WEST SHORE LAKE PONTCHARTRAIN
HURRICANE AND STORM DAMAGE RISK REDUCTION STUDY
INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

ECONOMIC
APPENDIX D

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West Shore Lake Pontchartrain LA Hurricane and Surge Risk Reduction Feasibility Study
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PART 1: BACKGROUND INFORMATION

INTRODUCTION

General. This appendix presents an economic evaluation of the three storm surge risk reduction alternatives being considered for the West Shore Lake Pontchartrain LA Hurricane and Surge Risk Reduction Feasibility Study (West Shore Lake Pontchartrain), evaluation area, which includes portions of three parishes in the state of Louisiana. It was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the User's Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC-FDA).

The economic appendix consists of a description of the methodology used to determine National Economic Development (NED) damages under existing and future conditions and projects costs. The evaluation reports damages and costs at October 2012 price level. The proposed alternatives were evaluated by comparing total project costs. The evaluation was conducted on the expectation that each alternative would perform equally thus provide the same level of risk reduction. Damages were converted to equivalent annual values by use of the current FY 2013 Federal discount rate of 3.75 percent and a period of analysis of 50 years. The year 2020 was identified as the base year for each of the alternatives as the basis for plan comparison. Three alternatives were screened to arrive at the selected alignment.

NED Benefit Categories Considered. The NED procedure manuals for coastal and urban areas recognize four primary categories of benefits for flood risk management measures: inundation reduction, intensification, location, and employment benefits. The majority of the benefits attributable to a project alternative generally result from the reduction of actual or potential damages caused by inundation. Inundation reduction, which is the only category of NED benefits addressed in this evaluation, includes the reduction of physical damages to structures, contents, and vehicles.

Physical Flood Damage Reduction. Physical flood damage reduction benefits include the decrease in potential damages to residential and commercial structures, their contents, and the privately owned vehicles associated with these structures. Damages included in the appendix considered both existing and future conditions. Projections of the future development expected to be in place in the study area during the period of analysis were included as part of the future condition analysis.

Office of Management and Budget survey forms were used to collect information on the value and placement of contents in the industrial facilities located in the study area. The information from these surveys was used to develop the physical flood damage and benefits for these industrial properties.

Emergency Cost Reduction Benefits. Emergency costs are those costs incurred by the community during and immediately following a major storm. They include the costs of emergency measures, such as evacuation and reoccupation activities conducted by local governments and homeowners, repair of streets, highways, and railroad tracks, and the subsequent cleanup and restoration of private, commercial, and public properties. In this evaluation, only the emergency cost reduction benefits associated with debris removal and cleanup and the reduction of damages to major and secondary highways and streets were considered. Emergency costs will be evaluated for the Tentatively Selected Plan (TSP) in the draft feasibility report.

Regional Economic Development. The RED account will be addressed in a separate appendix in the final feasibility report to evaluate the project alternatives. If the economic activity lost in the flooded region can be transferred to another area or region in the national economy, then these losses are not included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the RED account. The input-output macroeconomic model RECONS will be used to address the impacts of the construction spending only associated with the TSP, since only this alternative provides detailed cost information necessary to prepare a complete and accurate analysis.

DESCRIPTION OF THE STUDY AREA

Geographic Location. The study area includes the portions of St. James and St. John the Baptist Parishes located on the east bank of the Mississippi River and the portion of St. Charles Parish on the east bank of the Mississippi River west of the Bonnet Carre' Spillway. The West Shore Lake Pontchartrain evaluation area was divided into 81 unique hydrologic reaches to enable an economic analysis of the project alternatives through the use of the HEC-FDA certified model.

Land Use. The total number of acres of developed, agricultural, and undeveloped land in the study area is shown in **Table 1**. As shown in the table, approximately 5 percent of the total acres in the study area are currently developed. Since there are approximately 24,000 acres of agricultural land and 124,000 acres of undeveloped land there is sufficient land available to accommodate the projected residential and non-residential development through the year 2080 without impacting the wetlands in the area. This projected future development is expected to be located on parcels that tend to be relatively higher ground and are the least exposed to flood risk.

Table 1: Land Use in the Study Area

Land Use in the Study Area
West Shore Lake Pontchartrain, LA Feasibility Study
(2009)

Land Class Name	Acres	Percentage of Total
Developed land	10,947	4.7
Agricultural Land	23,779	10.3
Undeveloped Land	124,181	53.9
Open Water	71,576	31.1
Total	**230,483**	**100.0**

Source: National Agricultural Statistical Service
Note: Sugarcane accounts for approximately half of the agricultural land and pasture/hay the remainder.

SOCIOECONOMIC SETTING

Population and Number of Households. **Table 2** displays the population in each of the parishes for the years 1980, 1990, 2000, and 2010 as well as projections for the year 2020 and the year 2080, the two years that engineering inputs were modeled and used to calculate damages. Population projections are based on the Moody's County Forecast Database, which has population projections to the year 2038. Moody's projections were extended by New Orleans District from the year 2030 to the year 2080 based on the growth rate forecasted by Moody's for the years 2018 through 2038. As shown in **Table 2**, St. Charles, St. James and St. John Parishes experienced a steady increase in population between 1980 and 2010.

Table 2: Historical and Projected Parish Population
West Shore Lake Pontchartrain, LA Feasibility Study
(1,000s)

Parish	1980	1990	2000	2010	2020	2080
St. Charles	37.5	42.5	48.2	52.8	56.2	65.5
St. James	21.6	20.8	21.4	22.1	22.3	26.5
St. John the Baptist	32.3	40.1	43.1	45.9	51.7	60.2
Total	91.4	103.4	112.7	120.8	130.2	152.1

Source: U.S. Census data, and Moody's County Forecast Database

Table 3 displays the estimated population of the three parishes located within the inventoried portion of the study area for the year 2012 and the projected population for the years 2020 and 2070. The 2012 estimates are based on an inventory of residential and non-residential properties assembled in 2012 by field survey teams. The number of inventoried residential structures was then multiplied by 2.9, the average number of persons per household in the study area in 2012. The annual compounded growth rate in population between 2012 and 2020 is expected to be 0.32 percent and 0.77 percent between 2020 and 2070.

Table 3: Existing Condition and Projected Population within Inventoried Study Area
West Shore Lake Pontchartrain, LA Feasibility Study
(1,000s)

Parish	2012	2020	2070
Total in Study Area	62.90	64.7	95.9

Source: U.S. Census data, and Moody's County Forecast Database
Note: Population estimates uses 2.9 residents per housing unit and 20 housing units within a multi family structure.

Table 4 shows the total number of households in each parish for the years 1980, 1990, 2000, and 2010 and projections for the years 2020 and 2080. The projected number of households was based on the Moody's County Forecast Database and extended from the year 2038 to the year 2080 based on the growth rate forecasted by Moody's for the years 2018 through 2038.

Table 4: Number of Households by Parish

West Shore Lake Pontchartrain, LA Feasibility Study

(1,000s)

Parish	1980	1990	2000	2010	2020	2080
St. Charles	11.6	14.4	16.5	17.2	18.3	22.0
St. James	6.1	6.4	7.0	6.9	7.2	8.7
St. John the Baptist	9.4	12.7	14.3	15.1	16.3	19.6
Total	**27.1**	**33.5**	**37.8**	**39.2**	**41.8**	**50.2**

Source: U.S. Census data, and Moody's County Forecast Database

The three parishes experienced a steady increase in the total number of households between 1980 and 2010, which paralleled the growth in population. This increase is commensurate with the population growth experienced by the entire Gulf Coast region during the same period. Similar to the projected population growth in the three-parish area, the number of households is expected to continue increasing through the year 2080.

Income. **Table 5** shows the per capita personal income levels for each parish for the years 1990, 2000, 2005, 2010 and 2012, the year with the latest available data. As shown in the table, both parishes experienced a steady increase in per capita income between 1990 and 2012.

Table 5: Per Capita Income ($s)

West Shore Lake Pontchartrain, LA Feasibility Study

Parish	1990	2000	2005	2010	2012
St. Charles	$ 17,296.80	$ 24,227.67	$ 26,825.53	$ 32,598.93	$ 34,991.97
St. John the Baptist	$ 14,231.16	$ 18,326.72	$ 22,950.56	$ 29,663.46	$ 31,492.16
St. James	$ 14,440.30	$ 19,719.82	$ 24,714.85	$ 29,351.24	$ 31,348.64

Source: U.S. Census data, and Moody's County Forecast Database

Employment. **Table 6** shows the total nonfarm employment by parish for the years 1970, 1980, 1990, 2000, 2010, and projections for the years 2020 and 2080. The employment projections were based on the Moody's County Forecast Database and extended from the year 2038 to the year 2080 based on the growth rate forecasted by Moody's for the years 2018 through 2038.

In all portions of the study area, growth is highly dependent upon the major employment sectors. The increase in employment in the three parishes is likely the result of the influx of population and businesses that occurred to the area after Hurricane Katrina after 2005. The leading employment sectors include educational services, health care and social assistance, manufacturing, and retail trade. Approximately 1,900 non-residential structures are located in the study area including petroleum service companies, river services companies, Zapp's Potato Chips Factory in Gramercy, and the Marathon refinery in Garyville. Slightly over 10 percent of the total acres in the study area, or 23,800 acres, is devoted to agriculture, and about half of these acres are used for growing sugar cane.

Table 6: Total non-Farm Employment
West Shore Lake Pontchartrain, LA Feasibility Study
(1,000s)

Parish	1970	1980	1990	2000	2010	2020	2080
St. Charles	9.0	18.1	18.5	20.1	24.3	26.3	36.2
St. John the Baptist	5.4	9.8	9.4	7.6	8.1	8.9	11.5
St. James	4.2	9.4	11.0	13.4	15.0	16.3	22.4
Total	18.5	37.2	39.0	41.1	47.4	51.5	70.1

Source: U.S. Census data, and Moody's County Forecast Database

Compliance with Policy Guidance Letter (PGL) 25 and Executive Order 11988. Given continued growth in employment, it is expected that development will continue to occur in the study area with or without the storm surge risk reduction system, and will not conflict with PGL 25 and EO 11988, which state that the primary objective of a hurricane storm damage and risk reduction project is to protect existing development, rather than to make undeveloped land available for more valuable uses. However, the overall growth rate is anticipated to be the same with or without the project in place. Thus, the project will not induce development, but would rather reduce the risk of the population being displaced after a major storm event.

RECENT FLOOD HISTORY

Tropical Flood Events. While the three parishes have periodically experienced localized flooding from excessive rainfall events, the primary cause of the flood events that have taken place in the three-parish study area has been the tidal surges from hurricanes and tropical storms. During the past 25 years, coastal Louisiana was impacted by eight major tropical events: Hurricane Juan (1985), Hurricane Andrew (1992), Tropical Storm Isidore and Hurricane Lili (2002), Hurricanes Katrina and Rita (2005), and Hurricanes Gustav and Ike (2008). While none of these storms tracked directly through the study area, the tidal surges associated with these storm events inundated structures and resulted in billions of dollars in damages throughout coastal Louisiana.

Table 7 provides a summary of the total Federal Emergency Management Agency (FEMA) flood claims paid to all Louisiana policyholders as a result of these tropical events. It should be noted these claims include losses due to rainfall along with storm surge events. The table includes the number of paid losses, the total amount paid, and the average amount paid on each loss. The total and average paid losses have been converted to reflect 2012 price levels. The table excludes losses that were not covered by flood insurance.

Table 7: FEMA Flood Claims in Louisiana
West Shore Lake Pontchartrain, LA Feasibility Study

Event	Year	Number of Paid Claims	Total Amount Paid (1,000s)	Average Amount Paid (1,000s)
Tropical Storm Juan	Oct-85	6,187	$ 194,019	$ 31.4
Hurricane Andrew	Aug-92	5,589	$ 276,748	$ 49.5
Tropical Storm Isadore	Sep-02	8,441	$ 144,990	$ 17.2
Hurricane Lili	Oct-02	2,563	$ 47,062	$ 18.4
Hurricane Katrina	Aug-05	167,099	$ 18,964,492	$ 113.5
Hurricane Rita	Sep-05	9,507	$ 550,946	$ 58.0
Hurricane Gustav	Sep-08	4,524	$ 117,786	$ 26.0
Hurricane Ike	Sep-08	46,137	$ 2,772,654	$ 60.1
Hurricane Isaac	Aug-12	3,565	$ 229,820	$ 64.5

Source: Federal Emergency Management Agency (FEMA)
Note: Total amount paid and average amount paid have been updated to the October 2012 price level using the CPI for all urban consumers
Hurricane Isaac claims only include claims in St. Charles, St. James and St. John Parishes

The following is a summary of each of the eight major tropical events and their effects on the two-parish area and coastal Louisiana.

Hurricane Juan. Hurricane Juan caused extensive flooding throughout southern Louisiana due to its prolonged 5-day movement back and forth along the Louisiana coast. Rainfall totals in the area ranged from 5 inches to almost 17 inches. The storm was responsible for storm surges of 5 to 8 feet and tides of 3 to 6 feet above normal. According to FEMA officials, the estimated value of the residential and commercial damage and public assistance throughout coastal Louisiana totaled $112.5 million.

Hurricane Andrew. On August 26, 1992, Hurricane Andrew made landfall in St. Mary Parish, 80 miles west of Morgan City. FEMA reported that over 2,000 flood claims were filed as a result of the storm in Louisiana. These claims had a total value of over $25 million.

Tropical Storm Isidore and Hurricane Lili. On October 3, 2002, one week after Tropical Storm Isidore affected the southeastern and south central coastal areas of Louisiana, Hurricane Lili made landfall on the western edge of Vermilion Bay south of the cities of Abbeville and New Iberia as a weak Category 2 hurricane. The high winds caused tidal flooding in the communities east of the eye of the storm.

Insured flood losses from Tropical Storm Isidore and Hurricane Lili totaled nearly $600 million. Approximately $105 million of insured losses were related to Tropical Storm Isidore, while Hurricane Lili caused $471 million of insured losses. According to windshield surveys conducted by the American Red Cross, approximately 10,000 residential structures were damaged by winds and storm surges of the two storms. These surveys included both insured and uninsured structures. Tropical Storm Isidore caused damage to 2,905 structures, while Hurricane Lili caused damage to 7,356 structures.

In a revised report released in mid-November by the Louisiana State University Agricultural Center (LSU AgCenter), the estimated agricultural damages caused by Tropical Storm Isidore and Hurricane Lili totaled $454.3 million. This estimate also includes the agricultural damages caused by the continuation of rain during the month of October, which delayed the harvesting of crops. The excessive rains and storm surge flooded the agricultural fields and increased the harvest costs.

Hurricane Katrina. On August 29, 2005, Hurricane Katrina made landfall near the town of Buras in Plaquemines Parish about 50 miles east of coastal Lafourche and Terrebonne parishes. While the storm entered as a Category 3 with winds in excess of 120 mile per hour, its storm surge of approximately 30 feet was more characteristic of a Category 5 hurricane. The majority of the damages from Hurricane Katrina occurred outside of the West Shore Lake Pontchartrain study area. However, if the hurricane had taken a more westerly track, the study area could have experienced the same magnitude of flooding as the city of New Orleans.

According to the Department of Health and Hospitals, approximately 1,400 deaths were reported following Hurricane Katrina. Approximately 1.3 million residents were displaced immediately following the storm, and 900,000 residents remained displaced as of October 5, 2005.

The storm caused more than $40.6 billion of insured losses to the homes, businesses, and vehicles in six states. Approximately two thirds of these losses, or $25.3 billion, occurred in Louisiana based on data obtained from the Insurance Information Institute. According to the Louisiana Recovery Authority, approximately 150,000 housing units were damaged, and according to the Department of Environmental Quality, 350,000 vehicles, and 60,000 fishing and recreational vessels were damaged.

According to the LSU AgCenter, agricultural losses totaled approximately $825 million. The agricultural resources impacted by the storm include sugarcane, cotton, rice, soybeans, timber, pecans, citrus, and livestock. The losses to aquaculture (crawfish, alligators, and turtles), fisheries (shrimp, oysters, and menhaden), and wildlife and recreational resources totaled approximately $175 million.

Hurricane Rita. The hurricane made landfall along the Texas-Louisiana border on September 24, 2005, as a Category 3 storm with winds in excess of 120 miles per hour. A storm surge of approximately 15 to 20 feet affected Coastal Louisiana from Terrebonne Parish to the Texas border. With estimated insured losses of approximately $3 billion, Hurricane Rita became one of the most costly natural disasters in U.S. history.

Approximately 2,000 square miles of farmland and marshes throughout the coastal area were inundated from storm surge and associated rainfall with the tropical event. According to the LSU AgCenter, agricultural losses totaled approximately $490 million. The agricultural resources impacted by the storm include sugarcane, cotton, rice, soybeans, timber, pecans, citrus, and livestock. The losses to aquaculture (crawfish, alligators, and turtles), fisheries (shrimp, oysters, and menhaden), and wildlife and recreational resources totaled approximately $100 million.

Hurricanes Gustav and Ike. On September 1, 2008, almost exactly three years after Hurricane Katrina, Hurricane Gustav made landfall near Cocodrie in Terrebonne Parish as a strong Category 2 hurricane. It followed a northwest path into central Louisiana, and most of the damages caused by the storm resulted from its high winds and heavy rain. Coastal flooding occurred in the low lying areas of Jefferson and Lafourche Parishes and the coastal areas of Terrebonne Parish south of the City of Houma.

Nearly 2 million residents of South Louisiana evacuated in the days before Gustav made landfall. Louisiana officials reported that emergency spending totaled approximately $500 million, which included $210 million for state agencies, $48 million for deploying the National Guard, $13.5 million for general evacuation shelters, $3 million for special-needs medical shelters, $6.1 million for transporting the medical needy, $21 million for costs of contraflow and evacuation from coastal communities and other areas, $20 million in special generators to open ice plants, pharmacies and service stations throughout the impacted areas, $5 million for state-purchased fuel, $19.7 million for ready-to-eat meals, $5.3 million for ice, and $2.5 million for water supplies. The State Department of Transportation estimated that it cost approximately $50 million to remove 1.5 million cubic yards of debris, and approximately $20 million to repair draw bridges.

Almost two weeks later, on September 12 and 13, the Louisiana coastal region incurred additional flood damages as Hurricane Ike moved along the Louisiana coast. According to estimates from the state officials, approximately 12,000 homes and businesses were flooded by the two storms. Approximately 2,500 buildings in Terrebonne Parish south of the City of Houma incurred flood damages from Hurricane Ike.

The LSU AgCenter estimated that potential lost revenues and damages to the infrastructure of the agriculture, forestry, and fisheries industries in Louisiana resulting from the two hurricanes totaled approximately $959 million. The storm surge primarily affected the cattle, rice, soybeans, and sugarcane.

Hurricane Isaac. On 29 August 2012, exactly seven years to the day after Hurricane Katrina, Southeast Louisiana was impacted by Hurricane Isaac. The storm made landfall near the mouth of the Mississippi River as a minimal Category 1 hurricane. It then reentered the Gulf of Mexico and made a second landfall near Port Fourchon, Louisiana. Hurricane Isaac produced 45 hours of tropical force winds from the south and southeast as it slowly tracked west of the city of New Orleans. The wind speed and track, combined with slow forward motion, large maximum wind radius, and intense rainfall, produced high storm surges and water elevations throughout coastal Louisiana. Substantial flooding occurred in areas outside federal levee systems, including, but not limited to Slidell, Mandeville, Madisonville, LaPlace, Braithwaite, and Lafitte. In the study area, the hurricane flooded approximately 7,000 structures in the area of LaPlace. The flood claims attributed to Hurricane Isaac in St. John Parish were approximately $226,810,360. This figure is based on 3,332 flood claims reported by FEMA which does not include households obtaining flood insurance.

FEMA Flood Claims. The study area has been impacted by numerous tropical events during the past several decades. According to FEMA data, flood claims for the three parishes in the West Shore-Lake Pontchartrain evaluation area that were paid between 1978 and December 2012 totaled $338 million: $100 million in St. Charles Parish, $236 million in St. John the Baptist Parish, and $1.74 million in St. James

Parish. **Table 8** shows the insurance payments between 1978 and December 2012 for each of the parishes in the study area. It should be noted that these claims are due to both excessive rainfall and storm surges associated with tropical events.

Table 8: FEMA Flood Claims by Parish
West Shore Lake Pontchartrain, LA Feasibility Study
1978-2012

Parish	Number of Claims December 2012	Total Nominal Dollar Amount (in millions)	Average Dollar Amount per Claim (in thousands)
St. Charles	5907	$ 100.13	$ 16.95
St. James	135	$ 1.74	$ 12.87
St. John the Baptist	4851	$ 236.18	$ 48.69
Total	**10893**	**$ 338.05**	**$ 31.03**

Source: FEMA

SCOPE OF THE STUDY

Problem Description. The exposure of the study area to coastal storm surge was made apparent by Hurricane Isaac (August 2012). Approximately 7,000 structures in the study area were damaged and the I-10 and I-55 transportation routes were impassable for 6 days after the storm had passed. The damages and response times during Hurricane Isaac were exacerbated due to standing water for days after the event.

Project Alternatives. Alignment A consists of 20.41 miles of earthen levee which begins at the West Guide levee of the Bonne Carre Spillway. It extends west around the interstate interchange and along the wet/dry interface.

Alternative C follows the same alignment as Alternative A between the West Guide levee of the Bonnet Carre Spillway to the US-51 Interchange where it tracks north across US-51. It consists of 18.27 miles of earthen levees and a T-wall.

Both Alternative A and C will implement non-structural measures which include elevation of structures and acquisition by government in the western portion of the study area.

Alternative D is a westward continuation of Alternative C along the I-10 corridor into Ascension Parish. At the St. James' Parish line, Alternative D continues west just slightly north of I-10 until it reaches Old New River where it will proceed north to a non-federal levee in Ascension Parish (Laurel Ridge Levee). There is no non-structural feature involved in this alternative.

PART 2: ECONOMIC AND ENGINEERING INPUTS TO THE HEC-FDA MODEL

HEC-FDA MODEL

Model Overview. The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5a Corps-certified model was used to calculate the damages and benefits for the West Shore Lake Pontchartrain evaluation. The economic and engineering inputs necessary for the model to calculate damages for existing conditions (2012), the project base year (2020), and the final year in the period of analysis (2070) include structure inventory, future development, contents-to-structure value ratios, vehicles, first floor elevations, and depth-damage relationships, ground elevations, and without-project stage probability relationships.

The uncertainty surrounding each of the economic and engineering variables was also entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

ECONOMIC INPUTS TO THE HEC-FDA MODEL

Structure Inventory. Field surveys were completed in 2012 (prior to Hurricane Isaac) to develop a residential and non-residential structure inventory for the economic analysis. Based on the structural information collected during the field surveys, the Marshall and Swift Valuation Service was used to calculate a depreciated replacement cost for all residential and non-residential structures in the study area reaches. The inventoried structures were classified as one of 14 structure types: residential one-story with slab or pier foundation, residential two-story with slab or pier foundation, mobile home, eating and recreation, grocery and gas station, multi-family residence, professional building, public and semi-public building, repairs and home use establishment, retail and personal services building, and warehouse, and contractor services building. **Table 9** shows the number of structures by structure category and the total number of vehicles associated with the residential structures for existing conditions (2012) for each study area reach or HEC-FDA model station number. The value of the land was not included in the analysis.

Table 9: Number of Structures in the Existing Condition
West Shore Lake Pontchartrain, LA Feasibility Study
(2012)

Reach Name	HEC-FDA Station Number	Residential	Mobile Home	Non-Residential
Total		18,470	1,488	1,882

Future Development Inventory. Projections were made of the future residential and non-residential development to take place in the West Shore Lake Pontchartrain study area under without-project conditions. Based on a pattern of historical development, a total of 565 residential and 149 non-residential structures were placed on the undeveloped land within the study area reaches as part of the structure inventory for the year 2020. An additional 10,428 residential and 679 non-residential structures were added to the inventory for the year 2020 to obtain the structure inventory for the year 2070.

The development projected to occur in each study area reach between the year 2012 and the year 2020 was placed at an elevation equal to the stage associated with the 2020 without-project one percent annual chance exceedance (1% ACE) (100-year) event, unless the ground elevation was higher. The projected development occurring after the year 2020 was placed at an elevation equal to the stage associated with the without-project 1% ACE (100-year) event for the year 2070, unless the ground elevation was higher. The values for the projected residential and non-residential structures were assigned using the average value calculated for each structure category based on the 2012 existing development.

Table 10 shows the number of structures in each structure category and the average depreciated replacement values for (2012 price level) existing conditions. **Table 11** shows the projected number of structures in each structure category for the future years 2020 and 2070, respectively. The value of the land was not included in the analysis.

Table 10: Residential and Non-Residential Structure Inventory
West Shore Lake Pontchartrain, LA Feasibility Study
Existing Conditions (2012)
(2012 price levels in 1000's)

Structure Category	Number	Average Depreciated Replacement Value
	Residential	
One-Story Slab	11,532	$ 166
One-Story Pier	4,551	$ 91
Two-Story Slab	2,236	$ 186
Two-Story Pier	151	$ 171
Mobile Home	1,488	$ 14
Total Residential	**19,958**	
Eating and Recreation	128	$ 223
Professional	310	$ 646
Public and Semi-Public	402	$ 972
Repair and Home Use	74	$ 158
Retail and Personal Services	258	$ 368
Warehouse	543	$ 249
Grocery and Gas Station	78	$ 286
Multi-Family Occupancy	86	$ 307
Industrial	3	$ 2,568
Total Non-Residential	**1,882**	

Table 11: Number of Projected Residential and Non-Residential Structures

West Shore Lake Pontchartrain, LA Feasibility Study

Future Conditions (2020)	
Structure Category	Number
Residential	
One-Story Slab	312
One-Story Pier	63
Two-Story Slab	23
Two-Story Pier	5
Mobile Home	162
Total Residential	**565**
Non-Residential	
Eating and Recreation	11
Professional	27
Public and Semi-Public	32
Repair and Home Use	5
Retail and Personal Services	18
Warehouse	48
Grocery and Gas Station	5
Multi-Family Occupancy	3
Industrial	0
Total Non-Residential	**149**
Future Conditions (2070)	
Structure Category	Number
Residential	
One-Story Slab	5,745
One-Story Pier	1,206
Two-Story Slab	394
Two-Story Pier	91
Mobile Home	2,992
Total Residential	**10,428**
Non-Residential	
Eating and Recreation	54
Professional	120
Public and Semi-Public	133
Repair and Home Use	30
Retail and Personal Services	85
Warehouse	217
Grocery and Gas Station	23
Multi-Family Occupancy	17
Industrial	0
Total Non-Residential	**679**

Residential and Non-Residential Content-to-Structure Value Ratios. On-site interviews were conducted with the owners of a sample of ten structures from each of the three residential content categories (30 residential structures) and each of the eight non-residential content categories (80 non-residential structures). As shown in **Table 12**, a CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from the surveys. An average CSVR for each of the five residential structure categories and nine commercial structure classifications was calculated as the average of the individual structure CSVRs.

Table 12: Content-to-Structure Value Ratios (CSVRs) and Standard Deviations (SDs) by Structure Category

West Shore Lake Pontchartrain, LA Feasibility Study

Structure Category		(CSVR, SD)
Residential	One-story	(0.65,0.21)
	Two-story	(0.78,0.21)
	Mobile home	(0.60,0.24)
Non-Residential	Eating and Recreation	(1.14,0.48)
	Groceries and Gas Stations	(1.17,0.61)
	Professional Buildings	(0.43,0.14)
	Public and Semi-Public Buildings	(1.14,0.71)
	Multi-Family Buildings	(0.37,0.14)
	Repair and Home Use	(2.06,1.02)
	Retail and Personal Services	(1.42,0.93)
	Warehouses and Contractor Services	(1.68,0.98)

Vehicle Inventory. Based on 2000 Census block group data for the evaluation area, it was determined that there are an average of 1.64 vehicles associated with each household (owner occupied housing or rental unit). According to the Southeast Louisiana Evacuation Behavioral Report published in 2006 following Hurricanes Katrina and Rita, approximately 70 percent of privately owned vehicles are used for evacuation during storm events. The remaining 30 percent of the privately owned vehicles remain parked at the residences and are subject to flood damages. Using the Manheim Used Vehicle Value Index, which is based on over 4 million annual automobile transactions adjusted to reflect retail replacement value, each vehicle was assigned an average value of $12,879 at the 2012 price level. Since only those vehicles not used for evacuation can be included in the damage calculations, an adjusted average vehicle value of $6,723 ($12,879 x 1.74 x 0.30) was assigned to each individual residential structure record in the HEC-FDA model. If an individual structure had more than one housing unit, then the adjusted vehicle value was assigned to each housing unit in a residential or multi-family structure category.

First Floor Elevations and Elevation of Vehicles. Topographical data obtained from the Light Detection and Ranging (LIDAR) digital elevation model (DEM) using the NAVD88 (2004.65 epoch) were used to determine ground elevations. Field survey teams estimated the height of each residential and non-residential structure above the ground using hand levels. The ground elevation was added to the height of the foundation of the structure above the ground in order to determine the first floor elevation of the structure. Vehicles were assigned to the ground elevation of the adjacent residential structures.

Depth-Damage Relationships. Site-specific saltwater, long duration (approximately one week) depth-damage relationships, developed by a panel of building and construction experts for a separate study in Jefferson and Orleans Parishes, were used in the economic analysis. The Jefferson Orleans study area is adjacent to West Shore Lake Pontchartrain study area, approximately 25 miles to the east. These curves indicate the percentage of the total structure value that would be damaged at various depths of flooding. Damage percentages were determined for each one-half foot increment from one-half foot below first floor elevation to two feet above first floor, and for each one-foot increment from 2 feet to 15 feet above first floor elevation. The panel of experts developed depth-damage relationships for five residential structure categories and for three commercial structure categories. Depth-damage relationships were also developed for three residential content categories and eight commercial content categories.

The depth-damage relationships for vehicles were developed based on interviews with the owners of automobile dealerships that had experienced flood damages and were used to calculate flood damages to vehicles at the various levels of flooding.

Table 13 shows the residential and non-residential depth-damage relationships developed for structures, contents, and vehicles. More specific data regarding the depth-damage relationships can be found in the final report in support of Jefferson and Orleans Flood Control Feasibility Study (June 1996).

Uncertainty Surrounding the Economic Inputs. The uncertainty surrounding the four key economic variables was quantified and entered into the HEC-FDA model. These economic variables included structure values, contents-to-structure value ratios, first floor elevations, and depth-damage relationships. The HEC-FDA model used the uncertainty surrounding these variables to estimate the uncertainty surrounding the stage-damage relationships developed for each study area reach.

Structure and Vehicle Values. In order to quantify the uncertainty surrounding the values calculated for the residential and non-residential structure inventory, several survey teams valued an identical set of structures from various evaluation areas in the Gulf Coast region. The structure values calculated by each of the teams during windshield surveys were used to develop a mean value and a standard deviation for each structure in the sample. The standard deviation was then expressed as a percentage of the mean value for that structure. The average standard deviation as a percentage of the mean for the sampled structures was then used to represent the uncertainty surrounding the structure value for all the inventoried residential and non-residential structures. The average standard deviation, which was expressed as a percentage of the mean structure value, totaled 13.85 percent for residential structures and 10.52 percent for non-residential structures.

The uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function. The Manheim vehicle value, adjusted for number of vehicles per household and for the evacuation of vehicles prior to a storm event, was used as the most likely value. The average value of a new vehicle before taxes, license, and shipping charges was used as the maximum value, while the average 10-year depreciation value of a vehicle was used as the minimum value.

Table 13: Depth-Damage Relationships for Structures, Contents and Vehicles

West Shore Lake Pontchartrain, LA Feasibility Study

Occupancy Type	Category Name	Damage Type	Parameter																					
1STY-PIER	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	4.0	5.4	20.5	62.4	62.4	64.0	65.6	65.6	68.7	71.9	71.9	71.9	71.9	84.4	84.4	84.4	84.4	84.4	84.4	84.4
			Lower %	0.0	1.5	1.5	7.5	40.5	41.5	41.6	44.7	44.7	44.7	46.3	46.3	46.3	46.3	80.0	80.0	80.0	80.0	80.0	80.0	80.0
			Upper %	0.0	9.5	9.5	33.5	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	94.0	100.0	100.0	100.0	100.0	100.0	100.0
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
			Lower %	0.0	0.0	0.0	0.0	54.6	60.9	65.6	73.9	75.7	81.8	82.4	84.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0
			Upper %	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1STY-SLAB	Residential		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	0.0	7.2	56.4	56.4	58.7	58.7	58.7	63.4	66.4	66.4	66.4	66.4	82.1	82.1	82.1	82.1	82.1	82.1	
			Lower %	0.0	0.0	0.0	0.0	36.5	36.5	38.0	38.0	38.0	41.0	61.0	61.0	61.0	61.0	75.4	75.4	75.4	75.4	75.4	75.4	
			Upper %	0.0	0.0	9.5	14.5	63.4	63.4	66.0	66.0	66.0	71.3	72.5	72.5	72.5	72.5	100.0	100.0	100.0	100.0	100.0	100.0	
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	0.0	54.6	60.9	65.6	73.9	75.7	81.8	82.4	84.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
			Upper %	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
2STY-PIER	Residential		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
		Structure	Mean %	0.0	4.0	4.7	17.5	53.6	53.6	54.4	55.2	55.2	56.8	59.9	59.9	59.9	63.1	71.2	72.8	72.8	74.4	74.4	74.4	74.4
			Lower %	0.0	1.1	1.3	6.4	38.7	38.7	39.3	39.8	39.8	41.0	43.3	43.3	43.3	43.3	45.6	51.4	68.5	68.5	70.0	70.0	70.0
			Upper %	0.0	7.9	8.1	28.6	67.0	67.0	68.0	69.0	69.0	70.9	74.9	74.9	74.9	74.9	78.8	89.0	89.0	89.0	89.0	89.0	89.0
		Contents	Mean %	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	66.2	66.2	68.9	68.9	69.2	70.1	80.6	80.8	81.0	86.6	88.2	88.4	88.4	88.7	88.7	88.9	89.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
2STY-SLAB	Residential		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	5.1	44.2	44.2	45.1	46.0	49.7	51.6	51.6	51.6	51.6	51.6	55.7	66.2	68.0	68.0	69.9	69.9	69.9	
			Lower %	0.0	0.0	0.0	31.9	31.9	32.6	33.3	35.9	37.3	37.3	37.3	37.3	37.3	40.2	47.8	64.0	64.0	65.8	65.8	65.8	
			Upper %	0.0	0.0	7.6	55.2	55.2	56.4	57.6	62.2	64.5	64.5	64.5	64.5	64.5	69.6	82.7	82.7	82.7	82.7	82.7	82.7	
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Contents	Mean %	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	66.2	66.2	68.9	68.9	69.2	70.1	80.6	80.8	81.0	86.6	88.2	88.4	88.4	88.7	88.7	88.9	89.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
AUTO	AUTO		Stage	0.0	0.5	1.0	1.5	2.0	3.0															
		Structure	Mean %	0.0	2.3	22.8	54.2	95.8	100.0															
			Lower %	0.0	0.0	2.0	50.0	75.0	100.0															
			Upper %	0.0	5.0	50.0	75.0	100.0	100.0															
EAT	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	

		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	61.6	82.6	87.3	88.4	93.3	93.5	93.5	93.5	93.5	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3	
			Lower %	0.0	0.0	0.0	41.6	62.6	67.3	68.4	73.3	73.5	73.5	73.5	73.5	79.3	79.3	79.3	79.3	79.3	79.3	79.3	79.3	
			Upper %	0.0	0.0	0.0	81.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
GROC	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	82.5	97.5	97.8	99.1	99.4	99.7	99.7	99.7	99.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	77.5	92.5	9.3	94.1	94.4	94.7	94.7	94.7	94.7	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Upper %	0.0	0.0	0.0	87.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
MOBHOM	MOBHOME		Stage	-1.1	-1.0	-0.5	0.0	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	12.1	12.1	32.1	62.1	63.8	64.2	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	66.3	
			Lower %	0.0	10.1	10.9	29.6	57.4	59.3	59.7	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	62.2	
			Upper %	0.0	13.4	15.1	34.6	66.8	68.3	68.7	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	
		Contents	Mean %	0.0	0.0	0.0	0.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	
			Lower %	0.0	0.0	0.0	0.0	47.5	52.0	59.6	73.7	77.6	88.8	89.1	89.4	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	
			Upper %	0.0	0.0	0.0	0.0	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
MULT	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	80.0	80.0	80.0	80.0	80.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
PROF	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	98.5	98.5	98.5	98.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	78.5	78.5	78.5	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
PUBL	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	

		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	85.0	85.0	85.0	85.0	85.0	85.0	
			Upper %	0.0	0.0	0.0	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	100.0	100.0	100.0	100.0	100.0	100.0	
REPA	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
		Contents	Mean %	0.0	0.0	0.0	87.5	87.5	87.5	87.5	98.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	67.5	67.5	67.5	67.5	78.9	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
RETA	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Contents	Mean %	0.0	0.0	0.0	99.4	99.5	99.7	99.8	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
			Lower %	0.0	0.0	0.0	79.4	79.5	79.7	79.8	79.9	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	
			Upper %	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
WARE	COM		Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Structure	Mean %	0.0	0.0	3.5	36.5	36.8	36.8	41.1	41.1	48.5	48.5	48.5	49.5	49.5	65.0	65.0	72.5	75.0	77.8	77.8	77.8	
			Lower %	0.0	0.0	0.0	24.3	28.6	29.4	32.0	33.6	41.5	42.0	42.0	42.9	44.3	59.3	59.7	66.5	68.8	74.7	75.7	75.7	
			Upper %	0.0	0.0	7.0	41.0	41.3	41.3	46.1	46.1	54.5	58.2	58.2	58.2	58.2	79.2	79.2	88.3	91.4	94.8	94.8	94.8	
			Stage	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	
		Contents	Mean %	0.0	0.0	0.0	36.1	53.0	61.5	69.9	79.5	96.3	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	
			Lower %	0.0	0.0	0.0	1.1	18.0	26.5	34.9	44.5	61.3	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	
			Upper %	0.0	0.0	0.0	71.1	88.0	96.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Content-to-Structure Value Ratios. On-site interviews were conducted with the owners of a sample of ten structures from each of the three residential content categories (30 residential structures) and each of the eight non-residential content categories (80 non-residential structures). A CSVR was computed for each residential and non-residential structure in the sample based on the total depreciated content value developed from these interviews. The mean and standard deviation values for each residential and non-residential category were entered into the HEC-FDA model. The model used a normal probability density function to describe the uncertainty surrounding the CSVR for each content category. The expected values and standard deviations are shown for each of the three residential categories and the eight non-residential categories in the final report dated June 1996 entitled *Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs) in support of the Jefferson and Orleans Flood Control Feasibility Studies*.

First Floor Elevations. The topographical data used to estimate the first floor elevations assigned to the structure inventory contain two sources of uncertainty. The first source of uncertainty arises from the use of the 2009 LIDAR data, and the second source of uncertainty arises from the use of hand levels to determine the structure foundation heights above ground elevation. The error implicit in using LIDAR data to estimate the ground elevation of each of the inventoried structures is normally distributed with a mean of zero and a standard deviation of 0.6 feet. According to the Hydrologic Engineering Center training manual, and the uncertainty implicit in estimating foundation heights using hand levels from within 50 feet of the structure is normally distributed with a mean of zero and a standard deviation of 0.3 feet at the 95 percent level of confidence.

Depth-Damage Relationships. A triangular probability density function was used to determine the uncertainty surrounding the damage percentage associated with each depth of flooding. A minimum, maximum and most likely damage estimate was provided by a panel of experts for each depth of flooding. The specific range of values regarding probability distributions for the depth-damage curves can be found in the final report dated June 1996 entitled *Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs)in Support of the Jefferson and Orleans Flood Control Feasibility Studies*.

ENGINEERING INPUTS TO THE HEC-FDA MODEL

Ground Elevations. Geospatial Engineering acquired elevation data for the West Shore Lake Pontchartrain study area. The LIDAR data were processed and used to create a digital elevation model (DEM) with a five-foot by five-foot horizontal grid resolution. The DEM used NAVD88 2004.65 vertical datum to determine the ground elevations for each of the residential and non-residential structures in the evaluation area.

Stage-Probability Relationships. Stage-probability relationships were provided for the existing (2012) without-project condition and future without-project conditions (2020 and 2070). The stage probability relationships for the year 2070 included low, intermediate and high relative sea level rise scenarios. Water surface profiles were provided for eight annual chance exceedance (ACE) events: 99% (1-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), 1% (100-year), 0.5% (200-year), and 0.2% (500-year). The water surface profiles were based only on storm surge and did not incorporate heavy rainfall events.

The 99% ACE (1-year) event, 20% ACE (5-year) event, and 10% ACE (10-year) event water surface profiles for the year 2012 were based on gage data. For each of these ACE events, the water surface profiles for the years 2020 and 2070 were determined by adding relative sea level rise to the gage data. The water surface profiles for the 2% ACE (50-year) event through the 0.2% ACE (500-year) event were based on results from the ADCIRC model. The 4% ACE (25-year) event stages were determined by interpolation between the 10% ACE (10-year) event stages and the 2% ACE (50-year) event stages.

Uncertainty Surrounding the Engineering Inputs. The uncertainty surrounding two key engineering parameters was quantified and entered into the HEC-FDA model. These engineering variables included ground elevations and the stage-probability curves. The HEC-FDA model used the uncertainty surrounding these variables to estimate the uncertainty surrounding the elevation of the storm surges for each study area reach.

Ground Elevations. An engineering survey was conducted to estimate the uncertainty surrounding the use of the 2009 LIDAR data to estimate ground elevations in urbanized areas. A combination of the uncertainty surrounding the ground elevations and the foundation height (0.9 feet) of a residential and non-residential structure was discussed in the first floor elevation uncertainty section of this report.

Stage-Probability Relationships. A 50-year equivalent record length was used to quantify the uncertainty surrounding the stage-probability relationships for each study area reach.

Based on this equivalent record length, the HEC-FDA model calculated the confidence limits surrounding the stage-probability functions.

PART 3: NATIONAL ECONOMIC DEVELOPMENT (NED) FLOOD DAMAGE AND BENEFIT CALCULATIONS

NED FLOOD DAMAGE AND BENEFIT CALCULATIONS FOR STRUCTURES, CONTENTS, AND VEHICLES

HEC-FDA Model Calculations. The HEC-FDA model was utilized to evaluate flood damages using risk-based analysis. Damages were reported at the index location for each of the 81 study area reaches for which a structure inventory had been conducted. A range of possible values, with a maximum and a minimum value for each economic variable (first floor elevation, structure and content values, and depth-damage relationships), was entered into the HEC-FDA model to calculate the uncertainty or error surrounding the elevation-damage, or stage-damage, relationships. The model also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-probability relationships.

The possible occurrences of each variable were derived through the use of Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, a sampling technique was used to select from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes.

Stage-Damage Relationships with Uncertainty. The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study area reach under existing (2012) and future (2020 and 2070) conditions. The possible occurrences of each economic variable were derived through the use of Monte Carlo simulation. A total of 1,000 iterations were executed by the model for the West Shore Lake Pontchartrain evaluation. The sum of all sampled values was divided by the number of samples to yield the expected value for a specific simulation. A mean and standard deviation was automatically calculated for the damages at each stage.

Stage-Probability Relationships with Uncertainty. The HEC-FDA model used an equivalent record length (50 years) for each study area reach to generate a stage-probability relationship with uncertainty for the without-project condition under existing (2012) and future (2020 and 2070) conditions through the use of graphical analysis. The model used the eight stage-probability events together with the equivalent record length to define the full range of the stage-probability or stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided.

Without-Project Expected Annual Damages. The model used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of

exceedance (probability). From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without-project alternative, the expected annual damages (EAD) were totaled for each study area reach to obtain the total without-project EAD under existing (2012) and future (2020 and 2070) conditions. **Table 14** shows the Expected Annual Damages for structures, contents and vehicles for 2012, 2020 and the three relative sea level rise scenarios in the year 2070. **Table 15** shows the number and type of structure that is damaged by each of annual chance exceedance events for the years 2020 and 2070 using the intermediate relative sea level rise scenario.

Table 14: Expected Annual Damage (1,000's) Structure, Contents and Vehicles
West Shore Lake Pontchartrain, LA Feasibility Study

Analysis Year	Without- Project Damages	Percent Increase from 2012
2012	$ 44,331	
2020	$ 59,027	33%
2070 low sea level rise	$ 183,819	315%
2070 intermediate sea level rise	$ 266,933	502%
2070 high sea level rise	$ 590,067	1231%

Table 15: Number of Structures Receiving Damages by Probability Event in 2020 and 2070 Intermediate Sea Level Rise Residential, Commercial, and Mobile Homes Unadjusted Without-Project Condition

West Shore Lake Pontchartrain, LA Feasibility Study

Annual Chance Exceedance Event (ACE)	Residential	Non-Residential	Mobile Home	Total
Base year 2020				
0.99 (1 yr)	53	3	-	
0.20 (5 yr)	80	5	-	
0.10 (10 yr)		63	26	
0.04 (25 yr)		159	113	
0.02 (50 yr)		373	316	
0.01 (100 yr)		555	525	
0.005 (200 yr)		824	656	
0.002 (500 yr)		1,039	812	
Future year 2070 Intermediate Sea Level Rise				
0.99 (1 yr)	312	58	15	385
0.20 (5 yr)	552	95	64	711
0.10 (10 yr)	2,010	293	210	2,513
0.04 (25 yr)	4,862	456	338	5,656
0.02 (50 yr)	11,242	1,234	897	13,373
0.01 (100 yr)	17,296	1,524	1,207	20,027
0.005 (200 yr)	20,766	2,189	1,353	24,308
0.002 (500 yr)	26,113	2,373	1,524	30,010

Note: The table reflects the number of structures damaged by ACE event before adjustments were made to the structure inventory for repetitive flooding.

Equivalent Annual Damages. Damages for each of the years during the period of analysis were computed by linear interpolation between 2020 and 2070. The FY 2013 Federal interest rate of 3.75 percent was used to compound the stream of expected annual damages and benefits before the project base year and to discount the stream of expected annual damages and benefits occurring after the base year to calculate the total present value of the damages over the period of analysis. The present value of the expected annual damages was then amortized over the period of analysis using the Federal discount rate to calculate the equivalent annual damages. **Table 16** shows the equivalent annual without-project damages for each of the study area reaches using projected intermediate relative sea level rise.

Screening to Tentatively Selected Plan. Utilizing existing data, current and future without-project damages and parametric costs, the alternatives were screened based on the 1 percent or 100-year level of risk reduction. The alternatives are expected to provide the same level of risk reduction therefore the alternatives were screened based on costs. For Alternatives A and C to provide the same benefits, structure raisings or acquisitions will be offered in the area not receiving risk reduction by structural measures. The combination of the structural measure for Alternative A and Alternative C with a non-structural measure is equal to the risk reduction provided by the longer structural alignment, Alternative D.

Using the damage probability relationship from the HEC-FDA model for the top ten damage reaches, it was estimated that a 1 percent project would eliminate damages for the 25, 50 and 100-year events. The three alternatives would not eliminate damages from rainfall at the more frequent events (1 and 10 year events) and the less frequent events (200 and 500 year events). While benefits from structure elevation would accrue in the more frequent events, the reaches offering structure elevation were not in the top ten. Extrapolating the percent reduction in damages for the top ten damage reaches, 46 percent, to the remainder of the study area, the 2020 estimated benefits are estimated to be $27.7 million. If the 46 percent reduction is equally applicable to 2070 intermediate relative sea level rise damages, then the benefits are estimated to be $122.3 million. This increase is reflective of the intermediate rise level rise scenario only.

The expected annual estimated benefits for 2020 and 2075 were converted to an equivalent annual value using the current interest rate, 3.75 percent, and a 50-year period of analysis. The total cost for the project alternatives included the construction costs along with the costs of non-structural measures in the western portion of the study area. This cost was applied to Alternatives A and C since they provide the same level of risk reduction using the 1 percent (100-year) level of risk reduction. **Tables 17, 18 and 19** show the calculation of the estimated annual cost for the alternatives using the 3.75 percent interest rate and a 50-year period of analysis. **Tables 20, 21, and 22** show the estimated equivalent annual benefits, annual costs, and equivalent annual net benefits. The net benefit results show that the project alternatives are economically justified for the 1% (100-year) annual exceedance probability (AEP) system under the intermediate sea-level rise scenario. The results were obtained using parametric costs and adjustments to the without project damages to reflect the expected project performance.

Table 16: Annual Without Project Damages for Each Study Area Reach

West Shore Lake Pontchartrain, LA Feasibility Study

Equivalent Annual Damage Analysis

File Help

WSLP 2020
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.750
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories						Total Damage
				AUTO	COM	IND	MOBHOM	MOBHOME	RES	
Westshore	Stream added d	SA 18	SA 18	1.11	54.39	0.00	0.00	0.00	0.00	55.50
		SA 9	SA 9	25.92	475.39	0.00	5.83	0.00	1088.51	1595.65
		SA 1	SA 1	17.74	222.74	0.00	5.51	0.00	354.12	600.11
		SA 2	SA 2	27.33	198.88	0.00	9.24	0.00	419.20	654.66
		SA 3	SA 3	0.80	13.52	0.00	0.26	0.00	5.09	19.67
		SA 4	SA 4	14.30	77.65	0.00	3.50	0.00	282.40	377.85
		SA 5	SA 5	3.62	15.75	0.00	1.83	0.00	68.92	90.12
		SA 6	SA 6	3.33	12.29	0.00	0.28	0.00	49.13	65.03
		SA 7	SA 7	34.66	61.86	0.00	38.92	0.00	339.75	475.18
		SA 8	SA 8	59.37	284.05	0.00	17.53	0.00	1713.56	2074.50
		SA 10	SA 10	41.64	1045.75	0.00	14.11	0.00	1104.05	2205.55
		SA 11	SA 11	0.13	7.54	0.00	0.00	0.00	0.00	7.68
		SA 12	SA 12	18.45	300.36	0.00	20.45	0.00	227.36	566.63
		SA 13	SA 13	29.50	229.20	0.00	6.00	0.00	567.45	832.15
		SA 14	SA 14	14.35	533.59	0.00	2.52	0.00	464.21	1014.66
		SA 15	SA 15	10.77	86.51	0.00	2.24	0.00	202.98	302.51
		SA 16	SA 16	43.57	318.84	0.00	114.72	0.00	434.52	911.66
		SA 17	SA 17	0.90	0.00	0.00	0.00	0.00	30.81	31.71
		SA 25	SA 25	1.84	151.11	0.00	0.00	0.00	43.69	196.64
		SA 22	SA 22	17.38	23.15	0.00	13.98	0.00	375.42	429.92
		SA 21	SA 21	116.78	3598.57	0.00	16.94	0.00	2760.41	6492.70
		SA 19	SA 19	0.43	0.79	0.00	0.00	0.00	0.00	1.22
		SA 20	SA 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 43P	SA 43P	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 42P	SA 42P	0.30	3.52	0.00	0.00	0.00	0.00	3.82
		SA 26	SA 26	1.19	8.05	0.00	0.00	0.00	3.61	12.86
		SA 28Y	SA 28Y	2.32	386.48	0.00	0.00	0.00	0.00	388.80
		SA 29	SA 29	109.11	1747.47	0.00	5.65	0.00	2536.28	4398.52
		SA 30	SA 30	543.67	915.02	0.00	0.00	0.00	15725.93	17184.63
		SA 44C	SA 44C	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 41P	SA 41P	0.20	0.00	0.00	0.00	0.00	7.78	7.98
		SA 40P	SA 40P	7.01	24.98	0.00	0.00	0.00	9.62	41.61
		SA 31	SA 31	225.49	669.75	0.00	0.00	0.00	8206.81	9102.05
		SA 32	SA 32	505.83	414.33	0.00	0.00	0.00	17322.82	18242.99
		SA 41	SA 41	5.70	1037.17	0.00	0.00	0.00	0.00	1042.86
		SA 35	SA 35	71.32	575.09	0.00	0.00	0.00	2353.86	3000.28
		SA 38	SA 38	126.91	28.84	0.00	0.19	0.00	5463.73	5619.66

Equivalent Annual Damage Analysis

File Help

WSLP 2020
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.750
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories						Total Damage
				AUTO	COM	IND	MOBHOM	MOBHOME	RES	
		SA 38	SA 38	118.31	28.84	0.00	0.19	0.00	5463.89	5611.22
		SA 37	SA 37	0.05	0.00	0.00	0.00	0.00	0.72	0.77
		SA 36	SA 36	41.35	417.69	0.00	0.00	0.00	948.44	1407.48
		SA 27	SA 27	233.41	11299.39	0.00	0.00	0.00	0.00	11532.80
		SA 30C	SA 30C	26.03	0.00	0.00	0.00	0.00	1144.74	1170.78
		SA 23	SA 23	5.04	396.60	0.00	0.08	0.00	34.75	436.46
		SA 24	SA 24	33.75	525.89	0.00	75.50	0.00	152.60	787.74
		SA 28X	SA 28X	32.98	1085.35	0.00	25.59	0.00	284.89	1428.81
		SA 39	SA 39	4.33	89.90	0.00	3.09	0.00	9.98	107.29
		SA 39C	SA 39C	1.78	46.58	0.00	0.20	0.00	40.10	88.67
		SA 34	SA 34	332.56	2678.29	0.00	0.00	0.00	11627.86	14638.71
		SA 33	SA 33	300.72	448.24	0.00	0.00	0.00	8649.61	9398.58
		SA 31C	SA 31C	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SA 29C	SA 29C	8.09	313.48	0.00	0.00	0.00	92.19	413.75
		1	1	5.03	100.92	0.00	2.31	0.00	112.04	220.30
		2	2	0.07	0.00	0.00	0.00	0.00	0.00	0.07
		3	3	0.08	9.78	0.00	0.00	0.00	0.00	9.86
		4	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		5	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		6	6	0.00	28.89	0.00	0.00	0.00	0.00	28.89
		7	7	66.56	41.99	0.00	0.00	0.00	1803.29	1911.83
		8	8	39.82	454.83	0.00	17.15	0.00	719.79	1231.59
		9	9	0.74	0.80	0.00	0.00	0.00	12.37	13.90
		10	10	0.54	1.69	0.00	0.00	0.00	10.70	12.93
		11	11	35.45	26.89	0.00	0.00	0.00	921.14	983.48
		12	12	0.50	0.24	0.00	0.00	0.00	6.25	6.99
		13	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		14	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		15	15	0.00	0.79	0.00	0.00	0.00	0.01	0.81
		16	16	0.02	0.03	0.00	0.00	0.00	0.27	0.33
		17	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		18	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		19	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		20	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		21	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		22	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		23	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		24	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Equivalent Annual Damage Analysis

File Help

WSLP 2020
Equivalent Annual Damage by Damage Categories and Damage Reaches
for the Without (Without project condition) plan
(Damage in $1,000's)

Discount Rate: 3.750
Analysis Period: 50 Years
Plan was calculated with Uncertainty

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Equivalent Annual Damage or Damage Categories						Total Damage
				AUTO	COM	IND	MOBHOM	MOBHOME	RES	
		21	21	1.97	366.15	0.00	0.00	0.00	0.00	368.12
		22	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		23	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		24	24	2.99	0.00	0.00	0.00	0.00	184.75	187.74
		25	25	0.03	0.00	0.00	0.00	0.00	0.35	0.38
		26	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		27	27	0.24	0.00	0.00	0.00	0.00	23.69	23.93
		28	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		29	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		30	30	0.13	0.04	0.00	0.00	0.00	1.73	1.89
		31	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		32	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		33	33	0.38	32.93	0.00	0.00	0.00	0.00	33.31
		34	34	0.24	0.00	0.00	0.00	0.00	3.78	4.01
		35	35	0.15	0.00	0.00	0.00	0.00	2.39	2.54
		36	36	0.36	0.00	0.00	0.85	0.00	2.85	4.06
		37	37	2.94	7.15	0.00	0.00	0.00	117.82	127.91
		38	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		39	39	0.08	0.00	0.00	0.00	0.00	0.99	1.07
		40	40	0.01	0.00	0.00	0.00	0.00	0.08	0.09
		41	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		42	42	0.07	0.05	0.00	0.00	0.00	1.50	1.61
		43	43	0.16	0.12	0.00	0.00	0.00	3.76	4.04
		44	44	0.32	27.76	0.00	0.00	0.00	3.03	31.11
		45	45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		46	46	39.37	566.60	0.00	83.00	0.00	1050.73	1739.70
		47	47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		48	48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		49	49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		50	50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		51	51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		52	52	0.25	0.44	0.00	0.00	0.00	3.14	3.83
		53	53	7.90	67.28	0.00	5.96	0.00	180.87	262.02
		54	54	9.74	340.05	0.00	0.00	0.00	508.69	858.48
		55	55	16.57	536.02	0.00	2.65	0.00	409.51	964.75
		56	56	25.00	399.98	0.00	5.85	0.00	665.19	1096.03
	Total for stream:			3333.75	34798.68	163.64	502.08	0.00	91891.04	130689.20

Table 17: Alternative C - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2010	-9	$0	1.393	0
2011	-8	$0	1.342	0
2012	-7	$0	1.294	0
2013	-6	$0	1.247	0
2014	-5	$0	1.202	0
2015	-4	$0	1.159	0
2016	-3	$0	1.117	0
2017	-2	$150	1.076	161
2018	-1	$150	1.038	155
2019	0	$150	1.000	150
2020	1	$150	0.964	144
2021	2	$6	0.929	5
2022	3	$6	0.895	5
2023	4	$6	0.863	5
2024	5	$6	0.832	5
2025	6	$6	0.802	5
2026	7	$6	0.773	4
2027	8	$6	0.745	4
2028	9	$6	0.718	4
2029	10	$6	0.692	4
2030	11	$6	0.667	4
2031	12	$6	0.643	4
2032	13	$6	0.620	4
2033	14	$6	0.597	3
2034	15	$6	0.576	3
2035	16	$6	0.555	3
2036	17	$6	0.535	3
2037	18	$6	0.515	3
2038	19	$6	0.497	3
2039	20	$6	0.479	3
2040	21	$6	0.462	3
2041	22	$6	0.445	3
2042	23	$6	0.429	2
2043	24	$6	0.413	2
2044	25	$6	0.398	2
2045	26	$6	0.384	2
2046	27	$6	0.370	2

Table 17 (Cont.) Alternative C - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2047	28	$6	0.357	2
2048	29	$6	0.344	2
2049	30	$6	0.331	2
2050	31	$6	0.319	2
2051	32	$6	0.308	2
2052	33	$6	0.297	2
2053	34	$6	0.286	2
2054	35	$6	0.276	2
2055	36	$6	0.266	2
2056	37	$6	0.256	1
2057	38	$6	0.247	1
2058	39	$6	0.238	1
2059	40	$6	0.229	1
2060	41	$6	0.221	1
2061	42	$6	0.213	1
2062	43	$6	0.205	1
2063	44	$6	0.198	1
2064	45	$6	0.191	1
2065	46	$6	0.184	1
2066	47	$6	0.177	1
2067	48	$6	0.171	1
2068	49	$6	0.165	1
2069	50	$6	0.159	1
		880.901		734

Interest Rate (%)	3.75	
Amortization Factor	0.04457	
Average Annual Costs		32.7
O&M Costs		4.1
Total Average Annual Costs ($ Millions)		36.8

Table 18: Alternative A - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2010	-9	$0	1.393	0
2011	-8	$0	1.342	0
2012	-7	$0	1.294	0
2013	-6	$0	1.247	0
2014	-5	$0	1.202	0
2015	-4	$0	1.159	0
2016	-3	$0	1.117	0
2017	-2	$151	1.076	163
2018	-1	$151	1.038	157
2019	0	$151	1.000	151
2020	1	$151	0.964	146
2021	2	$6	0.929	5
2022	3	$6	0.895	5
2023	4	$6	0.863	5
2024	5	$6	0.832	5
2025	6	$6	0.802	5
2026	7	$6	0.773	4
2027	8	$6	0.745	4
2028	9	$6	0.718	4
2029	10	$6	0.692	4
2030	11	$6	0.667	4
2031	12	$6	0.643	4
2032	13	$6	0.620	4
2033	14	$6	0.597	3
2034	15	$6	0.576	3
2035	16	$6	0.555	3
2036	17	$6	0.535	3
2037	18	$6	0.515	3
2038	19	$6	0.497	3
2039	20	$6	0.479	3
2040	21	$6	0.462	3
2041	22	$6	0.445	3
2042	23	$6	0.429	2
2043	24	$6	0.413	2
2044	25	$6	0.398	2
2045	26	$6	0.384	2
2046	27	$6	0.370	2

Table 18 (Cont.) Alternative A - 1% AEP Total Annual Costs

(2012 Price Level; 3.75% Discount Rate)

West Shore Lake Pontchartrain, LA Feasibility Study

($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2047	28	$6	0.357	2
2048	29	$6	0.344	2
2049	30	$6	0.331	2
2050	31	$6	0.319	2
2051	32	$6	0.308	2
2052	33	$6	0.297	2
2053	34	$6	0.286	2
2054	35	$6	0.276	2
2055	36	$6	0.266	2
2056	37	$6	0.256	1
2057	38	$6	0.247	1
2058	39	$6	0.238	1
2059	40	$6	0.229	1
2060	41	$6	0.221	1
2061	42	$6	0.213	1
2062	43	$6	0.205	1
2063	44	$6	0.198	1
2064	45	$6	0.191	1
2065	46	$6	0.184	1
2066	47	$6	0.177	1
2067	48	$6	0.171	1
2068	49	$6	0.165	1
2069	50	$6	0.159	1
		887.591		741

Interest Rate (%)	3.75	
Amortization Factor	0.04457	
Average Annual Costs		33.0
O&M Costs		7.5
Total Average Annual Costs ($ Millions)		40.5

Table 19: Alternative D - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2010	-9	$0	1.393	0
2011	-8	$0	1.342	0
2012	-7	$0	1.294	0
2013	-6	$0	1.247	0
2014	-5	$0	1.202	0
2015	-4	$0	1.159	0
2016	-3	$0	1.117	0
2017	-2	$223	1.076	240
2018	-1	$223	1.038	231
2019	0	$223	1.000	223
2020	1	$223	0.964	215
2021	2	$0	0.929	0
2022	3	$0	0.895	0
2023	4	$0	0.863	0
2024	5	$0	0.832	0
2025	6	$0	0.802	0
2026	7	$0	0.773	0
2027	8	$0	0.745	0
2028	9	$0	0.718	0
2029	10	$0	0.692	0
2030	11	$0	0.667	0
2031	12	$0	0.643	0
2032	13	$0	0.620	0
2033	14	$0	0.597	0
2034	15	$0	0.576	0
2035	16	$0	0.555	0
2036	17	$0	0.535	0
2037	18	$0	0.515	0
2038	19	$0	0.497	0
2039	20	$0	0.479	0
2040	21	$0	0.462	0
2041	22	$0	0.445	0
2042	23	$0	0.429	0
2043	24	$0	0.413	0
2044	25	$0	0.398	0
2045	26	$0	0.384	0
2046	27	$0	0.370	0

Table 19 (Cont.): Alternative D - 1% AEP Total Annual Costs
(2012 Price Level; 3.75% Discount Rate)
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Year	Years from Base Year	Expenditures	Present Value	Present Value of
2047	28	$0	0.357	0
2048	29	$0	0.344	0
2049	30	$0	0.331	0
2050	31	$0	0.319	0
2051	32	$0	0.308	0
2052	33	$0	0.297	0
2053	34	$0	0.286	0
2054	35	$0	0.276	0
2055	36	$0	0.266	0
2056	37	$0	0.256	0
2057	38	$0	0.247	0
2058	39	$0	0.238	0
2059	40	$0	0.229	0
2060	41	$0	0.221	0
2061	42	$0	0.213	0
2062	43	$0	0.205	0
2063	44	$0	0.198	0
2064	45	$0	0.191	0
2065	46	$0	0.184	0
2066	47	$0	0.177	0
2067	48	$0	0.171	0
2068	49	$0	0.165	0
2069	50	$0	0.159	0
		891.085		908

Interest Rate (%)	3.75	
Amortization Factor	0.04457	
Average Annual Costs		40.5
O&M Costs		6.2
Total Average Annual Costs ($ Millions)		46.7

Table 20: 1% AEP (100-year) Alternative C
(2012 Price Level; 3.75% Discount Rate)
Total Equivalent Annual Net Benefits
West Shore Lake Pontchartrain, LA Feasibility Study
($ Millions)

Item	Equiv Annual W/O Project Damages (2020-2070)	Equiv Annual With-Project Damages (2020-2070)	Equiv Annual Benefits (2020-2070)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	$ 130.69	$ 70.80	$ 59.89
First Costs	-	-	$ 881.00
Interest During Construction	-	-	$ 17.00
Annual Operation & Maintenance Costs			$ 4.13
Total Annual Costs			$ 36.80
B/C Ratio			1.63
Equivalent Annual Net Benefits - 2020 Base Year			$ 23.05

Table 21: 1% AEP (100-year) Alternative A
(2012) Price Level; 3.75% Discount Rate
Toal Equivalent Annual Net benefits
West Shore Lake Pontchartrain, Louisiana Feasibility Study
($Millions)

Item	Equiv Annual W/O Project Damages (2020-2070)	Equiv Annual With-Project Damages (2020-2070)	Equiv Annual Benefits (2020-2070)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	$ 130.69	$ 70.8(	$ 59.89
First Costs	-	-	$ 887.59
Interest During Construction	-	-	$ 17.20
Annual Operation & Maintenance Costs			$ 7.51
Total Annual Costs			$ 40.53
B/C Ratio			1.48
Equivalent Annual Net Benefits - 2020 Base Year			$ 19.36

Table 22: 1% AEP (100-year) Alternative D
(2012 Price Level; 3.75% Discount Rate) Total Equivalent Annual Net Benefits
West Shore Lake Pontchartrain, LA Feasibility Study

Item	Equiv Annual W/O Project Damages (2020-2070)	Equiv Annual With-Project Damages (2020-2070)	Equiv Annual Benefits (2020-2070)
Damage Category			
Residential & Commercial - Structure/Content/Vehicles	$ 130.69	$ 70.80	$ 59.89
First Costs	-	-	$ 891.08
Interest During Construction	-	-	$ 25.40
Annual Operation & Maintenance Costs			$ 6.18
Total Annual Costs			$ 46.67
B/C Ratio			1.28
Equivalent Annual Net Benefits - 2020 Base Year			$ 13.22