gcr
Dewberry
VisseringPardue
Perez.
hc HENRYCONSULTING

Orleans Parish
2010 Hazard Mitigation Plan Update

City of New Orleans
Office of Homeland Security Emergency Preparedness

City of New Orleans Hazard Mitigation

Orleans Parish, Louisiana

2010 Hazard Mitigation Plan Update

Submitted to:

GOHSEP
FEMA, Region VI

Submitted by:

City of New Orleans
Office of Homeland Security Emergency Preparedness

March 7, 2011

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

Section 1. Executive Summary

The Executive Summary for the Orleans Parish 2010 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

As the costs for responding to disasters continued to grow through the 1990s, the federal government recognized the need for pre-disaster hazard mitigation planning. In 2000, Congress passed the Disaster Mitigation Act authorizing 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 include manmade disasters, too.

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.

Identified Hazards for the 2005 Orleans Parish Hazard Mitigation Plan and the Five Year Plan Update

The City of New Orleans adopted its Hazard Mitigation Plan in December 2005 after it was developed through a public planning process and 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 initial plan identified 11 hazards. In 2010 for the Five-Year Plan Update, the City reviewed the list of hazards, considered additional hazards and prioritized the updated list of hazards for the 2010 Plan Update. The following table shows the 14 identified hazards for the 2010 Plan Update and shows those hazards included in the 2005 Plan, new identified hazards, and the updated priorities for the list of hazards.

Identified Hazards, 2010 Plan Update

Natural Hazards (2005 Plan)	Priority
Floods	• High
Hurricanes/Tropical Storms	• High
Tornadoes	• Medium
Thunderstorms	• Medium
Lighting	• Medium
Subsidence	• Medium
Hail	• Low
Winter Storms	• Low
Drought	• Low

Natural Hazards (New 2010 Plan)	Priority
Storm Surge	• High
Coastal Erosion	• Medium-High
High Winds (part of Hurricanes)	• High

Man-made Hazards (2005 Plan)	Priority
Dam & Levee Failure	• High
Hazardous materials spills/contamination	• Medium-High

Overview of the 2010 Five-Year Plan Update

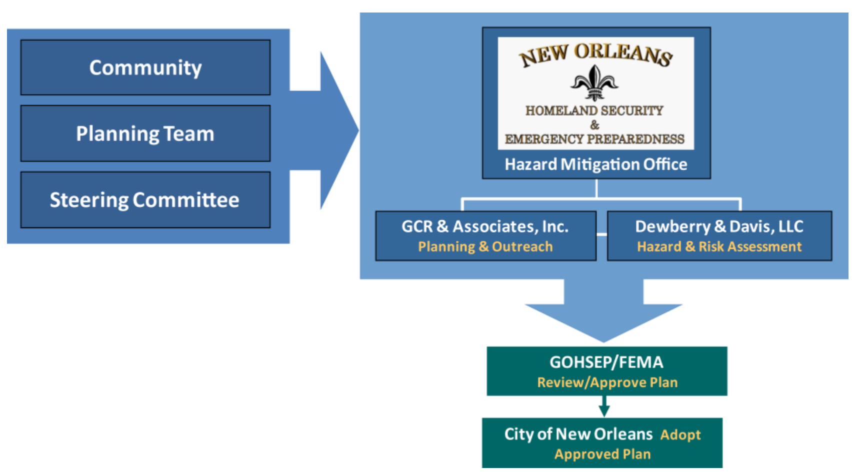
FEMA requires that all local governments update their Hazard Mitigation Plan every five years in order to remain eligible to receive federal hazard mitigation assistance funds. In 2010, Orleans Parish reviewed and updated each section of its 2005 Hazard Mitigation Plan using a comprehensive planning process described below. Critical information updated in the 2010 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 2005 Plan were reviewed and a new list of prioritized hazards was prepared for the 2010 Plan Update
- Each of the 14 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.
- Orleans Parish's vulnerability to hazards was updated after reviewing this section in the 2005 Plan and studying new vulnerability and risk studies completed after the 2005 Plan was prepared.
- The risk assessment of potential losses with future hazard events was also updated using the most recent available data.
- The evaluation of land uses, 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 planning process included a comprehensive community engagement/outreach strategy.

- 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 2010 Plan Update.
- The updated and expanded Mitigation Strategy includes updated goals and objectives, a review of the 2005 Plan and accomplishments, 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 Community Rating System.
- 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 New Orleans Homeland Security Emergency Preparedness (NOHSEP) Hazard Mitigation Office working with its consultant teams, GCR & Associates, Inc. and Dewberry & Davis LLC, received guidance and recommendations from the community, Planning Team, and Steering 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 neighborhood associations, civic organizations, churches, businesses, environmental groups, governmental agencies, and non-profit organizations with an interest in hazard mitigation planning as well as national, state, and elected officials. The Planning Team included representatives from a cross section of the community, including community members, business leaders, governmental and non-governmental organizations. The Steering Committee included representatives from the City of New Orleans departments that worked on the 2005 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 NOHSEP Hazard Mitigation Office and its planning consultants held four Progress and Coordination meetings with the Planning Team and Steering Committee between November 2009 and July 2010. The purpose of each meeting was as follows:

- November 12, 2009 – Kick-Off Meeting: discuss the hazard mitigation planning process; review the 2005 Plan; present the community engagement strategy; identify and prioritize hazards
- April 19, 2010 –Hazards and Risks: review the hazard profiles, community asset inventory, risk assessment for potential losses from identified hazards; establish goals and objectives
- May 10, 2010 – Goals, Objectives, Mitigation Actions: finalize goals and objectives; review mitigation actions from the 2005 Plan and develop new mitigation actions for the 2010 Plan Update
- June 29, 2010 – Implementation Strategy: Complete a benefit cost review to prioritize mitigation actions and review the implementation strategy

Four community meetings were also held between November 2009 and July 2010. A community meeting was scheduled immediately following each progress and coordination meeting to inform the public during each phase of plan development and to give the community an opportunity to comment and offer recommendations regarding the plan. The community meetings were held as follows:

- November 19, 2009 – Community Kick-Off Meeting
- April 20, 2010 – Hazards and Risks
- May 11, 2010 – Goals, Objectives, Mitigation Actions
- July 1, 2010 –Implementation Strategy

Once GOHSEP and FEMA reviewed and approved the 2010 Plan Update, a final Progress and Coordination meeting was 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.

In addition to holding community meetings, NOHSEP kept the community informed of the planning process through its hazard mitigation website (www.neworleansmitigation.com), email notices to community stakeholders before each community meeting including summary minutes of the preceding meeting, four newsletters that summarized each step of the planning process, press releases and newspaper ads issued before each set of progress/coordination and community meetings, and community surveys/questionnaires distributed at each community meeting.

Hazard Identification, Profiles and Ranking

Each of the 14 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 2010 Plan Update includes a complete review and update of the Orleans Parish 2005 Plan, as well as the State of Louisiana's 2008 Hazard Mitigation Plan. The 14 hazards were identified and prioritized by the 2010 Orleans Parish Hazard Mitigation Planning Team and presented to the community for their review. Three new hazards not included in the 2005 Plan were added to the 2010 Plan Update: storm surge, high winds, and coastal erosion. Other changes to the list of hazards include: 1) removing terrorism as a hazard in the 2010 Plan Update, 2) expanding the "Levee Failure" hazard to "Dam and Levee Failure" in keeping with the Louisiana 2008 Hazard Mitigation Plan, and 3) profiling the "Thunderstorm" hazard and the "Lightning" hazard individually in the 2010 Plan Update, rather than as a single hazard in the 2005 Plan.

Vulnerability (Risk) Assessment and Loss Estimation

The 2010 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 all hazards 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 2010 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 new Master Plan includes a chapter on "Resilience: Living with Water and Natural Hazards.

Capability Assessment

The 2010 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 NOHSEP, including the Office of Emergency

Preparedness and the Hazard Mitigation Office, will serve as the lead agency and coordinate with other agencies as needed to implement the Mitigation Strategy of the 2010 Plan Update.

The NOHSEP will also work with federal and state agencies and programs to implement the 2010 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 2010 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 2005 Plan to include updated goals and objectives, a review of the 2005 Mitigation Action Plan and accomplishments, and an updated Mitigation Action Plan that addresses the updated hazards and risk assessment. The Mitgation Strategy also includes a discussion of the Parish's compliance with the National Flood Insurance Program (NFIP) and participation in the NFIP Community Rating System.

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 65 actions designed to reduce or eliminate risks from the hazards identified in the plan. The actions were prioritized using the 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 goal and include actions that:

1. Identify and pursue preventative measures to reduce losses of life, properties (existing and future, and ecosystems due to hazards
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
3. Ensure the ability of emergency services providers and facilities, including essential facilities, to continue operating during hazard events.
4. Promote regional, federal, and state cooperation between parishes with regard to hazard mitigation activities.

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.

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 formally adopted by the City Council, the Plan must be implemented and maintained. The 2010 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 NOHSEP Hazard Mitigation Office will be responsible for monitoring and updating the plan annually. Further, the Hazard Mitigation Office will include the Hazard Mitigation Planning Team in the annual review and update of the plan. Annual Progress Reports will be prepared by the lead agency responsible for implementing specific actions. After all Annual Progress Reports are completed, the Hazard Mitigation Office will convene a meeting of the Planning Team to review the reports and assess progress in implementing the mitigation actions. As needed, the Planning Team will reprioritize, add, or change mitigation actions based on the accomplishments of the prior year. The Planning Team will also evaluate the 2010 Plan Update annually to make sure that the Risk Assessment and Capability Assessment sections of the Plan remain current.

The 2010 Plan Update will also be reviewed, revised, and updated in 2015. It will be necessary to begin this review and update cycle in 2013 to ensure that adoption of the revisions is completed by 2015. This five year update will require GOHSEP and FEMA approval, as well as Council adoption by 2015.

The public will be involved in the plan maintenance process. 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 will be held annually following each meeting of the Planning Team. The community will be given opportunities to comment on the progress in implementing the plan and on any proposed plan revisions.

Plan Contact

For more information, please contact:

New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP)
Hazard Mitigation Office
City Hall Room 9E06
1300 Perdido Street
New Orleans, LA 70112
(504) 658-8740
Bradford W. Case (bwcase@cityofno.com)

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

On August 29, 2005, Hurricane Katrina, a powerful category 3 storm at landfall, slammed into the Gulf Coast near the border of Louisiana and Mississippi. Initially, it was believed that Orleans Parish had escaped the brunt of the storm with the hurricane eye to the east of New Orleans, but that was not the case. The effects of the storm set off a series of catastrophic events, the most devastating being the failures in the levee system that is vital to the protection of the city. Massive flooding then followed as saucer shaped New Orleans began filling up. Federal officials later called it the greatest disaster in the history of the United States. 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 to natural disasters.

Hazard Mitigation is a vital piece of the City of New Orleans' 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, and most recently on October 31, 2007. 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), 3) Flood Mitigation Assistance (FMA), 4) Repetitive Flood Claims (RFC), and 5) Severe Repetitive Loss (SRL). 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 lessen 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 all hazards 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.

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., hurricanes and strong storms), as well as many man-made hazards (e.g., chemical leaks from petroleum plants or from vehicles transporting these materials). 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 that face it.

The Orleans Parish Hazard Mitigation Plan was originally approved by GOHSEP and FEMA in December 2005, and subsequently adopted by the New Orleans City Council. The Orleans Parish 2010 Hazard Mitigation Plan is an update to the 2005 Plan. The Planning Team for the 2010 Plan has reaffirmed and updated its 2005 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. 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.

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, this plan is dedicated to reducing vulnerabilities identified in the risk assessment in order to protect Parish infrastructure, as well as all critical public and private facilities identified in the plan. In protecting infrastructure and facilities, this plan also serves to protect human and animal life, and ecosystems.

The purpose of the 2010 Plan is to review and update all sections of the 2005 Orleans Parish Hazard Mitigation Plan.

2.4 Organization of Plan

The organization of the Orleans Parish 2010 Hazard Mitigation Plan Update has been changed slightly from the 2005 Plan to assist the reader. The table at the end of this section provides a comparison between the 2005 and 2010 Plans to show how the sections have changed. The five (5) sections of the 2005 Plan have been expanded into ten (10) sections in the 2010 Plan. 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 2005 and 2010.

The 2010 Plan update is organized as follows:

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 2010 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.

Changes in Plan Organization between 2005 Plan and 2010 Plan Update

Contents	2005 Plan	2010 Plan
Executive Summary	Not included	Section 1
Introduction	Section 1	Section 2
Plan Adoption	Not included	Section 3
Community Profile	Section 1	Section 4
Planning Process	Section 2	Section 5
Hazard Identification	Section 3	Section 6
Vulnerability (Risk) Assessment	Section 3	Section 7
Analysis of Future Development Trends	Section 3	Section 4
Capability Assessment	Section 4	Section 8
Mitigation Strategy	Section 4	Section 9
Mitigation Actions	Section 5	Section 9
Mitigation Implementation Plan	Section 5	Section 9
Plan Maintenance	Section 5	Section 10

2.5 Plan Contact

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

New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP)
Hazard Mitigation Office
City Hall Room 9E06
1300 Perdido Street
New Orleans, LA 70112
(504) 658-8740
Bradford W. Case (bwcase@cityofno.com)

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 Restoration Protection Authority
CZO	City 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 Act
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
IFR	Interim Final Rule
IHNC	Inner Harbor Navigational 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 Agency
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
OEP	Office of Emergency Preparedness
NWS	National Weather Service
PDM	Pre-Disaster Mitigation Program
RFC	Repetitive Flood Claims Program
SRL	Severe Repetitive Loss Program
STAPLEE	Social, Technical, Administration, Political, Legal, Economic, Environmental
TPC	Tropical Prediction Center
UNO-CHART	University of New Orleans Center Hazards Assessment Response Technology
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 2010 Hazard Mitigation Plan Update	

3.2 Official Record of Adoption

The GOHSEP and FEMA Approval Letters are included in Appendix A. On ______, the New Orleans City Council adopted Resolution No. _______, adopting the Orleans Parish 2010 Hazard Mitigation Plan Update, which is also included in 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 it 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 toward 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 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 was losing population had 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[1]. 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. As of July 2010 the population has exceeded eighty percent of the pre-Katrina residents.

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 Gentilly Ridge, the highest spots in the City are still only a few feet above sea level. 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[2]. 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.

One unique feature of New Orleans' geography that often surprises visitors is that the Mississippi River is actually higher than the surrounding land. This phenomenon is due to the large amount of silt deposited on the river bottom over time. To people on the dry side of the Mississippi River levees, ships on the River appear to float above them. Although the current levee system offers some protection, the Corps of Engineers working with the Levee Districts are upgrading the levees to withstand a 1% flood storm by 2011.

---

[1] NOAA NCDC Database: Orleans Parish, Hurricane and Tropical Storm Events

[2] Louisiana Department of Wildlife and Fisheries, Fur and Refuge Division, and the U.S. Geological Survey Biological Resources Division National Wetlands Research Center. "1997 Louisiana Coastal Marsh Vegetation Map."

4.3 Climate

New Orleans has a subtropical climate and enjoys pleasant weather for much of the year. Summers are long and hot with average high temperatures running into the low 90s. Hot summer days are made worse by the high levels of humidity that are common in New Orleans. Winters tend to be very mild with average high temperatures in the low 60s from December to February and average low temperatures in the 40s.

New Orleans's subtropical climate also results in high rainfall rates throughout the year. In fact, the average monthly rainfall for all months except October is between four and six inches. The annual average rainfall is 62 inches per year.

Climate Table

Indicators	January	February	March	April	May	June	July	August	September	October	November	December	Total
Avg. Temp	51.3	54.3	61.6	68.5	74.8	80.0	81.9	81.5	78.1	69.1	61.1	54.5	68.1
Avg. Max Temperature	60.8	64.1	71.6	78.5	84.4	89.2	90.6	90.2	86.6	79.4	71.1	64.3	77.6
Avg. Min Temperature	41.8	44.4	51.6	58.4	65.2	70.8	73.1	72.8	69.5	58.7	51.0	44.8	58.5
Precipitation (inches)	5.0	6.0	4.9	4.5	4.6	5.8	6.1	6.2	5.5	3.0	4.4	5.8	61.9

Source: CityRating.com – Weather History; http://www.cityrating.com/cityweather.asp?city=New+Orleans

4.4 Economy

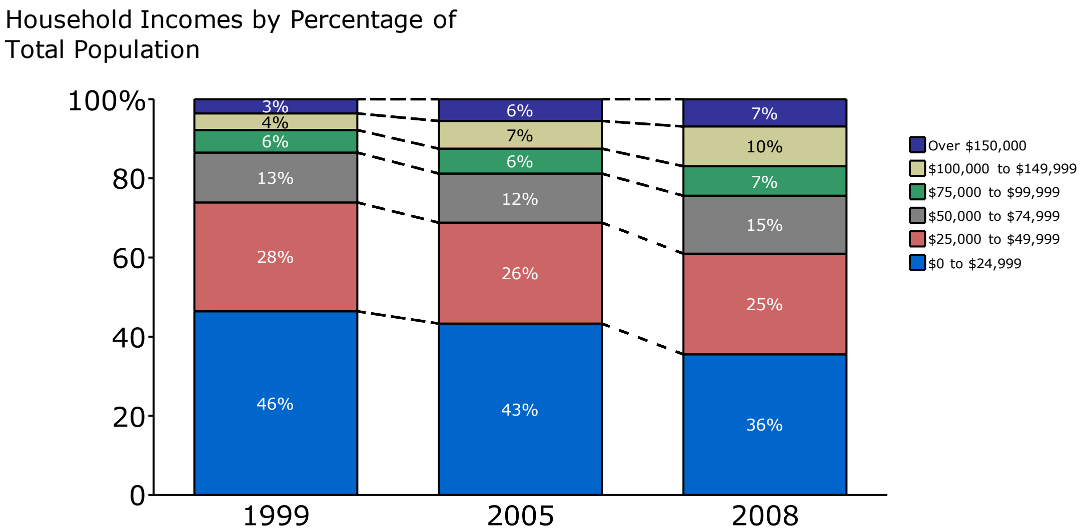
Since World War II, New Orleans' economy has been largely based on trade, energy, tourism and to a smaller extent industry and manufacturing. The New Orleans economy remained diversified and strong until the 1980s with the decline in the oil sector. Since the 1980s, the New Orleans economy has relied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

Today, the service/tourism sector has become a large part of the New Orleans economy. Service jobs accounted for 48 percent of all jobs in New Orleans in 2000 and retail trade accounted for another 16 percent. In recent years the city has sought to diversify the economy developing strengths in film and digital media[3]. Through incentives New Orleans, as well as the entire state of Louisiana, has become a major player in the film industry.

Prior to 2005 New Orleans had been experiencing a slow increase in household incomes. Due to Hurricane Katrina, which caused a significant shift in the cities' demographics, household incomes increased significantly. In 1999 only 29% of Orleans Parish households earned incomes of at least $50,000. By 2008 that same group, households earning incomes of $50,000 or greater, had expanded to 38% of all households.

[3] Greater New Orleans, Inc., Parish Fact Sheet – Orleans Parish



Source: U.S. Census Bureau; 2005 and 2008 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 April 2009 is operating at 78% of its pre-Katrina passenger levels[4].

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.

[4] Plan for the 21st Century New Orleans 2030, Volume 2, Chapter 11, Transportation, page 11.3, Draft January 2010.

Rail

Amtrak provides passenger rail service to New Orleans. Amtrak routes connect New Orleans to the Northeast, the Southeast, the Midwest, and Southern California. Also, New Orleans is served by six Class 1 freight railroads: Union Pacific, Kansas City Southern, Burlington Northern Santa Fe, Canadian National, Norfolk Southern, and CSX Transportation. The City also owns a non-profit switching railroad, the New Orleans Public Belt Railroad (NOPBRR). The NOPBRR interchanges with all Class 1 railroads serving New Orleans. Currently projects are being considered to add a high speed rail system that would connect New Orleans to the airport (LANOIA) and other neighboring cities including Houston and Atlanta.

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 in terms of import steel, natural rubber, plywood, and coffee. The Port of New Orleans is also the only deepwater port in the U.S. served by six Class 1 railroads. The Julia Street Cruise Ship Terminal, located at the Port of New Orleans, serves 700,000 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 up until 2008 the Mississippi River Gulf Outlet (MRGO) had provided a shortcut from the Gulf of Mexico to the Port of New Orleans. Following Hurricane Katrina, U.S. Congress de-authorized MRGO, closing MRGO to all ship travel in 2008. MRGO was closed as a result of the storm surge that occurred during Hurricane Katrina. In 2009, the USACE constructed a rock closure across MRGO at Bayou la Loutre to permanently close MRGO. In 2010, the USACE constructed a floodwall with navigational gates at Bayou Bienvenue and Gulf Intercoastal Water Way (GIWW). The floodwall is designed to reduce 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.

Congestion is a major problem during an evacuation. The number of routes out of the 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, crosses 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. Also, the residents in Parishes to the west headed east to avoid a storm, and vice versa, must travel through New Orleans on I-10, creating congestion for New Orleans residents trying to evacuate as well. 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 and three streetcar routes. New Orleans' famous street cars currently operate along St. Charles Avenue, Canal Street and along the riverfront through the French Quarter and Central Business District. A new streetcar line along Loyola Avenue is scheduled for completion is 2012, and RTA is currently examining other streetcar lines, including one that would run from the French Quarter east to the Industrial Canal.

4.6 Community Assets

In the aftermath of Hurricane Katrina, New Orleans still maintains its unique cultural heritage. Residents and new comers to the city take pride in the City's historic neighborhoods, its food, music and 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 20 historic districts and 140 landmarks on the National Register --- 14 of the districts also have local historic district status.

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 in the development phase, with some buildings already in construction, 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.

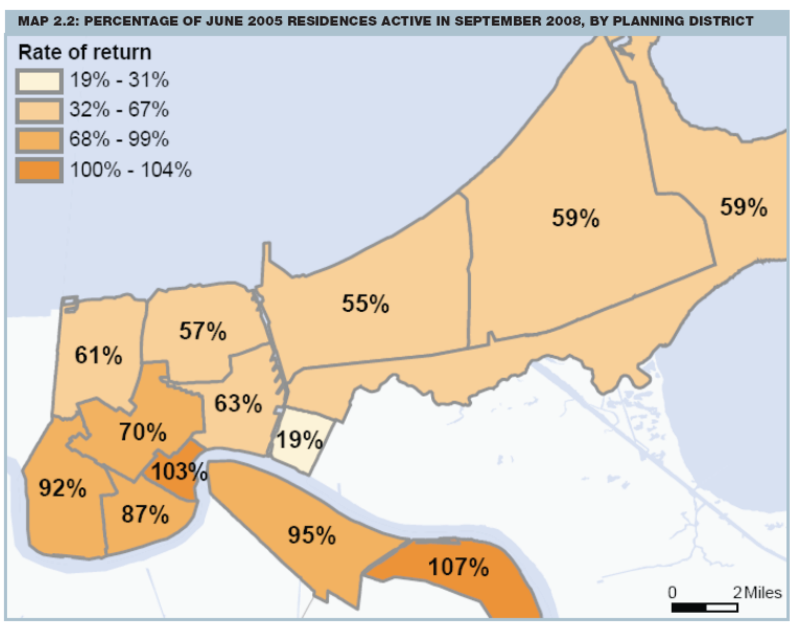
New Orleans also has many colleges and universities. Major institutions of higher learning in New Orleans include Tulane University, Loyola University, Xavier University, University of New Orleans, Southern University at New Orleans, Dillard University, Our Lady of Holy Cross College, and Delgado Community 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 other U.S. cities (e.g., Cleveland, Pittsburgh, and St. Louis) whose local economies were tied closely to manufacturing. However, during the 1980's 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, starting in the 1990s and continuing up to mid 2005, prior to Hurricane Katrina, New Orleans population had begun to stabilize.[5] In July 2005, New Orleans had an estimated population of 455,188.[6]

In August of 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 2010. The population has increased from 208,548 in July 2006 to 365,403 in July 2010.[6] In 2010, the Orleans Parish population was 80.3% of its pre-Katrina population estimate of 455,188. This recovery in population has exceeded most projections. As shown in the map below, by September 2008 most areas of the city had recovered to at least 55% of their pre-Katrina population with the exception of the Lower Ninth Ward which had recovered only 19% of its pre-Katrina population.[7]



SOURCE: GNO COMMUNITY DATA CENTER ANALYSIS OF VALASSIS RESIDENTIAL AND BUSINESS DATABASE

[5] "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.
[6] Greater New Orleans Community Data Center. http://gnocdc.org/census_pop_estimates.html, Updated March 23, 2010. New Orleans Five Years After Katrina. http://www.gcrconsulting.com/katrina5year/demographics.html August 29, 2010.
[7] "Plan For The 21st Century: New Orleans 2030", Volume 3, Chapter 2; "New Orleans Yesterday and Today: Population and Land Use Trends", pages 28, Draft January 2010.

4.8 Land Use and Development Trends

Overview of Land Use and Changes, 2005 to 2010

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. Whereas neighborhoods constructed post World War II are predominantly suburban type single family subdivisions, strip malls, or large multi-family developments.[8]. 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% of the residences were flooded. As expected there has been an increase in the number of vacant properties. In 2009 the Parish had an estimate of 65,888 unoccupied addresses. 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.[8] Highlights of the Future Land Use Map include:

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

This 2010 update to the Hazard Mitigation Plan will account for the potential changes in land use.

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

Section 5. Planning Process

Contents of this Section

Changes between the 2005 Plan and the 2010 Plan Update.
This section of the Plan has been completely rewritten to report the planning process completed for the 2010 Plan Update. The NOHSEP Mitigation Office provided oversight and direction in setting up the new Steering Committee and Planning Team for the 2010 Plan Update, and also worked closely with GCR & Associates, Inc., the firm responsible for planning and outreach for the 2010 Plan Update. The Community Stakeholder list was reviewed and updated to include active, current representation for all groups. The plans, ordinances, and codes reviewed in 2005 were examined again along with many new ones to identify all opportunities to integrate other plans into the 2010 Plan Update. Section 5 describes the planning process conducted between 2009 and 2010 and summarizes all Planning Team and community meetings held to develop and update each section of the 2010 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 inclusion 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, the GCR/Dewberry Planning Group worked with the Hazard Mitigation Office to review the 2005 Plan, establish the Planning Team and Steering Committee, develop a community engagement/outreach strategy, conduct a capability assessment survey, and coordinate with state and other agencies.

2) Assess Risks

During the second phase, Dewberry worked with the Hazard Mitigation Office, GCR, the Planning Team/ Steering Committee, and community to identify hazards to be profiled in the plan. Using the identified list of hazards, Dewberry 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 2010 Plan

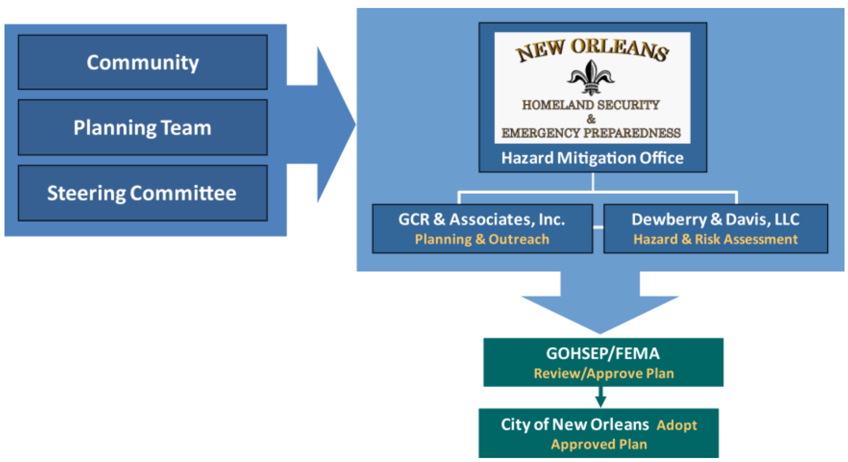
During the third phase GCR & Associates, Inc. worked with Dewberry& Davis, LLC, the Hazard Mitigation Office, the Planning Team/Steering Committee, and the community to prepare the capability assessment, update 2005 goals and objectives, select/prioritize mitigation actions, and submit an initial draft 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 GCR/Dewberry Planning Group worked closely with the Hazard Mitigation Office 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 diagram below shows the various groups involved in the planning effort to update the Orleans Parish Hazard Mitigation Plan. The New Orleans Homeland Security Emergency Preparedness (NOHSEP) Hazard Mitigation Office working with its consultant teams, GCR & Associates, Inc. and Dewberry & Davis LLC, received guidance and recommendations from the community, Planning Team, and Steering 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, 2010, is the NOHSEP Hazard Mitigation Office. The City used a public Request for Proposal process to select two planning consulting firms, GCR & Associates (GCR) and Dewberry and Davis, LLC (Dewberry) to lead the planning effort. The two firms worked closely with the Hazard Mitigation Office to update all sections of the plan.

GCR, working with Henry Consulting, Inc. (HCI), coordinated the Planning and Outreach for the overall project and prepared the final document, while Dewberry, working with Perez and VisseringPardue, prepared the Hazard and Risk Assessment sections of the updated plan.

Steering Committee

The Steering Committee included representatives from fourteen organizations. The organizations and participants are listed below and included representation from City of New Orleans departments that worked on the 2005 approved Hazard Mitigation Plan and other organizations that work closely with hazard mitigation planning efforts for Orleans Parish.

The Steering Committee members also served on the Planning Team (described below). The Steering Committee responsibilities included:

- Providing leadership and support
- Overseeing the planning process
- Helping to develop specific details for the
    - Risk assessment

  - Mitigation strategies
  - Implementation plan
- Attending planning and steering committee 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.

Steering Committee	
Organization	**Participants**
New Orleans Office of Homeland Secuirty & Emergency Preparedness (NOHSEP)	Col. Jerry Sneed
NOHSEP Office of Emergency Preparedness (OEP)	Mr. Matthew Kallmeyer
NOHSEP Hazard Mitigation Office	Mr. Brad Case
City of New Orleans Department of Code Enforcement	Mr. Winston Reid
City of New Orleans Department of Public Works	Mr. Marvin Thompson
City of New Orleans Mayor's Office of Environmental Affairs	Ms. Wynecta Fisher and Mr. Charles Allen
City of New Orleans Office of Safety and Permits	Mr. Paul May
New Orleans City Planning Commission	Ms. Rachel Heiligman
Orleans Parish Levee District	Mr. Gerry Gillen
New Orleans Area Regional Planning Commission	Mr. Chris Laborde
Sewerage and Water Board of New Orleans	Mr. Jason Higginbotham
U.S. Army Corps of Engineers	Mr. Reuben Mabry
UNO School of Urban Planning and Regional Studies	Dr. Earthea Nance
UNO Center for Hazards Assessment Response Technology (CHART)	Dr. Monica Farris

Planning Team
The Planning Team included the Steering Committee (described above) and 39 additional organizations that provided a broad cross section of the community, including community members, business leaders, governmental and non-governmental organizations. The 39 additional organizations and participating members are listed below. In addition to these organizations, representatives from the neighboring parishes responsible for hazard mitigation planning were invited to attend all Planning Team members and to participate in the planning process for the Orleans Parish 2010 Hazard Mitigation Plan Update. These neighboring parishes included Jefferson Parish, St. Bernard Parish, and Plaquemines Parish.

The Planning Team 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.

Planning Team	
Organization	**Participants**
Steering Committee	All 14 Members
American Red Cross	Mr. Bill Salmeron
Business Council of New Orleans and the River Region	Mr. Michael T. Gray
City of New Orleans Chief Administrative Office	Ms. Cynthia Silvain-Lear
City of New Olreans, Department of Parks and Parkways	Ms. Ann MacDonald
City Park Improvement Association	Mr. George Parker
Emergency Medical Service	Dr. Jullette Saussy
Entergy New Orleans	Mr. Lambart Buggage
Historic District Landmark Commission	Mr. C. Elliott Perkins
Home Builders Association of Greater New Orleans	Ms. Alexandra Rodriguez
City of New Orleans Health Department	Dr. Kevin Stephens
Lake Pontchartrain Basin Foundation	Ms. Anne Rheams
Mayor, City of New Orleans	Mayor Mitch Landrieu and Mayor Ray Nagin
Mayor's Office of Community Development	Ms. Belinda Little-Wood
Mayor's Office of Intergovernmental Relations	Ms. Maggie Merrill
Neighborhoods Partnership Network	Ms. Timolynn Sams
New Orleans Fire Department	Mr. Roman Nelson
New Orleans International Airport	Mr. Charles Cazayoux
New Orleans Police Department	Chief Ronald Serpas
New Orleans Regional Chamber of Commerce	Mr. G. Ben Johnson
Orleans Parish Communication District	Mr. Stephen J. Gordon
Port of New Orleans	Ms. Deborah Keller
Orleans Parish School Board	Mr. B.J. Bilbo
Regional Transit Authority	Mr. Marc Popkin; Mr. Don Harris
Louisiana Public Health Institute	Mr. Clayton Williams
Louisiana Recovery Authority	Ms. Alexandra Norton and Ms. Sandra Gunner
New Orleans Redevelopment Authority	Ms. Kristen Melberg
Orleans Parish Criminal Sheriff's Office	Mr. Marlin Gusman
Housing Authority of New Orleans	Mr. Wayne Woods
City of New Orleans Economic Devleopment	Mr. Ernest Gethers
United Way of NOLA	Mr. Nicholas Kindel
CARE - United Way for GNOA	Ms. Ellinor Simmons
Hispanic Chamber of Commerce of Louisiana	Ms. Darlene Kattan
Asia Pacific American Society	Ms. Raj Pannu
Cox Communications	Mr. Elvin Thobodeaux
AT&T	Mr. Daryl Hubbard
Urban Area Security Initiative	Mr. Tim Thomasson
Waggoner and Ball Architects	Mr. David Waggonner
GIS Department, City of New Orleans	Ms. Kristin Michel
RAND Gulf States Policy Insitute	Mr. Oliver Wise and Ms. Sally Sleeper

Community

Over 400 stakeholders from the community were encouraged to participate in the planning effort to develop the updated plan. The active stakeholder list included representation from neighborhoods, civic organizations, churches, businesses, environmental groups, governmental agencies, and non-profit organizations that have an interest in hazard mitigation planning. Representation included citywide organizations as well as representation from each of the 13 planning districts within the City. Stakeholders also included all elected official representing Orleans Parish, including U.S. and State senators and congressional leaders and all City Council members.

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 Team
- Identifying community priorities for hazard mitigation planning

5.4 Hazard Mitigation Plan Development

Planning and Organization

GCR & Associates (GCR), under the direction of the NOHSEP Hazard Mitigation Office, established an overall work plan, schedule, and budget to complete the Orleans Parish Hazard Mitigation Plan Update, 2010. The schedule was updated throughout the planning process, and the final completed schedule is included in Appendix B.

After establishing the Steering Committee and Planning Team as described above, GCR's next step was to develop a Community Engagement Strategy, compile a list of community stakeholders, and schedule the first meetings with the Planning Team and the community to introduce the planning effort for the 2010 updated plan. The Kick Off meeting for the Planning Team was held on November 12, 2009 at the Homeland Security Conference Room, New Orleans City Hall, and the first community meeting was held the following week on November 19, 2009 at the Holy Angels Chapel, 3500 St. Claude Avenue. At the Kick-Off meetings for the Planning Team and community, GCR introduced the planning effort by covering the following:

1. Overview of Hazard Mitigation
2. Review of the Planning Process
3. Role of Planning Team and Steering Committees
4. Review of the 2005 Plan and Implementation
5. Discussion of 2010 Hazard Mitigation Plan Update

The agendas, summary minutes, attendance sheets, comment sheets, handouts, press release and other public notifications of the Planning Team and community meetings are included in Appendix C.

During the Kick-Off meetings, the Planning Team reviewed the list of hazards included in the 2005 Plan, considered additional hazards, and prioritized a list of 21 potential hazards. As requested by the Planning Team, Dewberry reviewed the list, developed a methodology for analysis, and recommended a list of 14 hazards to be included in the 2010 Plan Update. This list was distributed to all Planning Team members ahead of the second set of meetings to discuss the Hazard Identification/Risk Assessment. The Planning Team concurred with Dewberry's recommendation. The recommended list of hazards for the 2010 Plan Update included hazards in the 2005 Plan, along with two new hazards: storm surge and coastal erosion. The prioritization of hazards along with the methodology for analysis of natural hazards and the recommended list of 14 hazards is included in Appendix D.

Following the Kick Off Meetings, GCR distributed a capability assessment survey to all departments and organizations that provide resources to support hazard mitigation planning in the City of New Orleans. A copy of the survey is included in Appendix E. Surveys were collected and used to develop the Capability Assessment in Section 8.

Review of Existing Plans and Integration with 2010 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:

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 and also includes the Orleans Parish Hazard Mitigation Plan (2005) as an appendix to the document. When the 2010 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 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 1990 and will be revised to support the City's new master plan once that document is approved by the City Council.

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 which 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 which 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 2008 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.

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 which 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 city-wide 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; and 6) the Public Belt Railroad Plan.

Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast. This plan 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

Dewberry & Davis LLC (Dewberry), under the direction of the NOHSEP Hazard Mitigation Office prepared the Hazard Identification/Risk Assessment (HIRA).

Upon completion of the HIRA, the second set of planning and coordination meetings were scheduled with the Planning Team and community to present the results. The Planning Team meeting was held April 19, 2010 at the Homeland Security Conference Room, New Orleans City Hall, and the second community meeting was held the following day on April 20, 2010 at the Regional Transportation Center, 10 Veterans Blvd., New Orleans. At the 2nd set of meetings for the Planning Team and community, Dewberry and GCR presented the following:

- Hazard Identification and Profiles. An update to those included in the 2005 Plan and a complete identification and profiles for new hazards included for the 2010 Plan.
- Update to the Community Asset Inventory, including private property, public infrastructure, and Repetitive Loss/Severe Repetitive Loss Properties
- 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 2005 Plan

The agendas, summary minutes, attendance sheets, comment sheets, handouts, press release and other public notifications of the second set of Planning Team and community meetings are including in Appendix F.

Mitigation Strategy

The third round of meetings for the development of the Plan's Mitigation Strategy, were held in early May. The third Progress and Coordination Meeting was held on May 10, 2010, at the Homeland Security Conference Room in New Orleans City Hall. The Planning Team reviewed and approved the updated goals and objectives for the Orleans Parish Hazard Mitigation Plan Update, 2010. Once the goals and objectives were established, the Planning Team reviewed an update of mitigation actions from the 2005 Plan and a list of new preliminary mitigation actions for the 2010 Plan Update.

A number of plans were reviewed to develop the list of mitigation actions for the 2010 Plan Update, including 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. GCR also reviewed the results from the Capability Assessment in preparing the preliminary list of mitigation actions. The updated goals and objectives and preliminary list of mitigation actions were sent to the Planning Team for their review before the May meeting. At the May 10 meeting, the Planning Team discussed actions for each goal, and established a final set of recommended mitigation actions for the updated plan.

The third Community Meeting was held on May 11, 2010, at Dillard University's DUICEF building. At this meeting, the community was presented with a review of planning efforts underway since the April 20, 2010 meeting, including the updated goals and objectives and recommended mitigation actions. The community was given an opportunity to ask questions and provide comments and recommendations. All community comments were recorded for consideration in the final plan and are included in Appendix G.

The agendas, summary minutes, attendance sheets, comment sheets, handouts, press release and other public notifications of the third set of Planning Team and community meetings are including in Appendix G.

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.

The agendas, summary minutes, attendance sheets, comment sheets, handouts, press release and other public notifications of the third set of Planning Team and community meetings are including in Appendix H.

5.5 Community Engagement/Outreach Strategy

To ensure community involvement in developing the plan, GCR, working with the City Hazard Mitigation Office and Dewberry, developed a Community Engagement/Outreach Strategy based on FEMA 386-1. The following is a summary of the overall strategy. This strategy was presented to the Planning Team and the community at the 1st set of meetings on November 12 and November 19, respectively. The full text of the strategy is included in Appendix I.

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

GCR identified over 400 stakeholders from 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. The list of stakeholders for the hazard mitigation planning effort is included in Appendix J.

Organize Community Events/Meetings

Four community events/meetings were organized and scheduled to follow each progress and coordination meeting of the Planning Team. The subject matter covered at each Planning Team meeting was also covered at the community meeting and included the following:

- 1st Meeting – Hazard mitigation planning process, review of the 2005 plan, and community engagement strategy
- 2nd Meeting – Hazard risk assessments, list of hazards, community asset inventory, loss estimates, and goals and objectives.
- 3rd Meeting – Goals, objectives, and mitigation actions.
- 4th Meeting – Benefit cost review to prioritize mitigation actions and implementation strategy

Distribute Information to the Community

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

- Hazard Mitigation Website - The City established the hazard mitigation website (www.neworleansmitigation.com) starting in April 2010 and information on the hazard mitigation planning effort was posted on this website.
- Email notices to Community Stakeholders – Notices were sent to the community stakeholders before each community meeting, and summary minutes of the meetings were sent to the stakeholders after each meeting.
- Newsletters – Four newsletters were distributed to summarize planning efforts. A newsletter was produced following each set of meetings to recap the planning effort and to announce the upcoming meeting.
- Press releases – A press release was issued before each set of progress/coordination and community meetings.
- Community Surveys/Questionnaires -- Four surveys/questionnaires were designed to give the community an opportunity to respond to the content of each community meeting, to solicit comments and recommendations, and to gauge support and understanding of the presented material. These survey/questionnaires were distributed at each community meeting.

The materials created to distribute information to the community are included in Appendices C, F, G, and H as part of each set of meeting documents.

5.6 Plan Development Meeting Summary

1st Progress and Coordination Meeting – November 12, 2009 Kick Off Meeting

Steering Committee Briefing Session – served many objectives some of which included introductions and an overview of the planning process. Additionally, the opportunity was taken to stress the importance of the planning process for delivering a strong workable plan.

Accomplishments:
- Selected a committee chair
- Established rules for decision making and conducting meetings

Planning Team Kick-Off Meeting – served as an opportunity to coordinate all resources and introduce the Planning Team to the importance of Hazard Mitigation Planning. An overview of the planning process was presented along with the work plan, roles of both Planning Team and the Steering Committee, and a proposed Community Engagement Strategy.

Accomplishments:

- Adopted a mission statement for the Orleans Parish 2010 Hazard Mitigation Plan Update
- Identified and developed initial prioritization of hazards

1st Community Meeting – November 19, 2009 Community Kick-Off Meeting

Community Kick-Off Meeting – served as a way to introduce the community to the hazard mitigation planning process and the purpose of the 2005 Hazard Mitigation Plan and the 2010 Plan Update, and the Plan Development Team, which includes the NOHSEP Mitigation Office Staff, the consulting team for the 2010 Plan Update, members of the Steering Committee and Planning Team, and the Community Stakeholders. Additionally, the meeting served as an opportunity to explain the reason for developing and updating a hazard mitigation plan for Orleans Parish.

Accomplishments:

- Introduced the Plan Development Team
- Introduced the planning process, mission statement, and work plan
- Provided the community an opportunity to ask questions concerning the planning process

2nd Progress and Coordination Meeting – April 19, 2010 Hazards and Risks

2nd Progress and Coordination Meeting – served as an opportunity for the Planning Team and Steering Committee to review and discuss the results of the hazard profiles, risk assessment, and loss estimates. In addition, the Planning Team reviewed and updated the goals and objectives in the 2005 Plan.

Accomplishments:

- Reviewed the results of the Hazard Profiles, Risk Assessment, and Loss Estimates
- Reviewed and updated Goal and Objectives for the 2010 Plan Update

2nd Community Meeting – April 20, 2010 Hazards and Risks

2nd Community Meeting – served as an opportunity for the community to review and ask questions concerning the results of the Hazard Identification and Risk Assessment (HIRA). It also gave the community a chance to review the updated the goals and objectives.

Accomplishments:

- Reviewed and discussed the results of the Hazard Identification and Risk Assessment
- Reviewed and discussed the updated Goals and Objectives for the 2010 Plan Update

3rd Progress and Coordination Meeting – May 10, 2010 Goals, Objectives, Mitigation Actions

3rd Progress and Coordination Meeting - served as an opportunity for the Planning Team and Steering Committee to review and approve the updated goals and objectives, and also to develop mitigation actions for the 2010 Plan Update.

Accomplishments:

- Approved the Goals and Objectives for the Orleans Parish 2010 Hazard Mitigation Plan Update.

- Developed Mitigation Actions for the Orleans Parish 2010 Hazard Mitigation Plan Update

3rd Community Meeting – May 11, 2010- Discuss Goals, Objectives, Mitigation Actions

3rd Community Meeting – served as an opportunity for the community to review the final approved goals and objectives, and also to provide comments and recommendations on the mitigation actions proposed for the 2010 Plan Update.

Accomplishments:

- Presented Goals, Objectives, and Mitigation Actions for the 2010 Plan Update
- Received comments and recommendations on the Mitigation Actions for the 2010 Plan Update

4th Progress and Coordination Meeting – June 29, 2010 Implementation Strategy

4th Progress and Coordination Meeting – served as an opportunity for the Planning Team and Steering Committee to review the final list of mitigation actions. The Planning Team also reviewed the results of the STAPLEE evaluations, finalized the priority ranking (high, medium, or low) for each mitigation action, and reviewed the implementation strategy.

Accomplishments:

- Reviewed and approved the Mitigation Actions for the 2010 Plan Update
- Reviewed results of the STAPLEE Evaluations and approved the final priority ranking of each Mitigation Action
- Reviewed and approved the Implementation Strategy

4th Community Meeting – July 1, 2010 - Implementation Strategy

4th Community Meeting – served as an opportunity to present the community with a review of all planning efforts underway since the May 11 meeting and to give the community an opportunity to review and comment on the final list of identified hazards, goals and objectives, mitigation actions, priority ranking of the mitigation actions, and implementation strategy for the updated plan.

Accomplishments:

- Presented an overview of the entire completed planning process
- Presented the list of Prioritized Mitigation Actions and Implementation Strategy for the 2010 Plan Update
- Received comments and recommendations on the Prioritized Mitigation Actions and Implementation Strategy for the 2010 Plan Update

Final Review and Progress and Coordination Meeting – Review of Final Plan

The Final Review Period—February 24, 2011– served as an opportunity for the Planning Team and Steering Committee to review the final plan approved by GOHSEP and FEMA prior to submitting the plan to the City Council for adoption. The Planning Team and Steering Committee received access to the final plan for a one week review period and issued comments and critiques via email and phone.
Progress and Coordination Meeting – March 29, 2011- served as an opportunity to discuss the plan maintenance process after the plan was adopted by City Council and approved by FEMA. The Planning Team and Steering Committee discussed implementation of the plan.

Final Community Meeting – March 17, 2011- Review of Final Plan
The final Community Meeting – served as an opportunity to present the community with the final plan approved by GOHSEP and FEMA prior to final adoption by the New Orleans City Council. This community meeting was held in conjunction with the City Council's public meeting to review and adopt the 2010 Plan Update as approved by GOHSEP and FEMA. This meeting also allowed the NOHSEP Mitigation Office to discuss implementation of the plan.

Schedule of Planning Team and Community Meetings	
Date of Meeting	**Purpose of Meeting**
November 12, 2009	Steering Committee Briefing Session Planning Team Kick Off Meeting
November 19, 2009	Community Kick Off Meeting
April 19, 2010	Steering Committee Update Meeting Planning Team Meeting – Hazard Identification Risk Assessment (HIRA); Goals and Objectives
April 20, 2010	Community Meeting – Hazard Identification Risk Assessment (HIRA); Goals and Objectives
May 10, 2010	Steering Committee Update Meeting Planning Team Meeting – Goals, Objectives, and Mitigation Actions
May 11, 2010	Community Meeting – Goals, Objectives and Mitigation Actions
June 29, 2010	Steering Committee Update Meeting Planning Team Meeting – Mitigation Priorities and Implementation Strategy
July 1, 2010	Community Meeting – Mitigation Priorities and Implementation Strategy
February 24, 2011 March 29, 2011	Steering Committee and Planning Team Review – Review Final Approved Plan and Discuss City Council Adoption of Plan Steering Committee and Planning Team Meeting-Discuss Procedures to Implement the Plan
March 17, 2011	Community Meeting -- Review Final Approved Plan, Discuss City Council Adoption of Plan, and Discuss Procedures to Implement the Plan

Section 6
Hazard Identification, Profiling, and Ranking

Contents of this Section

One of the first steps in developing the 2010 City of New Orleans[1] Hazard Mitigation Plan (HMP) update was to complete a comprehensive evaluation of the existing document, completed in 2005, to determine (a) specific areas that required updates, such as incorporation of data about recent hazards or documenting the 2010 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. With regard to the hazard identification/profiling and vulnerability assessment/loss estimation parts of the existing plan, the City (specifically the Steering Committee) and the technical consultants concurred, based on a detailed evaluation, that the most efficient method of updating the plan would be to completely re-organize and re-write the parts, dividing it into two sections: Sections 6 and 7. Although the original plan document was technically accurate when it was approved, numerous, highly detailed, vulnerability and risk studies have been completed by various government and private-sector organizations, all of which were reviewed in detail, analyzed, and incorporated into the City of New Orleans HMP.

Portions of the 2010 updated Plan were retained from the original December 2005 HMP), as appropriate, including portions of the historical hazard data. As part of the update, the list of hazards profiled in the original Plan was changed to focus on the natural hazards with the most potential to significantly impact the Parish. Specifically, storm surge, high winds, and coastal erosion were added to the hazard identification, profiling, and

[1] The terms Orleans Parish (and Parish) and City of New Orleans (and City) are used interchangeably throughout this document because the jurisdictions are geographically the same.

ranking subsections. While terrorism was profiled in the original Plan, it was deleted from this version as a result of the screening process documented in this Plan update. Also note that dam failure was added to the levee failure hazard, and the hazard is now titled "Dam and Levee Failure" in the update. Finally, the thunderstorm and lightning hazards (combined in the original Plan) were treated as individual hazards as part of the Plan update.

The list of hazards profiled as part of the State of Louisiana's 2008 HMP update were also reviewed to identify and compare the hazards profiled with those selected as part of the Orleans Parish update. In addition to the hazards mentioned above (profiled for the Orleans Parish update), the 2008 State Plan update also profiles three additional hazards:

- Earthquake
- Severe Summer and Winter Weather / Extreme Heat and Extreme Cold
- Wildfire

The 2010 Orleans Parish Hazard Mitigation Planning Committee (MPC) reviewed these additional hazards and determined that events associated with earthquakes, severe summer and winter weather (and extreme cold/heat), and wildfire have such low probability and potential minimal impact on life and property in the planning area that these hazards would not be profiled as part of the Plan update.

The original State of Louisiana HMP was prepared in compliance with Federal requirements for Standard State Mitigation Plans in the *Stafford Act*, as amended by the *Disaster Mitigation Act of 2000* (42 U.S.C. 5165). The original State HMP and the 2008 Plan update were prepared by the Louisiana Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), with the assistance of the State Hazard Mitigation Planning Committee (SHMPC). The 2008 Plan update includes a detailed characterization of 14 hazards and a risk assessment, for each hazard type, that leads to the determination of relative risk to physical assets, people, and operations. It also includes a set of goals, objectives, and mitigation actions, formulated in direct response to the identified risks.

Note that Appendix K of this updated HMP includes general descriptions of all the hazards in the present section.

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 Orleans Parish's MPC prepared this general assessment of the hazards that have potential to impact the Parish. 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, which include hurricanes winds, storm surge, and floods.

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

Overview of Orleans Parish's Natural Hazards History

According to the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database and other sources, the following natural hazards impacted Orleans Parish between 1950 and 2010.

Table 6-1
NCDC Database of Hazard Impact on Orleans Parish
(1950-2010)

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2010)							
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
109 New Orleans	5/9/1994	16:00	Flash Flood	N/A	0	500K	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2010)							
Location or County	**Date**	**Time**	**Type**	**Mag-nitude**	**Injury**	**Property Damage**	**Crop Damage**
115 ORLEANS	5/8/1995	20:30	Flash Flood	N/A	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
61 ORLEANS	4/18/1980	11:09	Hail	1.00 in.	0	0	0

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2010)							
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
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 – 2010)							
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 – 2010)							
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 – 2010)							
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 – 2010)							
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 – 2010)							
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 – 2010)							
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 – 2010)							
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 – 2010)							
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

NCDC Database of Hazard Impact on Orleans Parish (1950 – 2010)							
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

A number of these events caused property damage, injuries, and deaths. According to the NCDC database, Orleans Parish experienced 14 deaths and 37 injuries from natural hazards in the period from 1950 to 2009. Review of the 255 events listed in the NCDC database indicates that this total does not include 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.2

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

[2] NOAA NCDC database: Louisiana, Orleans Parish

Table 6-2
Hazard Recurrence Probability of Future Events

Hazard	No. of Events	Period of Record	Annual Probability	Probability
Hurricanes	25	100	25%	High
Tropical Storms	15	59	25%	High
Floods	27	59	46%	High
Storm Surge	9	59	16%	Moderate based on the event
High Winds*	8	59	20%	Moderate
Dam and Levee Failure	4	90	4%	Low
Tornadoes	17	59	27%	Low
Lightning	10	59	18%	Low**
Hail	28	59	47%	Low for significant events
Coastal Erosion***	-	-	-	Extremely High
Winter Storms	3	59	5%	Low
Thunderstorms	60-75 per year	59	100%	High
Drought	2	50	4%	Low
Subsidence****	5 mm per year	44	-	Extremely High
Hazardous Materials***** Spills/Contamination	31,064	23	100%	Extremely High

*70 knots or higher
**Thought to be 100% annually based on lack of sensitivity in NCDC Database.
*** 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.
*****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.

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 21 Presidential Disaster Declarations. These are summarized below in Table 6-3. 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.[3] These figures and events are discussed in more detail in the hazard-specific subsections that follow, including in particular Section 6.3.1 (Hurricanes and Tropical Storms).

Table 6-3
Natural Hazards and Declared Major Disasters in Orleans Parish, Louisiana (1965 to 2009)
(Sources: Public Entity Risk Institute (PERI) website, FEMA, NCDC database)

Disaster (DR) & 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.

[3] NOAA NCDCD database: Louisiana, Orleans Parish

Disaster (DR) & Date	Nature of Event	Description
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 Grande 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.

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.

As a start to the process of updating the hazard identification and risk assessment sections of the original Hazard Mitigation Plan, Orleans Parish and its consultant identified a list of potential hazards to be included in the Plan update. This initial draft list included 19 hazards, including both natural and manmade events. The list was compiled to include:

1. Hazards that were included in the original hazard mitigation plan
2. Hazards that were identified by the Parish and Steering Committee as being of particular interest
3. Hazards that were listed in the Planning Team survey conducted on November 12, 2009.

The Hazard Mitigation Plan update Planning Committee and the Steering Committee reviewed the complete list of natural hazards as outlined in the current State Plan, the 2005 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. This determination was made for several reasons: First, several of the hazards have little or no potential to negatively impact and/or to cause damage in the Parish. Secondly, FEMA grant funds are for the development of significant *natural hazard* mitigation plans. Finally, and most importantly, the Parish's efforts are focused on hazards and risks that have the greatest potential to affect loss of life and to do property damage as well as those that have the greatest mitigation potential.

Based on these criteria, the Parish evaluated each of the listed 19 hazards based on the eight general criteria outlined below:

1. Hazards identified by the Planning Team as those of particular interest or concern
2. Results of the Planning Team survey from November 12, 2009
3. Historical events
4. Significant damage in past events
5. Federal, State, or local emergency or disaster declarations
6. Availability of study data
7. Manmade vs. natural hazards in a Natural Hazards Mitigation Plan
8. Potential for FEMA to fund projects to mitigate the hazard

Based on these criteria, it was recommended that the Plan update include **hazard identification** for the following 14 hazards:

- Hurricanes and tropical storms
- Floods
- Storm surge
- High winds
- Dam and levee failure
- Tornadoes
- Lightning
- Hail
- Coastal erosion
- Winter storms
- Thunderstorms
- Subsidence
- Drought
- Hazardous materials spills/contamination

Note that the hazardous materials and contamination hazard is discussed in somewhat less detail than the other hazards because data addressing this manmade hazard is available through multiple agencies such as the Environmental Protection Agency (EPA) and, as noted previously, is not reviewed or funded via the FEMA Plan update process.

The following section profiles the 14 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. Upon review of the profiles developed for each hazard and evaluation of numerous technical studies and open-source documents related to the hazards included in the Plan update, the team determined that **Floods, Hurricanes and Tropical Storms, and Storm Surge** would be included in the more detailed risk assessments in the Vulnerability and Loss Estimation section.

6.3.1 Hurricanes and Tropical Storms

Description of the Hurricane and Tropical Storms Hazard

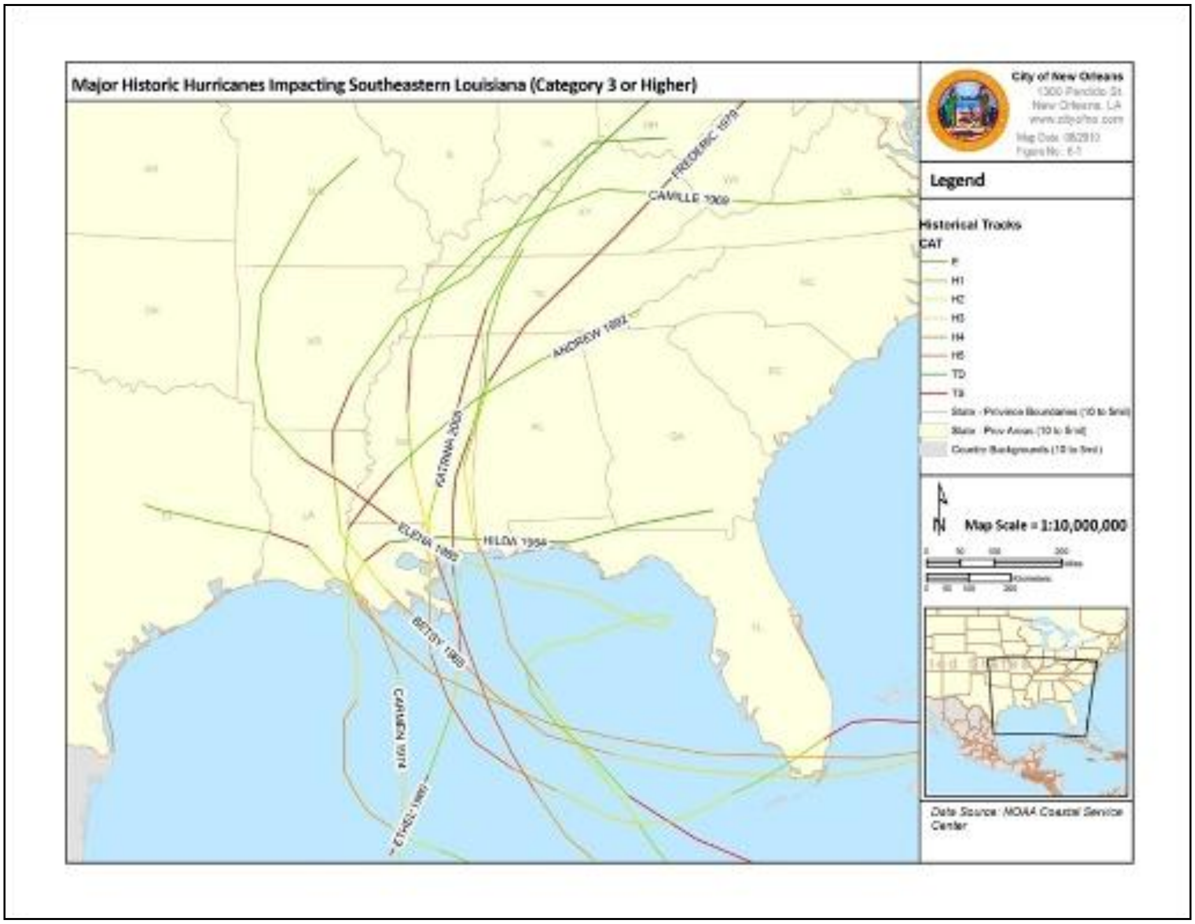
Hurricanes, tropical storms, and typhoons, collectively known as tropical cyclones, are among the most devastating naturally occurring hazards in the United States. Hurricanes generate several hazards that can cause extensive damage. High winds, heavy rainfall, tornadoes, and storm surge are all associated 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 Section 6.3.3 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 6.3.5.

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. See Appendix K for a more detailed description of Hurricanes and Tropical Storms.

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 6-1 shows all major historical hurricanes (Category 3 or higher) that impacted southeastern Louisiana within 100 miles of Orleans Parish from 1950 to 2009. The database was queried and the map developed using NOAA's Historic Hurricane Tracks database.

Figure 6-1
Major Historic Hurricanes Impacting Southeastern Louisiana (Category 3 or Higher)
(Source: NOAA Coastal Service Center – Historic Hurricane Tracks database)



Severity of the Hurricane and Tropical Storm 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 6-4, 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 6-4
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 6-2 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 6-5, 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. Property damage in Orleans Parish from Hurricane Katrina has been estimated at approximately $17 billion.[4] As mentioned above, the present subsection focuses on the effects from high winds associated with hurricanes. Floods and storm surge effects are discussed in sections that follow.

Table 6-6 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 6-6 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 declined to an estimated 114,426 as of the 2008 US Census estimate.

[4] NOAA NCDC Database: Orleans Parish, Hurricanes and Tropical Storm Events

Table 6-6
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

Several data sources were researched to identify historical hurricanes and tropical storms that have impacted southeastern Louisiana and Orleans Parish. The NCDC database indicates there have been 16 hurricanes and tropical storms in Orleans Parish between 1950 and 2009, with none of these occurring before 1995. The database provides no indication as to why there are no events prior to 1995, although other sources indicate that occurrences follow roughly the same pattern and frequency as shown in the NCDC list. Of the 16 hurricane and tropical storm events, 13 resulted in property damage. Table 6-7 below summarizes the 13 events that caused property damage within Orleans Parish.

Table 6-7
Hurricane and Tropical Storm Events Causing Property Damage, Orleans Parish, 1995 – 2009
(Source: NOAA/NCDC)

Date	Type	Property Damage
10/04/1995	Hurricane	200K
07/17/1997	Hurricane	5.0M
09/10/1998	Tropical Storm	31.5M
09/27/1998	Hurricane	30.1M
08/04/2002	Tropical Storm	50K
09/25/2002	Tropical Storm	108.6M
10/02/2002	Hurricane	149.6M
06/30/2003	Tropical Storm	34.0M
09/15/2004	Hurricane/typhoon	11.8M
10/09/2004	Tropical Storm	50K
07/05/2005	Hurricane/typhoon	47.5M
08/28/2005	Hurricane/typhoon	16.9B
09/23/2005	Tropical Storm	48.0M
Grand Total		**17.39B**

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, averaging approximately one event every four years.

In addition to the 25 hurricanes over the last century, Orleans Parish has also experienced numerous tropical storms. The National Hurricane Center's (NHC) Hurricane and Tropical Storm Tracker database was queried to identify past tropical storm events. According to the NHC, from 1950 to 2009, southeastern Louisiana, including Orleans Parish, has been impacted by 15 tropical storms. [5] 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, which calculates to a 25% annual probability of future hurricane or tropical storm occurrences.

Hurricane probability in southeastern Louisiana can also be assessed based on data from the 1999 study *Hurricanes of the North Atlantic, Climate and Society*. The study includes a series of maps showing the return periods and wait times for the southeastern Louisiana Parishes over the time period 1900 - 1996. The maps are shown in Figure 6-2 and Figure 6-3 and include the following

- hurricane return periods (Categories 1-5)
- wait times in coastal Parishes (Categories 1-5)
- major hurricane return periods
- wait times in coastal Parishes (major hurricanes)

The number in each Parish is the return period or wait time in years. The return period is defined as the statistical calculation of the annual probability of events of specific magnitudes or ranges of magnitudes occurring at a given location. The wait time is defined in the *Hurricanes of the North Atlantic, Climate and Society* as

> the number of consecutive years over which the probability of observing at least one hurricane increases to exceed 50% over the interval. Example - (w)ith an annual probability of 10%, a wait time of seven years gives a probability of better than 50% for observing at least one landfall in the consecutive-year interval.[6]

[5] National Hurricane Center (NHC), Historical Hurricane Tracks
[6] Hurricanes of the North Atlantic, Climate and Society, James Elsner and A. Birol Kara, 1999. Page 285.

Figure 6-2
Hurricane Return Periods and Wait Times Categories 1-5
(Source: *Hurricanes of the North Atlantic, Climate and Society, 1999*)

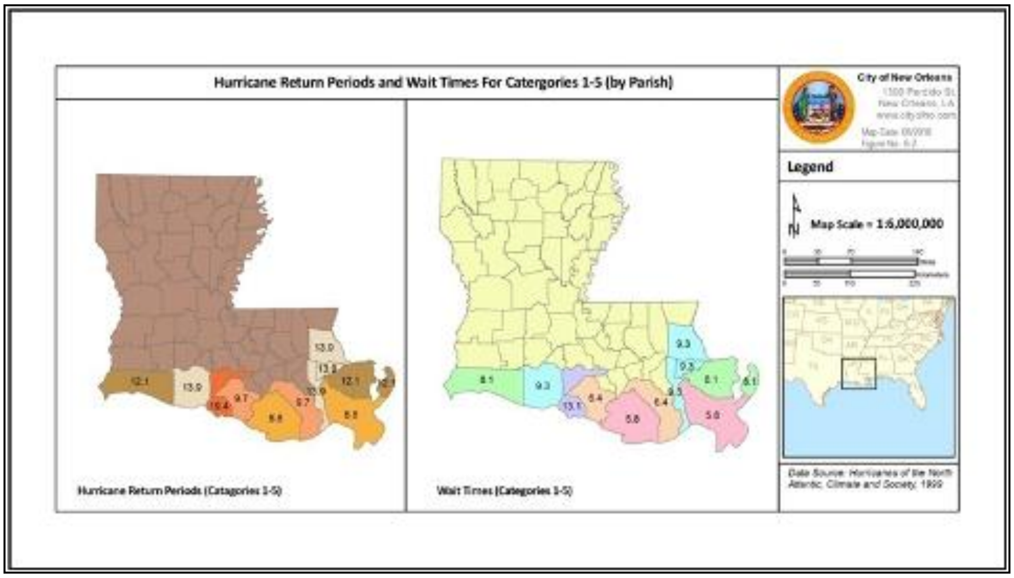
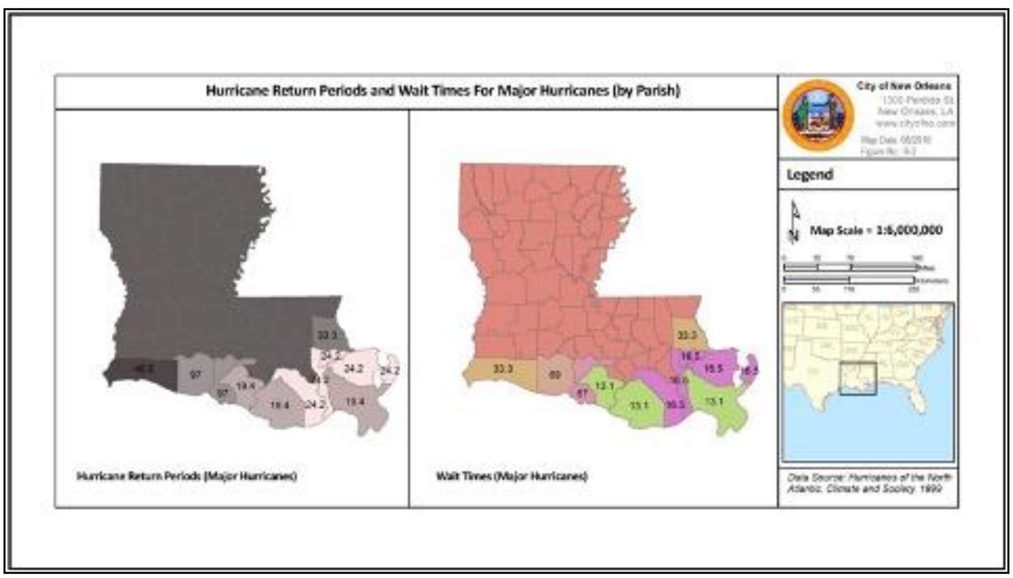


Figure 6-3
Hurricane Return Periods and Wait Times (Major Hurricanes)
(Source: *Hurricanes of the North Atlantic, Climate and Society, 1999*)



The upper left map in Figure 6-2 above shows the hurricane return period for Orleans Parish is 13.9 years. With a hurricane impacting Orleans Parish approximately every 14 years (from 1900 – 1996), there is a 7% annual probability of future occurrences for all categories of hurricanes. The Parish has experienced a major hurricane

(Category 3 or greater) every 24.2 years, which translates to a 4% annual probability for major events.[7] Clearly, this is merely a statistical method for estimating frequency; there is potential for a major hurricane every year, and it is possible for such events to happen in consecutive years, or even more than once in the same year. The entire planning area is subject to the effects of hurricanes and tropical storms.

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.[9] 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.[10] 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.[11] 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.

---

[7] Hurricanes of the North Atlantic, Climate and Society, James Elsner and A. Birol Kara, 1999
[8] NHC
[9] NHC
[10] NOAA
[11] NHC

- 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

[12] NOAA. NHC. Tropical Cyclone Report – Hurricane Lili September 21 – October 4, 2002. Miles B. Lawrence. Revised April 3, 2003.

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 34parishes 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.

[13] Source; National Hurricane Center http://www.nhc.noaa.gov/pdf/TCR-AL032005_Cindy.pdf)
[14] NOAA. NHC. Tropical Cyclone Report – Hurricane Gustav August 25 – September 4, 2008. John L. Beven II and Todd B. Kimberlain. Revised September 15, 2009.

Hurricane Katrina

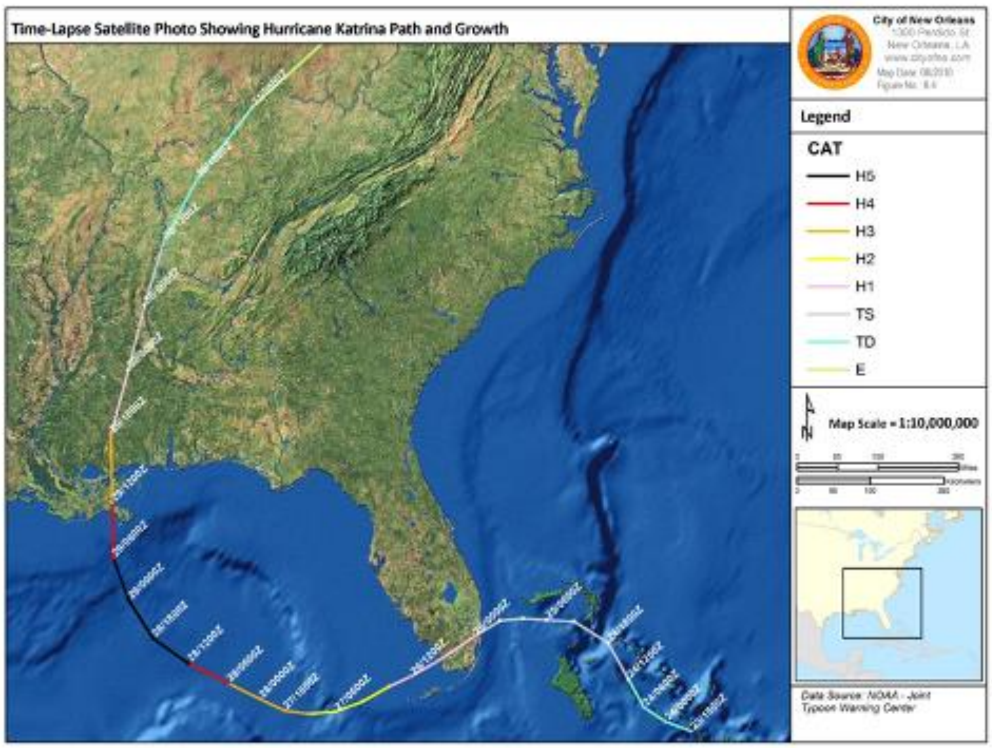
Hurricane Katrina made landfall as a powerful Category 3 Hurricane that had a devastating impact on the New Orleans area and the entire Gulf Coast region. The storm initially formed over the southeastern Bahamas on August 23, 2005, as Tropical Storm 12. As the cyclone moved north and eventually west 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 Sections 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 6-4 shows Katrina's storm path and growth using time-lapsed satellite photos.

[15] ; NHC. Tropical Cyclone Report - Hurricane Katrina

Figure 6-4
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 6-5, 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 6-5
Hurricane Katrina Wind Gust Analysis (MPH)
(Source: NOAA)

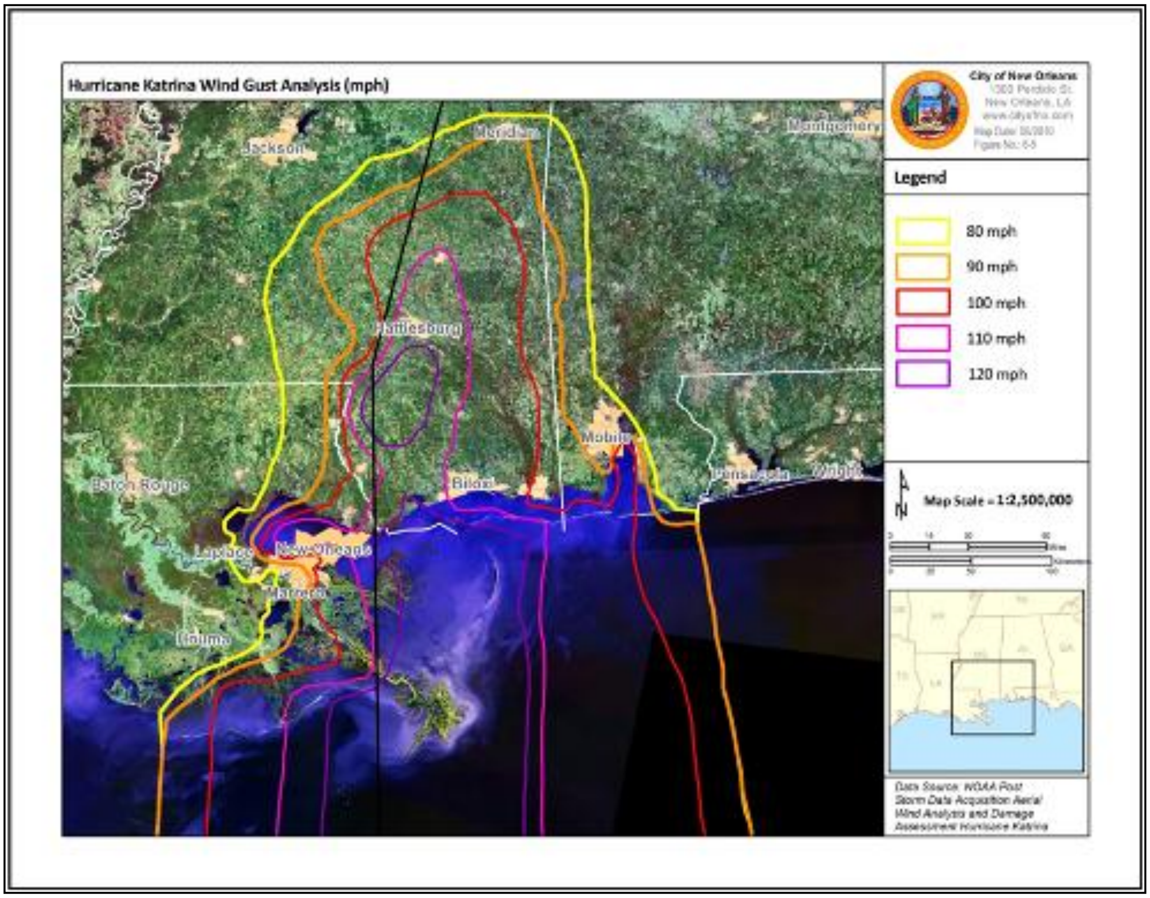


Table 6-8 shows where Hurricane Katrina's characteristics fall within the Saffir-Simpson Hurricane Scale (the shaded blocks represent Hurricane Katrina). Note that based on three physical characteristics, wind speed, central pressure and surge height, Hurricane Katrina displayed attributes from three 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 6-8
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.[17]

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.

[16] Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report (FEMA 549), July 2006
[17] Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report (FEMA 549), July 2006
[18] NHC. Tropical Cyclone Report - Hurricane Katrina

Figure 6-6 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 6-6
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)

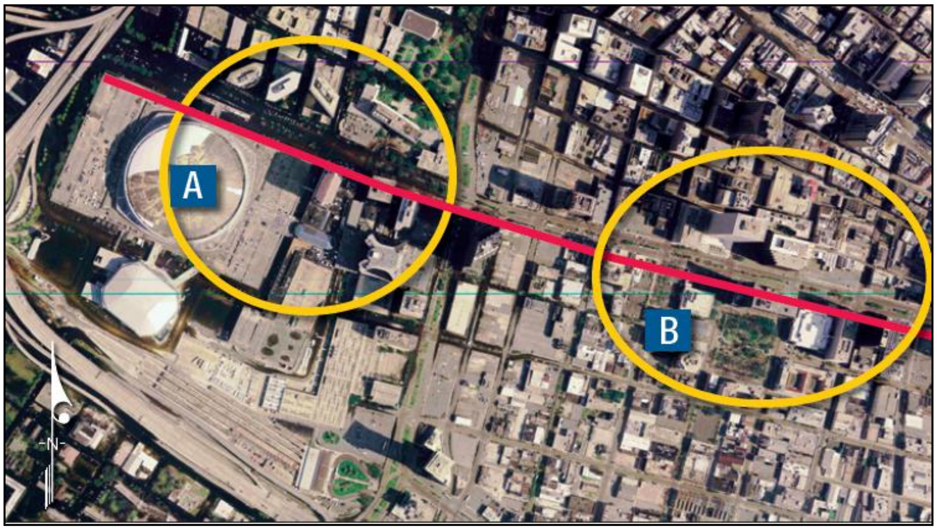


Figure 6-7 is a sample of the window glazing damage that occurred to the Hyatt Regency Hotel, one of the most heavily damaged buildings. The figure shows a close-up view of the north façade with broken windows and spandrel panels: the non-structural metal panels that cover the exterior façade of a building in the area between floors.

Figure 6-7
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.[19] This is consistent with the conclusions found within FEMA 549. Figure 6-8 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.[20] 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 6-8
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.[21] 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

[19] National Institute of Science and Technology (NIST); Performance of Physical Structure in Hurricane's Katrina and Rita
[20] Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report (FEMA 549), July 2006
[21] LSU Hurricane Center; Residential Wind Damage in Hurricane Katrina

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..[22]

Figure 6-9
Air Force Reserve Helicopter over the City of New Orleans
(Source: US Air Force)

Figure 6-10
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.[23] 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.[24] 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 6-9 below summarizes the damages from Hurricane Katrina for Orleans Parish, the State of Louisiana, and the Gulf Coast.

[22] US Coast Guard – Katrina Documentation Project
[23] FEMA – Urban Search and Rescue Operations Completed, Release Date: September 30, 2005
[24] US Department of Homeland Security. The First Year after Hurricane Katrina: What the Federal Government Did. October, 16,2008.

Table 6-9
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 6-10 below provides a summary of the peak wind gusts.

Table 6-10
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.

[25] NOAA – National Weather Service

6.3.2 Floods

Description of the Flood Hazard

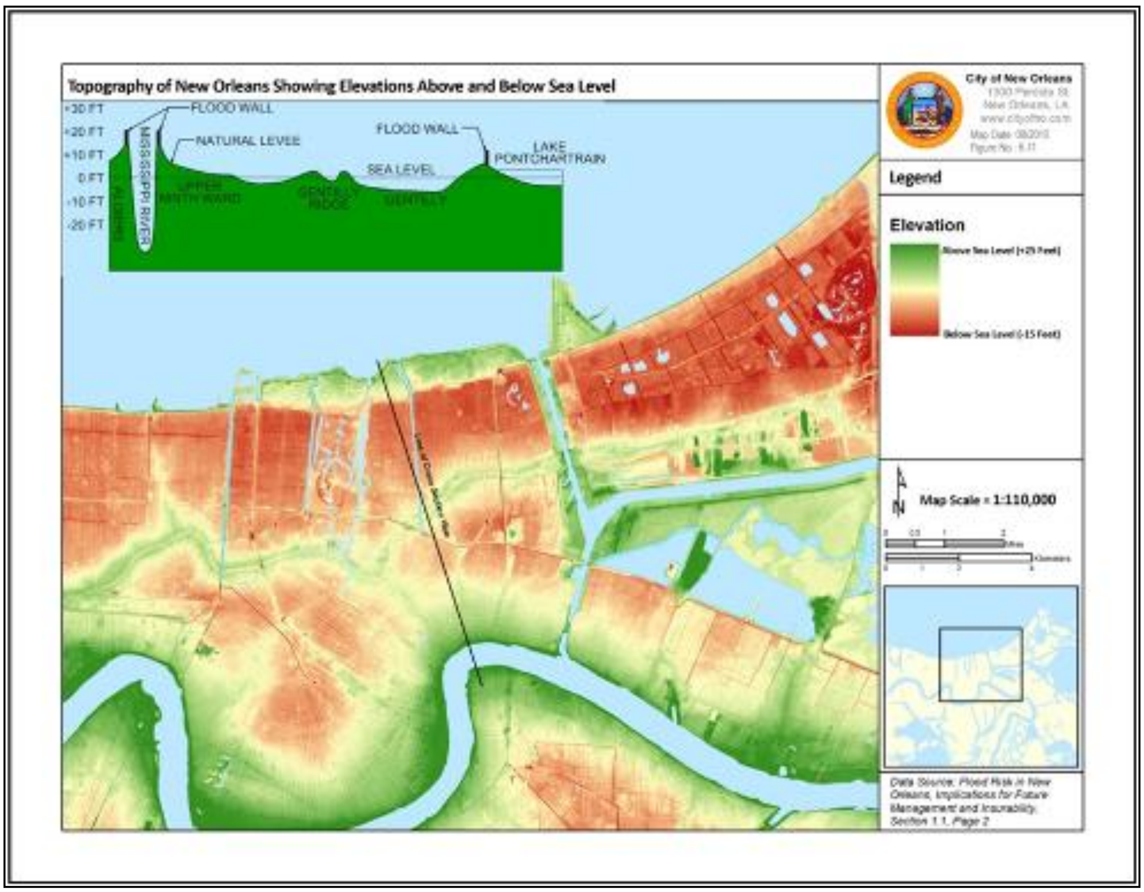
Flooding is defined as the accumulation of water within a water body and the overflow of excess water onto the adjacent floodplain. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding. Flooding is a natural 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. See Appendix K for a more detailed description of the flood hazard.

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 descibed in Section 4, Orleans Parish lies in southeastern Louisiana and is bordered by Lake Ponchartrain 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. Figure 6-11 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.[26] The map also shows that the lowest elevations of the City are located in the areas of Lakeview, Gentilly, and New Orleans East.

Figure 6-11
Topography of New Orleans Showing Elevations Above and Below Sea Level
(Source: Flood Risk In New Orleans, Implications for Future Management and Insurability, Section 1.1, Page 2)



[26] Flood Risk in New Orleans, Implications for Future Management and Insurability, Risk Management Solutions (RMS). Patricia Grossi and Robert Muir-Wood.

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 approximately 80 pumping stations in four Parishes (Orleans, Jefferson, St. Bernard, and Plaquemines) with a combined capacity of approximately 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 13 pump stations, which discharge directly to Lake Pontchartrain, the 17th Street, Orleans, and New London Canals, and the Inner Harbor Navigation Channel.[27]

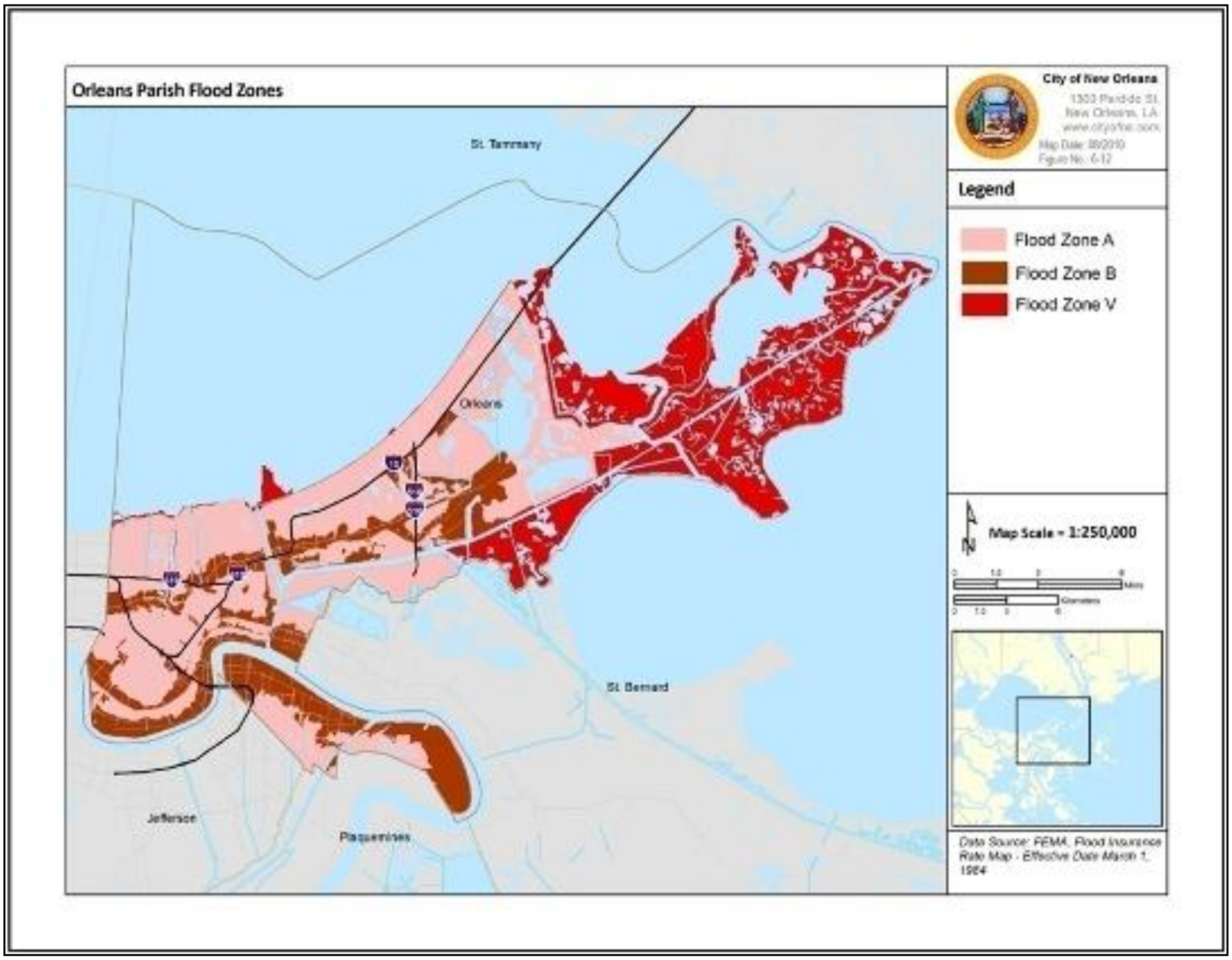
The most recent Flood Insurance Study (FIS) for Orleans Parish was published by FEMA in September of 1983. An FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS.[28] 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.[29]

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.[30] Although signficant enhancements and modifications have been made to pump stations and the flood defenses that protect the City since the FIS was produced in 1983, the principal causes of flooding described in the FIS appear unchanged.

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.[31]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. Sixty-nine percent of all structures in Orleans Parish (95,197 structures) lie within the SFHA Figure 6-12 shows the extent of the SFHAs (Zone A and V) in Orleans Parish. The map also identifies Zone B, which depicts an area of moderate flood risk. The flood risk zones are described immediately following Figure 6-12. The percentage of each flood zone in Orleans Parish is also provided below.

[27] Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, January, 2006
[28] FEMA: Flood Insurance Study (FIS) definition.
[29] FEMA – FIS for Orleans Parish, Effective Date - September 1, 1983 – Page 5
[30] FEMA – FIS for Orleans Parish, Effective Date - September 1, 1983 – Page 5
[31] FEMA – Flood Insurance Rate Map (FIRM) definition.

Figure 6-12
Orleans Parish Flood Zones
(Source: FEMA, Flood Insurance Rate Map - Effective Date March 1, 1984)



The flood zone designations are defined as follows:

Zone A1-30 (1percent- annual-chance flooding). These are also known as numbered A Zones (e.g., A7 or A14). BFEs are shown in these zones Orleans Parish includes A Zones 1-30. Forty percent of Orleans Parish is located in numbered A Zones.

Zone V. 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. No BFEs are shown within these zones. Forty-two percent of Orleans Parish is located in Zone V.

Zone B. Areas of moderate flood hazard, usually the area between the limits of the 1-percent-annual-chance flood and 0.2-percent-annual-chance flood. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 1-percent-annual-chance flood, or shallow flooding areas with average depths of less than 1 foot or drainage areas less than 1 square mile.[32] Eighteen percent of Orleans Parish is located in Zone B.

32 FEMA – Flood Zone Designations

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 stormwater pumps. As mentioned previously, New Orleans has a total of 13 drainage pumping stations and 15 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 pumps can handle about 3inches of water every 5 hours. 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 December 2007, Orleans Parish was ranked number one in the State with an average of over $244.6 million dollars in annual claims from the NFIP.[33] 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 (source: http://bsa.nfipstat.com/reports/1040.htm).

The 2008 State Plan update indicated the Orleans Parish ranking was based on the average annual losses as determined from FEMA's NFIP records. The average annual losses as compiled by the NFIP represent the total NFIP claims payments for each Parish for the years 1978 through 2007 divided by the number of years the Parish has participated in the NFIP during that same period. The total of the average annual losses for all Louisiana Parishes is

[33] 2008 State of Louisiana Plan update – Section 5.4, (Page I-96), April 2008

$531,404,895. The average annual loss figures were used because NFIP loss data provided the best relative measure for all the parishes in Louisiana.[34] The ten p in Louisiana with the highest average annual flood losses are shown in Table 6-11

Table 6-11
Ten Parishes in Louisiana with Highest Average Annual Flood Losses
(Source: 2008 State of Louisiana Hazard Mitigation Plan update, Section 5.4, Page 1-96)

Ranking	Parish	Average Annual Losses
1	Orleans	$244,657,555
2	Jefferson	$112,308,974
3	St. Bernard	$76,707,660
4	St. Tammany	$52,314,087
5	Plaquemines	$9,076,164
6	Terrebonne	$7,003,797
7	Cameron	$3,730,658
8	St. Charles	$3,281,302
9	East Baton Rouge	$3,143,092
10	Vermilion	$2,613,492

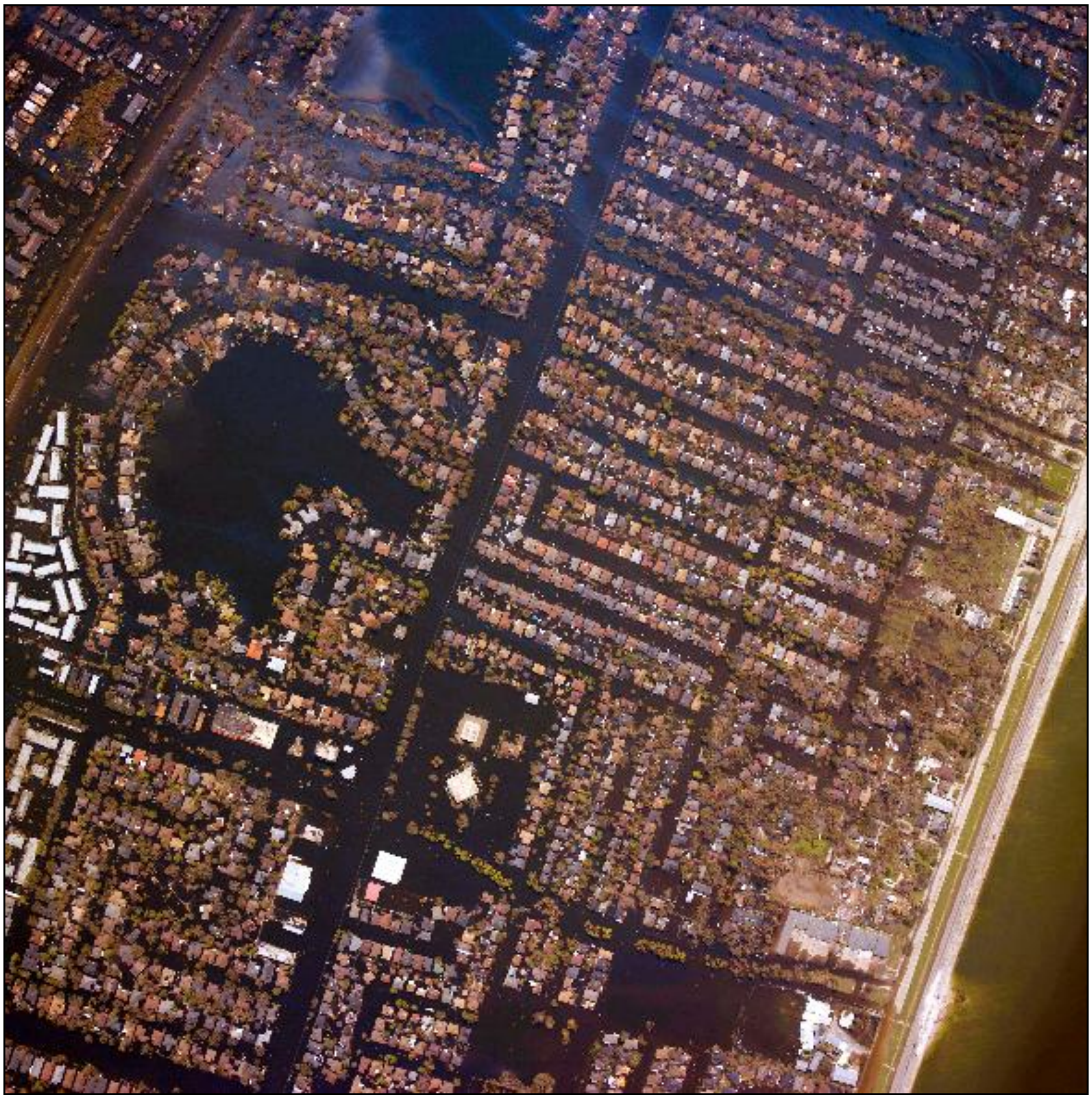
The Vulnerability and Loss Estimation section of this Plan update includes a much more detailed discussion of flood impacts on the Parish, in particular the history of NFIP claims and the number of FEMA repetitive loss properties.

Occurrences of the Flood Hazard

As part of the 2010 HMP 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 of the NCDC database indicates there have been 25 past flood events in Orleans Parish between 1994 and 2009. This total from the NCDC 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 flooding events that typically result in minor property damage from localized flooding; hurricane (and associated surge) damage is listed separately. Figure 6-13 shows some of the flooding experienced by the City from Hurricane Katrina.

[34] 2008 State of Louisiana Plan update – Section 5.4, (Page I-96), April 2008

Figure 6-13
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 20thcentury, 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.[35] 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 6-12, 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.

[35] Flood Risk In New Orleans, RMS Report.

Table 6-12

Orleans Parish: Significant Flood Events and Resulting Improvements in the HPS, 1915 - 2009

(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 four events described above, Orleans Parish has experienced numerous other flood events, many of which have resulted in Presidential Disaster Declarations. As shown in Table 6-1, all of the 21 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.

[36] National Weather Service – New Orleans / Baton Rouge – Top 20 Weather events of the 20th Century within the New Orleans Baton Rouge Service Area.
[37] All figures taken from articles that appeared in the *Times-Picayune* from May 10 to May 12, 1995.

Based on past and recent history, certain parts of Orleans Parish clearly have a high probability of flooding repeatedly in the future. With a total of 25 floods between 1994 and 2009, Orleans Parish experiences one to two flood events per year.

National Flood Insurance Program

The Vulnerability and Loss Estimation section of this Plan includes a more detailed explanation of how historic flood loss information can be used to estimate future losses. The most common source of such information is the NFIP, the predominant flood insurer in the United States Following catastrophic floods in the early 1960s (including the 1965 flooding of New Orleans from Hurricane Betsy), 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. The NFIP is administered by FEMA. 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.[38]

The NFIP maintains a very large database of claims information for millions of policies nationwide. Because of the prevalence of flooding in Orleans Parish, these NFIP records offer an excellent source of information about past flood losses and can be used as the basis of a risk assessment. As of December 2009, a total of 88,222 structures in Orleans Parish have flood insurance policies with the NFIP and pay annual premiums totaling $71,026,024. The total coverage value of these policies is approximately $19.8 billion. FEMA's NFIP statistics indicate that as of December 2009, NFIP policy holders within Orleans Parish have filed 120,657 insurance claims for a total loss value of approximately $7.1 billion.[39]

FEMA and the NFIP categorize policies in several ways, as part of their effort to focus mitigation program resources on properties with the highest risk. One such category is repetitive *loss* properties, which are defined as those that have received at least two payment claims of $1,000 or more over a rolling 10-year period. In recent years, FEMA has focused considerable attention on these insured, repetitive loss properties. In Orleans Parish, a total of 6,397 properties have been identified as repetitive loss properties as of December 2009. The Vulnerability and Loss Estimation section of the 2010 Plan update includes a detailed risk assessment of all areas of the Parish, based on NFIP statistics and FEMA Public Assistance Program records.

[38] Flood Risk In New Orleans, RMS Report. Section 4.1, (Page 22)
[39] FEMA website. Policy and Claim Statistics for Flood Insurance

6.3.3 Storm Surge

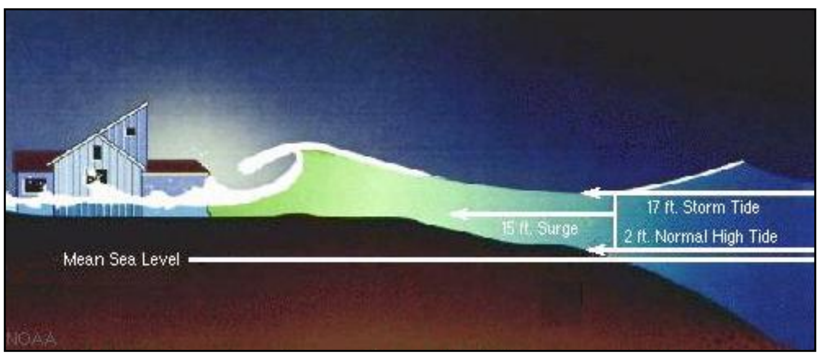
The storm surge hazard was not included the2005 version of the Hazard Mitigation Plan, but has been added as part of the 2010 Plan update.

Description of the Storm Surge Hazard

Storm surges occur when the water level of a tidally influenced 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.[40] See Appendix K for a more detailed description of the storm surge hazard.

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



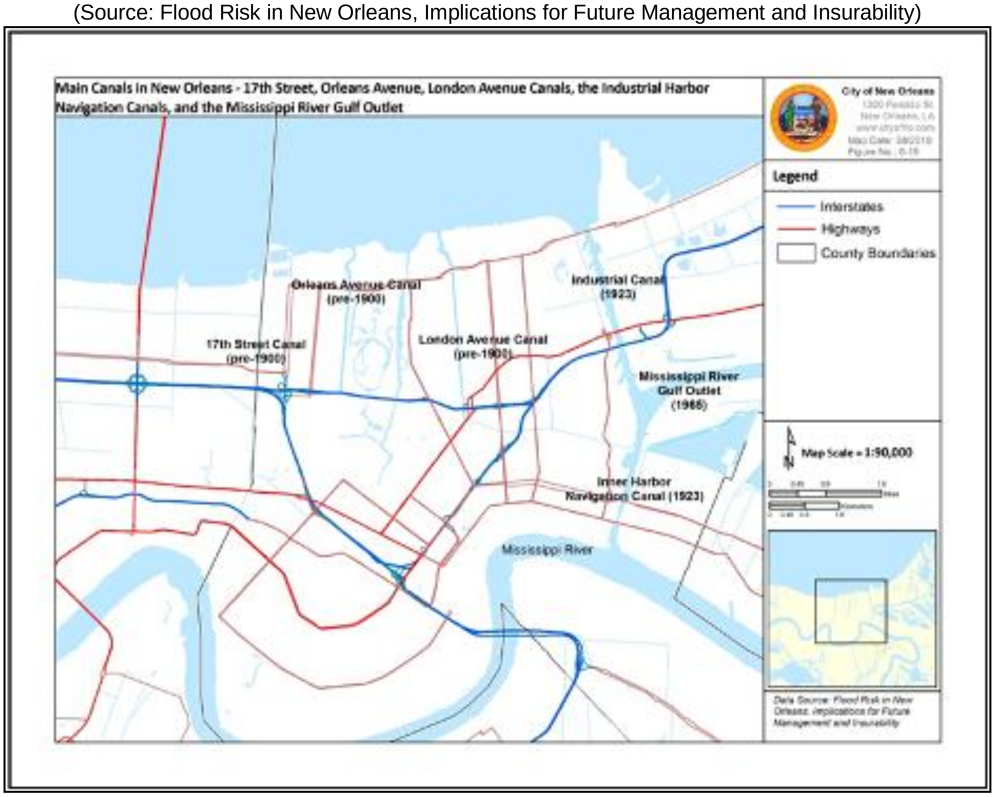
Location and Extent of the Storm Surge Hazard

[40] National Oceanic and Atmospheric Administration (NOAA) – National Hurricane Center. Hurricane Preparedness - Storm Surge.

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 storm surge hazard affects the entire planning area, although there are clearly some differentials from one area to another, based on such factors as elevation and proximity to flood sources (which are in turn related to potential levee failures).

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 stormwater from the City to Lake Pontchartrain through a network of pump stations. Three of the canals were completed in the mid-1800s so that stormwater 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).[41] Figure 6--15 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
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability)



[41] Flood Risk In New Orleans, RMS Report. Section 1.1, (Page 3)

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.[42]

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). At the time of the 2010 Orleans Parish HMP update, the Surge Barrier was under construction, with design and construction phases occurring simultaneously due to the accelerated schedule. 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 6.3.5).

[42] Flood Risk In New Orleans, RMS Report. Section 1.2, (Page 5)
[43] Flood Risk In New Orleans, RMS Report. Section 3.1, (Page 12)
[44] Flood Risk In New Orleans, RMS Report. Section 1.2, (Page 5)

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.

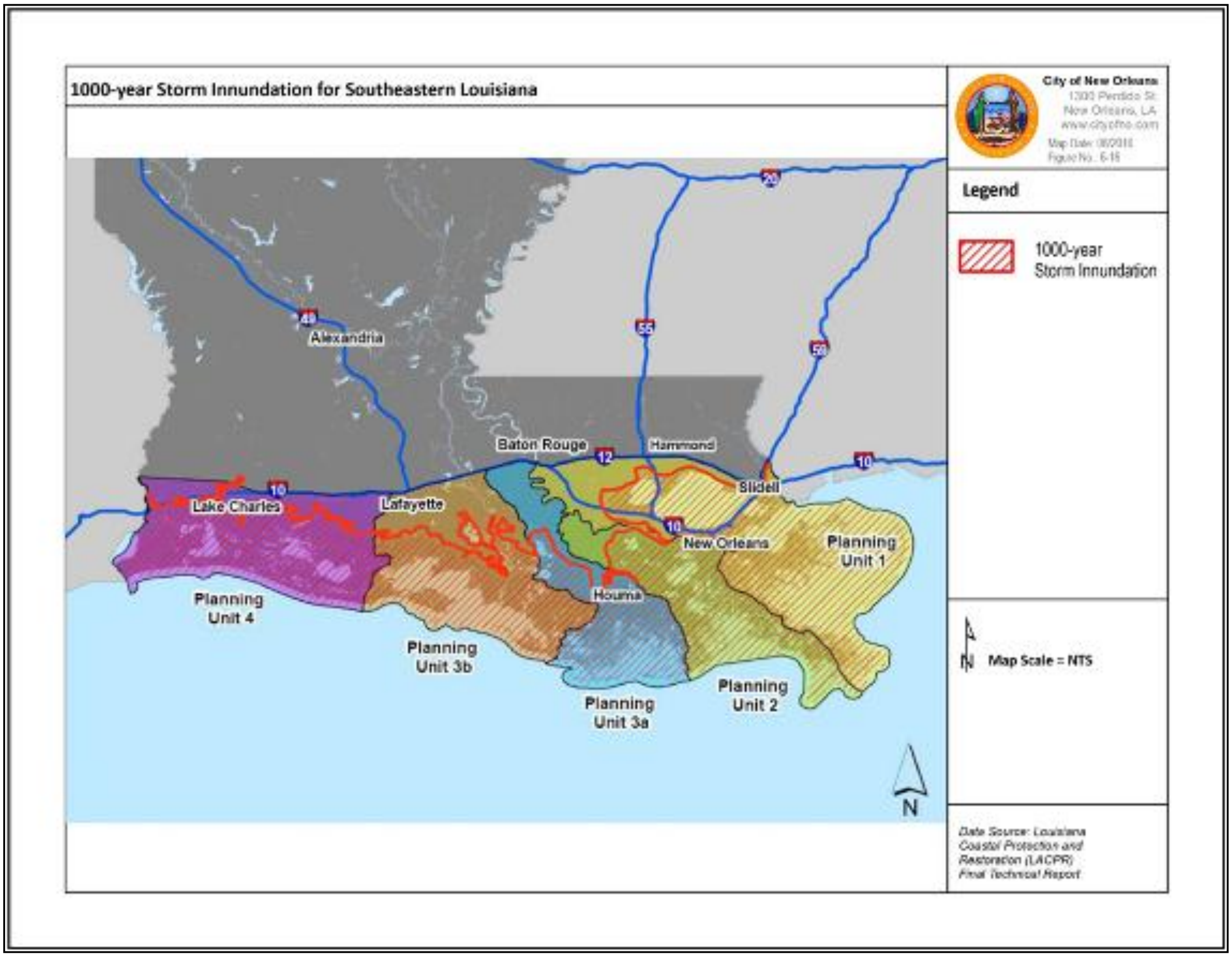
The LACPR technical report included advanced computer storm simulation software to evaluate a full range of hurricanes that could make landfall in coastal Louisiana. The USACE used a state of the art, physics-based computer model named ADCIRC (ADvanced CIRCulation) that can simulate a powerful storm 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. The USACE anticipates that improvements will be completed by 2011. 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.[46]

The analysis completed by the USACE included maps showing storm surge inundation limits for 1-percent annual chance flood, 400-year, and 1,000-year storm return frequencies (with 0.25% and 0.001% annual probabilities, respectively Figure 6-16 illustrates the extent of the 1,000-year hurricane surge inundation as indicated by the USACE for four planning units studied in the report). The City of New Orleans falls within Planning Unit 1. The 1-percent annual chance flood and 400-year limits are not shown on the map because they generally extend to the same limit but at lower levels.

[45] USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008, Page 16.
[46] USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008, Section 4 – Baseline Conditions, Page 29

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.

Figure 6-17
Flooding in New Orleans after Hurricane Katrina in August 2005
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability)

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 2010 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 nine storm surge events impacted Orleans Parish between 1950 and 2009. All the storm surge events listed in the database for Orleans Parish occurred between 1998 and 2008. Table 6-14 summarizes the storm surge events reported by the NCDC that have impacted southern Louisiana and Orleans Parish between 1998 and 2009. The NCDC provides no indication as to why there are no events listed prior to 1998. Review of other sources indicates there have been additional storm surge events prior to 1998. The events are summarized following Table 6-14.

Table 6-14
Storm Surge Events, Orleans Parish, 1998 – 2009
(Source: NOAA/NCDC)

Date	Time	Type	Property Damage ($)
02/15/1998	02:00 PM	Storm Surge	0
09/12/1998	11:00 AM	Storm Surge	0
06/30/2003	02:00 PM	Storm Surge	4.1M
09/15/2004	10:00 AM	Storm Surge	4.0M
10/09/2004	03:00 PM	Storm Surge	100K
07/05/2005	03:00 PM	Storm Surge	2.5M
08/29/2005	02:00 AM	Storm Surge	31.3B
09/23/2003	07:00 AM	Storm Surge	432.0M
09/11/2008	12:00 PM	Storm Surge/tide	0
Grand Total			**$31.743B**

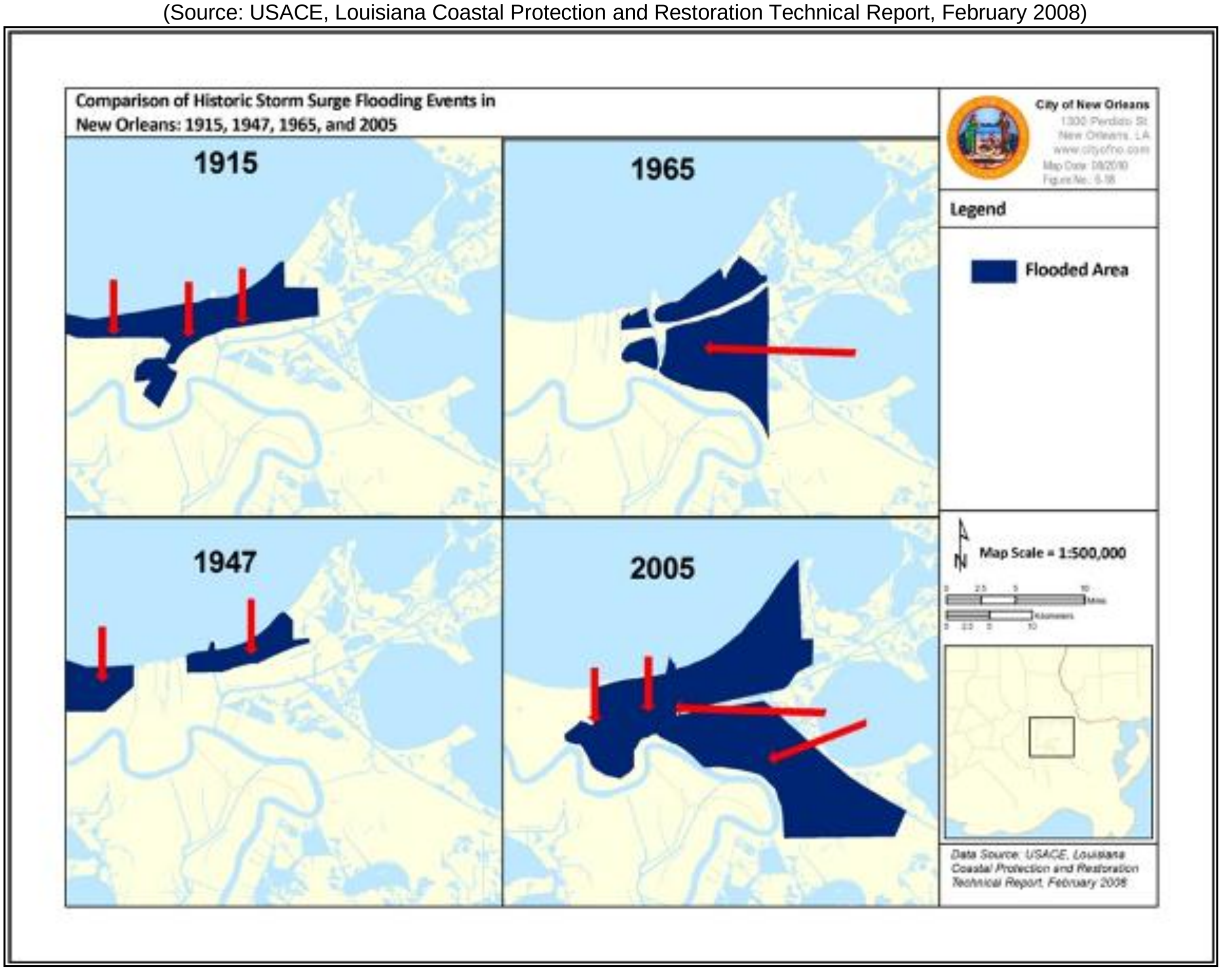
The NCDC database appears not to include some large events that impacted the Parish prior to 1998. The major events *missing* from this database are summarized in Table 6-15 below.

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
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
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
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
Hurricane Andrew	August 23, 1992	An 8-foot storm surge caused flooding from Lake Borgne westward to Vermillion Bay, LA.	$1 billion
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

Examining historical storm surge events prior to 1965 indicates that Orleans Parish has experienced four catastrophic flood events from storm surge between 1900 and 2009. 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.[47] These events occurred in 1915, 1947, 1965 (Hurricane Betsy), and 2005 (Hurricane Katrina). Figure 6-18identifies the geographic extent of the storm surge flooding in New Orleans from these historic storm surge events.

Figure 6-18
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 6.3.1, 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.

[47] Louisiana Coastal Protection and Restoration Technical Report

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.[48]

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.[49] See Section 6.3.5 for additional details about the New Orleans levee protection system and the breaches that resulted from Katrina.

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)

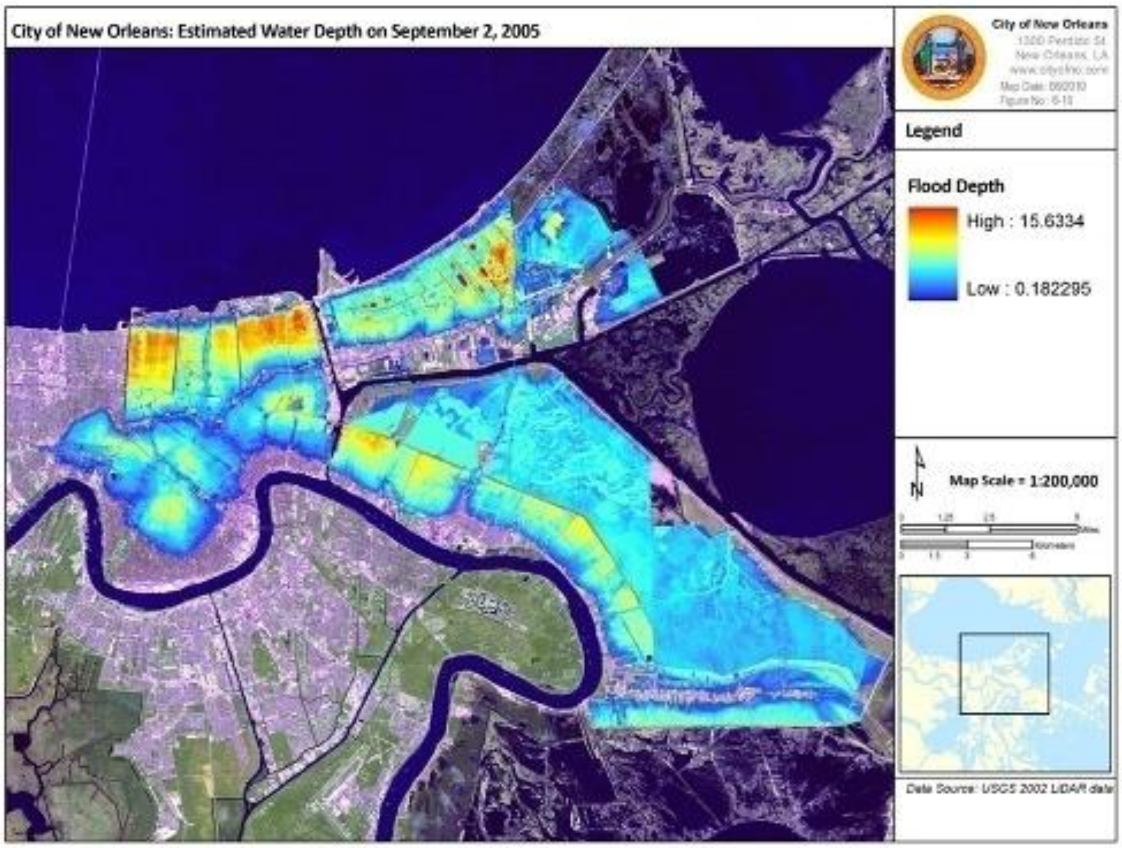
Scale Number (Category)	Winds (miles per hour)	Pressure (millibars)	Approximate Surge (feet)	Damage
1	74-95	980	4 to 5	Minor
2	96-110	965 – 979	6 to 8	Considerable
3	111 – 130	945 – 964	9 to 12	Extensive
4	131 - 155	920 - 944	13 to 18	Extreme
5	> 155	< 920	> 18	Catastrophic

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.

48 NHC. Tropical Cyclone Report - Hurricane Katrina
49 National Hurricane Center (NHC), Tropical Cyclone Report - Hurricane Katrina (August 23 – 30, 2005), Richard D. Knabb, et all. December 20, 2005.

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 6-19 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.[51]

Figure 6-19
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.[52]

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

---

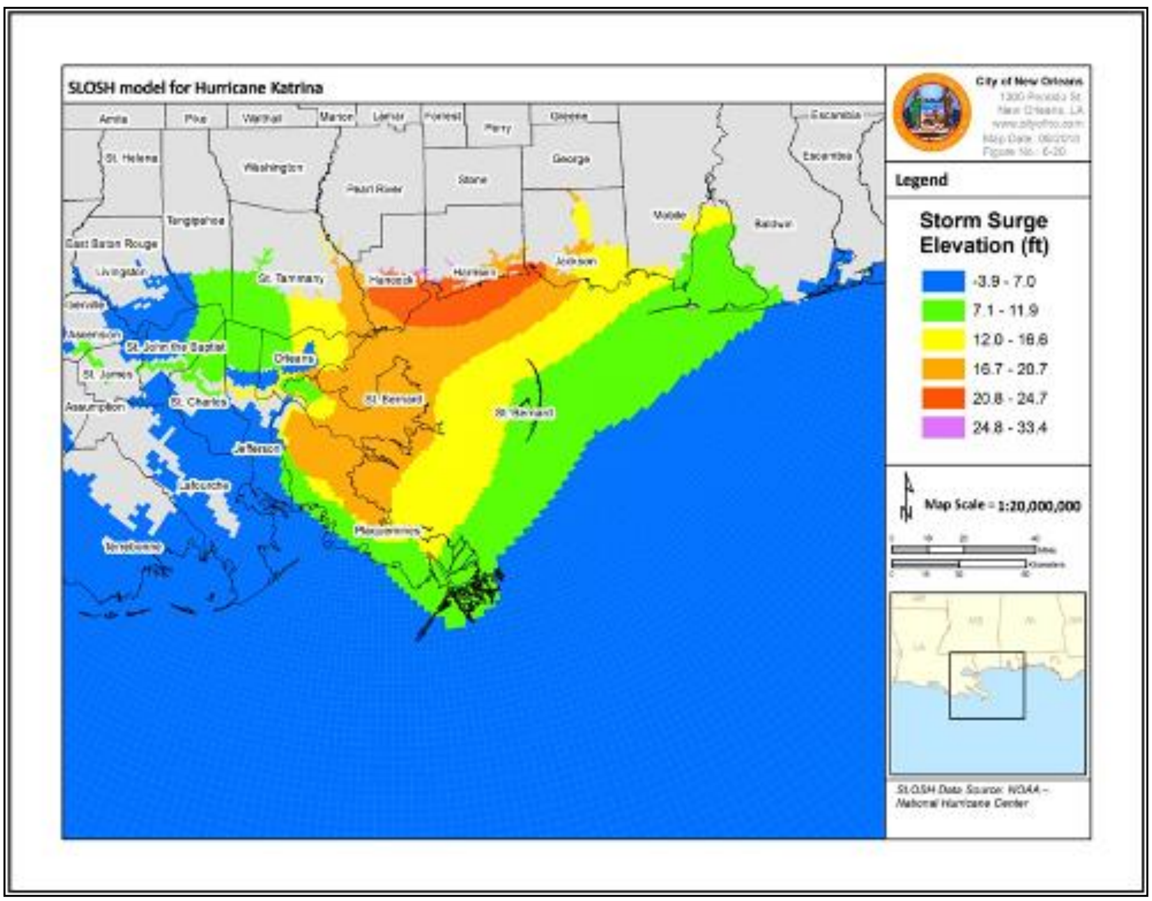
[50] USACE, Louisiana Coastal Protection and Restoration, Enclosure C. Louisiana Economy and 2005 Hurricane Damage. June 2006.
[51] NHC. Tropical Cyclone Report - Hurricane Katrina
[52] The Times-Picayune. Interactive Graphics (online). Hurricane Katrina Inundation of New Orleans, August 29, 2005.

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. The outputs for the Katrina model are based on an advisory from the NWS on August 29, 2005, for the Biloxi, Mississippi, region. The graphic output is color coded based on the height of the storm surge above the National Geodetic Vertical Datum of 1929. Figure 6-20 below shows the storm surge estimated by the NHC. Orleans Parish is highlighted in yellow indicating a 12- to 16.6-foot storm surge for this area.

Figure 6-20
SLOSH Model for Hurricane Katrina
(Source: NOAA – National Hurricane Center)



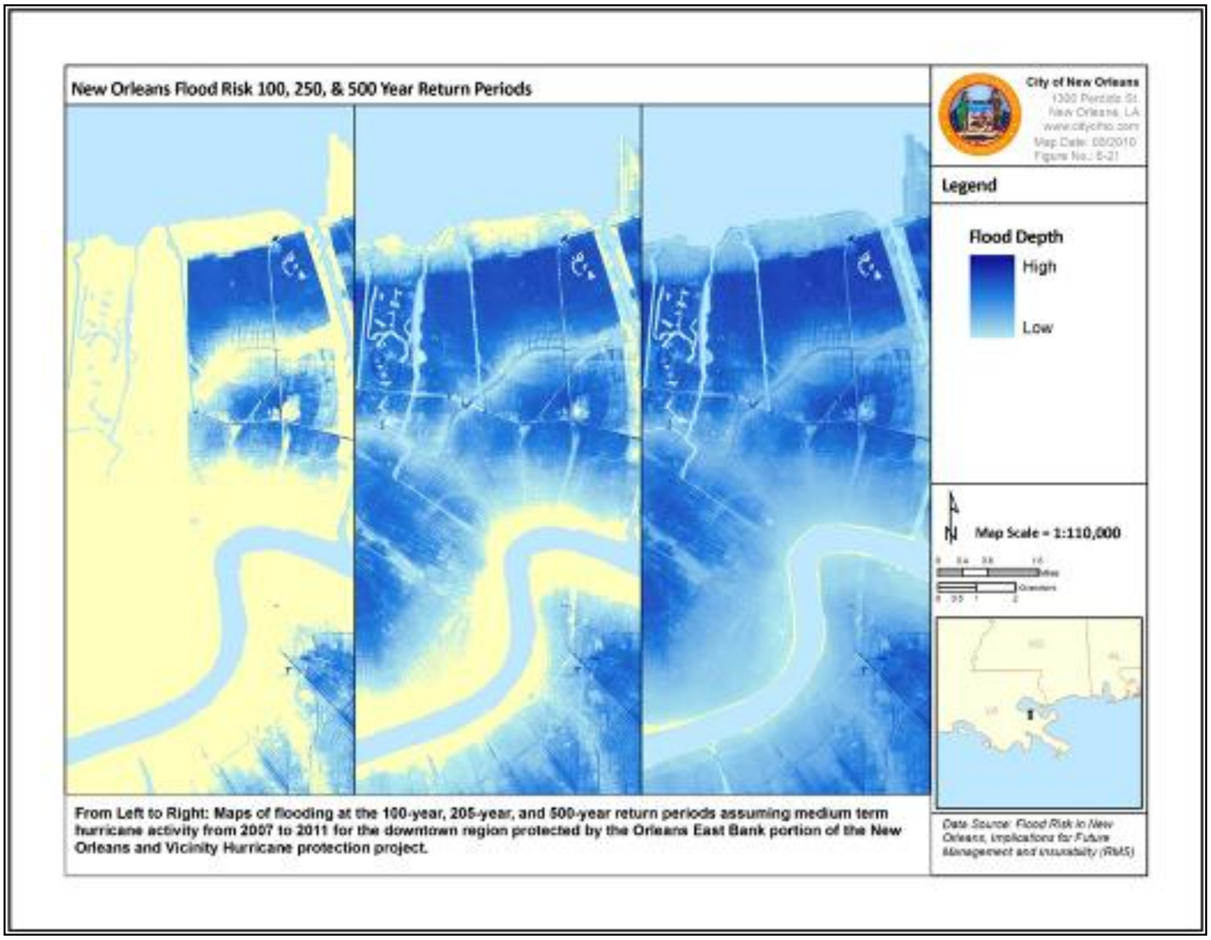
Prior to Katrina, SLOSH models developed for the Louisiana coastline estimated storm surge flooding inland up to 18 feet above sea level. The damages caused by Hurricane Katrina demonstrate that storm surge-related flooding can reach depths of up to 30 feet above sea level, with ability to reach either 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.[53]

Since 1965, Orleans Parish has experienced seven major hurricanes, all of which have caused significant damage to the Louisiana coastline and generated extremely large storm surges. With a total of seven significant storm surge events between 1965 and 2009, Orleans Parish experiences a storm surge on average slightly less than once every six to seven years. The seven events have occurred over a period of 44 years, which calculates to a 16 percent annual probability of future storm surge occurrences. The relatively frequent occurrence of the storm surge hazard suggests that this will continue to be a significant problem for Orleans Parish.

Several recently published technical reports that have studied storm surge risk in southeastern Louisiana were reviewed to identify potential storm surge probabilities. The report titled *Flood Risk in New Orleans* included an analysis of the storm surge risk for the area of New Orleans protected by the Lake Pontchartrain and Vicinity hurricane protection project. An analysis of the flood risk was completed using sophisticated hurricane modeling developed by the risk management firm Risk Management Solutions (RMS) that included three separate classes of models. Flood maps of relative risk throughout the region were developed based on high resolution digital elevation maps, showing expected flood depths at various return periods. Maps of flood depths for the 100-year, 250-year, and 500-year return periods (1-percent-annual-chance, 0.4-percent-annual-chance, and 0.2-percent-annual-chance floods, respectively) were generated, based on the medium term 5-year hurricane activity corresponding to the 2007-2011 period, as contained within the RMS U.S. Hurricane Model. Figure 6-21 identifies the 100-year, 250-year, and 500-year (1-percent-annual-chance, 0.4-percent-annual-chance, and 0.2-percent-annual-chance floods, respectively) assuming moderate hurricane activity from 2007 to 2011 for the downtown New Orleans region.[54]

[53] US Government Accountability Office (GAO) Report to Congressional Committees. NFIP. New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should be Improved, December, 2006. (Page 19)
[54] Flood Risk In New Orleans, RMS Report. Section 3.2, (Page 13)

Figure 6-21
SLOSH Model for Hurricane Katrina
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability)



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 High Winds

Note that the high wind hazard was not included in the 2005 HMP and has been added as part of the 2010 Plan update. High winds associated with hurricanes and tornadoes are discussed in separate sections relating to those specific hazards profiled as part of the 2010 Plan update. High winds associated with hurricanes can be found in Section 6.3.1, Hurricanes and Tropical Storms. High winds associated with tornadoes can be found in Section 6.3.6.

Description of the High Winds Hazard

Wind is defined as the motion of air relative to the earth's surface. In the mainland United States, the mean annual wind speed is reported to be 8 to 12 mph. High winds can result from thunderstorm inflow and outflow, or downburst winds when a storm cloud collapses, and can result from strong frontal systems, or gradient winds from high or low pressure systems. High winds are generally defined as those with speeds of 50 mph or greater, either sustained or gusting. A downburst wind is defined as a strong downdraft resulting in an outward burst of damaging winds on or near the ground. Downburst winds can produce damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.

Several meteorological conditions can result in winds severe enough to cause property damage. High winds have been associated with extreme hurricanes traveling inland, tornadoes, and locally strong thunderstorms. Thunderstorms are the by-products of atmospheric instability, which promotes vigorous rising of air particles. A typical thunderstorm may cover an area 3miles wide. The NWS considers a thunderstorm "severe" if it produces tornadoes, hail of 0.75 inches or more in diameter, or winds of 58 miles per hour or more. Structural wind damage may imply the occurrence of a severe thunderstorm. See Appendix K for a more detailed description of the high wind hazard.

Location and Extent of the High Winds Hazard

The potential for high winds is uniform for the entire Parish. All people and assets are considered to have the same degree of exposure.

Severity of High Winds Hazard

The severity of high winds is mainly measured by velocity, either *sustained* wind, or *peak gusts*. High wind effects may be exacerbated by the presence of debris, which are loose objects that become airborne missiles during high winds and can cause damage that winds would otherwise not create. Typical examples of windborne debris are gravel roof ballast and tree branches. Assets and people in areas with significant potential for missiles to be present are thus somewhat more exposed to secondary wind risks. Wind velocities from hurricanes and tornadoes are typically much higher than from thunderstorms, so building codes are usually calibrated based on potential sustained wind speed, or on 3-second peak gusts at a specific elevation about the surface.

Impact on Life and Property

The NCDC database shows one injury and two deaths from high wind events between 1950 and 2009 in Orleans Parish. Property damage from previous events totaled just under $1.5 million. Table 6-17 summarizes the past high wind events that resulted in property damage of at least $10,000.

Table 6-17
High Wind Events with at Least $10,000 in Property Damage,
Orleans Parish, 1950 – 2009
(Source: NOAA/NCDC)

Date	Time	Type	Wind Speed	Property Damage
05/08/1995	9:25 PM	Thunderstorm Winds	0 kts.	$750K
05/08/1995	9:33 PM	Thunderstorm Winds	50 kts.	$250K
03/19/1996	03:00 PM	High Wind	40 kts.	$250K
04/26/1997	03:04 AM	Thunderstorm Winds	57 kts.	$50K
07/22/2000	07:30 PM	Thunderstorm Winds	0 kts.	$10K
11/06/2000	01:45 PM	Thunderstorm Winds	0 kts.	$50K
06/05/2001	02:45 PM	Thunderstorm Winds	0 kts.	$15K
04/08/2002	01:15 PM	Thunderstorm Winds	0 kts.	$15K
04/08/2002	01:55 PM	Thunderstorm Winds	0 kts.	$10K
07/06/2004	01:00 PM	Thunderstorm Winds	50 kts.	$15K
Grand Total				**$1.415M**

Many buildings in Orleans Parish are vulnerable to high winds, given the large variation in building types, and the fact that a significant number of structures are relatively old, and built prior to the initiation of building codes and standards. There are numerous factors that must be considered when evaluating the wind vulnerabilities of structures; these factors are mainly related to construction type, building configuration (which includes height, roof type, number of windows, etc.), orientation, the physical surroundings of the structure (which may result in airborne missiles during high winds, which in turn can contribute to breaches in building envelopes), and the condition of the building or facility. Accurately characterizing wind vulnerabilities requires site-specific engineering evaluations, which are not part of the scope of this hazard mitigation plan update. It should also be noted that much of the possible past damage from wind events in the Parish was addressed through private-sector insurance claims simply absorbed by homeowners, so there is no known open-source database that can be queried to correctly characterize historical damages.

In order to more accurately characterize high-wind vulnerabilities to specific areas of Orleans Parish, it will first be necessary to have a more robust set of data related to structural characteristics of buildings, or to secure data from private-sector insurance companies. However, the latter information is presumed to be highly proprietary, so this is not a likely option. It may be possible to prioritize areas for additional engineering study based on the age and known structural characteristics of buildings, i.e. to find structures that are likely the most vulnerable based on open-source data, then further prioritize study based on use or occupancy. HAZUS wind damage functions could be used for this purpose. It may also be possible to prioritize additional study based on the hurricane wind loss estimation results presented in Section 7 of the 2011 HMP update (Hurricane Wind Risk in Orleans Parish) – that subsection provides a series of tables that show percentage damage and dollar amount of damage expected for a range of deterministic scenarios. The building classes or uses with the highest damage figures could be used as a method to prioritize additional study.

Occurrences of the High Wind Hazard

The NCDC database indicates that between 1950 and 2009, Orleans Parish experienced 134 severe thunderstorms and high wind events (8 of which had greater than 70 knot winds). Most wind damage (associated with thunderstorms) in the Parish has been limited to downed trees, blocked roads, and disabled power lines. Note that the thunderstorm and high winds category of the NCDC database excludes high wind events associated with tornadoes and hurricanes, so it is presumed to be limited to winds associated with thunderstorms. High winds associated with hurricanes are captured under the Hurricanes and Tropical Storms category of the NCDC database. Therefore, events such as Hurricane Ike in September of 2008 are not included as part of the query results for high winds. High winds associated with tornadoes are captured under the *Tornado* category. Table 6-18 summarizes the eight high wind events with greater than 70 knot winds.

Table 6-18
Orleans Parish: High Wind Events Over 70 Knots, 1950 – 2009
(Source: NOAA/NCDC)

Date	Time	Type	Magnitude
02/01/1970	1439	Thunderstorm Winds	90 kts.
07/04/1970	1508	Thunderstorm Winds	75 kts.
01/10/1975	1230	Thunderstorm Winds	70 kts.
04/30/1975	1751	Thunderstorm Winds	71 kts.
02/12/1984	1320	Thunderstorm Winds	74 kts.
02/12/1984	1320	Thunderstorm Winds	75 kts.
09/04/1990	1943	Thunderstorm Winds	72 kts.
05/09/1995	2235	Thunderstorm Winds	70 kts.

The probability of high winds occurring within Orleans Parish in the future is relatively high, based on previous data. With a total of 134 prior thunderstorm events between 1950 and 2009, the data suggest that the Parish experiences a few high-wind events every year, although for the most part the impacts have been limited. A general statistical probability for high winds (straight-line) can be estimated by dividing the reporting period (40 years) by the number of events (8). This yields an expected annual probability of about 20% for high winds exceeding the 70-knot threshold. If this threshold is adjusted downward (i.e. to capture lower-velocity wind events), the probability will increase, but for the purpose of a mitigation plan the 70-knot threshold is assumed to be sufficient, because damage (and hence the need for mitigation) are limited with lower wind speeds.

6.3.5 Dam and Levee Failure

Note that the 2005 HMP profiled the levee failure hazard. As part of the 2010 Plan update, dam failure has been added to this hazard. The hazard has been renamed "Dam and Levee Failure" for the Plan update.

Description of the Dam Failure Hazard

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[55].

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.

Location and Extent of the Dam Failure Hazard

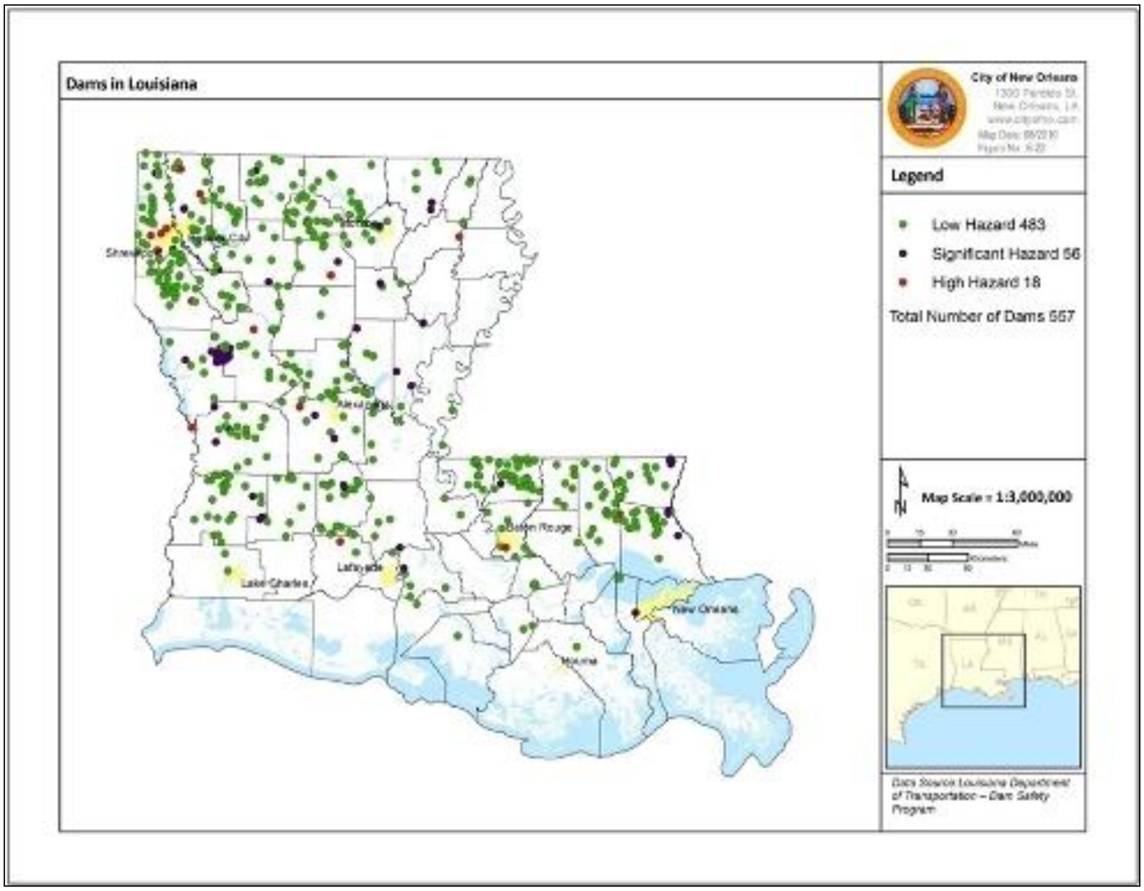
The Louisiana Department of Transportation and Development's (LADOTD) Dam Safety Program indicates that as of February 2007 there were 534 dams in Louisiana.[56] Dams are typically ranked by hazard classification, which is determined by the potential for infrastructure and property damages downstream 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.

Of the 534 dams in Louisiana, 28 are considered high hazard, and 65 are significant hazard.[57] Figure 6-22 identifies the 534 dams in Louisiana. The map indicates that there is only one dam in Orleans Parish. The dam is located at the Carrollton Water Purification Plant in Orleans Parish, and classified by the State as a significant hazard dam. The dam is owned and maintained by the Orleans Sewage and Water Board.

[55] New Jersey Department of Dam Safety and Flood Control board
[56] Louisiana Department of Transportation and Development (LADOTD), Dam Safety Program - Louisiana Dam Location Map
[57] LADOTD,, Dam Safety Program – Louisiana Dam Location Map

Figure 6-22
Dams in Louisiana
(Source: Louisiana Department of Transportation – Dam Safety Program)



Severity of Dam Failure

The severity of a dam failure event depends on several factors, including the size of the dam, the extent of the failure (i.e., catastrophic structural failure versus a small breech), the velocity of the floodwater released, and the density of built environment and populations downstream. There is the potential for total collapse of a dam, but less significant failures are more likely as a result of overtopping (inadequate spillway design, debris blockage), foundation defects, or seepage. Overtopping of a dam during a flood event due to clogged debris has the potential to be catastrophic. As mentioned above, dams are typically categorized into three hazard classifications consisting of high, significant, and low hazard.

Impact on Life and Property

According to the USACE's National Inventory of Dams Program, as of 2005 there were 79,500 dams in the United States. Approximately one third of these pose a "high" or "significant" hazard to life and property if failure occurs.

Dam failure has the potential for catastrophic impact on life and property. This risk can be reduced by proper design, construction and routine maintenance and inspection.

In February 2007 the LADOTD Dam Safety Program indicated there had been over 135 fatalities and $2.6 billion in property damage in the United States over the past 30 years. During this time period, no fatalities or property damage were reported in Louisiana.[58]

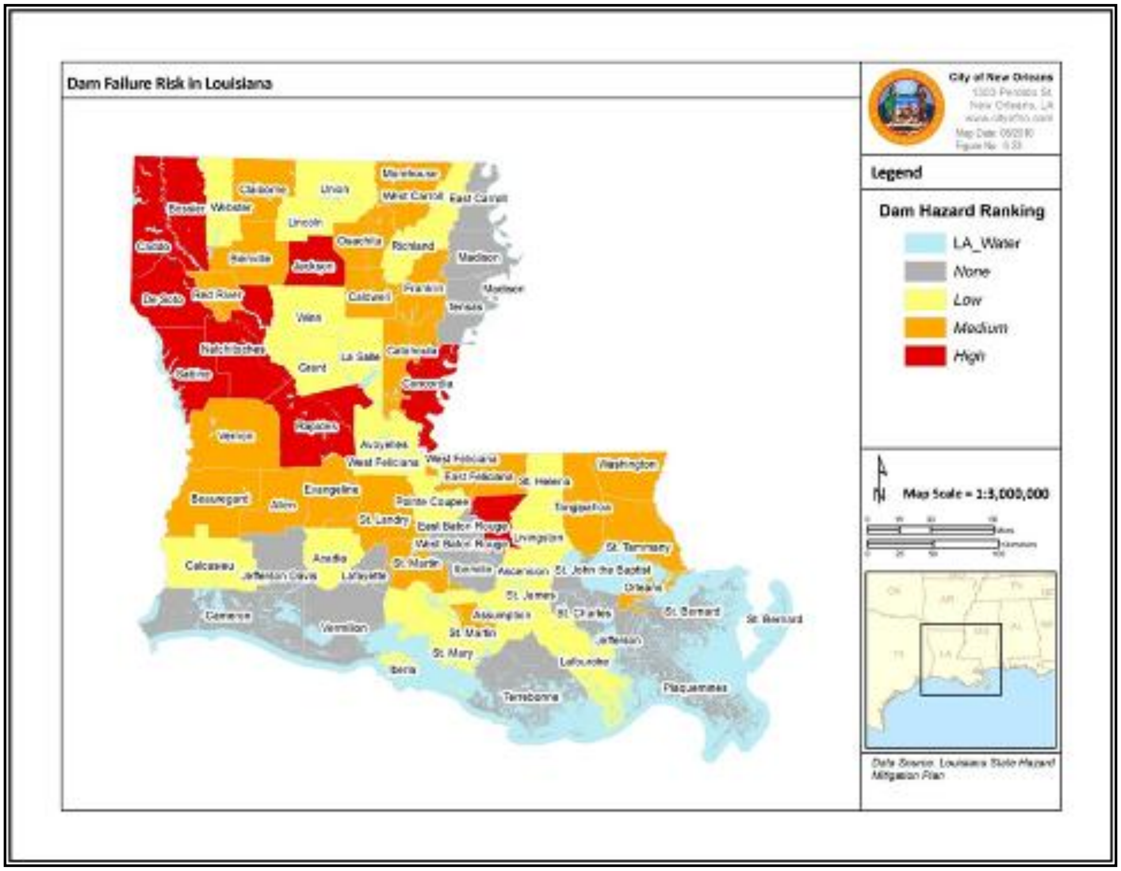
To prevent, or reduce the probability of a failure, existing dams are periodically inspected by professional engineers on a regular basis by the LADOTD Dam Safety Program. The purpose of the program is to provide for the regulation of the construction, operation, and maintenance of existing and future dams, both Federal and non-Federal in order to prevent and correct potential hazards to downstream life and property. The LADOTD exercises supervision and overview of the construction, modification, operation, and maintenance of dams to the extent required to protect life and property and to provide for the safety and welfare of the public. The LADOTD is required to inspect all dams to ensure conformity with established standards and regulations.[59] Although the LADOTD has classified the dam in Orleans Parish as "significant hazard", this classification reflects only the possible damage if the structure were to fail, and does not take in to account the likelihood that this will occur (i.e. the condition of the dam and the kind of hazard event that may cause it to fail are not factors in the classification). Given that part of the definition of this classification is two houses and six people at risk, the impacts of this hazard may be considered minimal in Orleans Parish, particularly in the context of the Parish's other natural hazard risks. With only one dam located within the City of New Orleans, or in close proximity, the impact on life and property is considered minimal.

The 2008 *Louisiana State Hazard Mitigation Plan update* was also reviewed to determine the dam failure risk in Orleans Parish. The Dam Failure risk assessment section (Section 5.11) of the State Plan includes a dam hazard ranking of high, medium, or low for each Parish. The rankings were completed after obtaining and evaluating data from the USACE's National Inventory of Dams. Review of the Dam Failure risk assessment indicates that Orleans Parish has a dam hazard ranking of medium. The State Plan assigned the medium ranking to Parishes in Louisiana with one or more significant hazard dams.[60] Figure 6-23 identifies the dam hazard rankings for Louisiana.

The Parish's vulnerability to dam failure is minimal. As noted above, the single dam in Orleans Parish is rated as significant hazard dam, meaning no more than two houses or six lives in jeopardy. Particularly in comparison to the Parish as a whole and the widespread vulnerability to storm surge and flooding, this vulnerability is relatively minor. It should also be noted that the single dam in the Parish is part of the Carrollton Water Treatment Plant, and is subject to regular monitoring and control.

[58] LADOTD) presentation February 13, 2007 – Overview of Dam Safety Program
[59] Louisiana Dam Safety and Regulatory Program
[60] 2008 State of Louisiana Hazard Mitigation Plan update, Volume 1. Section 5-11. April 14, 2008. Page I-112 – I-113.

Figure 6-23
Dam Failure Risk in Louisiana
(Source: Louisiana State Hazard Mitigation Plan)



Occurrences of Dam Failure

A review of current literature and open data sources revealed no known past dam failures in or near Orleans Parish. Based on no past dam failures in the Parish, the probability of future failures is projected to be low, particularly given the near absence of dams in the Parish. As noted in the paragraph above Figure 6-23, the Louisiana State HMP assigns a dam hazard ranking of "medium" to Orleans Parish. However, this is based on the presence of a single significant hazard dam with no history of failure. Dam failure probability is also difficult to predict accurately without additional and site-specific study. There are no instances of significant dam failures in Orleans Parish historically, and thus the statistical probability of failure can reasonably assumed to be very low, although absent additional engineering study it is impossible to assign a numerical probability to such an event.

Description of the Levee Failure Hazard

A levee is a natural or artificial slope or wall, either earthen or concrete and often parallels the course of a river. The main purpose of a manmade levee is to prevent flooding to adjacent development or farmland. Engineered levees are typically reinforced with concrete and rip-rap to prevent erosion or failure. Rip-rap is material that is placed on the banks of water courses (typically streams and rivers, but also including lakes and ponds) to prevent or reduce erosion (definition paraphrased from various sources, including Wikipedia and civil engineering guidance).

Levee failure can occur in numerous ways but the most common is the breaching of a levee. A breach occurs 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. Failure can also occur when water overtops the crest of a levee. This is known as overtopping, where floodwater exceeds the lowest crest of a levee, flooding the surrounding area. See Appendix K for a more detailed description and definition of the dam and levee failure hazard.

Location and Extent of the Levee Failure Hazard

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.[61] 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.[62] 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.

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.). 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.[63]

The levee system protecting New Orleans consists of over 350 miles of levees. 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.

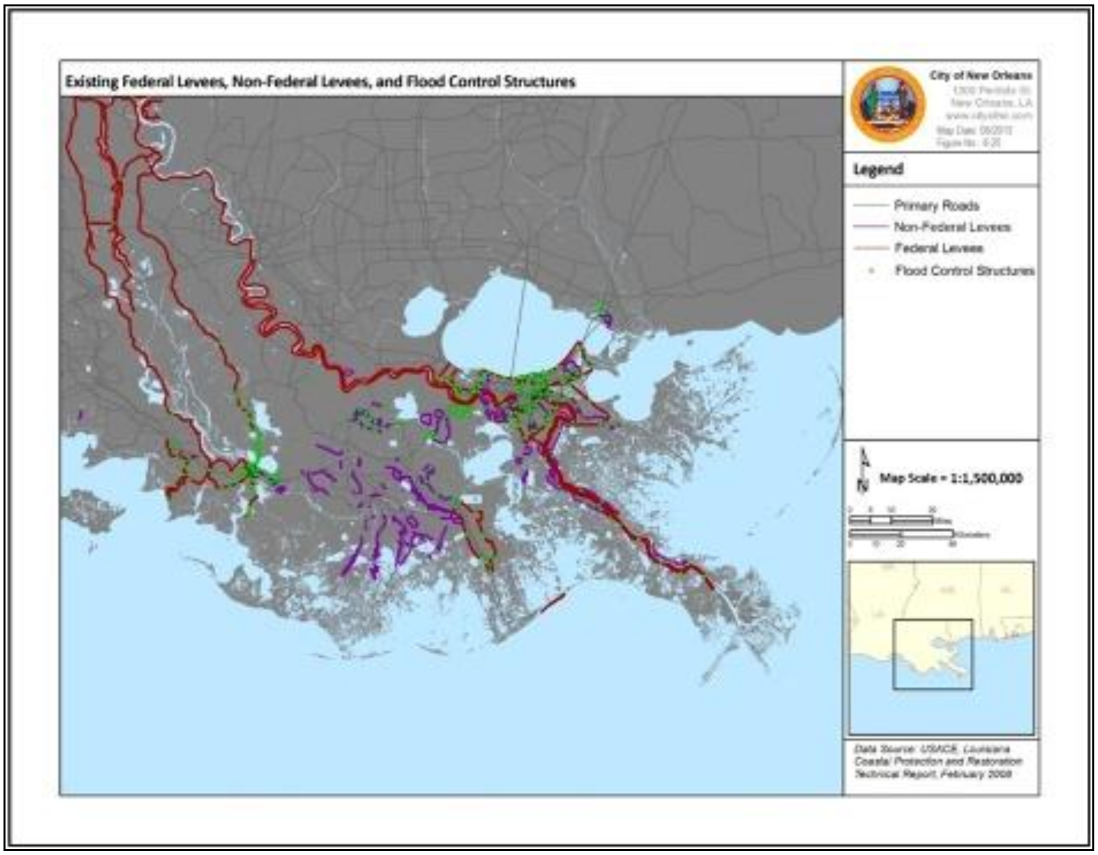
[61] Flood Risk In New Orleans, RMS Report. Section 1.1, (Page 3)
[62] Flood Risk In New Orleans, RMS Report. Section 1.1, (Page 3)
[63] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina in August of 2005

- **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 6-24
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. Figure 6-25 identifies all Federal, non-Federal, and flood control structures across southeastern Louisiana.

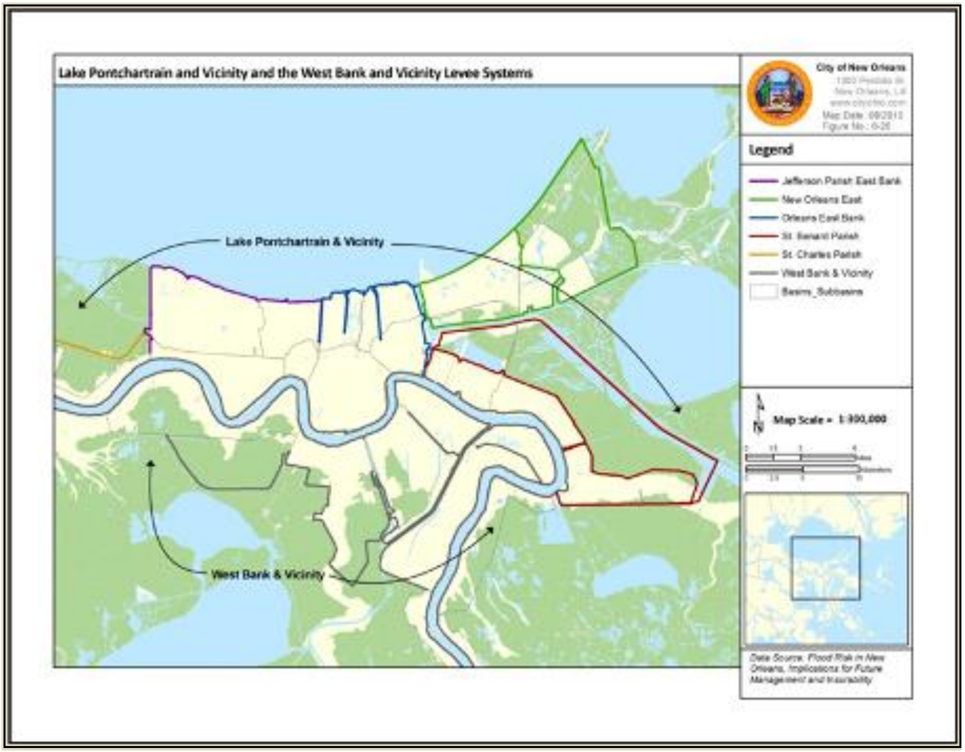
Figure 6-25
Existing Federal Levees, Non-Federal Levees, and Flood Control Structures
(Source: USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008)



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).[64] Figure 6-26 illustrates the Lake Pontchartrain and Vicinity and the West Bank and Vicinity USACE levee systems.

[64] Flood Risk In New Orleans, RMS Report. Section 1.2, (Page 5)

Figure 6-26
Lake Pontchartrain and Vicinity and the West Bank and Vicinity Levee Systems
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability)



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.[65] 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.

[65] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August, 29 2005, R.B. Seed, et al. Page 1-2.

The location of the Orleans East Bank protected section (shown in Figure 6-26) 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 6-27 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.[66]

Figure 6-27
Orleans East Bank Levee Protection System
(Source; Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005)

[66] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005. Page 1-2.

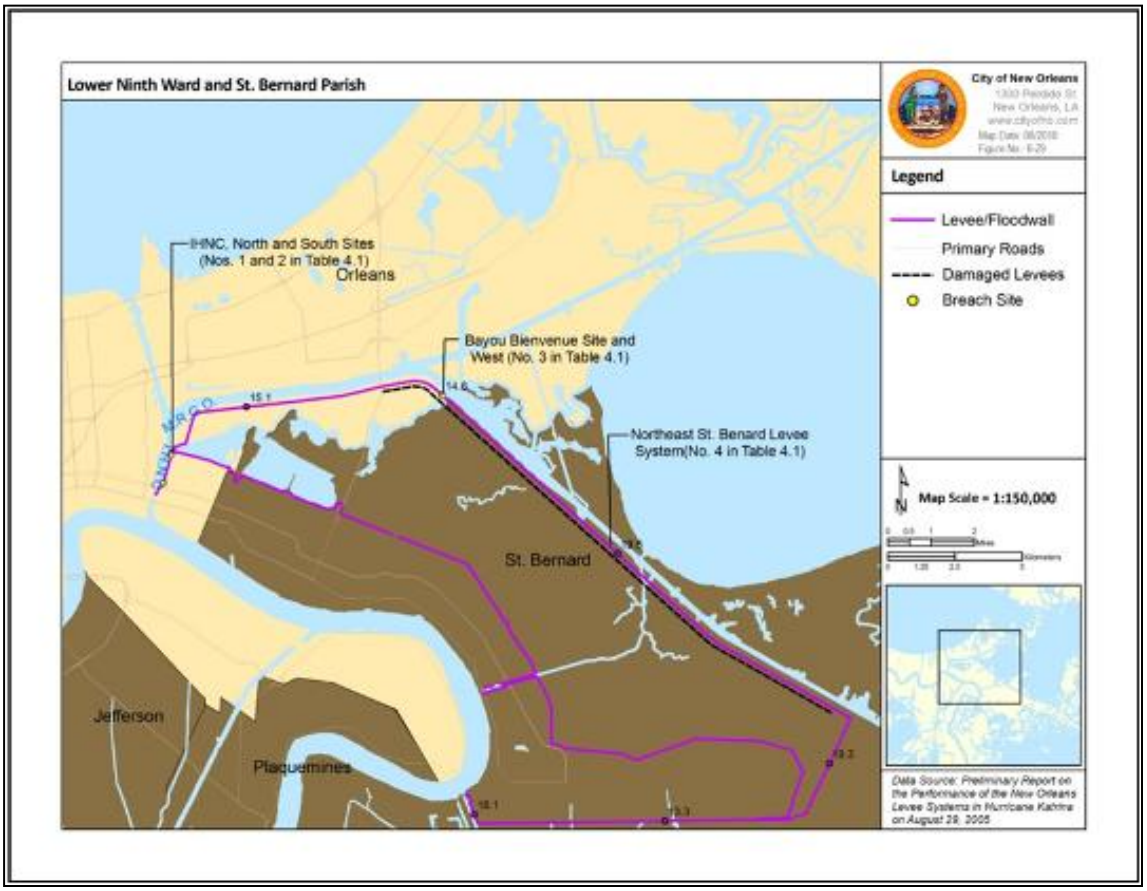
The region known as New Orleans East is bordered by distinctively different hydraulic boundaries: Lake Pontchartrain borders it to the north and east; the Inner Harbor Navigational Canal (IHNC), also known as the "Industrial Canal," borders it to the west; to the south and southeast is the Intracoastal Waterway (IW)/Mississippi River Gulf Outlet (MRGO) and Lake Borgne, respectively.[67] The principal flood control for the New Orleans East polder is illustrated with flood elevation protection levels in Figure 6-28

Figure 6-28
New Orleans East Levee Protection System
(Source; Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005)

[67] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005. Page 3-1.

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.[68] Figure 6-28 shows the primary levee 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. This graphic also indicates the areas of the levee damaged or breached by Hurricane Katrina in 2005. A detailed discussion about the levee failures caused by Hurricane Katrina can be found in the Occurrences of the Levee Failure Hazard subsection.

Figure 6-29
Lower Ninth Ward and St. Bernard Parish
(Source; Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005)



Hurricane Katrina and several other historical levee failures in New Orleans demonstrated that a breach of one or more levees can cause massive flooding in Orleans Parish. As described in the Flood section, much of New Orleans is below sea level and once a levee is overtopped or breached, it becomes very difficult, time consuming, and costly to remove the water from the affected area. As experienced during Katrina, affected structures and infrastructure

68 Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina in August, 29, 2005. Page 4-1.

could possibly remain submerged in floodwater 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.

Severity of Levee Failure

The severity of the levee failure hazard can range from minor cracks along the levee wall to a complete breach. The severity of failure can be influenced by a variety of factors, such as the topography of a region, population densities, volume, depth, and velocity of water released from behind the levee. The New Orleans topography is relatively flat, allowing floodwater that enters the City as a result of levee failure to potentially disperse over a wide area. The severity of a levee failure in New Orleans can be exacerbated by the fact that the majority of the City is located below sea level and floodwater requires removal by a network of pump stations, temporary pumps, and other methods. Removal of floodwater can require a couple of days to several weeks or even months. As evident from Hurricane Katrina, numerous levee breaches in the flood defenses protecting the City resulted in catastrophic damage and loss of life.

After Katrina, Congress directed the USACE and FEMA to determine which levees in the United States pose an unacceptable risk of failure during a flood. The USACE inspects approximately 2,000 levees nationwide and in February 2007, indicated there were 122 levees in the United States that posed an unacceptable risk of failing in a major flood (mainly due to poor maintenance).[69] Though many levees identified were in rural areas, some were in metropolitan regions including the District of Columbia, Springfield, Massachusetts; Stockton and Sacramento, California; and some suburbs of San Francisco. The list did not include any levees in Louisiana. The USACE indicated the Mississippi River levees are subject to stringent maintenance programs, and none in Louisiana show deficiencies.[70] As of spring 2010, numerous USACE projects were ongoing to strengthen the existing Hurricane Protection System (HPS) throughout the New Orleans area. (See the Levee Enhancements Post Hurricane Katrina subsection for details and map identifying improvements to the levee system since Katrina in 2005)

Impact on Life and Property

Levee failure in densely populated areas such as New Orleans can have a devastating impact on life and property in the planning area. Several historical levee failure events have resulted in significant loss of life, including hundreds or even thousands of injuries, and the potential for widespread damage to infrastructure including residential and commercial properties. See Table 6-12 in Section 6.3.3 for a detailed description of property damages, injuries, and loss of life from significant storm surge events that have resulted in levee failure.

As noted in various other sections of the 2011 HMP update, levee failure is not itself a natural hazard that presents risks to a community – the risk is related to the flooding that occurs as a result of a failure. So, as a practical matter, levee failure cannot be separated from surge and flooding risks, particularly since the effects of storm surges and flooding very often precede and cause such failures. As discussed in the present subsection and in Section 7 of the 2011 update, significant improvements and changes were made to the Hurricane Protection System following Hurricane Katrina, reducing the Parish's vulnerability (usually expressed as a protection level). Additional improvements are still on-going. The flood and storm surge subsections in Section 7 of this HMP update discuss this in detail. It should, however, be understood that the potential for levee failure (and hence the vulnerability of the citizens, physical elements and operations being protected) will change over time. The potential for failure can be reduced by physical improvements such as increasing overtop height,

[69] Insurance Journal. Levees in 27 States at Risk of Failing; Could Trigger Flood Mandate. Beverly Lumpkin. February 5, 2007.
[70] Insurance Journal. Levees in 27 States at Risk of Failing; Could Trigger Flood Mandate.

hardening the connections between adjoining levees, and ensuring that sheet piling is adequately designed and embedded, and may also be increased by a variety of factors, including subsidence, erosion, sea-level rise, and physical deterioration of the levee structure, among other reasons. It should also be noted that community vulnerability may also be increased when additional building occurs in areas protected by levees, or when populations increase in such areas. Given the very dynamic nature of all these phenomena, and the fact that levee failures are also partly a function of weather-related events, it is problematic to make a general statement about vulnerability over an extended period of time.

Occurrences of Levee Failure

The City of New Orleans has experienced several historic levee failure events since 1900. The four most significant events that have impacted the Parish occurred in 1915, 1947, 1965, and 2005. All four of the levee failure events were the result of storm surge associated with major hurricanes (Category 3 or higher) that resulted in severe flooding to portions or widespread areas of the City. The four events are summarized below, concentrating on describing the levee failure and resulting impacts associated with each event. Additional details about these events can also be found in the Hurricane and Tropical Storm and Storm Surge sections. As with the flooding hazard, it is impractical and potentially misleading to make any general statement as to the statistical probability of levee or dam failure. Particularly in the case of Orleans Parish, which is the site of an extensive levee network and very complex hydrologic situation, any study or discussion of failure probability must necessarily be very location-specific. As discussed elsewhere in this section and others, probabilistic levee design standards (e.g. 100-year levee, 500-year levee) are useful in a general sense, but cannot necessarily be accurately applied to specific locations, where the probability of failure is a function not only of water/surge elevation, but also of the structural characteristics of the levee itself. There are numerous studies of the levees in Orleans Parish that can be consulted to get a better sense of failure probability. Some of there studies are noted and used as references in this mitigation plan.

The levee failure event in 1915 was the result of storm surge from a Category 4 hurricane. Storm surge sent a 15- to 20-foot wave up the Mississippi River, overwhelming the river levees downstream of New Orleans. In Lake Pontchartrain, water reached 6 feet above sea level and overflowed the low protective embankments to flood the northern part of the city, including the low-lying downtown area to depths up to 8 feet. Water remained in the City for 4 days and was removed by the available pumps once electrical power was restored. 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.[71]

In 1947, portions of Orleans Parish flooded again when a Category 3 hurricane passed directly over the City. Flood defenses along Lake Pontchartrain failed at a number of locations to the northwest of the City. The western wall of the 17th Street Canal failed, flooding neighborhoods in Jefferson Parish up to 6 feet. In Orleans Parish, 9 square miles of Orleans Parish were flooded, although most of this land was not developed and water did not enter the downtown area. Since the water was in a part of the city away from the location of the major pumps, the floodwater remained for weeks and was only removed through digging and blasting holes in the flood defenses. In neighboring Jefferson Parish, 30 square miles were flooded, prompting the evacuation of 15,000 people. As a result of the event, the levees were heightened along the south shore of Lake Pontchartrain bordering the city and extended westward along Jefferson Parish.[72]

In 1965, levees in New Orleans failed when storm surge associated with Hurricane Betsy, a Category 3 hurricane, breached the earthen embankments along the Industrial Canal, flooding the entire eastern part of the City on either

[71] Flood Risk In New Orleans, RMS Report. Section 1.2, (Page 4)
[72] Flood Risk In New Orleans, RMS Report. Section 1.2, (Page 4)

side of the canal. The levee failures flooded a total of 13,000 houses. 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. As mentioned elsewhere in this section, 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.[73]

The worst levee failure event in New Orleans history occurred in August 2005 when storm surge from Hurricane Katrina caused numerous levee failures and flooded approximately 80 percent of the City. Hurricane Katrina had a devastating impact on southeastern Louisiana and the City of New Orleans. This event is described in much greater detail in Section 6.3.1 (Hurricanes and Tropical Storm) and 6.3.3 (Storm Surge). The description of Hurricane Katrina in this subsection focuses on describing the levee failures that occurred to the City's flood defenses. 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 back side caused by overtopping, but a few breaches occurred before the water reached the tops of the floodwalls.

To understand and analyze how the levee system was overtopped and breached after Hurricane Katrina in September 2005, numerous technical documents were examined and reviewed as part of the 2010 Plan update. These documents and reports were completed by various agencies and organizations including the USACE – New Orleans District, the American Society of Civil Engineers (ASCE), NHC, and FEMA. Some of the more significant documents included the following

- Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina in August of 2005
- USACE – Interagency Performance Evaluation Task Force; Preliminary Report on the Performance of New Orleans Levee System in Hurricane Katrina
- USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008
- USACE, Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System
- NHC – Hurricane Katrina Tropical Cyclone Report

Review of the studies mentioned above indicates that the surge overtopped large sections of the levees east of New Orleans, in Orleans Parish and St. Bernard Parish; the surge 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. Breaches along the Industrial Canal east of downtown New Orleans, the London Avenue Canal north of downtown, and the 17th Street Canal northwest of downtown appear to have occurred during the early morning on August 29.[74] Table 6-19 below summarizes the major levee breaches in New Orleans and the surrounding areas.

[73] Flood Risk In New Orleans, RMS Report. Section 1.2, (Page 5)
[74] NHC. Tropical Cyclone Report - Hurricane Katrina

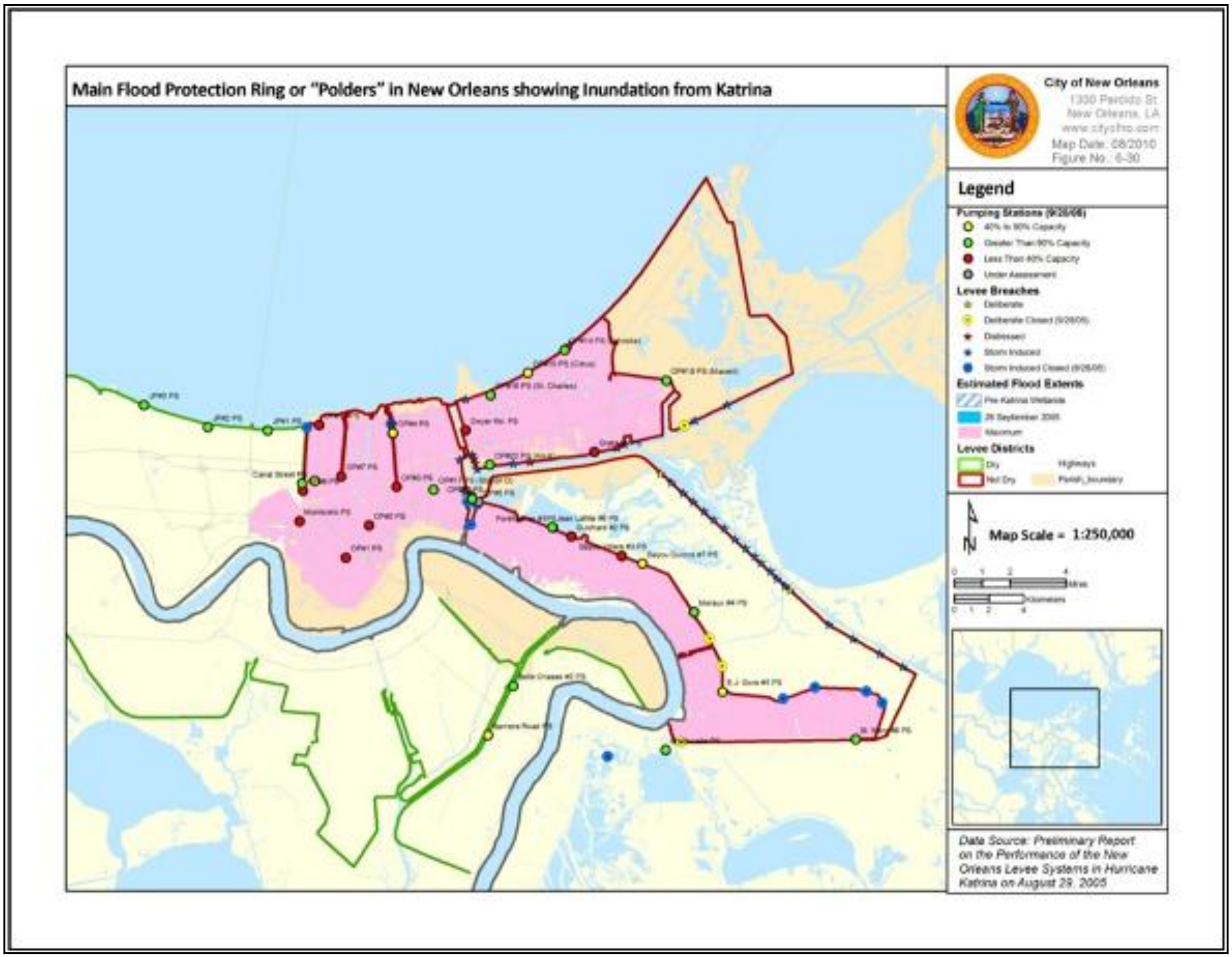
Table 6-19
Major Levee Breaches in New Orleans during Hurricane Katrina
(Source: US Army Corp. of Engineers – Interagency Performance Evaluation Task Force; Preliminary Report on the Performance of New Orleans Levee System in Hurricane Katrina)

Levee Name	Location	Description of Breach
17th Street Canal	North end of the 17th Street canal	Floodwaters breached the levee from erosion and storm surge, which pushed a section of embankment sideways about 45 feet. The breach produced significant flooding between the 17th Street and Orleans Ave. Canals.
London Ave. Canal (North Breach)	West side of canal near Robert E. Lee Boulevard	An entire 410-foot section became unstable; moving landward and upward causing the large failure.
London Ave. Canal (South Breach)	East side of canal near Mirabeau Ave	Erosion around the land side of the levee eventually collapsed the floodwall causing a 60-foot wide breach.
Industrial Canal (West Bank)	Entire western side of Industrial Canal	Numerous locations overtopped by floodwater caused multiple breaches. Several erosion failures combined with “transition” breaches at points where earthen embankments change to concrete walls.
Industrial Canal – East Bank (North Breach)	Lower Ninth Ward; In the vicinity of Florida and Surekote Avenues	Floodwater overtopped and destroyed a 210-foot section of levee. The I-wall was overturned and dragged inland as much as 70 feet.
Industrial Canal – East Bank (South Breach)	Ninth Ward near Claiborne Ave. Bridge	Floodwater overtopped and scoured material around the base of the floodwall. 900 feet of the wall were overturned and displaced from the force of the storm surge.
Mississippi River Gulf Outlet (MRGO)	Southwestern Bank of MRGO at Bayou Dupree	Floodwater washed out a section of concrete and sheet pile.
MRGO	Two miles Southeast of Bayou Dupree	Overtopping destroyed earthen levee.

.

Figure 6-30 identifies the location of the main flood protection ring and the areas inundated by Hurricane Katrina in August 2005. Levee breaches are shown with solid blue stars, and distressed sections as well as minor or partial breaches are indicated by red stars. The original base maps, and many of the stars, were identified by the USACE in late 2005, and additional stars have been added to the map as a result of the field studies conducted in support of the *Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina in August of 2005*. The yellow stars correspond to deliberate breaches utilized to facilitate draining the flooded areas after the storm.

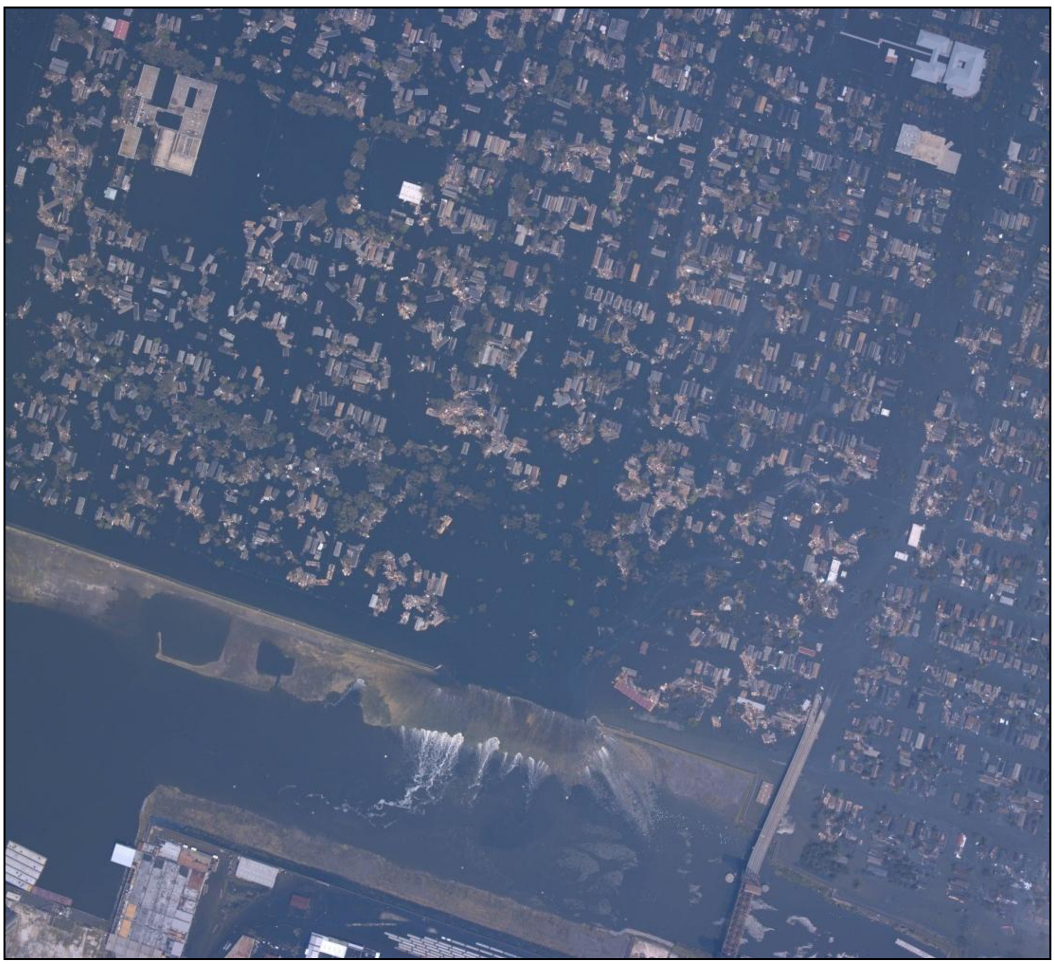
Figure 6-30
Main Flood Protection Ring or "Polders" in New Orleans Showing Inundation from Katrina
(Source; Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005)



One of the largest levee failures during Katrina occurred along the east bank of the Industrial Canal (South Breach). The flood protection system north of Claiborne Avenue is constructed of I-walls embedded in earthen levees. At this location, a 900-foot breach in the floodwall was caused by overtopping and scouring at the base of the wall. The storm surge almost completely destroyed the earthen portion of the levee. The I-wall was overturned and displaced inland as much as 187 feet. A large barge was docked in the canal at the time of the event and became unmoored during the storm surge. The barge was drawn through the breach and came to rest on the land side of the levee as the floodwater receded (See Figures 6-31 and 6-32).[75]

The south breach of the Industrial Canal combined with the north breach allowed floodwater to spill into the Lower Ninth Ward. Homes in the immediate vicinity of the levee failure were completely destroyed by the hydraulic forces of the high velocity floodwater while hundreds of others were shifted and displaced from their foundation. Figures 6--31 and 6-32 below are aerial photos of the levee failure and emergency repairs. The first photo was taken by NOAA on August 31, 2005, two days after Katrina made landfall. At the time the photo was taken, the water is already beginning to flow back into the Industrial Canal. The second photo was taken on October 15, 2005, after the floodwater receded, and shows the displacement of the I-wall and the emergency breach closure.

Figure 6-31
Industrial Canal; South Breach at the Lower Ninth Ward on August 31, 2005
(Source; NOAA – August 31, 2005)



[75] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina in August of 2005 – Page 4-2.

Figure 6-32
Industrial Canal; South Breach at the Lower Ninth Ward; emergency closure
(Source: National Science Foundation - Preliminary Report on the Performance of New Orleans Levee System in Hurricane Katrina)

Overtopping of the flood control levees and floodwalls during Hurricane Katrina was observed to have occurred on most sides of the New Orleans East polder. Overtopping evidence included significant backside scour and debris on the tops of walls and levees. On the north side (fronting Lake Pontchartrain), the best available field data and numerical calculations of storm surge suggest that the lakefront storm surge in this area stayed below the crests of the lakefront levees. No significant sustained overtopping, only "splash over" due to waves generated in the lake, occurred at certain locations along the lakefront. Breaches occurred in many parts of the levee system, and also occurred on most aspects with the notable exception of the north-south running earthen levee serving as the front line of protection from the east. As described in detail in the Storm Surge section (Section 6.3.3), water levels along the MRGO channel were elevated due to the storm surge pushed against the levees of St. Bernard Parish. This storm surge then propagated westward into the IW/MRGO channel. The LSU hurricane center believes that the convergence of the New Orleans East levee and the St. Bernard levee formed a funnel that caused the surge to heighten as it moved to the west.[76]

The volume of water entering the City when the levees failed immediately overwhelmed the 23 major pump stations throughout Orleans Parish, which are only designed to remove surface runoff during rain events. It is estimated by the Sewer and Water Board, responsible for managing the 115 pumps, that they can remove about 50,000 cubic feet of water per second (CFS). 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. See Section 6.3.3, Storm Surge, for additional details about the flooding caused by storm surge and levee breaches during and after Hurricane Katrina.

The levee breaches stranded survivors on roof tops and in attics. Many citizens who were trapped in attics were unable to escape, and 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 percent of Orleans Parish properties, over 100,000, received some flood damage as a result of the storm surge flooding and levee breaches that occurred as a result of Katrina. Hundreds of thousands of Orleans Parish residents had to abandon their flooded homes and relocate to other areas of the country. This relocation, in turn, strained the resources of the areas receiving the New Orleans residents.

Levee Enhancements Post Hurricane Katrina

The USACE is currently involved in numerous projects to strengthen the New Orleans Levee Flood Protection System. As mentioned in the Storm Surge section, after Hurricane Katrina Congress enacted several laws that provided funds to raise levee heights or otherwise enhance the West Bank and Vicinity and the Lake Pontchartrain and Vicinity projects to a 1-percent-annual-chance flood design level. Implementation of the 1-percent-annual-chance flood (100-year) 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. Table 6-20 identifies the status as of February 2008 for the major USACE projects and studies currently underway in the New Orleans area to achieve the 1-percent-annual-chance flood (100-year) design standard.

[76] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina in August of 2005, Page 3-1.

Table 6-20
Major USACE Hurricane and Flood Risk Reduction Projects and Studies in New Orleans
(Source: USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008)

Project Name	Design Standard	Status
Lake Pontchartrain and Vicinity	1-percent-annual-chance flood (100-year) design	Construction Phase
New Orleans to Venice	1-percent-annual-chance flood (100-year) design	Construction Phase
Mississippi River Levees	Mississippi River and Tributaries Project Design Flood	Construction Phase
Southwest Coastal Louisiana Feasibility Study	To Be Determined	Feasibility Cost Share Agreement currently being negotiated with the State of Louisiana
La Reussite to St. Jude Study (would be part of New Orleans to Venice project)	1-percent-annual-chance flood (100-year) Design	Revised decision report needed

Figure 6-33 is a map of the greater New Orleans area showing the status of the Hurricane and Storm Surge Damage Risk Reduction System (HSDDRS) as of June 2009. With post-Katrina design criteria and full Federal funding from Congress, the USACE is on track to complete construction of the HSDRRS with the goal of completing the work in 2011. The June 1, 2009, maps depict the current HSDRRS status. The map shows the required1-percent-annual-chance flood (100-year) risk reduction elevations, the current elevations of the system, and the system status elevations prior to Hurricane Katrina. The map identifies levels of vulnerability throughout the system as green, amber, and red.

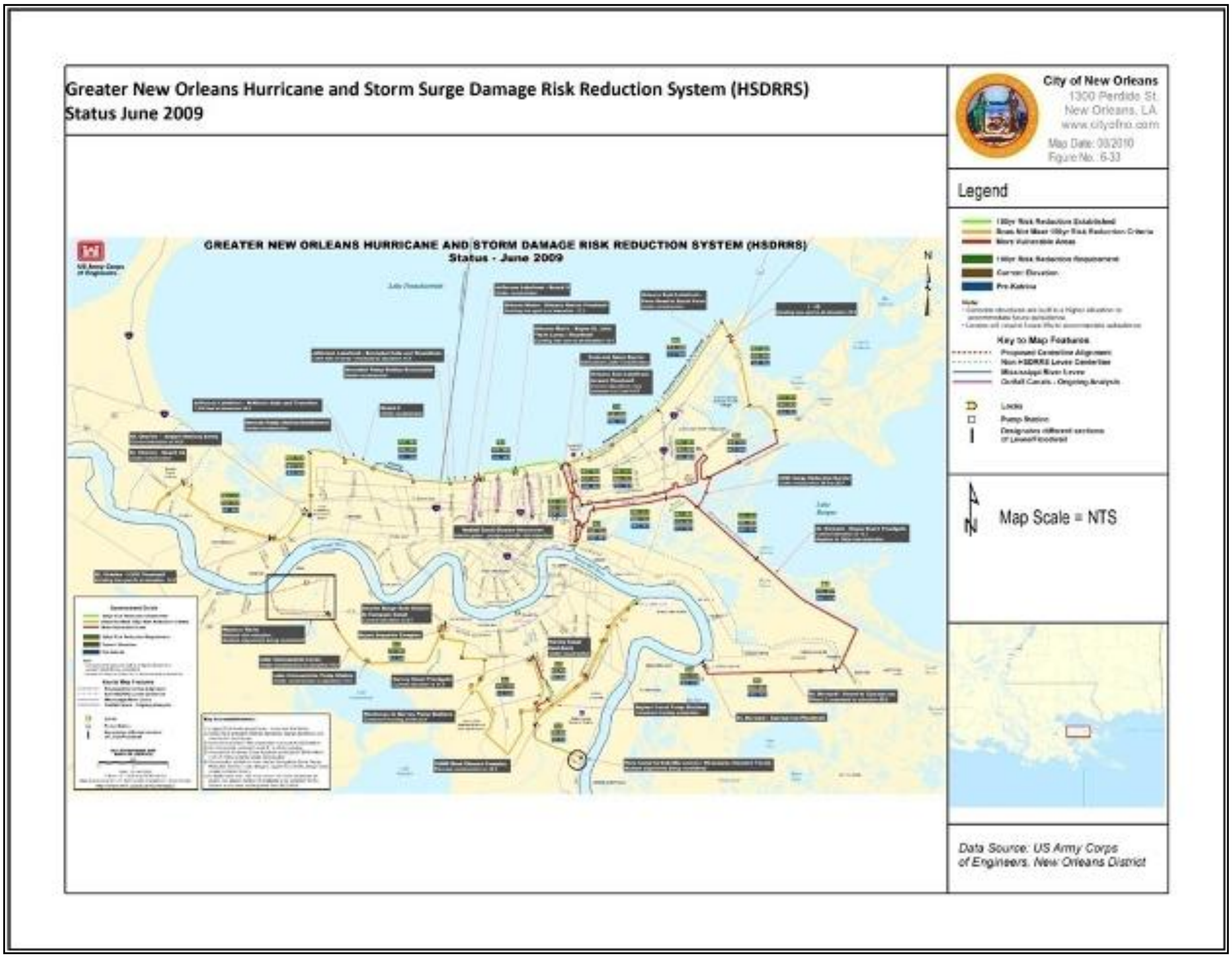
Green sections of the system meet 1-percent-annual-chance flood (100-year) level elevations and design criteria. Amber sections of the system do not meet the 1-percent-annual-chance flood (100-year) risk reduction criteria. They must meet1-percent-annual-chance flood (100-year) elevation and design criteria before they will be changed to green. Amber sections of the system may meet 1-percent-annual-chance flood (100-year) elevations, but are being evaluated to ensure they meet the 1-percent-annual-chance flood (100- year) risk reduction design criteria.
Red areas of the system are considered "more vulnerable" than others. These sections of the system are in areas that experience higher storm surges or are areas where minimal levels of risk reduction exist.

The map was developed by a team of scientists, engineers, members of academia, the Interagency Performance Evaluation Task Force (IPET), and the Engineering Research and Development Center. The team used a comprehensive probabilistic surge modeling system to determine surges for a storm with a 1-percent chance of occurring in any given year. This modeling dictated the required 1-percent-annual-chance flood (100-year) elevations, which vary throughout the system based upon surge elevations, wave heights, and wave periods. The status map indicates the required 2011,1-percent-annual-chance flood (100-year) elevations for earthen levees and structures. The map notes that concrete structures are built to a higher elevation to accommodate future subsidence and that levees will require future lifts to accommodate subsidence.[77]

The HSDRRS map and additional background information are available on the USACE – New Orleans District website at: http://www.mvn.usace.army.mil/hps2/hps_100_year.asp.

[77] USACE – New Orleans District website – Explanation of 100-Year Design Map

Figure 6-33
Greater New Orleans Hurricane and Storm Surge Damage Risk Reduction System (HSDRRS) – Status, June 2009
(Source: USACE, New Orleans District (website))



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.[78]

[78] National Hurricane Center (NHC), Tropical Cyclone Report - Hurricane Rita (September 18 – 26, 2005), Richard D. Knabb, et all. March 17, 2006.

6.3.6 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 1,315 tornadoes between 2007 and 2009. The highest monthly average during this time period occurred in May with an average of 305 tornadoes.[79]

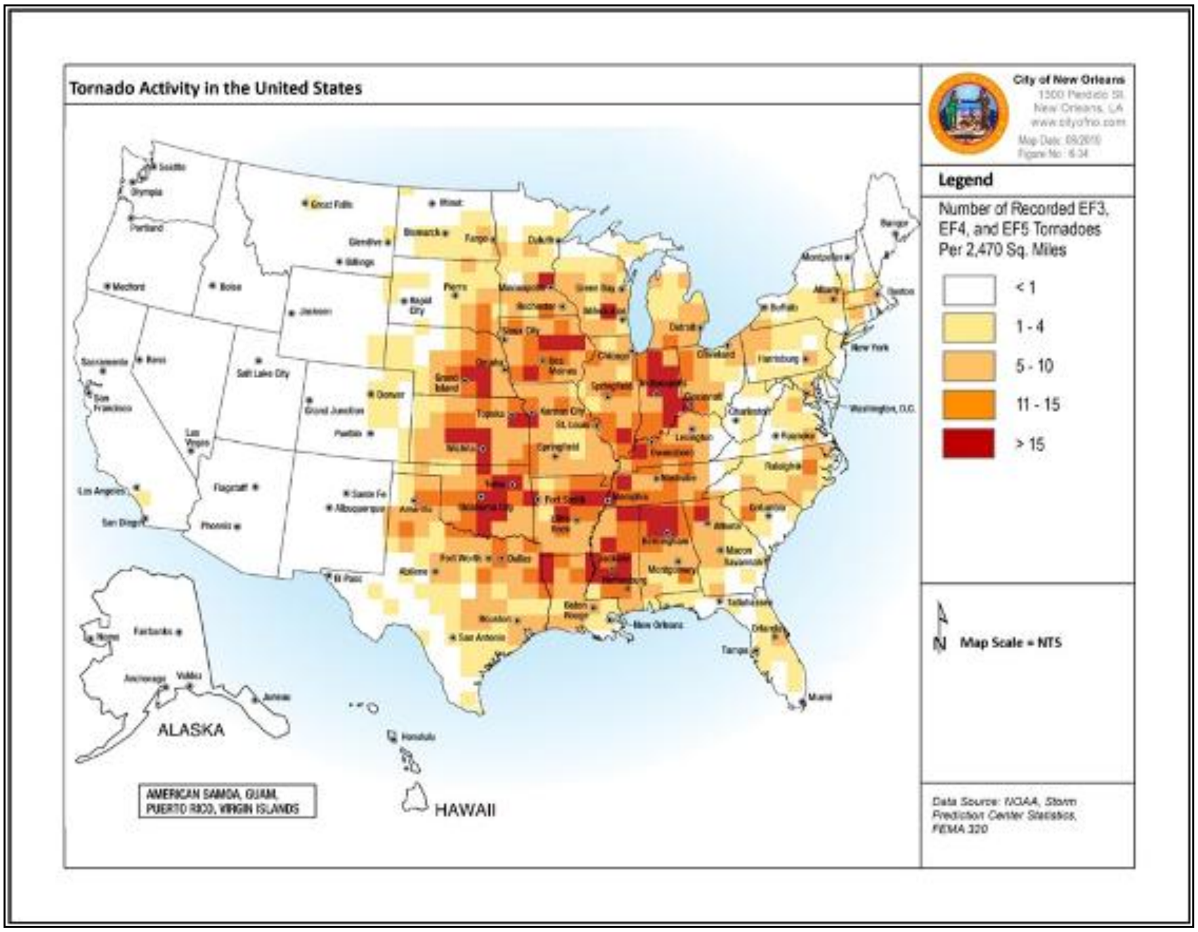
Tornadoes are most hazardous when they occur in populated areas. Tornadoes can topple mobile homes, lift cars, snap trees, and turn objects into destructive missiles. Among the most unpredictable of weather phenomena, tornadoes can occur at any time of day, almost anywhere in the country, and in any 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. See Appendix K for a more detailed description of the Tornado 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 (See Table 6-20 for Louisiana tornado ranking statistics).[80] Average annual tornado statistics were available only up to 2004 through NOAA's NCDC. In Louisiana, peak tornado occurrence is in March through May, and in November. Figure 6-34 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. The entire Parish is vulnerable to Tornadoes.

[79] National Weather Service (NWS), Monthly and Annual U.S. Tornado Summaries
[80] NOAA NCDC. Annual Average Number of Tornadoes, 1953 - 2004

Figure 6-34
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 6-21 for the Fujita Tornado Measurement Scale. The period of record for the table is 1950 to 2009.

Table 6-21
Fujita Tornado Measurement Scale
(Source: NOAA)

Category	Wind Speed	Examples of Possible Damage	Number in Louisiana (1950-2009)	% of LA Tornadoes
F0	Gale (40-72 mph)	Light damage. Some damage to chimneys; break branches of trees; push over shallow rooted trees; damage to sign boards.	321	22%
F1	Moderate (73-112 mph)	Moderate damage. Peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.	698	48%
F2	Significant (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.	292	20%
F3	Severe (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.	132	9%
F4	Devastating (207-260 mph)	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	18	1%
F5	Incredible (261-318 mph)	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.	2	0%

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.[81] 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 6-22 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.

[81] NOAA; Storm Prediction Center – Summary of Enhanced F-scale

Table 6-22
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. The tornadoes identified in the NCDC database for Orleans Parish ranged in severity from an F0 to an F2. See Table 6-23 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 2010 Plan update, open sources were reviewed in search of more recent tornado ranking statistics, but no updated data was identified.

Table 6-23
Louisiana National Ranking for Tornadoes, Fatalities, Injuries, and Damages from 1950-1994
(Source: NOAA)

Tornadoes		Fatalities		Injuries		Damages	
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 1950 and 2009. 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.[82]

With a total of 17 tornadoes between 1950 and 2009, Orleans Parish experiences a tornado event on average about once every 3.5 years. The 17 events have occurred over a period of 59 years which calculates to a 27 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 30 percent of the housing units in Orleans Parish, or 63,779 units, were built before 1940. Most of the housing units south of I-610 and west of the Industrial Canal were built before 1940. 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

[82] NOAA/NCDC database. Louisiana – Orleans Parish – Tornado Events

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 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 6-24
Tornado Events, Orleans Parish, 1950 – 2010
(Source: NOAA/NCDC)

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				**8.910M**

There has not been a tornado stronger than an F2 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. [83]

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.

[83] In 1953 damages totaling $250,000 were reported following a tornado. Two other tornadoes, in 1964 and 1971, each caused $2.5 million in damages; however, the records of the National Climatic Data Center are unclear about whether these damages were confined to Orleans Parish or whether the figures represent damages across all parishes affected by the tornadoes.
[84] NOAA / NCDC database – Louisiana, Orleans Parish – Tornado Events

6.3.7 Lightning

Description of the Lightning Hazard

Lightning events are generated by atmospheric imbalance and turbulence due to a combination of conditions. The hazard occurs during all thunderstorms and can strike virtually anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees Fahrenheit. See Appendix K for a more detailed description of the lightning hazard.

In the original 2005 HMP, the Lightning and Thunderstorm hazards were profiled as a single hazard. During the review and hazard prioritization process, the Hazard Mitigation Planning and Steering Committees addressed lightning and thunderstorms separately. As such, in the 2010 update, these hazards are addressed separately.

Location and Extent of the Lightning Hazard

Individual lightning strikes typically affect a relatively small geographic area. Lightning equally affects the entire Parish.

Severity of the hazard

Severe lightning events can occur anywhere in the planning area. Even during common events, the lightning current can branch off to strike a person from a tree, fence, pole, or other tall object. In addition, electrical current may be conducted through the ground to a person after lightning strikes a nearby tree, antenna, or other tall object. The current also may travel through power lines, telephone lines, or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture. Lightning may use similar processes to damage property or cause fires.

Impact on Life and Property

People and property in virtually the entire United States are exposed to damage, injury, and loss of life from lightning. According to NOAA, from 1963 to 1993, the average loss of life in the United States due to lightning was 89 per year, with an additional 300 persons injured each year. In the year 2000, lightning was responsible for three deaths (two while playing golf and one from an unknown cause) in Louisiana. Most lightning-related deaths and injuries occurred when people were outdoors during summer afternoons and evenings.

Between 1994 and 2007, the NCDC identifies three deaths and two injuries in Orleans Parish resulting from lighting strikes. Total property damage from lightning strikes was estimated at $270,000. Orleans Parish is not particularly vulnerable to the lightning hazard, as most lightning strikes do little harm to structures and populations. Significant operations and facilities in the Parish are generally protected from damage by grounding and surge protection.

Orleans Parish does not appear to be particularly vulnerable to negative impacts from lightning strikes, although the presence of many pre-code wood buildings in some areas may present some increased risks from fires related to strikes. As noted above in other subsections, there is no comprehensive, open source of information about the structural characteristics of buildings in the Parish, so statements about vulnerabilities are not meaningful on a

Parish-wide basis. In many cases, damage from lightning is addressed through private insurance, and records of such damages and claims payments is proprietary, and hence not available to use in generalized assessments.

Occurrences of the Lightning Hazard

The NCDC database identified 10 lightning events in Orleans Parish between 1950 and 2009. The NCDC's reporting threshold is not known; however, this figure significantly under-represents the actual number of lightning strikes in the Parish over this time period. Lightning strikes can easily number in the hundreds in a single thunderstorm. Table 6- 25 below summarizes the lighting events for Orleans Parish between 1950 and 2009. Note that the period of record extends to 2009, but there were no reported lightning events from 2007 to 2009, so the record of actual events in the table stops at 2007.

Table 6-25
Lightning Events, Orleans Parish, 1950 – 2009
(Source: NOAA/NCDC Database)

Date	Time	Type	Magnitude	Property Damage
06/17/1994	02:00 PM	Lightning	N/A	50K
05/30/1995	02:55 PM	Lightning	N/A	0
04/14/1996	02:00 PM	Lightning	N/A	0
04/17/1996	03:45 PM	Lightning	N/A	0
06/21/1998	05:20 PM	Lightning	N/A	120K
09/06/1999	07:15 PM	Lightning	N/A	50K
06/04/2000	11:00 AM	Lightning	N/A	0
05/30/2005	06:30 AM	Lightning	N/A	0
06/06/2005	12:00 PM	Lightning	N/A	0
06/04/2007	10:30 AM	Lightning	N/A	50K
Totals				**270K**

All 10 events were concentrated between 1994 and 2007 this indicates that additional events outside this period are not captured in the database. Although many more lightning events have occurred, they were not reported to the NCDC. This may be a result of how the NCDC gathers data. For "minor" hazards like lightning, they appear to capture only the most significant events, excluding ones that don't cause damage or are otherwise recorded/reported by public agencies. In the case of lightning, most of the thousands of strikes don't cause any damage, and when damages do occur they are seldom reported to public authorities. Significant events listed in the database are summarized below:

- **June 21, 1998.** A lightning strike started a house fire. The resulting fire caused an estimated $120,000 in property damage.
- **September 6, 1999.** A lightning strike caused a fire that extensively damaged two units of an apartment complex.
- **June 4, 2007.** A house was heavily damaged by a fire caused by a lightning strike.

The statistical probability of lightning impacting Orleans Parish is 100% on an annual basis. Lightning strikes occur numerous times in the Parish every month during the spring and summer. Lightning strikes that cause significant damage are rarer, with most damages limited to power interruptions and downed trees. Although deaths occur occasionally, this is impossible to predict except over very long time line and very generally.

.

6.3.8 Hail

Description of the Hail Hazard

Hail is a form of precipitation comprised of spherical lumps of ice. These spherical lumps of ice, known as hailstones, typically range from 0.25 inches to 2 inches in diameter on average, with much larger hailstones forming in severe thunderstorms. The size of hailstones is a direct function of the severity and size of the storm. Large hailstones, which fall at speeds faster than 100 mph, can be extremely dangerous. See Appendix K for a more detailed description and definition of the hailstorm hazard. Below is the TORRO Hailstorm Intensity Scale (H0 to H10) – the scale relates intensity to hail diameter, expected kinetic energy and typical damage impacts.

Table 6-26
TORRO Hailstorm Intensity Scale
(Source: The TORnado and storm Research Organization)

TORRO Hailstorm Intensity Scale				
	Intensity Category	Typical Hail Diameter (inches)*	Probable Kinetic Energy, J-m^2	Typical Damage Impacts
H0	Hard Hail	0.2	0-20	No damage
H1	Potentially Damaging	0.2-0.4	>20	Slight general damage to plants, crops
H2	Significant	0.4-0.8	>100	Significant damage to fruit, crops, vegetation
H3	Severe	0.8-1.2	>300	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2-1.6	>500	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	>800	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4		Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	2.4-3.0		Severe roof damage, risk of serious injuries
H8	Destructive	3.0-3.5		(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>4		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

* Approximate range (typical maximum size in bold), since other factors (e.g. number and density of hailstones, hail fall speed and surface wind speeds) affect severity.

Table 6-27
Hail Size and Diameter in relation to TORRO Hailstorm Intensity Scale
(Source: The TORnado and storm Research Organization)

Size code	Maximum Diameter (inches)	Description
H0	0-0.2	Pea
H1	0.2-0.4	Mothball
H2	0.4-0.8	Marble, grape
H3	0.8-1.2	Walnut
H4	1.2-1.6	Pigeon's egg > squash ball
H5	1.6-2.0	Golf ball > Pullet's egg
H6	2.0-2.4	Hen's egg
H7	2.4-3.0	Tennis ball > cricket ball
H8	3.0-3.5	Large orange > soft ball
H9	3.5-4	Grapefruit
H10	>4	Melon

Location and Extent of the Hail Hazard

Hailstorms occur most frequently during the late spring and early summer, when the jet stream migrates northward across the Great Plains. This period exhibits extreme temperature changes from the ground surface upward into the jet stream, which produces the strong updraft winds needed for hail formation.

Metal roof buildings, mobile homes, vehicles and certain types of agriculture can be particularly vulnerable to damage from large hailstones. Long-stemmed vegetation is particularly vulnerable to damage by hail impacts and winds. The land area affected by individual hail events is not much smaller than that of a parent thunderstorm, an average of 15 miles in diameter around the center of a storm.

Severity of the Hail Hazard

The severity of hailstorms is measured by duration, size of the hail itself, and geographic extent. All of these factors are directly related to the weather phenomena that create the hail and thunderstorms. There is wide potential variation in these severity components, and hence the severity of hailstorms can range from minor --- a short, localized event with small hailstones – to very severe, in which a large area is affected by large hailstones.

Data on the probability and frequency of occurrence of hailstorms is limited, with little recent research. What data that is available indicates that outside of the coastal regions and localized areas in the Rocky Mountain, most of the United States experiences hailstorms at least two or more days each year.

The entire Parish is at risk from hailstorms. Hailstorms have affected Orleans Parish and each of the jurisdictions equally and uniformly over time.

Figure 6-35
Large Hailstones

Impact on Life and Property

There are no known instances of injuries or deaths from hail events in Orleans Parish. Although typically not life threatening, severe hailstorms have the potential to cause significant property damage particularly to automobiles and some building types and roof systems. The development of hailstorms from thunderstorm events causes nearly $1 billion in property and crop damage each year. The NCDC database indicates there has been no property damage caused by hail in Orleans Parish; however, based on insurance records and our experience with similar jurisdictions, it is apparent that occasional hail-related damage to vehicles and property has taken place over time.

Although assessing hail requires site-specific evaluations that are outside the scope of a mitigation plan, it can be stated that structures and populations in Orleans Parish are not especially vulnerable to the effects of hail. Although there is clearly the potential for damage to structures and vehicles in a hailstorm, it requires a fairly extreme event to cause widespread damage. As shown below in Table 6-30, the Parish has experienced one very severe hailstorm (in 2000), which caused a significant amount of damage. This is does not, however, suggest that the Parish is particularly vulnerable to hail, only that the 2000 storm was very severe. As with several other hazards discussed in this section of the HMP, site-specific engineering study would be required in order to accurately characterize vulnerability to the hail hazard. Also, there are no open sources of information about insurance claims from hail storms, so it is difficult to properly describe damages in events other than the 2000 storm. Without detailed engineering evaluations of structures, it is not possible to make a meaningful statement about hail vulnerabilities in the Parish. At some point in the future, there may be a common database with information (such as structure type and roof configuration) about structures in the Parish that will allow assessment of hail vulnerability. However, given the relatively low historical impacts of the hazard, this should probably not be a Parish priority.

Occurrences of the Hail Hazard

The NCDC's database indicates that there have been 28 hail events in Orleans Parish between 1950 and 2009. With a total of 28 hailstorms, Orleans Parish experiences a significant hail event on average approximately every two years based on this data. The 28 reported events have occurred over a period of 59 years, which calculates to a 47-percent-annual statistical probability of future hailstorm occurrences that produce stones of 1" diameter or greater. Table 6-28 below summarizes the 15 past hailstorm events in Orleans Parish that have included hailstones of at least

1-inch diameter. The statistical probability of hail occurring somewhere in the Parish is approaching 100% annually, although significant events such as those listed below are much less probable.

Table 6-28
Hail Events, Orleans Parish, 1950 – 2009
(Source: NOAA/NCDC)

Date	Time	Type	Magnitude	TORO size
02/05/1962	03:50 PM	Hail	1.75 in.	5
04/26/1964	01:25 PM	Hail	1.75 in.	5
03/30/1972	01:00 PM	Hail	1.75 in.	5
09/01/1974	01:50 PM	Hail	1.00 in.	3
05/07/1975	10:00 PM	Hail	1.50 in.	4
07/01/1977	01:47 PM	Hail	1.75 in.	5
04/18/1980	11:09 AM	Hail	1.00 in.	3
04/26/1982	04:30 PM	Hail	1.75 in.	5
04/09/1991	05:30 PM	Hail	1.00 in.	3
02/17/1992	01:45 PM	Hail	1.00 in.	3
06/04/1992	01:20 PM	Hail	1.00 in.	3
10/27/1995	04:45 PM	Hail	1.75 in.	5
03/29/1997	03:55 PM	Hail	1.50 in.	4
01/23/2000	11:12 PM	Hail	1.00 in.	3
02/04/2004	10:30 PM	Hail	1.75 in.	5

The 28 hail events for Orleans Parish between 1950 and 2009 are summarized in Table 6-29 below. The most common size hail event the Parish has experienced is between 0.75 inches and 1.75 inches (TORO size: 2 to TORO size: 5), with 0.75 inches (TORO size:2) the most likely size hail that would occur.

Table 6-29
Hail Size Summary for Orleans Parish between 1950 and 2009
(Source: NOAA/NCDC)

Size of Hail	TORO size	Number of Events
0.75 inches	2	11
0.88 inches	3	2
1.00 inches	3	6
1.50 inches	4	2
1.75 inches	5	7

Although no property damages were reported in the NCDC database, other sources indicate that the hail event on January 23, 2000, brought some of the largest hail ever recorded in the area. Hail 1.75 inches in diameter (TORO size: 5) fell over a swath of New Orleans that was 5 miles long and 1 mile wide. As shown in Table 6-30, this hailstorm caused significant damage to property in the New Orleans metropolitan area. Ranging from dime to golf ball-size (see Table in Appendix K), the hail damaged roofs, windows, and vehicles, and resulted in nearly 42,000 homeowner and 37,500 auto insurance claims at an estimated cost of $353 million. The Institute for Building and

Home Safety (IBHS) identified this storm as the eighth most damaging storm in the nation in the period from 1994 to 2000.

Table 6-30
Top 10 National Hailstorm Events between 1994 and 2000
(Source: IBHS 2002 Annual Conference – Hailstorm Loss Database)

Rank	Date	Primary Location	Loss Amount
1	5-15-98	Minn.-St. Paul, MN	$1.73 billion
2	5-5-95	Ft. Worth, TX	$929 million
3	4-19-96	Indianapolis, IN	$658 million
4	5-18-00	Chicago suburbs, IL	$572 million
5	4-25-94	Dallas-Ft. Worth, TX	$542 million
6	4-23-99	Northern Virginia	$394 million
7	7-7-00	Minn.-St. Paul, MN	$381 million
8	**1-23-00**	**New Orleans, LA**	**$353 million**
9	5-3-96	Louisville, KY	$339 million
10	4-16-98	Bowling Green, KY	$290 million

No Presidential Disaster Declarations from hail have occurred in the Parish. Based on historical records from the NCDC database and other sources, the future probability of hailstorms in Orleans Parish is reasonably high. However, property damage and impact on life in the Parish is considered minimal compared to the potential damage from other hazards. 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 hail.

6.3.9 Coastal Erosion

The coastal erosion hazard has been added as part of the 2010 Plan update. Where appropriate, discussions from the original Plan about coastal erosion within the land subsidence hazard have been relocated to this section.

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.[85] 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. Some believe that shipping canals and oil industry canals have also contributed to this. More study is needed for verification. See Appendix K for a more detailed description and definition of the coastal erosion hazard.

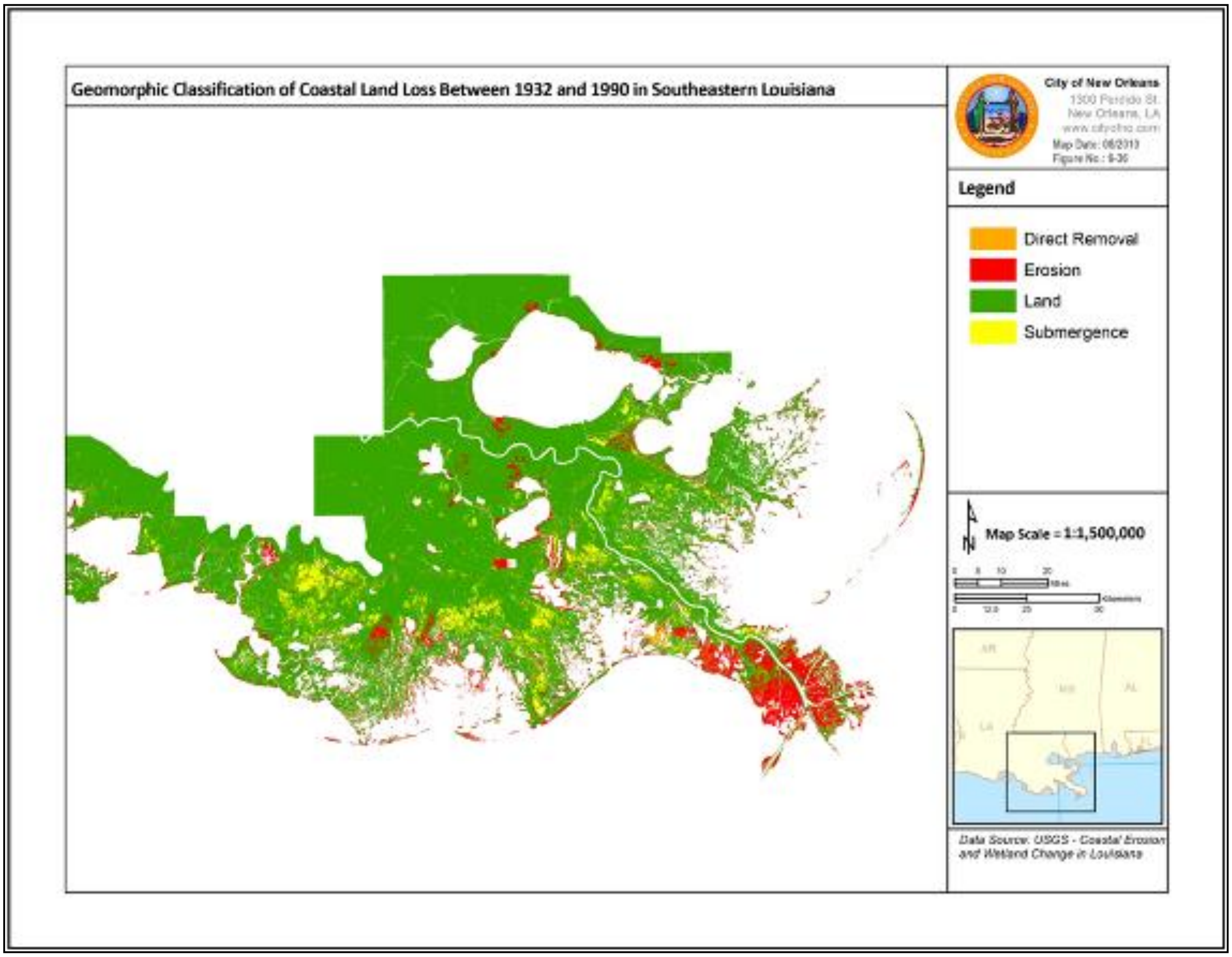
Location and Extent of Coastal Erosion

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 6-36 below identifies areas of coastal erosion that have occurred between 1932 and 1990 in southeastern Louisiana.

Orleans Parish is susceptible to Coastal Erosion in the areas outside of the levees, i.e. the eastern and southern portions of the parish. The maps below illustrate this.

[85] USGS – Coastal Erosion and Wetland Change in Louisiana
[86] USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008

Figure 6-36
Geomorphic Classification of Coastal Land Loss between 1932 and 1990 in Southeastern Louisiana
(Source: USGS – Coastal Erosion and Wetland Change in Louisiana)



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 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.

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.[88]

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

87 USGS – Coastal Erosion and Wetland Change in Louisiana

88 USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008

89 Danger & Opportunity: Implications of Climate Change for Louisiana; A Report for the Louisiana State Legislature to fulfill House Concurrent Resolution 74, May 1999

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.

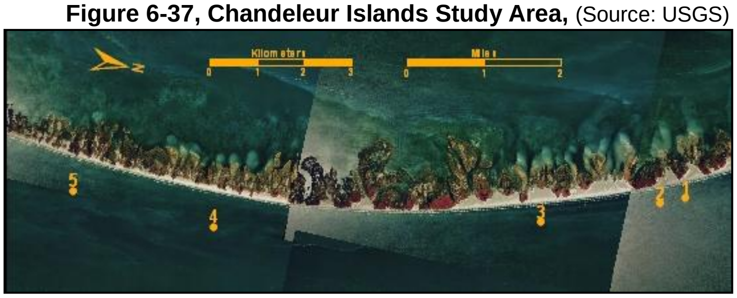
Occurrences of Coastal Erosion

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.

The NCDC database does not track occurrences of coastal erosion, but there are specific cases in southern Louisiana that 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 6-37 identifies the USGS study areas and sections photographed as part of the analysis. Figure 6-38 and 6-39 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.[91]

Figure 6-37, Chandeleur Islands Study Area, (Source: USGS)



[90] LA coastal Wetlands Planning, Protection, and Wetlands News Jan. 2004
[91] USGS Hurricane Katrina Impact Studies

Figure 6-38
Location 2; Photo of Barrier Islands in 2001

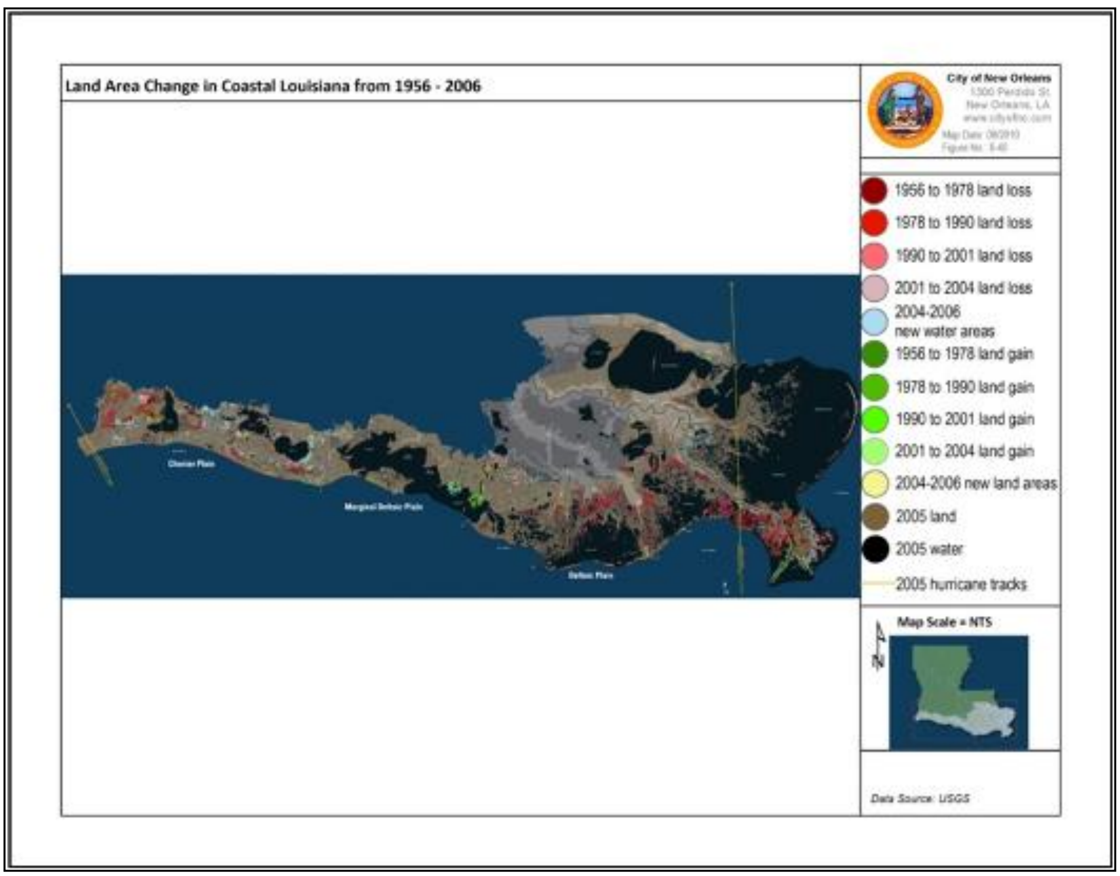
Figure 6-39
Location 2; Photo of Barrier Islands in 2005

- **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.[92]
Figure 6-40 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 6-40
Land Area Change in Coastal Louisiana from 1956 – 2005
(Source: USGS)



92 USACE, Louisiana Coastal Protection and Restoration Technical Report, February 2008

6.3.10 Winter Storms

Description of the Winter Storm Hazard

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 hazard in Louisiana. However, winter weather, ranging from extreme cold to freezing rain, snow and dense fog, can move across Louisiana and result in damage, service losses, injuries, and, in some cases, deaths.

Winter storms typically form along a front generally following the meandering path of the jet stream. These storms, called mid-latitude cyclones or extra-tropical cyclones, differ from hurricanes in that they move from west to east as opposed to east to west. These weather patterns carry cold air from Canada and the Rockies into the southern United States. The origins of the weather patterns that cause winter storms in Louisiana are affected by differences in temperature and pressure, moisture availability, and wind direction as well as weather systems in the Atlantic Ocean and Gulf of Mexico.

Winters in Orleans Parish are mild and the risk of winter storms is relatively low. In southern Louisiana, including Orleans Parish, the coldest months of the year are December through February. During this time, low temperatures average 45 degrees. However, cold fronts that move through the region can drop temperatures below freezing. A severe winter storm would affect the entire Parish; however, cold spells are rare in New Orleans and they seldom last for extended periods of time.

Winter storm events can bring extremely cold temperatures to a region. The wind chill temperature is an indication of 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. An 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. See Appendix K for a more detailed description and definition of the winter storm hazard.

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.

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 2009 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's database indicates that there has been one winter storm event in Orleans Parish between 1950 and 2009. This event occurred on December 25, 2004. The NCDC provides no indication as to why there are no other events than the one in 2004. Table 6-31 summarizes the one winter storm event for Orleans Parish.

Table 6-31
Winter Storm Events, Orleans Parish, 1950 – 2009
(Source: NOAA/NCDC)

Date	Time	Type	Magnitude	Property Damage
12/25/2004	07:00 AM	Winter Storm	N/A	0
Total				0

The Christmas 2004 event resulted in approximately half an inch of sleet and snow accumulating in New Orleans. Since severe winter storms are rare in the City, this event caused hazardous driving conditions. As a result of icy bridges, overpasses, and elevated roadways, there were transportation accidents and many road closures. The New Orleans International Airport was also shut down for several hours due to ice on the runways.

Review of other open sources as part of the 2010 Plan update identified two additional severe winter storms in addition to the 2004 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 6-41 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.[93]

Figure 6-41
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 relatively low, based on previous data. With a total of three winter storm events between 1950 and 2009, Orleans Parish experiences a winter storm on average once every 20 years. The three events have occurred over a period of 59 years, which calculates to a 5-percent annual probability of future winter storm occurrences. Due to its geographic location in the southeastern part of the State, Orleans Parish is at minimal risk to severe winter storms. 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.

[93] National Weather Service: New Orleans / Baton Rouge – Top 20 Weather events of the 20th Century within the New Orleans Baton Rouge Service Area.

6.3.11 Thunderstorms

The original 2005 Plan discussed thunderstorm and lightning hazards together. These hazards have been separated and addressed separately as part of the 2010 Plan update. Data and descriptions related to the lightning hazard have been relocated to Section 6.3.7 of the document. This subsection of the Plan discusses the high-wind component of thunderstorms; separate subsections discuss different components of the hazard, including flooding, tornadoes, hail and lightning.

Description of the Thunderstorm Hazard

Several meteorological conditions related to thunderstorms can result in winds severe enough to cause property damage. Thunderstorms are the by-products of atmospheric instability, which promotes vigorous rising of air particles. A typical thunderstorm may cover an area 3 miles wide. The NWS considers a thunderstorm "severe" if it produces tornadoes, hail of 0.75 inches or more in diameter, or winds of 58 mph or more. Structural wind damage may imply the occurrence of a severe thunderstorm. See Appendix K for a more detailed description of the high wind hazard.

Location and Extent of the Thunderstorm Hazard

Many thunderstorms occur in Orleans Parish each year. This is largely due to its proximity to the Gulf of Mexico, a rich source of the low-level moisture needed for the development of thunderstorms. The potential for thunderstorms is uniform for the entire Parish. All people and assets are considered to have the same degree of exposure.

The extent of thunderstorms may be measured by the cell intensity: ordinary cell, multi-cellular, and super cell. The most common type of thunderstorm is termed the "ordinary" cell, which is limited in size and lifespan, but can produce short bursts of severe weather.

Severity of the Thunderstorm Hazard

Several other variants also exist, but the most dangerous form is termed the "super cell" thunderstorm. The super cell is typically an isolated form and always has the potential to be severe because of its strong and persistent rotating updraft, which dissipates at the upper levels forming the characteristic anvil and overshoot of clouds. Vertical wind shear (i.e., wind speed increasing with height) is important in the development of severe storms such as super cells. The shearing effect serves to separate the updrafts from the downdrafts, thus creating a circulation. In a normal thunderstorm, the downdraft tends to fall back into the updraft, effectively dissipating the storm's energy. Hail and heavy rain are associated with the downdraft zones and under some specific conditions may also form a tornado towards the left rear flank of the storm cell. This small but rapidly rotating column of air descends below the cloud base, reaching the surface with devastating consequences. As the storms translate at speeds typically in the range of 25 to 30 mph, these relatively narrow impact widths become long swaths of potentially very high damage. Super cells may have a lifespan of several hours and present an impact front as wide as 25 miles. Records of damage generally indicate "pulsing" whereby the ground level impacts tend to fluctuate, probably depending on the supply of material held aloft by the updrafts. Very severe super cells can exhibit almost continuous damage fronts for several hours as combinations of wind, rain, and hail.

Impact on Life and Property

Property damage associated with strong thunderstorms in Orleans Parish has historically been minimal (less than 1 percent). The expected damage is assumed to be 1 percent of the value of a structure in the hazard area exposed to a strong thunderstorm. The NCDC database identifies one injury and two deaths from high wind events between 1950 and 2009 in Orleans Parish. Property damage from previous events totaled just under $1.5 million. The overall threat to human life is considered minimal. As stated previously, this section addresses the wind hazard related to thunderstorms – other components of the hazard that create more risks than wind are discussed in other subsections of the Plan. Impacts on life and property from the wind hazard are mostly related to the strength of structures that are exposed to its effects. Generally speaking, wood-frame structures (particularly those with roof overhangs and weak structural envelopes) are more vulnerable to high winds than are commercial structures and infrastructure, which are usually "engineered" and more able to withstand high wind pressures and windborne debris impacts. As such, most of the housing stock in the Parish can be considered somewhat vulnerable to thunderstorm-related winds.

Although, as discussed elsewhere, thunderstorms are quite common in southern Louisiana, past damages have generally been very limited. It should be noted that there is no open-source information available regarding insurance claims for damages from thunderstorms, so such an assessment is based on the limited information available from NOAA/NCDC. Note that the previous wind hazard section includes a brief discussion of wind vulnerabilities, which along with flooding are the main source of significant damage from thunderstorms. The tables show percentages and dollar damages by structure type and use for a range of wind scenarios. It would be possible to prioritize specific types of structures or structure uses for further study using this information, and eventually to identify specific areas in the Parish that may be more vulnerable to the effects of thunderstorm winds. However, as discussed above, this hazard is not particularly significant in the Parish, and this additional study may be a low priority.

Occurrences of the Thunderstorm Hazard

Orleans Parish averages between 60 and 75 thunderstorms per year. Although such storms occur year round, they are more common in the summer months, when the average is 10-15 per month, whereas they occur at an average of two or fewer per month at other times of the year, with variation. Thunderstorms in Orleans Parish frequently result in 1 to 4 inches of rain. The NCDC database indicates that between 1950 and 2009, Orleans Parish experienced 134 severe thunderstorms. Of the 134 thunderstorms, 29 resulted in property damage ranging between $1,000 and $750,000. Table 6-32 summarizes the past thunderstorm events that resulted in property damage of at least $5,000.

Table 6-32
Thunderstorm Events With Property Damage at Least $5,000, Orleans Parish, 1950 – 2009
(Source: NOAA/NCDC)

Date	Time	Type	Magnitude	Property Damage
05/08/1995	09:25 PM	Thunderstorm Winds	0 knots (kts)	750K
05/08/1995	09:33 PM	Thunderstorm Winds	50 kts	250K
03/18/1996	03:00 PM	High Wind	40 kts	250K
04/26/1997	03:04 AM	Thunderstorm Winds	57 kts	50K
07/22/2000	07:30 PM	Thunderstorm Winds	0 kts	10K
08/20/2000	07:40 PM	Thunderstorm Winds	0 kt	5K
09/01/2000	08:06 PM	Thunderstorm Winds	0 kts	5K
11/06/2000	01:45 PM	Thunderstorm Winds	0 kts	50K
06/05/2001	02:45 PM	Thunderstorm Winds	0 kts	15K
04/08/2002	01:15 PM	Thunderstorm Winds	0 kts	15K
04/08/2002	01:55 PM	Thunderstorm Winds	0 kts	10K
11/18/2003	09:45 AM	Thunderstorm Winds	50 kts	8K
07/06/2004	01:00 PM	Thunderstorm Winds	50 kts	15K
Grand Total				1.433M

As mentioned at the beginning of this subsection, historically, Orleans Parish has between 60 and 75 thunderstorms per year. This frequency is likely to remain about the same henceforth, with variations from year to year.
There is a 100% annual statistical probability of thunderstorms occurring in Orleans Parish.

6.3.12 Land Subsidence

Description of the Land 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. See Appendix K for a more detailed description and definition of the subsidence hazard.

Note that the coastal erosion hazard has been added as part of the 2010 Plan update. While most of this section is retained from the original version, specific discussions related to coastal erosion and loss of wetlands have been relocated to the coastal erosion hazard. See Section 6.3.9 for a detailed discussion of the coastal erosion hazard.

Location and Extent of the Land 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.[94]

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

[94] Sea Level Rise and Subsidence: Implications for Flooding in New Orleans, Louisiana

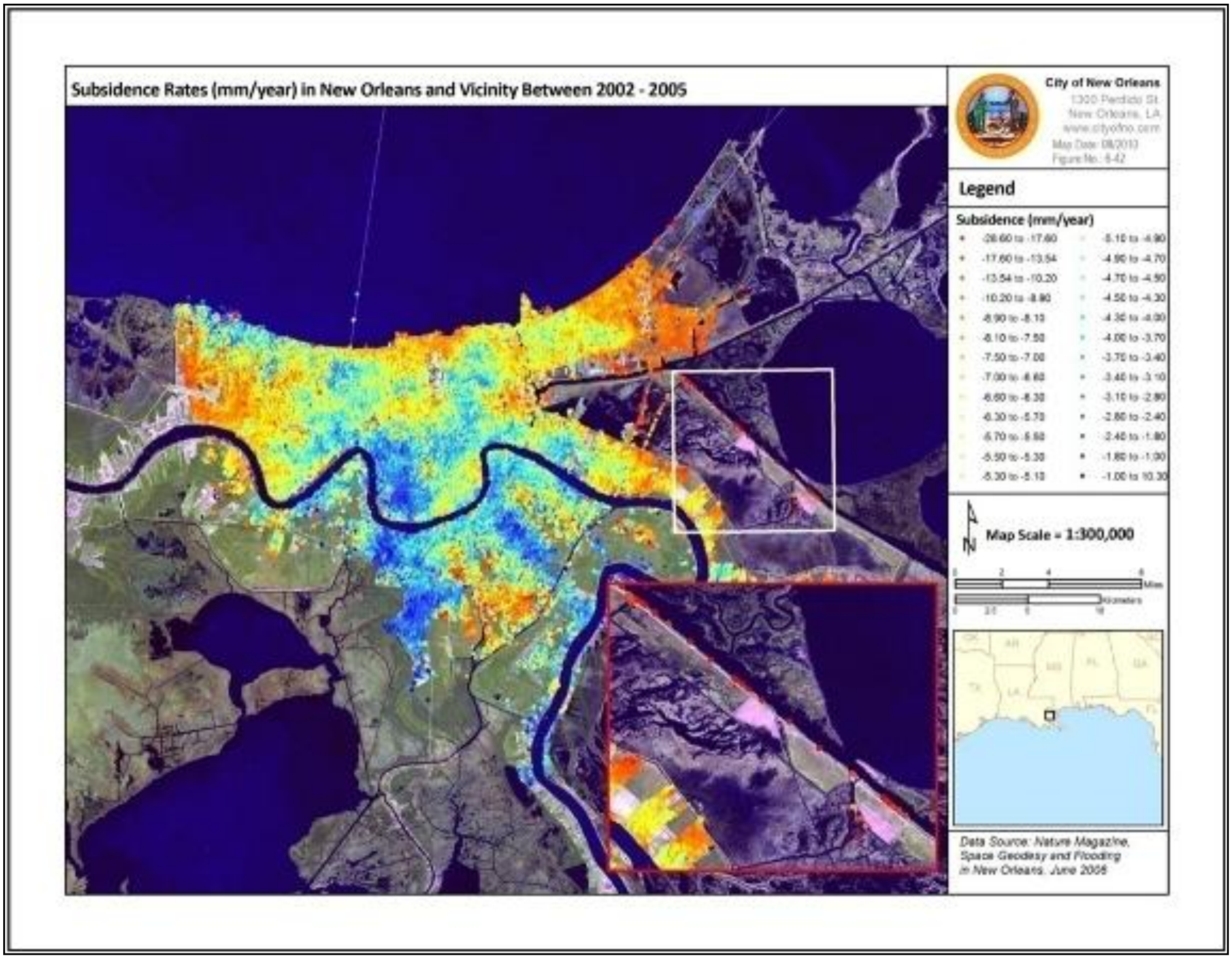
2002 and July 2005 determined the average rate of absolute subsidence across the city of New Orleans to be 0.2 inches +/- 0.1 inches (5.6 mm +/- 2.5 mm) per year. Higher rates of subsidence were found in the Lakeview region along the southern shores of Lake Pontchartrain, while in parts of St. Bernard 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.[95]

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.[96] Subsidence rate projections over the next 50 years are presented later in this subsection.

[95] Flood Risk In New Orleans, RMS Report. Section 3.3, Page 17.
[96] Flood Risk In New Orleans, RMS Report. Section 3.3, Page 17.

Figure 6-42 shows subsidence rates in New Orleans from 2002-2005. 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.[97] Historical subsidence rates from 1951 to 1995 can be found in the Occurrences of Land Subsidence subsection.

Figure 6-42
Subsidence Rates (mm/year) in New Orleans and Vicinity between 2002 – 2005
(Source: Nature Magazine, Space Geodesy and Flooding in New Orleans, June 2006)



[97] *Nature*, Space Geodesy: Subsidence and Flooding in New Orleans, Vol. 441, June 2006.

Severity of Land 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 6.3.9 for a detailed description of the coastal erosion hazard.

At the time of the 2010 Plan update, specific data about the extent of infrastructure and property damage in Orleans Parish due to subsidence was unavailable. Gathering and tracking data about damages in the Parish associated with subsidence has been added as an action item in Section 6 of the Plan update.

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 6-42 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 Land Subsidence

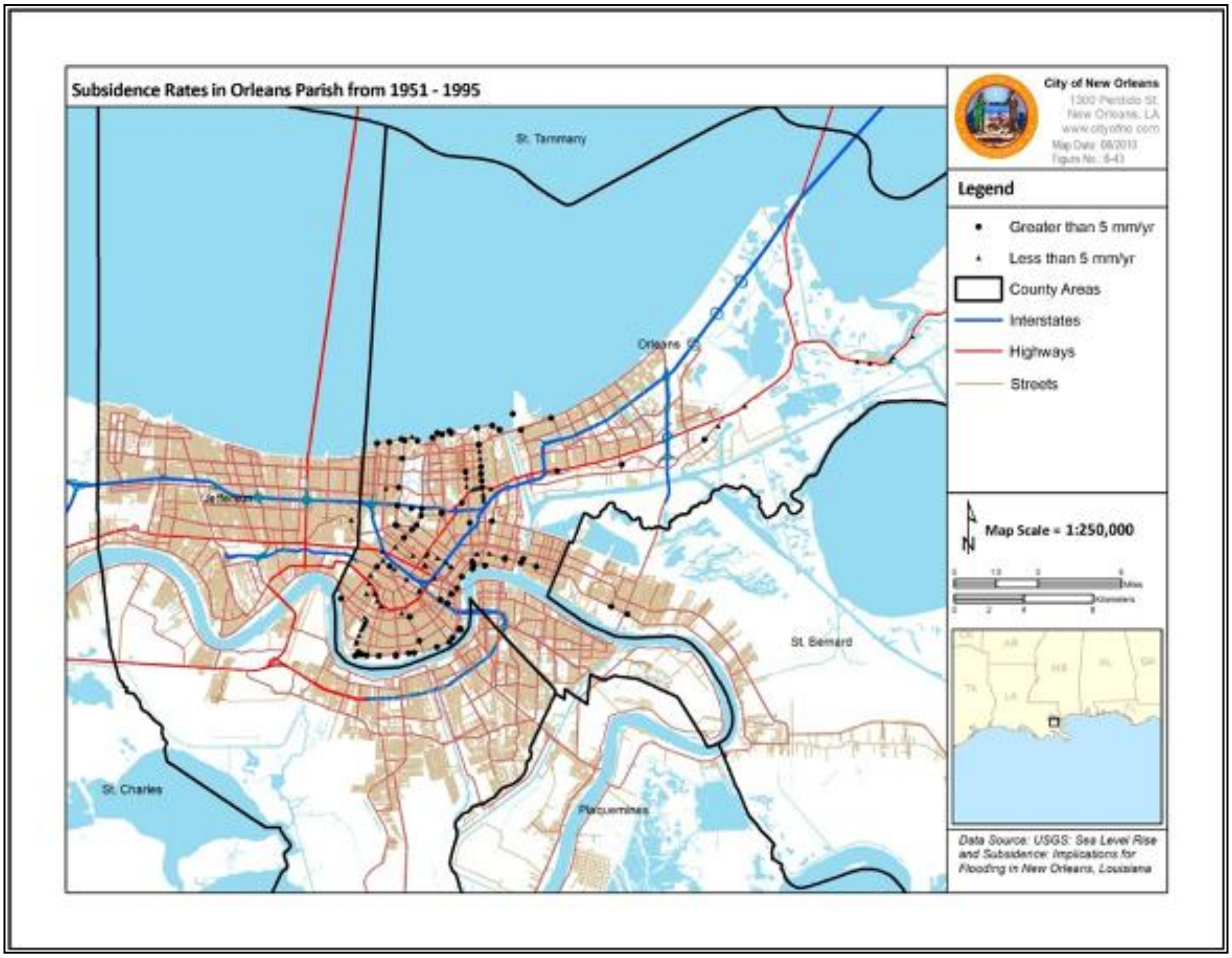
Most of the land surface within the New Orleans Metropolitan Statistical Area, a region that includes all or parts of seven parishes, is sinking or "subsiding" relative to mean sea level. This is an ongoing occurrence, and, therefore, it is difficult to identify specific occurrences of the land subsidence 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.[98]

[98] USGS: Sea Level Rise and Subsidence: Implications for Flooding in New Orleans, Louisiana

Figure 6-43 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)

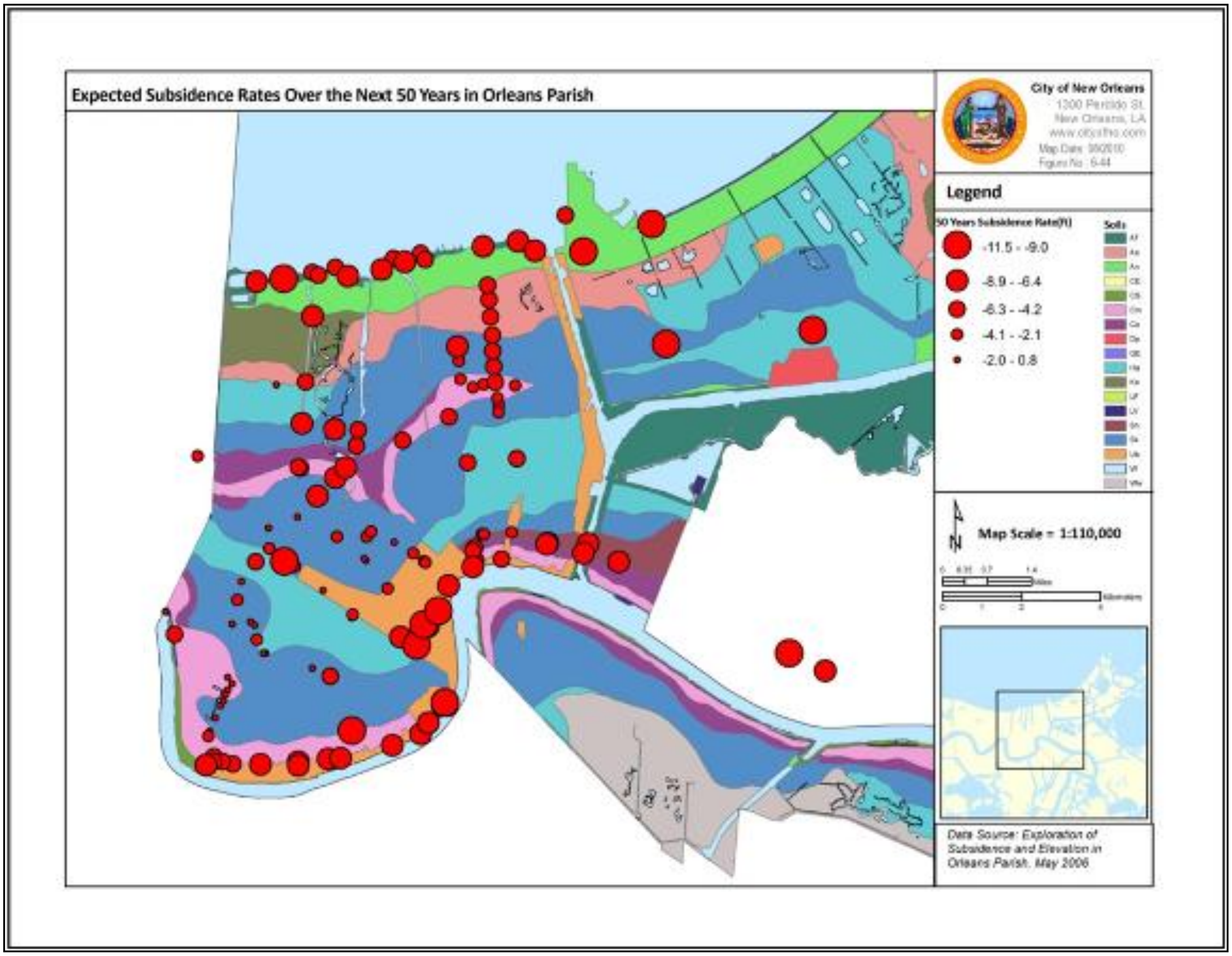


The report titled *Exploration of Subsidence and Elevation in Orleans Parish*, prepared by the Department of Regional Planning at the University of Wisconsin-Madison and published in May 2006 after Hurricane Katrina, provides subsidence rate predictions in the New Orleans area over the next 50 years. 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.[99]

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)



[99] Exploration of Subsidence and Elevation in Orleans Parish published in May, 2006

Table 6-33 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 6-33
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 is not possible to assign a probability percentage for this hazard. 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.

6.3.13 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. See Appendix K for a more detailed description and definition of the drought 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.

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.[100] 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.

[100] FEMA, 1997

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. Although no property damage was reported, crop damage from an August 1998 event totaled $77.5 million. The most significant threat presented by drought is the potential for agricultural losses. Because of the medium- to high-density character of Orleans Parish, the planning area is not considered vulnerable to the effects of drought.

Occurrences of the Drought Hazard

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 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)

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 Orleans Parish 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.[101] 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.[102] 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.[103]

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.[104]

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)

[101] NOAA. Palmer Index Chart
[102] NOAA. National Weather Service (NWS) – New Orleans / Baton Rouge Office
[103] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.
[104] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.

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. The Parish experiences a drought event on average slightly more than once every 12 years. The four events have occurred over a period of 59 years, which calculates to an 8-percent-annual probability of future drought occurrences. Based on the historical data provided by the NCDC, the probability of future droughts in Orleans is considered low to moderate. 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, and therefore the mitigation strategy does not include actions to address the effects of drought.

6.3.14 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. See Appendix K for a more detailed description of the hazardous materials spills/contamination hazard.

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.

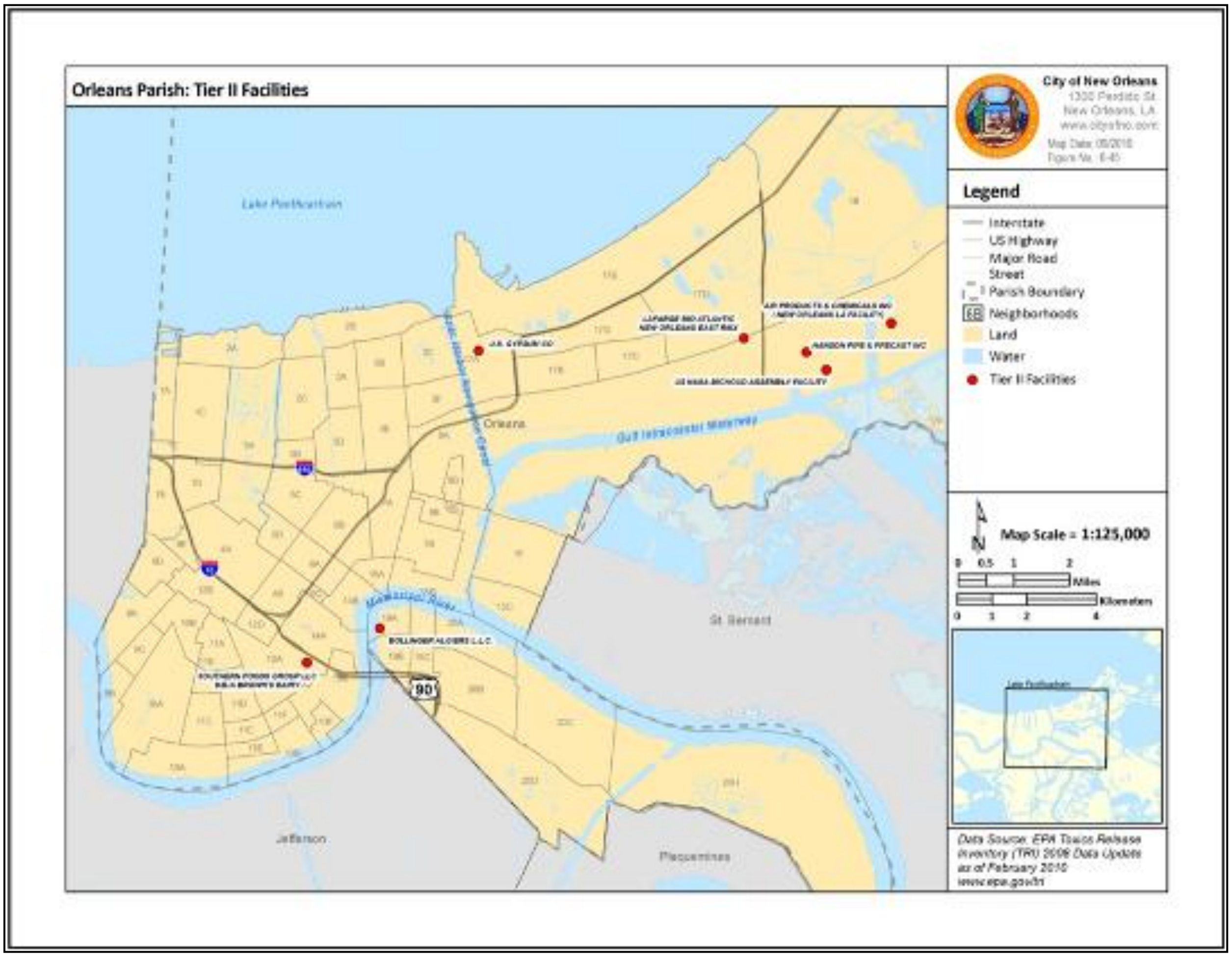
New Orleans also has an extensive system of navigable waterways, including the Mississippi River and the Industrial Canal. More than one third of all industrial chemicals transported on the nation's inland waterway system pass through the New Orleans Industrial Canal.[105] Also, because of the many modes 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

[105] Taxpayers for Common Sense and the National Wildlife Federation. "Troubled Waters." March 2000.

on which chemical is involved and which environmental medium the chemical is emitted into (i.e., land, air, water, or underground injection).

Figure 6-45
Orleans Parish: Tier II Facility Locations
(Source: EPA TRI, 2008)



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.[106] 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

106 Pine, John, Erno Sajo, and Rebecca East. "An Assessment of Transportation of Extremely Hazardous Substances for the Southern Mississippi River Corridors." January 1998. <http://www.risk.lsu.edu/Documents/MS_Rail_Study.pdf>

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 6-36 below illustrates the relatively small number of Hazardous Material-related incidents that led to a Presidential Disaster Declaration.

Table 6-36
Hazmat Related Federal Disaster Declarations
(Source: FEMA)

DR - Number	Declared	State	Description
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. Between 1995 and 2009, the NOFD HazMat unit responded to a total of 31,063 hazardous material incidents. Of this total, 1,394 were transportation related and 29,669 were fixed-site hazardous material calls.[107] Table 6-37 summarizes the fixed site and transportation incidents for Orleans Parish between 1995 and 2009, grouped into 5-year increments. The table shows that the majority of incidents occurred between 2005 and 2009. During this time period, the HazMat unit responded to 21,190 incidents, 68.2 percent of the 31,063 total incidents.

[107] Based on data on the number of HazMat team responses from 1995-2009.

Table 6-37
Summary of Fixed-Site and Transportation Hazardous Material Incidents for Orleans Parish, 1995-2009
(Source: New Orleans Fire Department HazMat Unit, February 2010)

HazMat Category	1995-1999	2000-2004	2005-2009	Total
Fixed-sites	2,842	5,888	20,939	29,669
Transportation	499	644	251	1,394
Grand Total	3,341	6,532	21,190	31,063

The data in Table 6-37 above can be further broken down to show the incident details within both the fixed sites and transportation categories. Table 6-38 summarizes the fixed-site hazardous material incidents between 1995 and 2009. The table is ordered by total incidents per category, and shows that hazardous material surveys performed after Hurricane Katrina in 2005 and 2006 had the most fixed-site incidents over the 15-year period. Of the 30,554 fixed-site incidents, a total of 14,056, or 46 percent, occurred in 2005, mainly resulting from the contamination associated with Hurricane Katrina. As a result of Katrina, the NOFD HazMat unit surveyed 11,619 hazardous material locations in 2005.

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.

Table 6-38
Orleans Parish: Number of Fixed Site Incidents per Year, 1009 - 2009
(Source: New Orleans Fire Department HazMat Unit)

Incident Type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Katrina Survey for HM items											11,619	1,973				**13,592**
Fuel / Oil Spills	286	231	318	397	812	748	760	797	764	826	384	376	237	451	212	**7,599**
Natural Gas Line Release	na	na	na	na	na	na	na	na	na	503	885	734	478	406	285	**3,291**
Fumigations	na	na	na	na	na	na	na	na	na	na	5	322	317	260	326	**1,230**
Gas Leak	15	61	18	14	13	17	4	6	16	53	1,000	0	0	4	4	**1,229**
Fire - Structure or Vehicle	72	24	18	13	40	28	36	23	35	40	14	40	46	44	44	**517**
Carbon Monoxide	0	0	0	0	0	0	77	53	45	31	0	0	125	26	28	**385**
Fire Alarms/Business	34	19	34	31	35	28	23	27	30	38	0	0	1	1	1	**302**
Investigations	15	29	12	32	43	64	13	8	23	43	0	0	1	5	7	**295**
Suspicious White Substance	0	0	0	0	0	0	167	22	35	24	0	0	8	3	10	**271**
Chemical/Fuel Spills	12	6	4	1	0	3	19	24	32	47	20	8	8	8	23	**215**
Odors	12	32	15	17	15	17	9	3	11	23	3	8	1	4	9	**179**
Special Assist Request	0	0					12	22	21	34	7	7	23	20	20	**166**
Carbon Monoxide	0	0	18	12	21	10	5	9	12	18	0	4	5	5	4	**123**
Explosions/Bomb Threats	0	0	12	29	19	17	15	4	5	6	0	4	5	2	0	**118**
Suspicious Letter/Package	0	0	0	0	0	0	37	13	4	6	0	0	5	1	5	**71**
Confine Space/Entrapment	0	0	0	1	0	3	8	8	6	10	0	0	19	2	6	**63**
Radiation Event	0	0	0	0	0	0	1	1	2	4	1	6	3	4	1	**23**
Grand Total	**446**	**402**	**449**	**547**	**998**	**935**	**1,186**	**1,020**	**1,041**	**1,706**	**13,938**	**3,484**	**1,286**	**1,246**	**985**	**29,669**

Table 6-34 summarizes the transportation hazardous material incidents between 1995 and 2009. As with the fixed-site incidents, the table is ordered by total incidents per category, and shows that the highway category had the most transportation incidents over the 15-year period. The highway category had a total of 480 incidents between 1995 and 2009.

The number of highway incidents is closely followed by the 479 railroad incidents. Of the 1,394 transportation incidents between 1995 and 2009, a total of 959, or 68.7 percent, were related to either highway or railroad incidents.

Table 6-39
Orleans Parish: Number of Transportation Incidents Per Year, 1995-2009
(Source: New Orleans Fire Department HazMat Unit)

Incident Type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Highway	63	94	37	20	43	50	29	24	32	34	3	5	23	21	2	**480**
Railroad	33	14	21	27	18	30	36	48	55	63	107	2	9	9	7	**479**
Truck/Container	0	0	28	33	29	27	33	27	35	49	4	17	11	6	3	**302**
Wharf/Vessel	22	2	2	4	4	6	8	9	13	12	2	4	3	5	2	**98**
Airport/Aircraft	0	0	1	2	2	2	6	1	4	11	2	0	2	1	1	**35**
Grand Total	**118**	**110**	**89**	**86**	**96**	**115**	**112**	**109**	**139**	**169**	**118**	**28**	**48**	**42**	**15**	**1,394**

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 6-46 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 6-47 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.

[108] Cityscape: A Journal of Policy Development and Research. Volume 9, Number 3. US Department of Housing and Urban Development. Hurricane Katrina: Environmental Hazards in the Disaster Area, Danny Reible, University of Texas. 2007

Figure 6-46
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)

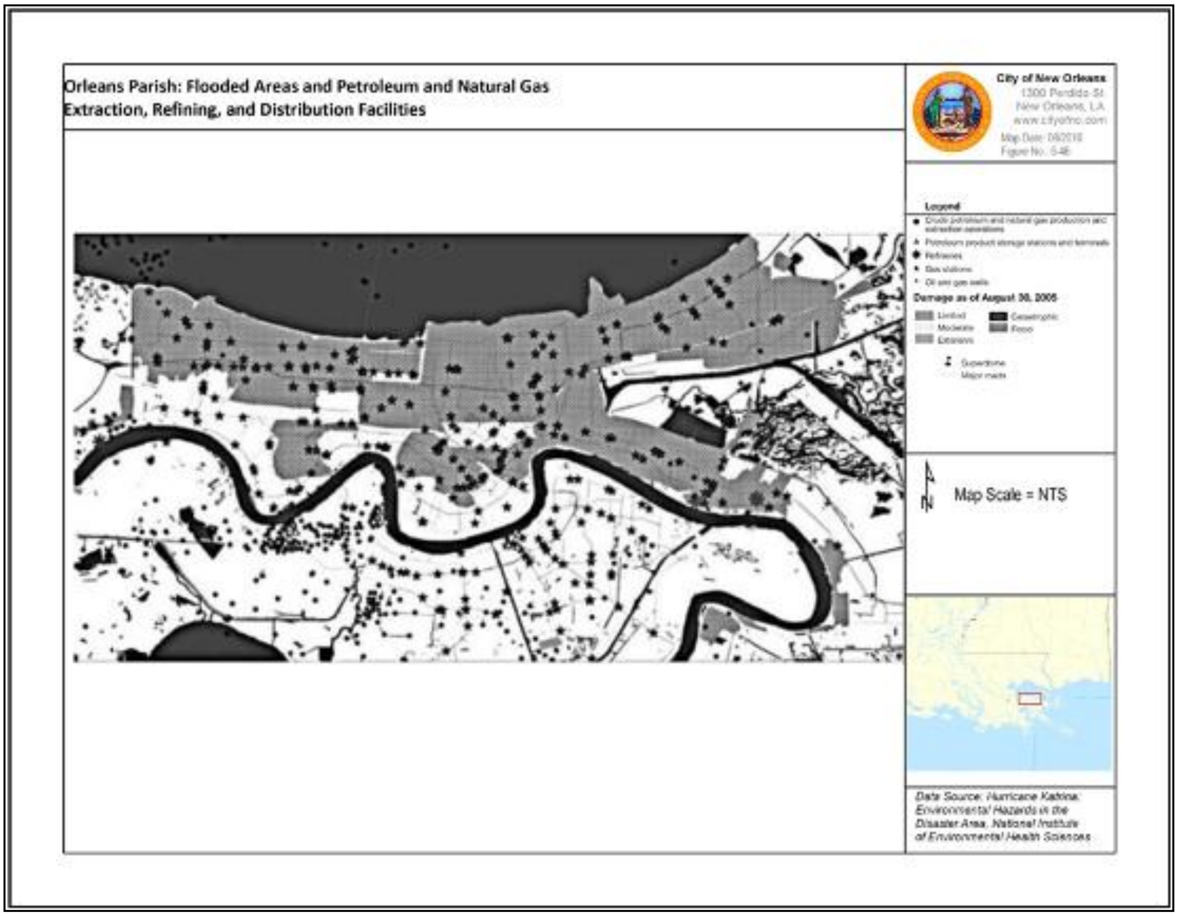
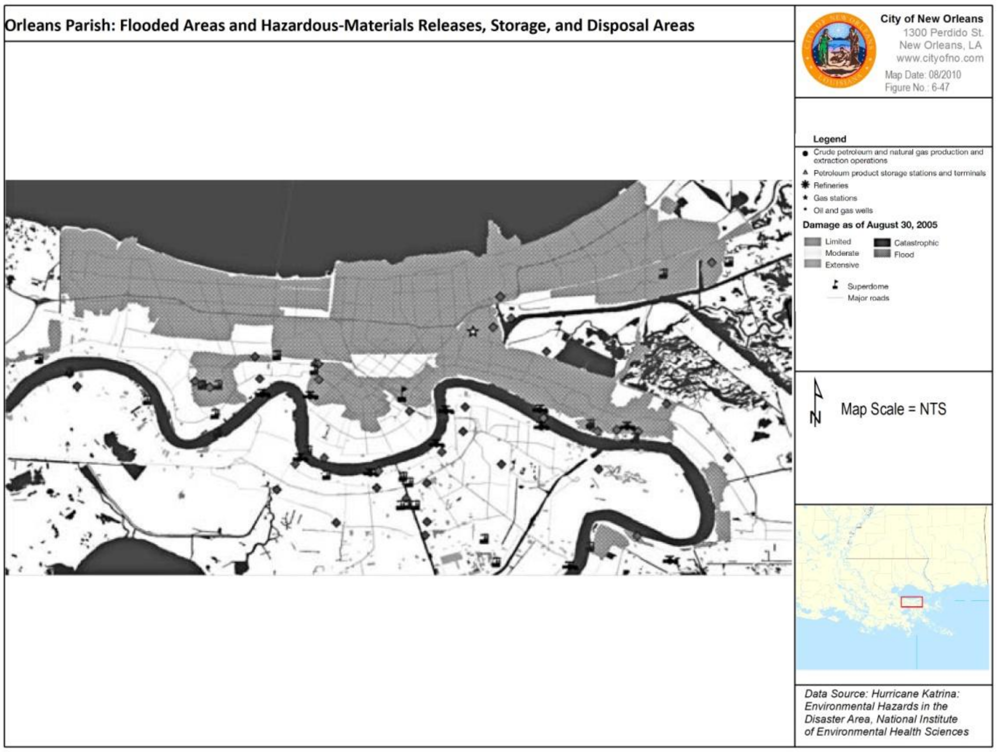


Figure 6-47
Orleans Parish: Flooded Areas and Hazardous-Material Releases, Storage, and Disposal Areas
(Source: Hurricane Katrina: Environmental Hazards in the Disaster Area, National Institute of Environmental Health Sciences, 2005)



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 6-48
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. In 2009, there were 4,474,079 barrels of crude oil taken offshore Louisiana (excluding Outer Continental Shelf (OCS) production.

Figure 6-49
Oil and Gas Extraction Infrastructure in HIB Region

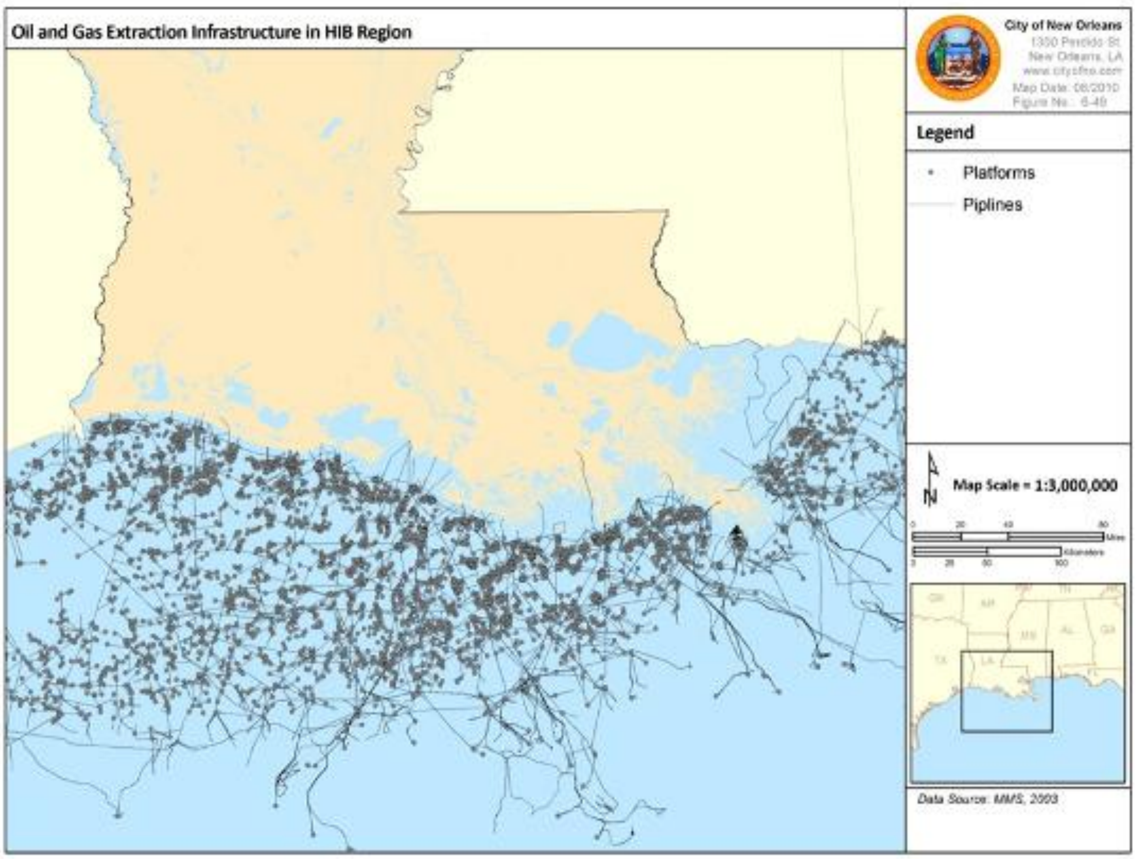
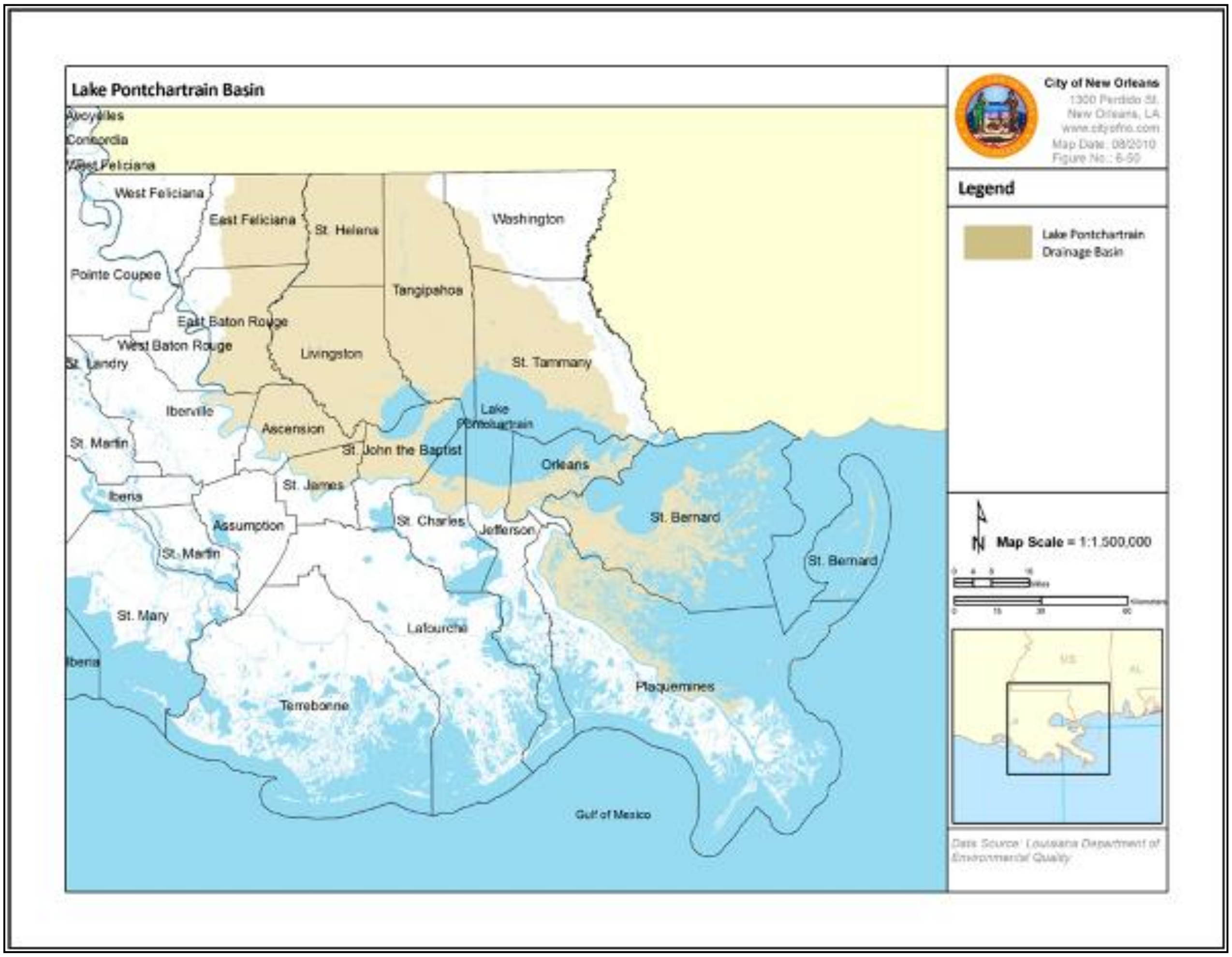


Figure 6-50
Lake Pontchartrain Basin



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. Many of those experts are shuddering at the possible consequences of a months-long oil spill washing up on the coast."

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

[109] Times Picayune: http://www.nola.com/news/index.ssf/2010/04/oil_to_reach_louisiana_coast_b.html

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.

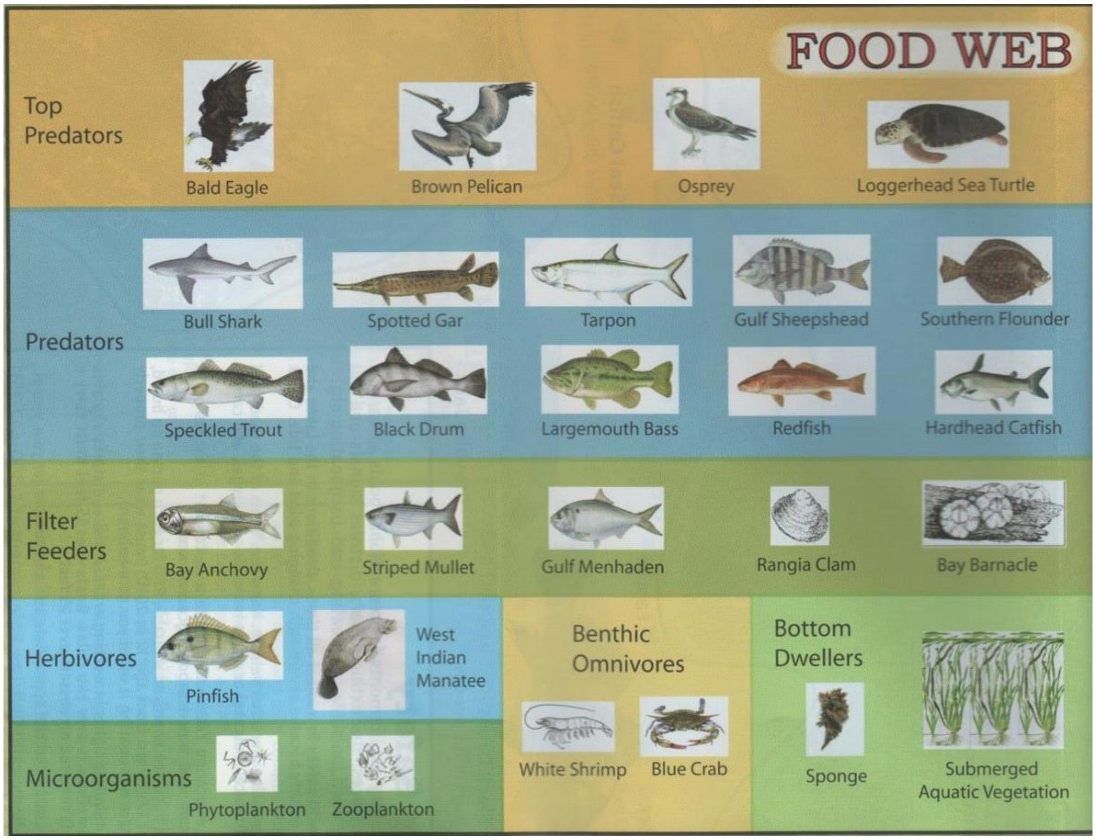
The Bayou Sauvage National Wildlife Refuge is located in eastern Orleans Parish at the south end of the Lake Pontchartrain Sanctuary, and Fort Pike State Park is found at its north end. According to the U. S. Fish & Wildlife Service "Bayou Savage National Wildlife Refuge" was established in 1990. Its 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."

According to the U.S. Fish and Wildlife Service, "Bayou Sauvage 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.

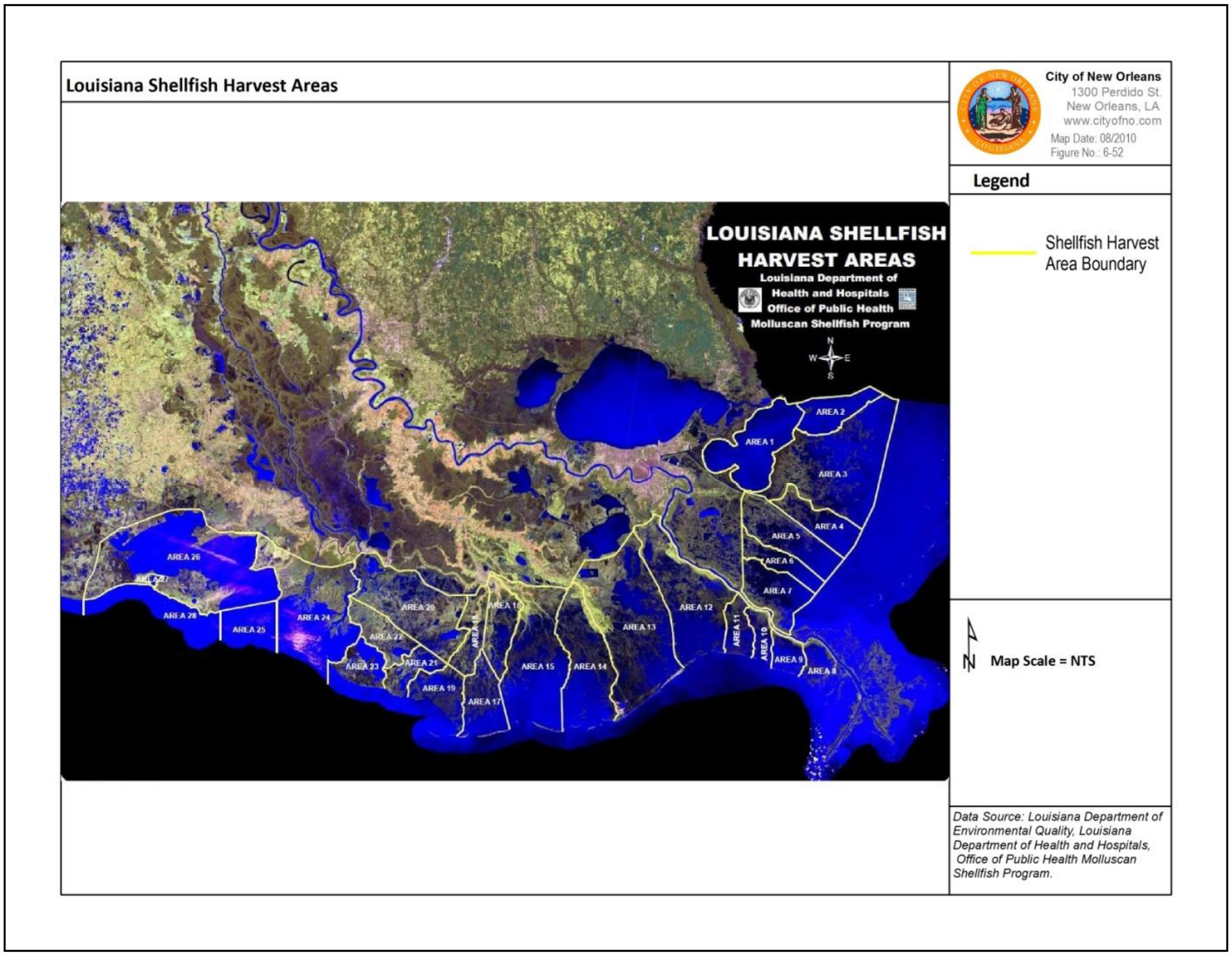
Figure 6-51
Food Web of the Gulf of Mexico



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.

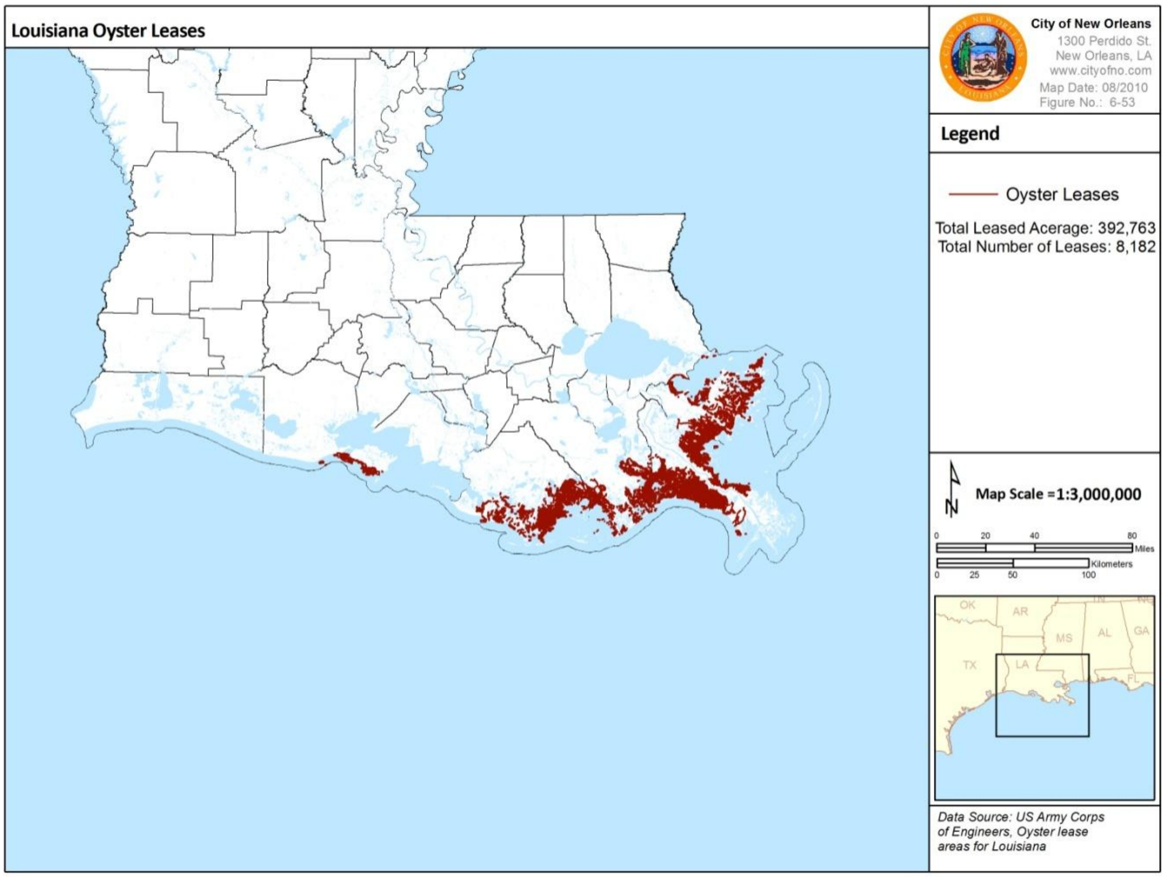
Crabs are found in many water areas throughout the Parish and the harvesting of crab is legal throughout these waters. The Louisiana Department of Wildlife and Fisheries estimates that approximately 993,000 pounds of blue crab was landed in Orleans Parish in 2009. Recreational crabbing is an important 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 6-52
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 6-53 shows the locations of the oyster leases.

Figure 6-53
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.

Section 7
Vulnerability Assessment and Loss Estimation

Contents of this Section

One of the first steps in developing the 2010 City of New Orleans HMP update was to complete a comprehensive evaluation of the existing document, completed in 2005, to determine (a) specific areas that required updates, such as incorporation of data about recent hazards or documenting the 2010 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. Specifically with regard to the hazard identification/profiling and vulnerability assessment/loss estimation parts of the existing plan, based on a detailed evaluation, the City (specifically the Steering Committee) and the technical consultants concurred that the most efficient method of updating the plan would be to completely re-organize and re-write the section, dividing it into two sections: Sections 6 and 7. Although the original plan document was technically accurate when it was approved, since that time there have been numerous, highly detailed vulnerability and risk studies completed by various government and private-sector organizations, all of which were reviewed in detail, analyzed and incorporated into the City of New Orleans Hazard Mitigation Plan.

7.1 Interim Final Rule Requirement for Risk Assessments

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

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.*

IFR §201.6(c)(2)(ii): *[The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.*

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

IFR §201.6(c)(2)(ii)(B): *[The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.*

IFR §201.6(c)(2)(ii)(C): *[The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

Background

As explained in the FEMA Local Multi-Hazard Mitigation Planning Guidance (July 2008), the purpose of a risk assessment in a Hazard Mitigation Plan is to "provide sufficient hazard and risk information from which to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards"[1]. The most significant hazard faced by Orleans Parish is flooding, which is caused by extreme rainfall events, storm surge, or both. With regard to vulnerability assessments, the focus of the FEMA rules and guidance for local mitigation plans is on the structures and people that are potentially at risk from hazards, including (but not limited to) "buildings, infrastructure, critical facilities, structures that house the elderly or disabled, and areas where low-income populations reside"[2]. This section of the 2010 Hazard Mitigation Plan update is divided into Vulnerability Assessment and Loss Estimation subsections. Each section is based in part on the extensive body of studies and reports that were conducted after Hurricane Katrina, and in part on first-generation assessments.

The Vulnerability Assessment subsection discusses the types and numbers of structures and people that are exposed to hazards, and also describes levee vulnerabilities as a component of flood and storm surge risks. The Loss Estimation section includes flood, storm surge, and hurricane wind loss estimates. These loss estimates are comprised of summaries of the extensive risk literature that exists for the City, as well as loss estimates based on (a) repetitive flood insurance claims information, (b) statistical projections of losses to public facilities based on FEMA Public Assistance records, and (c) FEMA HAZUS level-1 calculations of hurricane wind risk.

[1] FEMA Local Multi-Hazard Mitigation Planning Guidance, July 2008, page 29.
[2] FEMA Local Multi-Hazard Mitigation Planning Guidance, July 2008, page 36.

Note that the earlier Hazard Identification and Profiling section of this Plan includes detailed descriptions of 14 hazards with potential to impact Orleans Parish. That section includes discussions of past events, and their magnitude, extent, severity, and probability. This section is intended to supplement the hazard identifications and provide estimates of potential losses related to floods and hurricane-generated wind.

An Additional Note on Vulnerability and Risk Studies

As noted above, following Hurricane Katrina, the New Orleans area was the subject of several comprehensive and detailed vulnerability and risk studies. Some of the reports were forensic in nature, i.e., their intent was to identify and characterize the reasons why the City flooded so severely. These studies tend to focus on the performance of the Hurricane Protection System (HPS), the location and elevation of buildings and people, and the nature of the emergency response. Other studies are focused on risk, specifically the potential effects of future events, based on (a) their estimated probability and severity and (b) physical characteristics of the areas at risk, specifically the performance of the HPS, the potential effects of land subsidence and sea level rise, and the relative elevations of structures and people.

These studies (in particular the U.S. Army Corps of Engineers Evaluation of the New Orleans and Southeast Louisiana HPS , which is sometimes referred to as the Interagency Performance Evaluation Task Force (IPET) report because it is the final report of the IPET) and use state-of-the-art methodologies to estimate risk. A central purpose of this Hazard Mitigation Plan is to present and summarize these studies, place them in the context of FEMA planning requirements, and to combine them to the extent possible with first-generation risk estimates. In some cases there is insufficient information to complete detailed estimates. This is noted in text and where appropriate the Parish and Steering Committee have included strategies and actions to obtain such information and use it as part of the basis for the next plan update (and for further developing mitigation projects).

There are two recurrent themes in the various risk and vulnerability studies that were reviewed and incorporated in this Hazard Mitigation Plan. First, risk is dynamic, i.e., the potential for damage from the effects of natural hazards is changing constantly for a variety of reasons. Second, flood risk in New Orleans is created both by the potential for extreme rainfall and by the possibility of storm surges that overwhelm the HPS. All technically valid risk studies include discussions about the uncertainties inherent in probability-based loss estimations, and many present risk calculations in ranges to more accurately characterize this uncertainty.

7.2 Overview and Analysis of Orleans Parish's Vulnerability to Hazards

Vulnerability to natural hazards is directly related to the physical assets of a place and the operations that are taking place in it. Vulnerability is related to, but not analogous to, exposure, which is simply the numbers or value of assets and operations that can potentially be impacted by hazards. Vulnerability is the extent to which something is damaged, people are injured or killed, or operations interrupted when natural hazards strike. As noted in various reports and plans, the residential building stock in Orleans Parish is generally comprised of wood-frame structures, with earlier construction tending to be elevated above grade (often with crawlspaces), and the later construction generally being slab-on-grade. Wood frame construction tends to have about the same vulnerability to floods regardless of the year of construction, because the materials and construction techniques (balloon framing, gypsum board, etc.) are *generally* similar. There are potential differences in the vulnerabilities of such structures based on the quality of construction and materials – for example, engineered commercial structures with little or no gypsum board, no carpet, and elevated electrical panels are less vulnerable to flood damage than most ordinary residences. A similar point can be made about vulnerabilities to wind – structures that are built to higher standards, with certain structural details, are often less vulnerable to wind than ones of lower design or construction standards (and materials).

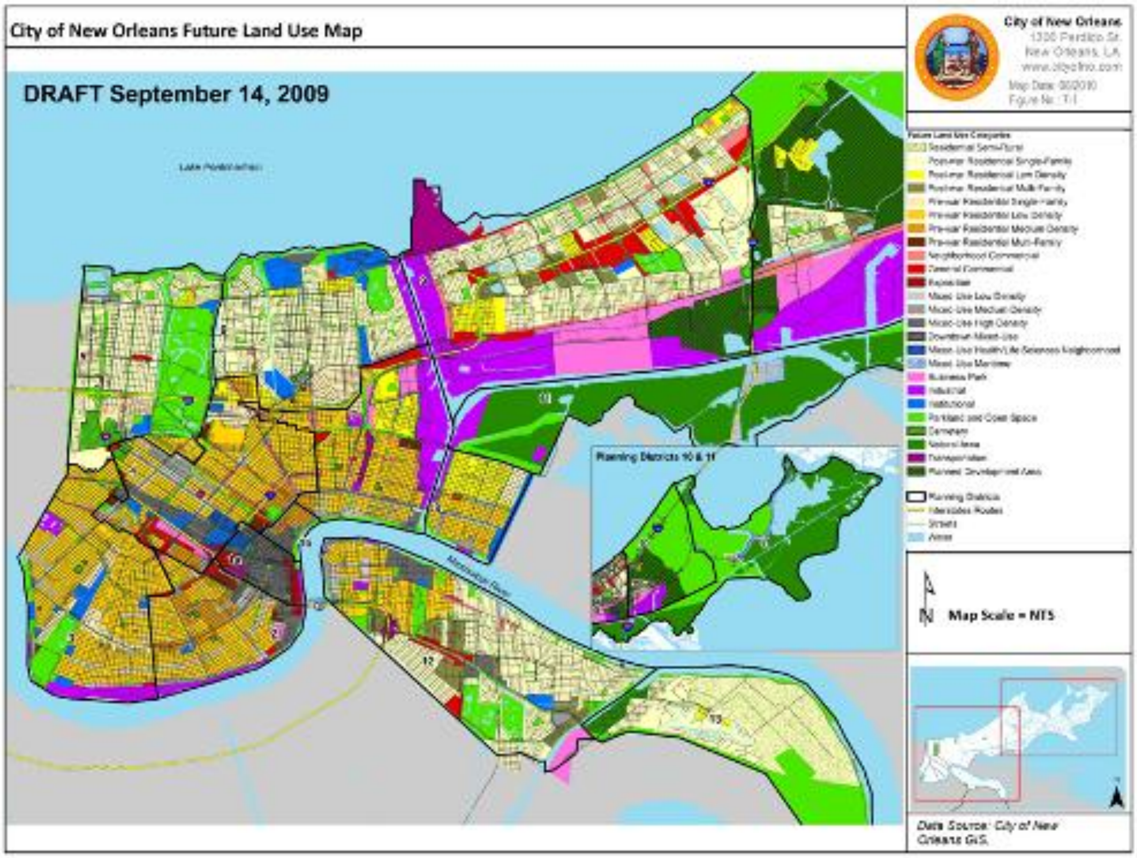
At this time in Orleans Parish, there exists no comprehensive database of structure types for either privately owned or publicly owned structures, so vulnerability assessments are necessarily general at this point in time and are closer to measures of exposure. However, the various reports and methodologies in the later Loss Estimation subsection assign specific damage functions (percentages of damage based on various hazard severities such as flood depth, wind speed, and so on) to various asset classes, in many cases based on FEMA HAZUS datasets. Table 7-1 below summarizes the square footage and value of exposure in Orleans Parish, from HAZUS version MR4. Note that the data in this table is intended only to provide a general sense of the level of exposure and in some cases may disagree with more current information in other studies or reports.

Table 7-1
Orleans Parish: Building Exposure and Square Footage by Occupancy Type
(Source: HAZUS-MH Version MR4)

Occupancy Type	Total Square Feet	Dollar Exposure	% of Total
Residential	316,586,000	$27,262,840,000	77.6%
Commercial	47,147,000	$5,089,867,000	14.5%
Industrial	8,931,000	$769,207,000	2.2%
Agriculture	397,000	$25,912,000	0.1%
Religious	7,112,000	$847,538,000	2.4%
Government	3,399,000	$362,212,000	1.0%
Education	6,692,000	$769,910,000	2.2%
Total	**390,264,000**	**$35,127,486,000**	**100%**

The most recent City of New Orleans land use map (Figure 7-1, below) gives a general idea about the distribution of land uses in the City.

Figure 7-1
City of New Orleans Future Land Use Map
(Source: Plan for the 21st Century. New Orleans 2030. Vol. 2, Technical Plan, September, 2009).



The next table (Table 7-2) displays the number of utility hookups and estimated population of all the neighborhoods in New Orleans. The table shows the trends in both categories from the month prior to Hurricane Katrina to November 2009. The utility hookup figures serve as an approximation of the number of occupied structures in the City, and the two metrics (occupied structures and population) are in turn measures of the overall vulnerability of the City to hazards, in terms of general exposure.

Table 7-2
Number of Orleans Parish Households with Active Electric Accounts and Population for Years 2005 – 2009, Ordered by Neighborhood
(Sources: Entergy/GCR Associates, November, 2009)

	Electric Accounts						Population					
Neighborhood	July 2005	July 2006	July 2007	July 2008	July 2009	Nov 2009	July 2005	July 2006	July 2007	July 2008	July 2009	Nov 2009
Algiers Naval Station	685	678	665	643	639	641	2,717	4,041	3,905	3,851	3,866	3,900
Algiers Point	1,308	1,280	1,291	1,293	1,292	1291	2,229	2,460	2,425	2,443	2,452	2,465
Algiers Whitney	902	831	837	850	850	854	2,400	2,456	2,304	2,376	2,389	2,417
Audubon/University	6,259	5,434	5,777	5,949	5,981	5830	13,947	13,687	14,237	14,625	14,948	14,658
Aurora/Walnut Bd./Huntlee	6,193	5,714	5,949	6,114	6,073	5988	14,798	15,108	15,434	15,672	15,726	15,571
Bayou St. John	2,144	1,408	1,632	1,768	1,846	1851	4,564	3,212	3,718	4,103	4,321	4,367
Behrman	3,679	3,108	3,118	3,131	3,113	3060	9,764	9,230	9,028	8,938	8,955	8,893
Black Pearl	1,075	994	1,023	1,017	1,021	1017	1,659	1,751	1,770	1,751	1,774	1,781
Broadmoor	3,043	815	1,512	1,960	2,213	2227	6,765	1,954	3,499	4,527	5,174	5,262
Bywater	2,297	1,625	1,708	1,839	1,922	1909	4,733	3,369	3,530	3,875	4,056	4,062
Calliope Project	112	23	41	51	53	53	4,089	55	86	110	118	121
Central Business District	1,333	1,318	1,579	1,625	2,056	2066	1,679	1,501	1,557	1,359	1,317	1,320
Central City/Magnolia	6,560	4,415	4,880	5,203	5,275	5249	17,827	10,521	11,677	12,180	12,436	12,551
City Park	971	801	868	880	901	903	1,547	1,389	1,470	1,492	1,547	1,555
Country Club Gardens	246	200	228	227	232	234	586	501	570	578	597	606
Country Club/Dixon A	650	206	367	440	505	517	1,653	568	938	1,112	1,306	1,347
Desire Area	1,252	160	363	402	441	445	3,549	465	1,102	1,181	1,335	1,359
Desire Project	138	-	-	67	193	190	618	-	-	48	276	274
Dillard	2,478	856	1,538	1,708	1,798	1823	6,058	2,336	3,952	4,369	4,682	4,786
East Carrollton	2,365	2,117	2,146	2,261	2,254	2178	4,155	4,274	4,247	4,481	4,519	4,401
East Riverside	1,541	1,421	1,421	1,459	1,460	1477	3,046	3,089	3,020	3,124	3,165	3,207
Edgelake/Little Woods	16,140	3,062	6,710	10,170	11,902	12137	41,488	9,089	19,630	28,860	33,621	34,521
Fairgrounds/ Broad	2,650	1,626	2,046	2,204	2,260	2290	6,184	3,898	4,897	5,374	5,609	5,663
Fillmore	2,793	462	928	1,192	1,591	1652	6,525	1,236	2,472	3,189	4,072	4,254

	Electric Accounts						Population					
Neighborhood	**July 2005**	**July 2006**	**July 2007**	**July 2008**	**July 2009**	**Nov 2009**	**July 2005**	**July 2006**	**July 2007**	**July 2008**	**July 2009**	**Nov 2009**
Fischer Project	170	168	243	232	225	224	1,904	2,708	3,073	3,092	3,100	3,173
Florida Area	1,090	77	241	315	419	441	2,969	230	702	923	1,248	1,319
Florida Housing Dev.	121	-	2	3	3	3	1,502	-	0	0	0	0
Freret	892	387	531	587	647	646	2,290	974	1,294	1,444	1,626	1,635
Garden District	1,156	1,092	1,133	1,144	1,131	1133	1,844	1,969	1,975	1,998	1,995	2,014
Gentilly Terrace	4,300	1,825	2,686	3,149	3,324	3352	9,869	4,519	6,602	7,819	8,379	8,514
Gentilly Woods	1,535	395	751	877	973	1000	3,995	960	1,979	2,358	2,634	2,721
Gerttown/Zion City	1,407	449	790	935	1,067	1043	4,418	1,315	2,059	2,413	2,912	2,894
Hollygrove	2,639	779	1,419	1,638	1,691	1761	6,507	2,107	3,655	4,225	4,535	4,794
Holy Cross	1,845	91	483	785	985	1013	5,155	270	1,477	2,367	2,978	3,114
Iberville Project	1	1	1	-	-	0	2,378	-	-	-	-	-
Irish Channel	1,798	1,630	1,661	1,694	1,713	1706	3,966	4,034	3,999	4,066	4,162	4,145
Lake Terrace/Lake Oaks	688	573	622	646	649	665	2,051	1,408	1,522	1,588	1,609	1,664
Lake Vista	818	650	697	702	733	741	1,822	1,601	1,674	1,688	1,775	1,810
Lakeshore	823	567	666	732	769	769	1,562	1,190	1,448	1,539	1,598	1,612
Lakeview	9,234	1,716	3,583	4,993	5,759	5970	16,535	2,757	5,816	8,511	10,226	10,746
Lakewood	496	71	211	277	315	335	1,110	174	524	688	794	849
Leonidas/ West Carrollton	3,722	2,864	3,072	3,204	3,270	3259	8,381	7,001	7,317	7,668	7,839	7,759
Lower Ninth Ward	4,539	27	313	535	869	934	13,114	77	860	1,565	2,566	2,801
Marigny	2,186	2,049	2,103	2,164	2,168	2191	2,923	3,006	2,999	3,095	3,108	3,170
Marlyville/Fountainebleau	2,884	1,817	2,258	2,477	2,543	2540	6,310	4,679	5,444	5,681	5,872	5,903
McDonogh	1,081	1,007	1,031	1,025	995	972	2,635	2,728	2,711	2,708	2,647	2,600
Mid-City	6,120	2,160	3,556	4,334	5,054	5192	18,627	6,371	9,312	10,942	12,345	12,372
Milan	3,185	1,858	2,223	2,428	2,472	2464	7,002	4,061	4,887	5,525	5,669	5,693
Milneburg	2,267	329	781	1,077	1,257	1261	5,280	846	1,952	2,684	3,151	3,199
Parkview	677	547	648	674	646	642	1,086	978	1,105	1,160	1,129	1,131
Pines Village	1,876	329	754	990	1,150	1168	4,767	778	2,019	2,643	3,128	3,247

	Electric Accounts						Population					
Neighborhood	**July 2005**	**July 2006**	**July 2007**	**July 2008**	**July 2009**	**Nov 2009**	**July 2005**	**July 2006**	**July 2007**	**July 2008**	**July 2009**	**Nov 2009**
Plum Orchard	2,414	379	971	1,232	1,363	1420	6,558	1,112	2,847	3,664	4,087	4,289
Pontchartrain Park	1,073	176	359	432	535	551	2,573	448	901	1,088	1,385	1,433
Read Boulevard East	3,121	999	1,786	2,128	2,370	2419	7,714	2,680	4,813	5,751	6,511	6,696
READ Boulevard West A	2,086	540	954	1,185	1,449	1487	5,209	1,541	2,698	3,374	3,839	4,006
READ Boulevard West B	3,655	304	913	1,294	1,482	1532	8,983	973	2,685	3,963	4,594	4,679
Riv. Pk. /Cut Off/L. Coast	1,889	1,767	1,869	1,881	1,833	1849	5,310	5,425	5,515	5,446	5,248	5,249
Seventh Ward	6,013	2,443	3,542	4,126	4,353	4321	15,860	7,438	10,264	11,903	12,598	12,584
Sixth Ward/Treme/Lafitte	2,825	1,983	2,260	2,451	2,533	2511	8,628	4,256	4,992	5,401	5,617	5,602
St. Anthony	2,491	290	721	974	1,177	1382	4,978	675	1,624	2,196	2,697	2,963
St. Bernard Area/ Project	664	138	264	363	390	379	6,002	333	1,230	1,502	1,565	986
St. Claude	4,013	1,380	2,177	2,552	2,837	2862	11,010	3,938	6,189	7,449	8,257	8,360
St. Roch	4,036	1,080	1,787	2,234	2,437	2460	11,216	3,358	5,296	6,653	7,288	7,359
St. Thomas/Lr. Gdn. Dist.	2,511	2,145	2,233	2,333	2,440	2397	4,201	4,149	4,178	4,285	4,569	4,509
St. Thomas Project	1,631	1,250	1,423	1,561	1,909	1987	3,513	2,577	2,510	2,904	3,191	3,215
Tall Timbers/Brechtel	4,838	3,952	4,160	4,655	4,650	4623	11,399	11,762	12,169	13,088	12,411	12,170
Touro	1,748	1,583	1,652	1,699	1,687	1683	3,035	2,943	2,955	3,036	3,068	3,093
Tulane/Gravier	1,285	341	617	869	975	1223	3,964	946	1,661	1,953	2,370	2,368
Uptown	3,466	3,143	3,236	3,265	3,301	3283	6,254	6,281	6,324	6,392	6,494	6,491
Viavant/Venetian Isles	650	172	224	294	273	354	1,763	299	453	722	734	950
Vieux Carre	4,030	3,823	3,898	3,919	3,972	3953	3,570	3,737	3,746	3,772	3,848	3,847
Village de L'Est	4,567	1,656	2,343	2,573	2,871	2876	13,729	6,159	9,245	9,866	10,159	10,168
Warehouse District	931	890	922	960	1,057	1105	779	771	753	830	906	910
West Riverside	2,807	2,608	2,628	2,637	2,677	2619	4,898	5,158	5,049	5,070	5,198	5,122
Grand Total	**187,108**	**95,054**	**120,025**	**135,687**	**145,269**	**146,583**	**453,728**	**229,885**	**289,973**	**328,312**	**351,920**	**355,268**

Data Limitations

It is worth noting that any vulnerability and risk assessment is limited by uncertainties in the underlying data. This is especially evident in New Orleans, where not only is the City subject to Gulf hurricanes and tropical storms (the probabilistic prediction of which is an inexact endeavor), but is protected by a large system of levees and other flood control structures, all of which have some potential for failure. Additionally, this potential for failure changes over time, as the levees are improved or degraded due to natural forces or neglect. In the Vulnerability Assessment and Loss Estimation section of this Plan, levees and levee failures are addressed in the vulnerability assessment and are factored into the loss estimations in different ways depending on the nature of the study in question. However, levee failure is not specifically calculated into the risk calculation.

Implications of Subsidence and Coastal Erosion

As described in Sections 6.3.9 (Coastal Erosion) and 6.3.12 (Land Subsidence) of this Hazard Mitigation Plan update, Orleans Parish (and the surrounding region) is subsiding, and the southern Louisiana coast is eroding fairly rapidly. Both of these phenomena increase the risk of flooding in Orleans Parish. Subsidence lowers ground elevations (and by extension levee heights and the elevations of structures and infrastructure) – with two potential impacts: (a) increasing the potential for levee and flood-wall overtopping during surge events and (b) increasing the potential depth of flooding if the City were to again be inundated. Erosion can also reduce the ability of coastal areas to attenuate storm surge as it approaches Orleans Parish and surrounding areas, thus increasing the inland reach and severity of storm surges that impact an area.

Levee Vulnerabilities

Note that Section 6.3.5 of this Hazard Mitigation Plan includes a detailed Hazard Identification and Profile for the Levee Failure hazard. That subsection includes a map (Figure 6-33) showing the current status of the USACE Hurricane and Storm Damage Risk Reduction System (HSDRRS). As described in various reports about flooding from Hurricane Katrina, many of the levees around New Orleans overtopped during the storm surge from that event. The overtopping not only created flooding, but it also directly contributed to some of the levee failures by eroding the toes of the structures on the land side, increasing the potential for tipping inward due to pressure from the surge on the “wet side.” Since these phenomena are well documented, they are not repeated in this section of the Hazard Mitigation Plan. With regard to levees, inadequate crest (or overtop) height is as much of a vulnerability as structural or design deficiencies. Various reports about the levees describe inconsistent overtop heights and connections between and among different types of levee structures in the flood control system around Orleans Parish, both before Katrina and at the present time. As described in the *Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005* [Chapter 8.2]:

> Levees are “series” systems, where the failure of one component (levee segment) equates to failure of the system. They have less redundancy than many other engineered systems. In the case of the canal levees, the three “weakest links” failed, and the “fourth weakest link” (near the north end of the London Avenue Canal, on the east bank) experienced a near failure. Should these and any other damaged sections be repaired, the fact remains that the “next weakest link” (and so on) has not yet been tested to its design water height. The failure of these levees at less than their design water height warrants an

> overall review of the design of the system.[3]

Simply put, the most vulnerable element in such a levee system indicates the vulnerability of the whole system, controlling factors including surge height, forward speed and direction of the surge, and debris. In spite of the many ongoing and planned repairs and adjustments to the levee system, including efforts to normalize the overtop heights, there is no expectation that vulnerabilities (and by extension, risk) will ever be completely eliminated. The USACE has already completed repairs and upgrades to more than 200 miles of levees around New Orleans, which is an indication of the size of the system and the effort required to monitor and maintain such a system. As noted in the FEMA Flood Recovery Guidance (April 2006, Advisory Base Flood Elevations):

> Although USACE improvements to the flood control system will make Orleans Parish safer than it was before the storms, they will not eliminate the potential for flooding. In fact, based on analyses recently completed by the USACE, the flood control system will not meet the standard necessary for providing protection against the 1-percent-annual-chance (100-year) flood…[4]

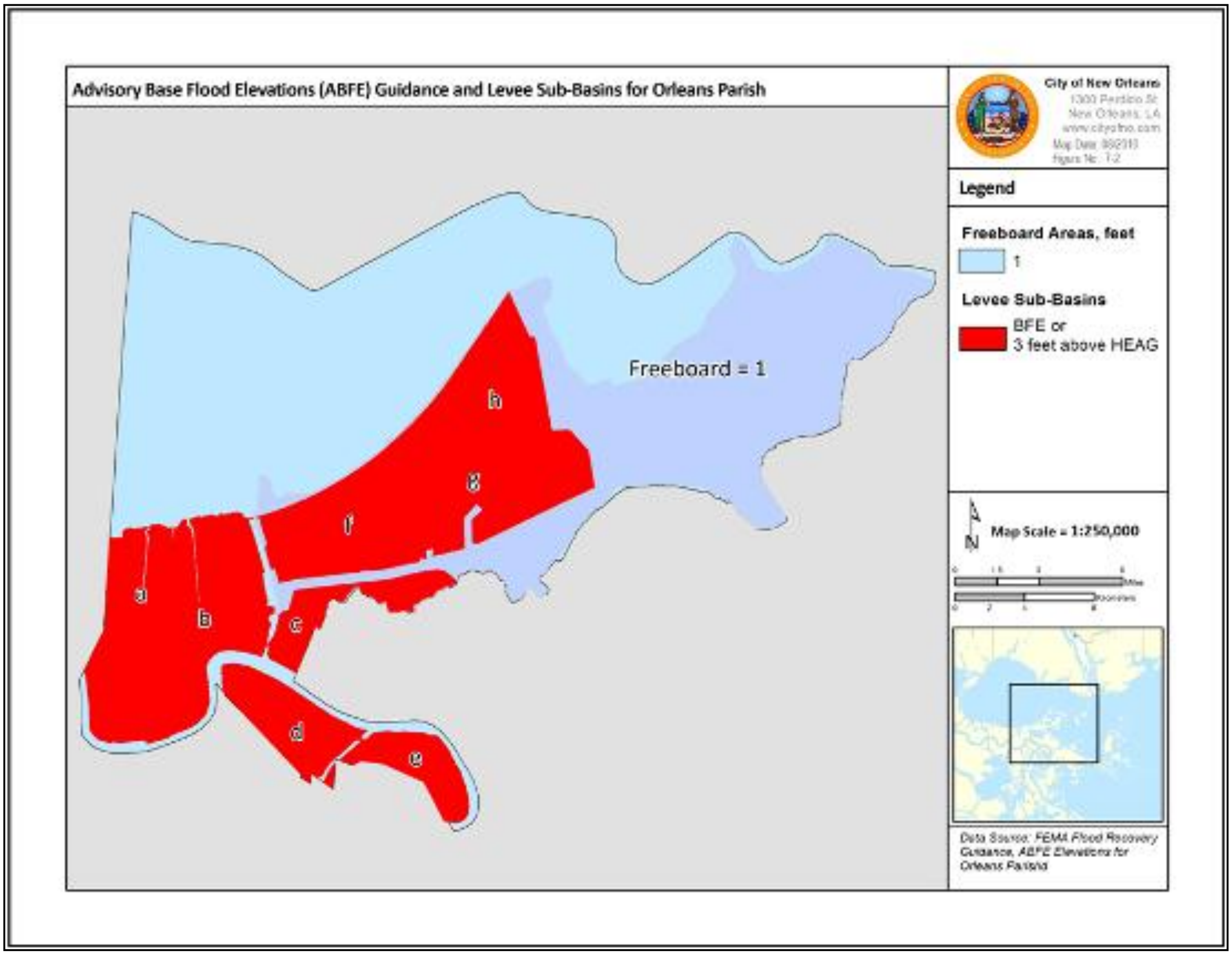
Following Hurricanes Katrina and Rita in 2005, FEMA provided advisory information concerning coastal flood elevations and interior levee ponding elevations. The information was intended to guide recovery efforts and reduce the effects of future floods on new construction (and reconstruction). The document included new floodplain guidance for substantially damaged structures and new construction, both inside and outside of the areas in Orleans Parish that are protected by the levee system.[5]

For structures located inside the levee areas (sub-basins "a - h" in Figure 7-2), FEMA recommended elevating to either the Base Flood Elevation (BFE) shown on the current effective Flood Insurance Rate Map (FIRM) or at least three feet above the highest adjacent existing ground elevation at the building site, whichever is higher. The guidance also recommended that new construction and substantially damaged homes and businesses that are not located in a designated FEMA floodplain be elevated at least 3 feet above the highest adjacent existing ground elevation at the building site. The recommended elevations are called "Advisory Base Flood Elevations" (ABFEs) and are to be applied inside the levee-protected areas until new FIRMs have been adopted.[6] Orleans Parish adopted the FEMA ABFEs in April 2006. All new construction must now comply with FEMA ABFE guidelines.

For the region outside of the areas protected by the levee system, FEMA recommended that 1 foot of "freeboard" be applied. Freeboard is additional elevation intended in part to address the inherent uncertainty in flood elevation calculations (i.e., an additional safety factor). For this area of the Parish, FEMA recommended structures be elevated at least 1 foot above the current BFE shown on the effective FIRM.[7] In Figure 7-2, this area is shaded light gray and includes the far eastern part of Orleans Parish.

[3] Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005, Chapter 8.2.
[4] FEMA Flood Recovery Guidance, Advisory Base Flood Elevations (ABFEs)for Orleans Parish, Louisiana, April 12, 2006
[5] FEMA Flood Recovery Guidance, (ABFEs) for Orleans Parish, Louisiana, April 12, 2006
[6] FEMA Flood Recovery Guidance, (ABFEs) for Orleans Parish, Louisiana, April 12, 2006
[7] FEMA Flood Recovery Guidance, (ABFEs) for Orleans Parish, Louisiana, April 12, 2006

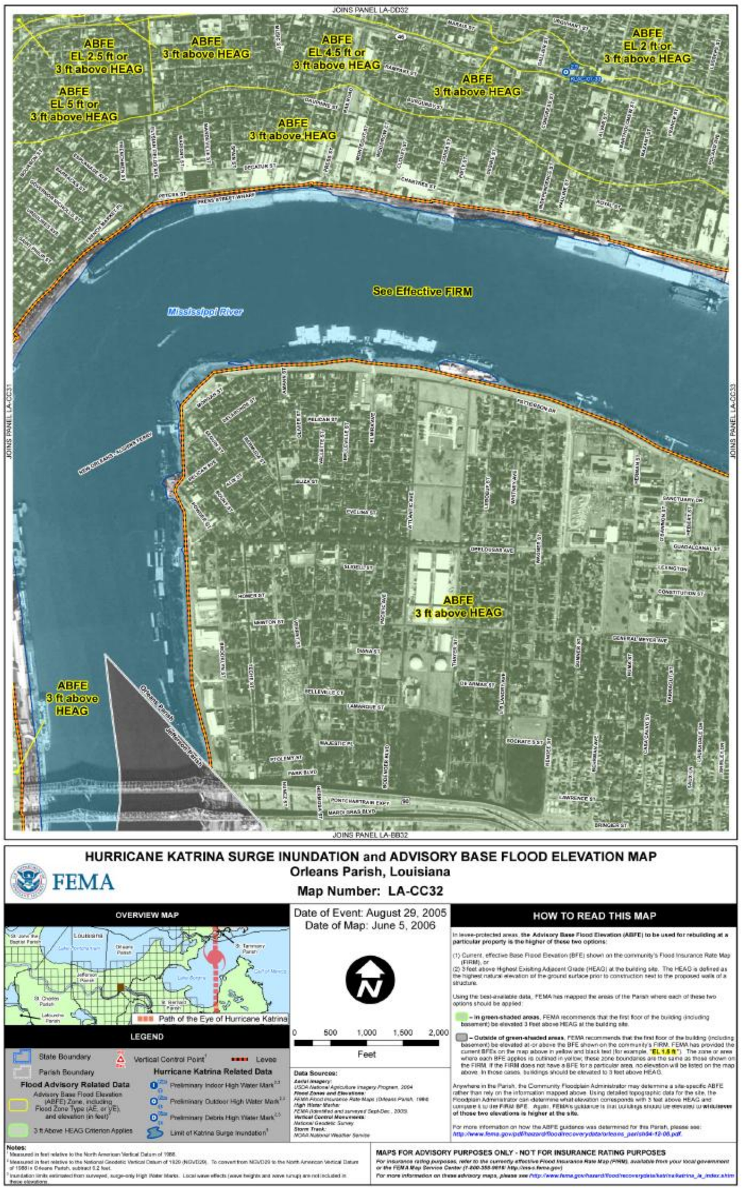
Figure 7-2
Advisory Base Flood Elevations (ABFE) Guidance and Levee Sub-Basins for Orleans Parish
(Source: FEMA - Flood Recovery Guidance, ABFE Elevations for Orleans Parish, HEAG = Highest Existing Adjacent Grade)



FEMA also developed detailed ABFE and Hurricane Katrina surge inundation maps for the areas of Louisiana and Mississippi that were impacted by the surge, including the areas of Orleans and other Parishes that are inside the HPS. In addition to displaying the Katrina surge inundation limits, the maps also identified the new ABFE described above. Approximately 50 individual surge inundation maps were completed for Orleans Parish in June of 2006. Figure 7-3 shows one of the surge maps of Orleans Parish.[8] Other ABFE and surge inundation maps can be found on FEMA's website by following the link:
http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_orleans.shtm

[8] FEMA website – Hurricane Katrina Surge Inundation and Advisory Base Flood Elevation Maps

Figure 7-3
Orleans Parish: Hurricanes Katrina and Rita Surge Inundation and Advisory Base Flood Elevation Map (Map #LA-CC32)
(Source: FEMA – Hurricane Katrina Surge Inundation and Advisory Base Flood Elevation Maps)



The effective flood hazard information for Orleans Parish is represented by the FEMA Flood Insurance Study (FIS) and associated FIRM panels published in 1984. Through a national effort called Flood Map Modernization (Map Mod), FEMA has produced more reliable flood hazard data and, at the same time, converted the data to a digital format. There have been extensive drainage improvements that have been completed throughout the parish as well as physical terrain changes that have occurred since the effective flood maps were published. FEMA allocated funding to develop revised FIRMs in Orleans Parish to reflect many of the improvements constructed by the Southeast Louisiana Flood Control Project (SELA). The Preliminary flood maps were to be issued in 2005; however, due to the effects of Hurricanes Katrina and Rita release of these maps was delayed to allow for new storm surge and wave run-up analyses to be completed and reflected accordingly.

Based on the magnitude and severity of flooding and the physical alterations to the floodplain that occurred from Hurricanes Katrina and Rita, FEMA determined that the BFEs reflected on the effective FIRMs for many Louisiana communities, including Orleans Parish, were too low. Therefore, to assist communities in the rebuilding effort FEMA created recovery maps showing the extent and magnitude of Hurricane Katrina's and Rita's surge, as well as information on other storms over the past 25 years. The advisory flood data shown on the Orleans Parish recovery maps (as illustrated in Figure 7-3) show high-water marks surveyed after Katrina; flood limits developed from these surveyed points; and ABFEs. The recovery maps and other advisory data were developed to assist communities and the public to reduce their vulnerability to future flooding. These ABFEs provide improved minimum guidance for elevating structures. For Orleans Parish, the recovery maps were issued in June 2006. These ABFEs do not supersede the effective FIRMs for flood insurance purposes.

The new preliminary FIRMs, which were issued in 2008 to the City and the public for review, represent improved flood hazard information. Normally, FEMA requires communities to adopt new FIRMs in order to continue participating in the NFIP. In case of Orleans Parish, however, FEMA allowed the community the option of not adopting the updated FIRMs while continuing in the NFIP, because repairs and upgrades to the hurricane protection system were ongoing. Once these repairs and upgrades are completed, flood risk and maps will be recalibrated as necessary, and the Parish will undertake the adoption process at that time. At the time of the 2010 HMP update, the Parish has elected to continue using the ABFEs shown on the recovery maps as the basis for regulating rebuilding and development. The post-preliminary processing and adoption of these preliminary FIRMs have been suspended by FEMA. Once the USACE completes the protection system improvements, new FIRMs will be issued by FEMA for review and adoption by the Parish. The new flood maps are expected to contain different BFEs.

The devastation caused by Hurricanes Katrina and Rita in 2005, resulted in the establishment of several coast-wide restoration and protection planning efforts that are independent, yet interrelated. Among these efforts is the Louisiana Coastal Protection and Restoration Project Report (LACPR) that recommends Category 5 level of protection and include a "full range of flood control, coastal restoration and hurricane protection measures." The USACE's New Orleans District was directed by the U.S. Congress to produce this study and report. The USACE's Preliminary Technical Report was produced in July 2006 and the final IPET documents were delivered in July 2009.[9]The firm Risk Management Solutions (RMS) prepared a report titled *Flood Risk in New Orleans, Implications for Future Management and Insurability*, published in 2006. This is also used in the Plan and referred to as the "RMS Report".

Historical levee failure data indicates the impact of levee failure could be catastrophic as shown by Hurricane Katrina. The impact would be great to the structures in the hazard area, which is assumed to be 69% of all structures based on analysis in the 2005 hazard mitigation plan. Levee failure is a major threat to the lives of the population of Orleans Parish. The table below shows the summary of the value of structures that could be damaged levee failure in Orleans Parish. Additional information on potential impacts of levee failure can be found in the flood loss estimation section later in this plan.

[9] USACE's Preliminary Technical Report located online: http://www.usace.army.mil/CECW/Pages/ipetrep_final.aspx

Table 7-3
Levee Failure Exposure and Loss Estimation
***Assume 100% loss catastrophic loss**

Occupancy of Structure	Total Exposure	*%in Hazard Area	Potential Losses
Residential	$27,262,840,000	69%	$18,811,359,600.00
Commercial	$5,089,867,000	69%	$3,512,008,230.00
Industrial	$769,207,000	69%	$530,752,830.00
Agriculture	$25,912,000	69%	$17,879,280.00
Religious	$847,538,000	69%	$584,801,220.00
Government	$362,212,000	69%	$249,926,280.00
Education	$769,910,000	69%	$531,237,900.00
Total	$35,127,486,000		$24,237,965,340.00
*%in planning area based on 2005 plan			
NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan			

Flood and Surge Vulnerabilities

As discussed earlier, flood and surge vulnerabilities are directly related to the types of structures and operations in various areas, and the populations that work and reside in them. All of the studies discussed below include a component of vulnerability, which is most often based on damage functions derived from either USACE or FEMA-based studies. The flood and surge loss estimation subsection includes more details about flood vulnerabilities.

> 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 Mississippi River Gulf Outlet (MRGO) shipping channel leads directly into the Inner Harbor Navigation Canal (IHNC) from the open sea of Lake Borgne. Only storm surges with this pathway have been included in the study. 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 tracks located close to the city would the surge in Lake Pontchartrain be higher than in Lake Borgne. Furthermore, 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 floodwaters to enter the city from this direction. Meanwhile, nothing has been done to resist the arrival of surges from Lake Borgne via the MRGO.[10]

Hurricane Wind Vulnerabilities

Vulnerability to hurricane winds is generally based on specific physical characteristics of a structure or asset. Wind damage to buildings is typically caused by either roof uplift or penetrations to the structural envelope, which can in turn lead to more damage to structure and contents. How much a structure is damaged when it is subjected to a particular wind load is a function of its construction, including design, building techniques, and the materials used to build it. Most jurisdictions in the United States use a standard building code as the basis for their construction permitting. Building codes are used to establish minimum standards for construction and materials, and part of the reason for these minimum standards is to ensure adequate performance under wind conditions that are typical of a particular area. On November 28, 2005, Louisiana adopted into law the Louisiana State Uniform Construction Code, designating the 2006 International Residential Code (IRC 2006) as the building code for all one- and two-family dwellings. Shortly after Hurricane Katrina, the State adopted the 2006 International Building Code.

Information about wind probabilities and the history of wind events is presented in more detail in the Hazard Identification and Profiling sections of this Hazard Mitigation Plan update, in the Hurricane Wind, Thunderstorm and Tornado subsections. Generally speaking, commercial and otherwise "engineered" structures, i.e., those that are designed by architects or engineers to specific structural performance standards, are less vulnerable to wind damage than are "non-engineered" structures such as most houses. Although there is wide variation among buildings, engineered structures are generally "harder" (i.e., less vulnerable to wind damage) because they are constructed of

[10] Risk Management Solutions Report, *Flood Risk in New Orleans, Implications for Future Management and Insurability*, 2006, page 12.

heavier materials, construction details are significantly more rigorous, and roof profiles are often lower and present fewer overhangs that can result in uplift. The amount of glazing (windows) on the exterior of a structure can also significantly affect its vulnerability to wind, for two primary reasons. First, windows are subject to penetration by flying objects (missiles) during wind storms, increasing the potential for breach of the building envelope. Second, windows are subject to breakage due to overpressure or vacuum effects created by high winds, which again increases the possibility of the building envelope being compromised. When a building envelope is compromised, not only are contents much more vulnerable to damage, but the effects of the wind on the building structure can be greatly exacerbated, in many cases resulting in severe damage or destruction.

Over the past 10 years or so, FEMA has incorporated *wind damage functions* into its software and methodology for benefit-cost analysis. The damage functions express the percent damage to structure and contents, and the degree of displacement (as days) for a series of wind speeds, and these are, in turn, used in an integrated mathematical calculation to estimate risk. The wind damage functions are based on extensive engineering research, much of which is described in publications of the American Society of Civil Engineers (ASCE). The damage functions, which number in the dozens based on a range of structure types and sizes, are also incorporated into FEMA's primary risk assessment software tool, HAZUS, and in the new Benefit-Cost Analysis Tool (BCAT). The Hurricane Wind Loss Estimation section of this Plan is based on HAZUS wind loss calculations for the City of New Orleans. The figure below shows a series of wind damage functions for a typical wood frame residential structure. The HAZUS wind analysis uses the figures in calculations with wind probabilities and the values of assets to determine future wind losses (wind risk). Each specific building type in the HAZUS database has its own damage functions. The third column in each table shows the percent damage as a function of wind speed and recurrence interval. The first figure is the structural damage function, and the second is for contents.

Figure 7-4
Sample Wind Damage Functions for Structure and Contents; Typical Wood frame Residential Structure
(Source: FEMA Benefit-Cost Analysis Tool VR4.5.5)

Building | Contents | Loss Of Function | Other Damages

Recurrence Interval (yr)	Wind Speed (mph)	Before Mitigation Pct.	Before Mitigation User Entered (Pct)
10	60	0.01%	
20	65	0.04%	
30	75	0.19%	
40	85	0.49%	
50	90	0.68%	
60	95	0.90%	
70	95	0.90%	
80	95	0.90%	
90	100	1.19%	
100	100	1.19%	
200	125	14.69%	
300	135	35.99%	
400	140	47.73%	
500	145	58.84%	
1000	155	78.84%	

Building | Contents | Loss Of Function | Other Damages

Recurrence Interval (yr)	Wind Speed (mph)	Before Mitigation Pct.	Before Mitigation User Entered (Pct)
10	60	0.00%	
20	65	0.00%	
30	75	0.00%	
40	85	0.00%	
50	90	0.00%	
60	95	0.01%	
70	95	0.01%	
80	95	0.01%	
90	100	0.05%	
100	100	0.05%	
200	125	10.65%	
300	135	30.70%	
400	140	41.93%	
500	145	53.11%	
1000	155	74.50%	

Due to a lack of detailed technical data, it is currently not possible to produce neighborhood-specific hurricane wind loss projections for the 2010 Parish mitigation plan update. At some point in the future it may be possible to, once the necessary data is updated and available in the City of New Orleans and the initiative is completed.

As noted in other sections of the Plan, wind vulnerabilities are closely related to structure type and construction quality. Generally, even lightly-engineered non-residential structures tend to perform better under most hazardous conditions than typical wood-frame residential buildings. However, the adoption and enforcement of modern building codes and construction techniques have greatly improved the latter. Currently, no detailed, location-specific database of building use, structure types and age, nor associated valuation exists in the City / Orleans Parish. Once the City has developed a structure based information system including information on building type, materials, current valuation etc., the information in this Plan can be used as the basis for a potential next phase of loss estimation. This can be accomplished by compiling information about individual structures on a neighborhood or planning district in the Parish, and completing more detailed loss calculations by customizing damage functions in HAZUS or the FEMA BCAR benefit-cost analysis software.

High Wind Hazard Vulnerability Assessment

High wind history, extent, and probability are discussed in Section 6 of this HMP update.

Many buildings in Orleans Parish are vulnerable to high winds, given the large variation in building types, and the fact that a significant number of structures are relatively old, and constructed prior to the initiation of building codes and standards. There are numerous factors that must be considered when evaluating the wind vulnerabilities of structures. These factors are mainly related to construction type, building configuration (which includes height, roof type, number of windows, etc.), orientation, the physical surroundings of the structure (which may result in airborne missiles during high winds, which in turn can contribute to breaches in building envelopes), and the condition of the building or facility. Accurately characterizing wind vulnerabilities requires site-specific engineering evaluations, which are not part of the scope of this hazard mitigation plan update. It should also be noted that much of the possible past damage from wind events in the Parish was addressed through private-sector insurance claims simply absorbed by homeowners, so there is no known open-source database that can be queried to correctly characterize historical damages.

There are many areas in Orleans Parish that are predominated by structures built prior to the institution of building codes, and in many cases residents have not had sufficient resources to maintain properties, and the resulting deterioration has made the structures and occupants more vulnerable to wind effects. Because of a current lack of detailed information about structural characteristics of buildings Parish-wide, at this time it is not possible to make accurate statements about wind vulnerabilities in specific neighborhoods or areas. However, it should be noted that the Parish is home to many fragile populations – communities and people where the integrity of structures may have been compromised over time, or where local circumstances may create difficulties in notifying residents about threats from natural hazards, evacuating citizens when hazards are predicted to impact an area (or have already impacted it, or addressing the effects of hazards after they have occurred. All of these factors create additional vulnerabilities for specific populations in Orleans Parish.

In order to more accurately characterize high-wind vulnerabilities to specific areas of Orleans Parish, it will first be necessary to have a more robust set of data related to structural characteristics of buildings, or to secure data from private-sector insurance companies. However, the latter information is presumed to be highly proprietary, so this is not a likely option. It may be possible to prioritize areas for additional engineering study based on the age and known structural characteristics of buildings, i.e. to find structures that are likely the most vulnerable based on open-source data, then further prioritize study based on use or occupancy. HAZUS wind damage functions could be used for this purpose. It may also be possible to prioritize additional study based on the hurricane wind loss estimation results presented in Section 7 of the 2011 HMP update (Hurricane Wind Risk in Orleans Parish) – that subsection provides a series of tables that show percentage damage and dollar amount of damage expected for a range of deterministic scenarios. The building classes or uses with the highest damage figures could be used as a method to prioritize additional study.

Historical high wind hazard data indicates the impact of a high wind event results in averages less than 1% of the value of the structures in the hazard area, which is assumed to be 100% of all structures. A high wind event is typically not considered a threat to the lives of the population of Orleans Parish. The table below shows the summary of the value of structures that could be damaged by high winds in Orleans Parish.

Table 7-4
High Wind Exposure and Loss Estimation
***Assume 1% loss (minimal loss)**

Occupancy of Structure	Total Exposure	%in Hazard Area	Potential Losses
Residential	$27,262,840,000	100%	$272,628,400.00
Commercial	$5,089,867,000	100%	$50,898,670.00
Industrial	$769,207,000	100%	$7,692,070.00
Agriculture	$25,912,000	100%	$259,120.00
Religious	$847,538,000	100%	$8,475,380.00
Government	$362,212,000	100%	$3,622,120.00
Education	$769,910,000	100%	$7,699,100.00
Total	$35,127,486,000		$351,274,860.00
NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan			

Dam Failure Hazard Vulnerability Assessment

Dam failure history, extent, and probability are discussed in Section 6 of this HMP update. Levee failure history, extent, and probability are discussed in Section 6 of this HMP update; levee failure vulnerability is discussed in both Sections 6 and 7 of this HMP update.

The 2008 *Louisiana State Hazard Mitigation Plan update* was also reviewed to determine the dam failure risk in Orleans Parish. The Dam Failure risk assessment section (Section 5.11) of the State Plan includes a dam hazard ranking of high, medium, or low for each Parish. The rankings were completed after obtaining and evaluating data from the USACE's National Inventory of Dams. Review of the Dam Failure risk assessment indicates that Orleans Parish has a dam hazard ranking of medium. The State Plan assigned the medium ranking to Parishes in Louisiana with one or more significant hazard dams. Figure 6-23 identifies the dam hazard rankings for Louisiana. It should also be noted that the single dam in the Parish is part of the Carrollton Water Treatment Plant, and is subject to regular monitoring and control.

The Parish's vulnerability to dam failure is negligible. As noted above, the single dam in Orleans Parish is rated as "significant hazard" dam, meaning no more than two houses or six lives in jeopardy. There are no significant populations, structures or operations that are at risk from the dam failure hazard in the Parish.

Tornado Vulnerability Assessment

Tornado history, extent, and probability are discussed in Section 6 of this HMP update.

Effective January 2004, New Orleans adopted the International Building Code, which requires new structures to be able to withstand winds up to 140 mph – this is a direct measure of vulnerability that indicates newer buildings are likely to withstand tornado wind speeds in the EF-2 to EF-3 range. However, structures built before 1940 were built under a different building code or no code at all. Approximately 30 percent of the housing units in Orleans Parish, or 63,779 units, were built before 1940, and this includes most of the housing units south of I-610 and west of the Industrial Canal.
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 latter part of the 20th 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, and people inside the buildings should be (relatively) safer than they would be in less well-constructed buildings.

Although Orleans Parish is not especially prone to tornadoes compared to other parts of the country, much of the older building stock (residential, Non-class A and minor structures) 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 (windows and doors, primarily) 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 typically 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. A later part of this subsection (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, although it is impossible to predict the locations or paths of future events. Populations that are located in poorly-constructed buildings, or that are exposed to high levels of blowing debris, are more vulnerable to injury and fatality than those that are protected by more robust structures.

Those historically most susceptible to negative impacts from tornado effects can generally be characterized as the most fragile residents. There are many neighborhoods in the Parish that are predominated by older structures and there are many areas that are home to residents who have historically lacked the resources necessary to maintain the structural integrity of their homes. The end result being increased exposure and vulnerability. Also, many homes are pre-building code, suggesting that in many cases the integrity of the structures may be insufficient to resist the effects of high winds. Residents in such areas may lack the resources (transportation, mobility, recognition of the necessity, etc.) to adequately prepare for the onset of a potential hazard by seeking safe shelter; they may have lacked the ability to take advantage of city-wide programs to enhance or enforce their structures; or, for a variety of reasons, they may have chosen to keep their properties status quo. After a tornado impacts the Parish, some burden of responsibility ultimately falls to the community overall - relief organizations, the City and FEMA - to respond and provide both short-term services, as well as long term services to such vulnerable populations. The City of New Orleans continues to strive to improve education, communications and outreach to these vulnerable populations before, during and after disasters and other significant hazard events.

Historical tornado data indicates the impact of a tornado event results in averages less than 1% of the value of the structures in the hazard area, which is assumed to be 100% of all structures. The table below shows the summary of the value of structures that could be damaged by tornados in Orleans Parish.

Table 7-5
Tornado Exposure and Loss Estimation
***Assume 1% loss (minimal loss)**

Occupancy of Structure	Total Exposure	%in Hazard Area	Potential Losses
Residential	$27,262,840,000	100%	$272,628,400.00
Commercial	$5,089,867,000	100%	$50,898,670.00
Industrial	$769,207,000	100%	$7,692,070.00
Agriculture	$25,912,000	100%	$259,120.00
Religious	$847,538,000	100%	$8,475,380.00
Government	$362,212,000	100%	$3,622,120.00
Education	$769,910,000	100%	$7,699,100.00
Total	$35,127,486,000		$351,274,860.00

NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan

Lightning Hazard Vulnerability Assessment

Lightning history, extent, and probability are discussed in Section 6 of this HMP update.

Between 1994 and 2007 (as noted in Section 6), the NCDC identifies three deaths and two injuries in Orleans Parish resulting from lighting strikes. Total property damage from lightning strikes was estimated at $270,000. Orleans Parish is not particularly vulnerable to the lightning hazard – the very large majority of strikes do little or no harm to people, structures or operations. There is presumed to be a very minor increased lightning vulnerability to structures that are inadequately grounded, and such structures may be proportionately greater in lower income areas or neighborhoods where most structures were built prior to building codes. The presence of many pre-code wood buildings in some areas may also present some increased risks from fires related to strikes. However, these statements should be considered supposition because there is no database or other source of information to verify them.

Significant operations and facilities in the Parish are generally protected from damage by grounding and surge protection. Orleans Parish does not appear to be particularly vulnerable to negative impacts from lightning strikes, although As noted above in other subsections, there is no comprehensive, open source of information about the structural characteristics of buildings in the Parish, so statements about vulnerabilities are not meaningful on a Parish-wide basis. In many cases, damage from lightning is addressed through private insurance, and records of such damages and claims payments is proprietary, and hence not available to use in generalized assessments.

Historical lightning data indicates the impact of a lightning event results in averages less than 1% of the value of the structures in the hazard area, which is assumed to be 100% of all structures. Lightning is not considered a threat to the lives of the population of Orleans Parish. The table below shows the summary of the value of structures that could be damaged by "insert hazard name" in Orleans Parish.

Table 7-6
Lightning Exposure and Loss Estimation
***Assume 1% loss (minimal loss)**

Occupancy of Structure	Total Exposure	%in Hazard Area	Potential Losses
Residential	$27,262,840,000	100%	$272,628,400.00
Commercial	$5,089,867,000	100%	$50,898,670.00
Industrial	$769,207,000	100%	$7,692,070.00
Agriculture	$25,912,000	100%	$259,120.00
Religious	$847,538,000	100%	$8,475,380.00
Government	$362,212,000	100%	$3,622,120.00
Education	$769,910,000	100%	$7,699,100.00
Total	$35,127,486,000		$351,274,860.00

NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan

Hail Vulnerability Assessment

Hail Vulnerability not included – this was one of the hazards that was dropped by consensus and not included in the actions table.

Coastal Erosion Hazard Vulnerability Assessment

Coastal erosion history, extent, and probability are discussed in Section 6 of this HMP update.

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, increasing the vulnerability of hundreds of thousands of citizens and structures, as well as businesses and cultures that rely on the coastline.

Coastal erosion also has the potential to cause substantial property damage and negative impacts to the Louisiana economy. 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 increase risk.

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. Particularly vulnerable are areas of the Parish that are close to the gulf, and are outside the boundary of the Hurricane Protection System. These areas and the populations that reside in them are subject to both the direct effects of erosion and the decreased capacity of the coast to absorb the energy of hurricanes and tropical storms. Such areas are also particularly vulnerable to issues related to response and evacuation, which may be severely impaired by degradation of coastline and infrastructure. Potential for damage to structures including residential structures can increase as coastal erosion increases. Older homes and other structures that were built prior to modern building codes and have not been elevated, flood proofed, strengthened or enhanced bear an increased risk of damage. Property owners who lack the means to upgrade structures or even relocate in order to be more resistant to the impacts of storm surge are often the most fragile of the Parish's population. Resident's may lack the knowledge, financial means or even the desire to enhance their properties or to move elsewhere. These fragile residents may be significant impacted – these personal impacts may become public impacts when the property owners require assistance from City, State, Federal and relief organization resources. These impacts, including financial, have the potential to continue long term.

Historical coastal erosion data indicates the impact of a coastal erosion event results in averages less than 1% of the value of the structures in the hazard area, which is assumed to be 1% of all structures. Coastal erosion is not considered a threat to the lives of the population of Orleans Parish. The table below shows the summary of the value of structures that could be damaged by coastal erosion in Orleans Parish.

Table 7-7
Coastal Erosion Exposure and Loss Estimation
***Assume 1% loss (minimal loss)**

Occupancy of Structure	Total Exposure	**%in Hazard Area	Potential Losses
Residential	$27,262,840,000	1%	$2,726,284.00
Commercial	$5,089,867,000	1%	$508,986.70
Industrial	$769,207,000	1%	$76,920.70
Agriculture	$25,912,000	1%	$2,591.20
Religious	$847,538,000	1%	$84,753.80
Government	$362,212,000	1%	$36,221.20
Education	$769,910,000	1%	$76,991.00
Total	$35,127,486,000		$351,274,860.00
**%in planning area based on map on page 142			
NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan			

Winter Storm Vulnerability Assessment

Winter Storm Vulnerability not included – this was one of the hazards that was dropped by consensus and not included in the actions table.

Thunderstorm Hazard Vulnerability Assessment

Thunderstorm history, extent, and probability are discussed in Section 6 of this HMP update.

Thunderstorms are very common in southern Louisiana, but past damages have generally been very limited. It should be noted that there is no open-source information available regarding insurance claims for damages from thunderstorms, so such an assessment is based on the limited information available from NOAA/NCDC. Note that the previous wind hazard section includes a brief discussion of wind vulnerabilities, which, along with flooding, are the main source of significant damage from thunderstorms. As is the case with various other hazards, areas of the Parish that are home to older or deteriorating housing stock (and other structures) are presumed to be more vulnerable to the effects of thunderstorm-related wind, although it is impossible to characterize these vulnerabilities on a neighborhood basis without further information. Specific populations must also be considered more vulnerable to thunderstorm winds, based on their potential exposure (again, a function of the type and condition of structures) and on the ability to evacuate an area in the event of a particularly severe event.

It may be possible for the Parish to prioritize specific areas for additional study based on the series of HAZUS output tables in the Hurricane Wind Hazard part of HMP Section 7. The tables show percentages and dollar damages by structure type and use for a range of wind scenarios. It would be possible to prioritize specific types of structures or structure uses for further study using this information, and eventually to identify specific areas in the Parish that may be more vulnerable to the effects of thunderstorm winds. However, as discussed above, this hazard is not particularly significant in the Parish, and this additional study may be a low priority.
Historical thunderstorm data indicates the impact of a thunderstorm event results in averages less than 1% of the value of the structures in the hazard area, which is assumed to be 100% of all structures. Thunderstorms are not considered a threat to the lives of the population of Orleans Parish. The Table below shows the summary of the value of structures that could be damaged by thunderstorms in Orleans Parish.

Table 7-8
Thunderstorm Exposure and Loss Estimation
***Assume 1% loss (minimal loss)**

Occupancy of Structure	Total Exposure	%in Hazard Area	Potential Losses
Residential	$27,262,840,000	100%	$272,628,400.00
Commercial	$5,089,867,000	100%	$50,898,670.00
Industrial	$769,207,000	100%	$7,692,070.00
Agriculture	$25,912,000	100%	$259,120.00
Religious	$847,538,000	100%	$8,475,380.00
Government	$362,212,000	100%	$3,622,120.00
Education	$769,910,000	100%	$7,699,100.00
Total	$35,127,486,000		$351,274,860.00
NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan			

Land Subsidence Vulnerability Assessment

Land subsidence history, extent, and probability are discussed in Section 6 of this HMP update.

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 6-42 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.

There is presumably some localized risk to structures related to differential subsidence and settling, but, generally the hazard has incremental impacts over relatively large areas, so this is not especially significant in the Parish. The hazard presents a more significant risk by increasing the risk of flooding in areas where the ground is sinking. Older structures that are not well-maintained will generally be more vulnerable to flood damage than will those that are better able to withstand inundation. Certain populations in the Parish are more vulnerable also, owing to their potential inability to respond and evacuate when floods occur, although this is not directly related to subsidence.

Such areas are also particularly vulnerable to issues related to response and evacuation, which may be severely impaired by degradation of coastline and infrastructure. Potential for damage to structures including residential structures can increase as coastal erosion increases. Older homes and other structures that were built prior to modern building codes and have not been elevated, flood proofed, strengthened or enhanced bear an increased risk of damage. Property owners who lack the means to upgrade structures or even relocate in order to be more resistant to the impacts of storm surge are often the most fragile of the Parish's population. Resident's may lack the knowledge, financial means or even the desire to enhance their properties or to move elsewhere. These fragile residents may be significant impacted – these personal impacts may become public impacts when the property owners require assistance from City, State, Federal and relief organization resources. These impacts including financial impacts, have the potential to continue long term.

Historical land subsidence data indicates the impact of land a subsidence event results in averages less than 1% of the value of the structures in the hazard area, which is assumed to be 100% of all structures. Land Subsidence is not considered a threat to the lives of the population of Orleans Parish. The table below shows the summary of the value of structures that could be damaged by land subsidence in Orleans Parish.

Table 7-9
Land Subsidence Exposure and Loss Estimation
***Assume 1% loss (minimal loss)**

Occupancy of Structure	Total Exposure	%in Hazard Area	Potential Losses
Residential	$27,262,840,000	100%	$272,628,400.00
Commercial	$5,089,867,000	100%	$50,898,670.00
Industrial	$769,207,000	100%	$7,692,070.00
Agriculture	$25,912,000	100%	$259,120.00
Religious	$847,538,000	100%	$8,475,380.00
Government	$362,212,000	100%	$3,622,120.00
Education	$769,910,000	100%	$7,699,100.00
Total	$35,127,486,000		$351,274,860.00
NOTE: Methodology for Exposure and Loss Estimation Table taken from the 2004 City Hazard Mitigation Plan			

Drought Vulnerability Assessment

Drought Vulnerability not included – this was one of the hazards that was dropped by consensus and not included in the actions table.

Hazardous Materials Spills/Contamination Impact on Life and Property

Hazardous Materials Spills/Contamination history, extent, and probability are discussed in Section 6 of this HMP update.

Although there is clearly some vulnerability to widespread contamination during significant flood events in Orleans Parish, vulnerability to hazardous materials spills and contamination is in most often site- and material-specific, so as a practical matter it is impossible to characterize the vulnerability of the entire Parish, as regards 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. Hazardous materials vulnerability assessments are usually the realm of health and environmental studies, and as such are generally outside the scope of this hazard mitigation plan update. Presumably, populations that are less mobile because of lack of access to transportation or physical limitations may be somewhat more vulnerable to hazmat spills because of the potential need to evacuate, but given the widespread presence of such materials in the Parish, it would require a detailed study to evaluate where these populations are located, and what specific remedies may be feasible.

7.3 Estimate of Potential Losses

In the context of mitigation planning, the terms *loss estimation* and *risk assessment* have the same meaning. They are defined as the expected future losses from the impacts of natural hazards. FEMA uses four general categories of risk (loss estimation) as the basis for most of its planning and risk assessment standards.

1. Structure – direct damage to buildings or infrastructure
2. Contents – direct damage to contents (usually contents of buildings)
3. Loss of function – the value of services that are interrupted or lost during hazard events
4. Injuries and fatalities – damage related to deaths and a range of injuries

Further, risk assessments have three components:

1. Probability – the likelihood that an event will occur
2. Vulnerability – as discussed above, the degree of damage from hazard impacts
3. Value – the monetary value of the asset or function being impacted

In a probability-based risk assessment, these elements are integrated into a single calculation that also considers the time value of money and specific planning horizons (the time period over which the risk is being projected). Most natural hazards have at least some potential to cause damage in all of these categories, although clearly certain hazards are far more significant in terms of causing losses. These include hurricane wind, storm surge, flooding, and levee failure. As discussed elsewhere in this Plan, hurricanes are natural hazards that are comprised of two other distinct hazards: high winds and flooding. Furthermore, the flooding hazard can itself be subdivided into rainfall-related hazards and storm-surge related hazards.

This subsection of the Hazard Mitigation Plan is a combination of summaries of existing risk assessments and first-generation loss estimates. Although the methodologies in these existing studies and reports are rooted in the same general kinds of calculations and procedures, there is some variation in the way that the results are presented and interpreted. Overall, the general conclusion of these studies is that the existing pumping/canal/levee system performs reasonably well for even severe rainfall events; the levee system (particularly after the USACE HPS 2007 improvements) has positive risk-reduction effects in many areas, up to certain levels of storm surge; and very severe storm surges will cause levee failures and significant flooding. The latter is especially true in the areas of the City at the lowest elevations, and those on the east end of the jurisdiction that are close to MRGO and canals, where there is more direct exposure to the Gulf. As noted earlier, these studies (the USACE/IPET study in particular) are very thorough, and only the most significant elements and findings are repeated here.

Data Limitations

At the time of the 2010 HMP update, Orleans Parish and the City of New Orleans had a database of City-owned facilities, but very few of the assets and buildings in the dataset had specific building attributes to support detailed flood or wind loss estimates. A detailed assessment would be possible with a set of attributes that include (a) square footage, (b) use, (c) structure type, and (d) value of the operations that take place in the facilities (usually done by annual budget). Although these attributes were not available at the time of the update, the Mitigation Plan includes an action to obtain and compile the data with the intent of completing risk calculations later. Even if data is not available for all facilities, it is possible to gather data and perform risk assessments for the most critical facilities first, with the purpose of later developing site-specific mitigation actions and grant applications.

High Wind, Tornado, Lightning, Thunderstorms, land Subsidence, Levee Failure and Coastal Erosion Loss Estimates

For ease of reporting, information on loss estimates for the following hazards: High Wind, Tornado, Lightning, Thunderstorms, land Subsidence, Levee Failure and Coastal Erosion have been included in tables in Section 7.2 in tandem with dollar exposure estimates. Note that the methodology for reporting loss estimates is taken directly from the 2004 City Mitigation Plan.

The Risk Management Solutions report entitled *Flood Risk in New Orleans; Implications for Future Management and Insurability* offers a good introduction to several factors that continue to influence the potential for flooding in the City of New Orleans.

> The threat to New Orleans from flooding is increasing due to a combination of three physical temporal factors. First, as a result of its location on thick recent delta sediments along the edge of an oceanic basin, the city is sinking at geologically rapid rates. Second, over the last decade, global sea level rise has increased as a result of climate change and is predicted to accelerate into the future. And third, the level of Atlantic basin hurricane activity has also risen, with the biggest increases for the strongest storms (with the largest surges), particularly in and around the Gulf of Mexico. These factors all serve to increase the storm surge flood hazard faced by New Orleans, and will significantly raise the risk of flooding in the city through the 21st century.[11]

Flood and Storm Surge Loss Estimation

As discussed earlier in this section, there are a number of highly detailed and current storm surge risk studies for the City of New Orleans. This section of the Hazard Mitigation Plan summarizes these studies and discusses them in the context of a FEMA-compliant Hazard Mitigation Plan. These studies include (a) the Louisiana Coastal Protection and Restoration Technical Report, (USACE, Mississippi Valley Division, February 2008), which begins on the present page of the HMP update, and reports on the Congressionally mandated study and design of an updated hurricane protection system; (b) Flood Risk in New Orleans, Implications for Future Management and Insurability (Risk Management Solutions, Inc.), and provides a succinct background explanation of the levees around and near Orleans Parish, as well as site-specific risk trend calculations; and (c) Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System. Draft Final Report of the Interagency Performance Evaluation Task Force, Volume VIII – Engineering and Operational Risk and Reliability Analysis, included in this HMP, and provides a highly detailed assessment of vulnerabilities in several southern Louisiana Parishes, and calculations of potential losses by drainage basin.

<u>Louisiana Coastal Protection and Restoration Technical Report, (USACE, Mississippi Valley Division, February 2008)</u>

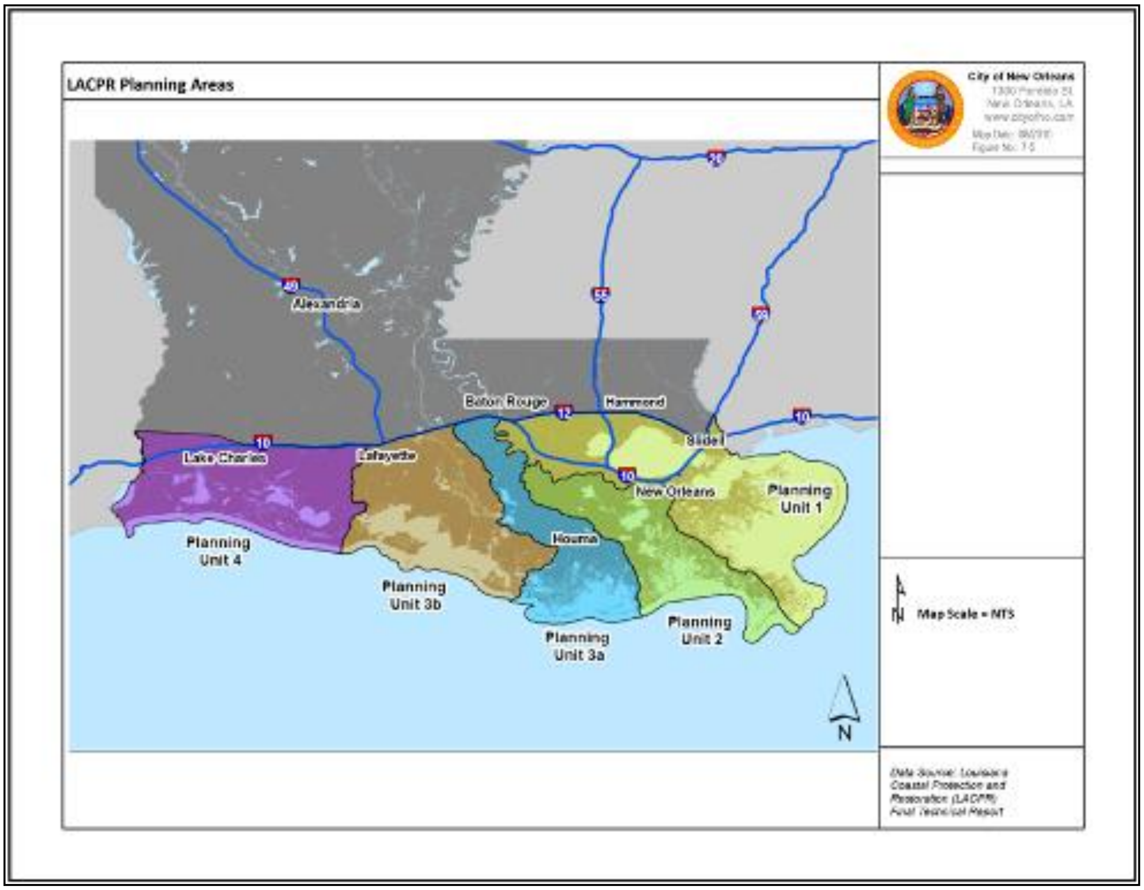
[11] Risk Management Solutions Report, *Flood Risk in New Orleans, Implications for Future Management and Insurability*, 2006.

Background and Purpose of Report

The purpose of the LACPR is "to describe the Louisiana Coastal Protection and Restoration (LACPR) effort that is being undertaken in response to the Energy and Water Development Appropriation Act of 2006 …." Congress and the President directed the Secretary of the Army 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 study underlying this report divided the study area into five planning units, as described below. New Orleans is encompassed by Planning Unit 1, which is shown in Figure 7-5, along with the four other planning areas.

- **Planning Unit 1 – Lake Pontchartrain Basin**, or the area east of the Mississippi River. Planning Unit 1 includes a population of about one million. The major portion of greater New Orleans is located within the planning unit.
- **Planning Unit 2 – Barataria Basin**, or the area from the Mississippi River west to Bayou Lafourche. Planning Unit 2 contains a population of about 300,000, including a portion of greater New Orleans.
- **Planning Unit 3a – Eastern Terrebonne Basin**, or the area west of Bayou Lafourche to Bayou de West. Planning Unit 3a includes a population of about 249,000.
- **Planning Unit 3b - Atchafalaya Influence Area**, or the area west of Bayou de West to Freshwater Bayou. Planning Unit 3b includes a population of about 350,000.
- **Planning Unit 4 – Chenier Plain**, or the area west of Freshwater Bayou to the Sabine River. Planning Unit 4 includes a population of about 250,000.

Figure 7-5
LACPR Planning Areas
(Source: Draft Louisiana Coastal Protection and Restoration Technical Report, Table 4-3, page 33)



As the basis of its task to identify appropriate protection measures (and to determine specific performance criteria such as heights of levees), the USACE had to conduct a risk assessment to identify vulnerabilities in the existing flood protection system. The report includes detailed explanations of the methodologies underlying the risk study. These are briefly summarized here. The summaries are taken directly from the report.

Period of Analysis. A 50-year period of analysis from 2025 to 2075 was used to evaluate all alternatives. 2025 was chosen as the common base year for comparison of alternatives since it generally represents the end of the implementation period for most alternatives considered.

Evaluation Process. Each alternative was evaluated for a range of storm events from a 10-year rainfall event to a 2,000-year hurricane surge event. Hydrologic modeling and economic results are based on three confidence limits related to the uncertainty associated with water level data. Each alternative was evaluated for the four future scenarios. Comparison of the no action alternative and the future with-project condition (maintained coast) measures risk reduction attributed to coastal features/alternatives.

Nonstructural Evaluation. The nonstructural analysis assumes that all new development, during the reconstruction post-2005 hurricanes, conforms to base floor elevations established for compliance with the National Flood Insurance

Program. Therefore, if a nonstructural measure proposes a level of risk reduction greater than the 100-year level, only the cost of the height increment above the 100-year was included as an economic cost of raising-in-place for future growth.

A GIS-based methodology similar to that used by the IPET was used to assess flood damages to residential and non-residential structures, their contents, and vehicles in the planning area. More details on the assets inventory used for the LACPR analysis can be found in the Economics Appendix of the report. The next two figures are from the LACPR draft report, and show the inundation limits and calculated storm surge heights for the 100- and 1,000-year events, respectively. The draft report also includes the 400-year graphic, which is omitted here for brevity.

Figure 7-6
Sample of Statistical Water Surface Elevation used in Surge Risk Calculation
(1-percent annual probability calculation)
(Source: Draft Louisiana Coastal Protection and Restoration Technical Report, Figure 4-4, page 35)

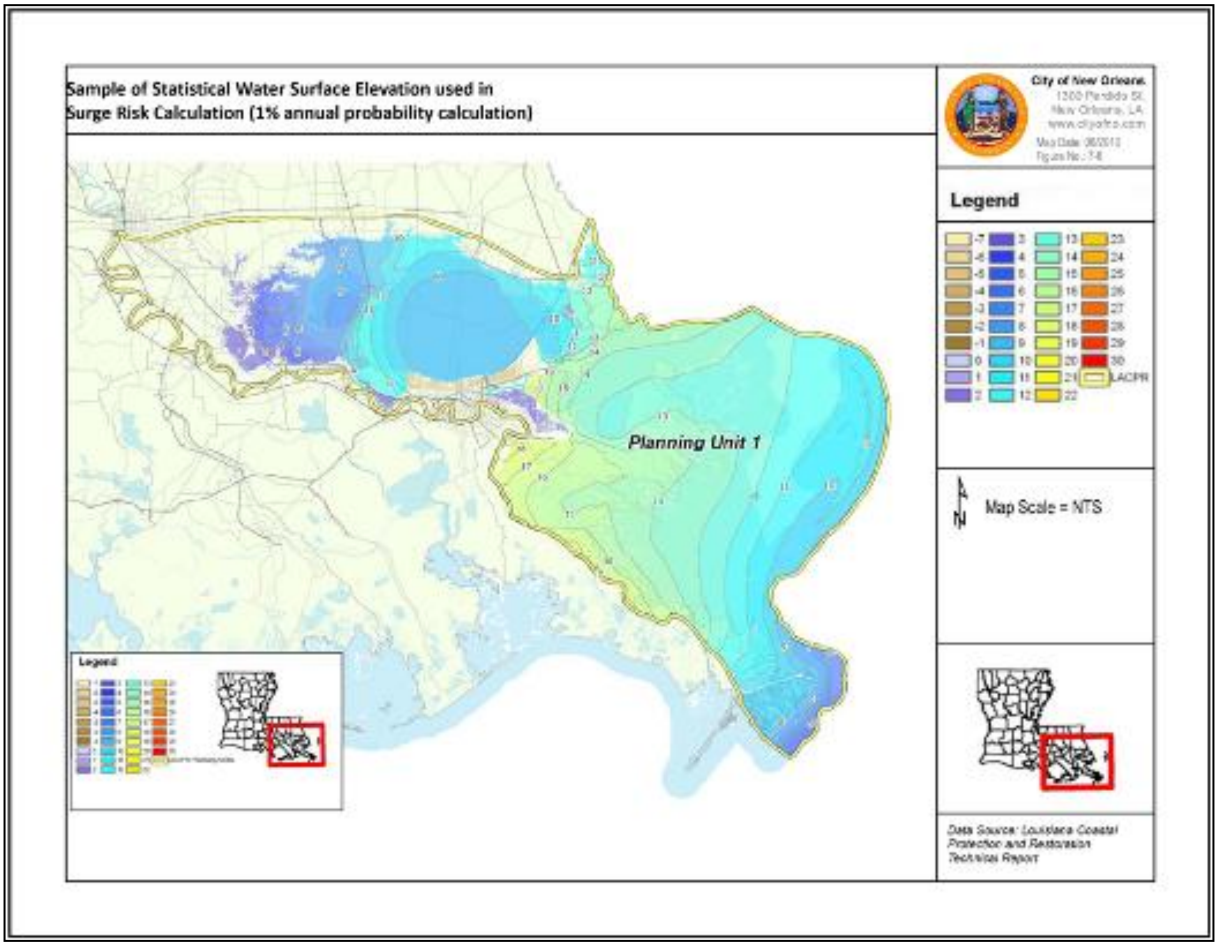
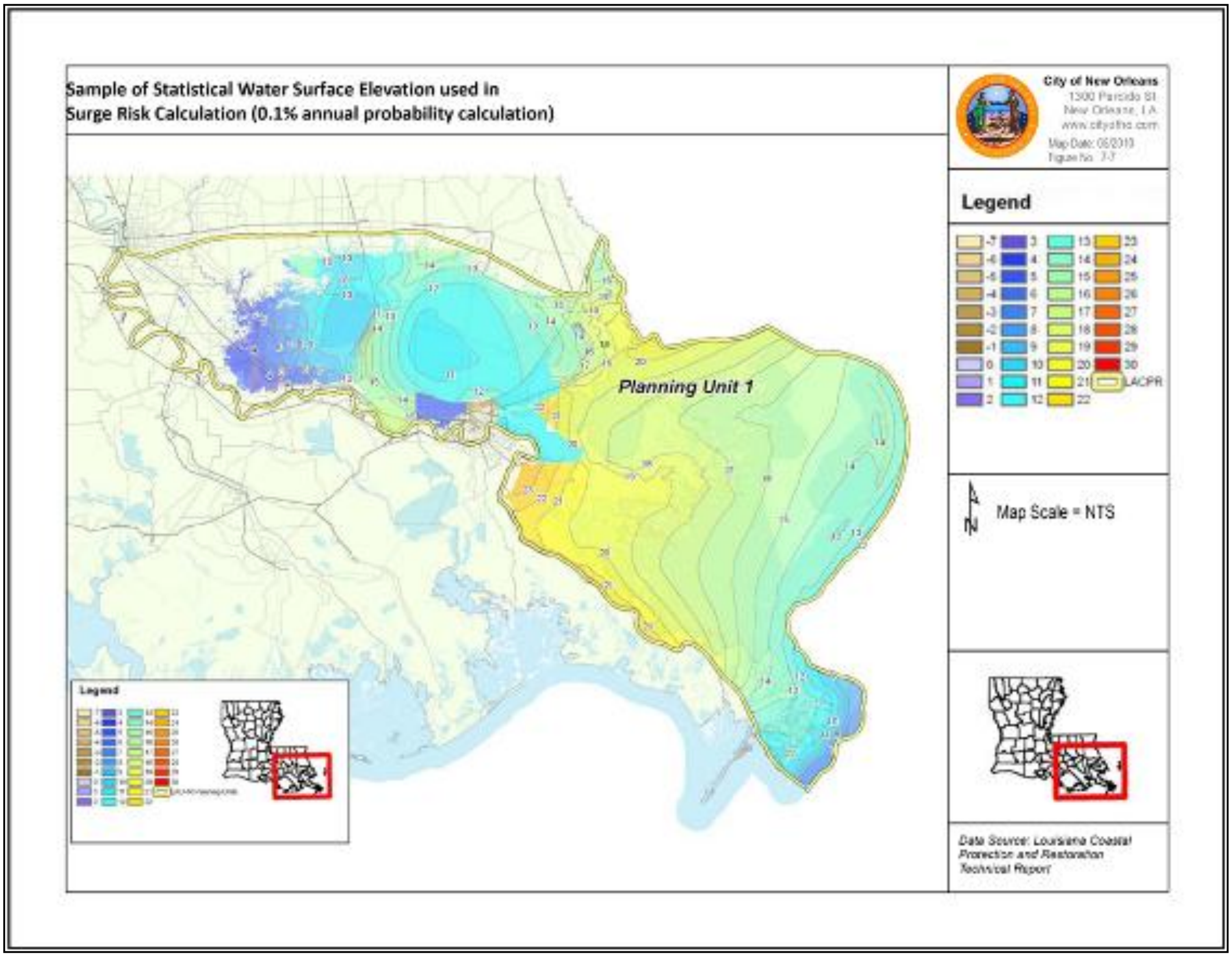


Figure 7-7
Sample of Statistical Water Surface Elevation used in
Surge Risk Calculation (0.10-percent annual probability calculation)
(Source: Draft Louisiana Coastal Protection and Restoration Technical Report, Figure 4-6, page 36)



Summary of Inputs to the LACPR Risk Calculation

The paragraphs below summarize inputs to the risk calculation. In most cases, the language is taken directly from the report. The damage numbers are based on each event happening at the same time across the entire planning unit and are, therefore, not representative of an actual event.

Asset Values

1. **Residential Structures.** Depreciated exposure values of residential structures obtained from the general building stock portion of the Hazard U.S.- Multi-hazard (HAZUS-MH), a multi-hazard loss estimation tool developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS);
2. **Non-Residential Structures.** Depreciated exposure values of non-residential structures, including public infrastructure and businesses, obtained from the Louisiana Department of Labor (LDOL) and the Louisiana State University;
3. **Contents of Structures.** Residential and non-residential contents values;
4. **Vehicles.** Depreciated exposure values of vehicles associated with residential and non-residential structures are based on the Manheim Used Vehicle Value Index and data obtained from the Louisiana Department of Motor Vehicles.
5. **Damages Related to Depth of Flooding.** Depth-damage relationships developed by panels of building and construction experts as part of previous USACE feasibility studies; and
6. **Topography.** Elevation data were obtained through satellite technology and computer modeling;

Stage-Damage Relationships. The GIS database of assets as described was used within a geospatial environment to generate a water elevation or stage-damage relationship for each census block. Flood damages were calculated at 1-foot increments from the beginning-damage elevation to an elevation where damages for all the structural categories have reached a maximum. Six general damage categories were considered:

1) Single-family residential
2) Multi-family residential
3) Manufactured housing/mobile homes
4) Commercial, industrial, public
5) Agricultural
6) Vehicles

The LACPR calculations consider the expected recovery projects, i.e., future development and land use, figures for which were provided by Calthorpe Associates. The damage figures reflect 2006 price levels.

Emergency Costs. An emergency depth-damage relationship cost for residential and nonresidential properties was developed for each increment of flooding up to 15 feet above the first floor elevation. Emergency costs for residential properties included evacuation and subsistence, clean up and reoccupation costs, debris removal, and landscaping costs throughout the necessary duration for recovery. The emergency costs associated with inundated non-residential properties include clean up and restoration costs, recovery of business records, and landscaping. These depth-damage relationships were then combined in the GIS framework with the number of residential and non-residential structures inundated at each 1-foot increment of flooding to develop a stage-damage relationship for the total of all residential and non-residential emergency cost categories.

Transportation. The GIS framework was used to determine the number of miles of highways, streets, and railroad tracks that would be inundated by the stages associated with each 1-foot increment of flooding. Data obtained by USACE New Orleans District staff were used to revise the depth-damage relationships for highways, streets, and railroad tracks that had been developed as part of a Mississippi River and Tributaries study entitled Economic Data Survey New Orleans District, which was conducted for the Lower Mississippi Valley Division in September. These depth-damage relationships were then combined in the GIS framework with the number of residential and non-residential structures inundated at each 1-foot increment of flooding to develop a stage-damage relationship for the total of all highways, streets, and railroad tracks.

Agricultural Resources. In addition to the stage-damage relationships developed for residential and non-residential structural damages and for the other emergency cost categories, stage-damage relationships were developed for the agricultural resources in the planning area. The total damage rate developed for each crop, including both crop loss and non-crop loss, was multiplied by the number of cleared acres inundated in order to calculate the total loss from inundation for each crop. The reduction in the acres inundated under the with-project alternatives was compared to the without-project condition and multiplied by the damage rates in order to determine the damages and benefits associated with each alternative.

The risk study was done as two analyses, based on different assumptions about relative sea level values, as shown in the figure immediately below (Figure 7-8) The figure after that (Figure 7-9) displays the results of the analyses. Note that for the Orleans Parish Hazard Mitigation Plan, the salient part of the table is the rows with results for Planning Unit 1. The base condition row indicates potential losses under current conditions; the future scenarios range displays a range of potential losses, which are based on the sea level inputs in Figure 7-8. The term "return interval" is the same as probability, so the 10-year return interval is equal to a 10-percent annual chance of occurrence; the 1,000-year event is equal to a 0.1-percent annual chance of occurrence, and so forth.

Figure 7-8
Potential Relative Sea Level Rise Values (2010 to 2060) in Meters and Feet
(Source: Draft Louisiana Coastal Protection and Restoration Technical Report, Table 4-2, page 45)

	Relative Sea Level Rise Values between 2010 and 2060 in meters (in feet)		
Basis for Value	**Pontchartrain Basin (Planning Unit 1)**	**Delta Plain (Planning Units 2, 3a, and 3b)**	**Chenier Plain (Planning Unit 4)**
Historic rate (for comparison only)	0.2 m (0.7 ft)	0.4 m (1.3 ft)	0.2 m (0.7 ft)
Future Projection 1 (based on Intergovernmental Panel of Climate Change values)	0.4 m (1.3 ft)	0.6 m (1.9 ft)	0.4 m (1.3 ft)
Future Protection 2 (based on National Research Council values)	0.8 m (2.6 ft)	1.0 m (3.2 ft)	0.8 m (2.6 ft)

Figure 7-9
Range of Without-Project Expected Damages for Events of Various Return Intervals.
(Source: Draft Louisiana Coastal Protection and Restoration Technical Report, Table 4-4, page 49)

Planning Unit	Alternative	10-Year Damage ($billions)	100-Year Damage ($billions)	400-Year Damage ($billions)	1000-Year Damage ($billions)	2000-Year Damage ($billions)
1	Base Condition	5.0 to 5.4	9.4 to 9.7	35.3 to 36.1	46.2 to 47.6	65.6 to 67.0
	Future Scenarios	6.4 to 8.1	16.2 to 29.4	62.9 to 107.1	75.9 to 111.1	76.9 to 112.5
2	Base Condition	2.6 to 4.4	4.6 to 6.4	29.9 to 33.9	31.7 to 35.9	32.2 to 36.5
	Future Scenarios	3.6 to 6.4	30.1 to 33.8	35.1 to 45.7	36.1 to 47.3	36.5 to 48
3a	Base Condition	8.7 to 10.3	10.3 to 12.1	13.8 to 15.3	15.4 to 16.8	16.0 to 17.5
	Future Scenarios	12.8 to 17.1	14.7 to 18.1	17.9 to 22.8	19.0 to 24.4	19.5 to 25.1
3b	Base Condition	2.7 to 2.9	3.4 to 3.7	5.5 to 6.1	7.1 to 7.8	8.0 to 8.6
	Future Scenarios	4.2 to 5.6	5.2 to 6.5	8.1 to 9.6	10.0 to 10.8	10.6 to 11.1
4	Base Condition	2.5 to 2.7	3.3 to 3.4	4.9 to 5.4	6.6 to 7.6	7.4 to 8.5
	Future Scenarios	3.3 to 4.7	4.3 to 5.7	7.6 to 9.9	9.3 to 11.9	10.2 to 13.1

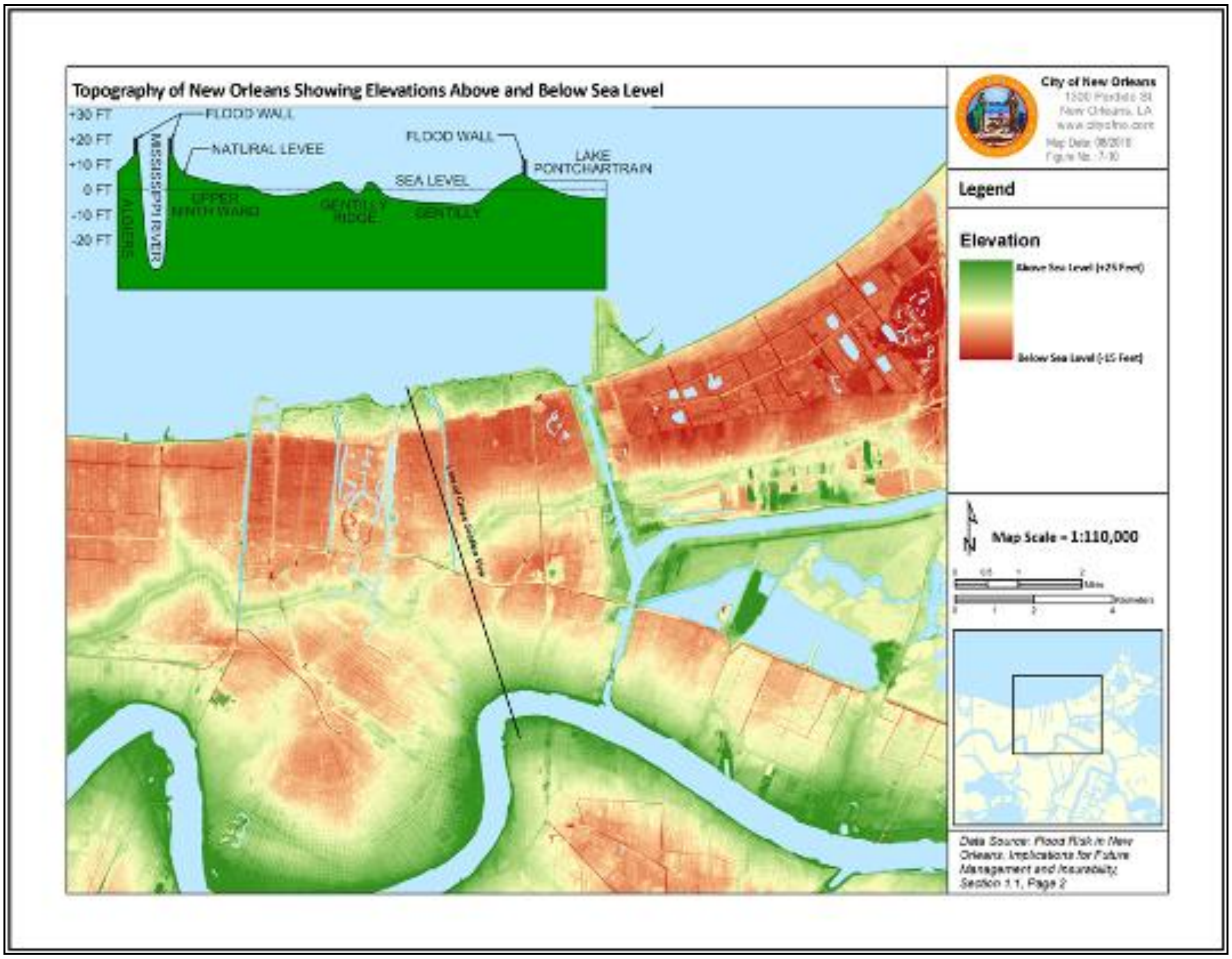
The utility of this result is somewhat limited by its general character. However, the result can be used to determine overall correlations with other risk studies for the City, among other things.

<u>Flood Risk in New Orleans, Implications for Future Management and Insurability</u>
Risk Management Solutions, Inc.

Background and Purpose of the Report

This report offers a good explanation of the genesis of flood risk in New Orleans, including geomorphology, development and expansion, and hurricane/surge probabilities. Figure 7-10 below shows both plan and cross-sectional views of topography and elevations for the City. This graphic is repeated from the Flood Hazard Profile subsection of this Plan, Section 1.1.

Figure 7-10
Topography of New Orleans Showing Elevations Above and Below Sea Level
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability, Section 1.1, Page 2)



The USACE has used a “standard project hurricane” as the basis for the design of flood protection systems since the 1960s. The report notes that “over time, the specifications for the storm were updated, but not fundamentally changed. For example, after Hurricane Betsy in 1965, revised wind field parameters were issued, but the other parameters defining the storm, including the central pressure, the radius of maximum winds, the forward velocity, the direction of approach, and the wind speed remained unchanged" (RMS report, p. 6). However, the report goes on to discuss the fact that some of the data that was employed in developing the standard storm parameters was flawed, and notes that "neither the probabilistic methodologies nor the computational resources, were available to USACE at the time to determine what a risk-based design level should be for a region with such a complex coastline and wide range of hurricane sizes, intensities, tracks and forward speeds" (RMS report, p. 6).

Figure 7-11
Parameters for USACE Standard Project Hurricane
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability
Risk Management Solutions, Inc.)

Standard Project Hurricane Meteorological Parameters	
Central Pressure	934 mb
Radius to Maximum Winds	30 nautical miles
Forward Speed	Varied by location, 5, 6, or 11 knots
Calculated Wind Speed	100 miles per hour

Parameters used to define the standard project hurricane for the New Orleans and Vicinity hurricane protection project

Section 2 of the RMS report is a detailed discussion of Hurricane Katrina, including storm history and the first and second phases of flooding in the region, the first from the south and east, and the second from the north via Lake Pontchartrain. Section 2.4.1 describes the need for a risk-based approach to flood management. The report cites the "Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System" (the IPET report, discussed separately herein). This section of the RMS report briefly discusses a number of related reports, including the one mentioned above, with the intent of establishing a basis for risk-based planning.

The next section of the report "Flood Risk in New Orleans" discusses the use of RMS's proprietary U.S. Hurricane Model ®. The risk calculation uses a "comprehensive stochastic hurricane track model" and modeling of the storm surge, to determine its height along the coast line, from which water levels are then "attenuated" over water and land. The report notes on (RMS report, p. 16) that

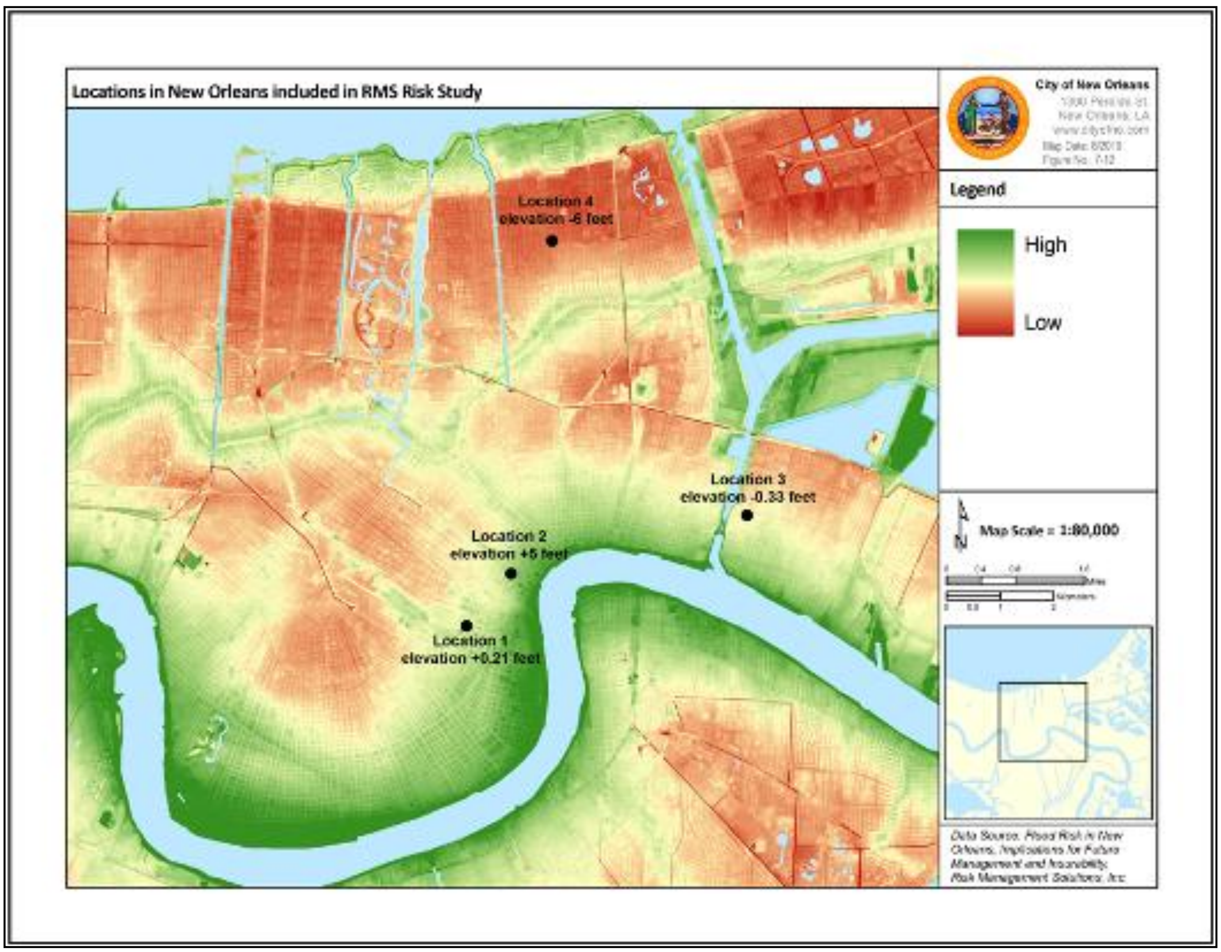
> the return period of first flooding is a good indicator of risk, as it represents the probability that sufficient water enters the city through overtopping and/or breaching of the flood defenses, filling the bowl of the city to that elevation. The return period of first storm surge flooding for current, 'medium term' hurricane activities is found to be around 55 years for the lowest parts of the city, increasing up to 275 years for the highest point selected along Bourbon Street, which remained above the flood waters from Katrina.

RMS report page 16 provides a good summary of some of the factors in future storm surge risk, specifically including increases in mean sea level and subsidence. In the middle of the 19^{th} Century, a period of significant expansion of New Orleans, "all of the land was above sea level." By 2006, the average elevation across the City is -6.0 feet MSL.

But, the report states, “The consequences of ongoing subsidence have not been part of the policy decisions for flood protection of the City.” The report discusses some of the more significant findings of the IPET report, including the fact that higher rates of subsidence are found in the Lakeview region along the southern shore of Lake Pontchartrain, and that “[a] number of the levee breaches in Katrina corresponded with the locations of some of the highest levels of subsidence”.

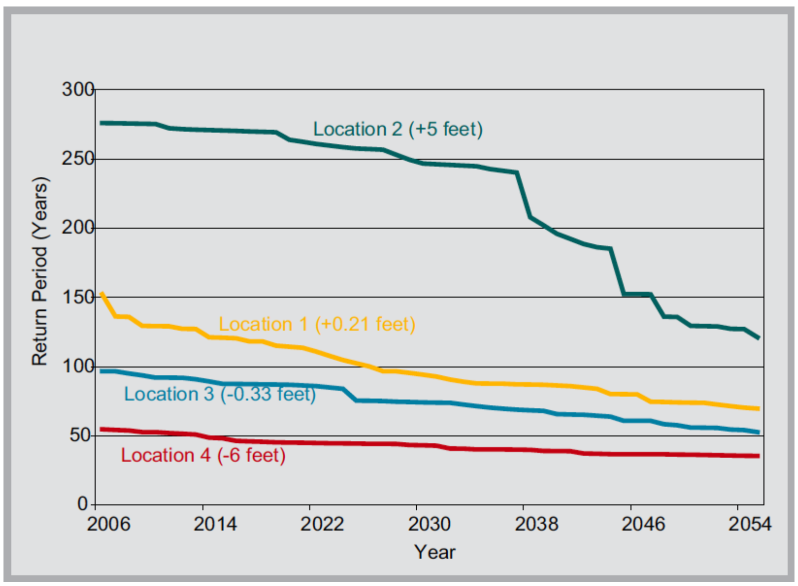
Figure 7-12 shows four locations in the City of New Orleans that were chosen for risk calculations (RMS report, p. 13). The locations are (1) the Superdome [0.21 feet MSL], (2) the French Quarter [5 feet MSL, (3) the center of the Lower Ninth Ward [-0.33 feet MSL], and (4) the intersection of Filmore Avenue and Elysian Fields in the northeast part of the City [-6.0 feet MSL]. The color scheme indicates relative elevations, with green at the higher points, and red at the lower ones.

Figure 7-12
Locations in New Orleans included in RMS Risk Study (page 13)
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability, Risk Management Solutions, Inc.)



The next figure (7-13, RMS report, page 18), shows changes in the return frequencies of hurricanes projected to flood these four study locations, over the time period 2006 to 2054. The figure illustrates the estimated effects of subsidence and sea level rise on flood risk. Other variables such as hurricane probability are calculated using proprietary methodologies. Note that over time the storm return frequency that causes floods in these locations gradually drops, i.e., increasingly, more common (probable) storms flood these locations over the study horizon. Notably, the area indicated by the green line (the French Quarter), while presently less prone to flooding because of its elevation, also has the most significant potential exacerbation of flooding due to subsidence. As calculated, it presently requires an approximate 275-year storm to flood the area, but the study estimates that an approximate 125-year storm will cause flooding there by the year 2054. It is notable that the subsidence also affects the height of flood control structures in the area, reducing their effectiveness because of lower overtop elevations.

Figure 7-13
Sensitivity Analysis of Future Flood Risk, Changes in Return Period of First Flooding, Four Locations in New Orleans
(Source: Flood Risk in New Orleans, Implications for Future Management and Insurability, Risk Management Solutions, Inc., Page 18)



The last main subsection of the RMS report discusses the potential effects of levee improvements on flood risk in the City. It considers two levels of potential levee improvement – raising the structures 3 feet, and raising them 6 feet. The modeling takes into account the greater fragility of the levees because of the increased height and the potential for greater flooding if the improved levees were to breach (because there is more water behind them). RMS indicates that "results [of the modeling to include levee improvements] suggest that flood risk can be reduced significantly with raised flood defenses. Measurements of return periods of first flooding for the four locations in New Orleans increase on average by 124-percent for a 3-foot rise in flood defenses, and increase by 375-percent for a 6-foot rise in flood defenses" (RMS report, p. 19). Possible increases in the extent of marshland (including restricting the flow of water through MRGO) were not modeled for this report.

While the RMS report does not specifically provide estimates of flood losses and in some cases the return intervals conflict with the USACE report, the information has been included in this Plan as they add to the overall picture of risk in Orleans Parish. Specifically, the sensitivity graphic shows the dual effects of subsidence and sea level rise on risk in the Parish though it must be noted that they do not provide exact numerical loss estimates. The RMS report provides value to the overall picture by explicitly including information about sea level rise and subsidence and in showing the trend of increasing risk as the return frequency required to generate specific flood elevations over time.

The end of the RMS report notes that flood risk in the City will be directly related to where redevelopment occurs (RMS report, p. 20), and how well controlled it is.

> Arguments about improving the level of protection for New Orleans will depend on cost-benefit analyses around the associated reductions in risk. While it is possible to identify and explore some of the issues that would need to be included in such analyses it would first require knowing what will be the future value, locations, and elevations of properties within a rebuilt New Orleans. There will be significant reductions in the values of exposure at greatest risk if all redevelopment is carefully controlled and zoned so that the lowest lying areas are abandoned and all new development forced to be located at higher elevations.

<u>Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System.</u> <u>Draft Final Report of the Interagency Performance Evaluation Task Force, Volume VIII – Engineering and Operational Risk and Reliability Analysis.</u>
June, 2009 Final Draft

Background and Purpose of the Report

This draft report provides perhaps the most comprehensive surge and flood loss estimation currently available for New Orleans and surrounding areas. The study area comprises the Parishes of Orleans, St. Bernard, Plaquemines, Jefferson, and St. Charles. The report is the next-to-last in a series of nine such documents produced by the Interagency Performance Evaluation Task Force (IPET). As described in the Executive Summary, the mission of this analysis was to:

> …examine risks to life and property posed by hurricanes in New Orleans for two conditions: The HPS in place prior to Katrina (pre- Katrina), and the HPS reconstructed after Katrina and as existing in June 2007. The risk analysis considered the expected performance of the many elements of the system and the consequences associated with that performance. The purpose of the analysis was to identify areas protected by the HPS that are vulnerable to flooding, to identify the causes of that vulnerability, and to provide estimates of the frequency of flooding within each area. The comparison of pre-Katrina and current risks was made to understand the effectiveness of the repairs and improvements. (IPET Report, page VIII-3)

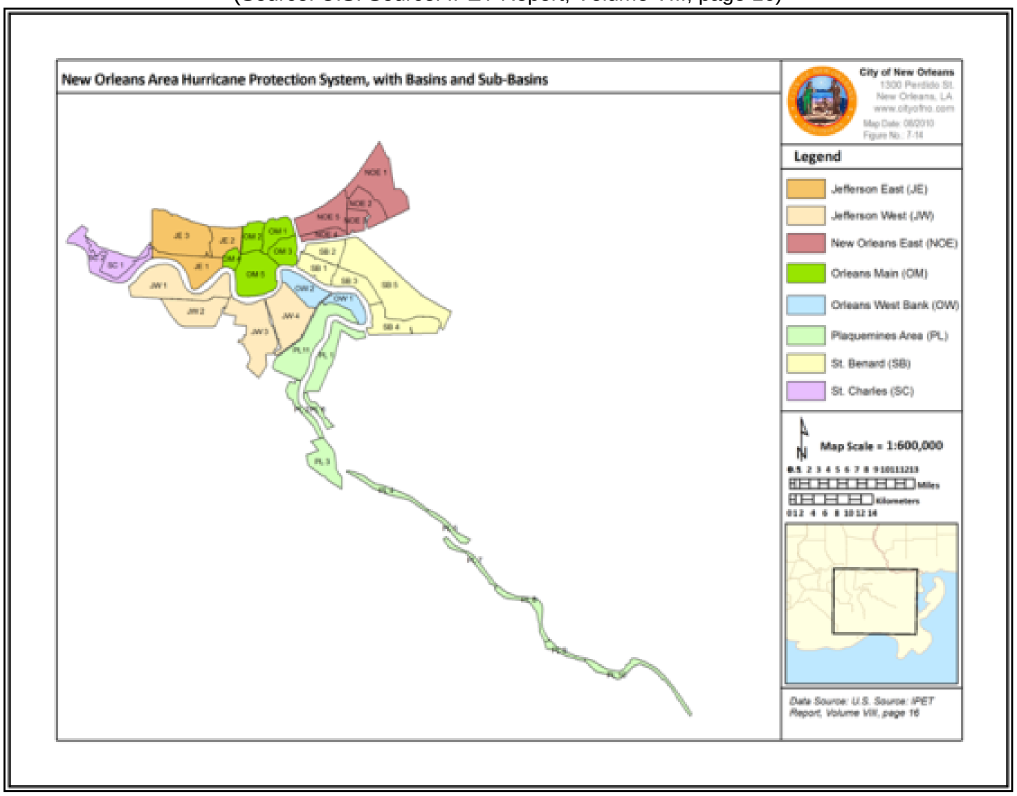
In this report, risk refers to expected loss of life and dollars. Conceptually, the study methodologies are based on a standard calculation that multiplies the probability of specific events by their expected consequences (Volume VII of the report comprises the calculations and results of a detailed consequences analysis). There are numerous references to the 2007 HPS, which is the improved Hurricane Protection System. The study methodology compares inundation probabilities for the pre-Katrina HPS to those of the 2007 HPS. The main purpose of the risk calculations in Volume VIII of the report is to identify areas of vulnerability.

The study shows that

> improvements in the HPS from pre-Katrina to the 2007 HPS have provided significantly reduced flood levels in a few areas, notably portions of Orleans Main (OM) and moderate reductions in the 1-percent flood level in St. Bernard (SB) and Plaquemines (PL11). Improvements in Orleans Main are largely due to the presence of the new gates and temporary pumps at the ends of the outfall canals. Continued vulnerability of the areas adjacent to the Inner Harbor Navigation Canal (IHNC) can be attributed to the remaining pre-Katrina elevations and significant fragility of the I-walls along the IHNC. Strengthening of the I-walls with stability berms and relief wells has improved the performance of the structures in the IHNC, but they remain unable to cope with surge conditions created by large storms.

Most of the central part of the report is comprised of a detailed explanation of the data and methodologies that were used to generate the risk calculations. There is also considerable discussion of the uncertainties in the analysis. For reasons of brevity, these are not repeated in this Hazard Mitigation Plan. The results of the risk analysis are summarized (IPET Report, VIII page 141), with an array of graphics presented in Appendix K. The graphics include (a) mosaic aerial photographs with flood inundation limits and depths for specific flood/surge return intervals and assumptions about pumping effectiveness, and (b) depictions of percent chance of total property value loss, with the same variables. Figure 7-14 shows the basins and sub-basins in the study area.

Figure 7-14
New Orleans Area Hurricane Protection System, with Basins and Sub-Basins
(Source: U.S. Source: IPET Report, Volume VIII, page 16)



The following few subsections offer summaries of the risk estimates for events of 2-percent, 1-percent and 0.2-percent annual probabilities . After these summaries there is a series of figures from the IPET Report that are provided here as examples of the graphics in the report, which includes a much larger group of figures, for storms of various return intervals, and for various assumptions about pumping effectiveness.

- **Risk from the 2-percent annual probability flood event.** New Orleans is "widely vulnerable" the flooding at the 50-year occurrence level may occur if significant pumping capacity is not available. There is little difference in flood elevations pre-Katrina vs. the 2007 configuration of the Hurricane Protection System, presumably because this level of flooding is due to rainfall, not storm surge. The report notes that there are very significant benefits to specific areas when pumping capacity is at 50 percent or greater of the ideal capacity of the pumps. The report notes that the Orleans Main (OM in above map) basin is among those receiving the most benefit from adequate pumping. The pre-Katrina loss of life potential was extremely high in the OM-2 sub-basin. Even after the 2007 HPS (without pumping scenario), the potential loss of life in OM-2 is very high because of the vulnerability of the IHNC. Pre-Katrina and 2007 HPS property loss maps are essentially the same, for the reason noted above. Property loss figures are relatively low for the 2-percent-annual-probability event, below 10-percent of total value, and from 10 to 20 percent in areas of OM near canals, and in OW.

- **Risk from the 1-percent annual probability flood event.** Without pumping, "the majority of the New Orleans area remains vulnerable to moderate to deep flooding (greater than 4 feet at the 1-percent annual) probability. HPS 2007 improvements significantly reduced potential flooding in several areas, including parts of OM-2 and OM-4. Fragility and relatively low overtop elevations of I-walls around the IHNC mean that nearby areas are still vulnerable to flooding. The West Bank area remains highly vulnerable to flooding in 2007, and pumping will likely have little impact on this conclusion until all of the area is protected by portions of the HPS yet to be completed" (IPET Report, VIII page 143). At the 1-percent annual probability event, loss of life risk is very high (pre-Katrina) for OM-2. Pumping at 50-percent capacity or greater would reduce loss of life in parts of OW [and other basins outside the planning area], but has little effect elsewhere. "The 2007 HPS provides risk reduction in three of five sub-basins of Orleans Main, but those near the IHNC remain at higher risk levels. Without pumping, moderate to high risk exists in most of New Orleans East" (and other basins).

- **Risk from the 500-year flood event.** "Virtually the entire New Orleans region remains highly vulnerable to deep and catastrophic flooding at the 500-year (0.2-percent) flood frequency," with the actual effects depending on the path of a storm. The report notes that "there is essentially no difference in flooding vulnerability at this frequency of occurrence between pre-Katrina and the 2007 HPS," and pumping has no effect at this level of flooding. The 0.20-percent-annual-chance flood has a very high potential for loss of life throughout basin OM, and large portions of other basins, including OW, for both the pre-Katrina and 2007 HPS conditions. Pumping has no impact in either case. Property loss risks is extremely high in all areas, with essentially no change in pre-Katrina vs. HPS 2007 conditions, and pumping has no effect on property losses.

Reliability of 2007 HPS

> The reliability of the post-Katrina (June 2007) HPS has been significantly increased in many portions of the system that did not perform well during Katrina and ongoing improvements are steadily making the system more reliable. Reasons for this are as follows: the gates at the ends of the drainage canals reduce the chance of I-wall failure along the canals; adding overtopping protection at many transitions throughout the system makes them less likely to erode and fail; replacing less reliable I-walls with more reliable T-walls or L-walls reduces probability of failure in those areas; adding erosion protection to levees reduces their susceptibility to damage from waves overtopping them; and the raising of some levees reduces the chance of overtopping erosion. There are, however, areas of the HPS where the project is unfinished, such as on the West Bank, and areas where the structures still have low reliability, such as along the IHNC and GIWW in New Orleans East and St. Bernard. These areas act as weak points in the HPS perimeter chain that lowers the overall reliability of the system. Because these weak points provide possible HPS failure points, the reliability of the June 2007 HPS was found to remain low. (IPET Report, VIII page 146)

The series of graphics below (Figures 7-15 through 7-18) display some elements of the IPET study. The first two graphics are mosaic images of potential flood limits and depth for two of the scenarios discussed in the report (the report includes a much longer series of these). The second two images are part of the results of the study, and show the probabilities of complete damage in the various sub-basins, for a combination of event return frequency and pumping effectiveness. The second pair of graphics is somewhat more informative in this context because they show potential damage sites and indicate where the most significant potential vulnerabilities and flood losses are likely to be. Below are tables with calculations of potential losses based on these scenario ranges, using current postal service delivery figures and estimated structure and contents values. Also note that a HAZUS-based estimate of total exposure (i.e., the value of property) is included in this report above in the vulnerability assessment subsection. This information is not readily translated into a calculation using the IPET data for two reasons. First, although the HAZUS data is from the latest version of the software (MR-4), some of it is still based on 2000 census information, and is presumed to be somewhat inaccurate at this point. Second, the HAZUS information is not readily assigned to specific neighborhoods within the Parish for the purpose of the calculation.

It should be noted that Volume VIII of the IPET report was preceded by Volume VII, which was a comprehensive assessment of *consequences* of various surge events. Volume VII includes detailed discussion of the technical background for the loss calculations.

Figure 7-15
New Orleans Area Flood Inundation Limits and Depths,
1-percent Return Frequency Event, Pre-Katrina, Pumping at assumed 100-percent Capacity
(Source: U.S. Source: IPET Report, Volume VIII, page 163)

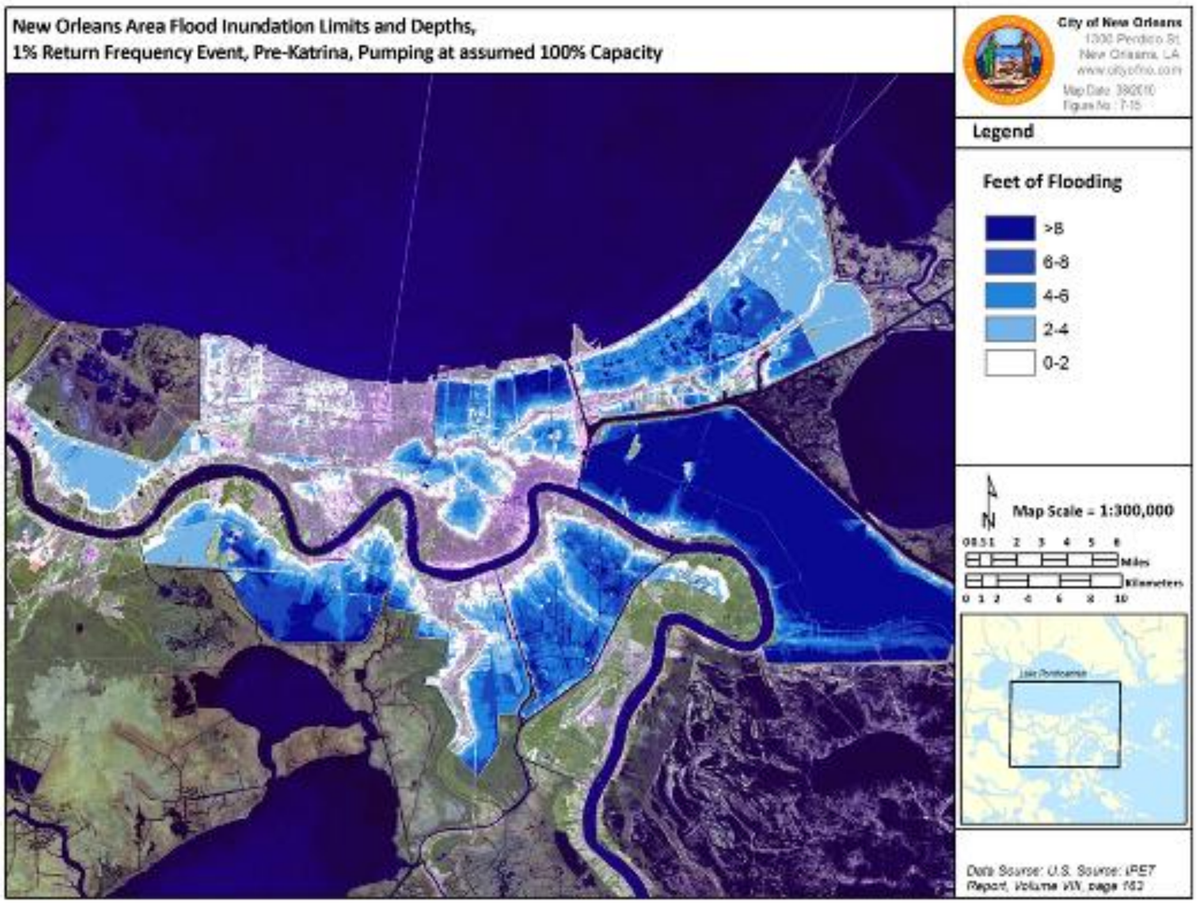


Figure 7-16
New Orleans Area Flood Inundation Limits and Depths,
1-percent Return Frequency Event, 2007 HPS, Pumping at assumed 100-percent Capacity
(Source: U.S. Source: IPET Report, Volume VIII, page 166)

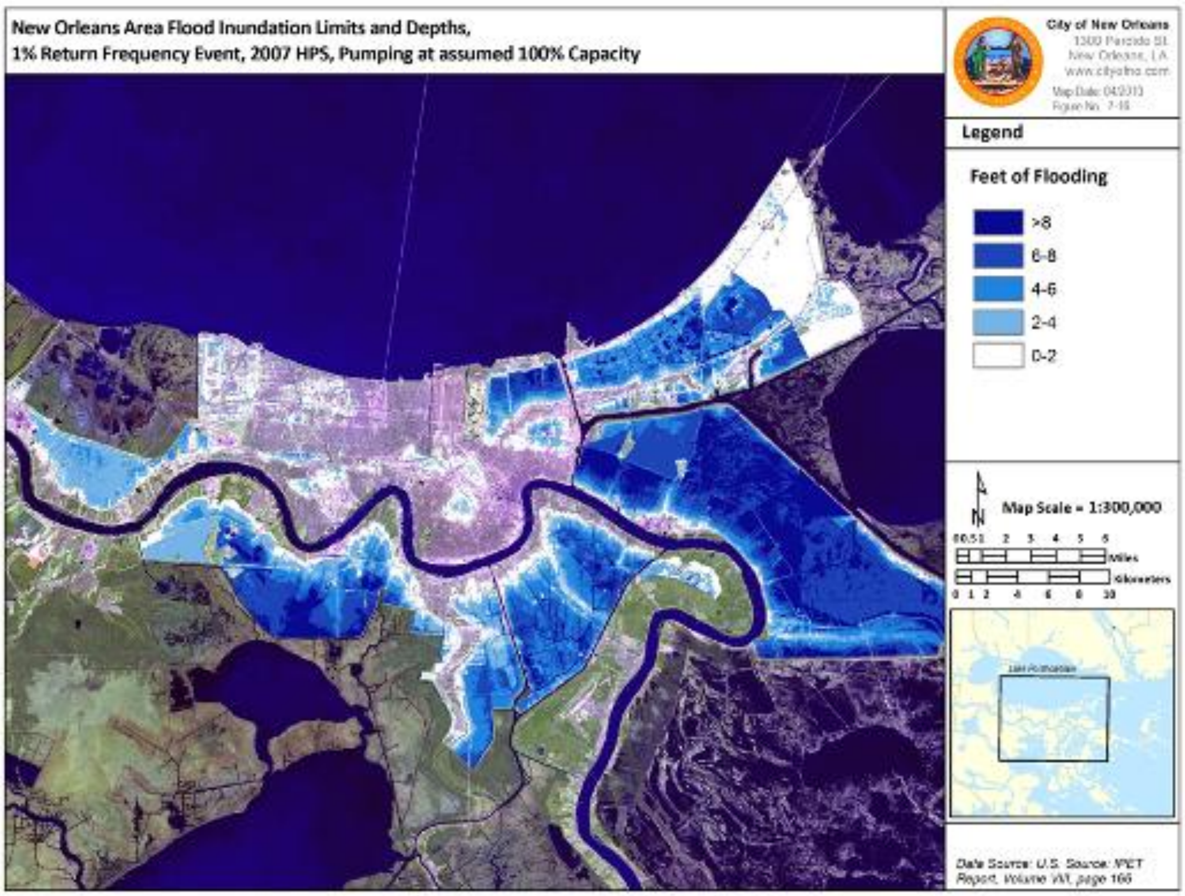


Figure 7-17
New Orleans Area, Percentage Chance of Total Property Value Lost,
1-percent Return Frequency Event, Pre-Katrina, Pumping at assumed 100-percent Capacity
(Source: U.S. Source: IPET Report, Volume VIII, page 169)

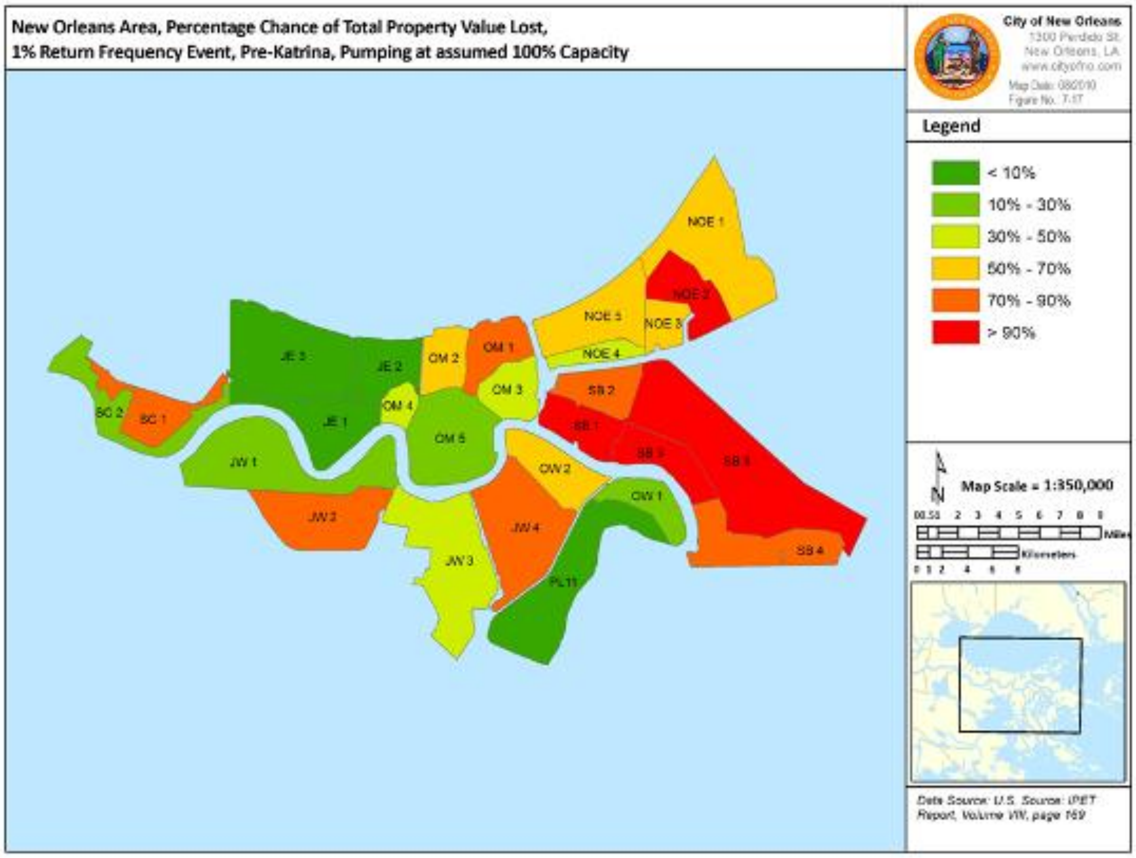
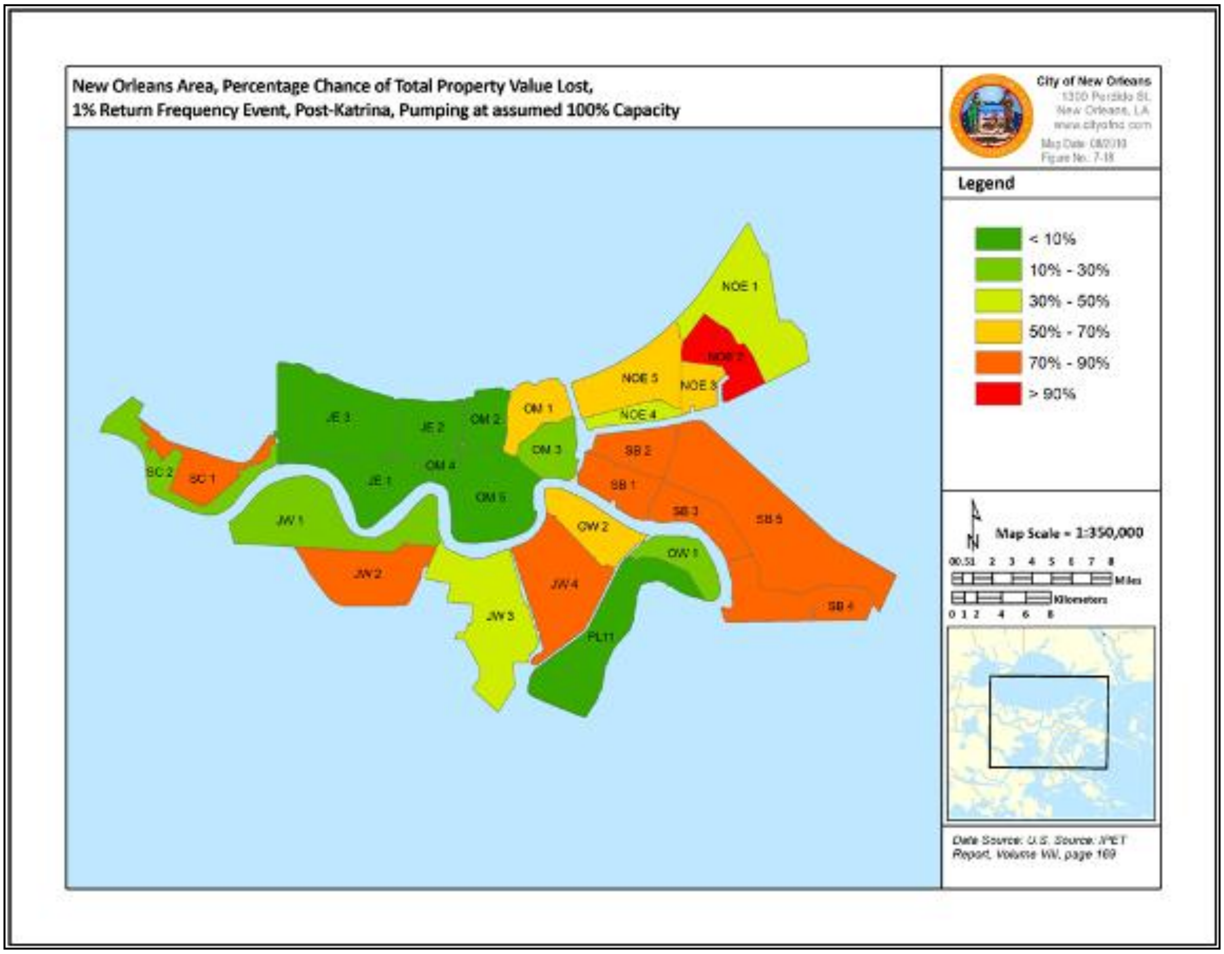


Figure 7-18
New Orleans Area, Percentage Chance of Total Property Value Lost,
1-percent Return Frequency Event, Post-Katrina, Pumping at assumed 100-percent Capacity
(Source: U.S. Source: IPET Report, Volume VIII, page 169)



Loss Estimation using FEMA/National Flood Insurance Program Claims Information

As discussed in the Flood Section (Section 6.3.2), following catastrophic floods in the early 1960s, the National Flood Insurance Program (NFIP) was established by the U.S. Congress in 1968, whereby homes and businesses could purchase coverage for water damage. The NFIP maintains a database of claims information for millions of policies nationwide. Because of the prevalence of flooding in Orleans Parish (coupled with the fact that a relatively high percentage of residents carry flood insurance), these NFIP records offer an excellent source of information about past flood losses and can be used as the basis for a risk assessment. As of December 2009, 88,222 structures located within Orleans Parish have flood insurance policies with the NFIP, paying annual premiums totaling $71,026,024. The 2008 estimate from the U.S. Census reported a total of 114,246 occupied housing units in Orleans Parish. The 88,222 NFIP-insured structures in Orleans Parish represent 77.2 percent of the housing units reported in 2008. The total coverage value of these policies is approximately $19.8 billion.

FEMA's NFIP statistics indicate that as of December 2009, NFIP policyholders within Orleans Parish have filed 120,657 insurance claims since the Parish joined the program in 1978 for a total loss value of approximately $7.1 billion.[12] The majority of these claims were associated with the devastating flooding that occurred as a result of Hurricane Katrina in 2005. After Katrina, more than 83,500 claims were filed with an average payment of approximately $94,000.[13]

The NFIP also maintains several subsets of claims data to track repetitive flood loss (RL) and severe repetitive loss (SRL) properties. An RL property is defined by FEMA as a property that is covered under an NFIP flood insurance policy and:

> Has been paid at least two insurance claims of more than $1,000 in any rolling 10 year period.

An SRL property is defined by FEMA as a property that is covered under an NFIP flood insurance policy and:

(a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
(b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.[14]

The following subsections analyze NFIP claims for both repetitive loss and severe repetitive loss properties within Orleans Parish.

Analysis of National Flood Insurance Program Repetitive Loss Records

This flood risk assessment method is based on an analysis of NFIP data for repetitive flood loss (RL) properties. As of September 2009, Orleans Parish had 6,397 such properties, based on a query of the FEMA BureauNet NFIP interface. The query results indicated that 623 of the repetitive loss properties had been mitigated through prior action

[12] FEMA. Policy and Claim Statistics for Flood Insurance (online)
[13] GAO Report to Congressional Committees. NFIP. New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should be Improved, December, 2006.
[14] FEMA. Severe Repetitive Loss Program – Program Overview. (online)

taken by Orleans Parish, GOHSEP, and/or FEMA. A column is included in the query results indicating that a site has been mitigated, but does not specify the date or type of mitigation action such as demolition or elevation. After deducting the 623 mitigated properties, there are a total of 5,774 remaining repetitive loss properties in Orleans Parish at the date of the query. Of this total, there are 5,137 residential and 637 non-residential properties. SRL properties are discussed in greater detail further in this section.

Table 7-3 summarizes the NFIP claims value and number of claims statistics for both residential and non-residential repetitive loss properties, excluding the 623 mitigated properties mentioned above. The Table shows that approximately 11 percent of the repetitive loss properties in the Parish are non-residential. Table 7-3 also indicates that the majority of the paid claims, approximately 68 percent, are associated with residential building damages. This skew in the ratio of numbers of non-residential RL properties (11 percent of sample) vs. the value of claims for those properties (32 percent of the total), is fairly typical, and is partly because the contents claims payments for non-residential properties are about three times higher per claim than residential ones.

Table 7-10
Summary of Residential and Non-Residential NFIP Repetitive Loss Statistics, Orleans Parish
(Source: FEMA/NFIP Query, September 2009)

Repetitive Loss Category	Properties	Building	Contents	Total	# Claims	Average
Residential	5,137	$456,551,668	$117,767,232	$574,318,900	18,391	$31,228
Non-Residential	637	$60,214,420	$41,442,925	$101,657,345	2,135	$47,615
Grand Total	**5,774**	**$516,766,087**	**$159,210,157**	**$675,976,245**	**20,526**	**$32,933**

The repetitive loss insurance claims for the parish were analyzed on a neighborhood bases. The 70 neighborhoods that make up the Parish are reflected in Figures 7-19 through 7-24.

Figure 7-19
Orleans Parish Neighborhood Map Sub Area 1
(Source: New Orleans Regional Planning Commission)
1

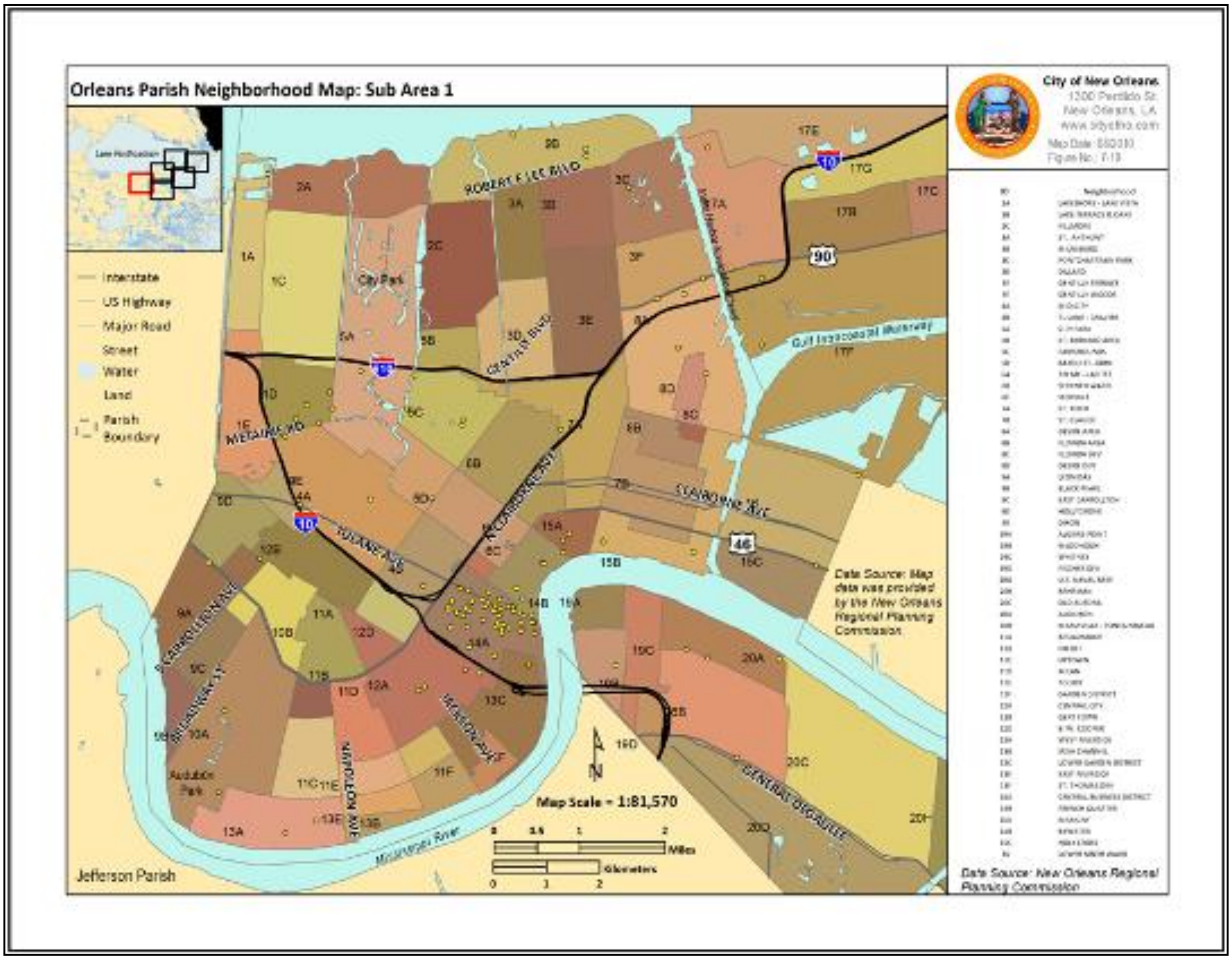


Figure 7-20
Orleans Parish Neighborhood Map Sub Area 2-2
(Source: New Orleans Regional Planning Commission)

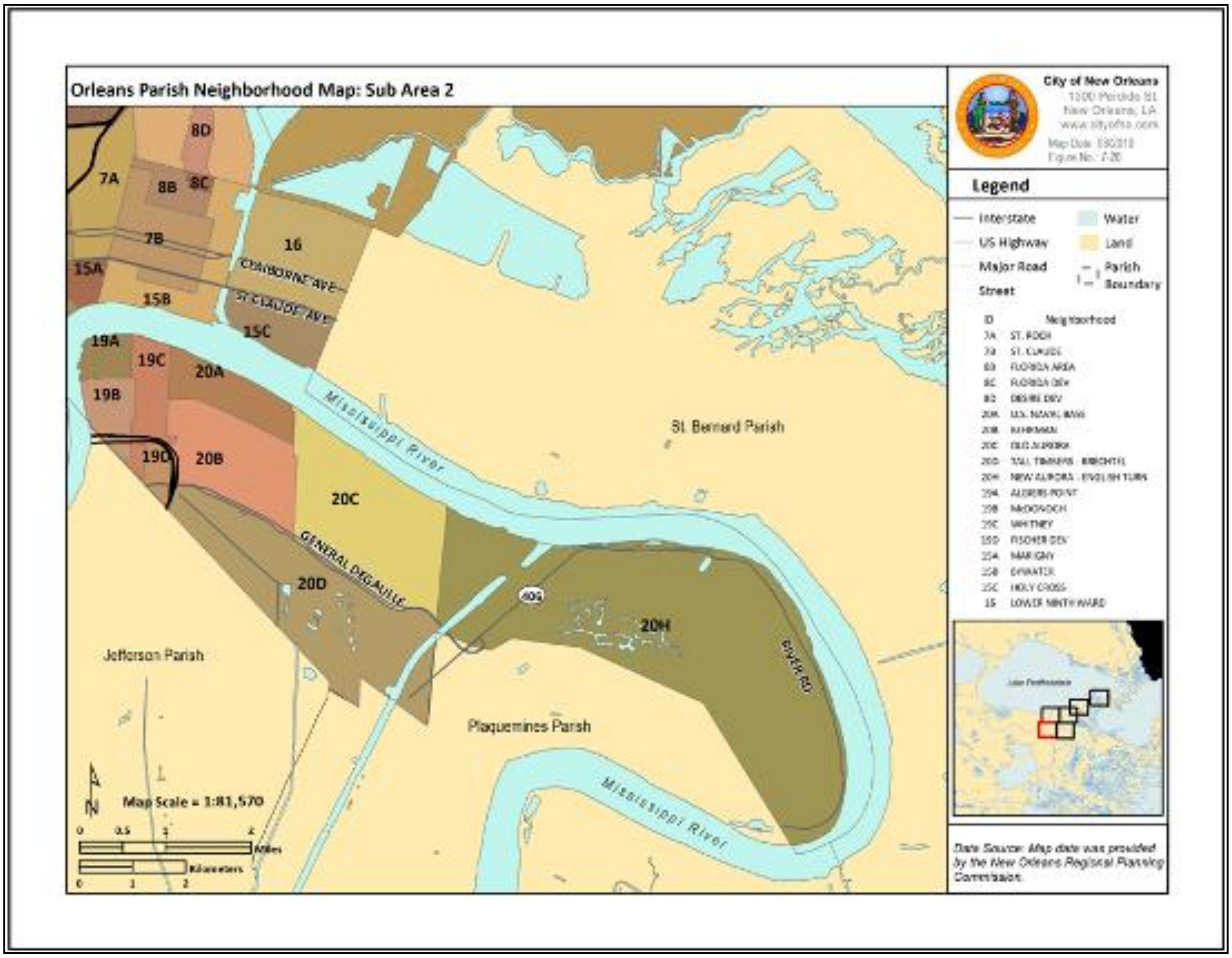


Figure 7-21
Orleans Parish Neighborhood Map Sub Area 3
(Source: New Orleans Regional Planning Commission)

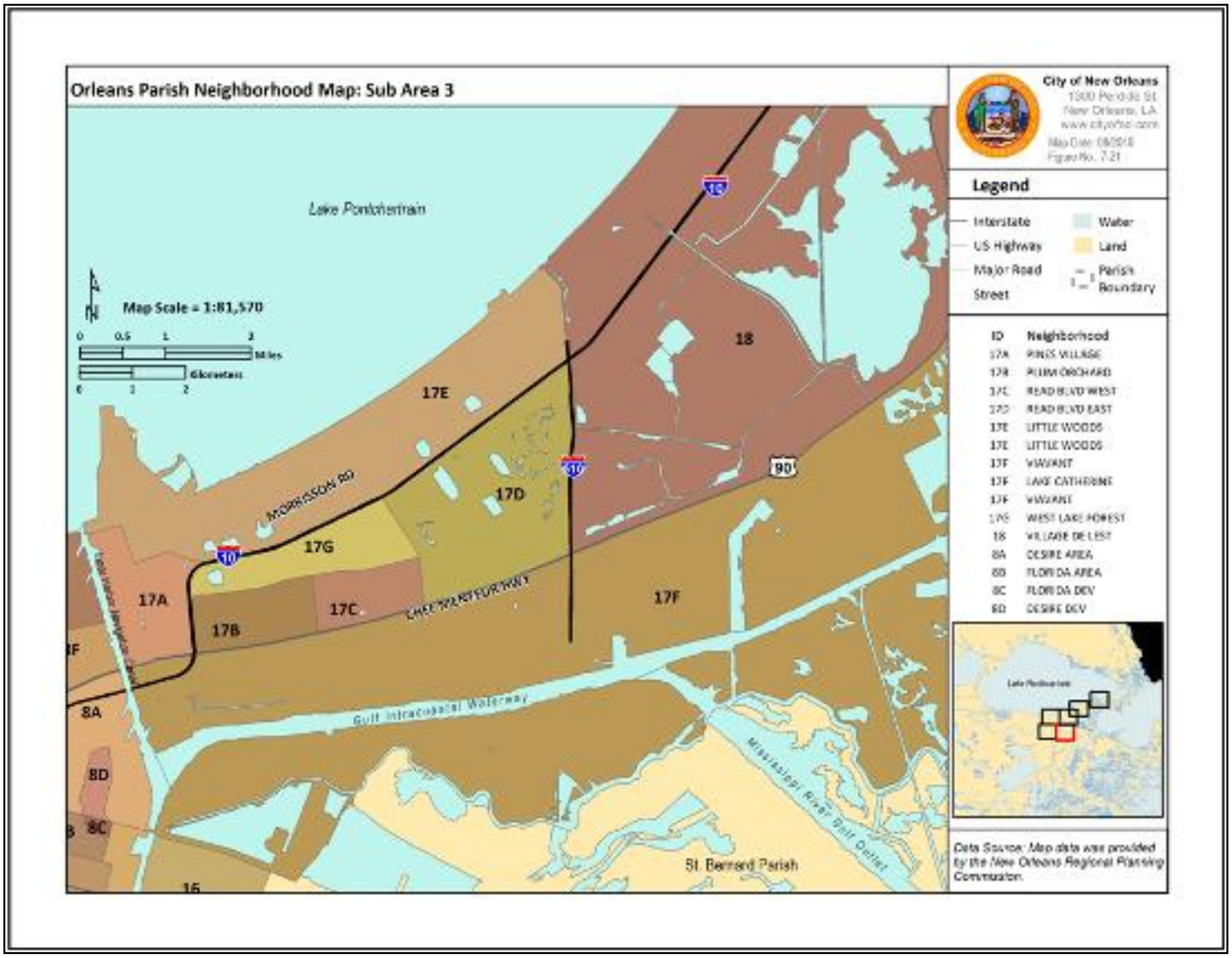


Figure 7-22
Orleans Parish Neighborhood Map Sub Area 4
(Source: New Orleans Regional Planning Commission)

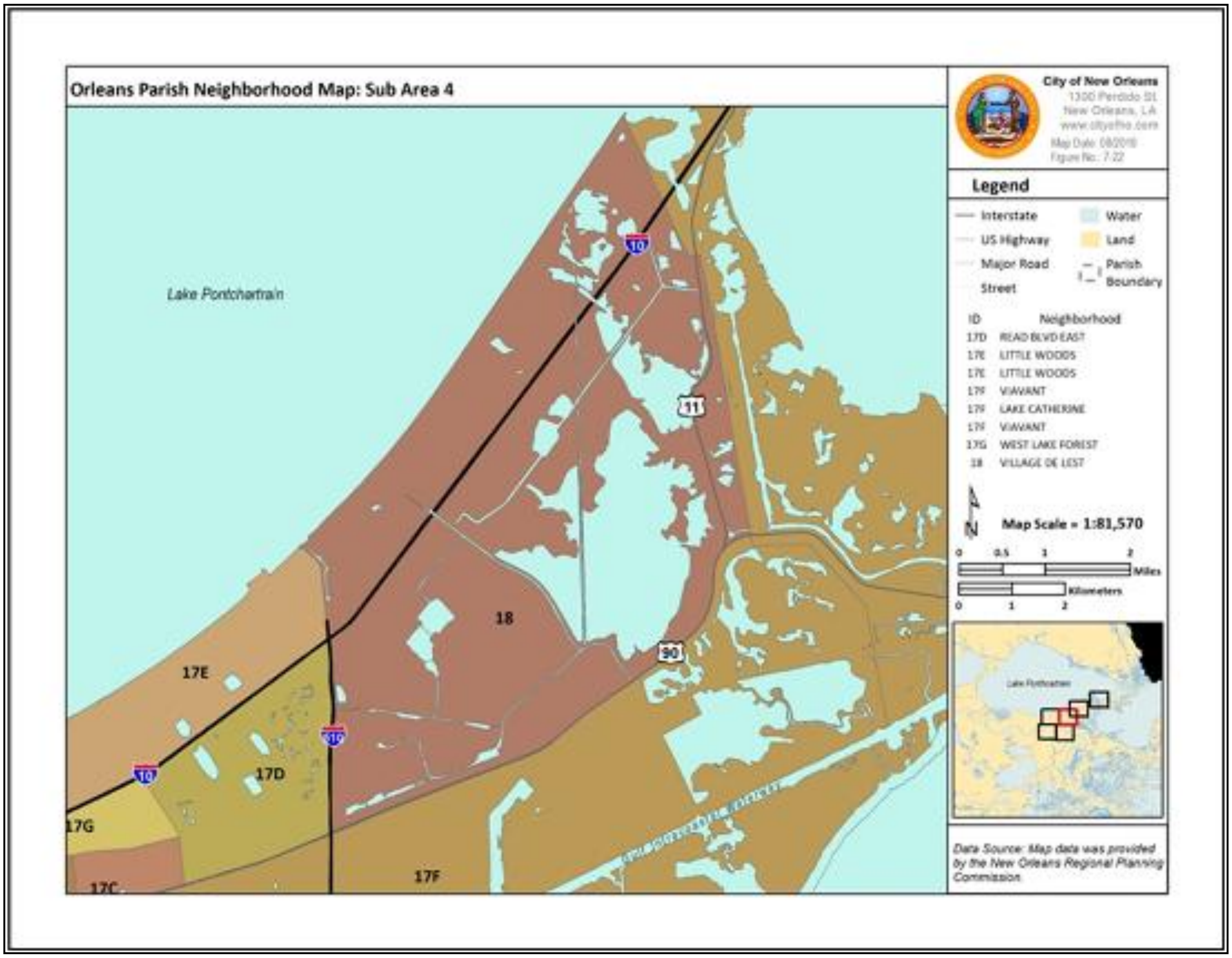


Figure 7-23
Orleans Parish Neighborhood Map Sub Area 5
(Source: New Orleans Regional Planning Commission)

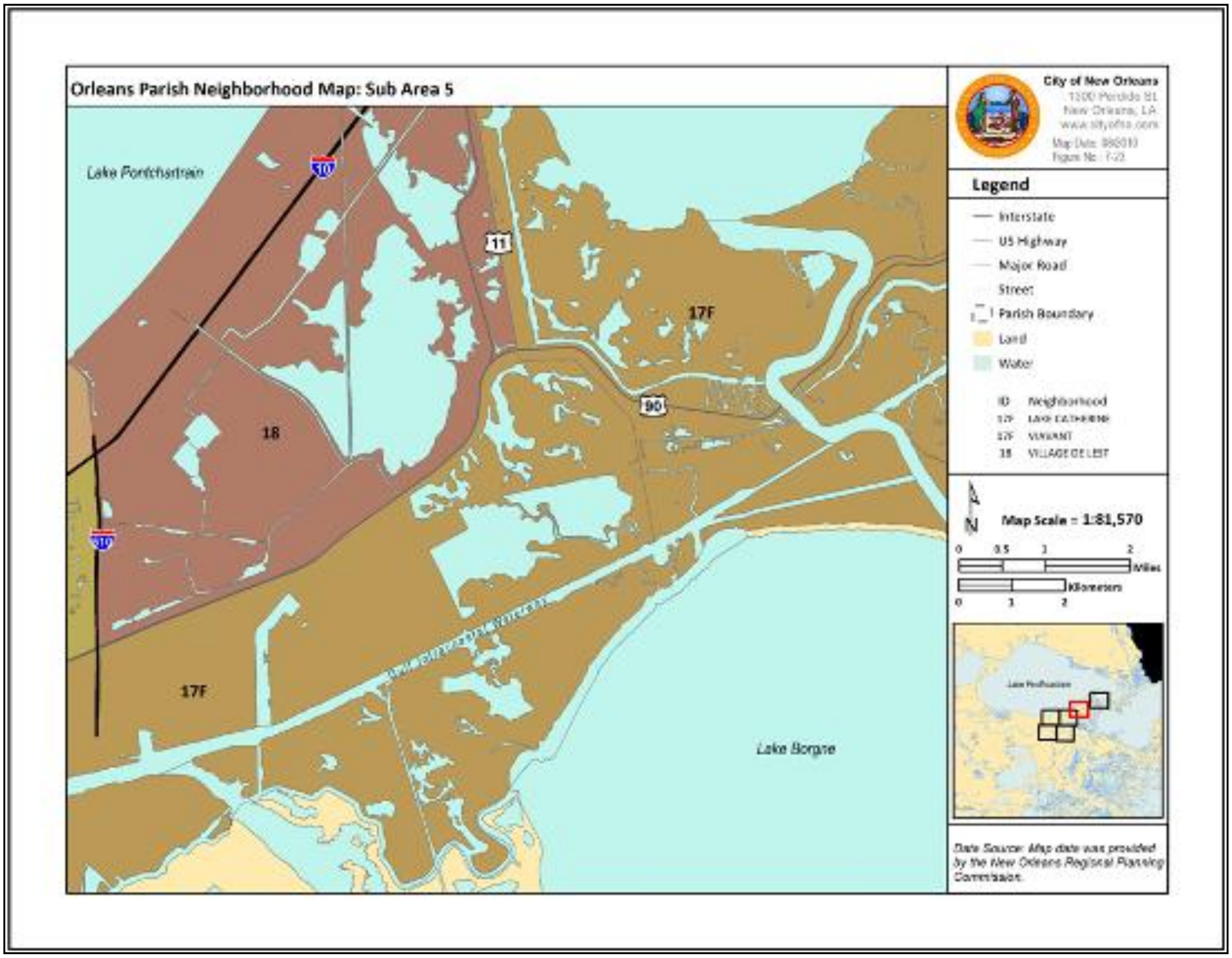
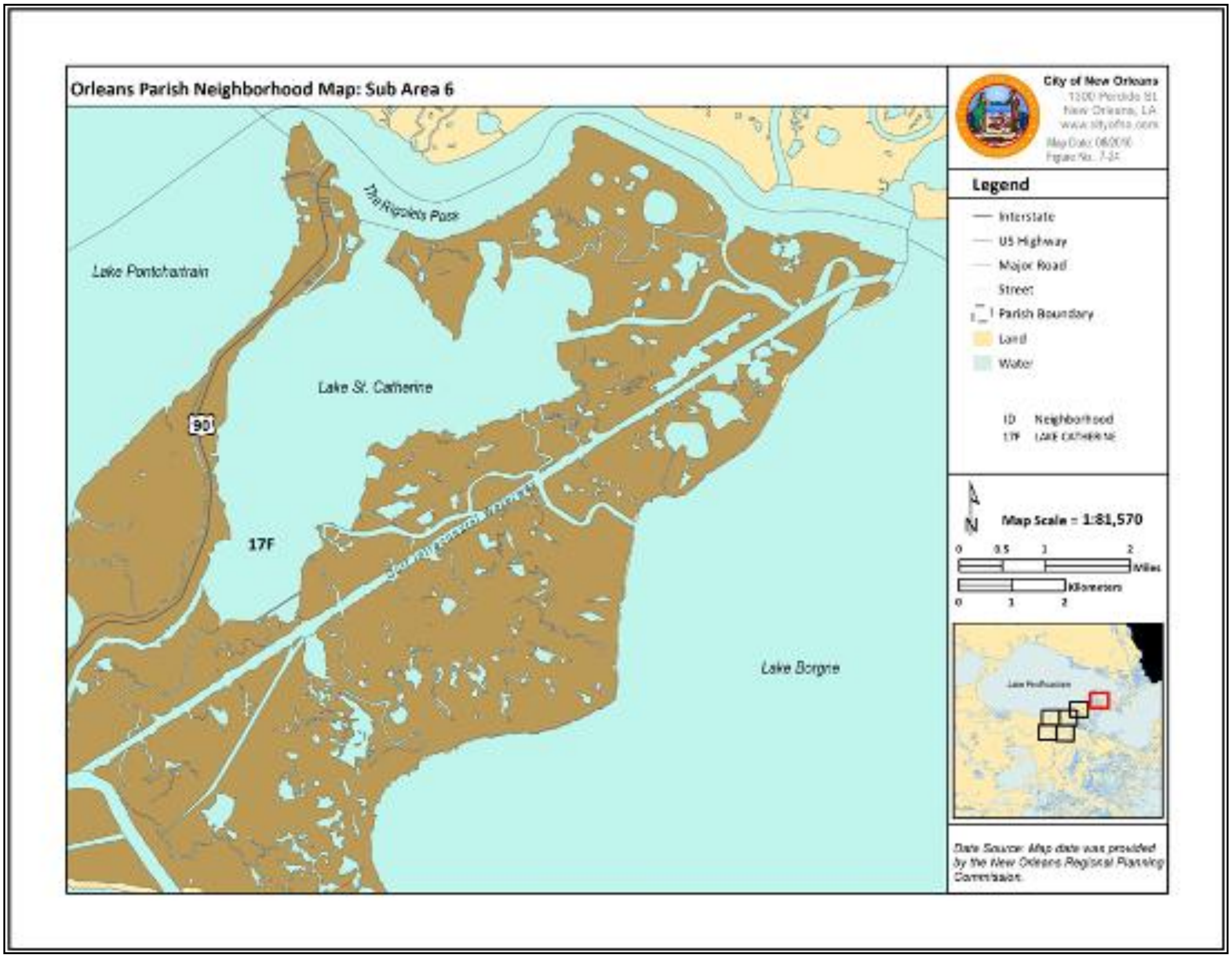


Figure 7-24
Orleans Parish Neighborhood Map Sub Area 6
(Source: New Orleans Regional Planning Commission)



The next series of Figures (7-25 through 7-30) highlights the numbers of residential and non-residential repetitive loss insurance claims for each of six planning areas in Orleans Parish. Of the 5,774 total repetitive loss properties (excluding mitigated properties) the map below includes the 5,433 properties that were successfully located and mapped. A total of 341 properties, or 6.2 percent, could not be mapped due to data limitations, such as incomplete or missing addresses, or addresses that could not be geocoded because they lacked sufficient street or numbering information. The map shows that the repetitive loss properties in New Orleans are distributed across the Parish. Note that the underlying floodplain map is the current effective FIRM, and does not reflect Advisory Base Flood Elevations (ABFEs).

Figure 7-25
Numbers of NFIP Flood Insurance Claims Per Repetitive
Loss Property in Orleans Parish – Planning Area #1
(Sources: FEMA NFIP Query, September 2009; FEMA Flood Zone Data Effective Date March, 1984)

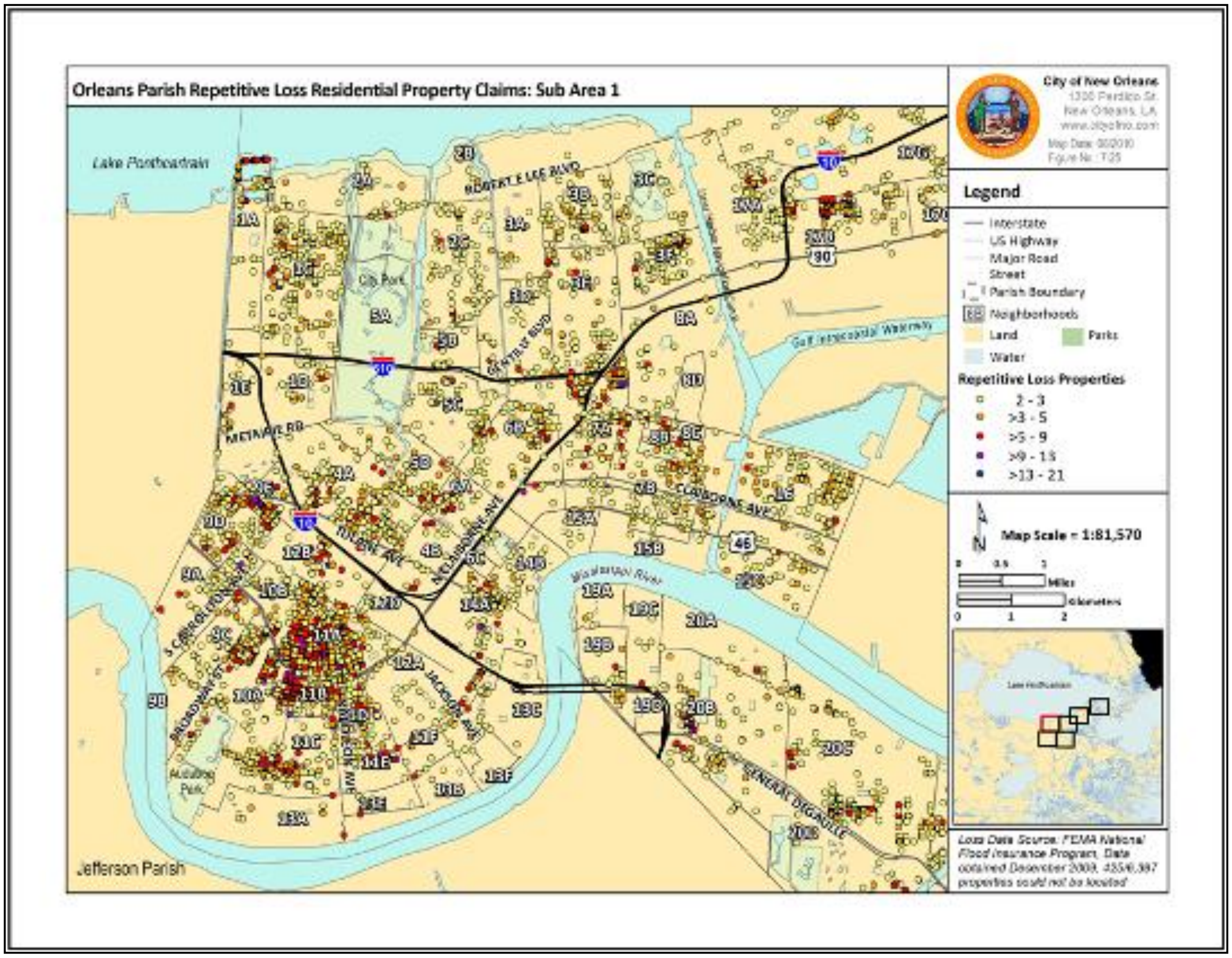


Figure 7-26
Numbers of NFIP Flood Insurance Claims Per Repetitive Loss Property in Orleans Parish – Planning Area #2
(Sources: FEMA NFIP Query, September 2009; FEMA Flood Zone Data Effective Date March, 1984)

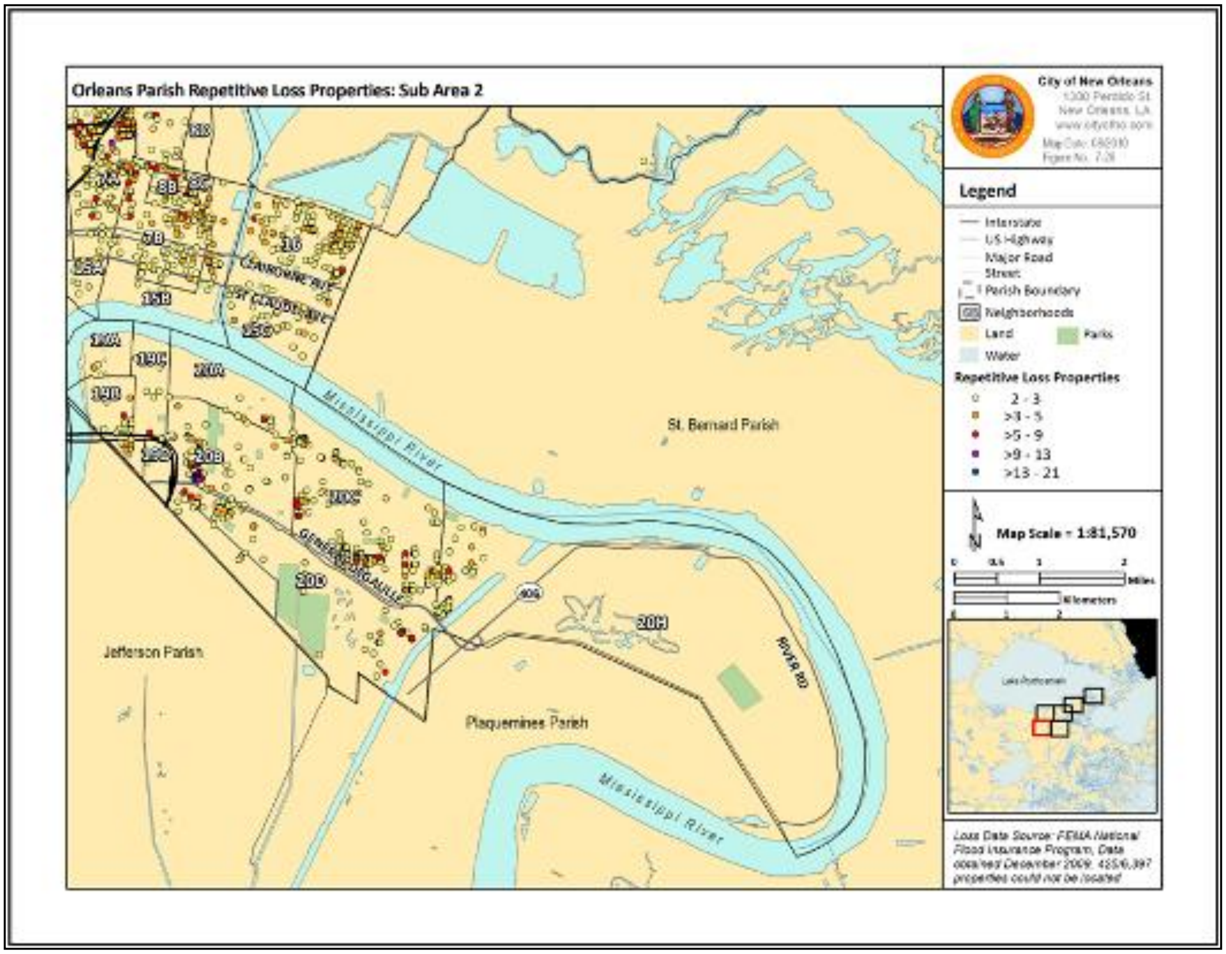


Figure 7-27
Numbers of NFIP Flood Insurance Claims Per Repetitive Loss Property in Orleans Parish – Planning Area #3
(Sources: FEMA NFIP Query, September 2009; FEMA Flood Zone Data Effective Date March, 1984)

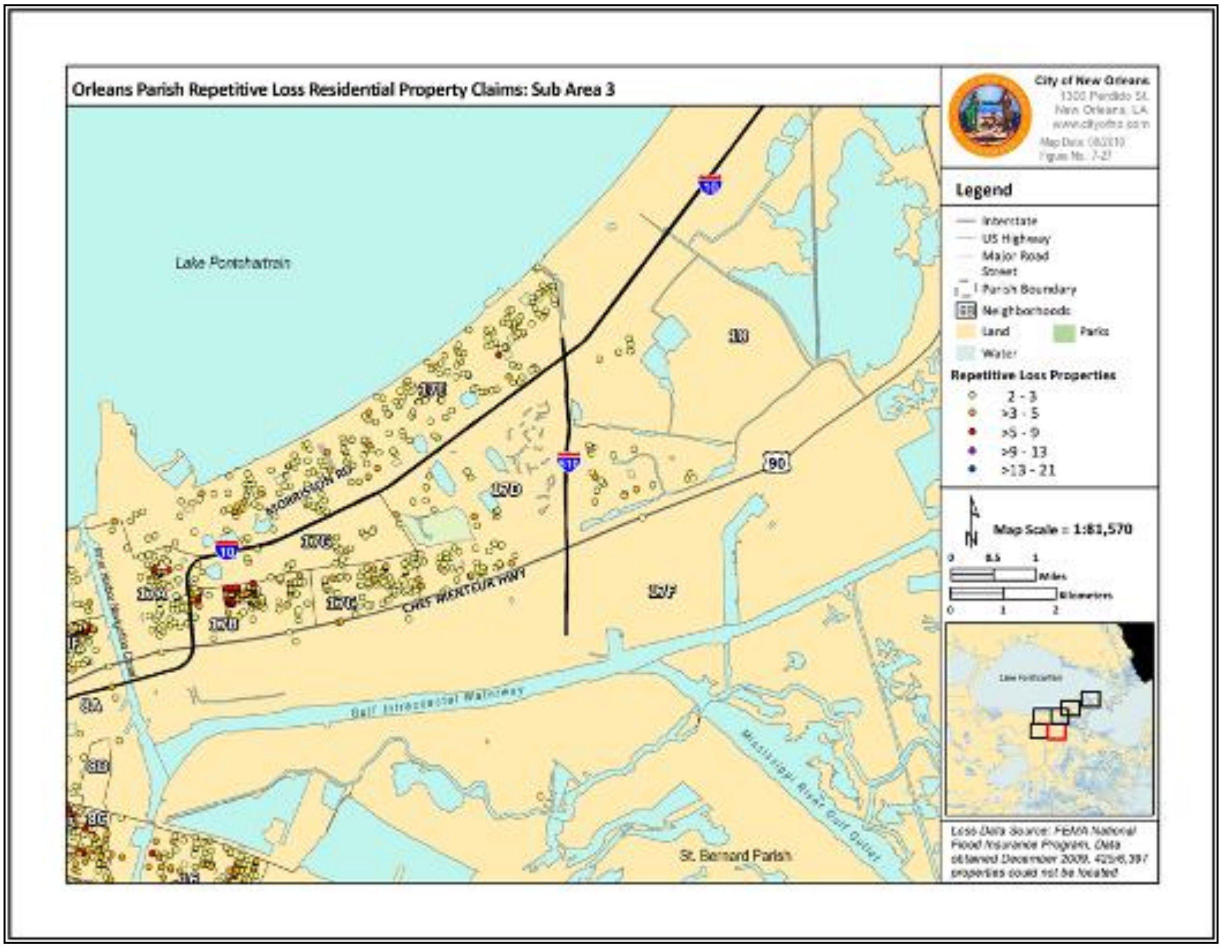


Figure 7-28
Numbers of NFIP Flood Insurance Claims Per Repetitive Loss Property in Orleans Parish – Planning Area #4
(Sources: FEMA NFIP Query, September 2009; FEMA Flood Zone Data Effective Date March, 1984)

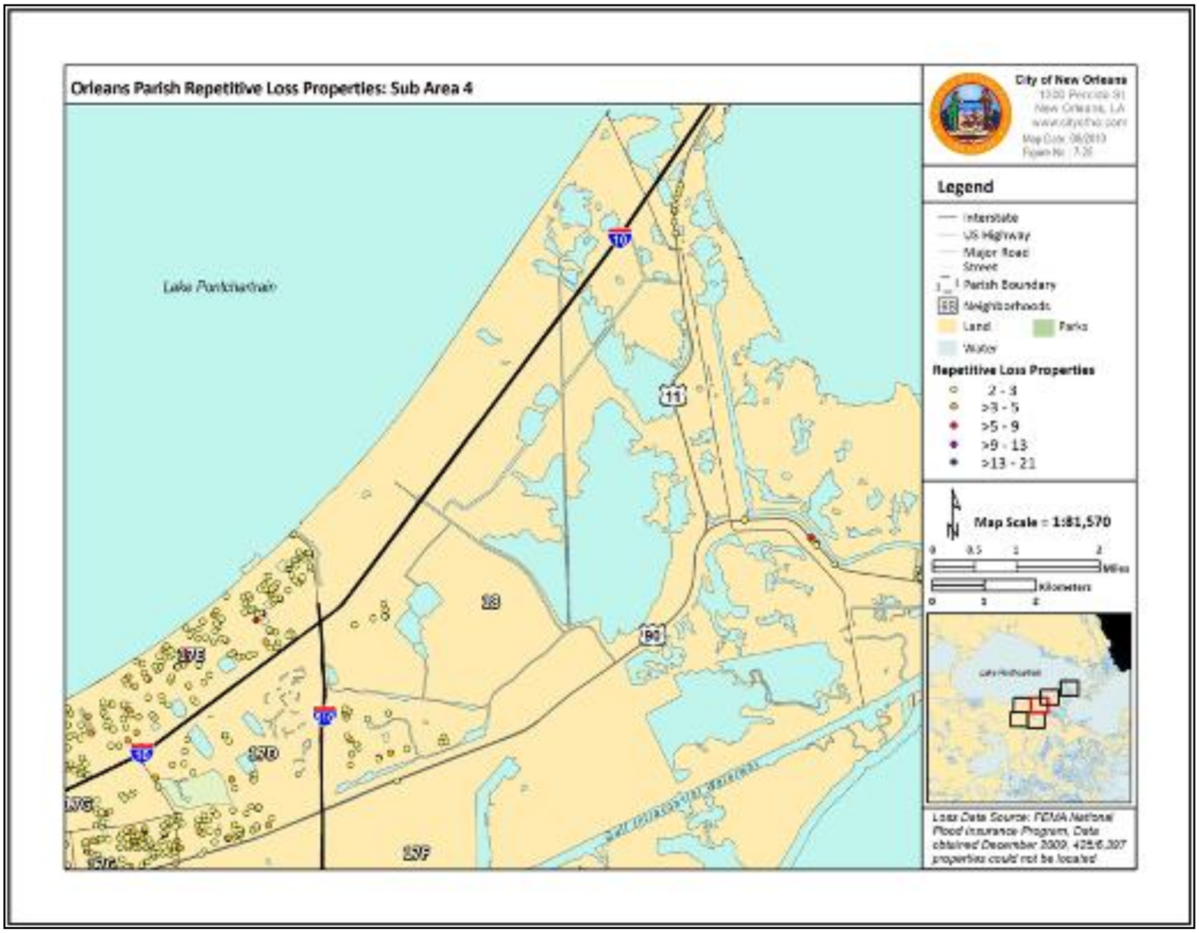


Figure 7-29
Numbers of NFIP Flood Insurance Claims Per Repetitive Loss Property in Orleans Parish – Planning Area #5
(Sources: FEMA NFIP Query, September 2009; FEMA Flood Zone Data Effective Date March, 1984)

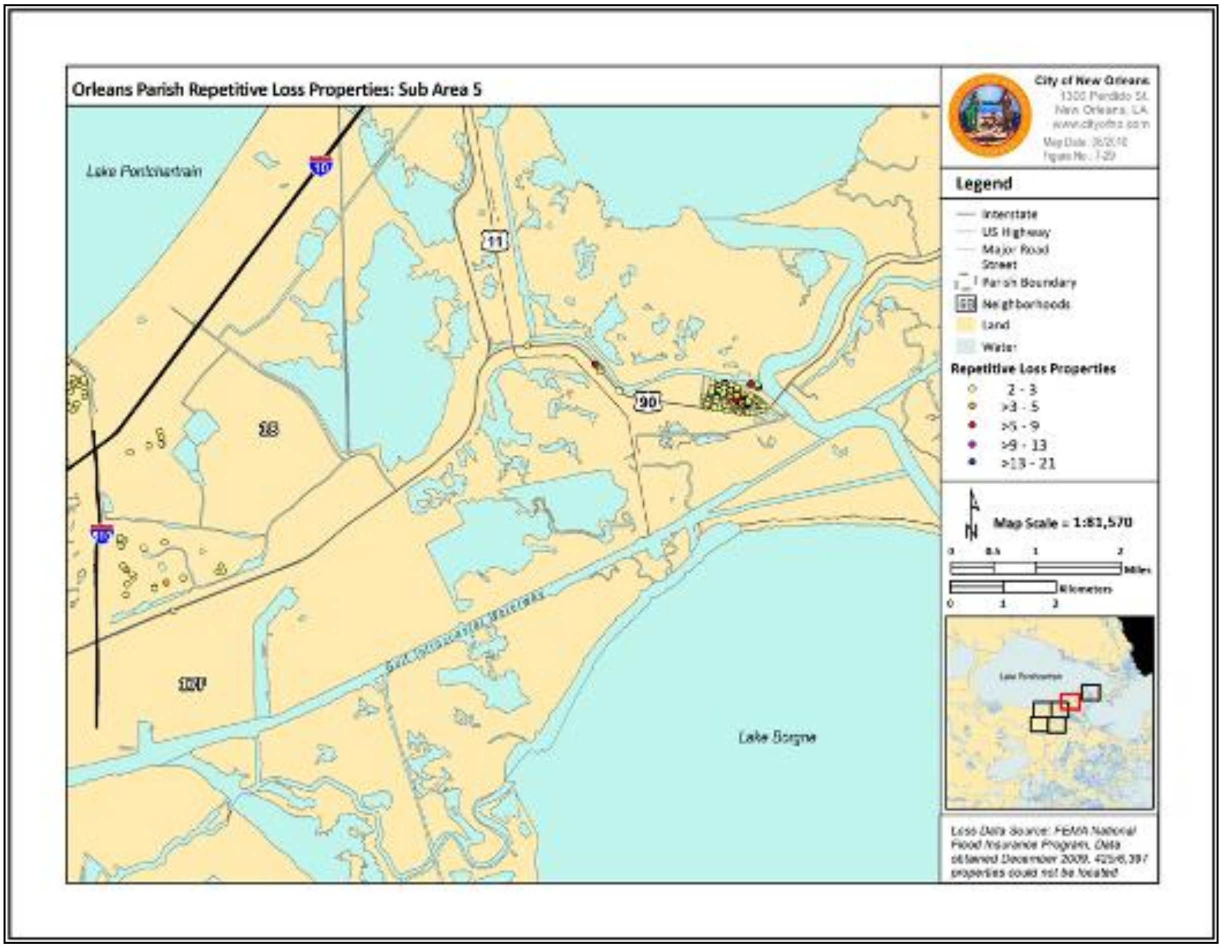
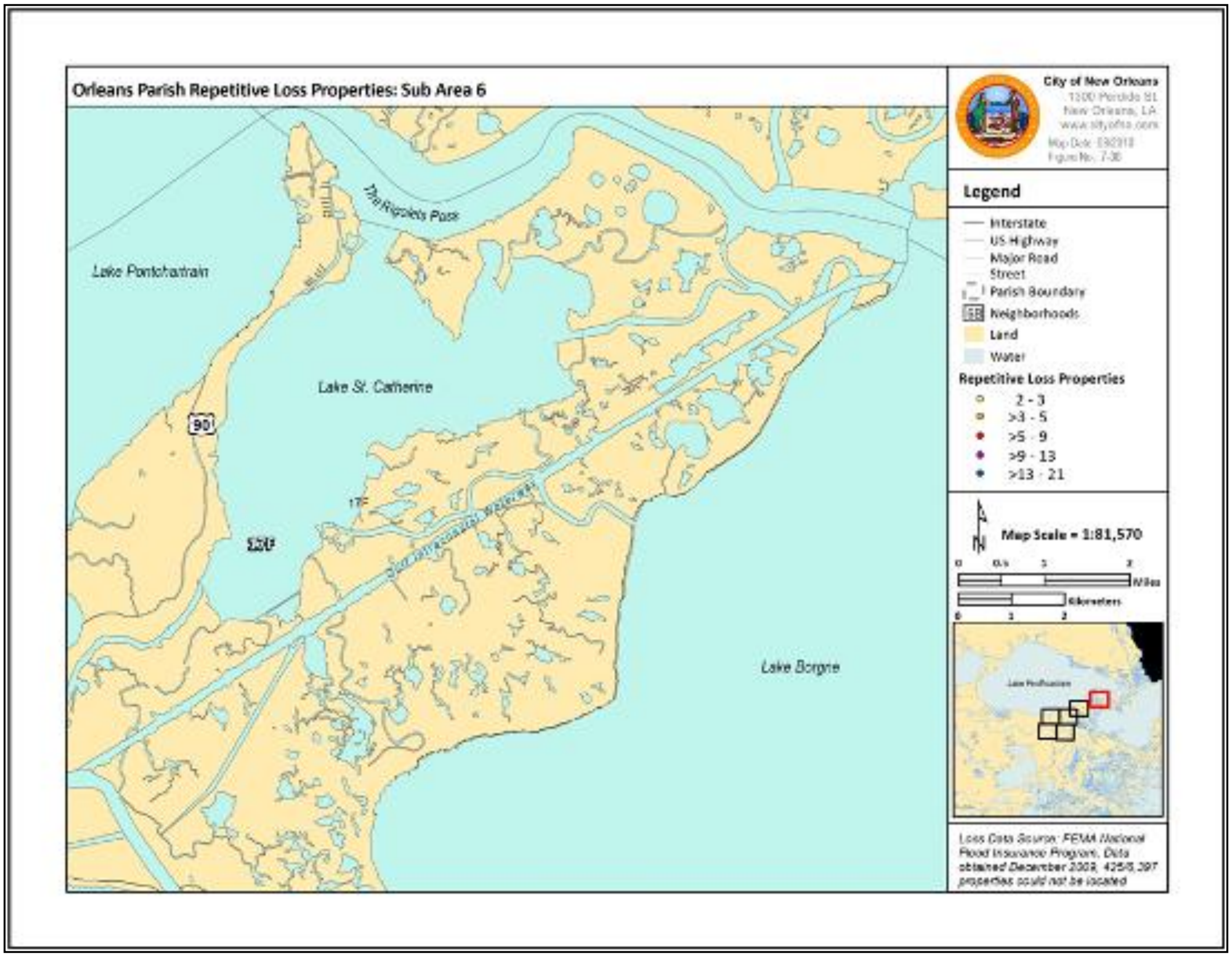
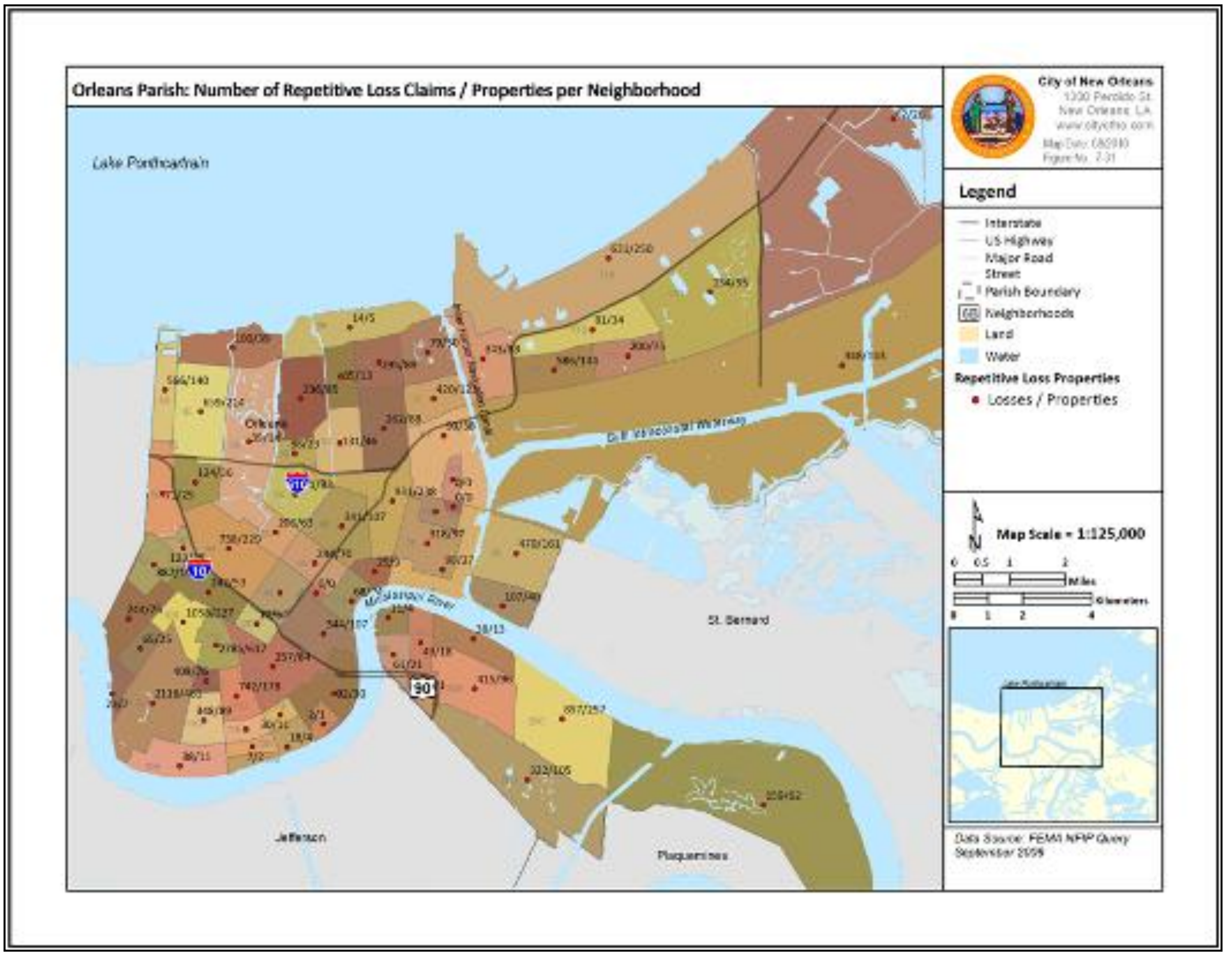


Figure 7-30
Numbers of NFIP Flood Insurance Claims Per Repetitive
Loss Property in Orleans Parish – Planning Area #6
(Sources: FEMA NFIP Query, September 2009; FEMA Flood Zone Data Effective Date March, 1984)



The number of residential and non-residential repetitive loss properties within Orleans Parish can also be summarized geographically by neighborhood. Figure 7-31 shows the number of RL properties and the number of claims for each neighborhood in Orleans Parish. The map indicates the highest number of RL properties (and number of claims) is located in the Broadmoor neighborhood, identified as neighborhood 11A on the map.

Figure 7-31
Orleans Parish: Number of Repetitive Loss Claims / Properties per Neighborhood
(Sources: FEMA NFIP Query, September 2009)



Residential Repetitive Loss Properties

As of September 2009, Orleans Parish had 5,137 residential repetitive loss properties in the NFIP database (excluding mitigated properties). Of the 5,137 residential RL properties, a total of 280, or 5.4 percent, could not be geocoded for the reasons mentioned at the beginning of this subsection. The remaining 4,857 residential RL properties are summarized in the following tables below and displayed on the map presented in Figure 7-32.

The residential repetitive loss properties that were successfully located as part of Figure 7-31 can be broken out by neighborhood to identify patterns in the data and reveal the areas of the Parish with the highest concentrations and numbers of RL properties, losses, and NFIP paid claims. Table 7-4 ranks the 4,857 residential repetitive loss properties (by number of properties) for the 70 neighborhoods in New Orleans that include at least one RL property. The Table includes the number of housing units, number of repetitive loss properties, percentage of RL housing units, building and contents damages, the total number of claims, and the average claim amounts in each Orleans Parish neighborhood. Tables 7-5 and 7-6 re-sort the neighborhood residential RL property data, first by the percentage of RL housing units, and then by average NFIP claim payment.

Table 7-11
Summary of Residential NFIP Repetitive Loss Statistics, Orleans Parish, Ordered by Number of Properties in Each Neighborhood
(Sources: FEMA/NFIP Query, September 2009, Greater New Orleans Community Data Center)

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	# of Claims	Average
Broadmoor	2,324	589	25.34%	$56,458,838	$14,846,729	$71,305,567	2665	$26,756
Audubon	7,292	438	6.01%	$52,183,478	$11,498,238	$63,681,716	2012	$31,651
Old Aurora	6,187	251	4.06%	$5,944,688	$2,261,200	$8,205,887	834	$9,839
Little Woods	11,385	242	2.13%	$22,233,227	$5,685,885	$27,919,112	605	$46,147
Marlyville/Fountainebleau	2,752	219	7.96%	$34,325,384	$8,547,145	$42,872,529	1014	$42,281
Mid-City	4,998	175	3.50%	$14,633,067	$3,030,713	$17,663,780	563	$31,374
Hollygrove	1,889	163	8.63%	$11,932,837	$3,716,597	$15,649,435	736	$21,263
St. Roch	3,105	162	5.22%	$8,684,608	$2,490,996	$11,175,604	575	$19,436
Milan	2,718	135	4.97%	$8,740,557	$1,700,570	$10,441,127	559	$18,678
Lakeview	2,358	127	5.39%	$19,737,862	$4,031,668	$23,769,530	347	$68,500
West End	1,511	122	8.07%	$20,527,229	$3,722,109	$24,249,338	507	$47,829
Lake Catherine	420	121	28.81%	$18,040,266	$3,596,691	$21,636,957	274	$78,967
Plum Orchard	1,407	120	8.53%	$13,151,803	$4,248,145	$17,399,948	484	$35,950
Tall Timbers/Brechtel	4,710	104	2.21%	$5,044,010	$1,142,685	$6,186,695	318	$19,455
Behrman	3,832	89	2.32%	$4,047,507	$1,093,620	$5,141,127	391	$13,149
Gentilly Woods	906	89	9.82%	$7,542,024	$2,066,966	$9,608,990	264	$36,398
Seventh Ward	4,939	87	1.76%	$5,279,551	$1,269,466	$6,549,017	270	$24,256
Fairgrounds	2,919	85	2.91%	$6,771,498	$1,380,404	$8,151,902	247	$33,004
Uptown	3,202	82	2.56%	$2,897,386	$1,019,765	$3,917,151	331	$11,834
St. Claude	3,276	81	2.47%	$5,031,893	$1,846,102	$6,877,995	265	$25,955
Gentilly Terrace	3,589	78	2.17%	$6,625,250	$1,419,007	$8,044,257	232	$34,674
Lower Ninth Ward	1,017	75	7.37%	$2,608,211	$879,975	$3,488,186	200	$17,441

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	# of Claims	Average
Read Blvd West	1,275	72	5.65%	$6,013,658	$1,282,708	$7,296,366	192	$38,002
Pines Village	1,161	71	6.12%	$6,780,843	$1,682,695	$8,463,538	297	$28,497
Filmore	1,480	67	4.53%	$7,755,051	$1,864,053	$9,619,104	186	$51,716
Freret	789	65	8.24%	$6,996,355	$2,023,434	$9,019,789	376	$23,989
Milneburg	1,342	64	4.77%	$5,335,281	$1,325,018	$6,660,299	205	$32,489
Leonidas	3,485	63	1.81%	$4,732,618	$1,260,465	$5,993,084	214	$28,005
New Aurora/English Turn	2,123	62	2.92%	$806,264	$231,012	$1,037,275	159	$6,524
Read Blvd East	2,307	54	2.34%	$5,703,667	$1,494,375	$7,198,042	130	$55,370
Bayou St. John	1,976	45	2.28%	$3,124,763	$1,299,448	$4,424,210	143	$30,939
Dillard	1,767	41	2.32%	$7,559,266	$2,142,374	$9,701,639	116	$83,635
Florida Area	523	39	7.46%	$2,514,801	$592,534	$3,107,335	132	$23,540
Tremé/Lafitte	2,291	38	1.66%	$2,420,005	$1,330,330	$3,750,334	114	$32,898
Lakeshore/Lake Vista	1,482	35	2.36%	$4,911,860	$1,468,132	$6,379,992	86	$74,186
Holy Cross	1,061	31	2.92%	$2,189,132	$830,653	$3,019,784	84	$35,950
Navarre	1,153	30	2.60%	$3,901,150	$1,031,484	$4,932,634	103	$47,890
West Lake Forest	1,399	28	2.00%	$2,189,836	$664,543	$2,854,379	69	$41,368
Dixon	529	27	5.10%	$1,657,281	$589,313	$2,246,595	86	$26,123
Village de l'est	2,642	26	0.98%	$1,830,441	$408,465	$2,238,906	62	$36,111
Central City	6,233	25	0.40%	$1,357,583	$523,915	$1,881,498	69	$27,268
Bywater	2,165	24	1.11%	$2,192,457	$686,900	$2,879,357	87	$33,096
East Carrollton	2,276	24	1.05%	$1,157,638	$259,014	$1,416,652	62	$22,849
Pontchartrain Park	507	24	4.73%	$1,290,646	$278,118	$1,568,764	58	$27,048
Gert Town	1,547	23	1.49%	$1,602,018	$959,048	$2,561,065	107	$23,935
Desire Area	532	22	4.14%	$3,017,357	$2,959,107	$5,976,463	61	$97,975
Central Business District	1,939	20	1.03%	$2,941,985	$1,201,835	$4,143,819	67	$61,848

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	# of Claims	Average
Lakewood	593	20	3.37%	$5,023,184	$1,548,257	$6,571,441	53	$123,989
Lower Garden District	4,295	20	0.47%	$3,444,622	$69,931	$3,514,553	63	$55,787
McDonogh	1,281	20	1.56%	$210,085	$125,645	$335,729	59	$5,690
St. Bernard Area	420	18	4.29%	$1,481,789	$476,231	$1,958,021	75	$26,107
Whitney	995	16	1.61%	$135,761	$68,955	$204,716	43	$4,761
City Park	1,585	14	0.88%	$1,607,539	$453,032	$2,060,570	39	$52,835
French Quarter	3,936	11	0.28%	$344,587	$153,706	$498,293	33	$15,100
Tulane/Gravier	1,237	11	0.89%	$748,040	$54,487	$802,527	42	$19,108
St. Anthony	1,395	10	0.72%	$1,086,640	$238,610	$1,325,250	28	$47,330
Garden District	1,192	9	0.76%	$152,083	$18,480	$170,563	26	$6,560
West Riverside	2,720	9	0.33%	$187,154	$55,100	$242,255	29	$8,354
U.S. Naval Support Area	1,041	8	0.77%	$69,424	$31,086	$100,510	27	$3,723
Black Pearl	1,082	6	0.55%	$170,047	$2,161	$172,208	19	$9,064
Touro	1,752	6	0.34%	$374,352	$31,578	$405,930	20	$20,296
Lake Terrace & Oaks	657	5	0.76%	$312,758	$34,179	$346,936	14	$24,781
Algiers Point	1,417	4	0.28%	$43,359	$16,057	$59,416	11	$5,401
B.W. Cooper	345	4	1.16%	$78,370	$32,330	$110,700	8	$13,837
Marigny	2,119	3	0.14%	$257,728	$127,355	$385,082	8	$48,135
Viavant/Venetian Isles	328	3	0.91%	$138,454	$54,564	$193,019	9	$21,447
East Riverside	1,472	2	0.14%	$48,258	$3,387	$51,645	7	$7,378
Irish Channel	1,913	2	0.10%	$15,187	$11,589	$26,776	5	$5,355
Fischer Project	291	1	0.34%	$16,911	$7,043	$23,955	2	$11,977
St. Thomas Development	862	1	0.12%	$20,587	$0	$20,587	2	$10,294
Grand Total	**153,648**	**4,857**	**3.16%**	**$438,390,047**	**$113,497,411**	**$551,887,458**	**17,580**	**$31,393**

Note: Housing unit estimate based on active postal addresses as of June, 2009.

The data indicates the highest number of residential RL properties is located in the Broadmoor neighborhood with 589 residential repetitive loss properties. The Broadmoor neighborhood also has the highest building damages, total claims amount, and total number of claims in Orleans Parish. Ranked second after Broadmoor is the Audubon neighborhood with 438 residential repetitive loss properties. There are several patterns in this data that provide insight into residential flood risk in the Parish. One such pattern is for the neighborhoods with the highest number of RL properties there is a relatively large ratio between the amounts of the claims for building damages versus contents damages. To a degree, this may be a result of the flood insurance policies, but it may also suggest that owners in these areas have relocated or elevated contents as they are aware of the flood risk.

Table 7-5 ranks the 4,857 residential repetitive loss properties by the percentage of RL housing units for each of the 70 New Orleans neighborhoods included in Table 7-4. The column headings remain the same as Table 7-4.

Table 7-12
Summary of Residential NFIP Repetitive Loss (RL) Statistics, Orleans Parish, Ordered by The RL Percentage of Total Housing Units in Each Neighborhood
(Sources: FEMA/NFIP Query September, 2009, Greater New Orleans Community Data Center)

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	# of Claims	Average
Lake Catherine	420	121	28.81%	$18,040,266	$3,596,691	$21,636,957	274	$78,967
Broadmoor	2,324	589	25.34%	$56,458,838	$14,846,729	$71,305,567	2665	$26,756
Gentilly Woods	906	89	9.82%	$7,542,024	$2,066,966	$9,608,990	264	$36,398
Hollygrove	1,889	163	8.63%	$11,932,837	$3,716,597	$15,649,435	736	$21,263
Plum Orchard	1,407	120	8.53%	$13,151,803	$4,248,145	$17,399,948	484	$35,950
Freret	789	65	8.24%	$6,996,355	$2,023,434	$9,019,789	376	$23,989
West End	1,511	122	8.07%	$20,527,229	$3,722,109	$24,249,338	507	$47,829
Marlyville/Fountainebleau	2,752	219	7.96%	$34,325,384	$8,547,145	$42,872,529	1014	$42,281
Florida Area	523	39	7.46%	$2,514,801	$592,534	$3,107,335	132	$23,540
Lower Ninth Ward	1,017	75	7.37%	$2,608,211	$879,975	$3,488,186	200	$17,441
Pines Village	1,161	71	6.12%	$6,780,843	$1,682,695	$8,463,538	297	$28,497
Audubon	7,292	438	6.01%	$52,183,478	$11,498,238	$63,681,716	2012	$31,651
Read Blvd West	1,275	72	5.65%	$6,013,658	$1,282,708	$7,296,366	192	$38,002
Lakeview	2,358	127	5.39%	$19,737,862	$4,031,668	$23,769,530	347	$68,500
St. Roch	3,105	162	5.22%	$8,684,608	$2,490,996	$11,175,604	575	$19,436
Dixon	529	27	5.10%	$1,657,281	$589,313	$2,246,595	86	$26,123
Milan	2,718	135	4.97%	$8,740,557	$1,700,570	$10,441,127	559	$18,678
Milneburg	1,342	64	4.77%	$5,335,281	$1,325,018	$6,660,299	205	$32,489
Pontchartrain Park	507	24	4.73%	$1,290,646	$278,118	$1,568,764	58	$27,048
Filmore	1,480	67	4.53%	$7,755,051	$1,864,053	$9,619,104	186	$51,716
St. Bernard Area	420	18	4.29%	$1,481,789	$476,231	$1,958,021	75	$26,107
Desire Area	532	22	4.14%	$3,017,357	$2,959,107	$5,976,463	61	$97,975

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	# of Claims	Average
Old Aurora	6,187	251	4.06%	$5,944,688	$2,261,200	$8,205,887	834	$9,839
Mid-City	4,998	175	3.50%	$14,633,067	$3,030,713	$17,663,780	563	$31,374
Lakewood	593	20	3.37%	$5,023,184	$1,548,257	$6,571,441	53	$123,989
Holy Cross	1,061	31	2.92%	$2,189,132	$830,653	$3,019,784	84	$35,950
New Aurora/English Turn	2,123	62	2.92%	$806,264	$231,012	$1,037,275	159	$6,524
Fairgrounds	2,919	85	2.91%	$6,771,498	$1,380,404	$8,151,902	247	$33,004
Navarre	1,153	30	2.60%	$3,901,150	$1,031,484	$4,932,634	103	$47,890
Uptown	3,202	82	2.56%	$2,897,386	$1,019,765	$3,917,151	331	$11,834
St. Claude	3,276	81	2.47%	$5,031,893	$1,846,102	$6,877,995	265	$25,955
Lakeshore/Lake Vista	1,482	35	2.36%	$4,911,860	$1,468,132	$6,379,992	86	$74,186
Read Blvd East	2,307	54	2.34%	$5,703,667	$1,494,375	$7,198,042	130	$55,370
Behrman	3,832	89	2.32%	$4,047,507	$1,093,620	$5,141,127	391	$13,149
Dillard	1,767	41	2.32%	$7,559,266	$2,142,374	$9,701,639	116	$83,635
Bayou St. John	1,976	45	2.28%	$3,124,763	$1,299,448	$4,424,210	143	$30,939
Tall Timbers/Brechtel	4,710	104	2.21%	$5,044,010	$1,142,685	$6,186,695	318	$19,455
Gentilly Terrace	3,589	78	2.17%	$6,625,250	$1,419,007	$8,044,257	232	$34,674
Little Woods	11,385	242	2.13%	$22,233,227	$5,685,885	$27,919,112	605	$46,147
West Lake Forest	1,399	28	2.00%	$2,189,836	$664,543	$2,854,379	69	$41,368
Leonidas	3,485	63	1.81%	$4,732,618	$1,260,465	$5,993,084	214	$28,005
Seventh Ward	4,939	87	1.76%	$5,279,551	$1,269,466	$6,549,017	270	$24,256
Tremé/Lafitte	2,291	38	1.66%	$2,420,005	$1,330,330	$3,750,334	114	$32,898
Whitney	995	16	1.61%	$135,761	$68,955	$204,716	43	$4,761
McDonogh	1,281	20	1.56%	$210,085	$125,645	$335,729	59	$5,690
Gert Town	1,547	23	1.49%	$1,602,018	$959,048	$2,561,065	107	$23,935
B.W. Cooper	345	4	1.16%	$78,370	$32,330	$110,700	8	$13,837

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	# of Claims	Average
Bywater	2,165	24	1.11%	$2,192,457	$686,900	$2,879,357	87	$33,096
East Carrollton	2,276	24	1.05%	$1,157,638	$259,014	$1,416,652	62	$22,849
Central Business District	1,939	20	1.03%	$2,941,985	$1,201,835	$4,143,819	67	$61,848
Village de l'est	2,642	26	0.98%	$1,830,441	$408,465	$2,238,906	62	$36,111
Viavant/Venetian Isles	328	3	0.91%	$138,454	$54,564	$193,019	9	$21,447
Tulane/Gravier	1,237	11	0.89%	$748,040	$54,487	$802,527	42	$19,108
City Park	1,585	14	0.88%	$1,607,539	$453,032	$2,060,570	39	$52,835
U.S. Naval Support Area	1,041	8	0.77%	$69,424	$31,086	$100,510	27	$3,723
Lake Terrace & Oaks	657	5	0.76%	$312,758	$34,179	$346,936	14	$24,781
Garden District	1,192	9	0.76%	$152,083	$18,480	$170,563	26	$6,560
St. Anthony	1,395	10	0.72%	$1,086,640	$238,610	$1,325,250	28	$47,330
Black Pearl	1,082	6	0.55%	$170,047	$2,161	$172,208	19	$9,064
Lower Garden District	4,295	20	0.47%	$3,444,622	$69,931	$3,514,553	63	$55,787
Central City	6,233	25	0.40%	$1,357,583	$523,915	$1,881,498	69	$27,268
Fischer Project	291	1	0.34%	$16,911	$7,043	$23,955	2	$11,977
Touro	1,752	6	0.34%	$374,352	$31,578	$405,930	20	$20,296
West Riverside	2,720	9	0.33%	$187,154	$55,100	$242,255	29	$8,354
Algiers Point	1,417	4	0.28%	$43,359	$16,057	$59,416	11	$5,401
French Quarter	3,936	11	0.28%	$344,587	$153,706	$498,293	33	$15,100
Marigny	2,119	3	0.14%	$257,728	$127,355	$385,082	8	$48,135
East Riverside	1,472	2	0.14%	$48,258	$3,387	$51,645	7	$7,378
St. Thomas Development	862	1	0.12%	$20,587	$0	$20,587	2	$10,294
Irish Channel	1,913	2	0.10%	$15,187	$11,589	$26,776	5	$5,355
Grand Total	**153,648**	**4,857**	**3.16%**	**$438,390,047**	**$113,497,411**	**$551,887,458**	**17,580**	**$31,393**

Note: Housing unit estimate based on active postal addresses as of June, 2009.

The data in Table 7-5 indicates the highest percentage of residential RL properties relative to the total housing units is located in the Lake Catherine neighborhood in East New Orleans. In the Lake Catherine neighborhood, RL properties represent 28.81 percent (121 properties) of the 420 total housing units in this neighborhood. One explanation why the Lake Catherine neighborhood is at the top when the data is ranked by percent of RL housing units is that this area is located outside of the Lake Pontchartrain and Vicinity levee system that protects the majority of New Orleans from flooding (See Figure 7-13).

In comparison to the ranking by number of residential RL properties, when sorted by the percent of residential RL housing units, several other neighborhoods move near the top including Freret and Gentilly Woods neighborhoods. The table shows that a total of seven neighborhoods have a percentage of residential RL properties in excess of eight percent of the total housing units. These neighborhoods include

- Lake Catherine
- Broadmoor
- Gentilly Woods
- Hollygrove
- Plum Orchard
- Freret
- West End

Table 7-6 ranks the 4,857 residential repetitive loss properties by the average claim payment for each of the 70 New Orleans neighborhoods.

Table 7-13
Summary of Residential NFIP Repetitive Loss (RL) Statistics, Orleans Parish, Ordered by Average Claim Payment in Each Neighborhood
(Sources: FEMA/NFIP Query September, 2009, Greater New Orleans Community Data Center)

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	Average	# of Claims
Lakewood	593	20	3.37%	$5,023,184	$1,548,257	$6,571,441	$123,989	53
Desire Area	532	22	4.14%	$3,017,357	$2,959,107	$5,976,463	$97,975	61
Dillard	1,767	41	2.32%	$7,559,266	$2,142,374	$9,701,639	$83,635	116
Lake Catherine	420	121	28.81%	$18,040,266	$3,596,691	$21,636,957	$78,967	274
Lakeshore/Lake Vista	1,482	35	2.36%	$4,911,860	$1,468,132	$6,379,992	$74,186	86
Lakeview	2,358	127	5.39%	$19,737,862	$4,031,668	$23,769,530	$68,500	347
Central Business District	1,939	20	1.03%	$2,941,985	$1,201,835	$4,143,819	$61,848	67
Lower Garden District	4,295	20	0.47%	$3,444,622	$69,931	$3,514,553	$55,787	63
Read Blvd East	2,307	54	2.34%	$5,703,667	$1,494,375	$7,198,042	$55,370	130
City Park	1,585	14	0.88%	$1,607,539	$453,032	$2,060,570	$52,835	39
Filmore	1,480	67	4.53%	$7,755,051	$1,864,053	$9,619,104	$51,716	186
Marigny	2,119	3	0.14%	$257,728	$127,355	$385,082	$48,135	8
Navarre	1,153	30	2.60%	$3,901,150	$1,031,484	$4,932,634	$47,890	103
West End	1,511	122	8.07%	$20,527,229	$3,722,109	$24,249,338	$47,829	507
St. Anthony	1,395	10	0.72%	$1,086,640	$238,610	$1,325,250	$47,330	28
Little Woods	11,385	242	2.13%	$22,233,227	$5,685,885	$27,919,112	$46,147	605
Marlyville/Fountainebleau	2,752	219	7.96%	$34,325,384	$8,547,145	$42,872,529	$42,281	1014
West Lake Forest	1,399	28	2.00%	$2,189,836	$664,543	$2,854,379	$41,368	69
Read Blvd West	1,275	72	5.65%	$6,013,658	$1,282,708	$7,296,366	$38,002	192
Gentilly Woods	906	89	9.82%	$7,542,024	$2,066,966	$9,608,990	$36,398	264
Village de l'est	2,642	26	0.98%	$1,830,441	$408,465	$2,238,906	$36,111	62
Plum Orchard	1,407	120	8.53%	$13,151,803	$4,248,145	$17,399,948	$35,950	484

Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	Average	# of Claims
Holy Cross	1,061	31	2.92%	$2,189,132	$830,653	$3,019,784	$35,950	84
Gentilly Terrace	3,589	78	2.17%	$6,625,250	$1,419,007	$8,044,257	$34,674	232
Bywater	2,165	24	1.11%	$2,192,457	$686,900	$2,879,357	$33,096	87
Fairgrounds	2,919	85	2.91%	$6,771,498	$1,380,404	$8,151,902	$33,004	247
Tremé/Lafitte	2,291	38	1.66%	$2,420,005	$1,330,330	$3,750,334	$32,898	114
Milneburg	1,342	64	4.77%	$5,335,281	$1,325,018	$6,660,299	$32,489	205
Audubon	7,292	438	6.01%	$52,183,478	$11,498,238	$63,681,716	$31,651	2012
Mid-City	4,998	175	3.50%	$14,633,067	$3,030,713	$17,663,780	$31,374	563
Bayou St. John	1,976	45	2.28%	$3,124,763	$1,299,448	$4,424,210	$30,939	143
Pines Village	1,161	71	6.12%	$6,780,843	$1,682,695	$8,463,538	$28,497	297
Leonidas	3,485	63	1.81%	$4,732,618	$1,260,465	$5,993,084	$28,005	214
Central City	6,233	25	0.40%	$1,357,583	$523,915	$1,881,498	$27,268	69
Pontchartrain Park	507	24	4.73%	$1,290,646	$278,118	$1,568,764	$27,048	58
Broadmoor	2,324	589	25.34%	$56,458,838	$14,846,729	$71,305,567	$26,756	2665
Dixon	529	27	5.10%	$1,657,281	$589,313	$2,246,595	$26,123	86
St. Bernard Area	420	18	4.29%	$1,481,789	$476,231	$1,958,021	$26,107	75
St. Claude	3,276	81	2.47%	$5,031,893	$1,846,102	$6,877,995	$25,955	265
Lake Terrace & Oaks	657	5	0.76%	$312,758	$34,179	$346,936	$24,781	14
Seventh Ward	4,939	87	1.76%	$5,279,551	$1,269,466	$6,549,017	$24,256	270
Freret	789	65	8.24%	$6,996,355	$2,023,434	$9,019,789	$23,989	376
Gert Town	1,547	23	1.49%	$1,602,018	$959,048	$2,561,065	$23,935	107
Florida Area	523	39	7.46%	$2,514,801	$592,534	$3,107,335	$23,540	132
East Carrollton	2,276	24	1.05%	$1,157,638	$259,014	$1,416,652	$22,849	62
Viavant/Venetian Isles	328	3	0.91%	$138,454	$54,564	$193,019	$21,447	9
Hollygrove	1,889	163	8.63%	$11,932,837	$3,716,597	$15,649,435	$21,263	736

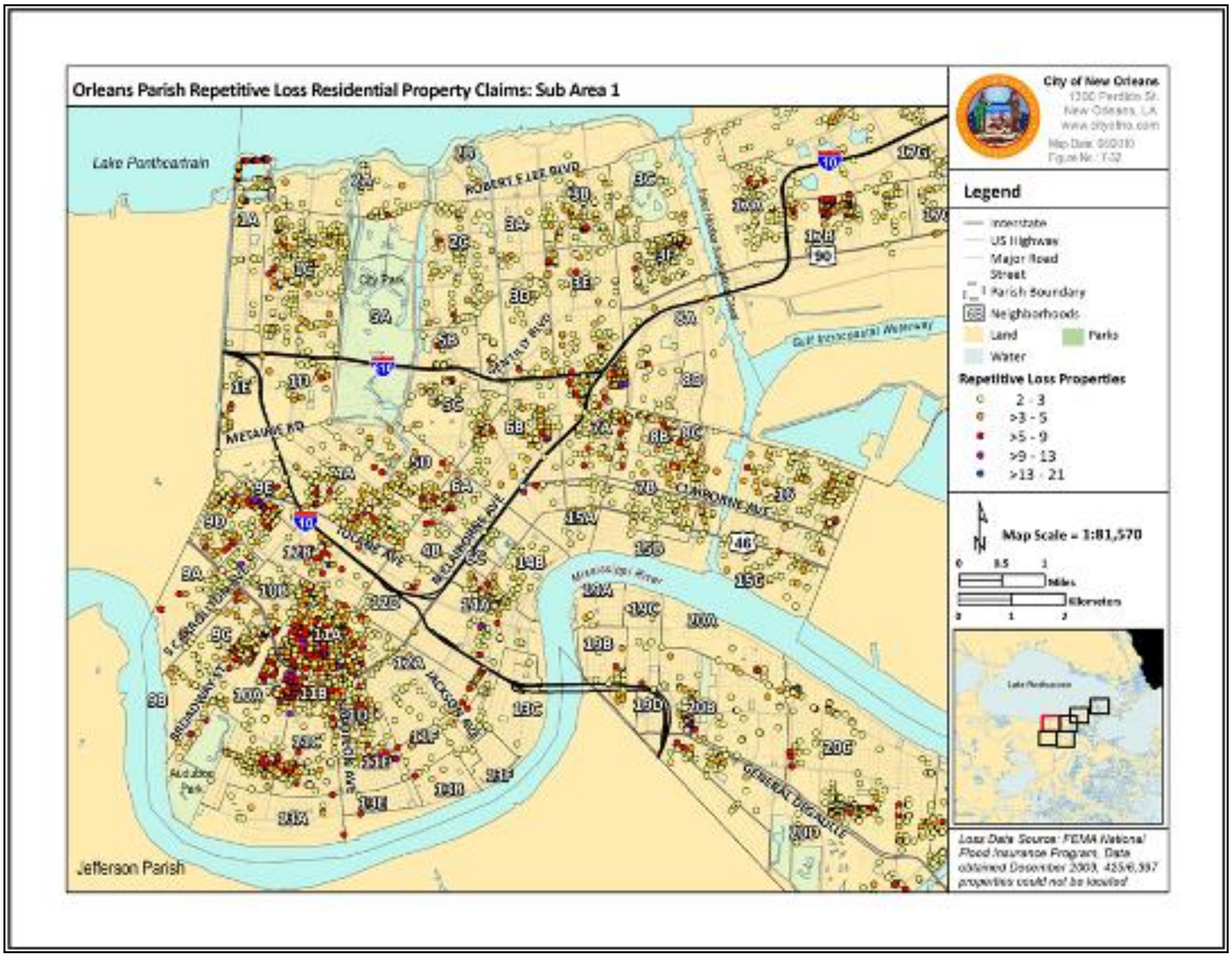
Neighborhood Name	Housing Units*	RL Properties	% of Total Housing Units	Building	Contents	Total Paid ($)	Average	# of Claims
Touro	1,752	6	0.34%	$374,352	$31,578	$405,930	$20,296	20
Tall Timbers/Brechtel	4,710	104	2.21%	$5,044,010	$1,142,685	$6,186,695	$19,455	318
St. Roch	3,105	162	5.22%	$8,684,608	$2,490,996	$11,175,604	$19,436	575
Tulane/Gravier	1,237	11	0.89%	$748,040	$54,487	$802,527	$19,108	42
Milan	2,718	135	4.97%	$8,740,557	$1,700,570	$10,441,127	$18,678	559
Lower Ninth Ward	1,017	75	7.37%	$2,608,211	$879,975	$3,488,186	$17,441	200
French Quarter	3,936	11	0.28%	$344,587	$153,706	$498,293	$15,100	33
B.W. Cooper	345	4	1.16%	$78,370	$32,330	$110,700	$13,837	8
Behrman	3,832	89	2.32%	$4,047,507	$1,093,620	$5,141,127	$13,149	391
Fischer Project	291	1	0.34%	$16,911	$7,043	$23,955	$11,977	2
Uptown	3,202	82	2.56%	$2,897,386	$1,019,765	$3,917,151	$11,834	331
St. Thomas Development	862	1	0.12%	$20,587	$0	$20,587	$10,294	2
Old Aurora	6,187	251	4.06%	$5,944,688	$2,261,200	$8,205,887	$9,839	834
Black Pearl	1,082	6	0.55%	$170,047	$2,161	$172,208	$9,064	19
West Riverside	2,720	9	0.33%	$187,154	$55,100	$242,255	$8,354	29
East Riverside	1,472	2	0.14%	$48,258	$3,387	$51,645	$7,378	7
Garden District	1,192	9	0.76%	$152,083	$18,480	$170,563	$6,560	26
New Aurora/English Turn	2,123	62	2.92%	$806,264	$231,012	$1,037,275	$6,524	159
McDonogh	1,281	20	1.56%	$210,085	$125,645	$335,729	$5,690	59
Algiers Point	1,417	4	0.28%	$43,359	$16,057	$59,416	$5,401	11
Irish Channel	1,913	2	0.10%	$15,187	$11,589	$26,776	$5,355	5
Whitney	995	16	1.61%	$135,761	$68,955	$204,716	$4,761	43
U.S. Naval Support Area	1,041	8	0.77%	$69,424	$31,086	$100,510	$3,723	27
Grand Total	**153,648**	**4,857**	**3.16%**	**$438,390,047**	**$113,497,411**	**$551,887,458**	**$31,393**	**17,580**

Note: Housing unit estimate based on active postal addresses as of June, 2009.

The data in Table 7-6 indicates the neighborhood with the highest average NFIP payment is Lakewood, which is located in the Lakeview area of Orleans Parish. In the Lakewood neighborhood the average residential RL paid insurance claim amount is $123,989. As noted at the beginning of this Section, the majority of the NFIP claims data is a result of the devastating flooding that occurred after Hurricane Katrina in August 2005. The Lakewood neighborhood experienced extensive flooding from Katrina, with flood depths in the northern portion of this neighborhood estimated at approximately 10 feet.

Figure 7-32 shows the number of NFIP claims per residential repetitive loss property in Orleans Parish planning area #1. For reasons of brevity, separate maps of the residential and non-residential properties are shown for planning area #1 only in the body of this section. The full series of maps for both categories is included in Appendix K.

Figure 7-32
Number of NFIP Flood Insurance Claims Per Residential Repetitive Loss Property in Orleans Parish, Planning Area #1
(Source: FEMA/NFIP Query September, 2009)



Non-Residential Repetitive Loss Properties

As noted earlier, as of September 2009, Orleans Parish had 637 non-residential repetitive loss properties in the NFIP database (excluding mitigated properties). Of this total, 576 non-residential properties were mapped in Figure 7-33, as with the residential properties, the non-residential repetitive loss properties mapped in Figure 7-33 can be broken out by neighborhood to identify the areas of the Parish with the highest number of RL properties, losses, and NFIP paid claims. Table 7-7 ranks the 576 non-residential repetitive loss properties (by number of properties) for the 54 neighborhoods in New Orleans that include at least one RL property. The table includes the number of repetitive loss properties, building and contents damages, the total number of claims, and the average claim amounts in each Orleans Parish neighborhood.

Table 7-14
Summary of Non-Residential Repetitive Flood Loss Claims in Orleans Parish, Ordered by Number of Properties in Each Neighborhood
(Source: FEMA/NFIP Query September, 2009)

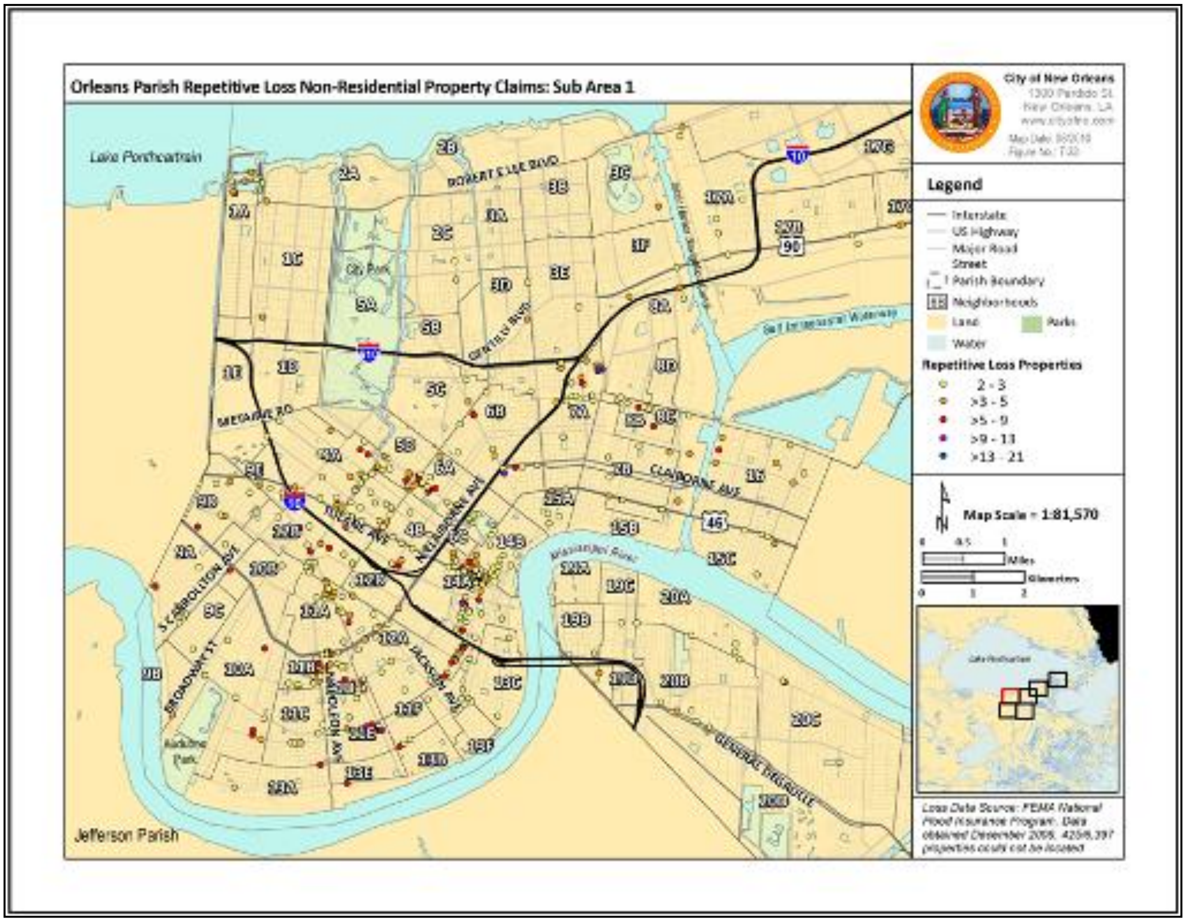
Neighborhood Name	Properties	Building	Contents	Total Paid ($)	# of Claims	Average
Central Business District	84	$12,992,713	$5,034,358	$18,027,071	262	$68,806
Central City	53	$2,864,494	$2,452,895	$5,317,389	167	$31,841
Mid-City	49	$6,280,679	$4,267,117	$10,547,796	158	$66,758
Milan	35	$2,259,248	$953,922	$3,213,171	154	$20,865
St. Roch	29	$968,098	$3,604,622	$4,572,720	134	$34,125
Tremé/Lafitte	28	$1,566,505	$1,655,315	$3,221,819	100	$32,218
Gert Town	21	$2,619,278	$2,259,984	$4,879,261	87	$56,083
Bayou St. John	16	$1,423,271	$651,217	$2,074,489	55	$37,718
Desire Area	15	$3,541,995	$4,683,202	$8,225,197	36	$228,478
Touro	15	$1,352,423	$735,651	$2,088,073	82	$25,464
Tulane/Gravier	15	$859,275	$738,883	$1,598,158	40	$39,954
French Quarter	13	$178,336	$342,470	$520,807	35	$14,880
Seventh Ward	13	$1,304,428	$719,821	$2,024,249	48	$42,172
Audubon	12	$1,604,275	$937,459	$2,541,734	45	$56,483
Broadmoor	11	$342,755	$216,068	$558,823	36	$15,523
Leonidas	11	$169,447	$88,004	$257,451	28	$9,195
West End	11	$1,637,673	$791,287	$2,428,960	42	$57,832
Freret	10	$1,082,021	$233,186	$1,315,207	27	$48,711
Lower Garden District	10	$934,000	$111,889	$1,045,889	29	$36,065
Viavant/Venetian Isles	10	$641,457	$171,526	$812,983	27	$30,110
St. Claude	9	$845,390	$106,796	$952,186	26	$36,623
Lower Ninth Ward	8	$349,576	$857,653	$1,207,229	27	$44,712
Uptown	7	$341,213	$23,855	$365,068	17	$21,475
Hollygrove	6	$197,416	$177,942	$375,358	21	$17,874

Neighborhood Name	Properties	Building	Contents	Total Paid ($)	# of Claims	Average
Marigny	6	$94,712	$209,096	$303,808	17	$17,871
Behrman	5	$717,005	$205,008	$922,014	13	$70,924
Dixon	5	$704,396	$270,562	$974,957	15	$64,997
Florida Area	5	$99,329	$39,733	$139,061	16	$8,691
Holy Cross	5	$63,234	$246,480	$309,714	13	$23,824
Lake Catherine	5	$872,453	$812,288	$1,684,741	22	$76,579
Pines Village	5	$436,475	$174,459	$610,934	13	$46,995
U.S. Naval Support Area	5	$38,472	$22,514	$60,987	11	$5,544
West Lake Forest	5	$1,527,977	$0	$1,527,977	10	$152,798
Old Aurora	4	$188,058	$310,360	$498,418	15	$33,228
Bywater	3	$94,513	$426,774	$521,287	11	$47,390
Little Woods	3	$419,953	$54,730	$474,683	9	$52,743
Dillard	2	$142,190	$138,541	$280,731	7	$40,104
Fairgrounds	2	$117,988	$56,338	$174,326	6	$29,054
Fillmore	2	$1,151,062	$0	$1,151,062	4	$287,766
Garden District	2	$2,425	$11,253	$13,678	4	$3,420
Irish Channel	2	$77,431	$164,584	$242,015	13	$18,617
Lakeshore - Lake Vista	2	$170,420	$104,308	$274,728	7	$39,247
Marlyville/Fountainebleau	2	$365,199	$25,964	$391,163	8	$48,895
St. Bernard Area	2	$0	$96,040	$96,040	5	$19,208
West Riverside	2	$39,020	$18,895	$57,915	9	$6,435
Whitney	2	$14,812	$16,415	$31,226	6	$5,204
Lakeview	2	$453,149	$57,818	$510,967	7	$159,751
B.W. Cooper	1	$0	$36,820	$36,820	2	$18,410
Black Pearl	1	$0	$36,192	$36,192	4	$9,048
East Carrollton	1	$26,673	$0	$26,673	3	$8,891
Gentilly Terrace	1	$67,708	$105,000	$172,708	2	$86,354
McDonogh	1	$3,400	$1,264	$4,664	2	$2,332
Pontchartrain Park	1	$0	$1,716,171	$1,716,171	5	$343,234
Read Blvd East	1	$334,079	$0	$334,079	4	$83,520
Grand Total	**576**	**$54,578,096**	**$37,172,727**	**$91,750,823**	**1,946**	**$47,148**

The data in Table 7-7 indicates that the Central Business District (CBD) has the highest number of non-residential RL properties. The CBD also has by far the highest claim totals for contents, total claims value, and number of claims. Although the CBD has the highest number of non-residential RL properties, the highest average is located in the Desire neighborhood with an average of $228,478 per claim. The Desire neighborhood is also notable for the very high total paid claims value, ranking second overall in the Parish with a total of $8,225,197 in paid claims.

Figure 7-33 shows the number of NFIP claims per non-residential repetitive loss property in Orleans Parish.

Figure 7-33
Number of NFIP Flood Insurance Claims Per Non-Residential Repetitive Loss Property in Orleans Parish, Planning Area #1
(Source: FEMA/NFIP Query September, 2009)



The repetitive loss claims for residential and non-residential properties can be further broken down by focusing on individual street level data. Table 7-8 provides a summary of residential repetitive loss claims for individual streets within Orleans Parish, with 25 or more repetitive loss properties. For these streets, the building, contents, and total claims data has been combined. The data displayed in the table summarizes the NFIP repetitive loss data for 31 of the 1,053 individual streets in the Parish that include a repetitive loss property. Address data about individual sites is omitted for privacy reasons. The data shows that Octavia Street has the highest number of repetitive loss properties in Orleans Parish. Octavia Street has a total of 132 RL properties with total paid claims of $25.5 million.

Table 7-15
Summary of NFIP Repetitive Loss Statistics for Orleans Parish, ordered by number of Properties on each Street
(Source: FEMA/NFIP query September 2009)

Street Name	Properties	Building	Contents	Total Paid ($)	# of Claims	Average (Per Policy)
Octavia Street	132	$20,074,445	$5,442,059	$25,516,504	808	$31,580
Jefferson Avenue	73	$8,456,588	$2,350,944	$10,807,533	401	$26,951
Breakwater Drive	72	$12,434,545	$2,276,922	$14,711,467	355	$41,441
Louisiana Avenue Parkway	68	$2,816,459	$804,181	$3,620,641	226	$16,021
Napoleon Avenue	62	$8,214,111	$2,370,054	$10,584,166	410	$25,815
Nashville Avenue	50	$6,108,188	$1,583,058	$7,691,246	232	$33,152
South Galvez Street	45	$6,629,433	$2,128,418	$8,757,850	265	$33,048
Broadway Street	40	$2,518,022	$638,618	$3,156,640	150	$21,044
South Miro Street	36	$3,375,235	$797,220	$4,172,455	149	$28,003
Prytania Street	35	$1,340,226	$285,321	$1,625,547	153	$10,624
South Rocheblave Street	35	$3,583,115	$770,867	$4,353,981	150	$29,027
Milan Street	34	$1,799,389	$417,940	$2,217,329	132	$16,798
Audubon Boulevard	32	$5,830,926	$1,981,728	$7,812,654	152	$51,399
South Tonti Street	32	$4,365,175	$1,192,280	$5,557,455	208	$26,719
Fontainebleau Drive	31	$3,374,154	$553,070	$3,927,223	122	$32,190
Stroelitz Street	31	$3,206,664	$1,079,999	$4,286,663	208	$20,609
General Taylor Street	30	$1,645,330	$400,747	$2,046,077	106	$19,303
Lauradale Drive	29	$1,409,283	$700,621	$2,109,904	160	$13,187
Peniston Street	29	$2,535,308	$467,846	$3,003,154	150	$20,021
Calhoun Street	28	$3,456,715	$726,656	$4,183,371	103	$40,615
Saint Charles Avenue	28	$19,783,873	$2,566,186	$22,350,059	98	$228,062
Delachaise Street	27	$1,702,294	$317,016	$2,019,310	96	$21,034
Joseph Street	27	$2,769,566	$764,610	$3,534,175	150	$23,561
River Oaks Drive	27	$683,119	$270,906	$954,025	81	$11,778
Vincennes Place	27	$3,075,699	$715,903	$3,791,602	125	$30,333
Audubon Street	26	$2,020,788	$411,537	$2,432,324	108	$22,522
Kraft Place	26	$1,705,200	$200,694	$1,905,894	124	$15,370
Pine Street	26	$1,798,001	$488,785	$2,286,786	93	$24,589
Robert Street	26	$1,869,486	$549,293	$2,418,778	116	$20,852
General Pershing Street	25	$1,920,141	$460,302	$2,380,444	117	$20,346
South Johnson Street	25	$3,447,807	$856,119	$4,303,926	134	$32,119

Note: The NFIP claims data in this table is limited to streets that include 25 or more properties, and therefore only includes 1,214 of the 4,857 (mapped) residential repetitive loss properties.

As noted earlier, a September 2009 query of NFIP data indicated that the City of New Orleans has completed projects to mitigate damages to an estimated 623 residential properties. Of this total, 583 properties, or 93.5 percent, were residential versus nonresidential. Of the 623 total properties, 539 were geo-coded successfully and mapped, providing the location of each property. Table 7-9 summarizes the NFIP claims history for each of the 46 neighborhoods that include at least one mitigated RL property. The Table shows that the Lakeview neighborhood has the highest number mitigated RL properties in Orleans Parish. In Lakeview, 86 such properties have been mitigated with past NFIP insurance claims for these properties totaling $17,186,116. The NFIP database does not specify the type of mitigation that was effected at the various properties, although presumably the large majority were elevations or acquisitions.

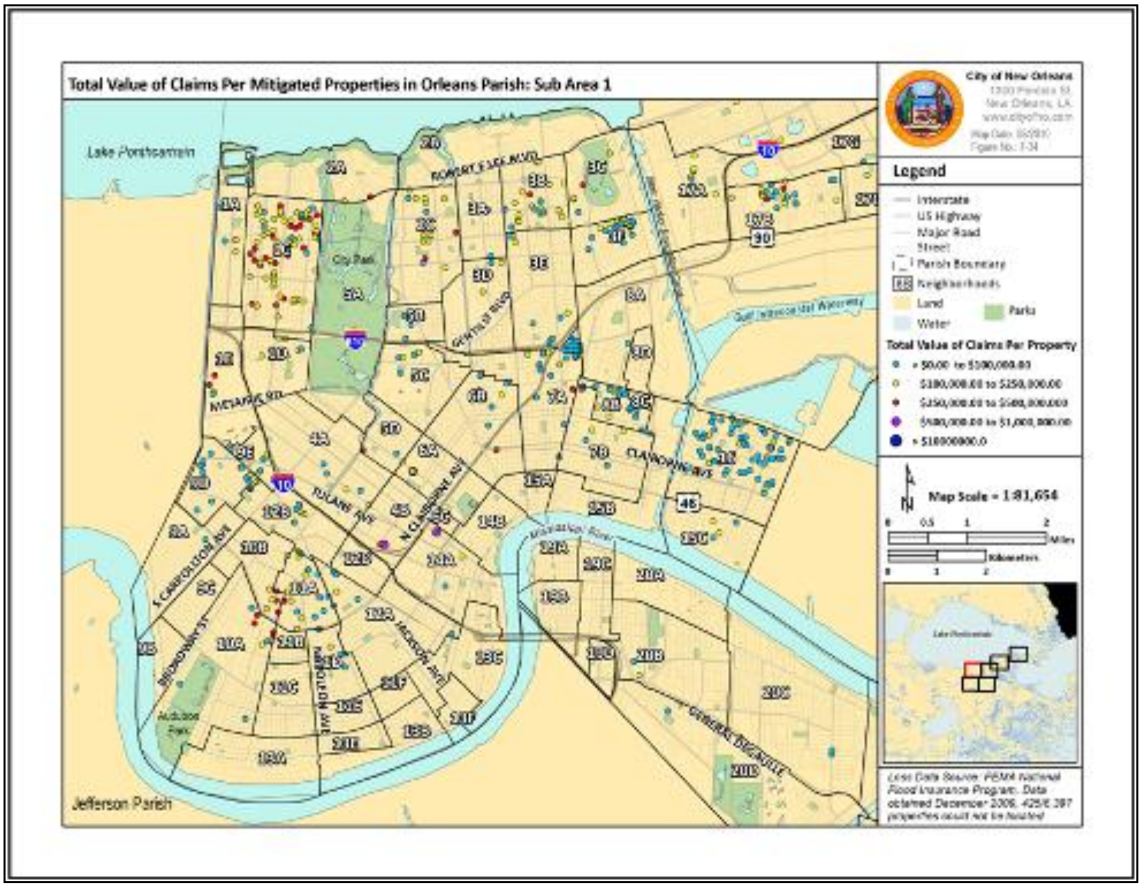
Table 7-16
Mitigated Repetitive Loss Properties in Orleans Parish, Ordered by Number of Properties in each Neighborhood
(Source: FEMA / NFIP Query September 2009)

Neighborhood Name	# of Properties	Building	Contents	Cumulative NFIP Claims Paid	# of Claims	Mitigation Type
Lakeview	86	$14,258,396	$2,927,720	$17,186,116	308	
Lower Ninth Ward	78	$3,672,472	$1,136,217	$4,808,689	243	
St. Roch	47	$3,082,356	$1,137,104	$4,219,461	222	
Gentilly Woods	34	$3,413,395	$948,742	$4,362,138	156	
Milneburg	25	$2,555,091	$706,889	$3,261,981	90	
Plum Orchard	24	$2,540,843	$781,311	$3,322,153	102	
Hollygrove	22	$1,867,569	$511,678	$2,379,247	130	
Florida Area	20	$1,249,879	$345,927	$1,595,806	85	
Broadmoor	17	$1,730,463	$363,307	$2,093,770	84	
Lake Catherine	17	$2,190,056	$989,806	$3,179,862	52	
Filmore	16	$2,104,106	$649,007	$2,753,113	46	
Audubon	11	$1,444,645	$501,881	$1,946,527	61	
Gentilly Terrace	9	$531,681	$110,779	$642,460	28	
Gert Town	9	$709,517	$297,505	$1,007,022	48	
Milan	8	$614,904	$254,152	$869,056	29	
Pines Village	7	$678,772	$236,130	$914,902	33	
Seventh Ward	7	$488,577	$170,216	$658,793	23	
St. Claude	7	$490,041	$217,228	$707,269	27	
West End	7	$778,496	$137,091	$915,587	17	
Central City	6	$370,123	$86,752	$456,875	21	
Dixon	6	$278,041	$351,259	$629,301	22	
Fairgrounds	6	$498,411	$90,970	$589,381	18	
Marlyville/Fountainebleau	6	$1,185,225	$188,975	$1,374,199	36	

Neighborhood Name	# of Properties	Building	Contents	Cumulative NFIP Claims Paid	# of Claims	Mitigation Type
Navarre	6	$716,507	$187,449	$903,956	21	
Little Woods	5	$468,559	$90,167	$558,725	17	
Mid-City	5	$376,971	$74,451	$451,422	17	
Pontchartrain Park	5	$633,595	$200,401	$833,995	16	
Holly Cross	4	$307,319	$110,124	$417,443	10	
Lakewood	4	$713,865	$176,349	$890,214	15	
Tremé/Lafitte	4	$730,775	$448,350	$1,179,125	30	
Central Business District	3	$120,548	$703,454	$824,002	15	
Dillard	3	$238,095	$84,306	$322,401	8	
Read Blvd East	3	$333,134	$83,262	$416,396	8	
St. Anthony	3	$223,576	$20,035	$243,611	7	
St. Bernard Area	3	$162,289	$26,101	$188,390	8	
Bayou St. John	2	$193,557	$315,197	$508,754	8	
Behrman	2	$111,237	$73,251	$184,488	11	
Lakeshore - Lake Vista	2	$388,531	$69,897	$458,428	7	
Old Aurora	2	$64,683	$8,992	$73,675	8	
Tulane - Gravier	2	$576,932	$566,616	$1,143,548	12	
Desire Area	1	$45,293	$10,000	$55,293	2	
Freret	1	$55,615	$74,997	$130,612	6	
Leonidas	1	$6,709	$0	$6,709	2	
Tall Timbers - Brechtel	1	$10,852	$2,132	$12,985	4	
Touro	1	$40,852	$27,042	$67,894	2	
West Lake Forest	1	$76,884	$11,000	$87,884	2	
Grand Total	**539**	**$53,329,435**	**$16,504,222**	**$69,833,658**	**2,117**	

Figure 7-34 shows the cumulative value of NFIP claims per *mitigated* repetitive loss property in Orleans Parish, in planning area #1.

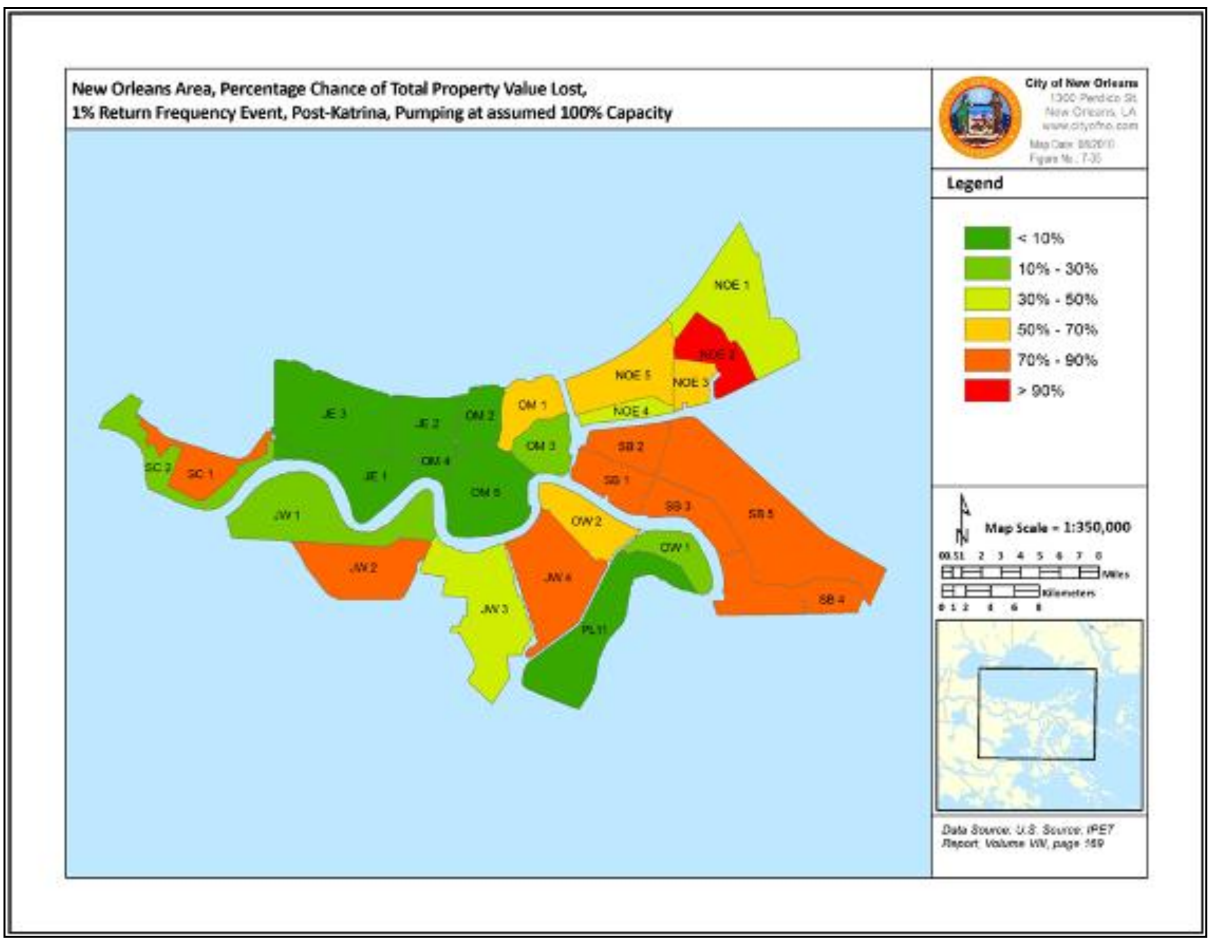
Figure 7-34
Value of NFIP Flood Insurance Claims Per Mitigated Repetitive Loss Property in Orleans Parish, Planning Area #1
(Source: FEMA/NFIP Query September, 2009)



Analysis and Estimated Surge Risk based on IPET Study Damage Ranges, by Neighborhood

This subsection estimates losses from storm surge events based on the range of potential losses from the IPET study, Volume VIII. The IPET report provides estimated ranges of potential 100-percent damage to structures within the various drainage basins that were included in the study, based on a series of scenarios of probability, pumping effectiveness, and Hurricane Protection System (HPS) configurations (pre-Katrina vs. 2007). As noted elsewhere, this information is presented in the IPET report as a series of graphics depicting the drainage basins and indicating the percentage of structures expected to be destroyed in various scenarios, as shown in Figure 7-35 below. This graphic shows the scenario for the 1-percent-annual-probability event (also known as the 100-year event), with pumps at 100-percent capacity, and the 2007 HPS configuration. The color coding of the various drainage basins shows the percentage of structures that the IPET study estimates would be totally destroyed in this scenario. For example, in New Orleans East (NOE) drainage basin 5, the study estimates between 50 and 70 percent of structures would be destroyed.

Figure 7-35
New Orleans Area, Percentage Chance of Total Property Value Lost,
1-percent Return Frequency Event, Post-Katrina, Pumping at assumed 100-percent Capacity
(Source: U.S. Source: IPET Report, Volume VIII, page 169)



Methodology

The present subsection uses this series of estimates in conjunction with information about the neighborhoods to estimate dollar losses from the scenarios. First, each neighborhood in Orleans Parish was related to a drainage basin from the IPET study, and the area of each neighborhood determined using GIS records. Then, postal service (USPS) data were used to estimate the number of occupied housing units in each neighborhood. This information is shown in Table 7-10, below. The first column (Neighborhood) names the neighborhoods; the second column (Basin) notes the IPET basin (or multiple basins) associated with the neighborhood; the third column (Acres) indicates the number of acres of each neighborhood that are in each basin. The next twelve columns (Pumps at 50 percent, subheadings 2-percent event, 1-percent event, and 0.5-percent event, then repeating the same pattern for Pumps at 100 percent) show the percentage of structures in each neighborhood that are estimated to be destroyed in events of various probabilities. The 2-percent event is simply an event with a 2-percent annual likelihood of occurring, alternatively the "50-year event". The 1-percent event corresponds to a "100-year" event, and the 0.2-percent event corresponds to the "500-year" event. Note that a few of the neighborhoods are listed more than once in the first column – these neighborhoods span multiple basins. The figures in the loss estimation table are based on proportioning the numbers of structures to the area of the neighborhood in each basin.

Table 7-17
Orleans Parish Neighborhoods, with Associated IPET Basins, Acreage, Occupied Units, and IPET Study Scenarios (HPS 2007)

			Pumps at 50%						Pumps at 100%						
Neighborhood	Basin	Acres	2% event		1% event		0.2% event		2% event		1% event		0.2% event		USPS
ALGIERS POINT	OW2	155.07	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	1417
ALGIERS U.S. NAVAL BASE	OW2	429.36	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	1041
AUDUBON	OM5	1278.73	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	7292
AURORA (OLD)	OW2	1605.82	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	NL
B. W. COOPER	OM5	202.96	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	345
BAYOU ST. JOHN	OM1	18.19	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	132
BAYOU ST. JOHN	OM5	253.72	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1751
BEHRMAN	OW2	980.99	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	3832
BLACK PEARL	OM5	104.32	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1082
BROADMOOR	OM5	361.82	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	2324
BYWATER	OM3	367.44	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	2165
CBD	OM5	594.42	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1939
CENTRAL CITY	OM5	903.12	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	6233
CITY PARK	OM1	68.62	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	69
CITY PARK	OM2	1294.88	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	1304
CITY PARK	OM5	210.80	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	212
DESIRE AREA	OM1	1.43	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1
DESIRE AREA	OM3	812.18	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	531
DESIRE DEV	OM3	147.47	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	128
DILLARD	OM1	483.43	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1405
DILLARD	OM3	124.61	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	804
DIXON	OM5	149.25	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	529
EAST CARROLLTON	OM5	242.57	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	2276

			Pumps at 50%						Pumps at 100%						
Neighborhood	Basin	Acres	2% event		1% event		0.2% event		2% event		1% event		0.2% event		USPS
EAST RIVERSIDE	OM5	158.63	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1472
FAIRGROUNDS	OM1	398.88	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	2064
FAIRGROUNDS	OM3	142.72	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	439
FAIRGROUNDS	OM5	22.41	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	71
FILLMORE	OM1	783.42	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1480
FISCHER DEV	OW2	119.36	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	291
FLORIDA AREA	OM3	201.59	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	523
FLORIDA DEV	OM3	35.57	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	2
FRENCH QUARTER	OM5	256.99	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	3936
FRERET	OM5	125.46	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	789
GARDEN DISTRICT	OM5	138.75	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1192
GENTILLY TERRACE	OM1	394.13	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1817
GENTILLY TERRACE	OM3	384.30	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	1752
GENTILLY WOODS	OM1	403.13	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	904
GENTILLY WOODS	OM3	1.08	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	2
GERT TOWN (W/ZION)	OM5	480.15	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1547
HOLLYGROVE	OM5	392.91	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1889
IBERVILLE	OM5	40.11	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	801
IRISH CHANNEL	OM5	218.22	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1913
LAKE CATHERINE	NOE1	86.36	0.00	0.10	0.30	0.50	0.90	1.00	0.00	0.10	0.30	0.50	0.90	1.00	420
LAKE TERRACE & OAKS	OM1	831.26	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	657
LAKE TERRACE & OAKS	OM2	0.00	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	1
LAKESHORE - LAKE VISTA	OM1	2.98	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	7
LAKESHORE - LAKE VISTA	OM2	656.95	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	577
LAKEVIEW	OM2	1030.21	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	2358

			Pumps at 50%						Pumps at 100%						
Neighborhood	Basin	Acres	2% event		1% event		0.2% event		2% event		1% event		0.2% event		USPS
LAKEWOOD	OM2	414.35	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	428
LAKEWOOD	OM5	160.29	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	136
LEONIDAS	OM5	540.49	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	3485
LITTLE WOODS	NOE5	3293.83	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	11385
LOWER GARDEN DISTRICT	OM5	561.38	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	4295
MARIGNY	OM3	179.04	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	2108
MARIGNY	OM5	0.98	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	5
MARLYVILLE - FONTAINBLEAU	OM5	409.90	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	2752
McDONOGH	OW2	265.91	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	1281
MID-CITY	OM2	0.50	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	2
MID-CITY	OM5	1056.69	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	3793
MILAN	OM5	335.69	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	2718
MILNEBURG	OM1	473.20	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1342
NAVARRE	OM2	423.72	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	1150
NAVARRE	OM5	0.95	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	0
NEW AURORA - ENG. TURN	OW1	4256.27	0.10	0.30	0.10	0.30	0.70	0.90	0.10	0.30	0.10	0.30	0.70	0.90	1915
NEW AURORA – ENG. TURN	OW2	463.10	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	846
PINES VILLAGE	NOE5	698.97	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1161
PLUM ORCHARD	NOE5	622.87	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1407
PONTCHARTRAIN PARK	OM1	502.36	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	507
READ BLVD EAST	NOE5	2354.37	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	2307
READ BLVD WEST	NOE5	496.13	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1275
SEVENTH WARD	OM3	725.82	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	4790
SEVENTH WARD	OM5	22.65	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	259

			Pumps at 50%						Pumps at 100%						
Neighborhood	Basin	Acres	2% event		1% event		0.2% event		2% event		1% event		0.2% event		USPS
ST. ANTHONY	OM1	409.89	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1395
ST. BERNARD AREA	OM1	232.22	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	420
ST. CLAUDE	OM3	649.21	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	3276
ST. ROCH	OM1	29.03	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	68
ST. ROCH	OM3	790.85	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.10	0.30	0.90	1.00	1640
ST. THOMAS DEV	OM5	132.71	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	862
TALL TIMBERS - BRECHTEL	OW2	1745.02	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	4710
TOURO	OM5	194.44	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1752
TREME - LAFITTE	OM5	441.53	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	2291
TULANE - GRAVIER	OM5	442.00	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	1237
UPTOWN	OM5	406.82	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	3202
VIAVANT	NOE1	3665.24	0.00	0.10	0.30	0.50	0.90	1.00	0.00	0.10	0.30	0.50	0.90	1.00	112
VIAVANT	NOE2	1980.42	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.70	0.90	0.90	1.00	92
VIAVANT	NOE3	1822.96	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	39
VIAVANT	NOE4	2419.15	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.30	0.50	0.90	1.00	46
VIAVANT	NOE5	809.05	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	17
VILLAGE DE LEST	NOE1	10417.35	0.00	0.10	0.30	0.50	0.90	1.00	0.00	0.10	0.30	0.50	0.90	1.00	153
VILLAGE DE LEST	NOE2	3667.26	0.10	0.30	0.70	0.90	0.90	1.00	0.00	0.10	0.70	0.90	0.90	1.00	158
VILLAGE DE LEST	NOE3	1069.87	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	101
VILLAGE DE LEST	NOE5	78.24	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	10
WEST END	OM2	373.14	0.10	0.30	0.50	0.70	0.90	1.00	0.00	0.10	0.00	0.10	0.90	1.00	1511
WEST LAKE FOREST	NOE5	858.34	0.00	0.10	0.70	0.90	0.90	1.00	0.00	0.10	0.50	0.70	0.90	1.00	1399
WEST RIVERSIDE	OM5	378.35	0.00	0.10	0.10	0.30	0.90	1.00	0.00	0.10	0.00	0.10	0.70	0.90	2720
WHITNEY	OW2	353.82	0.10	0.30	0.50	0.70	0.70	0.90	0.10	0.30	0.50	0.70	0.70	0.90	995

When the data is organized in this manner it can then be translated into a scenario based loss estimate by estimating the structure and contents values for the sample structures, then multiplying these values by the probability and percentage damage range (and the number of structures in each neighborhood). This estimate uses structure value of $150,000 for structures (1,200 square feet by $100 per square foot replacement value; the square footage is estimated, and the construction replacement value is from the City of New Orleans, April 2010), and the FEMA default valuation for contents, 30 percent of structure value. The next table shows the expected value of losses by neighborhood and by scenario (i.e. combinations of pumping effectiveness and return frequency of potential events). Note that all figures are based on IPET estimates, which are in this case for the HPS 2007 data that is included in Volume VIII of the report.[15]

[15] Interagency Performance Evaluation Task Force, Volume VIII, June 2009

Table 7-18
Orleans Parish Neighborhoods, with Expected Dollar Losses for three IPET Study Scenarios, with Pumping at 50-percent Effectiveness (HPS 2007)

		Pumps at 50%						
Neighborhood	Basin	2% event		1% event		0.2% event		USPS
ALGIERS POINT	OW2	$4,421,040	$13,263,120	$11,052,600	$15,473,640	$3,094,728	$3,978,936	1417
ALGIERS U.S. NAVAL BASE	OW2	$3,247,920	$9,743,760	$8,119,800	$11,367,720	$2,273,544	$2,923,128	1041
AUDUBON	OM5	$0	$22,751,040	$0	$11,375,520	$15,925,728	$20,475,936	7292
AURORA (OLD)	OW2	$0	$0	$0	$0	$0	$0	NL
B. W. COOPER	OM5	$0	$1,076,400	$0	$538,200	$753,480	$968,760	345
BAYOU ST. JOHN	OM1	$0	$412,341	$1,030,852	$1,443,193	$371,107	$412,341	132
BAYOU ST. JOHN	OM5	$0	$5,461,647	$0	$2,730,823	$3,823,153	$4,915,482	1751
BEHRMAN	OW2	$11,955,840	$35,867,520	$29,889,600	$41,845,440	$8,369,088	$10,760,256	3832
BLACK PEARL	OM5	$0	$3,375,840	$0	$1,687,920	$2,363,088	$3,038,256	1082
BROADMOOR	OM5	$0	$7,250,880	$0	$3,625,440	$5,075,616	$6,525,792	2324
BYWATER	OM3	$0	$6,754,800	$3,377,400	$10,132,200	$6,079,320	$6,754,800	2165
CENTRAL BUSINESS DISTRICT	OM5	$0	$6,049,680	$0	$3,024,840	$4,234,776	$5,444,712	1939
CENTRAL CITY	OM5	$0	$19,446,960	$0	$9,723,480	$13,612,872	$17,502,264	6233
CITY PARK	OM1	$0	$215,541	$538,854	$754,395	$193,987	$215,541	69
CITY PARK	OM2	$0	$4,067,482	$0	$2,033,741	$3,660,734	$4,067,482	1304
CITY PARK	OM5	$0	$662,177	$0	$331,088	$463,524	$595,959	212
DESIRE AREA	OM1	$0	$2,908	$7,270	$10,177	$2,617	$2,908	1
DESIRE AREA	OM3	$0	$1,656,932	$828,466	$2,485,398	$1,491,239	$1,656,932	531
DESIRE DEV	OM3	$0	$399,360	$199,680	$599,040	$359,424	$399,360	128
DILLARD	OM1	$0	$4,383,216	$10,958,041	$15,341,257	$3,944,895	$4,383,216	1405
DILLARD	OM3	$0	$2,508,493	$1,254,246	$3,762,739	$2,257,643	$2,508,493	804
DIXON	OM5	$0	$1,650,480	$0	$825,240	$1,155,336	$1,485,432	529
EAST CARROLLTON	OM5	$0	$7,101,120	$0	$3,550,560	$4,970,784	$6,391,008	2276
EAST RIVERSIDE	OM5	$0	$4,592,640	$0	$2,296,320	$3,214,848	$4,133,376	1472
FAIRGROUNDS	OM1	$0	$6,440,933	$16,102,334	$22,543,267	$5,796,840	$6,440,933	2064
FAIRGROUNDS	OM3	$0	$1,370,289	$685,145	$2,055,434	$1,233,260	$1,370,289	439
FAIRGROUNDS	OM5	$0	$220,559	$0	$110,280	$154,391	$198,503	71
FILLMORE	OM1	$0	$4,617,600	$11,544,000	$16,161,600	$4,155,840	$4,617,600	1480
FISCHER DEV	OW2	$907,920	$2,723,760	$2,269,800	$3,177,720	$635,544	$817,128	291
FLORIDA AREA	OM3	$0	$1,631,760	$815,880	$2,447,640	$1,468,584	$1,631,760	523
FLORIDA DEV	OM3	$0	$6,240	$3,120	$9,360	$5,616	$6,240	2
FRENCH QUARTER	OM5	$0	$12,280,320	$0	$6,140,160	$8,596,224	$11,052,288	3936
FRERET	OM5	$0	$2,461,680	$0	$1,230,840	$1,723,176	$2,215,512	789

		Pumps at 50%						
Neighborhood	Basin	2% event		1% event		0.2% event		USPS
GARDEN DISTRICT	OM5	$0	$3,719,040	$0	$1,859,520	$2,603,328	$3,347,136	1192
GENTILLY TERRACE	OM1	$0	$5,669,523	$14,173,808	$19,843,331	$5,102,571	$5,669,523	1817
GENTILLY TERRACE	OM3	$0	$5,464,972	$2,732,486	$8,197,458	$4,918,475	$5,464,972	1752
GENTILLY WOODS	OM1	$0	$2,819,201	$7,048,004	$9,867,205	$2,537,281	$2,819,201	904
GENTILLY WOODS	OM3	$0	$6,315	$3,158	$9,473	$5,684	$6,315	2
GERT TOWN (W/ZION)	OM5	$0	$4,826,640	$0	$2,413,320	$3,378,648	$4,343,976	1547
HOLLYGROVE	OM5	$0	$5,893,680	$0	$2,946,840	$4,125,576	$5,304,312	1889
IBERVILLE	OM5	$0	$2,499,120	$0	$1,249,560	$1,749,384	$2,249,208	801
IRISH CHANNEL	OM5	$0	$5,968,560	$0	$2,984,280	$4,177,992	$5,371,704	1913
LAKE CATHERINE	NOE1	$0	$1,310,400	$1,965,600	$3,276,000	$1,179,360	$1,310,400	420
LAKE TERRACE & OAKS	OM1	$0	$2,049,832	$5,124,580	$7,174,413	$1,844,849	$2,049,832	657
LAKE TERRACE & OAKS	OM2	$0	$2,184	$0	$1,092	$1,965	$2,184	1
LAKESHORE - LAKE VISTA	OM1	$0	$20,864	$52,161	$73,025	$18,778	$20,864	7
LAKESHORE - LAKE VISTA	OM2	$0	$1,800,439	$0	$900,219	$1,620,395	$1,800,439	577
LAKEVIEW	OM2	$0	$7,356,960	$0	$3,678,480	$6,621,264	$7,356,960	2358
LAKEWOOD	OM2	$0	$1,334,076	$0	$667,038	$1,200,668	$1,334,076	428
LAKEWOOD	OM5	$0	$423,193	$0	$211,596	$296,235	$380,874	136
LEONIDAS	OM5	$0	$10,873,200	$0	$5,436,600	$7,611,240	$9,785,880	3485
LITTLE WOODS	NOE5	$0	$35,521,200	$88,803,000	$124,324,200	$31,969,080	$35,521,200	11385
LOWER GARDEN DISTRICT	OM5	$0	$13,400,400	$0	$6,700,200	$9,380,280	$12,060,360	4295
MARIGNY	OM3	$0	$6,575,450	$3,287,725	$9,863,174	$5,917,905	$6,575,450	2108
MARIGNY	OM5	$0	$15,698	$0	$7,849	$10,989	$14,128	5
MARLYVILLE - FONTAINBLEAU	OM5	$0	$8,586,240	$0	$4,293,120	$6,010,368	$7,727,616	2752
McDONOGH	OW2	$3,996,720	$11,990,160	$9,991,800	$13,988,520	$2,797,704	$3,597,048	1281
MID-CITY	OM2	$0	$7,355	$0	$3,677	$6,619	$7,355	2
MID-CITY	OM5	$0	$11,834,241	$0	$5,917,120	$8,283,969	$10,650,817	3793
MILAN	OM5	$0	$8,480,160	$0	$4,240,080	$5,936,112	$7,632,144	2718
MILNEBURG	OM1	$0	$4,187,040	$10,467,600	$14,654,640	$3,768,336	$4,187,040	1342
NAVARRE	OM2	$0	$3,589,331	$0	$1,794,665	$3,230,398	$3,589,331	1150
NAVARRE	OM5	$0	$801	$0	$400	$561	$721	0
NEW AURORA - ENGLISH TURN	OW1	$5,973,786	$17,921,359	$2,986,893	$8,960,679	$4,181,650	$5,376,408	1915
NEW AURORA - ENGLISH TURN	OW2	$2,639,662	$7,918,986	$6,599,155	$9,238,817	$1,847,763	$2,375,696	846
PINES VILLAGE	NOE5	$0	$3,622,320	$9,055,800	$12,678,120	$3,260,088	$3,622,320	1161
PLUM ORCHARD	NOE5	$0	$4,389,840	$10,974,600	$15,364,440	$3,950,856	$4,389,840	1407
PONTCHARTRAIN PARK	OM1	$0	$1,581,840	$3,954,600	$5,536,440	$1,423,656	$1,581,840	507
READ BLVD EAST	NOE5	$0	$7,197,840	$17,994,600	$25,192,440	$6,478,056	$7,197,840	2307

		Pumps at 50%						
Neighborhood	Basin	2% event		1% event		0.2% event		USPS
READ BLVD WEST	NOE5	$0	$3,978,000	$9,945,000	$13,923,000	$3,580,200	$3,978,000	1275
SEVENTH WARD	OM3	$0	$14,943,332	$7,471,666	$22,414,997	$13,448,998	$14,943,332	4790
SEVENTH WARD	OM5	$0	$806,976	$0	$403,488	$564,883	$726,279	259
ST. ANTHONY	OM1	$0	$4,352,400	$10,881,000	$15,233,400	$3,917,160	$4,352,400	1395
ST. BERNARD AREA	OM1	$0	$1,310,400	$3,276,000	$4,586,400	$1,179,360	$1,310,400	420
ST. CLAUDE	OM3	$0	$10,221,120	$5,110,560	$15,331,680	$9,199,008	$10,221,120	3276
ST. ROCH	OM1	$0	$211,537	$528,844	$740,381	$190,384	$211,537	68
ST. ROCH	OM3	$0	$5,116,256	$2,558,128	$7,674,383	$4,604,630	$5,116,256	1640
ST. THOMAS DEV	OM5	$0	$2,689,440	$0	$1,344,720	$1,882,608	$2,420,496	862
TALL TIMBERS - BRECHTEL	OW2	$14,695,200	$44,085,600	$36,738,000	$51,433,200	$10,286,640	$13,225,680	4710
TOURO	OM5	$0	$5,466,240	$0	$2,733,120	$3,826,368	$4,919,616	1752
TREME - LAFITTE	OM5	$0	$7,147,920	$0	$3,573,960	$5,003,544	$6,433,128	2291
TULANE - GRAVIER	OM5	$0	$3,859,440	$0	$1,929,720	$2,701,608	$3,473,496	1237
UPTOWN	OM5	$0	$9,990,240	$0	$4,995,120	$6,993,168	$8,991,216	3202
VIAVANT	NOE1	$0	$350,652	$525,978	$876,630	$315,587	$350,652	112
VIAVANT	NOE2	$0	$288,226	$1,008,792	$1,297,018	$259,404	$288,226	92
VIAVANT	NOE3	$0	$120,603	$301,507	$422,110	$108,543	$120,603	39
VIAVANT	NOE4	$0	$142,996	$214,494	$357,490	$128,696	$142,996	46
VIAVANT	NOE5	$0	$51,865	$129,662	$181,527	$46,678	$51,865	17
VILLAGE DE LEST	NOE1	$0	$477,950	$716,925	$1,194,875	$430,155	$477,950	153
VILLAGE DE LEST	NOE2	$0	$493,971	$1,728,898	$2,222,869	$444,574	$493,971	158
VILLAGE DE LEST	NOE3	$0	$314,218	$785,545	$1,099,764	$282,796	$314,218	101
VILLAGE DE LEST	NOE5	$0	$32,392	$80,979	$113,370	$29,152	$32,392	10
WEST END	OM2	$0	$4,714,320	$0	$2,357,160	$4,242,888	$4,714,320	1511
WEST LAKE FOREST	NOE5	$0	$4,364,880	$10,912,200	$15,277,080	$3,928,392	$4,364,880	1399
WEST RIVERSIDE	OM5	$0	$8,486,400	$0	$4,243,200	$5,940,480	$7,637,760	2720
WHITNEY	OW2	$3,104,400	$9,313,200	$7,761,000	$10,865,400	$2,173,080	$2,793,960	995

Table 7-19
Orleans Parish Neighborhoods, with Expected Dollar Losses for three IPET Study Scenarios, with Pumping at 100-percent Effectiveness (HPS 2007)

		Pumps at 50%						
Neighborhood	**Basin**	**2% event**		**1% event**		**0.2% event**		**USPS**
ALGIERS POINT	OW2	$4,421,040	$13,263,120	$11,052,600	$15,473,640	$3,094,728	$3,978,936	1417
ALGIERS USN BASE	OW2	$3,247,920	$9,743,760	$8,119,800	$11,367,720	$2,273,544	$2,923,128	1041
AUDUBON	OM5	$0	$22,751,040	$0	$11,375,520	$15,925,728	$20,475,936	7292
AURORA (OLD)	OW2	$0	$0	$0	$0	$0	$0	NL
B. W. COOPER	OM5	$0	$1,076,400	$0	$538,200	$753,480	$968,760	345
BAYOU ST. JOHN	OM1	$0	$412,341	$1,030,852	$1,443,193	$371,107	$412,341	132
BAYOU ST. JOHN	OM5	$0	$5,461,647	$0	$2,730,823	$3,823,153	$4,915,482	1751
BEHRMAN	OW2	$11,955,840	$35,867,520	$29,889,600	$41,845,440	$8,369,088	$10,760,256	3832
BLACK PEARL	OM5	$0	$3,375,840	$0	$1,687,920	$2,363,088	$3,038,256	1082
BROADMOOR	OM5	$0	$7,250,880	$0	$3,625,440	$5,075,616	$6,525,792	2324
BYWATER	OM3	$0	$6,754,800	$3,377,400	$10,132,200	$6,079,320	$6,754,800	2165
CENTRAL BUS DIST	OM5	$0	$6,049,680	$0	$3,024,840	$4,234,776	$5,444,712	1939
CENTRAL CITY	OM5	$0	$19,446,960	$0	$9,723,480	$13,612,872	$17,502,264	6233
CITY PARK	OM1	$0	$215,541	$538,854	$754,395	$193,987	$215,541	69
CITY PARK	OM2	$0	$4,067,482	$0	$2,033,741	$3,660,734	$4,067,482	1304
CITY PARK	OM5	$0	$662,177	$0	$331,088	$463,524	$595,959	212
DESIRE AREA	OM1	$0	$2,908	$7,270	$10,177	$2,617	$2,908	1
DESIRE AREA	OM3	$0	$1,656,932	$828,466	$2,485,398	$1,491,239	$1,656,932	531
DESIRE DEV	OM3	$0	$399,360	$199,680	$599,040	$359,424	$399,360	128
DILLARD	OM1	$0	$4,383,216	$10,958,041	$15,341,257	$3,944,895	$4,383,216	1405
DILLARD	OM3	$0	$2,508,493	$1,254,246	$3,762,739	$2,257,643	$2,508,493	804
DIXON	OM5	$0	$1,650,480	$0	$825,240	$1,155,336	$1,485,432	529
EAST CARROLLTON	OM5	$0	$7,101,120	$0	$3,550,560	$4,970,784	$6,391,008	2276
EAST RIVERSIDE	OM5	$0	$4,592,640	$0	$2,296,320	$3,214,848	$4,133,376	1472
FAIRGROUNDS	OM1	$0	$6,440,933	$16,102,334	$22,543,267	$5,796,840	$6,440,933	2064
FAIRGROUNDS	OM3	$0	$1,370,289	$685,145	$2,055,434	$1,233,260	$1,370,289	439
FAIRGROUNDS	OM5	$0	$220,559	$0	$110,280	$154,391	$198,503	71
FILLMORE	OM1	$0	$4,617,600	$11,544,000	$16,161,600	$4,155,840	$4,617,600	1480
FISCHER DEV	OW2	$907,920	$2,723,760	$2,269,800	$3,177,720	$635,544	$817,128	291
FLORIDA AREA	OM3	$0	$1,631,760	$815,880	$2,447,640	$1,468,584	$1,631,760	523
FLORIDA DEV	OM3	$0	$6,240	$3,120	$9,360	$5,616	$6,240	2
FRENCH QUARTER	OM5	$0	$12,280,320	$0	$6,140,160	$8,596,224	$11,052,288	3936
FRERET	OM5	$0	$2,461,680	$0	$1,230,840	$1,723,176	$2,215,512	789

		Pumps at 50%						
Neighborhood	**Basin**	**2% event**		**1% event**		**0.2% event**		**USPS**
GARDEN DISTRICT	OM5	$0	$3,719,040	$0	$1,859,520	$2,603,328	$3,347,136	1192
GENTILLY TERRACE	OM1	$0	$5,669,523	$14,173,808	$19,843,331	$5,102,571	$5,669,523	1817
GENTILLY TERRACE	OM3	$0	$5,464,972	$2,732,486	$8,197,458	$4,918,475	$5,464,972	1752
GENTILLY WOODS	OM1	$0	$2,819,201	$7,048,004	$9,867,205	$2,537,281	$2,819,201	904
GENTILLY WOODS	OM3	$0	$6,315	$3,158	$9,473	$5,684	$6,315	2
GERT TOWN (W/ZION)	OM5	$0	$4,826,640	$0	$2,413,320	$3,378,648	$4,343,976	1547
HOLLYGROVE	OM5	$0	$5,893,680	$0	$2,946,840	$4,125,576	$5,304,312	1889
IBERVILLE	OM5	$0	$2,499,120	$0	$1,249,560	$1,749,384	$2,249,208	801
IRISH CHANNEL	OM5	$0	$5,968,560	$0	$2,984,280	$4,177,992	$5,371,704	1913
LAKE CATHERINE	NOE1	$0	$1,310,400	$1,965,600	$3,276,000	$1,179,360	$1,310,400	420
LAKE TERRACE & OAKS	OM1	$0	$2,049,832	$5,124,580	$7,174,413	$1,844,849	$2,049,832	657
LAKE TERRACE & OAKS	OM2	$0	$2,184	$0	$1,092	$1,965	$2,184	1
LAKESHORE - LAKE VISTA	OM1	$0	$20,864	$52,161	$73,025	$18,778	$20,864	7
LAKESHORE - LAKE VISTA	OM2	$0	$1,800,439	$0	$900,219	$1,620,395	$1,800,439	577
LAKEVIEW	OM2	$0	$7,356,960	$0	$3,678,480	$6,621,264	$7,356,960	2358
LAKEWOOD	OM2	$0	$1,334,076	$0	$667,038	$1,200,668	$1,334,076	428
LAKEWOOD	OM5	$0	$423,193	$0	$211,596	$296,235	$380,874	136
LEONIDAS	OM5	$0	$10,873,200	$0	$5,436,600	$7,611,240	$9,785,880	3485
LITTLE WOODS	NOE5	$0	$35,521,200	$88,803,000	$124,324,200	$31,969,080	$35,521,200	11385
LOWER GARDRN DIST	OM5	$0	$13,400,400	$0	$6,700,200	$9,380,280	$12,060,360	4295
MARIGNY	OM3	$0	$6,575,450	$3,287,725	$9,863,174	$5,917,905	$6,575,450	2108
MARIGNY	OM5	$0	$15,698	$0	$7,849	$10,989	$14,128	5
MARLYVILLE - FONTAINBLEAU	OM5	$0	$8,586,240	$0	$4,293,120	$6,010,368	$7,727,616	2752
McDONOGH	OW2	$3,996,720	$11,990,160	$9,991,800	$13,988,520	$2,797,704	$3,597,048	1281
MID-CITY	OM2	$0	$7,355	$0	$3,677	$6,619	$7,355	2
MID-CITY	OM5	$0	$11,834,241	$0	$5,917,120	$8,283,969	$10,650,817	3793
MILAN	OM5	$0	$8,480,160	$0	$4,240,080	$5,936,112	$7,632,144	2718
MILNEBURG	OM1	$0	$4,187,040	$10,467,600	$14,654,640	$3,768,336	$4,187,040	1342
NAVARRE	OM2	$0	$3,589,331	$0	$1,794,665	$3,230,398	$3,589,331	1150
NAVARRE	OM5	$0	$801	$0	$400	$561	$721	0
NEW AURORA - ENGLISH TURN	OW1	$5,973,786	$17,921,359	$2,986,893	$8,960,679	$4,181,650	$5,376,408	1915
NEW AURORA - ENGLISH TURN	OW2	$2,639,662	$7,918,986	$6,599,155	$9,238,817	$1,847,763	$2,375,696	846
PINES VILLAGE	NOE5	$0	$3,622,320	$9,055,800	$12,678,120	$3,260,088	$3,622,320	1161
PLUM ORCHARD	NOE5	$0	$4,389,840	$10,974,600	$15,364,440	$3,950,856	$4,389,840	1407
PONTCHARTRAIN PARK	OM1	$0	$1,581,840	$3,954,600	$5,536,440	$1,423,656	$1,581,840	507

		Pumps at 50%						
Neighborhood	Basin	2% event		1% event		0.2% event		USPS
READ BLVD EAST	NOE5	$0	$7,197,840	$17,994,600	$25,192,440	$6,478,056	$7,197,840	2307
READ BLVD WEST	NOE5	$0	$3,978,000	$9,945,000	$13,923,000	$3,580,200	$3,978,000	1275
SEVENTH WARD	OM3	$0	$14,943,332	$7,471,666	$22,414,997	$13,448,998	$14,943,332	4790
SEVENTH WARD	OM5	$0	$806,976	$0	$403,488	$564,883	$726,279	259
ST. ANTHONY	OM1	$0	$4,352,400	$10,881,000	$15,233,400	$3,917,160	$4,352,400	1395
ST. BERNARD AREA	OM1	$0	$1,310,400	$3,276,000	$4,586,400	$1,179,360	$1,310,400	420
ST. CLAUDE	OM3	$0	$10,221,120	$5,110,560	$15,331,680	$9,199,008	$10,221,120	3276
ST. ROCH	OM1	$0	$211,537	$528,844	$740,381	$190,384	$211,537	68
ST. ROCH	OM3	$0	$5,116,256	$2,558,128	$7,674,383	$4,604,630	$5,116,256	1640
ST. THOMAS DEV	OM5	$0	$2,689,440	$0	$1,344,720	$1,882,608	$2,420,496	862
TALL TIMBERS - BRECHTEL	OW2	$14,695,200	$44,085,600	$36,738,000	$51,433,200	$10,286,640	$13,225,680	4710
TOURO	OM5	$0	$5,466,240	$0	$2,733,120	$3,826,368	$4,919,616	1752
TREME - LAFITTE	OM5	$0	$7,147,920	$0	$3,573,960	$5,003,544	$6,433,128	2291
TULANE - GRAVIER	OM5	$0	$3,859,440	$0	$1,929,720	$2,701,608	$3,473,496	1237
UPTOWN	OM5	$0	$9,990,240	$0	$4,995,120	$6,993,168	$8,991,216	3202
VIAVANT	NOE1	$0	$350,652	$525,978	$876,630	$315,587	$350,652	112
VIAVANT	NOE2	$0	$288,226	$1,008,792	$1,297,018	$259,404	$288,226	92
VIAVANT	NOE3	$0	$120,603	$301,507	$422,110	$108,543	$120,603	39
VIAVANT	NOE4	$0	$142,996	$214,494	$357,490	$128,696	$142,996	46
VIAVANT	NOE5	$0	$51,865	$129,662	$181,527	$46,678	$51,865	17
VILLAGE DE LEST	NOE1	$0	$477,950	$716,925	$1,194,875	$430,155	$477,950	153
VILLAGE DE LEST	NOE2	$0	$493,971	$1,728,898	$2,222,869	$444,574	$493,971	158
VILLAGE DE LEST	NOE3	$0	$314,218	$785,545	$1,099,764	$282,796	$314,218	101
VILLAGE DE LEST	NOE5	$0	$32,392	$80,979	$113,370	$29,152	$32,392	10
WEST END	OM2	$0	$4,714,320	$0	$2,357,160	$4,242,888	$4,714,320	1511
WEST LAKE FOREST	NOE5	$0	$4,364,880	$10,912,200	$15,277,080	$3,928,392	$4,364,880	1399
WEST RIVERSIDE	OM5	$0	$8,486,400	$0	$4,243,200	$5,940,480	$7,637,760	2720
WHITNEY	OW2	$3,104,400	$9,313,200	$7,761,000	$10,865,400	$2,173,080	$2,793,960	995

These figures are based on preliminary data about the value of structures in the Parish. It should also be noted that the USPS data that indicates the numbers of properties that are currently receiving mail does not account for all structures in the Parish that could potentially be flooded in the future, because there are a significant number of structures that are presently unoccupied that could nevertheless be damaged by another major surge event. These loss estimates do not currently consider the value of displacement and disruption, which may be considered as a part of a FEMA-based risk assessment or benefit-cost analysis. Including displacement and disruption costs will add approximately 50 percent to the value of losses to the average structure in the Parish (with some variation based on size, etc.). Although these calculations are not site-specific, and thus cannot be used as the basis for decisions about mitigation on individual sites, they can nevertheless be used for overall estimates of potential benefits of mitigation across neighborhoods, or as the basis for determining scenario-based risks to average properties (by dividing the loss estimates by the number of structures in the neighborhoods).

The next two figures compare the IPET basin loss ranges to a calculation of potential flooding using a LIDAR-based depth grid. Both of the figures are based on a 0.20-percent-annual-probability event, with 50-percent pumping effectiveness.

Figure 7-36
New Orleans Area, Percentage Chance of Total Property Value Lost,
0.2-percent Annual Return Frequency Event, Post-Katrina (2007 HPS), Pumping at 50-percent Effectiveness

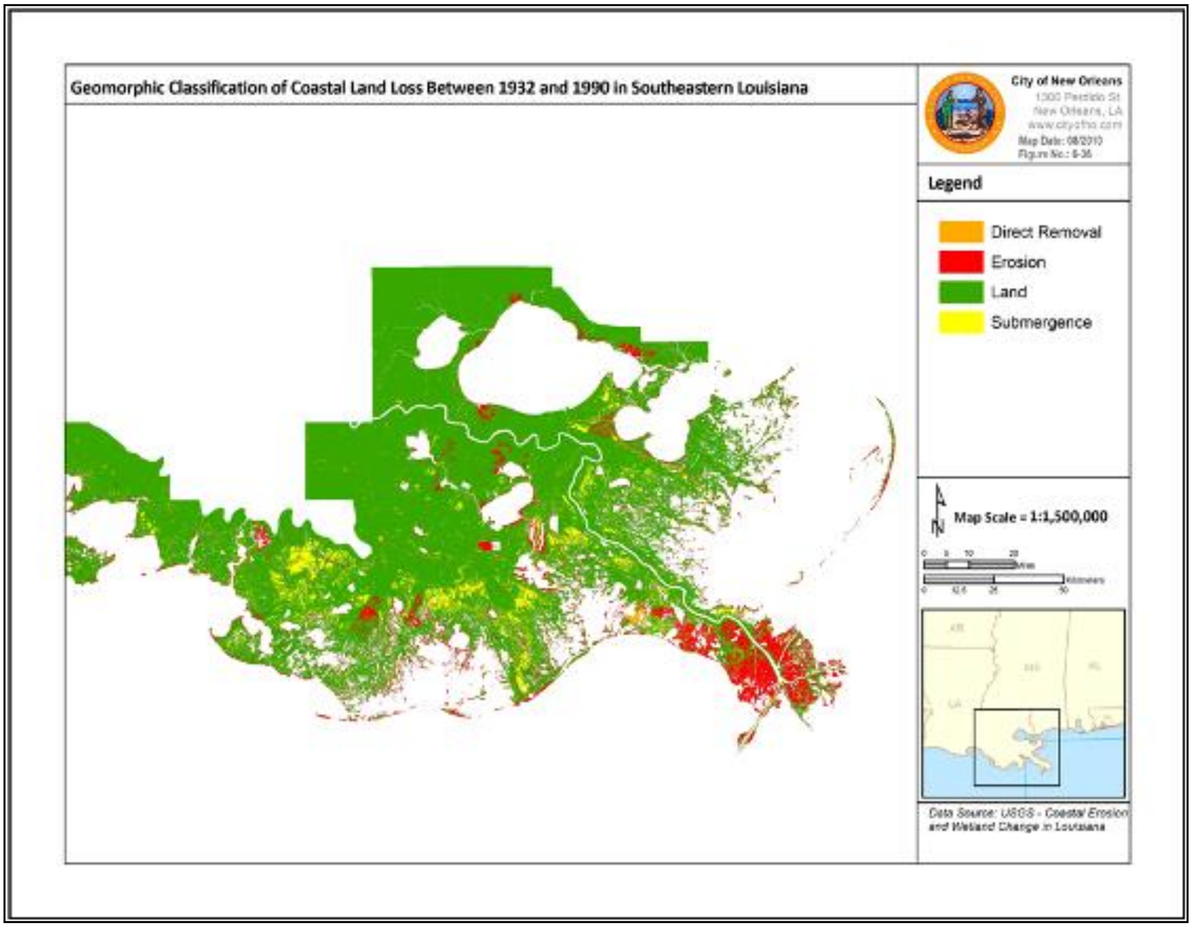
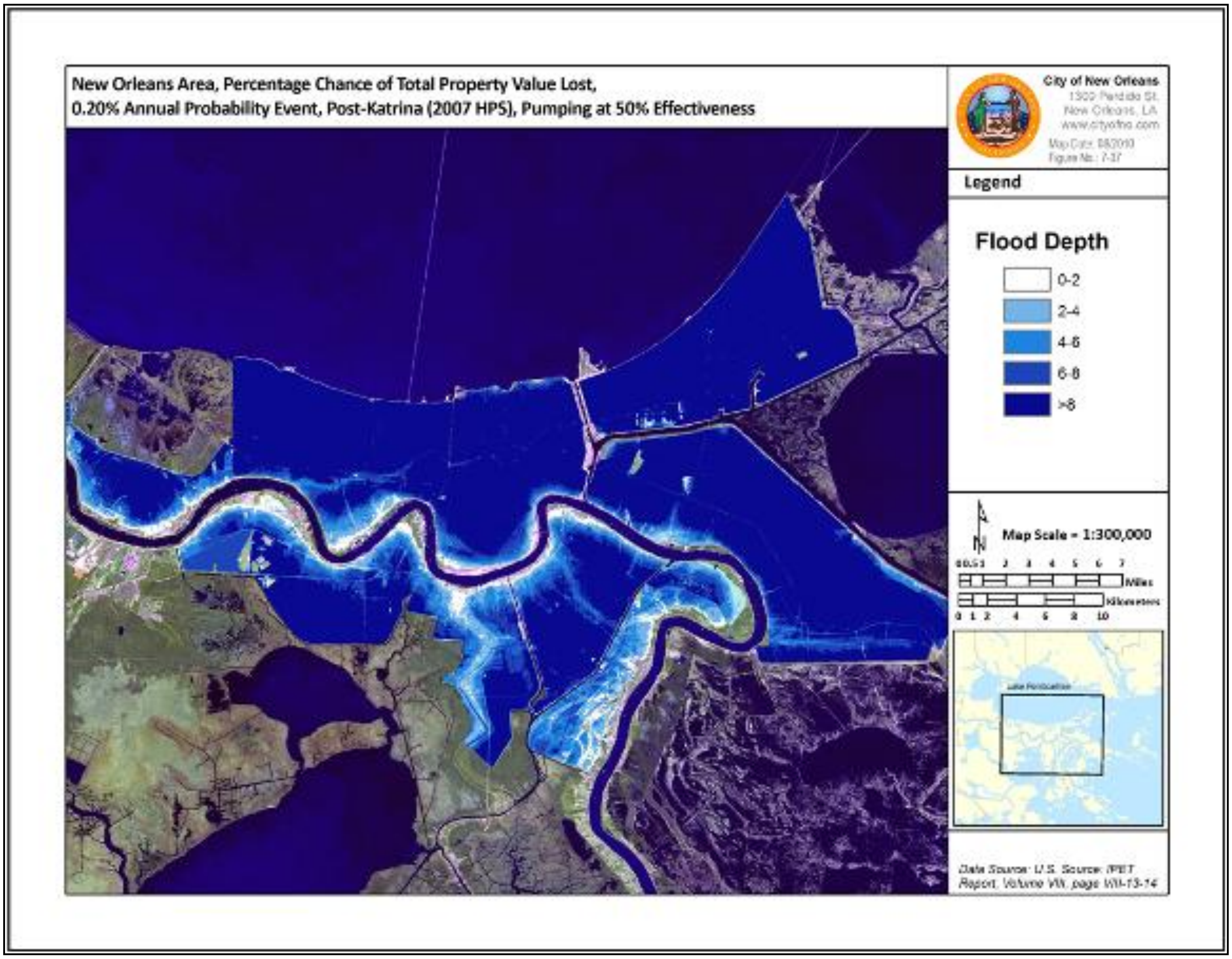


Figure 7-37
New Orleans Area, Percentage Chance of Total Property Value Lost,
0.20-percent Annual Probability Event, Post-Katrina (2007 HPS), Pumping at 50-percent Effectiveness



Flooding and Loss Estimates from Non-Surge Events

Table 7-13 summarizes the repetitive loss claims data for some of the major rainfall flooding events in Orleans Parish. With the exception of Hurricane Rita in 2005, the levee systems (mainly the Lake Pontchartrain and Vicinity system) in the greater New Orleans area prevented significant storm surge flooding from many of these events. Hurricane Rita is included in this Table given that the main levee breach in New Orleans from Rita predominately caused flooding to an area of the Lower Ninth Ward that had already flooded severely during Hurricane Katrina. This is supported by the RL claims data from Rita which indicates that only three RL claims were filed within the Lower Ninth Ward. Therefore, with the exception of a few claims, the flood damages that occurred due to the levee breach in the Lower Ninth Ward after Rita was predominately already captured under the claims filed after Hurricane Katrina. Note that the RL claims for Hurricane Katrina are excluded from this table, since the overwhelming majority of the flooding was associated with storm surge. For each event, the Table includes the number of claimants as well as building, contents, and total paid claims, and the average paid claim per property. All eight events listed in Table 7-13 resulted in a major Presidential Disaster Declaration.

The Table 7-14, sorts the major flood events by total paid RL claims. Sorting the flood events by total paid claims highlights the events with the greatest losses (in dollars) for RL properties in Orleans Parish. The Table indicates that the May 9, 1995 flood event was ranked highest with a total of $7,536,225 paid claims. To provide some perspective as to the overwhelming RL claims in Orleans Parish from Hurricane Katrina, the total for this event represents only slightly more than 1.5 percent of the total RL claims value of $454,410,464 from Katrina.

Table 7-20 Repetitive Loss Claims for Major Flood Events in Orleans Parish, 1978 – 2009, Ordered by Event Date
(Source: FEMA / NFIP Query September, 2009)

Event Description / Name	Loss Dates	FEMA DR #	# of Claims	Building	Contents	Total Paid Claims ($)	Average
Severe Storms, Flooding	May 3, 1978	DR-556	225	$1,084,881	$407,834	$1,492,940	$6,635
Severe Storms, Flooding	April 13, 1980	DR-616	222	$943,976	$460,952	$1,405,150	$6,330
Severe Storms, Flooding	April 6-7, 1983	DR-679	572	$2,449,972	$1,515,286	$3,965,830	$6,933
Severe Storms, Flooding	May 9, 1995	DR-556	402	$5,119,667	$2,416,157	$7,535,823	$18,747
Tropical Storm Frances	September 11-12, 1998	DR-1246	396	$3,251,233	$1,551,210	$4,802,838	$12,128
Tropical Storm Allison	June 5-12, 2001	DR-1380	40	$206,698	$49,942	$256,679	$6,417
Hurricane Rita	September 24 - 29, 2005	DR-1603	65	$3,295,987	$704,156	$4,000,208	$61,542
Hurricane Gustav	September 1, 2008	DR-1786	168	$2,782,741	$1,351,923	$4,134,832	$24,612
Grand Total	**-----**	**-----**	**2,090**	**$19,135,153**	**$8,457,458**	**$27,594,702**	**$13,203**

Table 7-21 Repetitive Loss Claims for Major Flood Events in Orleans Parish, 1978 – 2009, Ordered by Total Paid Claims
(Source: FEMA / NFIP Query September, 2009)

Event Description / Name	Loss Dates	FEMA DR #	# of Claims	Building	Contents	Total Paid Claims ($)	Average
Severe Storms, Flooding	May 9, 1995	DR-1049	402	$5,119,667	$2,416,157	$7,536,225	$18,747
Tropical Storm Frances	September 11-12, 1998	DR-1246	396	$3,251,233	$1,551,210	$4,802,838	$12,128
Hurricane Gustav	September 1, 2008	DR-1786	168	$2,782,741	$1,351,923	$4,134,832	$24,612
Hurricane Rita	September 24 - 29, 2005	DR-1603	65	$3,295,987	$704,156	$4,000,208	$61,542
Severe Storms, Flooding	April 6-7, 1983	DR-679	572	$2,449,972	$1,515,286	$3,965,830	$6,933
Severe Storms, Flooding	May 3, 1978	DR-556	225	$1,084,881	$407,834	$1,492,940	$6,635
Severe Storms, Flooding	April 13, 1980	DR-616	222	$943,976	$460,952	$1,405,150	$6,330
Tropical Storm Allison	June 5-12, 2001	DR-1380	40	$206,698	$49,942	$256,679	$6,417
Grand Total	**-----**	**-----**	**2,090**	**$19,135,153**	**$8,457,458**	**$27,594,702**	**$13,203**

This historical NFIP repetitive loss claims data can then be used to estimate annual flood damages and event return frequencies, using the FEMA Benefit-Cost Analysis Tool (version 4.5.5). The data entries are shown in Figure 7-38 below, and correspond to the losses shown in the tables above. The model is calibrated in part on the assumed construction date of structures that are in the NFIP claims data set. This information is not in the claims data, so for the purpose of this analysis it is assumed that the earliest construction date is approximately 1920.

Figure 7-38
Damage-Frequency Assessment using Historical Non-Surge NFIP Repetitive Loss Claims Records
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5)

HISTORIC DAMAGES BEFORE MITIGATION

Analysis year *	2010	Analysis Duration	91	Utilities ($/day)	$ 0.00
Year Built *	1920	User Input Analysis Duration		Buildings ($/day)	$ 0.00
				Roads/Bridges ($/day)	$ 0.00

HISTORIC DAMAGES BEFORE MITIGATION *

To add columns, click the column icon at the upper left corner of the table. All damages are in dollars.

Damage Year	Recurrence Interval (RI)	Damages ($)	Are damages in current dollars?	Total	Total Inflate
1978		$1,492,940	No	$1,492,940	$4,735,345
1980		$1,405,150	No	$1,405,150	$3,822,159
1983		$3,965,830	No	$3,965,830	$8,588,068
1995		$7,535,823	No	$7,535,823	$12,128,09
1998		$4,802,838	No	$4,802,838	$7,143,400
2001		$256,679	No	$256,679	$356,813
2005		$4,000,208	No	$4,000,208	$4,730,308
2008		$4,134,832	No	$4,134,832	$4,310,496
*			No		

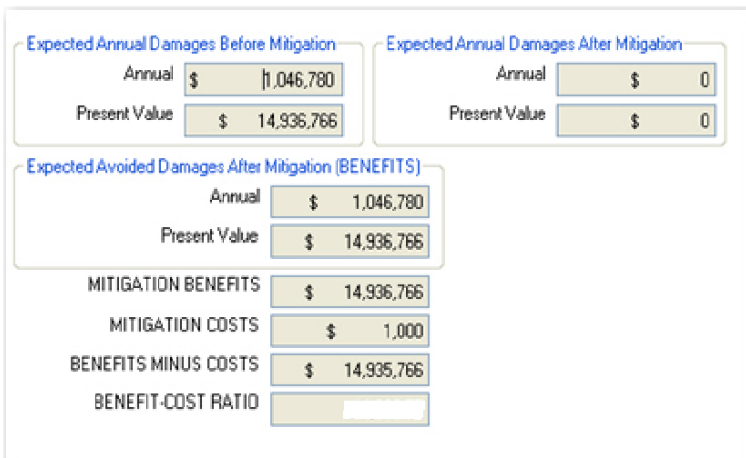
The next Figure (7-39) shows a series of event frequencies as calculated by the BCAT software. Note that the number of events differs from the above due to a statistical routine in the software.

Figure 7-39
Derived Frequencies of Non-Surge Flood Events, based on NFIP Repetitive Flood Insurance Claims Records.
(Source: FEMA Benefit-Cost Analysis Tool, Version 4.5.5)

Recurrence Interval (yr)	Total Damages And Losses	Annualized Damages And Losses
11.5	$356,813	$12,403
13.1	$3,822,159	$94,883
18.6	$4,622,899	$121,771
30.7	$7,143,400	$84,859
46	$8,588,068	$110,932
92	$12,128,098	$131,826
Total Annualized Damages		
		$556,674.00

The FEMA software can then be used to estimate expected annual (non-surge) flood losses, as shown in Figure 7-40, below. Note that the projection is based on insurance claims. Because of this, the data set necessarily undercounts actual damages from the events because uninsured properties (and properties that were insured but did not file claims) are not represented. Annual damages and expected damages over a 100-year planning horizon are shown in the screen section labeled "Expected Avoided Damages After Mitigation (Benefits)". Note that the cell titled *Mitigation Costs* is simply a placeholder in the analysis. Neither that figure nor the *Benefit-Cost Ratio* have an effect on the estimated loss calculation.

Figure 7-40
Estimated Annual Non-Surge Flood Damages over a 100-year Planning Horizon, based on NFIP Repetitive Flood Claims Records
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5)



***Note: Mitigation cost includes as a placeholder – the BCR is not applicable.

Flood Risk to Residential Properties

Residential flood risk is calculated by a methodology that uses the NFIP claims history in conjunction with FEMA default present-value coefficients from the benefit-cost analysis software modules. To perform this calculation, the repetitive loss data were reviewed to determine an approximate period over which the claims occurred. This is not an exact method because there are numerous properties in the database, and insurance policies come into force at different times, and are cancelled and reinstated periodically. These variables are not part of the query output. Review of the repetitive loss claims data for Orleans Parish indicates that the claim dates are spread out fairly even since Orleans Parish joined the NFIP in 1978 and the date of the database query (September 2009), a period of 31 years.

As shown in Table 7-15, there have been 20,526 residential claims in this 31-year period, for an average number of claims per year of 662. Based on a 100-year planning horizon and a present value coefficient of 14.27 (the coefficient for a 100-year planning horizon using the mandatory Office of Management and Budget (OMB) discount rate of 7 percent), the projected flood risk to these properties is calculated, and shown at the bottom of the table. It must be understood that individuals can obtain and cancel flood insurance policies, and the flood hazard depends on many variables, including the weather, so this projection is simply an estimate of potential damages. Nevertheless, it offers a useful metric that can be used in assessing the potential cost effectiveness of mitigation actions. It should be clearly understood that a single event (Hurricane Katrina) predominates the underlying data, which introduces additional uncertainty into the risk projection.

Table 7-22
Projected 100-year Flood Risk in Orleans Parish
Repetitive Loss Areas
(Source: FEMA / NFIP Query September 2009)

Data	Value
Period in years	31
Number of claims	20,526
Average claims per year	662
Total value of claims	$675,976,245
Average value of claims per year	$21,805,685
Projected risk, 100-year horizon	$311,167,129

The next Table (7-16) shows risk projections for the three streets that appear to have the most risk in Orleans Parish, based on NFIP repetitive loss records. These projections are done in the same manner as the calculation described above. The three streets analyzed include Octavia Street, Napoleon Avenue and Jefferson Avenue. Based on this methodology, Octavia Street appears to the highest long-term risk of any street in Orleans Parish. The projected 100-year risk for Octavia Street is calculated at **$11,882,144**. Octavia Street is followed by Napoleon and Jefferson Avenue, which both are somewhat similar in terms of the numbers of claims, average amount of claims and projected risk. These risk figures are a good basis for determining the total amount that can be spent (either overall, or per typical property) on mitigation actions, although ultimately cost-effectiveness is also a function of the risk-reduction effectiveness and useful life of the project.

Table 7-23
Projected 100-year Flood Risk, Select Streets in Orleans Parish with
Highest Number of Residential Repetitive Flood Loss Claims in NFIP Database
(Source: FEMA / NFIP, Query September 2009)

Octavia Street	
Total number of paid claims	817
Average number of paid claims per year	26.3
Total value of claims	$25,812,659
Average value of paid claims per year	$832,666
Projected risk, 100-year horizon	$11,882,144
Number of claimants	134
Projected risk per policy, 100-year horizon	$88,673
Napoleon Avenue	
Total number of paid claims	432
Average number of paid claims per year	13.9
Total value of paid claims	$11,487,787
Average value of paid claims per year	$370,574

Projected risk, 100-year horizon	$5,288,091
Number of claimants	68
Projected risk per policy, 100-year horizon	$77,766
Jefferson Avenue	
Total number of paid claims	426
Average number of paid claims per year	13.7
Total value of paid claims	$11,327,161
Average value of paid claims per year	$365,392
Projected risk, 100-year horizon	$5,214,148
Number of claimants	75
Projected risk per policy, 100-year horizon	$69,522

Flood Risk to Non-Residential Properties

As with the residential flood loss history, the past claims information can be used to project future flood losses for non-residential RL properties, as shown in Table 7-17 below. The methodology is the same as what is described above in the residential section. This Table shows the projected 100-year risk for the 36 Orleans Parish neighborhoods that have 10 or more non-residential RL claims. Neighborhoods with less than 10 claims were considered to have insufficient claims history for this methodology to be valid. The results in Table 7-17 show that the projected 100-year risk is highest in the Central Business District (CBD). The projected risk over a 100 year planning horizon is **$8,677,575** for the CBD. This is approximately 80-percent higher than Mid-City, the neighborhood ranked second.

Table 7-24
Projected 100-year Flood Risk, Select Non-Residential Repetitive Loss Neighborhoods in Orleans Parish, ordered by 100-year risk
(Source: FEMA / NFIP, Query September, 2009)

Neighborhood Name	Properties	Total Claims ($)	# of Claims	Average Annual	100-year risk
Central Business District	87	$18,851,073	277	$608,099	$8,677,575
Mid-City	49	$10,547,796	158	$340,251	$4,855,388
Desire Area	15	$8,225,197	36	$265,329	$3,786,244
Central City	55	$5,535,658	173	$178,570	$2,548,188
Gert Town	22	$5,127,678	90	$165,409	$2,360,386
St. Roch	30	$4,757,795	147	$153,477	$2,190,121
Tremé/Lafitte	31	$4,299,550	122	$138,695	$1,979,180
Milan	38	$3,577,911	169	$115,416	$1,646,993
Lake Catherine	6	$3,053,058	27	$98,486	$1,405,391
Tulane/Gravier	17	$2,741,706	52	$88,442	$1,262,069
West End	12	$2,596,497	46	$83,758	$1,195,226
Bayou St. John	17	$2,572,941	61	$82,998	$1,184,383

Neighborhood Name	Properties	Total Claims ($)	# of Claims	Average Annual	100-year risk
Audubon	12	$2,541,734	45	$81,991	$1,170,017
Seventh Ward	14	$2,344,583	54	$75,632	$1,079,265
Touro	16	$2,155,967	84	$69,547	$992,440
West Lake Forest	5	$1,527,977	10	$49,290	$703,362
Freret	11	$1,445,819	33	$46,639	$665,543
Lower Ninth Ward	11	$1,360,320	37	$43,881	$626,186
Dixon	6	$1,228,157	19	$39,618	$565,349
Lower Garden District	10	$1,045,889	29	$33,738	$481,446
St. Claude	10	$971,151	28	$31,327	$447,043
Behrman	5	$922,014	13	$29,742	$424,424
Viavant/Venetian Isles	10	$812,983	27	$26,225	$374,234
Pines Village	5	$610,934	13	$19,708	$281,226
Broadmoor	11	$558,823	36	$18,027	$257,239
Bywater	3	$521,287	11	$16,816	$239,960
French Quarter	13	$520,807	35	$16,800	$239,739
Old Aurora	4	$498,418	15	$16,078	$229,433
Hollygrove	6	$375,358	21	$12,108	$172,786
Uptown	7	$365,068	17	$11,776	$168,049
Florida Area	8	$349,094	26	$11,261	$160,696
Holly Cross	5	$309,714	13	$9,991	$142,568
Marigny	6	$303,808	17	$9,800	$139,850
Leonidas	11	$257,451	28	$8,305	$118,510
Irish Channel	2	$242,015	13	$7,807	$111,405
U.S. Naval Support Area	5	$60,987	11	$1,967	$28,074
Grand Total	**605**	**$99,001,040**	**2,087**	**------**	**-----**

Note: Neighborhoods with less than 10 losses (claims) have insufficient claims history for this calculation methodology to be valid.

Severe Repetitive Loss Properties

In 2004, FEMA began to develop the Severe Repetitive Loss (SRL) Grant Program in an effort to reduce or eliminate flood damages to residential properties that met certain minimum requirements. FEMA initiated the program early in 2008. As mentioned earlier, an SRL property is defined by FEMA as a property that is covered under an NFIP flood insurance policy and:

(a) "That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
(b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building."[16]

A link to the severe repetitive loss program is provided below.
http://www.fema.gov/government/grant/srl/index.shtm

As of January 2010, Orleans Parish had 5,972 properties on the NFIP Severe Repetitive Loss (SRL) list. NFIP Severe Repetitive Flood Loss properties are found in 71 Parish neighborhoods, although it should be recognized that both the overall number of SRL properties in the Parish and the numbers in specific neighborhoods are subject to change based on the technical definition of severe repetitive loss, and on the fact that some structures may no longer be present. As of the date of the query, the Broadmoor neighborhood had the highest number of SRL properties at 617, followed by Audubon with 461. As part of its start up of the SRL grant program, FEMA provided states with actuarial risk calculations (to show the maximum benefits of mitigation) for 30-year and 100-year planning horizons. The data provided by FEMA includes more details about claims histories at the policy level, but that information is not included here because of data confidentiality restrictions.

The columns labeled "30-year Risk" and "100-year Risk" show the expected future losses over those respective planning horizons, for the two streets in Union County that include an SRL property. As noted, the FEMA/NFIP calculations include these figures on the level of individual addresses and policies. It should be noted that the FEMA methodology does not express a complete range of potential risk (and benefits if the data is used in a Benefit-Cost Analysis (BCA) for a mitigation project), so individual properties should not be dropped from consideration for mitigation based solely on this calculation. More extensive risk assessment and benefit-cost analysis would include additional loss calculations that would likely increase the apparent risk along with the concomitant benefits of reducing or eliminating it.

[16] FEMA. Severe Repetitive Loss Program – Program Overview. (online)

Table 7-25
FEMA NFIP Actuarial Calculation of Potential Maximum Benefits for Mitigating SRL Properties in Orleans Parish, ordered alphabetically by Neighborhood Name
This table will be populated when the data is available from FEMA Region VI
(Source: FEMA/NFIP, Query XXX 20XX)

Neighborhood Name	Street Name	Paid Claims	Cumulative Claims	30-year Risk	100-year Risk

The series of maps below display information about the SRL properties in Orleans Parish. The first map (Figure 7-41) highlights the numbers of insurance claims by property. The second map (Figure 7-42) shows the cumulative amounts of insurance claims for the same properties.

Figure 7-41
Number of NFIP Flood Insurance Claims Per Severe Repetitive Loss Property in Orleans Parish
(Source: FEMA/NFIP Query September, 2009)

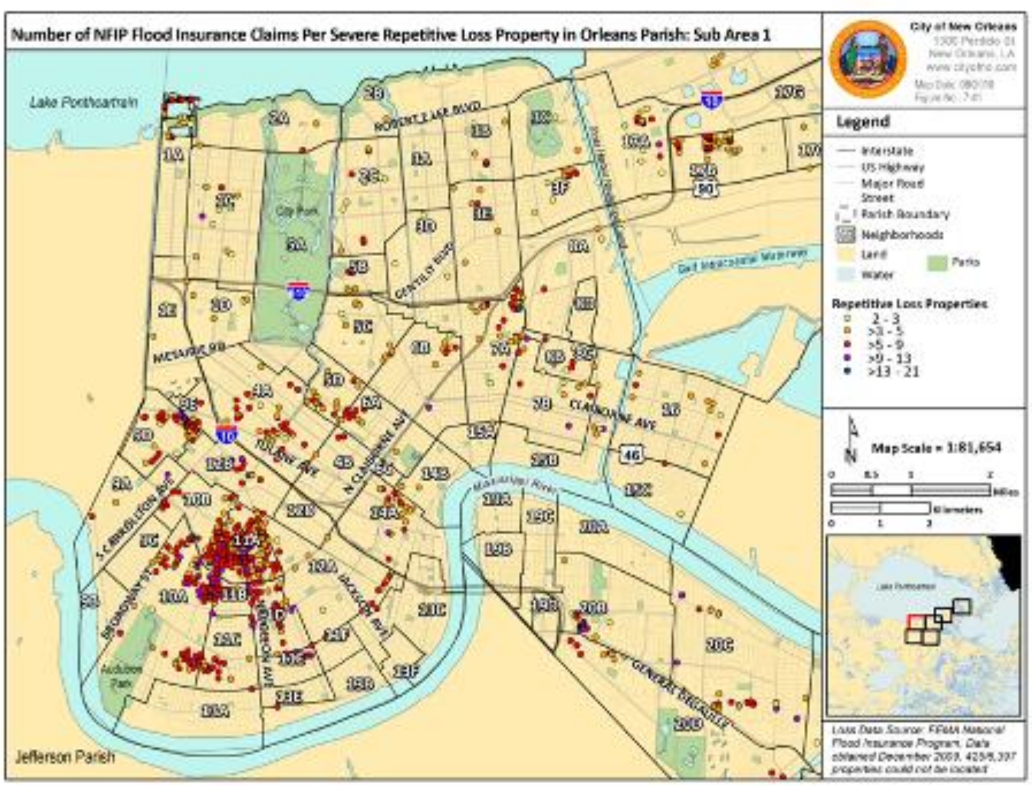
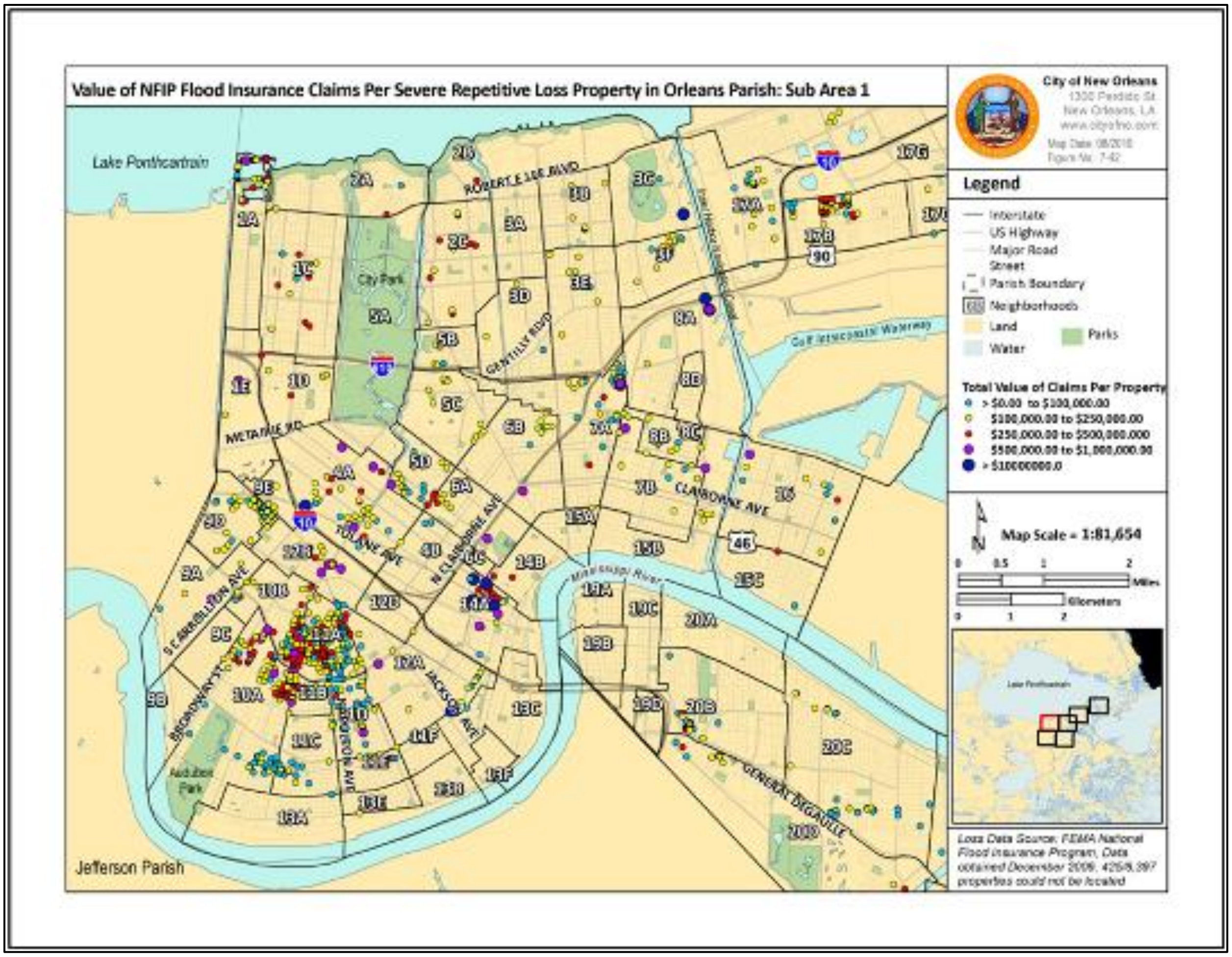


Figure 7-42
Value of NFIP Flood Insurance Claims Per Severe Repetitive Loss Property in Orleans Parish
(Source: FEMA/NFIP Query September, 2009)



Hurricane Katrina

As mentioned previously, Hurricane Katrina in August 2005 had a substantial and widespread impact on the NFIP. Statistics from the General Accounting Office (GAO) in a 2006 report to Congressional Committees indicated both the number of claims paid and the value of claims payments from Katrina were unprecedented.

As of May 2006, with over 95 percent of the reported claims closed by FEMA, the NFIP had paid approximately 135,000 claims in Louisiana. As of July 2006, more than 83,500 claims resulted from property damage in the New Orleans area alone, where floodwaters from storm surge breached levees and floodwalls. As of May 2006, the NFIP had paid approximately 162,000 flood damage claims from Hurricane Katrina in the States of Alabama, Florida, Mississippi and Louisiana.[17]

In 2006, FEMA projected that claims from NFIP policyholders who suffered flood damage from Hurricanes Katrina and Rita will total more than $20 billion (this includes claims in States other than Louisiana). In contrast, the NFIP reports that from its inception in 1968 until August 2005, it had paid a cumulative total of about $14.6 billion in claims.

The average amount paid per claim for Hurricane Katrina flood damages (approximately $94,800) was about three times the average paid per claim in 2004, the previous record year. Paid claims in Louisiana accounted for about $12.8 billion of the total estimated $20 billion in claims the NFIP is expecting from Hurricanes Katrina and Rita.

Data included in the NFIP query of past repetitive loss claims for Orleans Parish from September, 2009 can be isolated to identify the claims that were the direct result of Hurricane Katrina. To isolate the RL claims from Katrina, the query was sorted by loss date to include the dates from August 28 – September 2, 2005. The September 2009 query indicates a total of 3,733 repetitive loss claims (or properties) paid in Orleans Parish as a result of Katrina. This total represents 4.4 percent of the estimated 83,500 NFIP claims in Orleans Parish from Hurricane Katrina. Table 7-19 summarizes the RL claims from Hurricane Katrina. The Table shows that claims for RL properties totaled $454,410,464. The Table also shows the average paid claim per policy was $121,728. This average per claim is 28-percent higher than the average Katrina claim payment for non repetitive loss properties.

Table 7-26
Summary of Hurricane Katrina Residential and Non-Residential NFIP Repetitive Loss Statistics, Orleans Parish
(Source: FEMA/NFIP Query September 2009)

Repetitive Loss Category	# of Properties	Building	Contents	Total Paid Claims	Average
Residential	3,490	$327,970,730	$72,902,997	$400,873,728	114,864
Non-Residential	243	$35,828,948	$17,707,787	$53,536,736	220,316
Grand Total	**3,733**	**$363,799,678**	**$90,610,784**	**$454,410,464**	**$121,728**

The repetitive loss claims for Katrina can also be compared to the overall dataset of RL claims for Orleans Parish. Table 7-20 compares the RL statistics from Hurricane Katrina to the cumulative claims in Orleans Parish between 1978 and September 2009. The Table shows that the number of residential RL properties and total paid claims from Katrina represents approximately two-thirds of the total cumulative paid claims. Although the figure is significantly

[17] US Government Accountability Office (GAO) Report to Congressional Committees. National Flood Insurance Program (NFIP). New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should be Improved. December, 2006

lower for non-residential properties, the total paid claims from Katrina represents slightly more than half of the cumulative paid claims in Orleans Parish.

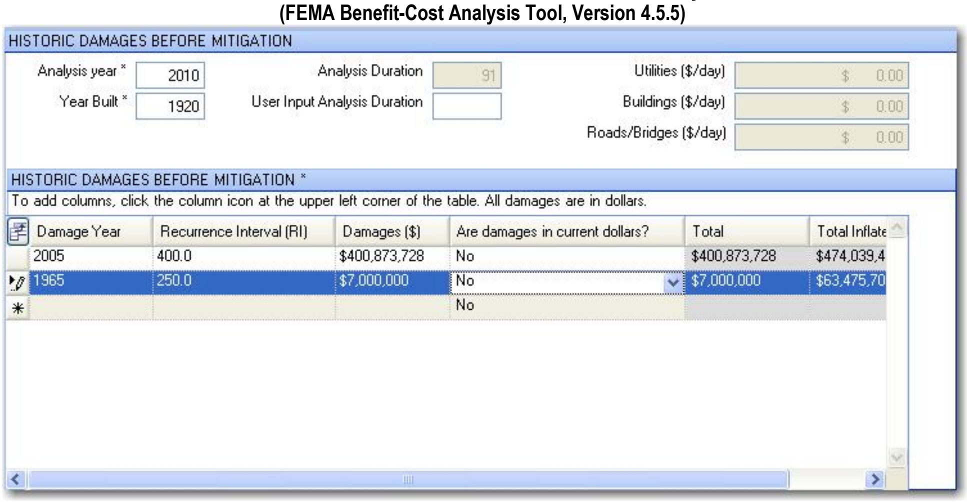
Table 7-27
Comparison of Hurricane Katrina Repetitive Loss (RL) Claims to Cumulative RL Claims, Orleans Parish
(Source: FEMA/NFIP Query September 2009)

	Cumulative RL Claims 1978 – Sept. 2009		Hurricane Katrina – RL Claims			
Repetitive Loss Category	# of Properties	Total Paid Claims	# of Properties	Total Paid Claims	% of Properties	% of Total Paid Claims
Residential	5,137	$574,318,900	3,490	$400,873,728	67.9%	69.7%
Non-Residential	637	$101,657,345	243	$53,536,736	38.1%	52.6%
Grand Total	**5,774**	**$675,976,245**	**3,733**	**$454,410,464**	**64.6%**	**67.2%**

The NFIP repetitive loss records from Hurricane Katrina can then be used as the basis for a statistical projection of risks associated with storm surge, using Katrina as the calibrating event, i.e. the event for which the frequency vs. damage relationship is established. The planning team reviewed a variety of technical reports to establish the frequency of Katrina for this projection. It should be noted that there is a difference between the estimated frequencies of Katrina with respect to surge, versus frequency based on wind speeds. Based on a review of the February, 2008 report titled *Louisiana Coastal Protection and Restoration (LACPR) Technical Report (Draft),* a surge return frequency of 400 years (a 0.25-percent annual chance) was selected for this estimate. This frequency estimate comports with frequency estimates in various other reports. It should be noted that this refers to the surge frequency *only,* not the estimated return frequency of the Katrina wind event, which is much lower than the surge frequency.

To calculate the annual risk and risk over a 100-year planning horizon, the repetitive flood loss claims total for the residential and non-residential RL damages from Katrina were entered into the FEMA BCAT software at the 400-year return frequency. The software requires damages from an additional event to calibrate the analysis, so loss figures from Hurricane Betsy were derived and used in the estimate. Based on the ratio of RL claims to estimated total losses from Hurricane Katrina, the estimated residential losses from Betsy were approximately $7,000,000 (this is an estimated figure because Betsy occurred well before the establishment of the National Flood Insurance Program).

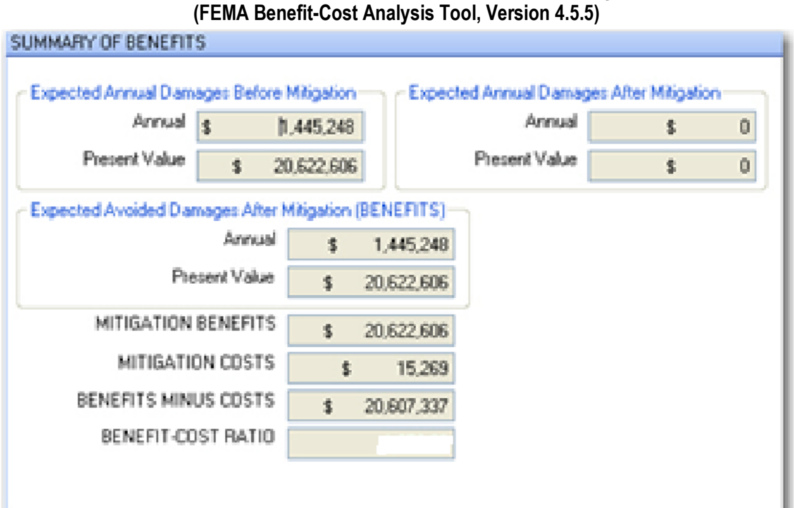
Figure 7-43
Damage-Frequency Assessment using Claims Information from Hurricane Katrina and Estimated Loss Data from Hurricane Betsy
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5)



Using these inputs, the software estimates expected annual surge losses for insured repetitive loss properties at $1,445,248, and losses over a 100-year planning horizon at $20,622,606. It should be noted that this estimate is based on NFIP records for repetitive loss properties only, and by definition underestimates the risk, because not all properties in the Parish were insured at the time of Katrina (and therefore losses to uninsured properties are not represented).

Note that the cell titled *Mitigation Costs* is simply a placeholder in the analysis. Neither that figure nor the *Benefit-Cost Ratio* has an effect on the estimated loss calculation.

Figure 7-44
Results of Damage-Frequency Assessment using Claims Information from Hurricane Katrina and Estimated Loss Data from Hurricane Betsy
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5)



Analysis of FEMA Project Worksheets (PWs) and Parish Insurance Claims from Hurricanes Katrina and Rita

The Public Assistance (PA) program is the primary vehicle for FEMA funding of repairs to public facilities after disasters. FEMA PA uses a system based on the use of Project Worksheets (PWs, previously called Damage Survey Reports). Project Worksheets are the platform that FEMA inspectors use to document estimated damages in seven categories, as shown below. The FEMA PA categories of work are generally defined as follows:

- Category A: Emergency work, primarily debris clearance.
- Category B: Emergency protective measures.
- Category C: Permanent repair work, roads and bridges.
- Category D: Permanent repair work, water control facilities.
- Category E: Permanent repair work, public buildings.
- Category F: Permanent repair work, utilities.
- Category G: Permanent repair work, parks and recreation facilities.

Table 7-21 summarizes the FEMA PWs by category and applicant for Hurricane Katrina in Orleans Parish. However, it must be noted that the FEMA PWs do not fully account for losses to public facilities. This is because, by law, the FEMA Public Assistance (PA) program deducts any insurance payments from the repair and replacement grant amounts.

Table 7-21(below) is a summary of a more detailed FEMA database of Project Worksheets. The database includes specific information about the location and nature of damages based on post-event FEMA inspections. The summary data can be used by the Parish as one means of identifying general vulnerabilities, by examining categories of damages, where damages have occurred and/or which applicants appear to have the most vulnerability. The FEMA PW data offers an additional perspective on damages to public facilities, particularly if the more detailed information is reviewed. It should be understood that damages alone are not a strong indicator of vulnerabilities, because in many cases facilities that were damaged in prior events have been replaced with stronger facilities or themselves hardened to better resist hazards.

Table 7-28
Hurricane Katrina (DR-1603): Project Worksheet Summary for All Orleans Parish Applicants, by FEMA Public Assistance Program Category
(Source: FEMA Region VI, November 2009)

Applicant Name	Cat. A Emergency Work/Debris	Cat. B Emergency Protective Measures	Cat. C Permanent Repair, roads/bridges	Cat. D Permanent Repair, water control facilities	Cat. E Permanent Repair, public buildings	Cat. F Permanent Repair, utilities	Cat. G Permanent Repair, parks and recreation	Total
Audubon Commission	$426,346	$585,030	$0	$11,901	$8,650,733	$0	$1,633,762	$11,307,773
Delgado Community College	$58,927	$2,700,990	$0	$0	$37,280,466	$0	$554,513	$40,594,896
Dillard University	$0	$56,973,353	$0	$0	$4,607,912	$353,288	$75,443	$62,009,996
Loyola University of New Orleans	$0	$263,622	$0	$0	$547,022	$0	$0	$810,645
New Orleans Chapter National Railway Historical Society	$0	$0	$0	$0	$509,247	$0	$0	$509,247
New Orleans Council on Aging	$0	$0	$0	$0	$90,733	$0	$0	$90,733
New Orleans Health Corporation	$0	$0	$0	$0	$688,496	$0	$0	$688,496
New Orleans Jazz and Heritage Festival Foundation	$0	$33,458	$0	$0		$0	$0	$33,458
New Orleans Museum of Art	$15,400	$1,250,881	$0	$0	$689,080	$0	$0	$1,955,361
New Orleans Parish Aids Task Force	$0	$0	$0	$0	$78,996	$0	$0	$78,996
New Orleans Public Belt Railroad	$67,094	$389,866	$65,894	$0	$673,514	$17,744,955	$0	$18,941,322
New Orleans Sewerage and Water	$3,870,458	$76,324,065	$339,919	$2,227,507	$52,528,723	$279,126,718	$57,623	$414,475,013

Applicant Name	Cat. A Emergency Work/Debris	Cat. B Emergency Protective Measures	Cat. C Permanent Repair, roads/bridges	Cat. D Permanent Repair, water control facilities	Cat. E Permanent Repair, public buildings	Cat. F Permanent Repair, utilities	Cat. G Permanent Repair, parks and recreation	Total
New Orleans Towers	$0	$646,163	$0	$0	$25,000	$0	$0	$671,163
New Orleans, City of	$73,982,617	$212,112,137	$39,597,032	$0	$402,654,217	$4,547,415	$25,777,652	$758,671,070
Orleans Levee District	$0	$3,714,794	$7,555,903	$0	$43,999,655	$6,396,616	$22,753,090	$84,420,058
Orleans Parish Civil Sheriff's Office	$0	$93,769	$0	$0	$88,463	$0	$0	$182,232
Orleans Parish Communication District	$0	$2,339,158	$0	$0	$0	$0	$0	$2,339,158
Orleans Parish Criminal Sheriff's Office	$0	$45,375,557	$0	$0	$227,346,504	$0	$0	$272,722,061
Orleans Parish District Attorney	$0	$2,573,583	$0	$0	$291,738	$0	$0	$2,865,320
Orleans Parish School Board	$1,846	$9,813,677	$0	$0	$165,552,613	$0	$1,351,058	$176,719,193
Port of New Orleans	$40,122	$2,520,300	$9,563,433	$93,209	$13,334,206	$865,085	$5,893,375	$32,309,730
Recovery School District	$2,500	$98,096,709	$0	$0	$921,296,822	$0	$7,911,605	$1,027,307,636
Roman Catholic Church/Archdiocese of New Orleans	$0	$20,733,256	$0	$0	$393,522,348	$0	$1,592,147	$415,847,752
The Administrators of Tulane Educational Fund	$0	$37,214,754	$0	$0	$118,540,192	$106,861	$197,400	$156,059,206
The Housing Authority of New Orleans	$18,487,129	$6,600,783	$0	$0	$51,320,661	$0	$0	$76,408,574
University of New Orleans	$692,353	$4,316,193	$37,344	$0	$21,932,264	$36,733	$2,083,565	$29,098,451
Xavier University of Louisiana	$223,409	$10,476,971	$0	$0	$66,474,039	$5,944,411	$0	$83,118,830
Grand Total	**$97,868,200**	**$595,149,069**	**$57,159,524**	**$2,332,617**	**$2,532,723,644**	**$315,122,081**	**$69,881,233**	**$3,670,236,369**

The data in Table 7-21 above indicates that the category of work with the highest damages from Katrina is Category E (Building Damages). As of November, 2009, PWs prepared for this category totaled approximately $2.53 billion in estimated damages. This total represents 69 percent of the total damages for all FEMA categories. The total building damages far exceeds the damages estimated for any of the other categories. As noted, this amount significantly underestimates the total damages. This is because anticipated or actual insurance proceeds have been deducted from the estimated PW amount.

The Table also shows that the FEMA category of work with the least amount of damages is Category D, Water Control Facilities. This Category totaled only $2.3 million in estimated damages. This total represents just 1.5 percent of the total combined damages. This low figure for Category D is somewhat misleading given the fact the levee repairs in New Orleans falls almost entirely under the responsibility of the USACE.

The data in Table 7-21 identifies that as of November, 2009 the Recovery School District (RSD) has received the most FEMA Public Assistance funds in the Parish after Hurricane Katrina. The RSD has received a total of just under $1 billion in PA funds. Of this total, $921.2 million, or 89.6 percent, was for building damages (Category E). It should be noted that the damages covered under this applicant extend beyond Orleans Parish and include all Parishes in Louisiana that were eligible for FEMA PA funding after Hurricane Katrina. However, due to the extent and severity of the flooding, the majority of the damages associated with this applicant occurred in Orleans Parish, and therefore have been included in the analysis. The Table indicates that the City of New Orleans has received the second highest amount of PA funds with approximately $758.6 million in assistance.

In Orleans Parish, Hurricane Rita was limited to an Emergency Declaration, meaning that FEMA funding was limited to emergency work (FEMA Categories A and B). Review of the PWs from Hurricane Rita indicated there were only a minimal number of PWs prepared for applicants within Orleans Parish for a relatively low dollar amount, so the data is not included in the HMP update.

Hurricane Wind Risk in Orleans Parish

Wind is a significant component of the risks presented by hurricanes, and this section of the updated Plan describes the potential future losses (risk) from this hazard. As noted in the Hazard Identification and Profiling section, high winds have the potential to impact the entire Parish. The risk calculations for Orleans Parish were completed in February 2010 using the loss estimation modeling software Hazards U.S. (HAZUS) Multi-Hazard (MH) version MR-4. HAZUS is a multi-hazard loss estimation model that was developed by FEMA in coordination with the National Institute of Building Sciences. The original purpose of HAZUS is to provide a methodology and software application to develop catastrophic earthquake losses at a regional scale, but has been expanded to cover multiple hazards including wind and flood. These loss estimates can be used for planning purposes to reduce risks from multiple hazards and to prepare for emergency response and recovery.[18] HAZUS modeling of hurricane scenarios have been used in the present analysis to determine loss estimates for Orleans Parish.

The HAZUS analysis was completed using HAZUS Version MR-4, which is the latest version at the time the 2010 hazard mitigation plan update was prepared. However, this version of HAZUS was based on population and housing statistics from the 2000 US Census, so the population statistics in particular may be somewhat overestimated. As of the 2000 Census, there were over 188,000 households in the Parish and a total population of 484,674. Table 7-22 summarizes the number of residential and commercial buildings included in the analysis. The HAZUS analysis

[18] HAZUS – Hurricane Event Report. February, 2010.

estimates that there are 150,551 buildings in Orleans Parish, with an aggregate total replacement value of $35.1 billion (2002 dollars). Approximately 97 percent of the buildings (and 78 percent of the building value) are associated with residential housing.[19]

Table 7-29
Orleans Parish: Number of Structures and Dollar Exposure for Residential and Commercial Buildings
(Source: HAZUS MH Version MR4)

Occupancy Type	# of Structures	Dollar Exposure
Residential	145,545	$27,262,840,000
Commercial	3,382	$5,089,867,000
Other	1,624	$2,774,779,000
Total	**150,551**	**$35,127,486,000**

These values can be further broken down by occupancy to include total square footage and dollar exposure for the residential and commercial occupancy types plus five additional categories that include Industrial, Agriculture, Religious, Government and Education. Table 7-23 presents the relative distribution of the value (and percentage) with respect to seven occupancy types. The Table indicates that the residential category has the highest exposure in Orleans Parish by a substantial majority.

Table 7-30
Orleans Parish: Building Exposure and Square Footage By Occupancy Type (figures in thousands except percent of total)
(Source: HAZUS-MH Version MR4)

Occupancy Type	Total Square Feet (K)	Dollar Exposure ($K)	% of Total
Residential	316,586	$27,262,840	77.6%
Commercial	47,147	$5,089,867	14.5%
Industrial	8,931	$769,207	2.2%
Agriculture	397	$25,912	0.1%
Religious	7,112	$847,538	2.4%
Government	3,399	$362,212	1.0%
Education	6,692	$769,910	2.2%
Total	**390,264**	**35,127,486**	**100%**

[19] HAZUS – Hurricane Event Report. February, 2010.

HAZUS - Hurricane Wind Loss Estimates

For the hurricane wind loss estimate, the output from HAZUS included both building damage by occupancy and building damage by structure type for various high wind event frequencies in Orleans Parish. The results also included building-related economic loss estimates for the categories residential, commercial, and industrial. Loss estimates were calculated for the event frequencies included in Table 7-24. The table also provides the range of 3-second wind gusts for each corresponding return period for the 181 census tracts in Orleans Parish. The column titled “Return Period” shows the statistical return interval, and the annual probability (latter in parentheses).

Table 7-31
High Wind Return Period and Corresponding Peak Gust Ranges for Orleans Parish
(Source: HAZUS-MH Version MR4)

Return Period	Peak Gust Range (mph)
10-year (10%)	69 – 73
20-year (5%)	87 – 91
50-year (2%)	105 – 110
100-year (1%)	117 – 122
200-year (0.50%)	126 – 132
500-year (0.20%)	137 – 144
1,000-year (0.10%)	145 – 153

The hurricane modeling results from HAZUS also included maps of Orleans Parish showing the peak winds (3-second gusts) for each of the return periods included above in Table 7-24. Figure 7-45 provides a sample of the results and displays the 100-year 3-second peak wind gusts for each of the 181 census track in Orleans Parish. As indicated in the table above, estimated wind speeds across the Parish for the 100-year event range from 117 mph - 123 mph. In this scenario, a hurricane passes just west of Orleans Parish and the highest wind peaks for this scenario event are located in the northwestern part of the Parish. As reported in the FEMA Mitigation Assessment Team report for Katrina, winds from the event in the New Orleans area were about 105 mph, place the storm at a return interval of approximately 50 years.

Figure 7-45
Peak Winds (3 Second Gusts) for A 100-Year Event - Orleans Parish
(Source: HAZUS MH Version MR4)

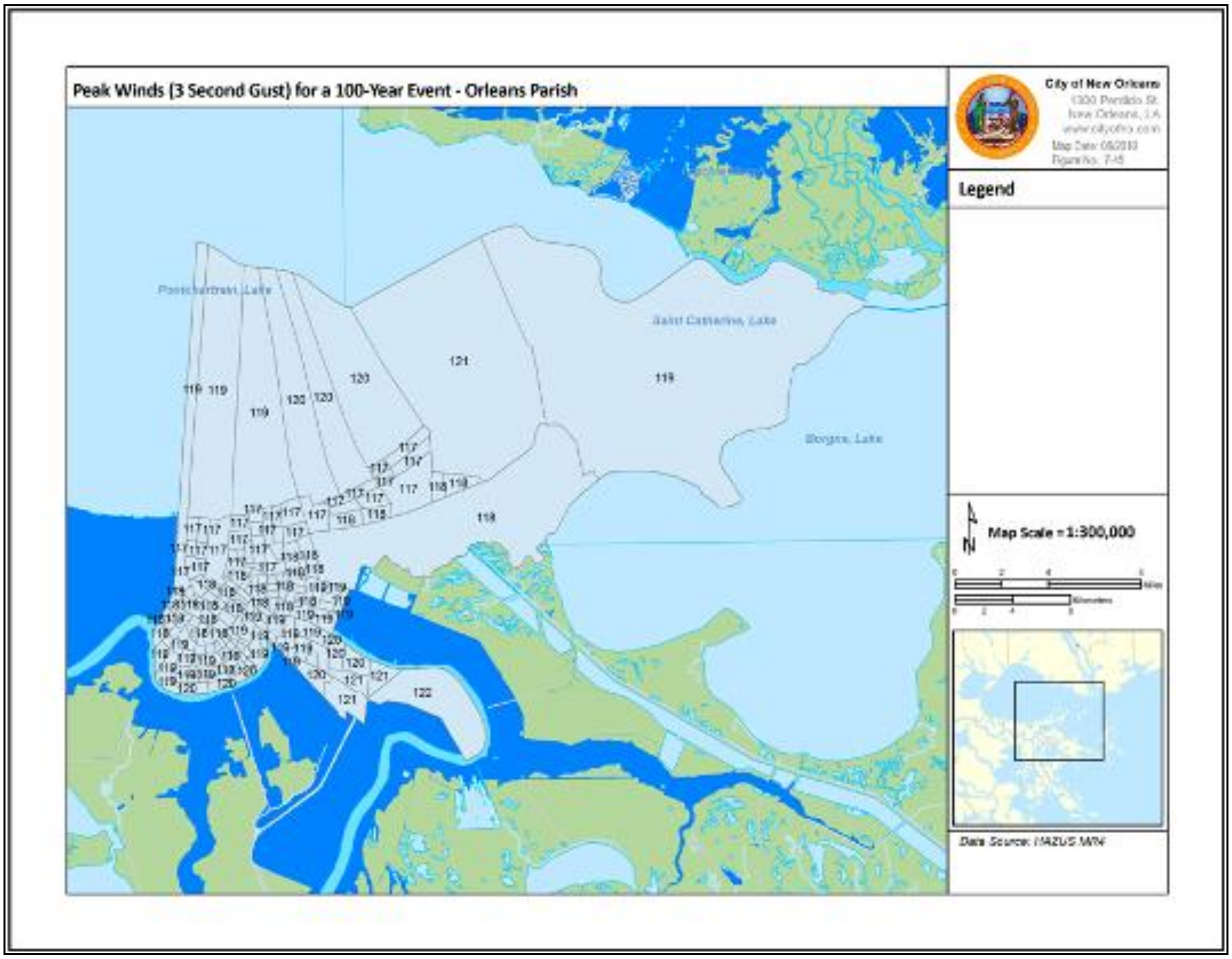


Table 7-25 summarizes the building losses (in thousands of dollars) for the six hurricane scenarios, which range from 10-year to 1,000-year events. The HAZUS scenario results show that 1-percent-annual (100-year) hurricane wind event would result in an estimated \$3.7 billion in losses. A more detailed breakdown of each event can be found in the Building Damage by Occurrence and Structure Type subsection below.

Table 7-32
Losses for Buildings in Orleans Parish, in Thousands of Dollars
(Source: HAZUS MH Version MR4)

	10%annual event	5% annual event	2% annual event	1% annual Event	0.50% annual event	0.10% annual event
Building Damage	$30,983	$214,456	$1,121,261	$2,795,474	$5,811,088	$14,811,795
Contents Damage	$808	$15,928	$246,928	$928,957	$2,365,120	$7,112,233
Inventory Loss	$1	$105	$3,013	$9,818	$26,435	$69,347
Total	**$31,792**	**$230,489**	**$1,371,202**	**$3,734,249**	**$8,202,643**	**$21,993,375**

Building Damage by Occupancy and Structure Type

The following tables (Tables 7-26 through 7-31) summarize the HAZUS loss estimation results for occupancy building damages and general building type for each the event frequencies listed above. Table 7-26 summarizes the expected damages by general building occupancy for a 10-year event. As indicated above in Table 7-24, wind speeds across the Parish for this scenario event would range from 69-73 mph, strong tropical storm force winds. In the 10-year event scenario, HAZUS estimates that approximately 38 buildings will be at least moderately damaged. Only one building would be severely damaged, and no buildings destroyed.

Table 7-33 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 10-percent annual probability event: Expected Building Damage by Occupancy
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Occupancy	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	94	99.09	1	0.84	0	0.06	0	0.02	0	0.00
Commercial	3,335	99.20	26	0.77	1	0.03	0	0.00	0	0.00
Education	226	99.40	1	0.60	0	0.00	0	0.00	0	0.00
Government	332	99.30	2	0.66	0	0.01	0	0.00	0	0.00
Industrial	532	99.38	3	0.62	0	0.00	0	0.00	0	0.00
Religion	431	99.48	2	0.52	0	0.00	0	0.00	0	0.00
Residential	144,831	99.51	676	0.46	36	0.03	1	0.00	0	0.00
Grand Total	**149,800**		**712**		**37**		**1**		**0**	

Table 7-27 summarizes the expected damage by general building type for a 10-percent-annual-probability event.

Table 7-34 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 10-percent annual probability event: Expected Building Damage by Building Type
(Source: HAZUS MH Version MR4, Hurricane Event Report ,February, 2010)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Building Type	Count	%	Count	%	Count	%	Count	%	Count	%
Concrete	797	99.02	8	0.97	0	0.01	0	0.00	0	0.00
Masonry	20,484	99.20	153	0.74	12	0.06	0	0.00	0	0.00
Manufactured Housing	675	99.99	0	0.01	0	0.00	0	0.00	0	0.00
Steel	1,396	99.02	13	0.94	1	0.04	0	0.00	0	0.00
Wood	126,276	99.59	496	0.39	21	0.02	2	0.00	0	0.00
Grand Total	**149,628**		**670**		**34**		**2**		**0**	

Table 7-28 summarizes the expected damages by general building occupancy for a 5percent annual probability event. As indicated above in Table 7-24, wind speeds across the Parish for this scenario event would range from 87-91 mph, equivalent to a Category 1 hurricane. In the 5-percent-annual probability scenario, HAZUS estimates that approximately 1,052 buildings will be at least moderately damaged. In addition, 35 buildings would be severely damaged, and nine buildings completely destroyed.

Table 7-35 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 5-percent annual probability event: Expected Building Damage by Occupancy
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	87	91.09	6	6.09	2	1.88	1	0.86	0	0.07
Commercial	3,130	92.56	208	6.16	42	1.23	2	0.05	0	0.00
Education	215	94.56	11	4.94	1	0.49	0	0.01	0	0.00
Government	311	93.21	20	5.97	3	0.79	0	0.03	0	0.00
Industrial	504	94.17	28	5.16	3	0.62	0	0.04	0	0.00
Religion	409	94.57	21	4.95	2	0.46	0	0.01	0	0.00
Residential	134,731	92.57	9,817	6.75	956	0.66	32	0.02	9	0.01
Grand Total	**139,387**		**10,112**		**1,008**		**35**		**9**	

Table 7-29 summarizes the expected damage by general building type for a 5-percent-annual-probability event.

Table 7-36 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 5-percent annual probability event: Expected Building Damage by Building Type
(Source: HAZUS MH Version MR4, Hurricane Event Report, February 2010)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Building Type	Count	%	Count	%	Count	%	Count	%	Count	%
Concrete	740	91.89	56	6.91	9	1.18	0	0.02	0	0.00
Masonry	19,037	92.19	1,303	6.31	303	1.47	6	0.03	1	0.00
Manufactured Housing	671	99.43	3	0.42	1	0.12	0	0.00	0	0.03
Steel	1,289	92.04	86	6.12	25	1.76	1	0.08	0	0.00
Wood	117,760	92.87	8,448	6.66	549	0.43	28	0.02	10	0.01
Grand Total	**139,497**		**9,896**		**887**		**35**		**11**	

Table 7-30 summarizes the expected damages by general building occupancy for a 5-percent-annual-probability event. As indicated above in Table 7-24, wind speeds across the Parish for this scenario event would range from 105-110 mph, equivalent to a strong Category 2 hurricane. In this event scenario, HAZUS estimates that approximately 12,880 buildings will be at least moderately damaged. In addition, 1,135 buildings would be severely damaged, and 492 buildings completely destroyed.

Table 7-37 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 2-percent annual probability event: Expected Building Damage by Occupancy
(Source: HAZUS MH Version MR4, Hurricane Event Report, February 2010)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	56	58.63	18	18.55	12	13.08	8	8.20	1	1.54
Commercial	2,108	62.33	763	22.55	441	13.03	70	2.07	1	0.02
Education	152	67.07	47	20.66	24	10.43	4	1.84	0	0.00
Government	208	62.16	74	22.17	42	12.69	10	2.98	0	0.00
Industrial	348	65.03	113	21.13	60	11.17	14	2.62	0	0.06
Religion	289	66.78	97	22.30	40	9.27	7	1.64	0	0.00
Residential	91,573	62.92	41,827	28.74	10,633	7.31	1,022	0.70	490	0.34
Grand Total	**94,734**		**42,937**		**11,252**		**1,135**		**492**	

Table 7-31 summarizes the expected damage by general building type for a 2-percent annual probability event.

Table 7-38 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 2-percent annual probability event: Expected Building Damage by Building Type
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Building Type	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Concrete	50	59.00	178	22.10	135	16.77	17	2.13	0	0.00
Masonry	13,037	63.14	5,018	24.30	2,387	11.56	181	0.87	26	0.12
Manufactured Housing	579	85.73	50	7.39	33	4.86	2	0.25	12	1.78
Steel	864	61.26	271	19.19	229	16.25	46	3.26	1	0.04
Wood	80,342	63.36	37,206	29.34	7,873	6.21	922	0.73	453	0.36
Grand Total	**94,872**		**42,723**		**10,657**		**1,168**		**492**	

The July 2006 report titled *Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report (FEMA 549)*, found a 2-percent–percent-annual chance scenario event, most closely resembles the winds speeds experienced in Orleans Parish during Hurricane Katrina in 2005. The MAT report indicates wind speeds from Katrina in New Orleans were approximately 105 mph. Figure 7-46 shows building damage to an apartment complex in Harvey, Louisiana from the estimated 105 mph winds during Hurricane Katrina. Harvey is located adjacent to Orleans Parish on the West Bank of Jefferson Parish. The photograph shows a substantial amount of siding that blew off from the high winds. Additional details about the wind damages associated with Hurricane Katrina can be found in Section 6.3.1, Hurricanes and Tropical Storms.

Figure 7-46
Wind Damage from Hurricane Katrina – Estimated Wind Speed 105 mph)
(Source: Hurricane Katrina in the Gulf Coast, Mitigation Assessment Team (MAT) Report Hurricane, FEMA 549, July 2006)

Table 7-32 summarizes the expected damages by general building occupancy for a 1-percent-annual-probability event. As indicated above in Table 7-24, wind speeds across the Parish for this scenario event would range from 117 mph to 122 mph, equivalent to a Category 3 hurricane. In the 100-year event scenario, HAZUS estimates that approximately 33,203 buildings will be at least moderately damaged. This is slightly more than 22 percent of the buildings in Orleans Parish. In addition, 5,203 buildings would be severely damaged, and 2,651 buildings completely destroyed.

Table 7-39 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 1-percent annual probability event: Expected Building Damage by Occupancy
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	34	35.90	20	20.77	20	21.38	16	17.36	4	4.59
Commercial	1,317	38.94	915	27.05	858	25.37	288	8.51	4	0.13
Education	99	43.69	58	25.45	50	22.02	20	8.84	0	0.00
Government	129	38.68	85	25.56	80	23.96	39	11.79	0	0.01
Industrial	222	41.52	137	25.69	119	22.32	55	10.30	1	0.18
Religion	187	43.16	125	28.95	88	20.31	33	7.57	0	0.01
Residential	57,979	39.84	56,040	38.50	24,133	16.58	4,751	3.26	2,642	1.81
Grand Total	**59,968**		**57,380**		**25,349**		**5,203**		**2,651**	

Table 7-33 summarizes the expected damage by general building type for a 1-percent-annual-probability event.

Table 7-40 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 1-percent annual probability event: Expected Building Damage by Building Type
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Building Type	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Concrete	285	35.47	182	22.60	260	32.32	77	9.63	0	0.00
Masonry	8,348	40.43	6,627	32.09	4,663	22.58	861	4.17	149	0.72
Manufactured Housing	427	63.26	87	12.89	92	13.60	12	1.83	57	8.42
Steel	539	38.24	289	20.49	408	28.90	172	12.19	3	0.18
Wood	50,868	40.12	50,180	39.58	19,117	15.08	4,213	3.32	2,417	1.91
Grand Total	**60,467**		**57,365**		**24,540**		**5,335**		**2,626**	

Table 7-34 summarizes the expected damages by general building occupancy for a 0.5-percent-annual-probability event. As indicated above in Table 7-24, wind speeds across the Parish for this scenario event would range from 126 mph to 132 mph, equivalent to a strong Category 3 or weak Category 4 hurricane. In the 0.50-percent-annual-probability event scenario, HAZUS estimates that approximately 63,758 buildings will be at least moderately damaged. This is approximately 42 percent of the buildings in Orleans Parish. In addition, 14,569 buildings would be severely damaged, and 7,321 buildings completely destroyed.

Table 7-41 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 0.50-percent annual probability event: Expected Building Damage by Occupancy
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	17	18.02	16	17.36	24	25.20	28	29.21	10	10.21
Commercial	677	20.02	823	24.35	1,148	33.96	718	21.24	15	0.44
Education	52	22.91	51	22.45	68	30.15	56	24.46	0	0.02
Government	66	19.80	72	21.53	102	30.51	94	28.10	0	0.07
Industrial	115	21.53	121	22.55	159	29.66	138	25.81	2	0.44
Religion	95	22.01	118	27.32	129	29.73	90	20.86	0	0.08
Residential	29,084	19.98	55,485	38.12	40,237	27.65	13,445	9.24	7,294	5.01
Grand Total	**30,106**		**56,687**		**41,868**		**14,569**		**7,321**	

Table 7-35 summarizes the expected damage by general building type for a 0.5-percent annual probability event.

Table 7-42 Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 0.50-percent annual probability event: Expected Building Damage by Building Type
(Source: HAZUS MH Version MR4, Hurricane Event Report – 200-Year Return Period)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Building Type	Count	%	Count	%	Count	%	Count	%	Count	%
Concrete	144	17.86	133	16.56	322	39.99	206	25.58	00	0.01
Masonry	4,369	21.16	6,575	31.84	6,802	32.94	2,477	12.00	426	2.06
Manufactured Housing	253	37.49	96	14.26	146	21.69	36	5.33	143	21.24
Steel	284	20.12	223	15.84	488	34.58	407	28.89	8	0.57
Wood	25,337	19.98	49,793	39.27	33,297	26.26	11,706	9.23	6,662	5.25
Grand Total	**30,387**		**56,820**		**41,055**		**14,832**		**7,239**	

Table 7-36 summarizes the expected damages by general building occupancy for a 0.10-percent annual probability event. As indicated above in Table 7-24, wind speeds across the Parish for this scenario event would range from 145 mph -153 mph, corresponding to a strong Category 4 hurricane. In the 1,000-year (0.1-percent annual probability) scenario, HAZUS estimates that approximately 119,403 buildings will be at least moderately damaged. This comprises about 79 percent of the buildings in Orleans Parish. In addition, 41,428 buildings would be severely damaged, and 30,315 buildings completely destroyed.

Table 7-43
Probabilistic Hurricane Scenario Damages to Orleans Parish Assets
for a 0.10-percent annual probability event: Expected Building Damage by Occupancy
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	4	4.42	7	7.12	18	19.45	45	47.00	21	22.01
Commercial	167	4.93	360	10.65	1,014	29.99	1,722	50.90	119	3.53
Education	14	6.27	22	9.77	60	26.26	129	57.00	2	0.71
Government	18	5.35	30	8.84	82	24.61	200	59.88	4	1.31
Industrial	30	5.66	52	9.73	136	25.49	306	57.23	10	1.89
Religion	23	5.41	54	12.44	128	29.51	221	50.93	7	1.72
Residential	4,669	3.21	25,697	17.66	46,222	31.76	38,806	26.66	30,151	20.72
Grand Total	**4,926**		**26,222**		**47,660**		**41,428**		**30,315**	

Table 7-37 summarizes the expected damage by general building type for a 0.10-percent annual probability event.

Table 7-44
Probabilistic Hurricane Scenario Damages to Orleans Parish Assets for a 0.10-percent annual probability event: Expected Building Damage by Building Type
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Damage Type	None		Minor		Moderate		Severe		Destruction	
Building Type	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Concrete	39	4.82	48	5.93	238	29.53	479	59.53	2	0.19
Masonry	875	4.24	3,258	15.78	7,089	34.33	7,338	35.54	2,089	10.12
Manufactured Housing	64	9.55	55	8.17	135	20.05	74	10.94	346	51.28
Steel	80	5.67	84	5.97	342	24.29	863	61.19	41	2.91
Wood	3,979	3.14	22,841	18.01	39,459	31.12	33,093	26.10	27,424	21.63
Grand Total	**5,037**		**26,286**		**47,263**		**41,847**		**29,902**	

Building Related Economic Loss Estimates

As mentioned previously, the HAZUS results also included building-related economic loss estimates. Economic loss estimates were calculated for the same frequencies as the building damage by occupancy and type categories. The results are summarized below in Tables 7-38 – 7-44.

The building related losses are broken into two categories that include direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.[20]

Table 7-38 summarizes the building-related economic loss estimates for a 10-percent annual probability event (in thousands of dollars). As mentioned previously, the wind speeds for a 10-percent annual probability event range from 69 – 73 mph, equivalent to tropical storm force winds. In this scenario, HAZUS estimates hurricane related economic losses at $33.5 million. The total property damages were estimated at $31.7 million. The majority of the damages (95 percent of the total losses) were sustained by residential assets. The table shows that $1.7 million, or 5.1-percent of the estimated losses in Orleans Parish, were related to business interruption.

Table 7-45
Orleans Parish Assets: Building Related Economic Loss Estimates (in Thousands of Dollars), 10-percent annual probability Event
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage	Building	$29,696	$989	$82	$216	$30,983
	Content	$771	$33	$3	$1	$808
	Inventory	$0	$0	$1	$0	$1
	Subtotal	**$30,467**	**$1,022**	**$86**	**$217**	**$31,792**
Business Interruption Loss	Income	$0	$93	$0	$0	$93
	Relocation	$526	$38	$0	$1	$565
	Rental	$979	$22	$0	$0	$1,001
	Wage	$0	$74	$0	$0	$74
	Subtotal	**$1,505**	**$228**	**$0**	**$1**	**$1,733**
Grand Total		**$31,972**	**$1,249**	**$86**	**$218**	**$33,525**

Table 7-39 summarizes the building-related economic loss estimates for a 5-percent annual probability event (wind speeds 87-91 mph). In this scenario HAZUS estimates hurricane related economic losses at $265.8 million. The total property damages were estimated at $230.4 million. The majority of the damages, 89 percent of the total losses, were sustained by residential occupancies. The table shows $35.3 million, or 13.3 percent of the estimated losses in Orleans Parish were related to business interruption.

[20] HAZUS – Hurricane Event Report. February, 2010.

Table 7-46
Orleans Parish Assets: Building Related Economic Loss Estimates (in Thousands of Dollars), 5-percent annual probability Event
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage	Building	$200,326	$11,189	$927	$2,014	$214,456
	Content	$12,822	$2,351	$336	$419	$15,928
	Inventory	$0	$34	$64	$7	$105
	Subtotal	**$213,148**	**$13,574**	**$1,327**	**$2,440**	**$230,489**
Business Interruption Loss	Income	$0	$3,129	$8	$105	$3,242
	Relocation	$10,690	$2,239	$59	$242	$13,230
	Rental	$13,250	$1,339	$6	$21	$14,616
	Wage	$0	$2,033	$14	$2,178	$4,225
	Subtotal	**$23,940**	**$8,740**	**$87**	**$2,546**	**$35,313**
Grand Total		**$237,088**	**$22,314**	**$1,414**	**$4,986**	**$265,802**

Table 7-40 summarizes the building-related economic loss estimates for a 2-percent annual probability event (wind speeds 105-110). In this scenario HAZUS estimates hurricane related economic losses at $1.65 billion, which represents 4.72 percent of the total replacement value for buildings in Orleans Parish. The total property damages were estimated at $1.37 billion. The majority of the damages, 82 percent of the total losses, were sustained by residential occupancies. The table shows that $288.4 million, or 17.3 percent of the estimated losses in Orleans Parish were related to business interruption.

Table 7-47
Orleans Parish Assets: Building Related Economic Loss Estimates (in Thousands of Dollars), 2-percent annual probability Event
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage	Building	$984,371	$94,703	$15,286	$26,900	$1,121,260
	Content	$182,281	$39,868	$11,373	$13,405	$246,927
	Inventory	$0	$864	$2,069	$79	$3,012
	Subtotal	**$1,166,652**	**$135,435**	**$28,728**	**$40,384**	**$1,371,199**
Business Interruption Loss	Income	$1,919	$10,800	$243	$2,968	$15,930
	Relocation	$118,369	$23,086	$1,652	$7,584	$150,691
	Rental	$75,670	$12,461	$239	$814	$89,184
	Wage	$4,524	$10,306	$353	$17,492	$32,675
	Subtotal	**$200,482**	**$56,653**	**$2,487**	**$28,858**	**$288,480**
Grand Total		**$1,367,134**	**$192,088**	**$31,215**	**$69,242**	**$1,659,679**

Table 7-41 summarizes the building-related economic loss estimates for a 100-year event (wind speeds 117-122). In this scenario HAZUS estimates hurricane related economic losses at $4.54 billion, which represents 12.93 percent of the total replacement value for buildings in Orleans Parish. The total property damages were estimated at $3.73 billion. The majority of the damages, slightly more than 80 percent of the total losses, were sustained by residential occupancies. The table shows that $288.4 million, or 17.7 percent of the estimated losses in Orleans Parish were related to business interruption.

Table 7-48
Orleans Parish Assets: Building Related Economic Loss Estimates (in Thousands of Dollars), 1-percent annual probability Event
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage	Building	$2,403,659	$262,029	$45,345	$84,442	$2,795,475
	Content	$699,423	$140,268	$37,962	$51,303	$928,956
	Inventory	$0	$2,836	$6,766	$216	$9,818
	Subtotal	**$3,103,082**	**$405,133**	**$90,073**	**$135,961**	**$3,734,249**
Business Interruption Loss	Income	$7,383	$55,526	$779	$3,298	$66,986
	Relocation	$344,812	$60,435	$4,263	$23,499	$433,009
	Rental	$178,854	$34,566	$705	$2,742	$216,867
	Wage	$17,403	$49,740	$1,170	$20,845	$89,158
	Subtotal	**$548,452**	**$200,267**	**$6,917**	**$50,384**	**$806,020**
Grand Total		**$3,651,534**	**$605,400**	**$96,990**	**$186,345**	**$4,540,269**

Table 7-42 summarizes the building-related economic loss estimates for a 0.50-percent annual probability event (wind speeds 126-132). In this scenario HAZUS estimates hurricane related economic losses at $4.54 billion, which represents 12.93 percent of the total replacement value for buildings in Orleans Parish. The total property damages were estimated at $3.73 billion. The majority of the damages, slightly more than 80 percent of the total losses, were sustained by residential occupancies. The table shows that $806 million, or 17.5 percent of the estimated losses in Orleans Parish were related to business interruption.

Table 7-49
Orleans Parish Assets: Building Related Economic Loss Estimates (in Thousands of Dollars), 0.50-percent annual probability Event
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage	Building	$4,884,922	$603,308	$112,002	$210,857	$5,811,089
	Content	$1,736,538	$378,700	$104,236	$145,646	$2,365,120
	Inventory	$0	$7,546	$18,424	$465	$26,435
	Subtotal	**$6,621,460**	**$989,554**	**$234,662**	**$356,968**	**$8,202,644**
Business Interruption Loss	Income	$16,487	$174,805	$2,193	$3,295	$196,780
	Relocation	$695,009	$127,765	$8,652	$54,457	$885,883
	Rental	$341,734	$77,073	$1,676	$6,741	$427,224
	Wage	$38,859	$169,287	$3,320	$20,100	$231,566
	Subtotal	**$1,092,089**	**$548,930**	**$15,841**	**$84,593**	**$1,741,453**
Grand Total		**$7,713,549**	**$1,538,484**	**$250,503**	**$441,561**	**$9,944,097**

Table 7-43 summarizes the building-related economic loss estimates for a 0.10-percent annual probability event (wind speeds 145-153). In this scenario HAZUS estimates hurricane related economic losses at $26.02 billion, which represents 74.10 percent of the total replacement value for buildings in Orleans Parish. The total property damages were estimated at $21.99 billion. The majority of the damages, approximately 77 percent of the total losses, were sustained by residential occupancies. The table shows that $1.74 billion, or about 15.5 percent of the estimated losses in Orleans Parish were related to business interruption.

Table 7-50
Orleans Parish Assets: Building Related Economic Loss Estimates (in Thousands of Dollars), 0.10-percent annual probability Event
(Source: HAZUS MH Version MR4, Hurricane Event Report)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage	Building	$12,401,854	$1,583,377	$266,202	$560,362	$14,811,795
	Content	$5,211,075	$1,190,211	$271,899	$439,048	$7,112,233
	Inventory	$0	$20,811	$47,339	$1,198	$69,348
	Subtotal	**$17,612,929**	**$2,794,399**	**$585,440**	**$1,000,608**	**$21,993,376**
Business Interruption Loss	Income	$47,051	$451,049	$5,246	$6,863	$510,209
	Relocation	$1,522,796	$285,331	$16,155	$124,788	$1,949,070
	Rental	$760,966	$184,586	$3,599	$16,380	$965,531
	Wage	$110,895	$444,638	$7,794	$47,759	$611,086
	Subtotal	**$2,441,708**	**$1,365,604**	**$32,794**	**$195,790**	**$4,035,896**
Grand Total		**$20,054,637**	**$4,160,003**	**$618,234**	**$1,196,398**	**$26,029,272**

In addition to the HAZUS loss estimation scenarios presented above for various frequency events, hurricane wind risk in Orleans Parish can also be shown in annualized losses. Table 7-44 summarizes the annual economic losses (in thousands of dollars) for both property (capital stock losses) and business (income losses). The HAZUS results show that total annual losses in Orleans Parish are estimated at $187.8 million.

Table 7-51
Annual Economic Losses in Orleans Parish, in Thousands of Dollars
(Source: HAZUS MH Version MR4)

	Capital Stock Losses				Income Losses				
	Building Damage	**Content Damage**	**Inventory**	**Loss Ratio %**	**Relocation Loss**	**Capital Related Loss**	**Wage Losses**	**Rental Income Loss**	**Total Loss**
Orleans Parish	$115,090	$41,621	$434	0.33%	$15,243	$3,198	$4,135	$8,150	$187,870

Critical Facilities

The HAZUS hurricane loss estimation model also included an analysis of the critical facilities in Orleans Parish. The HAZUS model identifies the following essential services for Orleans Parish

- 196 schools
- 36 police stations
- 25 hospitals – total bed capacity of 5,078
- 5 fire stations
- 1 emergency operations center (EOC)

Table 7-45 summarizes the expected damages to critical facilities (greater than 50-percent probability of moderate damage) for four of the six hurricane frequency events, ranging from the 50-year event up to the 1,000-year event. Review of HAZUS loss estimations for critical facilities indicated that for the 10-percent, 5-percent and 2-percent annual probability hurricane events none of the facilities had a greater than 50-percent probability of moderate damage. The table shows that for a 100-year hurricane event, 11 critical facilities would have greater than a 50-percent probability of moderate damage.

Table 7-52
Orleans Parish: Expected Damage to Essential Facilities, Greater than 50-Percent Probability of Moderate Damage
(Source: HAZUS MH Version MR4, Hurricane Event Reports 2-percent to 0.10-percent annual probability events)

		Greater than 50-percent Probability of Moderate Damage					
Classification	**# of Facilities**	**10% event**	**5% event**	**2% event**	**1% event**	**0.50% event**	**0.10% event**
EOC	1	0	0	0	0	1	1
Fire Stations	5	0	0	0	0	2	5
Hospitals	25	0	0	0	3	25	25
Police Stations	36	0	0	0	1	18	36
Schools	196	0	0	0	7	132	196
Total	**263**	**0**	**0**	**0**	**11**	**178**	**263**

7.4 Land Uses, Development and Re-development Trends

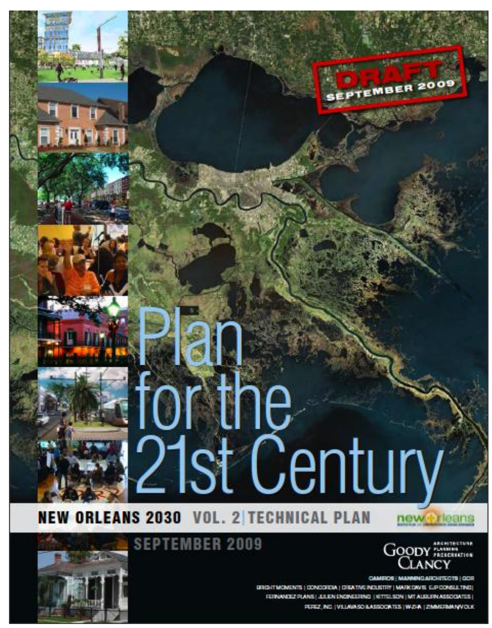
The FEMA Interim Final Rule (IFR) and "Blue Book" guidance states the HMP "should provide a general overview of land uses and types of development occurring within each community participating in the plan." and notes that "a land use map would be useful to depict the descriptive information". The guidance 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.

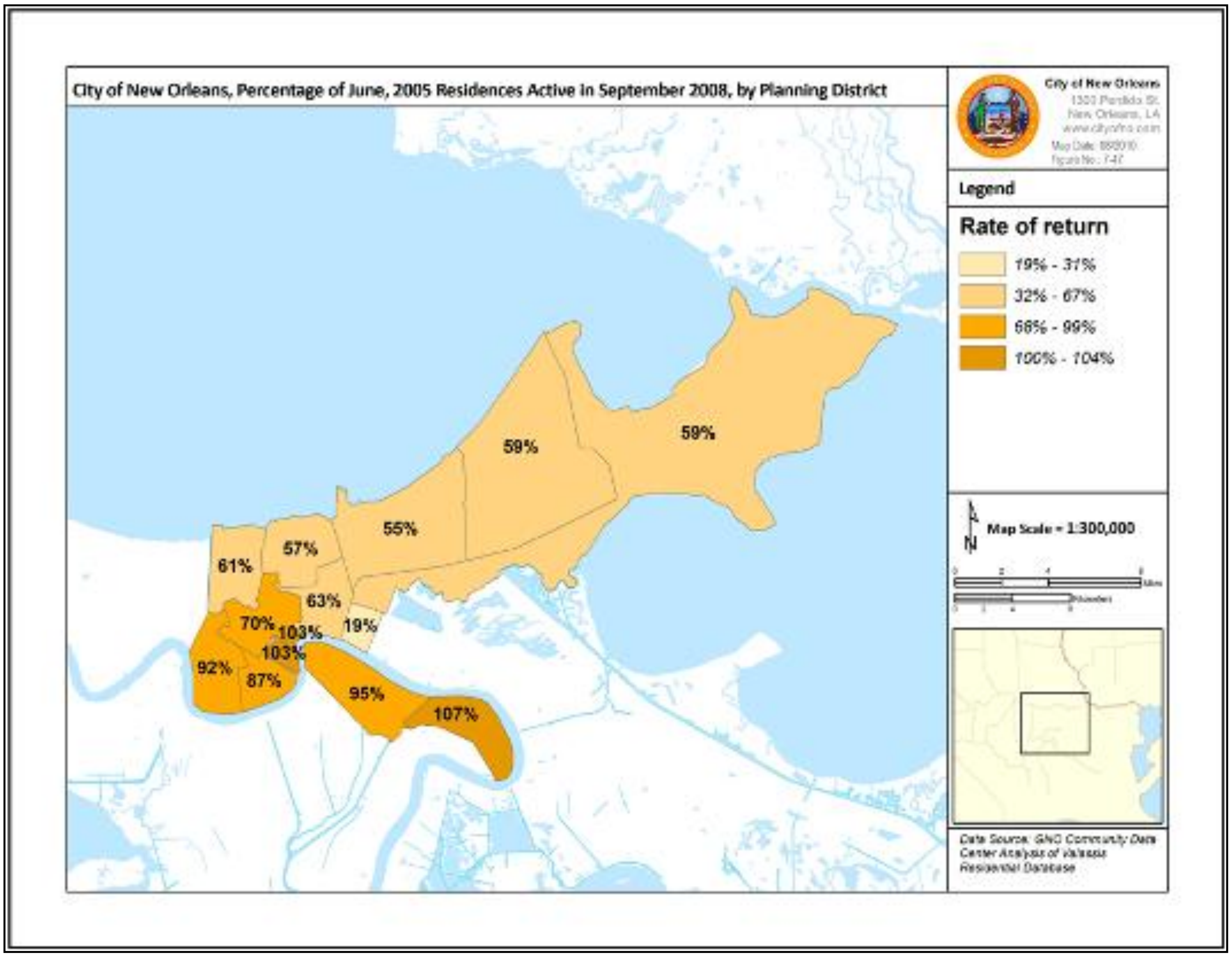
Because, as the Plan notes, most office uses were (and remain) concentrated in the downtown business district, these were not subjected to the most severe flooding (most did not flood at all), and hence were among the fastest types of operations to recover. Notably, no real estate development project 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.

Figure 7-47
City of New Orleans
Percentage of June, 2005 Residences active in September 2008, by Planning District
(Source: City of New Orleans, Plan for the 21st Century, Volume 2, page 2.8)



With regard to the increase in blight, the City has experienced since Katrina, the Plan states "Not coincidentally, the neighborhoods that are grappling with the blight wrought by Hurricane Katrina are for the most part those whose development was made possible by the wetland drainage and the levee protection system. When the levees and floodwalls failed in August 2005, these lower lying areas bore the brunt of the flooding." In these badly damaged areas, "the major change in the land use profile has been the exponential increase in the amount of vacant and underutilized property."[21]

[21] City of New Orleans, Plan for the 21st Century, Volume 2

Figure 7-48
City of New Orleans
Residential Lots that became Vacant or that Contain Vacant Units
(time period July 2005 and August 2008, based on utility account data)
(Source: City of New Orleans, Plan for the 21st Century, Volume 2, page 2.25)

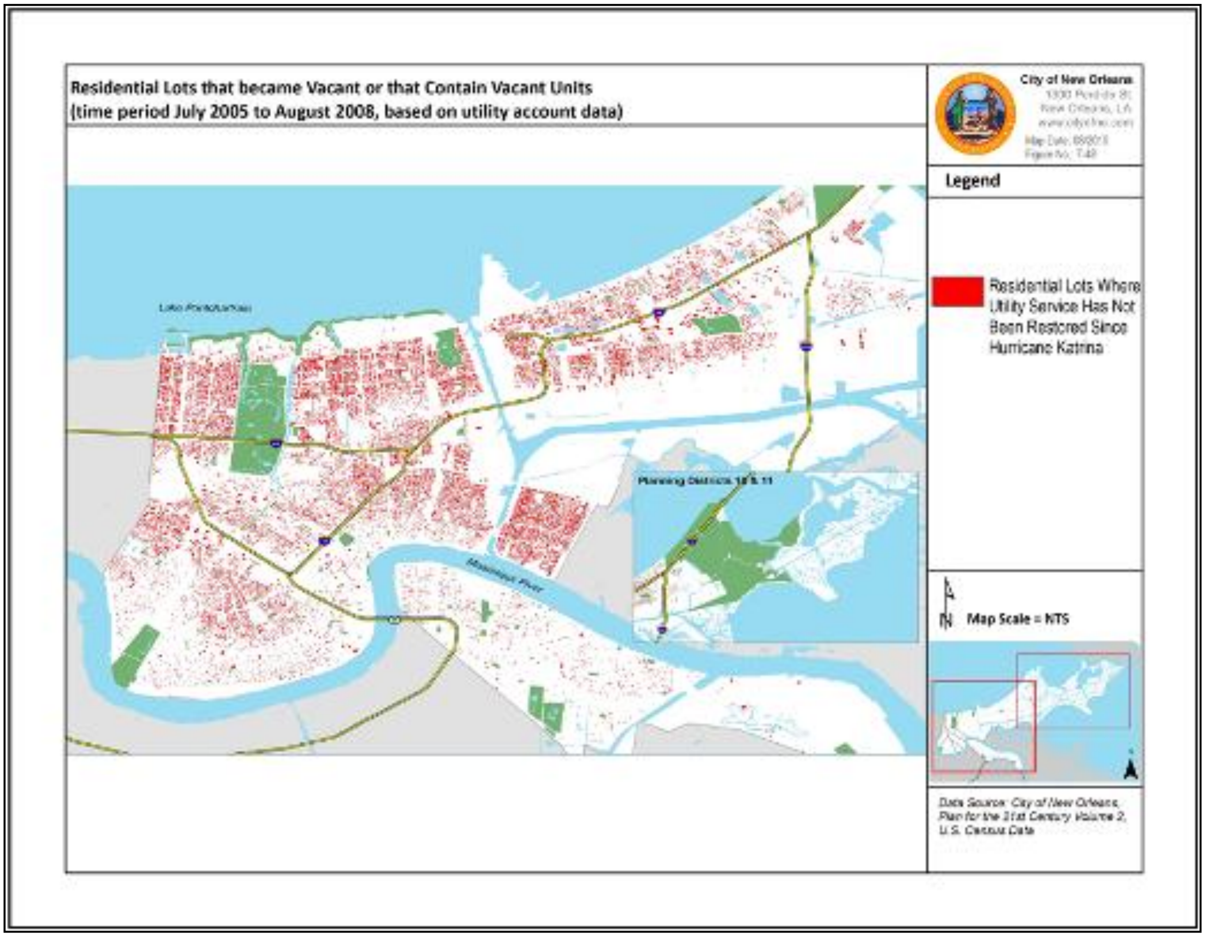
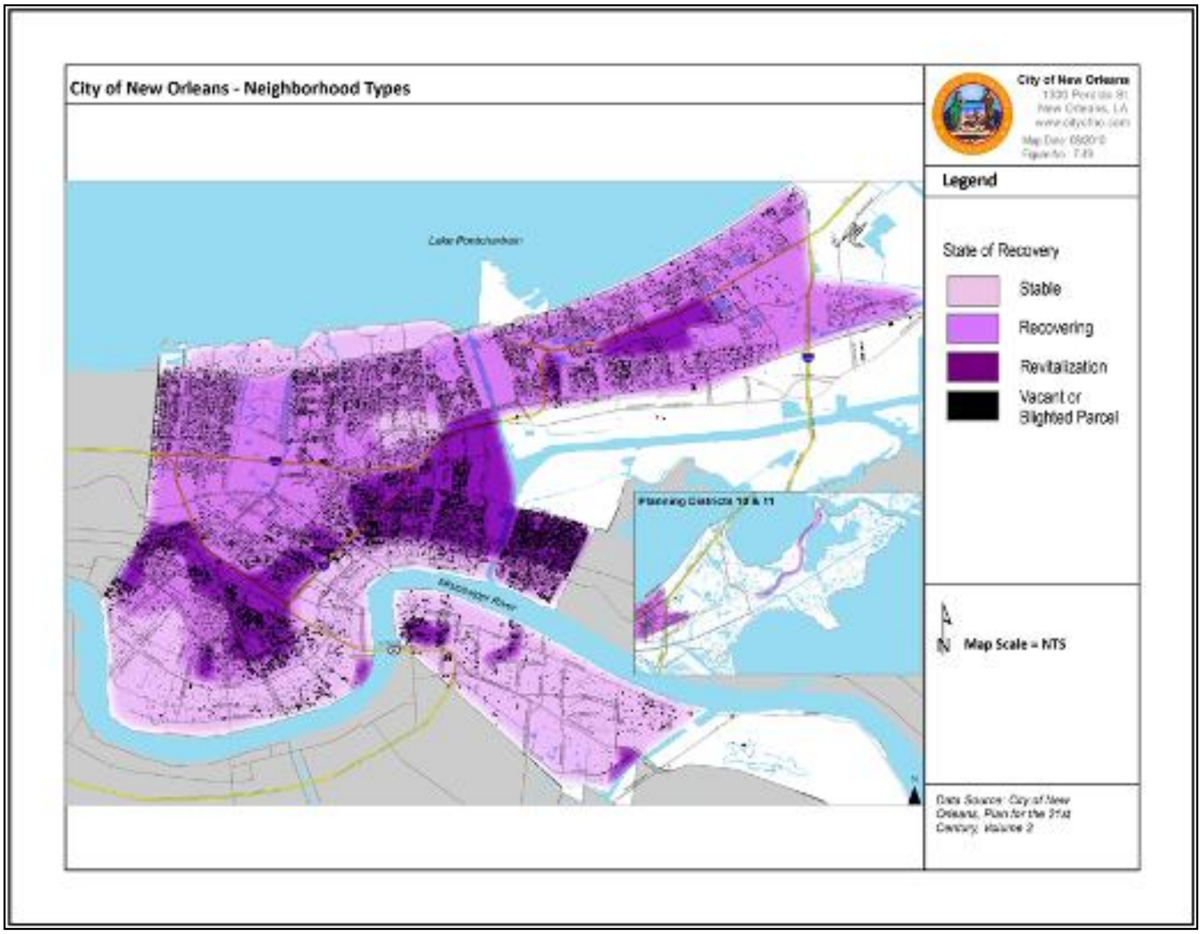


Figure 7-48 above shows the vacant residential units as of August 2008. There appears to be a strong correlation between the water depths from Hurricane Katrina flooding and the densities and numbers of properties with no utility service. To illustrate, Figure 7-49. below shows the areas that are in various states of recovery, with lighter shades of purple categorized as "stable" and the darkest shade of purple being "blighted". When you overlay this map with vacant residential units, the relationship becomes very clear.

Figure 7-49
City of New Orleans – Neighborhood Types
(Source: City of New Orleans, Plan for the 21st Century, Volume 2, page 5.7)



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.

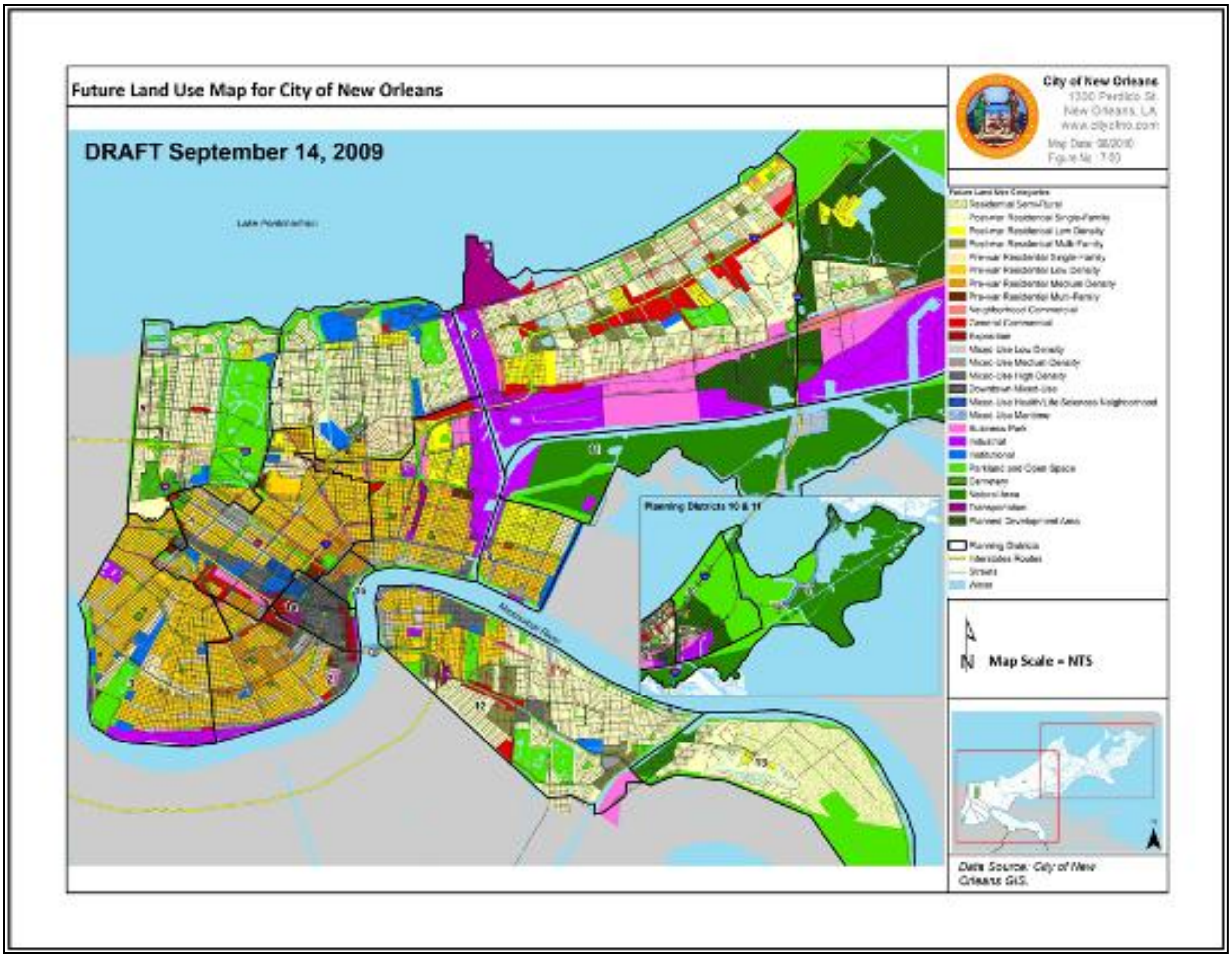
The focus of this part of the Master Plan is the Future Land Use Map, which shows the categories of land uses desired over time, and their densities and intensities. The map reflects the land uses that correspond to the long-term vision, goals and policies expressed elsewhere in the plan, and it constitutes 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 7-50
Future Land Use Map for City of New Orleans
(Source: City of New Orleans, Plan for the 21st Century, Volume 2, page 2.2)



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:

Table 7-53
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.

7.5 Summary

The purpose of the Hazard Identification and Vulnerability/Loss Estimation sections of this Hazard Mitigation Plan is to establish a sound, risk-oriented basis for the City of New Orleans to identify and prioritize mitigation activities. These sections are designed to meet specific requirements found in the Interim Final Rule and various guidance that FEMA has issued since the IFR was published.

Notes on Flood and Storm Surge Loss Estimation

As discussed in various parts of the present section, there are several recent and comprehensive flood and surge risk assessments completed by both public and private sector organizations. Although the purpose of these studies varies somewhat, the overarching reason for studying vulnerabilities and estimating losses is to identify, prioritize and accurately design projects to mitigate the risk. In the case of New Orleans, it is clear that the primary natural hazard risk is related to flooding, which is in turn related to hurricanes and storm surge. Generally speaking, the studies discussed in this section of the City's mitigation plan have several key bases for risk estimates.

- The City of New Orleans and surrounding areas are subsiding at a fairly rapid rate, which is increasing flood risk by lowering elevations relative to surge levels.
- Erosion is gradually reducing the capacity of the coast to attenuate storm surges.
- Sea level rise may be increasing the potential elevations of storm surges.
- There are two distinct sources of flood risk: high-intensity rainfall events that exceed the capacity of pumps, and storm surges.

These reports, studies, and the analysis of NFIP repetitive flood claims data illustrate a significant and somewhat obvious point about the spatial distribution of flood risk in the City: the areas with the lowest elevations and closest proximity to specific water courses (MRGO and canals) tend to have the largest risk. There are several factors contributing to this conclusion. The most apparent of these is that the lower the elevation, the greater the potential for flooding. Furthermore, even when flooding is widespread, the areas of lowest elevation generally receive the deepest water (increasing damages and potential for injuries and death) and drain last, thereby increasing the secondary damages associated with long-duration inundation and contamination.

The ***Draft Louisiana Coastal Protection and Restoration Technical Report*** (the LACPR report) divides the region into planning areas, and estimates a range of potential losses for two sea-level rise scenarios, and for a series of deterministic (meaning single events) hurricanes of various return frequencies, from the ten-year event to the 2000-year event. The report presents a range of damages for both the base condition (meaning the current situation) and the two assumptions about potential future sea level increase. The overall range (from the base-condition ten year event to the high sea level 2000-year event) is $5.0 billion to $112.5 billion. This estimate appears to disagree somewhat with information in the Army Corps' *Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, Draft Final Report,* in that the latter report suggests little or no damage in events up to the 50-year return frequency because of the effects of the canal and pump systems in the City. This is a somewhat significant difference because of the obviously much higher potential for a 10- or 50-year storm than for a 100-year or greater event. The LACPR report suggests a minimum of $5.0B in damages in a ten-year event. In identifying specific mitigation actions to include in this mitigation plan, the City should probably complete a detailed technical examination of the LACPR methodology and report, to determine if specific locations and risk factors can be identified.

The Army Corps of Engineers' (Interagency Performance Evaluation Task Force) ***Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, Draft Final Report*** approaches the risk calculations by drainage basin and sub-basin. The report describes potential losses for a range of events in both narrative, and in terms of potential percent property losses by basin and sub-basin. There is a fairly detailed discussion of the improvements in flood risk due to the implementation of the 2007 Hurricane Protection System, particularly in the OM-2 and OM-4 sub-basins, which are located on the north end of Orleans Parish along the levee at Lake Pontchartrain, and on the west end of the Parish, respectively.

The Risk Management Solutions (RMS) report ***Flood Risk in New Orleans, Implications for Future Management and Insurability*** uses a proprietary software model as part of its analysis and projection of future flood potential in the City. Among other things, the study examines the expected flood depth increases over time for four specific locations in New Orleans. The report found that presently the return period for "first storm surge flooding" for medium-term hurricane activities is about 55-years for the lowest elevations in the City, and around 275 years for the highest areas, which include Bourbon Street, which experienced little or no flooding in Katrina. Rather than specifically estimate flood potential flood losses (risk) in monetary terms, the RMS report indicates changes in the expected return periods of surge events that will cause flooding at specific elevations (in the report these elevations are linked to the four study locations). The report also discusses increases in return periods vs. specific flood elevations under different assumptions about increases in the elevations of flood defenses (primarily levees). The report makes two observations about flood risk in New Orleans. First, estimating losses will require knowing or accurately projecting the location and elevation of future development and re-building in the City. Second, that re-development should be carefully controlled so that it occurs at higher elevations in the City.

The subsection about **NFIP repetitive loss claims** data is based on a summary and analysis of flood insurance claims data from the City of New Orleans extending back to 1978. As noted in the narrative, the City has among the highest number of flood insurance claims and repetitive loss properties for any jurisdiction in the nation. The flood claims subsection of this plan summarizes the repetitive loss data by New Orleans neighborhood, and projects flood risk over 30- and 100-year planning horizons. The information is presented by neighborhood, and is sorted in several ways. The data and associated maps (not surprisingly) show strong correlation with the other studies, which indicate the highest potential flood losses (risk) at the areas of lowest elevation.

Notes on Wind Risk Assessment

Although the HAZUS-based wind risk assessment offers a reasonable start to the process of estimating expected losses, securing more complete and accurate information about both public and private assets would form the basis of a more thorough calculation. Although the HAZUS calculation is presumed reasonably accurate on a broad scale, it may also be in the City's interest to gather detailed information regarding City-owned and operated facilities in order to more accurately assess wind risk. This information should include structure type, square footage, use, and occupancy. The overall facility list could be prioritized to identify the operations and assets that are most critical to the City before, during and after hazard events. This level of risk assessment requires significantly more data, but is a fundamental part of identifying and prioritizing high-risk facilities, and by extension mitigation projects to reduce these risks.

Section 8. Capability Assessment

Contents of this Section

Changes between the 2005 Plan and the 2010 Plan Update
The Capability Assessment section of the 2005 Plan has been updated and expanded to include results of a new capability assessment survey completed by key departments and agencies that will serve as lead agencies to implement the Mitigation Strategy in the 2010 Plan Update. The Capability Assessment section for the 2010 Plan Update also includes an expanded discussion of federal and state capabilities to support Orleans Parish and 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 New Orleans' 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, it has the power to adopt and implement regulations for land use, zoning, and historic preservation and to adopt standards for the use, construction, demolition, and modification of areas and structures.

The City of New Orleans is currently in the process of updating many of the regulations that govern its application of these powers. One important milestone is the City's a new Master Plan, 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 new Land Use Plan. This new 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. The Master Plan must be reviewed every five years and may be reviewed and amended once a year. Elected officials, as well as city departments, boards and commissions are charged with implementing the policies of the new Master Plan. The 2005 Hazard Mitigation Plan is a part of the new Master Plan and once the City Council approves the 2010 Hazard Mitigation Plan Update, it will replace the 2005 Plan and become a part of the new 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.

Now that the Master Plan has been adopted, the next step is to adopt a new City Zoning Ordinance that will establish the rules to implement the policies of the new Master Plan. The City has begun the process to prepare the new City Zoning Ordinance and the City Planning Commission has outlined the principles that will guide the planning process to develop the new CZO. Once adopted, the CZO will provide the regulatory tool to implement not only the new Master Plan but also the Mitigation Strategy outlined in the 2010 Plan Update.

Departments, Boards, Commissions, and Communications District

Many City departments, boards, commissions, and the Orleans Parish Communications District perform functions related to hazard mitigation. The organizations listed below are those that are most likely to be involved in mitigation activities or to facilitate other organizations in that capacity.

New Orleans City Departments and Office of the Mayor

Chief Administrative Office – Serving as the administrative arm of the Mayor, this office oversees other city departments and the city budget. The office is also responsible for capital projects and other important city initiatives.

Office of Communications – The Office of Communications is responsible for coordinating all external communications that come from the Mayor.

Office of Intergovernmental Relations – This office oversees federal and state programs and grant monitoring. This office coordinates and works directly with federal, state and local agencies to secure funding for the City.

Office of Homeland Security and Emergency Preparedness (NOHSEP) – In cooperation with the U.S. Office of Homeland Security, this office is charged with developing and coordinating the implementation of a comprehensive national strategy to secure the United States from terrorist threats or attacks. The NOHSEP also is also responsible for emergency planning and responding to disasters and coordinating those 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 are made through this office. The NOHSEP also encompasses the Hazard Mitigation Office. The Hazard Mitigation Office manages the City's FEMA-funded hazard mitigation programs, including the elevation and reconstruction of homes, hardening of critical facilities, and updates to the Orleans Parish Hazard Mitigation Plan. The office is responsible for gathering knowledge about local hazards and risks, and incorporating this knowledge into city planning and project development. The Hazard Mitigation Office also communicates hazard and risk information to New Orleans residents, coordinates with city, state, and federal agencies, and builds long-term capacity in integrated disaster planning.

Office of Environmental Affairs – The Office of Environmental Affairs was established in 1994 to enhance and protect the New Orleans environment for current and future generations. The Office seeks to improve quality of life by promoting economic development, public education, community involvement, policy development, and other broad-based initiatives that benefit the environment and all of the City's residents.

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 insure 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 Code Enforcement – The Code Enforcement Department enforces a broad set of housing standards in the City Code. The Department's main functions include inspecting houses, prosecuting code violators, and initiating the expropriation process when needed. The Department works to encourage recovery by making 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.

Department of Public Works – Generally, the Public Works 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. During a hurricane evacuation, Public Works is in charge of making emergency road repairs as needed.

Department of Health – The New Orleans Health Department 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 valuable services including disease mapping, prevention and health maintenance. During an evacuation situation the Health Department is in charge of implementing the evacuation plan for special needs citizens.

Department of Sanitation – The Sanitation Department is responsible for the collection of refuse and keeping city streets clean.

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.

New Orleans City Council

City Council – The City Council serves as the legislative body of the City and consists of seven members – give 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 New Orleans' 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 Council employs the Clerk of Council, research and fiscal offices, and a utility regulatory staff.

Boards and Commissions

New Orleans Sewerage and Water Board – The mission of the Sewerage and Water Board is to provide New Orleans with adequate drainage, sewerage collection, and drinking water. The Board is responsible for operating pumping stations throughout the City to pump out storm water.

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 or "No Objection" to any work or structures intended to occur 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, the New Orleans Office of Emergency Preparedness, and the Orleans Levee District. Each October or November, the same parties conducted 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).

Southeast Louisiana Flood Protection Authority-East (SLFPA-East) – The Southeast Louisiana Flood Protection Authority - 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.

The Southeast Louisiana Flood Protection Authority-West (SLFPA-West) – The SLFPA-West is the other of two levee authorities serving the City of New Orleans and the 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.

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."

Regional Planning Commission (RPC) – The RPC, created by the State legislature, 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.

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 and Termite Control Board – The Mosquito and Termite Control Board is responsible for administering and evaluating mosquito and termite activities and monitoring the population of disease and virus transmitting mosquitoes.

Regional Transit Authority (RTA) – The RTA operates public buses and streetcars in New Orleans. Current plans call for RTA to provide transit to persons without other transportation during an evacuation of the City in advance of a hurricane.

Orleans Parish Communications District

Orleans Parish Communication District (OPCD) – The OPCD provides the infrastructure for and administers the 911 emergency communication system. The office was created by the State Legislature in 1982. Primary responsibilities include the purchasing and the maintenance of equipment and providing training for new and experienced police, fire and emergency medical personnel.

Other Organizations

U.S. Army Corps of Engineers (USACE) – The USACE's New Orleans division (Team New Orleans) 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 USACE is prepared to conduct contingency operations as well as support the national response plan.

Lake Pontchartrain Basin Foundation (LPBF) – The Foundation 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.

AT&T – AT&T is one the City of New Orleans' lead provider of telecommunications services, including residential phone, Internet, DSL, Wi-Fi, and cell phone services.

Cox Communications – Cox is one of the leading providers of cable entertainment and broadband services in Orleans Parish.

Entergy New Orleans (ENO) – ENO, a subsidiary of Entergy Corporation, is an electric and gas utility serving Orleans Parish. Customers on the east bank of the parish are served by Entergy New Orleans, while customers on the west bank, or Algiers portion of Orleans Parish, are served by Entergy Louisiana. ENO provides electricity to approximately 150,000 electric customers and natural gas to approximately 96,000 customers in Orleans Parish.

Survey of Local Capabilities

Surveys were distributed to all agencies that provide services that directly or indirectly support hazard mitigation planning activities. Participants provided information that helped make clear how local programs are used to lessen the impacts of potential hazards and further support hazard mitigation planning efforts. The resulting information helped identify gaps, conflicts, and or weaknesses to be addressed through the Orleans Parish 2010 Hazard Mitigation Plan Update.

The purpose of the survey questionnaire was to identify existing capabilities within Orleans Parish to implement hazard mitigation activities. The survey requested information regarding: 1) planning and regulatory tools in place or under development; 2) administrative and technical resources; 3) funding resources; and 4) political support.

The results of the Local Capability Assessment survey are shown in the following tables.

STAFF/PERSONNEL RESOURCES **Agency**	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused disasters	Emergency Manager	Floodplain Manager	Land Surveyors	Scientists familiar with the hazards of the community	Staff with education or expertise to assess the community vulnerability to hazards	Personnel skilled in Geographic Information Systems (GIS) and/or FEMA's HAZUS program	Resource development staff or grant writers
City of New Orleans Homeland Security and Emergency Preparedness (including Office of Emergency Preparedness and Hazard Mitigation Office)	X		X	X	X			X	X	X
New Orleans City Planning Commission (CPC)	X		X					X	X	X
City of New Orleans Mayor's Office of Environmental Affairs							X			X
New Orleans Fire Department		X					X	X	X	X
New Orleans Area Regional Planning Commission				X					X	X
Sewerage and Water Board	X	X	X	X				X	X	X
Entergy	X	X	X	X					X	
Orleans Levee District		X	X	X	X	X				
U.S. Army Corps of Engineers	X	X	X	X		X	X	X	X	
UNO Center for Hazard Assessment Response Technology (CHART)	X	X	X				X	X	X	X
City Park Improvement Association	X	X	X	X				X		X
Lake Pontchartrain Basin Foundation	X		X				X		X	
Port of New Orleans	X	X	X	X		X		X		X
Regional Transit Authority		X	X	X						
Louisiana Recovery Authority	X	X	X							

Local Hazard Mitigation Capabilities

Administrative, Technical Resources Available to Implement the Orleans Parish 2010 Hazard Mitigation Plan

Survey Comments:

City of New Orleans Office of Homeland Security and Emergency Preparedness NOHSEP (includes Emergency Preparedness and Hazard Mitigation)

- Ability to implement hazard mitigation plan is contingent on the annual budgeting process, elections, and cycles of various hazards.
- Mitigation is most effective pre-disaster, but implementation of proactive policies is difficult because the focus is often on disaster recovery.
- The scarcity of funds to implement policies and programs in New Orleans creates a competition among departments and programs for funds.
- Need strong outreach effort to educate community of the benefits of pre-disaster planning. This will strengthen political resolve to fund pre-disaster mitigation.

New Orleans City Planning Commission (CPC)

- Most CPC staff has degrees in planning related fields and regularly deal with land development and management in their day-to-day work.
- Grant writing is not an official role, but many CPC staff have grant writing experience.
- Ability to put forth positions on politically charged, unpopular issues, e.g., recommendations to restrict development opportunities through future land use maps and restricting land uses on ground floor in areas vulnerable to flooding.

New Orleans Fire Department (NOFD)

- NOFD Hazardous Materials Technicians are knowledgeable in chemical and other community hazards.
- NOFD has personnel trained in GIS for mapping and response analysis.
- NOFD Homeland Security Liaison functions as department grant writer.

Sewerage and Water Board (S&WB)

- S&WB Emergency Manager is CEM rated.

Orleans Levee District

- Planners can provide comments on federal, state and local wetland permits.

Port of New Orleans (PONO)

- PONO outsources, as needed, planning services with a certified planning consultant.
- PONO outsources land surveying services.

Louisiana Recovery Authority (LRA)

- Engineers/Professionals trained in construction practices related to buildings and/or infrastructures are part of the OCD-Disaster Recovery Unit.
- LRA expired in June 2010.

FINANCIAL RESOURCES Agency	Capital Improvement Programming	Community Development Block Grants (CDBG)	Special Purposes Taxes (or taxing districts)	Fees for Water, Sewer, Gas or Electric 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	Withhold spending in hazard-prone areas
City of New Orleans Homeland Security and Emergency Preparedness (including Office of Emergency Preparedness and Hazard Mitigation Office)	X									
New Orleans City Planning Commission (CPC)	X	X						X		X
City of New Orleans Mayor's Office of Environmental Affairs										
New Orleans Fire Department										
New Orleans Area Regional Planning Commission	X							X		
Sewerage and Water Board	X	X	X	X	X	X	X	X	X	X
Entergy		X		X			X	X		
Orleans Levee District	X	X	X				X	X		
U.S. Army Corps of Engineers								X		
UNO Center for Hazard Assessment Response Technology (CHART)										
City Park Improvement Association	X	X	X						X	
Lake Pontchartrain Basin Foundation										
Port of New Orleans	X	X					X	X		
Regional Transit Authority	X						X	X		
Louisiana Recovery Authority		X								X

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. The Chief Administrative Officer prepares the budget proposals and the Mayor presents them to the City Council. The City Council may increase, decrease, or delete any budget item; it may also add budget items under certain conditions. 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 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

- **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. The FMA 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, flood mitigation, and more. The FMA covers up to 75% of costs.

- **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 Severe Repetitive Loss Program (SRL)**: Severe Repetitive Loss grants target acquisition funds to NFIP-insured properties that have either had four or more claims of $5,000; two or more claims with a cumulative value of $20,000; or two or more claims whose net value exceeds the property's value. The SRL Program typically requires a 25% state/local match; however, the state/local match can be decreased to as low as 10% in cases in which a FEMA-approved Standard or Enhanced Hazard Mitigation Plan exists, and includes a strategy for mitigating existing and future SRL properties. The Incremental Cost of Compliance (ICC) funds have been used as a match for the SRL Program.

- **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. The majority of hurricanes Katrina- and Rita-related funds came through PA and HMGP.

- **FEMA Map Modernization**: FEMA's flood hazard maps are one of the essential tools for flood hazard mitigation in the United States. FEMA's Flood Map Modernization is a federal program to increase the reliability of flood maps. This program requires the cooperation and input of state and local agencies and jurisdictions to collect and update flood data.

- **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 Louisiana, the non-federal share is typically borne by the community or the property owner.

Other Federal Mitigation Related Program

The following other federal mitigation related programs represent only some of the federal programs available to support the Orleans Parish 2010 Hazard Mitigation Plan. A more comprehensive listing of potential funding sources to support the 2010 Plan Update is included in Table 8.1 at the end of Section 8.

- **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 damage 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, to 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 or 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 and 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, the Louisiana Recovery Authority (LRA), and the Louisiana Floodplain Management Association 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 both within the State and including federal partners are needed.

GOHSEP, DNR, 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, and to integrate local and state planning, a better system of GIS and other data creation, consistency, management, and distribution is needed. The most viable option is likely one that involves partnerships between GOHSEP, Louisiana universities, and other state agencies, as well as local and regional entities.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
FEMA	Emergency Management Performance Grants (97.042)	Assist State and local governments in enhancing and sustaining all-hazards emergency management capabilities.	State government	Planning, Organization, Equipment, Training, Exercises, EOC Construction and renovation, maintenance and sustainment.	329,799,991 (FY2010)	State Administrative Agency apply for the available funding on behalf of eligible state, local, and tribal entities.	50 percent grantee share
FEMA	Emergency Operations Center (EOC) Grant Program (97.052)	Funding for construction or renovation of a state, local, or tribal governments' principal EOC.	State government	EOC construction or renovation	57,600,000 (FY2010)	State Administrative Agency apply for the available funding on behalf of eligible state, local, and tribal EOCs.	25 percent grantee share
NFIP (FEMA)	National Flood Insurance Program (NFIP) (97.022)	The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP.	Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding.	Building property and personal contents property.	(Insurance) FY 09 $145,680,052; FY 10 est $146,000,000;	Community officials must submit an NFIP eligibility application form, copies of adopted floodplain management measures meeting the minimum standards of 44 CFR Section.	Matching requirements are not applicable to this program.
FEMA	Flood Mitigation Assistance (FMA) (97.029)	To assist States, Indian tribal governments, and communities to reduce or eliminate the long-term risk of flood damage to structures insured under the National Flood Insurance Program (NFIP).	States, Territories, local and Federally-recognized Indian tribal governments.	Acquisition and relocation of at-risk structures, conversion of property to open space; elevation of existing structures to the Base Flood Elevation (BFE) or an ABFE Advisory Base Flood Elevation (ABFE) or higher; minor flood control projects.	(Project Grants) FY 09 $30,000,000; FY 10 est $30,000,000; FY 11 est $35,000,000	Preapplication coordination is required. OMB Circular No. A-102 applies to this program. Contact the headquarters or regional office, as appropriate, for application deadlines.	An applicant's FMA project and planning target allocation is based on the national percentage of NFIP policies present within the jurisdiction. An applicant may apply for funding up to or exceeding its target allocation.
FEMA	Severe Loss Repetitive Program (SRL) (97.11)	To assist States and local governments in supporting actions that reduce or eliminate the long-term risk of flood damage to severe repetitive loss residential properties insured under the National Flood Insurance Program (NFIP).	Beneficiary Eligibility (082): States, Territories, local governments, Federally-recognized Indian tribal governments, and homeowners.	Acquisition and relocation of at-risk structures and the conversion of property to open space; elevation of existing structures; minor physical localized flood control projects; and dry-flood proofing (historic properties only).	(Project Grants) FY 09 $63,000,000; FY 10 est $35,000,000; FY 11 est $35,000,000	OMB Circular No. A-102 applies to this program.	DHS FEMA may contribute up to 75 percent of the eligible costs of activities that target SRL properties. The SRL program offers up to 90 percent Federal cost share funding that include a strategy for mitigating existing and future SRL properties.
FEMA	Repetitive Loss Claims (97.092)	To reduce or eliminate the long-term risk of flood damage to structures insured under the National Flood Insurance Program (NFIP) that have had one or more claims for flood damages.	Specific information on sub-applicant eligibility, and application procedures for Federally-recognized Indian tribal governments, is provided on the SRL program guidance.	Acquisition of insured structures for the purpose of converting flood-prone land back to open space use; elevation of existing structures; dry floodproofing; and minor localized flood reduction projects.	(Project Grants) FY 09 $10,000,000; FY 10 est $10,000,000; FY 11 est $10,000,000	OMB Circular No. A-102 applies to this program.	Statutory formulas are not applicable to this program. DHS FEMA may contribute up to 100 percent of the eligible costs of activities that target eligible properties. MOE requirements are not applicable to this program.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
FEMA	Pre-Disaster Mitigation (PDM) (97.047)	To provide funding support to states, tribes, territories, communities, and public colleges and universities for pre-disaster mitigation planning and projects primarily addressing natural hazards.	Local governments participating in NFIP are eligible to apply to the grantee for assistance as a subgrantee under the PDM program. mitigation plans that meet planning criteria outlined in 44 CFR Part 201 are eligible for the PDM program.	Mitigation Planning, Mitigation Projects	(Project Grants) FY 09 $90,000,000; FY 10 est $100,000,000; FY 11 est not reported. - No Data Available for FY 2011.	Preapplication coordination is required. An environmental impact statement is required for this program. OMB Circular No. A-102 applies to this program. OMB Circular No. A-110 applies to this program.	Statutory Formula: Title Robert T. Stafford Disaster Relief and Emergency Assistance Act, Chapter 42, Part 5133, Public Law 93-288. Matching Requirements: At most 25% nonfederal, 75% Federal.
FEMA	Hazard Mitigation Grant Program (HMGP) (97.039)	To provide States and local governments financial assistance to implement measures that will permanently reduce or eliminate future damages and losses from natural hazards.	State agencies, local governments, public entities, private nonprofit organizations as defined in 44 CFR Section 206.433.	acquisition of real property, relocation, demolition of structures, seismic rehabilitation or retrofitting of existing structures; strengthening of existing structures; initial training of architects, engineers, building officials.	(Project Grants) FY 09 $312,936,080; FY 10 est not reported.; FY 11 est not reported.	OMB Circular No. A-102 applies to this program. OMB Circular No. A-110 applies to this program.	This program has no statutory formula. Matching Requirements: FEMA can fund up to 75 percent of the eligible costs of each project. The State or project applicant must provide a 25 percent match.
FEMA	Regional Catastrophic Preparedness Grant Program (RCPGP) (97.111)	The goal of RCPGP is to support an integrated planning system that provides for regional all-hazard planning for catastrophic events and the development of necessary plans, protocols, and procedures to manage a catastrophic event.	Applicant Eligibility: Specific information on applicant eligibility is identified in the funding opportunity announcement and program guidance; Beneficiary Eligibility: State and local governments.	Creating regional planning processes and planning communities through the establishment of a Catastrophic Planning Working Group; ; Identifying and assessing priority areas of concern using both capabilities-based and scenario-based planning models.	(Salaries) FY 09 $35,000,000; FY 10 est $35,000,000; FY 11 est $35,000,000	Preapplication coordination is required. OMB Circular No. A-102 applies to this program. This program is excluded from coverage under OMB Circular No. A-110.	Statutory formulas are not applicable to this program. Matching Requirements: 25%. The program will require a soft match of non-Federal funds totaling 25 per cent. MOE requirements are not applicable to this program.
DHS	Emergency Management Institute_Training Assistance Student Stipend Reimbursement Program SEP (97.026)	To defray travel expenses of State, local, and tribal emergency management personnel who attend training courses conducted by the Emergency Management Institute.	Individuals who are assigned to an emergency management position in State, local or tribal government are eligible.	Reimbursement may be made for a portion of student's travel, but attendees are required to pay for meals.	(Direct Payments for Specified Use) FY 09 $1,466,942; FY 10 est $1,500,000; FY 11 est $1,500,000	Applications for admission to training course are processed/coordinated through county, State, tribal, and regional emergency management entities. The Student Stipend Agreement must be accompanied by the required supporting documentation.	This program has no statutory formula. Matching Requirements: Certain match requirements include payment of meals by attendees. This program does not have MOE requirements.
DHS	Community Disaster Loans (97.03)	To provide loans subject to Congressional loan authority, to any local government that has suffered substantial loss of revenues in an area in which the President designates a major disaster exists.	Applicants must be in a designated major disaster area and must demonstrate that they meet the specific conditions of FEMA Disaster Assistance Regulations 44 CFR Part 206, Subpart K, Community Disaster Loans.	The funds can only be used to maintain existing functions of a municipal operating character and the local government must demonstrate a need for financial assistance.	(Direct Loans) FY 08 $4,400,000; FY 09 est $32,000,000; FY 10 est not reported.	OMB Circular No. A-102 applies to this program. OMB Circular No. A-110 applies to this program.	This program has no statutory formula. Matching requirements are not applicable to this program. MOE requirements are not applicable to this program.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
DHS	Assistance to Firefighters Grant (97.044)	To provide financial assistance directly to fire departments and nonaffiliated EMS organizations to enhance their capabilities with respect to fire and fire-related hazards.	Eligible applicants for AFG are limited to fire departments and nonaffiliated EMS organizations.	Training, Wellness and Fitness, Firefighting Equipment, Personal Protective Equipment, Modifications to Firefighting Facilities for Firefighter Safety, Other Equipment and Supplies;	(Project Grants) FY 09 $565,000,000; FY 10 est $300,000,000; FY 11 est $420,000,000	OMB Circular No. A-102 applies to this program. OMB Circular No. A-110 applies to this program.	This program has no statutory formula. Matching Requirements: Applicants who protect a population of over 50,000 are required to provide a nonfederal cost-share of not less than 20 percent of the total award.
DHS	Citizen Corps (97.053)	To bring together government and community leaders and involve citizens in all-hazards emergency preparedness and resilience.	Local governments may receive assistance as subgrantees to the States in which they are located.	Cooperative Agreements	(Project Grants) FY 09 $15,000,000; FY 10 est $12,480,000; FY 11 est not reported. - FY 11 est not available.	OMB Circular No. A-102 applies to this program. This program is excluded from coverage under OMB Circular No. A-110.	This program has no statutory formula. This program has no matching requirements. MOE requirements are not applicable to this program.
DHS	Interoperable Emergency Communications (97.055)	To provide governance, planning, training and exercise funding to States, territories, and local and tribal governments to carry out initiatives to improve interoperable emergency communications.	Applicant Eligibility: Applicant Eligibility - All states and territories. Beneficiary Eligibility (082): Beneficiary Eligibility: States, territories, and local and tribal governments.	The Program provides the flexibility to purchase interoperable communications equipment.	(Project Grants) FY 09 $48,575,000; FY 10 est $48,000,000; FY 11 est not reported.	Preapplication coordination is required. This program is excluded from coverage under E.O. 12372. OMB Circular No. A-102 applies to this program. This program is excluded from coverage under OMB Circular No. A-110.	Statutory formulas are not applicable to this program. Matching Requirements: 25%. Grant awards will require a 25 percent nonfederal cost share on all equipment purchases.
DHS	Metropolitan Medical Response System (MMRS) (97.071)	The MMRS program supports the integration of emergency management, health, and medical systems into a coordinated response to mass casualty incidents caused by any hazard.	Beneficiary Eligibility: Local jurisdictions.		(Project Grants) FY 09 $39,831,404; FY 10 est $41,000,000; FY 11 est not reported.	Preapplication coordination is required. OMB Circular No. A-102 applies to this program. This program is excluded from coverage under OMB Circular No. A-110.	Statutory formulas are not applicable to this program. Matching requirements are not applicable to this program. MOE requirements are not applicable to this program.
DHS	Disaster Donations Management Program (97.098)	To distribute a web-based technology solution to State governmentsand Private Voluntary Organization (PVOs) s in order to ensure that in the event of a disaster to allow the general public to make offers of donated goods, volunteer services, and financial.	Applicant Eligibility: Refer to announcement or program guidance for further information. Beneficiary Eligibility: State and local governments and Private Voluntary.	Enable the "matching" of donated resources and PVO needs, thus adding value to the overall relief efforts.	(Cooperative Agreements) FY 09 $515,425; FY 10 est $500,000; FY 11 est $500,000	This program is excluded from coverage under OMB Circular No. A-102. This program is excluded from coverage under OMB Circular No. A-110. Unsolicited applications will not be accepted.	Statutory formulas are not applicable to this program. Matching requirements are not applicable to this program. MOE requirements are not applicable to this program.
DHS	Emergency Food and Shelter National Board Program (97.024)	To conduct minimum rehabilitation of existing mass shelter or mass feeding facilities, but only to the extent necessary to make facilities safe, sanitary and bring them into compliance with local building codes.	Funds are initially distributed to jurisdictions based on either a National Board formula or recommendations from State Set-Aside Committees, there is no application process for jurisdictions.	Food and related expenses; mass shelter; other shelter; and rent/mortgage and/or utility assistance limited to one month; and limited repairs to feeding and sheltering facilities.	(Project Grants) FY 09 $200,000,000; FY 10 est $200,000,000; FY 11 est $100,000,000	There is no application process for local jurisdictions since the award notification to local jurisdictions is based on either a National Board formula or recommendations from State Set-Aside Committees.	Statutory formulas are not applicable to this program. This program has no matching requirements. MOE requirements are not applicable to this program.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
CDC	Environmental Public Health and Emergency Response (93.07)	To bring public health and epidemiologic principles together to identify, clarify, and reduce the impact of complex environmental threats, including terrorist threats and natural disasters, on populations, domestic and foreign.	OMB Circular No. A-87 applies to this program.	Cooperative Agreements	(Cooperative Agreements) FY 09 $28,641,481; FY 10 est $28,641,481; FY 11 est $28,641,481	OMB Circular No. A-102 applies to this program. OMB Circular No. A-110 applies to this program. Preapplication coordination is required. This program is eligible for coverage under E.O. 12372, "Intergovernmental Review of Federal Programs."	This program has no statutory formula. This program has no matching requirements. Length and Time Phasing of Assistance Support is recommended for a specified project period, not to exceed 5 years.
CDC	Centers for Disease Control and Prevention_Investigations and Technical Assistance (93.283)	To assist State and local health authorities and other health related organizations in controlling communicable diseases, chronic diseases and disorders, and other preventable health conditions.	States, political subdivisions of States, local health authorities, Federally recognized or state recogonized American Indian/Alaska Native tribal governments and organizations with specialized health interests may apply.		Salaries) FY 09 not reported.; FY 10 est $36,370,099; FY 11 est not reported.	Preapplication coordination is required.	This program has no statutory formula. This program has no matching requirements. MOE requirements are not applicable to this program.
DHHS	Bioterrorism Training and Curriculum Development Program (93.996)	To develop a health care workforce with the knowledge, skills, abilities and core competencies to (3) participate in a coordinated, multidisciplinary response to terrorist events and other public health emergencies.	Academic health centers; other public or private nonprofit accredited or licensed health professions schools.	Training	FY 07 $21,000,000; FY 08 est not available; and FY 09 not reported.	Grant applications and required forms for this program can be obtained from Grants.gov.	None
Department of Commerce	Automated Flood Warning Systems (AFWS) (11.45)	The objective of the Automated Flood Warning Systems Program is to provide funding to communities with flood or flash flood problems that affect safety of life and property.	Eligible applicants are States, counties, municipalities, educational institutions, and non-profit organizations	Creating, renovating, or enhancing Automated Flood Warning Systems (AFWS).	(Cooperative Agreements) FY 08 $0; FY 09 est $0; FY 10 est $0 - No estimate available for future funding.	Preapplication coordination is required. OMB Circular No. A-102 applies to this program. OMB Circular No. A-110 applies to this program. All proposals are subject to the requirements of OMB Circular Nos. A-21 and A-110, as applicable.	This program has no statutory formula. Matching requirements are not applicable to this program. MOE requirements are not applicable to this program.
Department of Commerce	Hydrologic Research (11.462)	To maintain a cooperative university/Federal partnership to conduct joint research and development on pressing surface water hydrology issues.	Eligible applicants are Federally recognized institutions of higher learning, agencies of State or local governments, quasi-public institutions	Funds can be used to support research and development on issues related to the forecasting of surface hydrologic conditions.	(Cooperative Agreements) FY 08 $634,735; FY 09 est $1,101,599; FY 10 est $1,100,000	Preapplication coordination is required. Proposals for new cooperative agreements are solicited with an announcement in the Federal Register or grants.gov.	This program has no statutory formula. Matching requirements are not applicable to this program. MOE requirements are not applicable to this program.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
DOD	Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works (12.102)	To assist in the repair and restoration of flood control works damaged by flood, or federally authorized hurricane flood and shore protection works damaged by extraordinary wind, wave, or water action.	For public entities, copy of resolution or other proceeding constituting official request for assistance. For private owners, public sponsorship is required	Emergency repair or rehabilitation of flood control works damaged by flood, and restoration of federally authorized coastal protection structures damaged by extraordinary wind, wave, or water action	(Salaries and expenses) FY 07 est not reported; FY 08 est not reported; and FY 09 est not reported.	Written application by letter or by form request if such form is locally used by the District Engineer of the Corps of Engineers.	Nonfederal flood control projects: 1. Maintain an acceptable maintenance rating; 2. Provide 20 percent cost-share of construction cost either by monetary value or in- kind services; and, 3. Obtain public sponsorship by a public entity;
DOD	Flood Plain Management Services (12.104)	To promote appropriate recognition of flood hazards in land and water use planning and development through the provision of flood and flood plain related data, technical services, and guidance.	States, political subdivisions of States, other nonfederal public organizations and the public.	Advisory Services and Counseling; Dissemination of Technical Information.	(Salaries and expenses) FY 07 est not reported; FY 08 est not reported; and FY 09 est not reported.	The request must come from an official of a nonfederal public agency.	These services are provided to State and local governments at full Federal expense. Federal agencies and the private sector must pay for services.
DOD	Protection of Essential Highways, Highway Bridge Approaches, and Public Works (12.105)	To provide bank protection of highways, highway bridges, essential public works, churches, hospitals, schools, and other nonprofit public services endangered by flood-caused erosion.	Each project selected must be engineering feasible, complete within itself and economically justified.	Provision of Specialized Services. Corps of Engineers designs and constructs the project.	(Salaries and expenses) FY 07 est not reported; FY 08 est not reported; and FY 09 est not reported.	State or local government officials should consult the nearest District Engineer regarding specific problems and the possibility of remedial action under this program. An environmental assessment is required.	In most cases project studies will be at Federal expense. Cost-sharing is required for project, but Federal participation cannot exceed $1,000,000.
DOD	Flood Control Projects (12.106)	To reduce flood damages through projects not specifically authorized by Congress.	States, political subdivisions of States, or other responsible local agencies established under State law with full authority and ability to undertake necessary legal and financial responsibility.	Provision of Specialized Services.	(Planning and construction) FY 07 est not reported; FY 08 est not reported; and FY 09 est not reported. No current information provided by Agency.	Formal letter to the District Engineer indicating clear intent to provide all required local participation.	Nonfederal sponsoring agency will share equally in the cost of feasibility studies (cash and in-kind services), shares in the project cost in cash, lands, damages and project costs in excess of the Federal cost limit of $7,000,000.
HUD	Community Development Block Grants/Entitlement Grants (14.218)	To develop viable urban communities by providing decent housing, a suitable living environment, and expanding economic opportunities, principally for persons of low and moderate income.	Recipients are states; cities in Metropolitan Areas designated by OMB as a central city of the Metropolitan Area; other cities over 50,000 in Metropolitan Areas; and qualified urban counties of at least 200,000	Entitlement communities develop their programs and set their funding priorities in conformance with the statutory standards, program regulations, and other federal requirements.	(Formula Grants) FY 09 $2,544,477,000; FY 10 est $2,758,902,000; FY 11 est $2,760,289,000 - Allocations made to entitled metropolitan cities and urban counties.	For formula grants, action plans associated with the Consolidated Plan must be submitted based on the grantee's program year, but no earlier than November 15 or no later than August 16 of the fiscal year for which the funds are allocated.	Statutory Formula: Title 24, Part 570. This program has no matching requirements. This program does not have MOE requirements.
HUD	Community Development Block Grants/Technical Assistance Program (14.227)	To help States, units of general local government, Indian tribes and area-wide planning organizations to plan, develop and administer local Community Development Block Grant programs.	Applicants need to obtain a DUNS number to receive an award and submit other documentation as described in a solicitation document. OMB Circular No. A-87 applies to this program.	Assistance may take several forms, such as the provision of written information, person-to-person exchange, seminars, workshops or training sessions	(Cooperative Agreements (Discretionary Grants)) FY 09 $5,000,000; FY 10 est $0; FY 11 est $0	Proposals may be submitted in response to competitions and solicitations. The Federal Register publication detailing each competition spells out the submission requirements.	Statutory formulas are not applicable to this program. Matching requirements are not applicable to this program. This program does not have MOE requirements.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
HUD	Community Development Block Grants_Section 108 Loan Guarantees (14.248)	To provide communities with a source of financing for economic development, housing rehabilitation, public facilities, and large scale physical development projects.	Eligible Applicants include: metropolitan cities and urban counties, i.e., CDBG entitlement recipients	For purposes of determining eligibility, the Community Development Block Grant (CDBG) rules and requirements apply.	(Guaranteed/Insured Loans) FY 09 $275,000,000; FY 10 est $275,000,000; FY 11 est $500,000,000	Preapplication Coordination: Preapplication requirements are foundin 24 CFR Section 570.704.	This program has no statutory formula. This program has no matching requirements. MOE requirements are not applicable to this program.
HUD	Historically Black Colleges and Universities Program (14.52)	To assist Historically Black Colleges and Universities (HBCUs) expand their role and effectiveness in addressing community development needs in their localities.	Historically Black Colleges and Universities as determined by the Department of Education in 34 CFR 608.2 pursuant to that Department's responsibilities under Executive Order 13256, dated February 12, 2002.	ch activity proposed for funding must meet the established Community Development Block Grant (CDBG) Program requirements and at least one of the three CDBG national objectives.	(Project Grants (Discretionary)) FY 09 $9,000,000; FY 10 est $9,682,200; FY 11 est $9,780,000	Applications will be reviewed against published criteria, rated and ranked, and awards made to the highest ranking applications.	This program has no statutory formula. This program has no matching requirements. This program does not have MOE requirements.
DHS	National Fire Academy Training Assistance - Student Stipend Reimbursement Program (97.018)	To provide travel stipends to students attending Academy courses.	Any student who is a member of a fire department or has significant responsibility for fire prevention and control and has been accepted into an eligible course at the National Fire Academy may apply for stipend reimbursement.	DIRECT PAYMENTS FOR A SPECIFIED USE	(Salaries) FY 09 $1,597,554; FY 10 est $1,600,000; FY 11 est $1,600,000	Application is made to the National Emergency Training Center Admission's Office using the Student Stipend Agreement (FEMA Form 75-3) and Student Stipend Agreement (Amendment) (FEMA Form 75-3a) after acceptance into the course.	This program has no statutory formula. This program has no matching requirements. MOE requirements are not applicable to this program.
DHS	National Urban Search and Rescue (US&R) Response System (97.025)	Develop, maintain, deploy, coordinate, and support National Urban Search and Rescue resources on-scene to locate, provide initial medical treatment, and extricate victims of incidents requiring specialized search and rescue operations.		PROJECT GRANTS; State and local emergency management agencies may jointly develop one or more US&R Task Force(s), as defined in the National US&R Response System Operation Manual.	(Project Grants) FY 09 $28,629,280; FY 10 est $29,620,000; FY 11 est $29,620,000	Preapplication coordination is required. Application deadline and other information are contained in the yearly application/program guidance.	This program has no statutory formula. This program has no matching requirements. Refer to Program Guidance. MOE requirements are not applicable to this program.
DHS	Cooperating Technical Partners (CTP) (94.045)	To increase local involvement in, and ownership of, the production development and maintenance of Digital Flood Insurance Rate Maps (DFIRMS) flood hazard maps produced for for the National Flood Insurance Program (NFIP).	All States and Commonwealths (including the District of Columbia and territories and possessions of the United States), regional agencies, and communities may apply.	Cooperative Agreements. Program Management and Technical Mapping Activities as delineated in Tables 2 and 3 of the FY 2010 program guidance.	(Project Grants) FY 09 $77,000,000; FY 10 est $44,000,000; FY 11 est not reported.	All applicants should consult with the FEMA Regional office for application information and technical assistance.	Statutory formulas are not applicable to this program. This program has no matching requirements. This program has no matching requirements unless otherwise stated in Congressional Appropriations language.

Table 8.1 Funding Source Matrix

Source	Program Name (CFDA #)	Purpose	Eligibility Requirements	Types of Projects Funded	Annual Funding Amount	Application Requirements	Local Match Requirement
EPA	Capitalization Grants for Drinking Water State Revolving Funds (66.468)	Grants are made to States to capitalize their Drinking Water State Revolving Funds (DWSRFs) which will provide a long-term source of financing for the costs of drinking water infrastructure.	States, the District of Columbia, U.S. Territories or Possessions (the Commonwealth of Puerto Rico, Virgin Islands, Mariana Islands American Samoa, and Guam), and Federally Recognized Indian Tribal Governments are eligible for grants from the program.	Infrastructure improvement projects that are needed to achieve or maintain compliance with SDWA requirements, protect public health, and assist systems with economic need.	(Formula Grants) FY 09 $2,809,029,000; FY 10 est $1,383,000,000; FY 11 est $1,283,000,000 - FY 09 $829,029,000; FY 10 est. $1,383,000,000; and FY 11 est. $1,283,000,000. Recovery Act funds - FY 09 $1,980,000,000; FY 10 est. $0; and FY 11 est. $0.	To receive a grant, an applicant enters into an agreement with the EPA Regional Administrator which shall include, but are not limited to, the requirements set forth in Section 130 of the SDWA. Recipients must follow OMB Circular No. A-87.	Statutory Formula: Title Safe Drinking Water Act. Matching Requirements: The funds available for allotment to State DWSRF programs are those funds appropriated by Congress under the Safe Drinking Water Act (SDWA 1452; 40 CFR 35.3540 and 35.3585).
USDA	Cooperative Extension Service (10.5) Cooperative Extension Service CES; Smith-Lever Special Needs Program (aka ESPN Special Needs Projects)	Innovative extension education approaches to addressing risks, hazards and disasters.	SMITH-LEVER 3(b) & (c): (a) Cooperative Extension Programs at 1862 Land-Grant Institutions (aka 3b & c Formula Funds); Louisiana State University;	Reduce risk through planning, disaster preparedness and emergency response by improving communication between the public, community leaders, state and Federal agencies;	(Project Grants) FY 08 $433,701,675; FY 09 est $453,461,047; FY 10 est $465,245,580	Contact local representative	
USDA	Emergency Watershed Protection Program (Recovery) (10.923)	The objective of the EWP Program is to assist sponsors, landowners, and operators in implementing emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards to life and property created by a natural disaster.	Public and private landowners are eligible for assistance but must be represented by a project sponsor. Project sponsor means a State government or a State agency or a legal subdivision thereof, local unit of government.	All EWP work must reduce threats to life and property and must be economically, environmentally, and socially defensible and sound from a technical standpoint.	(Cooperative Agreements (Discretionary Grants)) FY 08 $0; FY 09 est $74,729,331; FY 10 est $41,270,769. (Cooperative Agreements (Discretionary Grants)) FY 08 $147,393,731; FY 09 est $244,240,385; FY 10 est $200,022,769	Preapplication coordination is required. Potential sponsors submit formal requests for assistance to the NRCS state conservationist.	NRCS may bear up to 75 percent (90 percent within limited resource areas as identified by the US Census data) of the construction cost; 25 percent local sources as cash or in-kind services.
EPA	Performance Partnership Grants (PPGs) (66.605)	PPGs are innovative grant delivery tools that allow States and Tribes to combine up to 20 eligible STAG program grants into a single grant with a single budget.		PPGs are a type of modified block grant, where recipients may combine funds from categorical grants to accomplish their joint and several purposes, so long as recipients meet program requirements for each categorical grant combined into the PPG.	(Formula Grants) FY 09 $381,000,000; FY 10 est $381,000,000; FY 11 est $381,000,000	Applicants should coordinate with their appropriate EPA regional office to develop a PPG through joint negotiations.	This program has no statutory formula. Matching Requirements: Major portions of the PPGs are by statutory formula. The allocation for a PPG consists of the cumulative allocations for the categorical grants included in the PPG.
HUD	Healthy Homes Implementation Grant Program (14.913)	The purpose of the Healthy Homes Implementation Program is to comprehensively address multiple residential health and safety hazards, including mold, carbon monoxide, home safety hazards, pesticides and allergens (from pets and pests).	Eligible applicants include not-for-profit institutions and for-profit firms, state and local governments.	For Fiscal Year 2010, potential applicants should consult the NOFA for available grant funding	(Project Grants) FY 09 $0; FY 10 est $10,000,000; FY 11 est $17,000,000	The competitive Notification of FundingAvailability (NOFA) for fiscal year 2010 Healthy Home Implementation Program grants provides information about the www.grants.gov application procedure.	Statutory formulas are not applicable to this program. Matching requirements are not applicable to this program. MOE requirements are not applicable to this program.

Section 9. Mitigation Strategy

Contents of this Section

Changes between the 2005 Plan and the 2010 Plan Update.
The Mitigation Strategy section of the 2005 Plan has been updated, expanded, and completely rewritten to include updated goals and objectives, a review of the 2005 Mitigation Action Plan and accomplishments, an updated Mitigation Action Plan that addresses the updated hazards and risk assessment, and a discussion of Orleans Parish's compliance with the National Flood Insurance Program and participation in the NFIP Community Rating System. The Mitigation Strategy section identifies which of the 23 mitigation actions from the 2005 Plan were completed, deleted, or carried over into the 2010 Updated Plan. The 2010 Mitigation Action Plan includes an expanded list of 65 mitigation actions. The updated Mitigation Strategy section describes how the mitigation actions for the updated plan were developed, evaluated, and prioritized with an emphasis on a benefit-cost review. Finally, the 2010 Plan Update 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) Goal and Objectives, 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 and Objectives

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 2005 approved plan. On April 19, 2010 the Planning Team reviewed and discussed the following set of questions in order to update goals and objectives for the 2010 Hazard Mitigation Plan Update.

Do the goals and objectives identified in the 2005 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 2005 goals and objectives on April 19, the Planning Team and Steering Committee voted at its next meeting, May 10, 2010, to approve the updated goals and objectives for the 2010 Hazard Mitigation Plan Update. As shown in Appendix H, the 2010 updated goals and objectives are very similar to those developed for the 2005 plan. Some of the key changes to the updated goals and objectives include:

a) Goal 1 – expand to include loss of life and loss of ecosystems.
  - Objectives for Goal 1 – expand Objective 1.1 to include probable risk areas; update Objective 1.2 and 1.3; and add two new objectives to maintain mitigation staff to track, monitor, and implement the plan, and also to restore wetlands as a natural life of defense.

b) Goal 2 – expand to emphasize "developing a culture of mitigation" and include protection of the economic infrastructure, as well as the health and well-being of Orleans Parish residents.

- Objectives for Goal 2 – updated Objectives 2.1 and 2.2, and added three new objectives to conduct performance tracking, to establish Community Rating System (CRS) goal and target dates, and to document historical lessons.

c) Goal 3 – no change.

- Objectives for Goal 3 – updated Objectives 3.1 and 3.2, and added two new objectives to promote interparish communication and to institutionalize the role of mitigation in the recovery.

d) Goal 4 – expand to include cooperation with federal and state entities.

- Objectives for Goal 4 – updated Objective 4.1 and added one new objective to promote policy changes to state and federal laws to encourage participation in hazard mitigation planning.

The updated goals and objectives for the 2010 Hazard Mitigation Plan Update are as follows:

Goal #1 -- Mitigation -- Identify and pursue preventative measures to reduce losses of life, properties (existing and future), and ecosystems due to hazards.

Objective 1.1 – Target known (e.g., FEMA/National Flood Insurance Program repetitive loss structures) and probable hazard risk areas for proper protection measures.
Objective 1.2 – Implement/modify, enforce, and measure results of regulations that impact the vulnerability of persons and property to hazards.
Objective 1.3 – Promote property protection through structural and nonstructural measures as a means of hazard mitigation.
Objective 1.4 – Develop and maintain mitigation staff capacity to track, monitor, and implement the plan.
Objective 1.5 – Restore wetlands as a natural line of defense for Orleans Parish.

Goal #2 – Preparedness – Develop a culture of mitigation. Enhance public awareness and understanding of hazard mitigation and 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.

Objective 2.1 – Create an effective communication/education plan for mitigation and preparedness.
Objective 2.2 – Establish a broader support base for hazard mitigation across Orleans Parish.
Objective 2.3 – Conduct performance tracking and publish results each year at the beginning of hurricane season.
Objective 2.4 – Establish Community Rating System (CRS) goal and target dates to improve City's rating.
Objective 2.5 – Document historical lessons to improve planning and decision making with regard to hazard mitigation.

Goal #3 -- Response – Ensure the ability of emergency services providers and facilities, including essential facilities, to continue operating during hazard events.

Objective 3.1 – Pursue hazard mitigation measures at critical facilities.
Objective 3.2 – Promote interagency communication and coordination between critical service providers.
Objective 3.3 –Promote interparish communication and coordination for hazard mitigation.

Objective 3.4 -- Specify and institutionalize the role of mitigation in the recovery from an event.

Goal #4-- Coordinate– Promote regional, Federal, and State cooperation between parishes with regard to hazard mitigation activities.

Objective 4.1 – Encourage Federal and Regional cooperation in hazard mitigation in order to address improvements to structural and nonstructural assets.
Objective 4.2 – Promote policy changes to State and Federal laws, regulations, procedures that encourage participation in hazard mitigation planning.

Although the Planning Team identified new objectives for the 2010 Plan, no objectives from the 2005 Plan were completely met. Instead, the existing objectives were updated and carried over to the 2010 Plan.

9.4 Mitigation Action Plan

Review of 2005 Mitigation Action Plan and Accomplishments

The Planning Consultant for the Hazard Mitigation Plan Update met with the Hazard Mitigation Office staff to review the Hazard Mitigation Actions included in the 2005 Plan, to identify progress in local mitigation efforts, and to summarize the status of each mitigation action. Highlights of accomplishments since 2005 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
- 2006 International Building Code adopted.
- Floodplain Management Ordinance adopted as part of the City Zoning Ordinance
- 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.
- A chapter on hazard mitigation goals added to the draft Master Plan.
- 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.
- Orleans Parish Emergency Operations Center upgraded to permit operations to continue during and after disaster events.
- Generators installed for some critical facilities.

The following table shows the status of each mitigation action in the approved 2005 as of June 2010. The Status Update column also indicates whether or not the mitigation action will be included in the updated plan. Although many of the actions have been implemented, the actions will be carried over to the 2010 Plan and remain ongoing. Several actions have been revised in the updated plan and a few have been deleted and will not be carried over to the 2010 updated plan. The deleted actions are Sewerage & Water Board mitigation actions that will be included in the New Orleans Sewerage and Water Board (S&WB) Hazard Mitigation Plan. Orleans Parish will coordinate with the S&WB on implementing these actions.

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

Goal 1 - Identify and pursue preventative measures to reduce losses to existing and future property due to hazards.

No.	Action Item/Benefits	2010 Status Update
1	Implement a program to coordinate with the USACE and Orleans Levee District to restore the damaged levee system to withstand a Category 3 Hurricane. **Benefits: Greatly reduces the risk that Orleans Parish will be flooded because of a levee break during a hurricane.**	A program to coordinate with the USACE and Orleans Levee District was established. Regular meetings are held between the administration and key department members to achieve this goal. Levee repairs are underway to provide protection against the 1% annual chance flood depth. Revise action to state "continue to coordinate". **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
2	Implement a program to coordinate with the ASACE and Orleans Levee District to enhance the levee system to withstand a Category 5 Hurricane. **Benefits: Greatly reduces the risk that Orleans Parish will be flooded because of a levee break during a powerful hurricane.**	A program to coordinate with the USACE and Orleans Levee District was established. Monthly meetings are held between the administration and key department members to achieve this goal. Revise action to state "continue to coordinate". **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
3	Implement the Sewerage and Water Board's proposed mitigation projects with a goal of reaching a pumping /drainage capacity of 1" of water per hour (presently at 3" per 5 hours). **Benefits: Greatly reduces the Parish's vulnerability to flooding. See Table 15 for specific details of projects.**	Pumping capacity is improved but has not achieved this level. **ACTION OMITTED FROM 2010 MITIGATION ACTION PLAN. ALL S&WB ACTIONS WILL BE INCLUDED IN THE S&WB HAZARD MITIGATION PLAN.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
4	Establish a Parish capability to review the maintenance and strength levels of the levee system. **Benefits: Provides added protection and gives residents and city officials current information on levee systems.**	This is not performed by City/Parish employees. Will revise this mitigation action in the 2010 Plan and include the updated lead agency. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
5	Develop a program including changing city code that is consistent with FEMA Grant and Assistance Guidelines and Louisiana Recovery Authority's priorities. **Benefits: Reduces future losses due to flooding.**	The 2006 International Building Code was adopted by the City of New Orleans in 2008. Floodplain management ordinance was adopted as part of the City Zoning Ordinance in 2008 to meet the NFIP minimum standards. **COMPLETED BUT ACTION ITEM ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
6	Develop programs for severe and repetitive loss structures as well as substantially damaged structures to seek funding to support and enforce building requirements to reduce flood losses through implementation of future mitigation actions to include elevation, relocation, demolition/rebuild, retrofitting or flood proofing. Encourage and promote mitigation actions when building requirements cannot be enforced. **Benefits: Reduces future losses due to flooding.**	These programs are in place and underway. These actions occur largely with State and FEMA grant funds. Requires continuous effort and strengthening of the program(s). The Hazard Mitigation Office is responsible for this goal but is not included in the City's budget at this time. **COMPLETED BUT ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
7	Develop/maintain comprehensive GIS database that includes all properties in the City, hazard areas, service districts, public works facilities, transportation infrastructure, and special needs residents. **Benefits: Provides data to plan, prepare, recover from disasters.**	The GIS was developed in 2007 and will continue to be updated to remain current and effective. **COMPLETED BUT ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
8	Initiate, develop, and 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. Incorporate this database into the City's Geographic Information System. **Benefits: Provides city officials with valuable data to plan, prepare and recover from a disaster.**	The GIS was developed in 2007 and will continue to be updated to remain current and effective. This information is available only to the GIS department. **COMPLETED BUT ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
9	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. Ensure compliance with this document for all capital projects. Amend Comprehensive Zoning Ordinance, which is the governing land use regulatory document to implement the policies and principles of the Master Plan to implement hazard mitigation goals and action plan. To the extent that some regulatory tools may be included in the Code of the City of New Orleans amend such to be consistent with the above referenced document. **Benefits: Provides Parish with a consolidated plan to reduce future losses by incorporating mitigation action.**	The new Master Plan draft is complete and includes a chapter on hazard mitigation goals, Chapter 12 "Resilience". The City has completed its public review process and is preparing final changes to the Plan document. The citizens of New Orleans voted to give the finished Master Plan the force of law once it is adopted. Once adopted, the Master Plan will include the Hazard Mitigation Plan as an appendix. The City is now preparing to update the zoning code to complement the new Master Plan. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
10	Initiate and implement Parish policy changes to require the use of roofing materials that are less susceptible to damage by severe weather in the construction and renovation of critical and parish facilities. **Benefits: Reduces losses to parish owned properties.**	This is addressed in the 2006 International Building Code was adopted by the City of New Orleans in 2008. **COMPLETED BUT ACTION ITEM ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
11	Initiate and implement a Parish ordinance that addresses infrastructure repair techniques that mitigate hazards caused by drought and land subsidence, including water pipe shifts and breakage. **Benefits: Reduces damage to vital Parish infrastructure.**	**ACTION OMITTED FROM 2010 MITIGATION ACTION PLAN. ALL SWB ACTIONS WILL BE INCLUDED IN THE Sewerage and Water Board (S&WB) HAZARD MITIGATION PLAN.**

Goal 2 - Enhanced public awareness and understanding of disaster preparedness in order to protect the health and well being of the people of Orleans parish from negative effects of hazards.

No.	Action Item/Benefits	2010 Status Update
1	Develop a public service campaign to encourage home and business owners, who are not otherwise mandated to meet flood hazard standards, to voluntarily upgrade protection, especially in repetitive loss areas. **Benefits: Reduces the loss of lives and property.**	In 2008 and 2009, the City conducted a public service campaign in conjunction with the public meetings held to present the FEMA Flood Insurance Rate Maps. The City will continue a public service campaign for owners of non-conforming properties not covered by the floodplain management standards until the non-conformities are phased out and/or redeveloped. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
2	Develop a program to promote purchase of flood insurance. Advertise the availability, cost, and coverage of flood Insurance through the National Flood Insurance Program (NFIP). **Benefits: Enables homeowners to financially recover from the devastating effects of flooding as rapidly as possible. Serves to educate area residents that any homeowner, regardless of location, can purchase flood insurance.**	With FEMA assistance, the Hazard Mitigation Office promoted purchase of flood insurance during outreach meetings. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
3	Develop a hurricane awareness brochure that includes hazard information, evacuation information, and mitigation information and distribute to residents and visitors at facilities throughout the City. **Benefits: Increases public awareness and preparedness.**	The City and State produced contraflow maps and a Citizen Assisted Evacuation brochure. These maps and brochure are updated, produced, and distributed annually. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
4	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. **Benefits: Increases public awareness and preparedness.**	This educational campaign was conducted with a focus on preparedness. The City will redesign its educational campaign to add more information regarding mitigation. The education campaign has focused on radio announcements. The City will broaden its campaign to include other forms of media. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
5	Establish a Last Resort Shelter/Resource Center in each of the 13 Planning Districts to perform the following: A) Serve as a rendezvous point, staging area, and bus pickup location for evacuations during emergency situations. B) Be a last resort shelter for persons unable to evacuate. C) Be a year round resource center for the public to gain information on hazard mitigation, including evacuation plans, disaster preparedness, and property loss reduction strategies. **Benefits: Increases opportunities to provide services, information, and options available to citizens during mandatory evacuations.**	The City has changed its policy. Shelters of last resort do not currently meet the City's evacuation procedures. Instead, rendezvous points have been implemented according to current policy. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
6	Evaluate the implementation of a voluntary incentive and reward program 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. **Benefits: Reduces the risk of losses by construction methods.**	The City participates in the NFIP's Community Rating System. This program rewards participating communities who go beyond the minimum standard requirements of the NFIP. The City is currently rated 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 5% discount added at each level. Continue to maintain current rating and set goal of Class 7 or higher. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
7	Speakers Bureau to provide information 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. Offer these engagements to civic groups, church groups, business groups, and others throughout the Parish. **Benefits: Increases public awareness and preparedness.**	No change/progress to report for this item. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
	Goal 3 - Ensure the ability of emergency services providers and facilities, including essential facilities, to continue operating during hazard events.	
1	Initiate 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. **Benefits: Protects the Parish from the loss of vital records.**	Improvements have been made to protect vital records. Standard operating procedures and controls should be put in place to systematize and solidify these improvements. Additional work is needed on this action. Need to move GIS department out of the basement of City Hall, which is exposed to flooding. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**
2	Upgrade the Parish EOC to permit operations to continue during and after disaster events, includes hardening the structure to withstand high winds, adding fixed elevated generators, enhancing communications system, and adding self containment equipment and supplies. **Benefits: Reduces the risks of loss by allowing the Emergency Operations Center to operate during a disaster.**	Vast improvements have been made to the EOC in 2009. However, additional improvements are needed. The EOC is on the 9th floor of City Hall (safe from direct effects of flood waters), but the building is not flood-proofed and has not been retrofitted to withstand hurricane force winds. In a full activation of the EOC, damage sustained to areas of the building other than the EOC itself (especially lower floors and the roof) would have significant negative impacts on the EOC, its staff, and their functions. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions

No.	Action Item/Benefits	2010 Status Update
3	Install emergency generators at all emergency shelters and critical faculties. **Benefits: Provides power source during outages to enable emergency facilities to function and to provide safety.**	Generators have been installed for some but not all critical facilities. Many of the generators/backup power supplies are movable to accommodate emergency shelters that change every year. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

Goal 4 - Promote regional cooperating between parishes with regard to hazard mitigation activities.

No.	Action Item/Benefits	2010 Status Update
1	Identify, coordinate, and implement key unfunded components of Southeast Louisiana Urban Flood Control Projects (SELA) relating to regional projects. **Benefits: Overall flood loss reduction.**	**ACTION OMITTED FROM 2010 MITIGATION ACTION PLAN. ALL S&WB ACTIONS WILL BE INCLUDED IN THE S&WB HAZARD MITIGATION PLAN.**
2	Participate and contribute in all regional and statewide efforts for continued funding of Coastal Wetlands Planning, Protection, and Restoration Act projects. **Benefits: Allows the Parish to participate in vital regional anti-subsidence initiatives.**	Continued work is needed in the area of coastal protection and mitigation. **ACTION ITEM IS ONGOING. SEE NEW 2010 MITIGATION ACTION PLAN TABLE.**

2010 Mitigation Action Plan

In addition to reviewing and updating the 2005 mitigation actions for the 2010 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 FEMA 549, Mitigation Assessment Team Report, the RMS Flood Risk in New Orleans Report, the Flood Protection Alliance Report on, Polderize New Orleans, the Unified Plan for New Orleans, the New Orleans Master Plan (draft), Chapter 12: Resilience, the New Orleans Emergency Preparedness Freeze Plan, the Emergency Response Disaster Debris Management Plan, the New Orleans City Assisted Evacuation Plan, the Building Code of the City of New Orleans, the Orleans Parish / City of New Orleans Emergency Operations Plan, Louisiana's Comprehensive Master Plan for a Sustainable Coast (CPRA), and the USACE, Louisiana Coastal Protection and Restoration (LACPR) Final Technical Report.

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 2005 mitigation actions that are ongoing and new potential mitigations actions, was presented to the Hazard Mitigation staff for its review and then to the Planning Team and Steering Committee at the May 10 Progress and Coordination Meeting. During the May 10th meeting, the Planning Team and Steering Committee recommended changes to the list of actions. Some actions were removed, while others were added or revised. Details of the May 10 Planning Team discussions are included in Appendix G. The Planning Team and Steering Committee identified, analyzed, and selected a comprehensive range of mitigation actions for each profiled hazard. All actions included in the plan address existing and new buildings and infrastructure.

As the Planning Team reviewed the mitigation actions to establish the final list for the Mitigation Action Plan, the Team also reviewed the ranking of the hazards that was completed earlier in the planning process. The review of ranking was important to ensure that a full range of mitigation actions was included for all hazards ranked either high or medium. The following summarizes the ranking of hazards included in the Orleans Parish 2010 Hazard Mitigation Plan Update:

High: Hurricanes/tropical storms, high winds (part of hurricanes), floods, storm surge, dam or levee failure
Medium: Coastal erosion, hazardous materials/contamination, tornadoes, lightning, thunderstorms, subsidence,
Low: Hail, drought, and winter storms

The list of actions was then presented to the community on May 11. Recommendations from the community were reviewed with the Planning Team and Steering Committee and included in the final list. Details of the May 11th Community Meeting discussion is included in Appendix G. The Mitigation Action Plan includes 65 mitigation actions that meet the goals and objectives established by the Planning Team, 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 if 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 nform 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 (Appendix N). The Hazard Mitigation Plan Update includes a mitigation action to keep City ordinances consistent with FEMA 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 NOHSEP Hazard Mitigation Office is working to complete the new FIRMs for Orleans Parish by 2013. Remapping will begin once the US Army Corps of Engineers (USACE) has completed the levee improvements – currently scheduled for completion in June 2011. Once the remapping is complete, the City will hold open house public meetings to present the FIRMs and begin the approval process.

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

CRS. The updated Orleans Parish 2010 Hazard Mitigation Plan includes the following mitigation actions that will improve the Parish's participation in the NFIP and CRS:

1) 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.

2) 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.

3) Provide training in floodplain management principles for local officials and ensure that each city department working with hazard mitigation or floodplain management has at least two Certified Floodplain Managers on staff. The training would ensure that officials are able to consider flood risk and floodplain management in their decision making.

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.

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.

9.6 Prioritized Mitigation Actions

Once the final list of hazard mitigation actions was established, the Planning Team used the same STAPLEE methodology from the original 2005 Plan to evaluate and prioritize the mitigation actions for the 2010 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 Planning Team 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 Planning Team 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 Table 7-2, STAPLEE Criteria, Page 7-2, Multi-Jurisdictional Hazard Mitigation Plan, Lewis County, New York, URS, April 2010.

The Planning Team and Steering Committee 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 2005 actions that were revised and carried forward to the updated plan.

The Planning Team and Steering Committee completed the STAPLEE evaluation forms in June and discussed the results of the STAPLEE evaluation and final prioritization at the June 29th Progress and Coordination Meeting. The summary results of the STAPLEE Evaluation before the June 29th meeting is included in Appendix L.

The STAPLEE summary results of the benefit-cost review were presented to the Planning Team and Steering Committee on June 29. At this meeting, the priority ranking for each hazard mitigation action was reviewed and in some cases the Planning Team and Steering Committee determined that the ranking based on the STAPLEE review was too low. 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 mitigation actions for Goal 3 -- To ensure the ability of emergency services providers and facilities to continue operating during hazard events -- were moved from Medium to High, again due to the critical nature of these actions. Details of the June 29 Progress and Coordination Meeting discussion regarding changes to the priority ranking of mitigation actions is included in Appendix G. The final priority ranking, approved by the Planning Team and Steering Committee at the June 29 meeting, 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". Details of the ranking methodology used for the benefit-cost review of the STAPLEE criteria for all hazard mitigation actions are included in Appendix L

While this qualitative approach was used to evaluate and prioritize mitigation actions for the updated Plan, a formal quantitative benefit-cost analysis will be prepared for specific projects that will be scoped for formal grant applications. These scoped projects will be added to the updated Plan when complete.

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, FEMA category 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 identifies the specific objectives that will be met with each action. The Plan also shows the specific hazards for which risks will be reduced or eliminated as specific mitigation actions are implemented. Finally, Table 9.1 shows the source of recommendation for each mitigation action. This information was added to the table to show how other planning efforts for New Orleans have been integrated into the Mitigation Action Plan. Specific mitigation actions supported by the community and identified in other plans also meet the requirements for hazard mitigation actions in the Orleans Parish 2010 Hazard Mitigation Plan Update. All of the 65 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 and Objectives	Identifies the hazard mitigation goals and objectives addressed by the mitigation action.
Hazards	Lists all hazards for which risks will be reduced or eliminated with implementation of the mitigation action.
Source of Recommendation	Lists the plan or planning effort that provided the basis for the mitigation action.
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.
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.
FEMA Category	Identifies the FEMA category-Prevention, Property Protection, Public Education/Awareness, Natural Resource Protection, Emergency Services, Structural Projects
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 2010 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.

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.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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 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.	1.1, 1.3	Subsidence & floods,	UNOP Citywide Plan	City of New Orleans (DPW, Capital Projects), Sewerage & Water Board	$1,250,000[1]	City of New Orleans Capital Improvements budget, FEMA (PA, HMGP)	5-10 yrs	High
2	Harden/retrofit all critical and non-critical existing public facilities and construct future public fac-ilities that are resilient to wind and flooding. Wind hardening projects	1.1, 1.3	floods, storm surge, dam & levee failure, wind, hurricanes &	City Master Plan - Chapter 12 Resilience	City of New Orleans (Capital Projects), Sewerage & Water Board, Entergy	$90,000,000[2]	FEMA (PA, HMGP)	5-10 yrs	High

[1] Unified New Orleans Plan, Project #65 (cost estimates are for design only).
[2] Unified New Orleans Plan, Project #1. Cost estimate is gross estimate for parishwide program.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	can include but are not limited to shutters, roof tie downs, etc.		tropical storms		New Orleans				
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.	1.1, 1.3	floods, storm surge, dam & levee failure, wind, hurricanes & tropical storms	Hazard Mitigation Office	NOHSEP, Entergy New Orleans	TBD	Private Sector businesses, City of New Orleans Capital Improvements budget, FEMA (PA, HMGP)	5-10 yrs	Medium
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.	1.1, 1.3	floods, storm surge, dam & levee failure, hurricanes & tropical storms	UNOP Citywide Plan	NORA	$1,050,000,000[3]	HUD (CDBG), FEMA (HMGP), State of Louisiana	3-5 yrs	Low
5	Pursue programs to mitigate at-risk structures by physically	1.1, 1.3	floods, storm surge, dam & levee failure,	UNOP Citywide	City of New Orleans (Capital	$3,300,000,000[4]	FEMA (Individual Assistance Program, PA,	5-10 yrs	Medium

[3] Unified New Orleans Plan, Project #49. Cost estimate is gross estimate for parishwide program.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	elevating buildings to or above the Base Flood Elevation (BFE), wet flood proofing, and/or dry flood proofing where appropriate.		hurricanes & tropical storms	Plan	Projects), NORA		HMGP), SBA, Private insurance		
6	Recommend to City Council to adopt freeboard requirements.	1.1, 1.3	floods, storm surge, dam & levee failure, hurricanes & tropical storms	Hazard Mitigation Office	NOHSEP Hazard Mitigation Office	City staff time[5]	City staff time	3-5 yrs	Medium
7	Promote use of building methods that are flood resilient and built to the latest building code or standard.	1.1, 1.3	floods, storm surge, dam & levee failure, hurricanes & tropical storms	UNOP Citywide Plan	New Orleans Office of Safety and Permits, NORA	City staff time (see Note 1)	City staff time	1-2 yrs	High
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	1.1, 1.3	floods, storm surge, dam & levee failure, hurricanes & tropical storms	Steering Committee/Planning Team	City Council, City of New Orleans (Offices of the Mayor, Safety and Permits, Hazard	City staff time (see Note 1)	City staff time, FEMA (Pre-Disaster Mitigation)	3-5 yrs	Low

[4] Unified New Orleans Plan, Projects #2 and 3. Cost estimate assumes: 1) 85,000 housing units each eligible for up to $65,000 elevation assistance; and 2) 60,000 housing units eligible for up to $70,000 slab-on-grade remediation program.
[5] Estimate assumes that the City currently has the capacity to execute the action without additional budgeted staffing.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	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.				Mitigation, and Environmental Compliance), CPC, NORA				
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.	1.1, 1.3, 2.4	floods, storm surge, dam & levee failure, hurricanes & tropical storms	Steering Committee/Planning Team	City of New Orleans Offices of the Mayor, Safety and Permits, and Hazard Mitigation	City staff time (see Note 1)	City staff time, NFIP	1-2 yrs	High
10	Pursue measures to improve the City's Community Rating System (CRS) credit, allowing for a reduction in NFIP insurance	2.4	floods, storm surge, dam & levee failure, hurricanes & tropical	Hazard Mitigation Office	City of New Orleans Office of the Mayor, Safety and Permits,	$225,000[6]	City staff time	3-5 yrs	High

[6] Approximate cost for three additional staff personnel including one (1) Junior Hazard Mitigation Specialist, one (1) Senior Hazard Mitigation Specialist, and one (1) Hazard Mitigation Administrator. The three individuals will support mitigation actions included in goals: 1.11; 1.16; 1.26; 1.30; 2.1; 2.5; 2.6; 2.7; 2.8; 2.9; 2.12; 2.13; 2.14; 2.16; 4.1; 4.2; 4.3; and 4.4. Estimates provided by the City of New Orleans Hazard Mitigation Office.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	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.		storms		Hazard Mitigation, and Sewerage & Water Board				
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.	1.1, 1.3	floods, storm surge, dam & levee failure, hurricanes & tropical storms	UNOP Citywide Plan	Sewerage & Water Board, New Orleans Department of Public Works	$694,000,000[7]	FEMA (HMGP), City of New Orleans Capital Improvements budget, LADOTD	3-5 yrs	High
12	Restore coastal wetlands.	1.3, 1.5	Coastal erosion, storm surge, floods, high winds, hurricanes & tropical storms	Steering Committee/Planning Team and UNOP Citywide	Louisiana Office of Coastal Protection and Restoration (OCPR), USACE	$15-20,000,000,000[8]	Federal offshore oil revenue sharing, USACE, Private sector businesses, LA Coastal Protection and	10-20 yrs	High

[7] Unified New Orleans Plan, Projects #13 and 20. Cost estimate is gross estimate for systemwide repairs.
[8] Louisiana's Comprehensive Master Plan for a Sustainable Coast; various other sources.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
				Plan			Restoration Fund		
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.	1.3, 1.5	Coastal erosion, storm surge, floods, high winds, hurricanes & tropical storms	UNOP Citywide Plan	Sewerage & Water Board, USACE, SLFPA-East	$40,000,000[9]	Delta Regional Authority, DNR, LDEQ, EPA, Ducks Unlimited, CWPPRA, LTCR	5-10 yrs	High
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.	1.3, 1.5	Coastal erosion, storm surge, floods, high winds, hurricanes & tropical storms	UNOP Citywide Plan	USACE, SLFPA-East	$4,000,000[10]	FEMA (PA)	3-5 yrs	High
15	Maintain current information on known hazards present in facilities	1.3	Hazard Materials	CNO Emergency Operations Plan	City of New Orleans	$225,000	City staff time	ongoing	High

[9] Unified New Orleans Plan, Project # 16.
[10] Unified New Orleans Plan, Project #67.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	such as refineries, power plants, and other public or commercial businesses in a centrally located, accessible location or by other possible methods.		Spills/Contamination	(EOP)	(Environmental Compliance, NOHSEP), EPA	(see Note 2)			
16	Implement pilot reconstruction projects in hazard prone areas to mitigate structures against future damage.	1.3	Storm surge, floods,high winds, hurricanes & tropical storms	Steering Committee/Planning Team, GOHSEP, FEMA	City of New Orleans (DPW, Capital Projects)	TBD	TBD	5-10 yrs	Medium
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	1.3, 1.5	Coastal erosion, storm surge, floods, high winds, hurricanes & tropical storms	CPRA Comprehensive Plan	USACE, LADOTD	$4,500,000[11]	USACE, LADOTD	3-5 yrs	Medium

[11] Consultant team estimate. Similar 2mi. project in Bayou Chevee Marsh area cost $2.58MM.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	Marsh, and Brazalier Marsh).								
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.	1.3, 1.5	Coastal erosion, storm surge, floods, high winds, hurricanes & tropical storms	UNOP Citywide Plan	USACE, DNR, SLFPA-East, Lake Pontchartrain Basin Foundation, New Orleans Office of Environmental Compliance	$87,500,500[12]	CWPPRA, CIAP	3-5 yrs	Medium
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.	1.3	Storm surge, floods, high winds, hurricanes & tropical storms	Hazard Mitigation Office	U.S. Coast Guard, Port of New Orleans, USACE	Staff time[13]	Staff time (U.S. Coast Guard, Port Authority, USACE)	3-5 yrs	High

[12] Lake Pontchartrain Basin Foundation, *Pontchartrain Coastal Lines of Defense Program—Project #8*. http://www.saveourlake.org/pontchartrain-lines-of-defense.php#8.
[13] Mitigation action assumes a procedural change only.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
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.	1.3	Coastal erosion, storm surge, floods, high winds, hurricanes & tropical storms	Hazard Mitigation Office	SLFPA (East and West), NOHSEP Hazard Mitigation Office	$6,500,000[14]	DNR (CWPPRA), Coastwide Nutria Control Program (CNCP)	ongoing	High
21	Support efforts to raise ICC funding cap above $30K or expand the availability of ICC to Repetitive Loss properties.	1.3	Storm surge, floods, high winds, hurricanes & tropical storms	Hazard Mitigation Office	City of New Orleans (Offices of the Mayor, Hazard Mitigation, Safety and Permits)	City staff time (see Note 1)	City staff time	1-2 yrs	Medium
22	Mitigate contamination resulting from illegal dumpsites, including but not limited to those sites in New Orleans East	1.2	Hazard Materials Spills/Contamination	Public Meeting, May 11, 2010	NOHSEP Hazard Mitigation Office; Office of Environmental Compliance	$30,000,000[15]	EPA	3-5 yrs	High

[14] Estimated annual cost to trap or kill approximately 4,000 nutria per year (based on similar projects in other Louisiana parishes). A second option, considered infeasible by the consultant team, is to line levees with concrete at cost of $15MM per linear mile.
[15] Unified New Orleans Plan, Project #71.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
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.	4.1	Hurricanes & tropical storms, dam and levee failure, floods, storm surge	2005 Plan	USACE, SLFPA-East	$3,100,000,000	USACE, City of New Orleans Operating Budget	3-5 yrs	High
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.	4.1	Hurricanes & tropical storms, dam and levee failure, floods, storm surge	2005 Plan	USACE; SLFPA (East and West)	$20,000,000,000	USACE, City of New Orleans Operating Budget	5-10 yrs	High
25	Establish a Parish capability to review the maintenance and strength levels of the levee system.	4.1	Hurricanes & tropical storms, dam and levee failure, floods	2005 Plan	NOHSEP Hazard Mitigation Office	$225,000* (see Note 2)	City of New Orleans (Operating budget, special funds)	ongoing	Low
26	Keep City ordinances consistent with FEMA Grant and Assistance Guidelines, as well as with state and local priorities.	1.2	Hurricanes & tropical storms, dam and levee failure, floods	2005 Plan	New Orleans Office of Safety and Permits	City staff time (see Note 1)	City of New Orleans Operating budget	ongoing	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
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.	1.2	Hurricanes & tropical storms,dam and levee failure, floods	2005 Plan	NOHSEP Hazard Mitigation Office	City staff time (see Note 1)	City of New Orleans Operating budget, FEMA (HMGP, Severe Repetitive Loss Program, and Repetitive Flood Claims Program)	1-2 yrs	High
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.	1.1	All hazards	2005 Plan	New Orleans Office of Technology	City staff time (see Note 1)	City of New Orleans Operating budget	ongoing	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
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.	1.1	All hazards	2005 Plan	New Orleans Office of Technology	City staff time (see Note 1 and End Note xiii)	City of New Orleans Operating budget	ongoing	Medium
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.	1.3	All hazards	2005 Plan	New Orleans City Planning Commission	City staff time (see Note 1)	City of New Orleans Operating budget	1-2 yrs	Medium
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	1.1, 1.3	floods, storm surge, dam & levee failure, hurricanes & tropical storms	City Master Plan - Chapter 12 Resilience	SLFPA (East and West), City of New Orleans (Capital Projects), USACE	$1,000,000 (feasibility study)	City of New Orleans Capital Improvements budget, FEMA (Flood Mitigation Assistance)	5-10 yrs	High

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	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.								
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,	2.1	All hazards	Hazard Mitigation Office	NOHSEP Hazard Mitigation Office	\$500,000-\$1,000,000[16] (also see Note 2)	FEMA, USACE, City of New Orleans (staff time, special funds, operating budget)	1-2 yrs	Medium

[16] Consultant team estimate includes costs for program design, project management, marketing (including printed materials; Internet Web design and maintenance; print, television, and radio advertisements), and public meetings.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	etc.) to get the message out. Document and publicize local mitigation success stories.								
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.	1.2, 1.3	Floods, storm surge, dam & levee failure, high winds, hurricanes & tropical storms	Coastal Protection Restoration Authority (CPRA) Comprehensive Plan	NOHSEP Hazard Mitigation Office	$50-100,000[17]	FEMA, City of New Orleans (staff time, special funds, Operating budget)	1-2 yrs	High
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	2.1, 2.5	All hazards	City Master Plan	NOHSEP Hazard Mitigation Office	$200-400,000[18] (per year)	City of New Orleans Operating budget, USACE, FEMA	1-2 yrs (or ongoing)	Medium

[17] Consultant team estimate includes costs for program design, project management, marketing, and conducting a two-day training seminar.
[18] Consultant team estimate includes costs for program design, project management, marketing, and conducting several two-hour public seminars in various locations throughout the City of New Orleans.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	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.								
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.	1.2, 1.3	Floods, storm surge, dam & levee failure, hurricanes and tropical storms	Hazard Mitigation Office	City of New Orleans (Offices of Safety and Permits; and Environmental Compliance)	$50-100,000 (see End Note xv)	City of New Orleans (Operating budget, special funds), FEMA	1-2 yrs	Medium
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	2.1, 2.4	Floods, storm surge, dam & levee failure, hurricanes and tropical storms	Hazard Mitigation Office	NOHSEP Hazard Mitigation Office	$100-200,000 (see Note 2 and End Note xv)	City of New Orleans (Operating budget, special funds), NFIP	1-2 yrs	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	premiums.								
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.	2.3, 3.4	all hazards	American Planning Association (APA) Zoning Practice, Issue 10, 2009	NOHSEP Hazard Mitigation Office	$200-300,000[19] (also see Note 2)	City of New Orleans Operating budget, APA	1-2 yrs	Medium
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.	2.2	all hazards	Dr. Nance -UNO	NOHSEP Hazard Mitigation Office	$225,000* (see Note 2)	City staff time	1-2 yrs	Medium

[19] Consultant team estimate includes the cost for a three-person consultant team conducting the audit over a 6-month period.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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	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 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.	2.5	all hazards	APA Conference, Hazard Mitigation Planning Session	CPC, New Orleans Office of Environmental Compliance	$225,000* (see Note 2)	City staff time	3-5 yrs	High
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	1.4	all hazards	Steering Committee/ Planning Team	City of New Orleans (NOHSEP Hazard Mitigation, Environmental Affairs, Safety and Permits)	$225,000* (see Note 2)	City of New Orleans Operating budget	1-2 yrs	High

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	and the Department of Safety and Permits to support hazard mitigation planning efforts.								
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.	1.3	all hazards	City Master Plan	City Council, City of New Orleans (City Planning Commission, Office of the Mayor, Hazard Mitigation, Environmental Affairs), Sewerage and Water Board	City staff time (see Note 1)	City staff time	1-2 yrs	High
11	Develop Parish wetlands regulations that provide the "intent" of the regulations for flood storage (available for CRS credit).	1.2, 2.4	floods, storm surge, dam & levee failure, hurricanes & tropical storms	LACPR Technical Report	CPC, City Council, New Orleans Office of Environmental Compliance	City staff time (see Note 1)	City staff time	3-5 yrs	Medium
12	Encourage adoption of higher regulatory standards to increase Community Rating System (CRS) and enforce NFIP regulations.	2.4, 1.2	floods, storm surge, dam & levee failure, hurricanes & tropical storms	Hazard Mitigation Office	City of New Orleans (NOHSEP Hazard Mitigation Office, Safety and Permits), City	$225,000* (see Note 2)	City staff time	1-2 yrs	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
					Council				
13	Educate the public about storm water management, such as the importance of keeping drains and culverts clear, using handouts and community events. (New action added by HM Office--Brad & Miriam--after May 10 Meeting.)	2.1	floods, hurricanes & tropical storms	Hazard Mitigation Office	City of New Orleans (Hazard Mitigation Office, DPW), Sewerage and Water Board	$225,000* (see Note 2)	City of New Orleans Operating budget	1-2 yrs	High
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.	2.1, 2.2	all hazards	Hazard Mitigation Office	NOHSEP Hazard Mitigation Office	$225,000* (see Note 2)	City staff time	3-5 yrs	Medium
15	Continue public education campaign for owners of non-conforming properties until the non-conformities are phased out and/or redeveloped.	1.3	Floods, dam and levee failure, storm surge, thunderstorms	2005 Plan	NOHSEP (Office of Emergency Preparedness and Hazard Mitigation Office)	City staff time (see Note 1)	City of New Orleans (Operating budget and special funds), FEMA (HMGP, PDMP)	5-10 yrs	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
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).	1.1	Floods, dam and levee failure, storm surge, thunderstorms	2005 Plan	NOHSEP (Office of Emergency Preparedness and Hazard Mitigation Office)	$225,000* (see Note 2)	City of New Orleans (Operating budget and special funds), FEMA (HMGP, PDMP)	3-5 yrs	Medium
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.	2.1	Hurricanes and tropical storms	2005 Plan	NOHSEP (Office of Emergency Preparedness and Hazard Mitigation Office)	TBD	City of New Orleans (Operating budget and special funds), FEMA (HMGP, PDMP)	ongoing	Medium
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.	2.2	All hazards	2005 Plan	NOHSEP (Office of Emergency Preparedness and Hazard Mitigation Office)	TBD	City of New Orleans (Operating budget and special funds), FEMA (HMGP, PDMP)	ongoing	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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	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.	2.1	Hurricanes and tropical storms, floods, dam and levee failure, storm surge	2005 Plan	NOHSEP (Office of Emergency Preparedness and Hazard Mitigation Office)	$250,000[20]	City of New Orleans Operating budget, HUD (CDBG), FEMA (PA, HMGP)	3-5 yrs	Medium
20	Evaluate the implementation of a voluntary incentive and reward programs that encourages builders and contractors to go beyond adopted minimum	1.3	Hurricanes and tropical storms, floods, storm surge, high winds, dam and levee failure,	2005 Plan	New Orleans Office of Safety and Permits	City staff time (see Note 1)	City of New Orleans (Operating budget and special funds), FEMA (HMGP)	3-5 yrs	High

[20] Unified New Orleans Plan, Project #43. Estimate includes cost of planning, project management, marketing, conducting public meetings, and citywide mail distribution.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	building code requirements to make buildings better able to withstand the forces of natural hazards.		tornadoes, lightning , thunderstorms						
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.	3.1	all hazards	Emergency Operations Plan (EOP)	City of New Orleans (NOHSEP, Capital Projects), Entergy New Orleans, Sewerage and Water Board	TBD (also see Goal 1.3)	FEMA (HMGP), City of New Orleans Capital Improvements budget	3-5 yrs	High
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	3.1	Floods, storm surge, dam & levee failure, hurricanes and tropical storms	UNOP CityWide Plan	Entergy New Orleans, New Orleans Department of Public Works, Sewerage and Water Board	TBD	Private sector business, LADOTD, City of New Orleans Capital Improvements budget	5-10 yrs	High

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	streets.								
3	Upgrade and install Management Information Systems equipment to ensure communication system remains operational during hazard events.	3.1, 3.2	all hazards	Emergency Operations Plan (EOP)	City of New Orleans (NOHSEP, Office of Technology)	$20-30,000,000[21]	City of New Orleans (operating budget and special funds)	3-5 yrs	High
4	Construct shelters and/or safe rooms for emergency services and emergency service personnel to ensure continued operation of critical services during hazard events.	3.1, 3.4	all hazards	Steering Committee/-Planning Team revision of 2005 Plan action	City of New Orleans (NOHSEP, Capital Projects)	TBD (also see Goal 1.3)	HMGP, City of New Orleans Capital Improvements budget, Private sector businesses	3-5 yrs	High
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	1.3	Hurricanes and tropical storms, dam and levee failure, floods, tornadoes, storm surge	2005 Plan	New Orleans Office of Technology	City staff time (see Note 1)	City of New Orleans Operating budget	3-5 yrs	High

[21] Cost estimate provided by the City of New Orleans Office of Technology.

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	developing backup data systems. Establish standard operating procedures and controls for these improvements.								
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.	1.3	Hurricanes and tropical storms, dam and levee failure, floods, tornadoes, storm surge	2005 Plan	NOHSEP Office of Emergency Preparedness	City staff time (see Note 1)	City of New Orleans Operating budget, FEMA (HMGP, PDMP)	3-5 yrs	High
7	Install emergency generators at all emergency shelters and critical facilities.	3.1	All hazards	2005 Plan	NOHSEP Office of Emergency Preparedness	TBD	City of New Orleans Operating budget, FEMA (PA, HMGP, PDMP), Sewerage and Water Board, Entergy New Orleans), Non-profit sector organizations	3-5 yrs	High

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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 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.)	3.2	all hazards	See individual agency plans	NOHSEP Hazard Mitigation Office	$225,000* (see Note 2)	City staff time, Operating budgets of other Orleans parish agencies)	3-5 yrs	High
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.	3.3, 4.1	all hazards	APAConference - Hazard Mitigation Planning Session	NOHSEP Hazard Mitigation Office	$225,000* (see Note 2)	City staff time, State of Louisiana, other LA parish/city operating budgets	1-2 yrs	High
3	Promote Stafford Act and other regulatory changes to strengthen	4.2	all hazards	Steering Committee/Planni	City of New Orleans (Office of the Mayor, Hazard	$225,000*	City staff time	1-2 yrs	Medium

Table 9.1, Orleans Parish Hazard Mitigation Action Plan

No.	Action Item/Benefits	Objective	Hazards	Source of Recommendation	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
	hazard mitigation planning.			ng Team	Mitigation Office)	(see Note 2)			
4	Ensure effective coordination regarding wetlands policy among State, US Army Corps of Engineers, and Local governments.	4.1	floods, storm surge, dam & levee failure, hurricanes & tropical storms	City Master Plan	City of New Orleans (NOHSEP, Hazard Mitigation Office), USACE	$225,000* (see Note 2)	City staff time, USACE, State of Louisiana	3-5 yrs	Medium
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.	4.1	all hazards	2005 Plan	New Orleans Office of Environmental Compliance	City staff time (see Note 1)	City of New Orleans Operating budget	ongoing	High

Section 10. Plan Maintenance

Contents of this Section

Changes between the 2005 Plan and the 2010 Plan Update. The Plan Maintenance Section of the 2005 Plan has been rewritten and expanded in the 2010 Plan Update. The Plan Maintenance Section in the 2005 Plan provided the basic skeletal plan maintenance process. The 2010 Plan Update builds on the basic plan presented in the 2005 Plan and provides more detail on how the process will be implemented and on specific agency responsibilities to ensure the plan maintenance process is conducted properly. The FEMA forms that will be used for monitoring and maintaining the 2010 Plan Update are also included. The updated section also includes a discussion of the 2005 Plan Maintenance Update and how the community was kept informed of progress in implementing the plan and any changes needed to the 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 2005 Plan Maintenance Update

The Orleans Parish Hazard Mitigation Plan was approved in December 2005, just four months after Hurricane Katrina. It was the intent of the City to update the plan annually during the off-season for hurricanes. The NOHSEP had planned to monitor the plan annually and prepare an implementation progress report after coordinating with the agencies and departments designated as the lead agencies for the mitigation actions. However, between 2006 and 2008 there were many staff changes and there are no records of what was accomplished to monitor the plan during this period.

It was the intention of the City to include the 2005 Plan in the Appendices of the New Orleans Master Plan, however previous city plans were abandoned in 2008 when planning for the New Orleans Master Plan and Comprehensive Zoning Ordinance began. The 2005 Hazard Mitigation Plan was not incorporated into the City's Master Plan or the

Comprehensive Emergency Master Plan (CEMP). The 2010 Orleans Parish Hazard Mitigation Plan will be incorporated into the appendix of the City's master plan after adoption.

Starting in 2008, the NOHSEP established the Hazard Mitigation Office and began maintaining better records of progress on implementation of the mitigation actions. The Review and Status Update of 2005 Orleans Parish Hazard Mitigation Actions in Section 9 provides a summary of the progress in implementing mitigation actions over the past five years.

No changes were made to the 2005 Plan prior to the 2010 Plan Update. The 2010 Plan update has followed the update cycle as indicated in the 2005 Plan. The review and update of the 2005 Plan began in November 2009 and continued through 2010 until the Plan Update was submitted to GOHSEP and FEMA for review and approval in the fall of 2010.

The community was kept involved during the plan maintenance process over the past five years. Between 2006 and 2010, the NOHSEP and the NOHSEP Hazard Mitigation Office (starting in 2008) accepted public comment on the Plan on an ongoing basis. Public comment was received at the NOHSEP and/or the NOHSEP Hazard Mitigation Office during this period. Then, starting in the fall of 2009, the NOHSEP Hazard Mitigation Office began the planning process for the 2010 Plan Update, which is documented in the Section 5 of the Plan Update.

In addition to receiving public comment during the previous five years, the NOHSEP Hazard Mitigation Office also conducted or participated in a number of community events that provided the public with information on various elements of the Orleans Parish Hazard Mitigation Plan. These events include the following:

- Open Houses in the Spring, 2009 – The City of New Orleans, in coordination with FEMA< USACE, the LaMP Team, and others, held a serious of open house public meetings 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 meetings also included information on progress with implementing the Hazard Mitigation Plan.
- The City participated in a number of neighborhood meetings held by UNO CHART (Center for Hazards Assessment, Response, and Technology) in 2008 and 2009 to update the community on mapping of the severe repetitive loss areas and claims made in those areas. These meetings provided an opportunity to inform the community of progress in implementing the Hazard Mitigation Plan.

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/Steering Committee 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/Steering Committee to review the reports and to assess progress in implementing the mitigation actions. After reviewing the Annual Progress Reports, the Planning Team/Steering Committee will reevaluate the implementation strategy. The Planning Team/Steering Committee will discuss successes, challenges, problems, and new opportunities that have occurred over the past year and determine whether there is a need to reprioritize, add, or change mitigation actions based on the accomplishments of the prior year. The review will also address the accuracy of cost-benefit estimates and the availability of resources for implementation. Worksheet #1, Progress Report, in the FEMA 386-4 Guidance, "Bringing the Plan to Life", will be used to prepare the Annual Progress Reports for the mitigation actions. The NOHSEP Hazard Mitigation Office will also work with the lead agencies for the mitigation actions to complete a Project Evaluation Report that will summarize the project results and report on key performance indicators. This evaluation will be based on Worksheet #3, Evaluate Project Results, in the FEMA 386-4 Guidance. Worksheets that will be used to monitor and evaluate implementation progress are included in Appendix O.

During these annual reviews, the Planning Team/Steering Committee 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/Steering Committee 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 the FEMA 386-4 Guidance to complete its annual evaluation of the Hazard Mitigation Plan and to determine if the Plan should be revised. See evaluation forms in Appendix O.

In addition to the annual meetings, the NOHSEP Hazard Mitigation Office will initiate interim site visits, phone calls, and/or meetings as needed to supplement the Annual Progress Reports and to ensure that ongoing progress with implementation of the mitigation actions.

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/Steering Committee 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/Steering Committee 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/Steering Committee. 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 2010, the Plan will enter the review and update cycle in 2013, with adoption of the revisions in 2015. The Plan will be sent back to FEMA for re-approval within the five-year cycle. The Planning Team/Steering Committee will be convened to conduct the comprehensive evaluation and update.

10.4 Incorporating Action Plan into Existing Planning Mechanisms

Once adopted, the Orleans Parish Hazard Mitigation Plan will serve as the main statement of mitigation policy for the City of New Orleans. In order to ensure that the Mitigation Action Plan is implemented as planned, the NOHSEP Hazard Mitigation Office will work closely with the Planning Team/Steering Committee to incorporate the Mitigation Action Plan into the City's existing planning mechanisms.

The NOHSEP Hazard Mitigation Office with support from the Planning Team/Steering Committee 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:

- 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.
- Also work with the CAO to add a line item for mitigation project funding into the City's capital and operating budgets.
- Issue a letter to department heads to solicit their support and explore opportunities to integrate hazard mitigation planning into day-to-day operations.
- 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.
- 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:

- Coordinate with Code Enforcement and other appropriate departments to ensure that the minimum standards established in the International Building Code are being enforced.
- 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).
- 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 final adopted 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.
- 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.

- Coordinate the annual reviews of the Master Plan with the Hazard Mitigation Plan to include risk area maps. As the Comprehensive Zoning Ordinance (CZO) is being developed, review the Hazard Mitigation Plan Update to make sure the two documents are compatible.
- 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/Steering Committee meeting and discuss new opportunities to build on what has already been accomplished.

10.5 Public Participation in Plan Maintenance Process

The NOHSEP Hazard Mitigation Office will review the Community Engagement Strategy used to prepare the 2010 Hazard Mitigation Plan Update to address public participation in the plan maintenance process. The updated Community Engagement Strategy will be presented to the Planning Team/Steering Committee for their review and approval when they meet following City Council adoption of the plan to begin Mitigation Plan implementation. The community will be given an opportunity to review the updated Community Engagement Strategy, and the strategy will continue to be updated annually as needed. The following public participation process uses the same general public outreach activities used during the development of the 2010 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. When it becomes necessary to revise the Plan, the public will be included in the plan review process and will be given an opportunity to review and comment on the changes to the Plan. A meeting with the community will be held following the Planning Team/Steering Committee meeting held after City Council adoption of the Hazard Mitigation Plan Update. At this public meeting, the NOHSEP Hazard Mitigation Office will explain the status of the Hazard Mitigation Plan, the implementation process that has begun, and present the updated Community Engagement Strategy that will be used to ensure public participation throughout the 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.

- A community survey will be distributed to the public at the first community meeting following Plan adoption (and periodically thereafter) 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.
- Appropriate public workshops will be held following the annual meetings of the Planning Team/Steering Committee to review the results of the monitoring reports and project evaluation reports, and to receive a summary report of the Planning Team/Steering Committee findings and recommendations.
- Public comments submitted to the NOHSEP Hazard Mitigation Office:
- Public comments submitted to the Hazard Mitigation website (www.neworleansmitigation.com).

The NOHSEP Hazard Mitigation Office will hold a minimum of one public meeting annually following the annual Planning Team/Steering Committee 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.

- Information updates on the Hazard Mitigation website (www.neworleansmitigation.com)
- 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
- Press releases and public service announcements (PSA's)
- 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.neworleansmitigation.com). 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

APPENDICES