardous Materials, Terrorism	New	City of New Orleans (NOFD, NOHSEP), Department of Homeland Security	$1,500,000	FEMA (HSGP), Private Sector	1-5 years	Medium
4	Education and outreach on sheltering in place in the event of a hazardous materials incident. Ensure that critical facilities have shelter-in-place kits and plans	Hazardous Materials	New	City of New Orleans (NOHSEP, NOPD, NOFD, NOEMS), FEMA, GOHSEP	$250,000	FEMA, CDC (Cities Readiness)	1-5 years	High
5	Develop outreach materials regarding post-disaster air quality.	Hazardous Materials	New	City of New Orleans (NOHD), State of Louisiana (DEQ, GOHSEP), FEMA, EPA	$100,000	FEMA, Private Sector, CDC	1-5 years	Medium
6	Provide shade structures and minimal seating for evacuation pick-up sites.	Tropical Cyclone	New	City of New Orleans (NOHSEP, Property Management, Capital Projects), Evacuteer, NORDC	$1,500,000	FEMA, Private Sector	5-10 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
7	Mitigate contamination resulting from illegal dumpsites.	Hazardous Materials	New	City of New Orleans (Sanitation, Code Enforcement), LADEQ, EPA	Unknown- costs depend on chemical contamination and remediation necessary	FEMA, EPA	5-10 years	Low
8	Purchase needed equipment for the USAR Team	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP, NOFD, NOEMS, NOPD), GOHSEP, State	$1,250,000	FEMA (HSGP, AFG)	5-10 years	Medium
9	Develop a warning and notification system in the event of sudden river flooding.	Flood, Tropical Cyclone, Levee Failure, Infrastructure Failure	New	City of New Orleans (NOHSEP), GOHSEP, FEMA, NOAA, NWS,	Unknown- stand alone automated flood sensors are currently in development	FEMA, Army Corps of Engineers, Sewerage and Water Board	5-10 years	High
10	Map the interior of critical facilities to assist first responders in the event of an incident.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP, ITI), Private Partners	$250,000	City of New Orleans, FEMA (HSGP)	1-5 years	Low

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
11	Obtain a mobile dialysis unit.	Power outages	New	City of New Orleans (NOHD), LA DHH, Area Hospitals	$800,000	FEMA, DHH, Private Sector	1-5 years	Medium
12	Set up cooling shelters during extreme heat events	Extreme heat	New	City of New Orleans (NOHD, NOHSEP)	$5,000 - $50,000	City Budget	1-5 years	Medium
13	Adopt ordinance requiring water saving measures in time of drought.	Drought	New	City of New Orleans (City Council)	Unknown	City Budget	1-5 years	Low
Goal 2: Reduce Risk and Vulnerability to the Built Environment including current and future structures; critical facilities; historical structures; and, infrastructure including communications.								
1	Conduct a feasibility study regarding the use of polders, ring levees, or stepped levees as part of the City's internal flood protection system.	Flood, Tropical Cyclones, Levee Failure, Storm Surge, Coastal Erosion, Subsidence	New	Army Corps of Engineers, Sewerage and Water Board	Unknown	Army Corps of Engineers, FEMA	10-20 years	Medium
2	Implement pilot reconstruction projects in hazard prone areas to mitigate structures against future damage.	Flood, Tropical Cyclones, Storm Surge, Coastal Erosion, Subsidence, Levee Failure	New	City of New Orleans (NORA), LA GOHSEP, FEMA	Unknown	FEMA (HMGP, FMA, PDM)	5-10 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
3	Improve drainage infrastructure through measures in high flood risk areas including, but not limited to, the upgrade and improvement of culvert design and construction, retention and detention areas.	Flood, Tropical Cyclone, Storm Surge, Coastal Erosion, Subsidence, Infrastructure Failure	New	City of New Orleans (DPW, Sewerage and Water Board, NORA), Army Corps of Engineers, FEMA	$2,000,000,000+ , based on current SELA project costs	FEMA, Army Corps of Engineers, City of New Orleans Capital Improvements	5-10 years	High
4	Citywide Enhancements to Street Drainage. This project will provide $500K-$2 million in green infrastructure enhancement such as curb cutouts, green sidewalks, above and below ground storage tanks, and neutral ground enhancements to the FEMA Recovery Roads pavement restoration and waterline replacement projects and bond funded reconstruction projects in the Gentilly District. This product will benefit the entire city. This product includes a component for groundwater monitoring and sewerage pumping data collection.	Flood, Tropical Cyclone, Storm Surge, Infrastructure Failure, Coastal Erosion, Subsidence	New	City of New Orleans (NORA), FEMA	$2,000,000+	FEMA, City of New Orleans Capital Improvement, Private Sources	5-10 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
5	Continue the Southeast Louisiana (SELA) Drainage program is to reduce flood damages in the City of New Orleans and surrounding parishes. This will be accomplished by constructing new pumping stations and better drainage canals throughout our city. The program was authorized in 1996 by the United States Congress and administered under a project cooperation agreement between the Sewerage and Water Board of New Orleans and the U.S. Army Corps of Engineers.	Flood, Tropical Cyclone, Storm Surge, Coastal Erosion, Subsidence, Infrastructure Failure	New	City of New Orleans (DPW, Sewerage and Water Board, NORA), Army Corps of Engineers, FEMA	$2,000,000,000+ , based on current SELA project costs	FEMA, Army Corps of Engineers, City of New Orleans Capital Improvements	5-10 years	High
6	St. Roch Streetscape Improvements by the Sewerage and Water Board. The primary problem this activity will address is repetitive flooding. Approximately 540 properties in the area suffer repetitive damage. It will also improve the water quality of Lake Pontchartrain. The project will upgrade drainage ditches as well as provide green infrastructure enhancements to better manage groundwater. There is also a subsidence monitoring component. This project will reduce pressure on the existing piping system. Benefits of this project will include beautification, improved recreational areas, flood mitigation, and social cohesion.	Flood, Tropical Cyclone, Storm Surge, Coastal Erosion, Subsidence, Infrastructure Failure	New	City of New Orleans (DPW, Sewerage and Water Board, NORA), Army Corps of Engineers, FEMA	$4,600,000	FEMA (FMA, PDM, HMGP), Army Corps of Engineers, City of New Orleans Capital Improvements	5-10 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
7	Mirabeau Water Park. The project will daylight 1/3 flow of neighborhood trunk line into the water park to store/cleanse/alleviate pressure on Pump Station #14 during peak flow periods. This project will address repetitive flood and sending untreated polluted water to Lake Pontchartrain. This project will provide benefits to over 3,000 acres, 3717 homes and businesses. It will provide improved water quality, habitat creation, recreation, and serve as an economic development opportunity. This project will support nearby streetscape enhancements.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NORA, DPW), Sewerage and Water Board, FEMA	$6,000,000,000	FEMA (HMGP, PDM, FMA), Private Sources, HUD, City of New Orleans (Capital Improvement and General Fund)	5-10 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
8	Mac 35/Hall/Youth Study Center. The base project will be the Willie Hall Playground alone, $2.5 million; the premium version would add the modification to the landscape at the Youth Studies Center to provide an amenity to the community that also improves the retention of storm water in the immediate vicinity. The cost for the premium project would approximate $12 million. This project will remediate and repurpose the location for programmatic recreation and education and the remediation of the soil to reach the aspiration. The project's primary focus will be safety and recreation with the potential of significant storm water management. The project will address storm water management at a nexus of public investment for a school, recreation venue, and youth justice facility (correctional). The population served by the new Mac 35 School, which has a city-wide enrollment, and the immediate community of St Bernard will be affected by this project as a recreational venue, an educational asset, and a storm water detention/retention. The project will also place land into service that was environmentally degraded.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NORA, DPW), FEMA	$15,000,000	FEMA (HMGP, PDM, FMA), HUD, Private Sources, City of New Orleans Capital Improvement	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
9	Pontilly Project. Scattered site green infrastructure interventions including increasing the capacity of and improving flow to the Dwyer canal, vacant lots graded and planted to detain stormwater, bioswales, and curb bumpouts. This project will benefit residents in the Pontchartrain and Gentilly Woods neighborhoods. These projects will decrease flood risk but will also provide recreational space, beautify the neighborhood, rebalance the real estate market by taking surplus properties off the market, improve walkability, and increase community pride.	Flood, Tropical cyclone, storm surge, erosion, subsidence, levee failure	New	City of New Orleans (NORA, DPW), Sewerage and Water Board, FEMA	$5,000,000	FEMA (HMGP, PDM, FMA), HUD, Private Sources, City of New Orleans Capital Improvement	1-5 years	High
10	Hagan Lafitte. Study subsidence from groundwater pumping and stabilizing and mitigate chronic flooding by increasing the capacity of subsurface drainage and the daylight flow in canal.	Flood, Tropical cyclone, storm surge, erosion, subsidence, levee failure	New	City of New Orleans (NORA, DPW), Sewerage and Water Board, FEMA	Unknown; preliminary study estimated at $500,000	FEMA (HMGP, PDM, FMA), HUD, Private Sources, City of New Orleans Capital Improvement	5-10 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
11	Install rain gardens and storm water runoff filtration and water retention systems along streets to reduce subsidence and flooding. Develop and advocate the necessary site design and landscape standards for streets, neighborhoods, and building sites.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, DPW), Sewerage and Water Board FEMA	$1,250,000	FEMA (HMGP, PDM, FMA), HUD, Private Sources, City of New Orleans Capital Improvement	5-10 years	High
12	Harden/Retrofit all critical and non-critical existing public facilities, including City Hall, remote sites and all distribution points, and construct future public facilities that are resilient to wind and flooding. Wind hardening projects can include shutters, roof tie downs, etc. Flood protection projects include switches to turn off equipment in the event of flooding and floodproofing.	Tropical Cyclones, Coastal Erosion, Hail, Winter Storms	New	City of New Orleans (Capital Projects), Sewerage and Water Board	$90,000,000	FEMA (PA, HMGP)	5-10 years	Medium
13	Locate electrical and other critical buildout-system hubs and sensitive equipment, along with files and documents, on upper floors; design buildings to minimize threats to people and property. Pursue hardening of power grid infrastructure to minimize impact of power outages.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP, Capital Projects), Entergy	Unknown- private infrastructure is involved	Private Sector, City of New Orleans Capital Improvement, FEMA (PA, HMGP)	5-10 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
14	Pursue an acquisition/buy-out program wherein property owners could elect to move out of high risk area to a lower risk area.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA)	$1,090,000,000	HUD, FEMA (HMGP), State of Louisiana	3-5 years	Medium
15	Pursue programs to mitigate at-risk structures by physically elevating buildings to or above the Base Flood Elevation (BFE), wet flood proofing, and/or dry floodproofing where appropriate.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU)	$4,000,000,000	HUD, FEMA (IA, HMGP), State of Louisiana, Private Sector (Insurance)	3-5 years	Medium
16	Adopt freeboard and other higher regulatory standards such as cumulative substantial damage and requiring non-enclosure agreements. These are adopted through updates to the CZO and the Flooplain Management Ordinance	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU, Safety and Permits)	Staff Time	City of New Orleans General Fund	1-5 years	Medium
17	Continue public information campaign for owners of non-conforming properties.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU, Safety and Permits)	Staff Time	City of New Orleans General Fund	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
18	Develop a program to promote the purchase of flood insurance.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU, Safety and Permits)	Staff Time	City of New Orleans General Fund	1-5 years	High
19	Strengthen existing programs for severe and repetitive loss structures, as well as substantially damaged structures. This includes mitigation actions such as elevation, relocation, retrofitting or flood proofing.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU, Safety and Permits)	Staff Time	City of New Orleans General Fund	1-5 years	High
20	Undergo a Safe Growth Audit to guide post-Katrina redevelopment.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU, Safety and Permits), City Planning Commission	Staff Time	City of New Orleans General Fund	1-5 years	High
21	Harden utility services and street infrastructure. Harden all flood protection infrastructure including pump support with alternative energy sources. Establish an implementation plan giving priority to emergency evacuation routes and primary arterials.	Tropical Cyclones, Tornadoes	New	City of New Orleans (NOHSEP), Entergy, Critical Infrastructure Partners, FEMA, LA GOHSEP	Unknown, due to vast network of above ground utilities in City of New Orleans	FEMA (PA, HMGP, PDM, FMA), DHS, HUD, Private Sector, City of New Orleans Capital Improvements	5-10 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
22	Install a system of sensors, including groundwater, that are automated and machine readable.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NORA, NOHSEP, ITI), Sewerage and Water Board	Unknown- some sensors do not exist or are not dependable at this time	FEMA (PA, HMGP, FMA, HSGP), HUD, Army Corps, Private Sector	5-10 years	Medium
23	Construct a Flood Wall to protect the Lakefront Airport	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana, City of New Orleans (Capital Projects)	Unknown- due to the fact that it is an airport, there are serious engineering considerations with building a high levee wall near runways	FEMA (PA, HMGP), State Capital Outlay, FAA Funding	5-10 years	Medium
24	Install lightning rods to critical facilities	Lightning	New	City of New Orleans (NOHSEP, DPW)	$50,000	FEMA (HMGP)	1-5 years	Low

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
Goal 3: Reduce Risk and Vulnerability to the Natural Environment including wetland restoration and recognition of New Orleans as a coastal city.								
1	The Golden Triangle Marsh Creation Project will build over 600 acres of marsh. The marsh will function as support for the Inner Harbor Navigation Canal – Lake Borgne Surge Barrier increasing flood protection for nearby communities. The Golden Triangle Marsh Creation Project creates marsh within the boundaries of Bayou Savage, the largest urban wildlife refuge in the United States, leading to an increase in the refuge's wildlife and fish habitat	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA)	$4,500,000	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	High
2	The Biloxi Marsh Living Shoreline Project. The Biloxi Marshes consist of approximately 49,000 hectares of brackish and salt marshes, which provide important storm buffer for New Orleans as well as key habitat and ecosystem services. The marshes have been greatly impacted by shoreline erosion from wind-driven waves. The proposed Biloxi Marsh Living Shoreline project, if implemented in the future, would create approximately 47,000 feet of bioengineered oyster barrier reef fringing the marshes, which would reduce shoreline erosion and recession, prevent further marsh degradation, promote community resilience, and enhance local fisheries and oyster production.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA)	$3,500,000 in planning costs	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
3	Work with the EPA to develop and implement the Gulf of Mexico Conservation Enhancement Grant Program (GMCEGP), a funding assistance opportunity to enhance private/public partnerships that support land protection and conservation across the Gulf Coast region. This program would be available to land conservation organizations such as land trusts, non-governmental organizations (NGOs), and state land preservation agencies across the Gulf of Mexico region through a competitive grant selection process. Two categories of activities: Category 1 is the solicitation and approval of designs submitted to a competition that EPA will under the program; Category 2 is proposed for potential future funding and would allow for the implementation of the planning project.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA), City of New Orleans (NORA, DPW, PDU), Sewerage and Water Board	$2,500,000 in planning costs	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
4	Gulf of Mexico Habitat Restoration via Conservation Corps Partnership Program to recruit and train local workers in a variety of habitat restoration techniques and provide paid, hands-on work experience in on-the-ground restoration projects. These jobs vary depending upon the scope of the project, but can include operators, machinists, welders, surveyors, and a variety of laborers, scientists, and managers.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA), City of New Orleans (NORA, DPW, PDU), Sewerage and Water Board	$2,500,000 in planning costs	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	High
5	Create a plan to enhance ecosystem sustainability in the Mississippi River Deltaic Plain without negatively impacting navigation and flood risk management on the Mississippi River. This planning effort would enhance the science developed under the Louisiana Coastal Area (LCA) Mississippi River Hydrodynamic and Delta Management Study (MRHDMS) to form the foundation for any future river management analysis by creating an integrated science-based management strategy for the Lower Mississippi River (LMR) to improve navigation, reduce flood risk, and provide for a more sustainable deltaic ecosystem.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA), City of New Orleans (NORA, DPW, PDU), Sewerage and Water Board	$9,300,000+ in planning, per the State of Louisiana	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
6	Repair the Orleans Land Bridge Shoreline Protection and Marsh Creation Project (CIAP) to help secure 41,270 linear feet of marine mattress revetments along the Lake Borgne shoreline between Bayou Bienvenue and Alligator Point. This project will help provide flood protection for the Greater New Orleans region.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA), City of New Orleans (NORA, DPW, PDU), Sewerage and Water Board	$17,500,000+ per the Coastal Wetlands Conservation and Restoration Task Force	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	High
7	Restore protective wetlands near Fort Pike	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	State of Louisiana (CPRA), City of New Orleans (NORA, DPW, PDU), Sewerage and Water Board	Unknown	FEMA (PA, HMGP), EPA, State Capital Outlay, Private Sector	5-10 years	High
8	Develop Parish wetlands regulations that provide the intent of the regulation for flood storage.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, DPW, Safety and Permits)	City time	City of New Orleans General Fund	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
9	Lake Pontchartrain Fringe Marsh & Shoreline Stabilization. Use methods such as the placement of wave dampening structures to encourage accretion.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	USACE, LA DNR	$87,500,000	CWPPRA, State Capital Outlay, CIAP	5-10 years	High
Goal 4: Maximize the Involvement of Individuals, Businesses, and Groups in Risk Reduction Measures through Education/Outreach on Hazard Mitigation Appropriate to all Groups, Particularly Vulnerable Populations								
1	Implement a public education campaign about the Community Rating Systems and ways in which to reduce flood insurance premiums.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP)(	$200,000	City of New Orleans, NFIP	1-5 years	High
2	Utilize informational brochures, hold educational events, and utilize social networks to inform the public about risk levels, historic impacts, and Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes, Hail, Lightning, Winter Storms, Extreme Heat, Drought and Subsidence mitigation - including non-structural measures and alternatives to elevation.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes, Hail, Lightning, Winter Storms, Extreme Heat, Drought and Subsidence	New	City of New Orleans (NORA, NOHSEP)	$100,000	City of New Orleans, FEMA (HMGP, PA, FMA, PDM)	1-5 years	Medium

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
3	Document and publicize local success stories.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NORA, NOHSEP, PDU)	City staff time	City of New Orleans General Fund, USACE, FEMA	1-5 years	High
4	Educate the public about storm water management, including their role in keeping drains and culverts clear.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP), Sewerage and Water Board	$225,000	City of New Orleans General Fund	1-5 years	High
5	Partner with non-profit organizations, universities, and professional associations to build a strong broad support base to promote non-structural mitigation	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP, DPW, PDU, Capital Projects), NORA	City staff time	City of New Orleans General Fund	1-5 years	High
6	Promote the use of building methods which are hazard resistant and built above the code.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Safety and Permits, NOHSEP, DPW, PDU, Capital Projects), NORA	City staff time	City of New Orleans General Fund	1-5 years	Medium
7	Implement methods to avoid damage caused by un-tethered ships during storms.	Flood, tropical cyclone, storm surge, dam/levee failure, hazardous materials incident, terrorism,	New	US Coast Guard, Port of New Orleans, USACE	Staff time	Staff time at listed agencies	1-5 years	Medium
8	Explore alternative financing methods to support flood mitigating projects, such as a rebate program	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NORA, NOHSEP), Sewerage and Water Board	Staff time	City of New Orleans General Fund	1-5 years	High

9	Assist homeowners with soils testing to determine infiltration rates	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (Safety and Permits, Code Enforcement), Sewerage and Water Board, NORA	Staff time	Staff time	1-5 years	Low

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
10	Promote greater use of pervious concrete	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (Safety and Permits, Code Enforcement), Sewerage and Water Board, NORA	Staff time	Staff time	1-5 years	High
11	Assist homeowners with soils testing to determine infiltration rates	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (Safety and Permits, Code Enforcement), Sewerage and Water Board, NORA	Staff time	Staff time	1-5 years	High
12	Require mandatory training in floodplain regulations for all building officials.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (Safety and Permits, Code Enforcement),	$100,000	City of New Orleans, FEMA	1-5 years	High
13	Annually update, produce, and distribute a hurricane awareness brochure that includes hazard information, evacuation information, and mitigation information and distribute to residents and visitors.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NOHSEP, NOHD)	$50,000	City of New Orleans General Fund, FEMA (HSGP), Private Sources	1-5 years	High
14	Provide hazard mitigation information to resource centers throughout the City including information on types of disasters, family disaster plans, business continuity plans, and basic mitigation projects. Give presentations to civic groups, church groups, business groups, etc.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NOHSEP, Safety and Permits, PDU, Capital Projects), NORA, FEMA	$100,000	City of New Orleans General Fund, FEMA (HSGP), Private Sources	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
15	Evaluate the implementation of voluntary incentive and reward programs that encourage builders and contractors to go beyond minimum requirements.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Safety and Permits)	City staff time	City of New Orleans (General Fund), FEMA (HMGP)	1-5 years	Medium
16	Create a Leadership Development Program for City Resilience.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion,	New	City of New Orleans (NOHSEP), NORA	City staff time	City of New Orleans (General Fund)	1-5 years	Medium
17	Develop a small business resilience program	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP), NORA	City staff time	City of New Orleans (General Fund)	1-5 years	High
18	Establish a resilience Retrofit Program	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP), NORA	Unknown- due to size and scope	FEMA (HMGP, PDM, FMA), Private Sources	1-5 years	High

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Goal #5: Promote Coordination Locally, Regionally, and Nationally including all levels of government, private sector entities, as well as nonprofits and community based organizations.								
1	Provide training in floodplain management principles for local officials and increase the number of Certified Floodplain Managers on City staff.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence	New	City of New Orleans (NOHSEP, Safety and Permits, PDU, Capital Projects), NORA, FEMA	$100,000	City of New Orleans General Fund, FEMA (HSGP), Private Sources	1-5 years	Medium
2	Adopt a new Master Plan, which contains the guiding principles for both public and private development in the Parish, and including the hazard mitigation goals and action plan.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City Planning Commission	City staff time	City of New Orleans (General Fund)	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
3	Maintain a comprehensive GIS database including data on properties, hazard areas, service districts, public works facilities, transportation infrastructure, and vulnerable populations.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (ITI, NOHSEP, PDU, Capital Projects, NOHD), NORA, FEMA, LA GOHSEP	City Staff time	City of New Orleans (General Fund)	1-5 years	High
4	Continue compliance with the NFIP and adopt the revised flood insurance rate maps currently expected to arrive in 2015.	Flood, tropical cyclone, storm surge, dam/levee failure, infrastructure failure	New	City of New Orleans (Safety and Permits)	City staff time	City of New Orleans (General Fund), NFIP	1-5 years	Medium
5	Support efforts to raise ICC funding cap above $30k or expand the availability of ICC to Repetitive Loss Properties	Flood, storm surge, tropical cyclone, tornado	New	City of New Orleans (Mayor, Safety and Permits)	City staff time	City of New Orleans General Fund	1-5 years	Medium
6	Engage with regional hazard mitigation planning efforts. Coordinate with other local plans to ensure consistency and coordinate actions with other parishes.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP), NORA	City staff time	City of New Orleans General Fund	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
7	Engage with regional and statewide efforts for the protection of coastal wetlands – including coordination regarding wetlands policy.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence, infrastructure failure	New	City of New Orleans (Mayor, NOHSEP, Coastal and Environmental), NORA	City staff time	City of New Orleans General Fund	1-5 years	High
8	Incorporate hazard mitigation projects into CIP	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects, NOHSEP, PDU), NORA	City staff time	City of New Orleans General Fund, Capital Improvement	1-5 years	High
19	Strengthen the City's capacity to implement mitigation projects through staffing.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects, NOHSEP, PDU), NORA	City staff time	City of New Orleans General Fund, Capital Improvement	1-5 years	High
10	Maintain current information on known hazards present in facilities such as refineries, power plants, etc.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects, NOHSEP, PDU, ITI), NORA	City staff time	City of New Orleans General Fund	1-5 years	Medium
11	Increase coordination with urgent care facilities and community health centers.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHD, NOHSEP, EMS), NORA	City staff time	City of New Orleans General Fund	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
12	Resource type the USAR Team	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP, NOFD)	City staff time	City of New Orleans General Fund, FEMA (HSGP)	1-5 years	Low
13	Coordinate with USACE and SLFPAE regarding the levee system improvements and maintenance.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence, infrastructure failure	New	City of New Orleans (Capital Projects), NORA, SWB	Staff time	Staff time	1-5 years	Medium
14	Support levee maintenance through programs to deal with invasive species.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence, infrastructure failure	New	City of New Orleans (Capital Projects), NORA, SWB	Staff time	Staff time	1-5 years	Low
15	Establish a Parish capability to review the maintenance and strength levels of the levee system	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, and Subsidence, infrastructure failure	New	City of New Orleans (Capital Projects), NORA, SWB	Staff time	Staff time	1-5 years	Medium
16	Maintain a database of all properties that sustain damage as a result of a hazard, including critical facilities. Include this information as part of the	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHD, NOHSEP), NORA	City staff time	City of New Orleans General Fund	1-5 years	Medium
17	Assist other local agencies with hazard mitigation plans in the implementation of actions from their plans.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP), NORA	City staff time	City of New Orleans General Fund	1-5 years	Medium
18	Promote Stafford Act and other regulatory changes to strengthen hazard mitigation planning.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Mayor), NORA	City staff time	City of New Orleans General Fund	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
19	Develop pre-disaster Disaster Recovery Plans	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP), NORA, FEMA, LA GOHSEP, Private Sector	City staff time	City of New Orleans General Fund	1-5 years	High
20	Incorporate climate change impacts into all planning.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects), NORA, City Planning Commission	City staff time	City of New Orleans General Fund	1-5 years	High
Goal 6: Ensure Continuity of Operations for local government and businesses, including protection of critical functions, records and cultural assets.								
1	Set up an Enterprise Data Warehouse to integrate data across City departments.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (ITI)	City staff time	City of New Orleans General Fund	1-5 years	High
2	Upgrade, or replace, the Parish EOC.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (NOHSEP), FEMA,	$30,000,000	City of New Orleans Capital Improvement Plan, FEMA (HMGP, PA, HSGP)	5-10 years	Medium
3	Install emergency generators at all emergency shelters and critical facilities.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects)	$250,000 to $800,000 per site	City of New Orleans Capital Improvement Plan, FEMA (PA, HMGP), SWB, Private Sector	1-5 years	High
4	Continue to implement improvements to the comprehensive program to protect vital records, to include removing records from low areas, digitizing records, and developing back up data systems. Establish standard operating procedures and controls for these improvements.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (ITI)	City staff time	City of New Orleans General Fund	1-5 years	High

No.	Action Item/Benefits	Hazards		Lead Agency/Support Agencies that will Implement Action	Preliminary Costs (including ongoing maintenance costs) – to be refined as more date becomes available	Funding Sources (Specify specific entity that could potentially fund this action -- See list below	Time Frame for Implementing Action	Priority Ranking
5	Consolidate public safety warehouses.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects)	$20,000,000	City of New Orleans Capital Improvement Plan, FEMA (PA, HMGP), SWB, Private Sector	1-5 years	High
6	Construct shelters and/or safe rooms for emergency services and emergency service personnel to ensure continued operation of critical services during hazard events.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (Capital Projects, NOHSEP)	$TBD	City of New Orleans Capital Improvement Plan, FEMA (PA, HMGP), SWB, Private Sector	5-10 years	High
7	Upgrade and install Management Information Systems equipment to ensure communication system remains operational during hazard events.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (ITI)	$30,000,000	City of New Orleans General Fund	1-5 years	High
8	Improve asset management to assist with the documentation of damages.	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (ITI, NOHSEP, Capital Projects, PDU)	City staff time	City of New Orleans General Fund	1-5 years	High
9	Create a one-pager for City staff re: protecting IT equipment	Floods, Tropical Cyclones, Storm Surge, Levee Failure, Coastal Erosion, Tornadoes and Subsidence	New	City of New Orleans (ITI)	City staff time	City of New Orleans General Fund	1-5 years	High

Section 10. Plan Maintenance

Contents of this Section

Changes between the 2010 Plan and the 2015 Plan Update. The Plan Maintenance Section of the 2010 Plan has been revised in the 2015 Plan Update. Portions of the 2015 Plan were retained from the original December 2010 HMP, as appropriate, including portions of the historical hazard data. As part of the update, the list of hazards profiled in the 2010 Plan was modified to better align with the State of Louisiana Hazard Mitigation Plan. Additionally, a comprehensive evaluation of the existing document, completed in 2010, was conducted to determine (a) specific areas that required updates, such as incorporation of data about recent hazards or documenting the 2015 update process, (b) where recent City, State, or FEMA guidance required new elements in the plan, and (c) where there are opportunities to incorporate technical data and studies that have been completed since the original plan was written and approved. As a result, additional hazards were identified and addressed in the 2015 plan.

10.1 Interim Final Rule (IFR) Requirements for Plan Maintenance

IFR §201.6(c)(4)(i): The plan maintenance process shall include a) section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five year cycle.

IFR §201.6(c)(4)(ii): The plan shall include a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, where appropriate.

IFR §201.6(c)(4)(iii): The plan shall include a discussion on how the community will continue public participation in the plan maintenance process.

10.2 2010 Plan Maintenance Update

The 2010 Orleans Parish Hazard Mitigation Plan was approved in March 2011 and is routinely referenced in the City's Master Plan. As discussed in Section 1, The City's 2010 Plan Update included 12 identified natural hazards and 2 man-made hazards. For the 2015 five-year Plan Update, the City reviewed the list of hazards, considered additional hazards and prioritized the updated list of hazards for the 2015 Plan Update.

No changes were made to the 2010 Plan prior to the 2015 Plan Update. The Hazard Mitigation Office began the 2015 Plan Update process in February 2014 by convening advisors and initiating conversations with relevant City departments. Beginning in May 2015, the City accelerated the Plan Update process. As discussed in the Executive Summary (Section 1), an Advisory Committee and City Hall Working Group met eight times between June and October 2015 to discuss updates for the

plan including risk assessment, mitigation strategies, and community concerns.

Community stakeholders for the hazard mitigation planning effort also included non-profit organizations, community organizations, environmental groups, and regional governmental agencies with an interest in hazard mitigation planning. The Advisory Committee included representatives from a cross section of the community, including community members, university representatives, and governmental and non-governmental organizations. The City Hall Working Group included representatives from the City of New Orleans departments that worked on the 2010 approved Hazard Mitigation Plan and other organizations that work closely with hazard mitigation planning efforts for Orleans Parish.

Public outreach was vital to the 2015 Hazard Mitigation Plan update. Public meetings were advertised and an Orleans Parish Hazards Survey was distributed to the public to solicit input and encourage resident's participation in the planning process.

10.3 Monitoring, Evaluating, Updating the Plan

Recognizing that this Plan must be updated on a regular basis to remain an effective tool, the Plan will be monitored by the NOHSEP Hazard Mitigation Office. To meet this requirement Orleans Parish has developed a timeline and process for updating the Plan. The Plan will be updated annually during the off-season for hurricanes (December through May). The NOHSEP Hazard Mitigation Office will be responsible for all Plan updates.

The Hazard Mitigation Planning Team designated for this plan update will continue to meet annually to monitor, evaluate, and update the plan. Annual Progress Reports will be prepared by the lead agency responsible for implementing specific mitigation actions. The Director of the NOHSEP Hazard Mitigation Office, or his/her designated representative, will be responsible for ensuring that the annual progress reports are completed.

Once all reports are prepared, the Hazard Mitigation Office will schedule a meeting with the Hazard Mitigation Planning Team to review the reports and to assess progress in implementing the mitigation actions. After reviewing the Annual Progress Reports, the Planning Team will reevaluate the implementation strategy.

During these annual reviews, the Planning Team will also evaluate the Plan to ensure that the Risk Assessment and Capability Assessment sections of the Plan are current. Any major changes to the hazards that threaten New Orleans or to the vulnerability of persons or property in New Orleans will be noted. The Plan review will consider issues such as changes to the distribution of the population or the value of property in the Parish, changes in vulnerability due to the completion of mitigation projects, and new information about hazards. The Plan review will also assess changes in the Parish's capability to implement projects. The NOHSEP Hazard Mitigation Office and the Planning Team will review changes in regulations, funding, socioeconomic conditions of the community, and political support for the Mitigation Action Plan. Also, the goals and objectives will be reviewed to determine their relevance to current conditions in the Parish. When needed, the goals, objectives, mitigation actions, and priorities will be changed to reflect changing needs of the community. The Parish will utilize FEMA's IS-328 Plan Review for Local Mitigation Plans tool to complete its annual evaluation of the Hazard Mitigation Plan and to determine if the Plan should be revised.

Once the City Council has formally adopted the Hazard Mitigation Plan Update, the NOHSEP Hazard Mitigation Office will convene a meeting of the Hazard Mitigation Planning Team to discuss its new roles and responsibilities to monitor, evaluate, and update the plan over the next five years. The group will decide whether any changes in membership are

needed to carry out the new responsibilities of implementing and administering the Plan. The Planning Team will also consider whether to draft a Memorandum of Agreement (MOA) to designate all agencies that will have responsibilities for implementing the Hazard Mitigation Plan as partners of the MOA. It is recommended that the MOA would include specific responsibilities of all lead and supporting agencies charged with implementing specific mitigation actions. The MOA would further establish the reporting requirements for annual progress reports on the hazard mitigation actions, include commitments of staffing, technical resources, and funding to ensure progress in implementing the Plan, and identify how the public will be kept involved in the process to update the plan.

The NOHSEP Hazard Mitigation Office will be responsible for updating the plan with assistance from the Planning Team. The plan will be reviewed, revised and updated every five years from the date of FEMA's approval. If a disaster occurs or as action items are met, the plan will be reviewed, revised, and updated sooner than the required five years, via the process outlined above. With adoption in 2016, the Plan will enter the review and update cycle in 2019, with adoption of the revisions in 2020. The Plan will be sent back to FEMA for re-approval within the five-year cycle. The Planning Team will be convened to conduct the comprehensive evaluation and update.

10.4 Incorporating Action Plan into Existing Planning Mechanisms

The Orleans Parish Hazard Mitigation Plan will serve as the main statement of mitigation policy for the City of New Orleans. The 2015 plan will play an important role in the City's recently launched Resilience Strategy, which outlines the need to consider environmental shocks and stresses together and integrate overall approaches to them. Aligning the Hazard Mitigation Plan with the Resilience Strategy vision will guide the city's risk reduction plans for natural and man-made disasters.

The NOHSEP Hazard Mitigation Office with support from the Planning Team will review the findings from the Capability Assessment (Section 8) and work with the City's Chief Administrative Officer (CAO) to find effective ways to integrate the mitigation actions into day-to-day operations within City departments. The Hazard Mitigation staff will begin with the following:

10.2.1 Work with the CAO to obtain proper authority to require the cooperation and participation from departments and agencies to implement the Hazard Mitigation Action Plan.

10.2.2 Also work with the CAO to add a line item for mitigation project funding into the City's capital and operating budgets.

10.2.3 Issue a letter to department heads to solicit their support and explore opportunities to integrate hazard mitigation planning into day-to-day operations.

10.2.4 Examine administrative functions that have a bearing on reducing risks from hazards identified in the Mitigation Plan. Where needed, work plans, policies, and procedures will be changed to integrate mitigation planning efforts into these administrative functions.

10.2.5 Work with department heads to review job descriptions and identify day-to-day work assignments that can be broadened to effectively integrate mitigation planning activities throughout city government.

The NOHSEP Hazard Mitigation Office will also work with the following departments to integrate implementation of the Hazard Mitigation Action Plan into enforcement and implementation of other planning tools, codes, and ordinances. Examples of these efforts include the following:

10.2.6 Coordinate with Code Enforcement and other appropriate departments to ensure that the minimum standards established in the International Building Code are being enforced.

10.2.7 Coordinate with Safety and Permits and other appropriate departments to

enforce the Floodplain. Management Ordinance, to participate in the National Flood Insurance Program, and to implement improvements for the Community Rating System (CRS).

10.2.8 Coordinate with the City Planning Commission and other appropriate departments to ensure that the adopted Hazard Mitigation Plan is added as an Appendix to the New Orleans Master Plan. Chapter 12, Resilience of the Master Plan already includes hazard mitigation planning. However, the full Hazard Mitigation Plan will also be added to the final Master Plan, which will have the force of law.

10.2.9 Coordinate with the City Planning Commission and other appropriate departments to work with zoning and subdivision boards to educate them on the Hazard Mitigation Plan and how zoning and subdivision enforcement will reduce risks for the community

10.2.10 Coordinate the annual reviews of the Master Plan with the Hazard Mitigation Plan to include risk area maps. Review the Hazard Mitigation Plan to ensure compatibility with Comprehensive Zoning Ordinance (CZO) (czo.nola.gov).

10.2.11 Coordinate with the NOHSEP Office to ensure that appropriate sections of the Hazard Mitigation Plan are integrated into the New Orleans Comprehensive Emergency Management Plan (CEMP). The CEMP addresses mitigation of, preparation for, and recovery from a wide variety of emergencies and disasters. Once the Hazard Mitigation Plan has been adopted, it will become part of the CEMP and included as an appendix to that document.

The NOHSEP Hazard Mitigation staff will report on efforts to integrate the Mitigation Action Plan into other planning mechanisms at each Planning Team meeting and discuss new opportunities to build on what has already been accomplished.

10.5 Public Participation in Plan Maintenance Process

The public will be given opportunities to comment on progress in implementing the Hazard Mitigation Action Plan and on any proposed plan revisions through community surveys and during periodic public workshops/meetings.

10.2.12 A community survey will be distributed to the public periodically to solicit information regarding: 1) understanding of the identified hazards, mitigation actions, and implementation strategy, and plan maintenance process; 2) recommendations for keeping the community informed about implementation progress of the Plan; and 3) comments regarding progress in implementing specific mitigation projects or any proposed plan revisions.

10.2.13 Appropriate public workshops will be held to review the results of the monitoring reports and project evaluation reports, and to receive a summary report of the Planning Team findings and recommendations.

10.2.14 Public comments submitted to the NOHSEP Hazard Mitigation Office:

10.2.15 Public comments submitted to the Hazard Mitigation website (www.nola.gov).

The NOHSEP Hazard Mitigation Office will hold a minimum of one public meeting annually following the annual Planning Team meeting. However, additional small group meetings will be held as needed throughout the life of the Plan. The community will be notified and included in any public hearing process conducted by the City Council to adopt any Plan revisions.

The NOHSEP Hazard Mitigation Office will use the following means to keep the community informed regarding implementation of the Hazard Mitigation Plan, the plan maintenance process, and any proposed changes to the Hazard Mitigation Plan.

10.2.16 Information updates on the Hazard Mitigation website (www.nola.gov)
10.2.17 Emails to neighborhood associations; community, business, and non-profit organizations; churches, etc. as included in the Stakeholder Email Database developed during the 2010 Plan Update
10.2.18 Press releases and public service announcements (PSA's)
10.2.19 Annual progress report fact sheets

The NOHSEP Hazard Mitigation Office will accept public feedback on the Plan on an ongoing basis. The chief method of soliciting feedback will be Hazard Mitigation website (www.nola.gov). Once the Hazard

Mitigation Plan is approved, it will be posted on the website and hard copies of the plan will be distributed to all branches of the New Orleans Public Library. Any updates to the Plan will also be posted on the Hazard Mitigation website.

The NOHSEP Hazard Mitigation Office will use press releases, public service announcements, the Hazard mitigation website, and emails to inform the community regarding where to send comments and how to view a copy of the Plan or any Plan revisions. Information on where to send comments will also be noted in the press releases, public service announcements, on the Hazard Mitigation website and in emails to Stakeholders.

All comments will be directed to:

New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP)
Hazard Mitigation Office
City Hall Room 9E06
1300 Perdido St
New Orleans, LA 70112