Amite River and Tributaries East of the Mississippi River, Louisiana

Appendix G – Economic and Social Considerations

March 2025

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1.1 INTRODUCTION

1.1.1 General

This appendix presents an economic evaluation of the flood risk management Plans for the Amite River and Tributaries (ART) Study East of the Mississippi River, Louisiana. It was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, ER 1105-2-103, 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).

This appendix consists of a description of the methodology used to determine both the National Economic Development (NED) damages and benefits and total project benefits under existing and future conditions and the project costs. For comparison of alternative plans, the time of analysis was based on Fiscal Year (FY) 2024 (October 2023) price levels and the contemporary 2024 Federal discount rate of 2.75 percent. More detailed analysis was then undertaken of the preferred alternative. This analysis used Fiscal Year (FY) 2025 (October 2024) price levels, the FY 2025 Federal discount rate of 3.00 percent, and a 50-year period of analysis with the year 2028 as the base year.

1.1.2 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 Plan generally result from the reduction of actual or potential damages caused by inundation. Inundation reduction includes the reduction of physical damages to structures, contents, and vehicles and indirect losses to the national economy. Due to the nonstructural nature of the final array of plans, physical flood damages to structures and their contents was the only NED benefit category included in this analysis.

1.1.3 Regional Economic Development

When the economic activity lost in a flooded region can be transferred to another area or region in the national economy, these losses cannot be included in the NED account. However, the impacts on the employment, income, and output of the regional economy are considered part of the Regional Economic Development (RED) account. The input-output

macroeconomic model RECONS can be used to address the impacts of the construction spending associated with the project Plans.

1.1.4 Other Social Effects

The Other Social Effects (OSE) account includes impacts to overarching social themes including social vulnerability & resiliency, health & safety, economic vitality, social connectedness, and participation. Impacts to these social themes are prevalent in flood risk management projects and are evaluated and discussed in the OSE account.

The economics team evaluated outcomes of the various Plans on socially vulnerable populations using the Center for Disease Control, Agency for Toxic Substances and Disease Registry's Social Vulnerability Index and US. Census Bureau statistics, and United States Geological Survey Food Atlas, and the formerly available Council on Environmental Quality's Climate and Economic Justice Screening Tool. Additionally, the PDT evaluated the life safety risk to the study area utilizing submergence criteria from the HEC-LifeSim technical manual.

1.2 DESCRIPTION OF THE STUDY AREA

1.2.1 Geographic Location

The ART study area includes the Amite River Basin in addition to an influence area directly south of the basin, which extends to the Mississippi River. The area includes portions of four Mississippi counties: Amite, Lincoln, Franklin, and Wilkinson in the upper portion of the basin; and portions of eight Louisiana parishes: East Feliciana, St. Helena, East Baton Rouge, Livingston, Iberville, St. James, St. John the Baptist, and Ascension in the mid- to lower-basin. An inventory of residential and nonresidential structures was developed for the portions of these counties and parishes within the HEC-RAS modeled area. The West Shore Lake Pontchartrain (WSLP) project, which covers the portions of the St. James and St. John the Baptist Parishes within the ART study area, was not included in the ART hydraulic modeling. To avoid double counting benefits that will be realized by construction of WSLP, structures within St. James Parish and St. John the Baptist Parish were removed from the ART structure inventory. Figure G:1-1 shows the structure inventory and the boundaries of the counties/parishes along with the study area boundary.

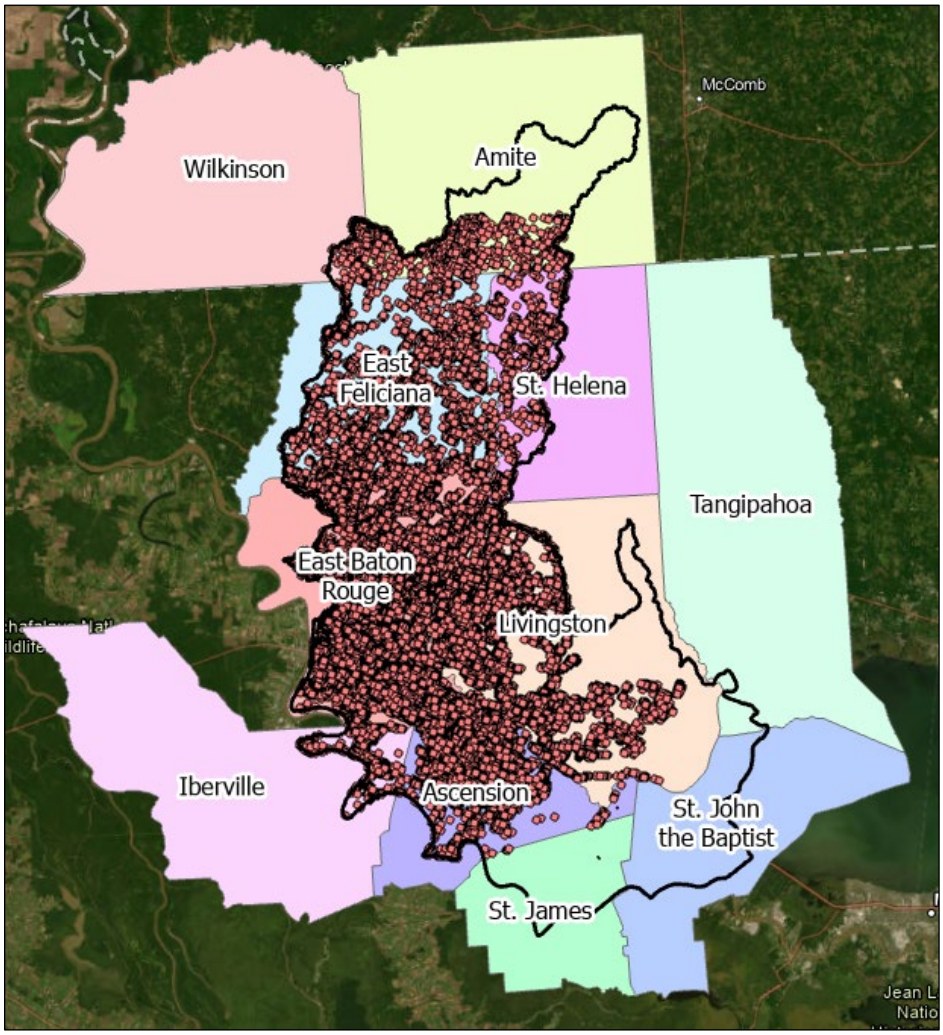

Figure G:1-1. Parish/County Boundaries, Structure Inventory, & Study Area Boundary

1.2.2 Study Area Reaches

The portion of the study area included in the hydraulic model was divided into 106 reaches with similar hydrology. Figure G:1-2 shows the study area reach boundaries for the ART study area.

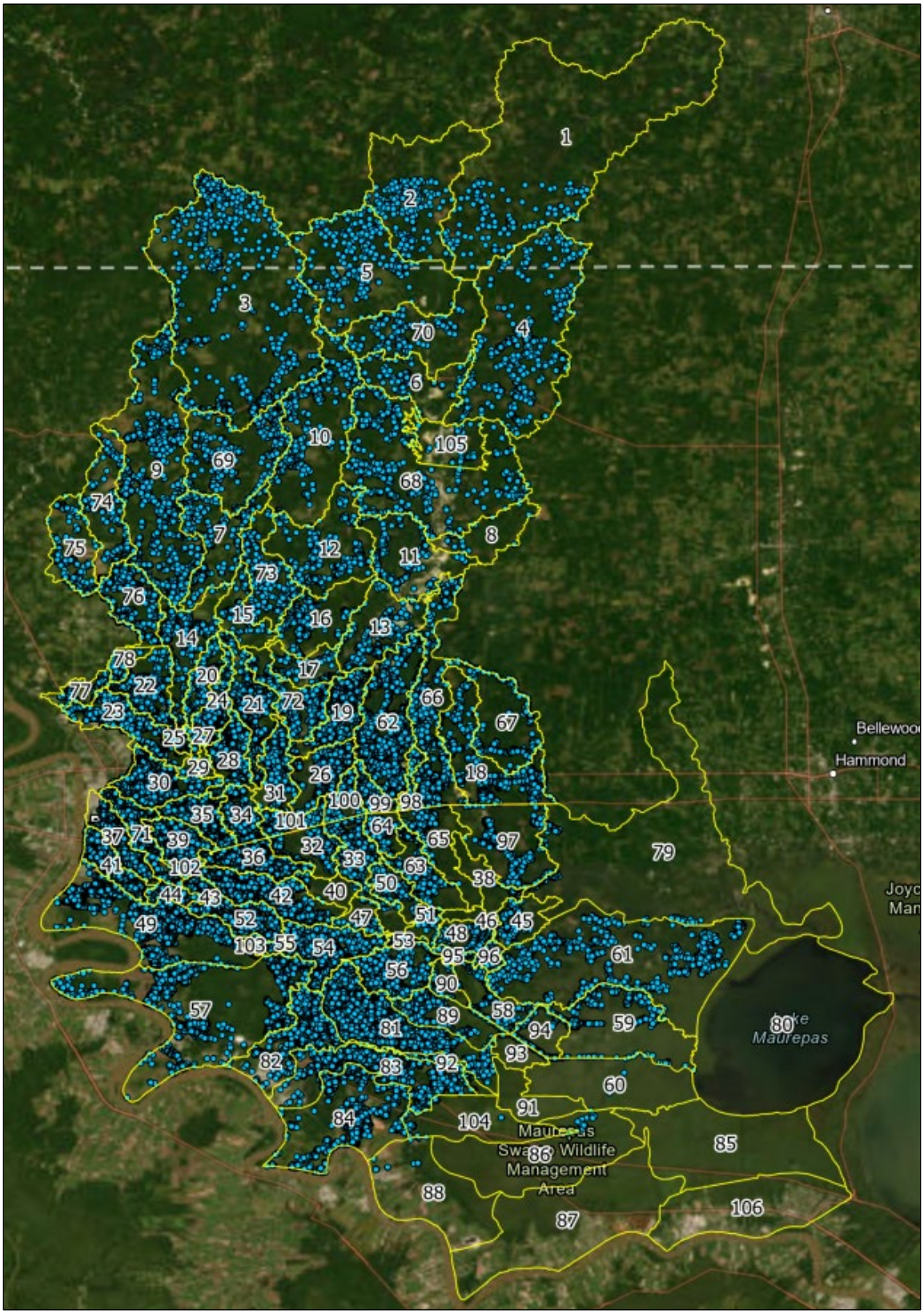

Figure G:1-2. Reach Boundaries, Structure Inventory

Sub-Reaches with Social Vulnerability Considerations

To evaluate the impacts to the OSE account, study area reaches based on hydraulic characteristics shown in Figure G:1-3 were further divided into sub-reaches based on social vulnerability. The CDC's Social Vulnerability Index (SVI) uses the American Community Survey to quantify a community's ability to respond and cope with a hazardous event. Within the overall SVI, there are four subthemes that are incorporated, which include Socioeconomic Status, Household Characteristics, Racial & Ethnic Minority Status, and Housing Type & Transportation. To identify areas experiencing social vulnerability, a 90th percentile threshold was applied across the four themes, in addition to the overall vulnerability. Out of 191 Louisiana Census Tracts within the ART study area, there were 46 that were identified as experiencing social vulnerability. Economic reaches intersecting with tracts experiencing social vulnerability were divided into sub-reaches to evaluate how the existing and future without project conditions will affect areas experiencing social vulnerability and develop plans that specifically target these areas.

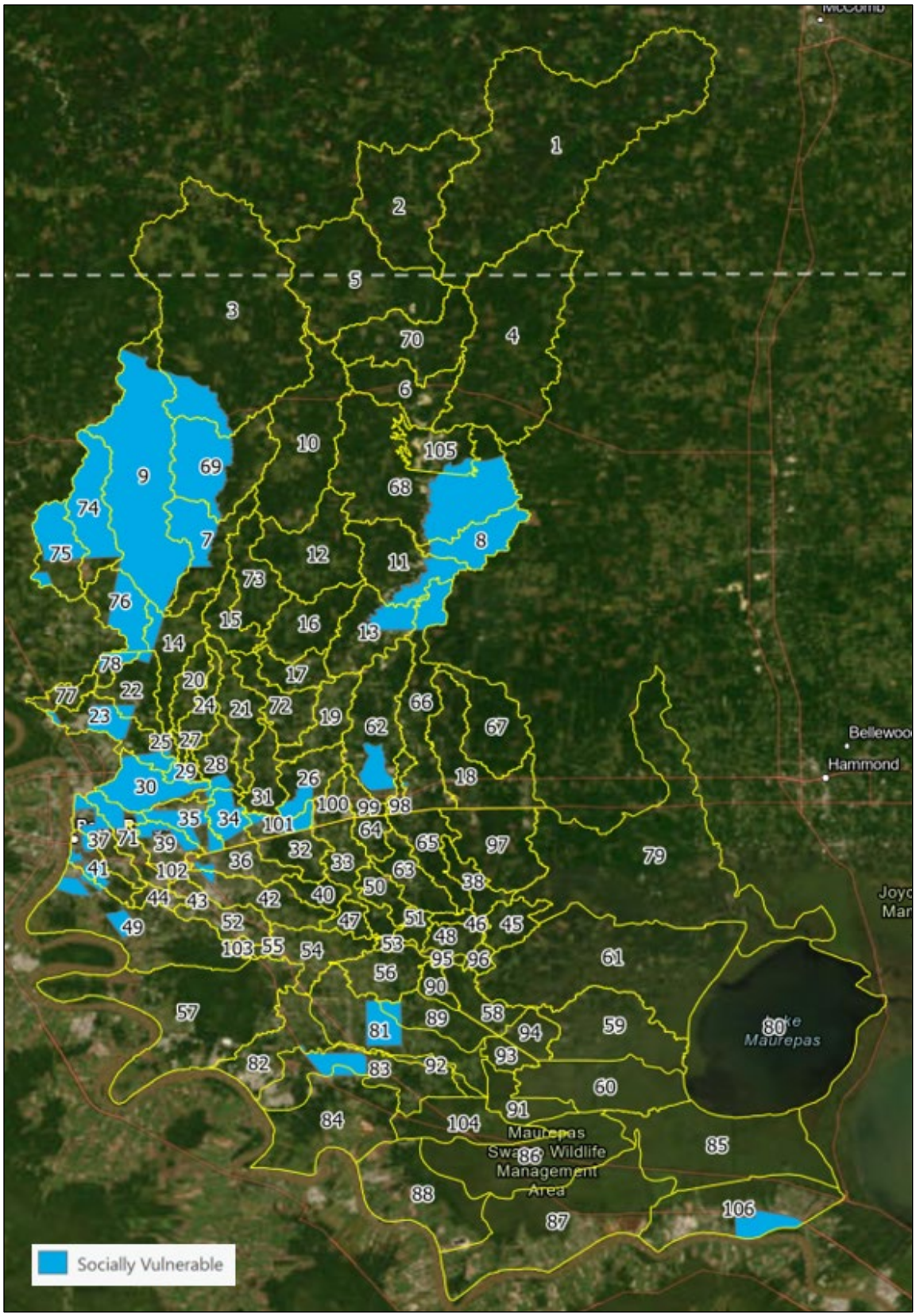

Figure G:1-3. Reach Boundaries, Sub-reaches with Social Vulnerability

1.2.3 Land Use

The total number of acres of developed, agricultural, and undeveloped land in the study area is shown in Table G:1-1. As shown in the table, undeveloped land makes up the majority of the study area with 13 percent of the total acres categorized as developed land.

Table G:1-1. Land Use in the Study Area

Land Class Name	Acres	Percentage of Total
Developed Land	945,085	13%
Agricultural Land	986,813	14%
Undeveloped Land	5,097,445	73%
Total	7,029,343	100%

Source: USGS National Land Cover Database 2015

1.3 SOCIOECONOMIC SETTINGS

1.3.1 Population, Number of Households, and Employment

Tables G:1-2, G:1-3, and G:1-4 display the population, number of households, and the employment (number of jobs) for each of the parishes and counties for the years 2000, 2010, and 2017 as well as projections for the years 2025 and 2045. The 2000 and 2010 population, number of households and employment is based on estimates from the 2010 U.S. Census and the projections were developed by Moody's Analytics (ECCA) Forecast, which has projections to the year 2045.

Table G:1-2. Historical and Projected Population by Parish

Parish	2000	2010	2017	2025	2045
Ascension	76,627	107,215	122,948	136,988	161,973
East Baton Rouge	412,852	440,171	446,268	441,495	415,720
East Feliciana	21,360	20,267	19,412	18,140	15,910
Iberville	33,320	33,387	33,027	31,166	27,428
Livingston	91,814	128,026	138,228	150,306	166,260
St. Helena	10,525	11,203	10,363	9,681	8,592
Total	646,498	740,269	770,246	787,775	795,883

Sources: 2000, 2010, 2017 from U.S. Census Bureau; 2025, 2045 from Moody's Analytics (ECCA) Forecast

Table G:1-3. Historical and Projected Households by Parish

Parish	2000	2010	2017	2025	2045
Ascension	26,995	38,050	44,890	51,815	66,244
East Baton Rouge	156,740	172,440	179,910	184,008	186,082
East Feliciana	6,694	6,996	6,922	6,752	6,411
Iberville	10,697	11,075	11,229	11,137	10,643
Livingston	32,997	46,297	52,184	57,891	69,149
St. Helena	3,890	4,323	4,116	3,995	3,810
Total	238,012	279,181	299,251	315,598	342,339

Sources: 2000, 2010 from U.S. Census Bureau; 2017, 2025, 2045 from Moody's Analytics (ECCA) Forecast

Table G:1-4. Historical and Projected Employment by Parish

Parish	2000	2010	2017	2025	2045
Ascension	36,431	49,414	59,670	65,803	82,614
East Baton Rouge	197,789	205,112	227,301	222,833	222,810
East Feliciana	7,811	7,427	7,866	7,321	6,820
Iberville	11,745	12,622	13,661	12,892	12,054
Livingston	42,326	56,675	66,010	70,000	82,219
St. Helena	3,830	4,097	4,171	3,868	3,649
Total	299,931	335,346	378,679	382,717	410,166

Sources: 2000, 2010 from U.S. Bureau of Labor Statistics; 2017, 2025, 2045 from Moody's Analytics (ECCA) Forecast

1.3.2 Income

Table G:1-5 shows the per capita personal income levels by parish for the years 2000, 2010, 2017, and 2025, with projections provided by Moody's Analytics Forecast.

Table G:1-5. Historical and Projected Employment by Parish/County

Parish	2000	2010	2017	2025
Ascension	24,052	39,416	47,628	60,180
East Baton Rouge	27,228	39,651	48,120	60,048
East Feliciana	20,049	33,122	39,908	53,331
Iberville	18,681	32,342	38,960	50,288
Livingston	21,521	32,621	39,883	51,341
St. Helena	16,821	34,136	41,273	55,046

Sources: 2000, 2010 from U.S. Census Bureau; 2017, 2025 from Moody's Analytics (ECCA) Forecast

1.3.3 Compliance with Policy Guidance Letter (PGL) 25 and Executive Order 11988

Given continued growth in employment and income, it is expected that development will continue to occur in the study area with or without a flood risk management project and will not conflict with PGL 25 and EO 11988, which state that the primary objective of a flood risk reduction project is to protect existing development, rather than to make undeveloped land available for more valuable uses. Given the nonstructural nature of all plan measures in the final array, the project would not induce development, but would rather reduce the risk of the population being displaced after a major storm event.

1.4 RECENT FLOOD HISTORY

1.4.1 Flood Events

The study area has experienced riverine flooding from excessive rainfall events in addition to incurring flood damages associated with storm surge from hurricanes and tropical storms. Since 1851, the paths of 51 tropical events have crossed the study area. The paths and intensities of these storms are shown in Figure G:1-4.

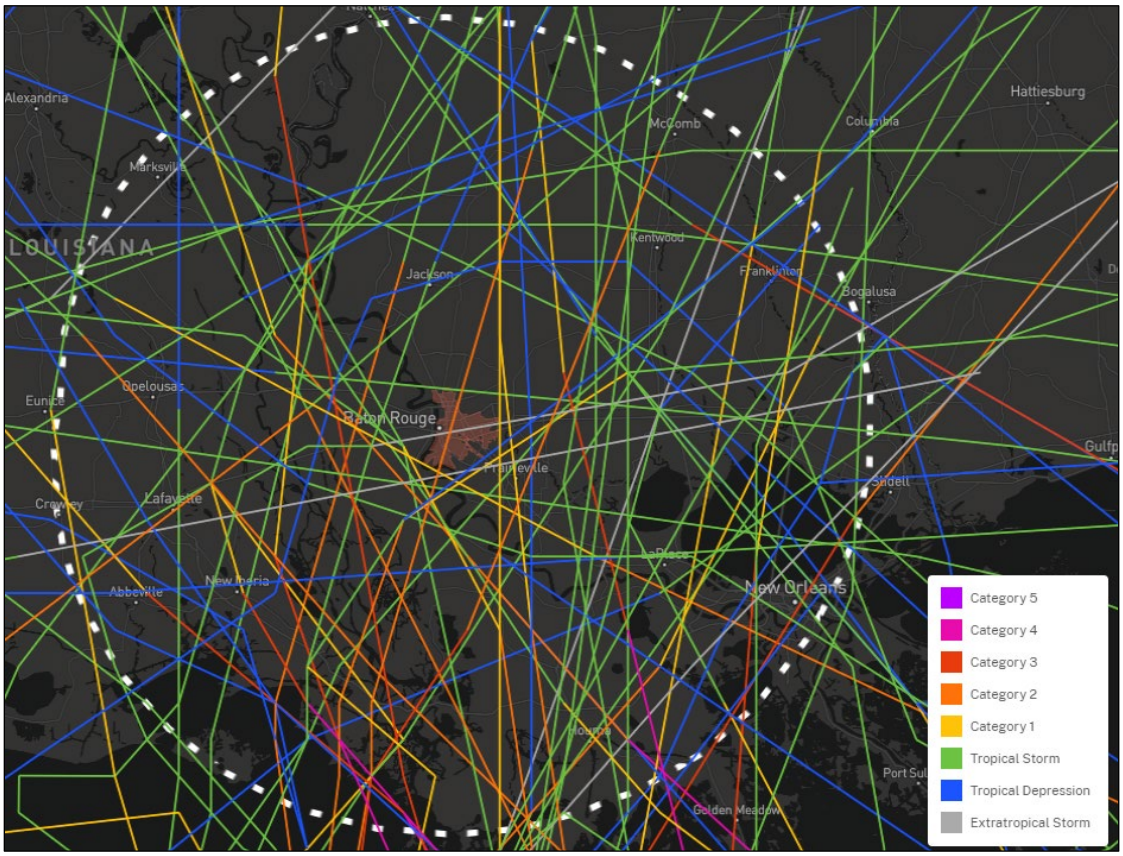

Figure G:1-4. Hurricane and Tropical Storm Paths Since 1851

1.4.2 FEMA Flood Claims

The most recent extreme riverine event to affect the study area was the 2016 Louisiana Floods. This event brought catastrophic flooding damage to Baton Rouge and the surrounding areas with both localized flooding and riverine flooding from the Amite and Comite Rivers and their tributaries. The FEMA flood claims for the most recent events to impact the area are shown in Table G:1-6.

Table G:1-6. Top Tropical Storms and Amount Paid by FEMA

Event	Month & Year	Number of Paid Claims	Total Amount Paid (millions)
Hurricane Andrew	August 1992	5,242	$128.9
Hurricane Rita	September 2005	8,921	$348.7
Hurricane Gustav	September 2008	4,396	$88.9
Hurricane Ike	September 2008	45,374	$2,074.1
Tropical Storm Lee	September 2011	9,725	$377.6
2016 Louisiana Floods	August 2016	20,641	$1,689.2
Hurricane Zeta	October 2020	1,041	$17.3
Hurricane Ida	September 2021	21,637	$1,112.0
Tropical Storm Nicholas	September 2021	254	$5.6

Source: Federal Emergency Management Agency (FEMA)

Note 1: Total amount paid is at price level at time of the event.

Note 2: Claims and amount paid are for entire event, which may include areas outside of the study area.

Table G:1-7 shows the FEMA flood claims paid between January 1978 and September 2023 for all counties and parishes in the study area. The table includes the number of claims, number of paid losses, and the total amount paid in the dollar value at the time of the payment. The table excludes losses that were not covered by flood insurance.

Table G:1-7. FEMA Flood Claims by Parish

Parish	Total Number of Claims	Number of Paid Claims	Total Payments (millions)
Ascension	6,005	5,141	$285.7
East Baton Rouge	18,958	15,792	$948.5
East Feliciana	14	12	$0.6
Iberville	544	439	$7.3
Livingston	10,270	8,829	$477.2
St. Helena	51	36	$1.7
Total	35,842	30,249	$1,721.0

Source: Federal Emergency Management Agency (FEMA)

Note 1: Total amount paid is at price level at time of the event.

Note 2: Period of record covers January 1978 to September 2023

1.5 SCOPE OF STUDY

1.5.1 Problem Description

The study area is urban with pockets of rural communities scattered among the eight-county area. Flood risk management is the only authorized purpose for the study. The study area is impacted by riverine flooding from major rainfall events as well as storm surge from tropical events in the southern portion of the study area. Since authorization is limited to flood risk management, project formulation was conducted based on hydraulics associated with just riverine flooding. After formulation, damage analysis for both without project and with project conditions was conducted based on predominant condition hydraulics that incorporate both riverine flooding and storm surge to accurately capture project performance and residual risk. The predominant condition hydraulics takes the higher of the water surface elevation at a certain probability generated by two hydrologic boundary condition scenarios: one condition accounts for basin-wide extreme rainfall events with normal highwater downstream boundary condition, and a secondary condition that has negligible basin rainfall with storm surge downstream boundary conditions. The details of these HEC-RAS models used to compute predominant condition hydraulics is available in the H&H Appendix.

1.5.2 Nonstructural – Final Array

Three nonstructural plans have been carried forward to the final array; they include elevating residential structures and floodproofing nonresidential structures. For the purposes of benefit evaluation, residential structures were elevated to the future year 0.01 AEP predominate

condition stage (not to exceed 13 feet) and nonresidential structures received 3 feet of dry floodproofing.

Nonstructural Plan Development

Nonstructural plan development in the final array relied on the comparison of the costs and benefits of floodplain aggregations at the reach or sub-reach level. Eligibility for nonstructural floodplain aggregations was determined using the future year (2078) riverine water surface elevations at the 0.1 AEP, 0.04 AEP, 0.02 AEP, and 0.01 AEP flood events. Structures with flooding above the first-floor at each of the flooding events were included in the floodplain aggregations. The residual risk implications of limiting eligibility to exclude storm surge can be found in Section 5 of this appendix. Table G:1-8 displays the number of structures included at each floodplain aggregation included in the plans used for nonstructural Plan development.

Table G:1-8. Structures with First-Floor Flooding by Floodplain

Structure Type	0.1 AEP (10-year)	0.04 AEP (25-year)	0.02 AEP (50-year)	0.01 AEP (100-year)
Residential	772	1,292	1,900	3,417
Nonresidential	85	155	250	495
Total	857	1,447	2,150	3,912

To determine the economic benefits for comparison, equivalent annual damages were calculated in HEC-FDA for each of the four floodplain aggregations. A detailed description of the HEC-FDA modeling can be found in Section 2 of this appendix. Parametric construction cost estimates (including contingency) were developed per structure in collaboration with New Orleans District cost engineering. At the time of the Tentatively Selected Plan (TSP), elevation of residential structures was costed at $95 per square foot and dry floodproofing of nonresidential structures was costed at $236,721 per structure under 20,000 square feet or $560,254 per structure over 20,000 square feet (2025 Price Level). These costs were used to determine the net benefits during plan formulation. Net benefits are the benefits remaining once the costs of a plan have been paid. Positive net benefits are considered economically justified for the purposes of the National Economic Development account. The plan determined to have the highest net benefits is considered the NED Plan.

Plan 2: Nonstructural NED Plan

Eligibility for nonstructural measures in Plan 2 relied on the optimization of the floodplain aggregations in Table G:1-8 as well as the sub-reaches developed using social vulnerability criteria described in Section 1.2. For each reach, the floodplain aggregation that received the highest net benefits, when compared to cost, was selected for inclusion in the plan. If determined beneficial, optimization was determined at the sub-reach level for socially

vulnerable sub-reaches. Only reaches (or sub-reaches) with positive net benefits were included in this plan.

Plan 3: Nonstructural NED + OSE Increment 1

Structures included in Plan 2 were also included in Plan 3. OSE Increment 1 adds structures within the largest floodplain that retained positive net benefits for all socially vulnerable sub-reaches. Only reaches or sub-reaches with positive net benefits were included in this plan.

Plan 4: Nonstructural NED + OSE Increment 2

Structures included in Plan 3 were also included in Plan 4. OSE Increment 2 adds structures within the next highest floodplain from Plan 3 for all socially vulnerable sub-reaches.

The composition of the final array plans is shown in the tables below. Table G:1-9 displays the number of structures eligible for nonstructural measures in each plan. Table G: 1-10 shows the with-project foundation heights of the structures elevated by plan. Table G: 1-11 displays the number of reaches or sub-reaches that optimized at each floodplain per plan.

Table G:1-9. Structures Eligible for Nonstructural Measures by Plan

Plans in Final Array	Elevate	Floodproof	Total Structures
Plan 2 (NED)	1,554	189	1,743
Plan 3 (NED+OSE1)	1,755	216	1,971
Plan 4 (NED+OSE2)	1,810	241	2,051

Table G:1-10. Residential Foundation Heights After Elevation

Plans in Final Array	<5'	5' to 8'	8' to 10'	10' to 12'	>12'	Total Structures	Average Foundation Height
Plan 2 (NED)	270	706	507	67	4	1,554	7.7
Plan 3 (NED+OSE1)	452	724	508	67	4	1,755	7.4
Plan 4 (NED+OSE2)	478	752	509	67	4	1,810	7.3

Table G:1-11. Number of Reaches or Sub-reaches by AEP Floodplain by Plan

Plans in Final Array	Number of Reaches or Sub-reaches				
	0.1 AEP (10-year)	0.04 AEP (25-year)	0.02 AEP (50-year)	0.01 AEP (100-year)	Total
Plan 2 (NED)	8	25	4	11	48
Plan 3 (NED+OSE1)	5	23	4	16	48
Plan 4 (NED+OSE2)	5	25	7	20	57

SECTION 2

Economic and Engineering Inputs to the HED-FDA Model

2.1 HEC-FDA MODEL

2.1.1 Model Overview

The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.4.3 Corps-certified model was used to calculate the damages and benefits for the Amite River and Tributaries FRM evaluation. The economic and engineering inputs necessary for the model to calculate damages include the existing condition structure inventory, contents-to-structure value ratios, foundation heights, ground elevations, depth-damage relationships, and 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 maximum, and 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 first-floor elevations. While normal distributions were preferred to represent the uncertainty in the economic variables, triangular distributions were utilized in select variables where not enough observations were known to fully develop a normal distribution. Instead of modeling without uncertainty, the economics team decided to use a triangular distribution to represent known variations in the data. The number of years that stages were recorded at a given gauge was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

2.2 ECONOMIC INPUTS TO THE HEC-FDA MODEL

2.2.1 Structure Inventory

A structure inventory of residential and nonresidential structures within the study area was obtained through the National Structure Inventory (NSI) version 2022. The following modifications were made to refine the NSI:

- Data gathered during structure surveys was incorporated
    1. Square footages, foundation heights, foundation types, age, condition,
- Depreciated replacement values were computed using costs and depreciation factors from the 2025 RSMeans Square Foot Catalog
- Repetitively damaged structures (those receiving damages at the 0.2 AEP predominate event) were adjusted to reflect a most likely future of self-mitigation

Structure Values. The 2025 RSMeans Square Foot Costs Data catalog (RSMeans catalog) was used to assign a depreciated replacement cost to the residential and nonresidential structures in the study area. Residential replacement costs per square foot were provided for four exterior wall types (wood siding on wood frame, brick veneer on wood frame, stucco on wood frame, and solid masonry) and three construction qualities (economy, average, and luxury) for homes constructed with average quality materials. An average replacement cost per square foot for the four exterior wall types was calculated for each construction quality. Based on windshield surveys, it was determined that the majority of the structures in the study area were in average condition, with an approximate age of 20 years. The associated depreciation proportion was used to calculate a most-likely depreciated square foot cost. An additional regional adjustment factor (87 percent of the national square foot costs) for the Baton Rouge area was then applied to the depreciated cost per square foot. The square footage for each of the individual residential structures was multiplied by the most-likely depreciated cost per square for the average construction class to obtain a total depreciated replacement cost.

Nonresidential replacement costs per square foot were provided in the RSMeans catalog for six exterior wall types, which were specific to each occupancy type. An average replacement cost per square foot was calculated for each of the six exterior wall types in each nonresidential occupancy. The RSMeans catalog depreciation schedule for nonresidential structures provides depreciation percentages for three building materials: frame, masonry on wood, and masonry on masonry or steel. Based on windshield surveys, it was determined that the majority of the structures in the study area were built with masonry on wood, with an observed age of 20 years. The associated depreciation proportion was used to calculate a most-likely depreciated square foot cost. An additional regional adjustment factor (88 percent of the national square foot costs) for the Baton Rouge area was then applied to the depreciated cost per square foot. The square footage for each of the individual structures was multiplied by the most-likely depreciated cost per square foot for each nonresidential occupancy to obtain a total depreciated cost. Table G:2-1 shows the average depreciated replacement value for residential and nonresidential structures by category and occupancy type.

Table G:2-1. Residential and Nonresidential Structure Inventory (2025 Price Level, $1,000s)

Category	Occupancy Type	Count	Average Depreciated Replacement Value
Residential	One-Story Slab	146,322	$358.0
	One-Story Pier	8,093	$353.8
	Two-Story Slab	49,640	$322.1
	Two-Story Pier	2,796	$338.1
	Mobile Home	20,587	$38.3
Commercial	Eating and Recreation	1,571	$697.8
	Professional	10,298	$869.3
	Repair and Home Use	1,511	$538.9
	Retail and Personal Services	15	$695.3
	Grocery and Convenience	1,825	$734.4
	Multi-Family Occupancy	1,513	$587.3
Public	Public and Semi-Public	1,866	$696.5
Industrial	Warehouse	5,010	$502.3
	Residential	227,438	$242.9
	Non-residential	23,609	$811.9
	Total	251,047	$296.4

Structure Value Uncertainty. A triangular probability distribution based on the depreciated replacement costs was used to represent the uncertainty surrounding the residential structure values in each occupancy category. The most-likely depreciated value for residential structures was based a 20 percent depreciation rate (consistent with an estimated age of a 20-year old structure in average condition), the minimum value was based on a 45 percent depreciation rate (consistent with an estimated age of a 30-year old structure in poor condition), and the maximum value was based on a 7 percent depreciation rate (consistent with an estimated age of a 10-year old structure in good condition). These values were then converted to a percentage of the most-likely value with the most-likely value equal to 100 percent of the average value for each occupancy category. The triangular probability distributions were entered into the HEC-FDA model to represent the uncertainty surrounding the structure values in each residential occupancy category.

A triangular probability distribution based on the depreciated replacement costs was used to represent the uncertainty surrounding the nonresidential structure values in each occupancy category. The most-likely depreciated value for nonresidential structures was based a 25 percent depreciation rate (consistent with an observed age of a 20-year old masonry on wood structure), the minimum value was based on a 40 percent depreciation rate (consistent with an observed age of a 30-year old frame structure), and the maximum value was based on an 8 percent depreciation rate (consistent with an observed age of a 10-year old masonry on masonry or steel structure). These values were then converted to a percentage of the most-likely value with the most-likely value equal to 100 percent of the average value for each occupancy category. The triangular probability distributions were entered into the HEC-FDA model to represent the uncertainty surrounding the structure values in each nonresidential occupancy category. Table G:2-2 shows the minimum and maximum percentages of the most-likely structure values assigned to the various structure categories.

Table G:2--2. Structure Value Uncertainty Parameters

Category	Occupancy Type	Structure Value Error	
		Lower (%)	Upper (%)
Residential	One-Story Slab	68.75	116.25
	One-Story Pier	68.75	116.25
	Two-Story Slab	68.75	116.25
	Two-Story Pier	68.75	116.25
	Mobile Home	48.33	146.68
Commercial	Eating and Recreation	80	122.67
	Professional	80	122.67
	Repair and Home Use	80	122.67
	Retail and Personal Services	80	122.67
	Grocery and Convenience	80	122.67
	Multi-Family Occupancy	80	122.67
Public	Public and Semi-Public	80	122.67
Industrial	Warehouse	80	122.67

2.2.2 Residential and Nonresidential Content-to-Structure Value Ratios

The content-to-structure value ratios (CSVRs) applied to the residential and nonresidential structure occupancies were taken from an extensive survey of owners in coastal Louisiana

for three large CSRM evaluations. These interviews included a sampling from residential and nonresidential content categories from each of the three evaluation areas.

Since only a limited number of property owners participated in the field surveys and the participants were not randomly selected, statistical bootstrapping was performed to address the potential sampling error in estimating the mean and standard deviation of the CSVR values. Statistical bootstrapping uses re-sampling with replacement to improve the estimate of a population statistic when the sample size is insufficient for straightforward statistical inference. The bootstrapping method has the effect of increasing the sample size and accounts for distortions caused by a specific sample that may not be fully representative of the population.

2.2.3 Content-to-Structure Value Ratio Uncertainty

For each of the residential and nonresidential occupancies, a mean CSVR and a standard deviation was calculated and entered into the HEC-FDA model. A normal probability density function was used to describe the uncertainty surrounding the CSVR for each content category. The expected CSVR percentage values and standard deviations for each of the residential and nonresidential occupancies are shown in Table G:2-3.

Table G:2-3. Content-to-Structure Value Ratios (CSVRs) and Standard Deviations (SDs) by Occupancy

Category	Occupancy Type	CSVR (%)	SD (%)
Residential	One-Story Slab	69	37
	One-Story Pier	69	37
	Two-Story Slab	67	35
	Two-Story Pier	67	35
	Mobile Home	114	79
Commercial	Eating and Recreation	170	293
	Professional	54	54
	Repair and Home Use	236	295
	Retail and Personal Services	119	105
	Grocery and Convenience	134	78
	Multi-Family Occupancy	28	17
Public	Public and Semi-Public	55	80
Industrial	Warehouse	207	325

2.2.4 First Floor Elevations

Topographical data based on Light Detection and Ranging (LiDAR) data using the North American Vertical Datum of 1988 (NAVD 88) were used to assign ground elevations to structures and vehicles in the study area. The assignment of ground elevations and the placement of structures were based on a digital elevation model (DEM) with a 2-foot by 2-foot grid resolution developed by the United States Geological Survey (USGS), which was resampled at a 40-foot by 40-foot resolution. This ground elevation raster was obtained from the HEC-RAS hydraulic model to avoid continuity errors between the engineering and economic inputs. The ground elevation was added to the height of the foundation of the structure above the ground in order to obtain the first-floor elevation of each structure in the study area. While the structure inventory in the HEC-FDA model does not use a ground elevation, the incorporation of the ground elevation at the structure location was incorporated in the formatting of the water surface profiles associated with each structure to provide depths instead of elevations.

Sampling of Foundation Heights Above Ground. The foundation heights of the residential and nonresidential structures above the ground were determined using statistical random sampling procedures. Sampling was necessary due to varying types of structure foundations (slab on grade and pier/pile) and the large variation in the heights of these foundations above the ground elevation. Statistical formulas were used to account for the estimated variation, acceptable error, and level of confidence and to determine a statistically significant number of structures to be surveyed. A focused Agency Technical Review (ATR) was conducted in on this process in August of 2024 to confirm the adequacy of the sampling techniques used to develop the results.

The study area was stratified by the occupancy and foundation types provided in the National Structure Inventory. A total of 357 residential and nonresidential structures were randomly selected. If a selected structure had been demolished or razed, then an adjacent structure was surveyed in its place. The survey team used Google Earth to collect the required information including the height of the foundation above ground (measured from the bottom of the front door to adjacent ground) and the foundation type (slab or pier). This information was used to develop the average height above ground of slab on grade and pier/pile foundation structures and the proportion of slab on grade foundations and pier/pile foundations.

The mean foundation height and proportions of sampled residential 1-story and 2-story pile foundation structures and residential 1-story and 2-story slab foundation structures were applied to all the unsampled residential structures. The mean foundation height and proportions of the sampled commercial 1-story and 2-story pile foundation structures and commercial 1-story and 2-story slab foundation structures were randomly applied to the unsampled commercial structures. Since the commercial depth-damage relationships are only provided for commercial 1-story structures, all the commercial structures were treated as 1-story structures.

2.2.5 Uncertainty Surrounding Elevations

There are two sources of uncertainty surrounding the first-floor elevations: the use of the LiDAR data for the ground elevations, and the methodology used to determine the structure foundation heights above ground elevation. The error surrounding the LiDAR data was determined to be plus or minus 0.5895 feet at the 95 percent level of confidence. This uncertainty was normally distributed with a mean of zero and a standard deviation of 0.3 feet.

The uncertainty surrounding the foundation heights for the residential and commercial structures was estimated by calculating the standard deviations surrounding the sampled mean values for the combined inventory. An overall weighted average standard deviation for the four structure groups was computed for each structure category. The standard deviation was calculated to be 0.75 feet for residential pier foundation structures and 0.25 feet for slab foundation structures. The standard deviation for nonresidential structures was calculated to be 0.64 feet.

The standard deviations for the ground elevations and foundation heights were combined, which resulted in a 0.81 feet standard deviation for residential pier foundation structures and 0.439 for slab foundation structures. For nonresidential structures, the combined standard deviation was calculated to be 0.71 feet. Table G:2-4 displays the calculations used to combine the uncertainty surrounding the ground elevations with uncertainty surrounding the foundation height to derive the uncertainty surrounding the first-floor elevations of residential and nonresidential structures. Table G:2-5 displays the average foundation heights and standard deviations by occupancy type.

Table G:2-4. First-floor Stage Uncertainty Standard Deviation (SD) Calculation

Ground - LiDAR (conversion cm to inches to feet)		
+/- 18 cm @ 95% confidence	18cm	
	x	0.393
z = (x - u)/ std. dev.		7.074in
	÷	12
1.96 = (0.5895 - 0)/ std.dev.		0.5895ft
0.3007 = std.dev.		

Foundation Height (shown in feet)			
Residential		Commercial	Industrial
Pier	Slab	All	All
0.75	0.25	0.64	0.64

Combined First Floor (shown in feet)				
Residential		Commercial	Industrial	
Pier	Slab	All	All	
0.30	0.30	0.30	0.30	ground std. dev.
0.09	0.09	0.09	0.09	ground std. dev. Squared
0.75	0.25	0.64	0.64	1st floor std. dev.
0.56	0.06	0.41	0.41	1st floor std. dev. squared
0.65	0.15	0.50	0.50	Sum of Squared
0.81	**0.39**	**0.71**	**0.71**	**Square Root of Sum of Squared = Combined Std. Dev.**

Note 1: Mobile Homes are assigned the same uncertainty as Residential Pier.
Note 2: Autos do not have foundations, so only ground uncertainty is used.

Table G:2--5. Average Foundation Heights and Standard Deviations (SD) by Occupancy Type (feet)

Category	Occupancy Type	Average Foundation Height	Standard Deviations		
			Ground Stage SD	Foundation Height SD	First Floor SD
Residential	One-Story Slab	1.68	0.30	0.25	0.39
	One-Story Pier	2.66	0.30	0.75	0.81
	Two-Story Slab	1.57	0.30	0.25	0.39
	Two-Story Pier	2.71	0.30	0.75	0.81
	Mobile Home	3.18	0.30	0.75	0.81
Commercial	Eating and Recreation	1.28	0.30	0.64	0.71
	Professional	1.22	0.30	0.64	0.71
	Repair and Home Use	1.22	0.30	0.64	0.71
	Retail and Personal Services	1.14	0.30	0.64	0.71
	Grocery and Convenience	1.22	0.30	0.64	0.71
	Multi-Family Occupancy	1.18	0.30	0.64	0.71
Public	Public and Semi-Public	1.18	0.30	0.64	0.71
Industrial	Warehouse	0.87	0.30	0.64	0.71

2.2.6 Depth-Damage Relationships

Depth-damage relationships indicate the percentage of the total structure value damaged at various depths of flooding. For residential (no basement) and non-residential structures, damage percentages were estimated for each 1/2 foot increment of flooding from1 foot below first-floor elevation to 2 feet above first-floor elevation, and for each 1-foot increment from 2 feet to 15 feet above the first-floor elevation. Damage percentages for vehicles were estimated for each 1/2 foot increment of flooding from 1 foot above the ground to 2 feet above the ground and for each 1-foot increment above 2 feet. Damage percentages for residential and non-residential contents were estimated for each 1/2 foot increment from 1/2 foot above the first-floor elevation to 2 feet above the first-floor, and for each 1-foot increment of flooding from 2 feet above the first-floor to 15 feet above the first-floor.

Since site-specific residential and non-residential depth-damage relationships were not available for the study area, depth-damage relationships developed by a panel of building, construction, restoration and insurance experts for the Lower Atchafalaya and Morganza to the Gulf, Louisiana feasibility study were used in the economic analysis. These relationships

were deemed appropriate because the two study areas are geographically close, have similar sources of flooding, and have similar structure categories and occupancies. Since the study area is impacted by both freshwater riverine flooding from the Amite River and its tributaries as well as saltwater storm surge from Lake Maurepas, the predominate source at the 0.01 AEP event was used to determine if a structure would receive long-duration depth-damage relationships associated with freshwater or saltwater.

Most tropical storms in coastal areas are multiple day events with heavy rainfall and storm surge. The water pushed into the area during a tropical event must flow over land features such as beaches, agricultural land, roads and highways, ridges along waterways and localized flood risk management systems. After the storm system moves through the area, there are no mechanisms to push the water back over these land features, and the saltwater could remain inside of inundated structures for several days. Evacuated residents may not be able to return to their homes until the roads are safely passable and electrical power has been restored.

According to the panel of experts, saltwater flooding leads to more damages to structures and contents in a shorter amount of time than freshwater flooding. Saltwater is more corrosive on both metal and wood frame structures than freshwater. Inundation of four feet or more above the first-floor elevation of one-story residential structures causes substantial or total damage to the following structural components: soffit and fascia, exterior walls, structural frame and the heating and cooling units. For metal frame non-residential buildings, the following structural items are damaged at four feet: windows, hardware, framing, flooring, electrical, plumbing, HVAC, and building structure façade.

The combination of saltwater and warm, humid climate promotes the growth of mold and allows the mold to spread rapidly throughout inundated structures and contents. As the floodwaters begin to evaporate, the salt becomes more concentrated in the remaining moisture in the room, and contents of the structure that were not touched by the saltwater can also incur damages. For this reason, large damage percentages occur to the contents of structures at relatively low depths of flooding.

The conclusions of the panel of experts were confirmed by the actual damages to structures and contents in the New Orleans area following the saltwater, long duration flooding at various depths caused by Hurricane Katrina. The saltwater remained in the inundated structures for several weeks following the storm.

All of the structural and content depth-damage relationships, including uncertainty distributions, have been included at the end of this economic appendix in Addendum 2.

2.2.7 Uncertainty Surrounding Depth-Damage Relationships

A triangular probability density function was used to determine the uncertainty surrounding the damage percentage associated with each depth of flooding for all occupancy types. 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 May 1997 entitled *Depth-*

Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVRs) in Support of the Lower Atchafalaya Reevaluation and Morganza to the Gulf, Louisiana Feasibility Studies.

2.3 ENGINEERING INPUTS TO THE HEC-FDA MODEL

2.3.1 Stage-Probablility Relationships

Stage-probability relationships were provided for the existing condition (2028) and future condition (2078). Water surface profiles were provided for eight annual exceedance probability (AEP) events: 0.50 (2-year), 0.20 (5-year), 0.10 (10-year), 0.04 (25-year), 0.02 (50-year), 0.01 (100-year), 0.005 (200-year), and 0.002 percent (500-year). The ART experiences flooding from riverine rainfall events and coastal storm surge. The water surface profiles used in the damage analysis were based on predominant condition hydraulics, so the stage was associated with whichever flooding source resulted in a higher water surface elevation. Relative sea level change for high and intermediate scenarios was evaluated and documented in Appendix H for the areas impacted by storm surge. Economic analysis was limited to the intermediate sea level change scenario.

2.3.2 Uncertainity Surrounding the 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. The 50-year equivalent record length used across the study area falls within 50%-90% of the record lengths of the gauged locations within the watershed used for model calibration. This is compliant with the equivalent record length guidelines laid out in Engineering Manual 1110-2-1619 Engineering and Design Risk-based Analysis for Flood Damage Reduction Studies, dated 1 August 1996. For more information, please see Section 4 of Appendix H.

SECTION 3
National Economic Development (NED) Flood Damage and Benefit Calculations

3.1 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 study area reaches and sub-reaches for which a structure inventory had been created. 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.

3.1.1 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 base year (2028) conditions and the future without project (2078) 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 in the model for the stage-damage relationships. 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.

3.1.2 Stage-Probability Relationships with Uncertainty

The HEC-FDA model used an equivalent record length (50 years) for each reach or sub-reach to generate a stage-probability relationship with uncertainty for the without-project condition under base year (2028) conditions and future without project (2078) 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

functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided.

3.1.3 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 weighing 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 Plan, the EAD were totaled for each study area reach to obtain the total without-project EAD under base year (2028) conditions and future without project (2078) conditions.

Tables G:3-1 and G:3-2 show the number of structures and total damage, respectively, at each of the annual exceedance probability (AEP) events in the base year and the future year without project condition by category.

Table G:3-1 Structures Damaged Without Project by Probability Event

AEP Event	Residential	Commercial	Industrial	Public	Total
Base Year 2028					
0.5	0	0	0	0	0
0.2	0	0	0	0	0
0.1	2,696	114	111	12	2,933
0.04	4,909	251	205	23	5,388
0.02	7,872	466	340	45	8,723
0.01	12,311	879	511	74	13,775
0.005	17,605	1,376	723	114	19,818
0.002	26,542	2,144	1,017	207	29,910
Future Year 2078					
0.5	0	0	0	0	0
0.2	0	0	0	0	0
0.1	4,769	205	214	21	5,209
0.04	7,942	407	370	47	8,766
0.02	11,425	780	519	74	12,798
0.01	16,423	1,276	753	115	18,567
0.005	20,769	1,655	948	157	23,529
0.002	30,139	2,374	1,258	238	34,009

Table G:3-2 Damage Without Project by Probability Event (2025 Price Level; $ Millions)

AEP Event	Residential	Commercial	Industrial	Public	Total
Base Year 2028					
0.5	0	0	0	0	0
0.2	0	0	0	0	0
0.1	$246.8	$19.6	$23.7	$5.2	$295.3
0.04	$549.2	$55.2	$57.4	$10.9	$672.7
0.02	$989.7	$122.8	$111.5	$22.6	$1,246.6
0.01	$1,727.8	$262.1	$198.7	$45.0	$2,233.6
0.005	$2,741.0	$485.6	$306.0	$71.8	$3,604.4
0.002	$4,590.3	$905.4	$497.6	$131.3	$6,124.6
Future Year 2078					
0.5	0	0	0	0	0
0.2	0	0	0	0	0
0.1	$565.6	$62.1	$63.0	$12.5	$703.2
0.04	$1,094.8	$145.4	$138.7	$28.4	$1,407.3
0.02	$1,767.8	$284.6	$229.6	$49.9	$2,331.9
0.01	$2,684.5	$518.5	$344.4	$75.1	$3,622.5
0.005	$3,652.5	$769.8	$490.5	$118.8	$5,031.6
0.002	$5,655.2	$1,184.9	$720.5	$180.9	$7,741.5

3.1.4 Expected and Equivalent Annual Damages and Benefits for the Final Array of Plans

The HEC-FDA model used linear interpolation for the years between 2028 and 2078 to obtain the stream of expected annual damages over the 50-year period of analysis. The FY 2025 Federal interest rate of 3.00 percent was used 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 interest rate to calculate the equivalent annual damages. Expected and equivalent annual damages for the final array are shown by structure category in Table G:3-3. Expected and equivalent annual

damages and benefits for the final array are shown in Table G:3-4. Table G:3-5 shows the probability benefits for each of the plans exceeds the values indicated at the 0.75, 0.50 and 0.25 confidence levels. Damages and benefits by reach for each plan can be found in Addendum A.

Table G:3-3 Expected and Equivalent Annual Damage by Plan and Category (2024 Price Level; FY24 Federal Discount Rate; $Millions)

Plan	Commercial	Industrial	Public	Residential	Total
Base Year 2028					
Plan 1 (No action)	$22.1	$19.6	$2.9	$118.2	$162.8
Plan 2 (NED)	$18.7	$14.4	$2.6	$78.0	$113.6
Plan 3 (NED+OSE1)	$18.4	$14.3	$2.5	$74.0	$109.3
Plan 4 (NED+OSE2)	$18.3	$14.3	$2.5	$73.7	$108.9
Future Year 2078					
Plan 1 (No action)	$37.9	$36.4	$5.1	$187.2	$266.6
Plan 2 (NED)	$34.4	$30.9	$4.7	$136.5	$206.5
Plan 3 (NED+OSE1)	$34.1	$30.9	$4.7	$132.4	$202.2
Plan 4 (NED+OSE2)	$34.0	$30.9	$4.7	$132.1	$201.7
Equivalent at 2.75% FY24 Interest Rate					
Plan 1 (No action)	$28.1	$26.0	$3.8	$144.4	$202.3
Plan 2 (NED)	$24.7	$20.7	$3.4	$100.3	$148.9
Plan 3 (NED+OSE1)	$24.4	$20.6	$3.4	$96.2	$144.6
Plan 4 (NED+OSE2)	$24.3	$20.6	$3.4	$95.9	$144.2

Table G:3-4 Expected and Equivalent Annual Damages and Benefits by Plan (2024 Price Level; FY24 Federal Discount Rate; $1,000s)

Plan	Damages	Benefits
Base Year 2028		
Plan 1 (No action)	$162,845	$0
Plan 2 (NED)	$113,610	$49,235
Plan 3 (NED+OSE1)	$109,311	$53,534
Plan 4 (NED+OSE2)	$108,868	$53,977
Future Year 2078		
Plan 1 (No action)	$266,598	$0
Plan 2 (NED)	$206,522	$60,077
Plan 3 (NED+OSE1)	$202,169	$64,429
Plan 4 (NED+OSE2)	$201,721	$64,878
Equivalent at 2.75% FY24 Interest Rate		
Plan 1 (No action)	$202,305	$0
Plan 2 (NED)	$148,947	$53,358
Plan 3 (NED+OSE1)	$144,628	$57,678
Plan 4 (NED+OSE2)	$144,183	$58,123

Table G:3-5 Expected and Equivalent Annual Damages and Benefits by Plan and Probability (2024 Price Level; FY24 Federal Discount Rate; $1000s)

Plan	Probability Benefits Exceeds Values Indicated		
	0.75	0.50	0.25
Base Year 2028			
Plan 2 (NED)	$35,376	$46,420	$61,284
Plan 3 (NED+OSE1)	$38,800	$50,156	$66,211
Plan 4 (NED+OSE2)	$39,027	$50,563	$66,825
Base Year 2078			
Plan 2 (NED)	$45,431	$57,832	$72,942
Plan 3 (NED+OSE1)	$48,908	$61,634	$77,928
Plan 4 (NED+OSE2)	$49,142	$62,060	$78,554
Equivalent at 2.75% FY24 Interest Rate			
Plan 2 (NED)	$39,200	$50,760	$65,701
Plan 3 (NED+OSE1)	$42,644	$54,521	$70,650
Plan 4 (NED+OSE2)	$42,874	$54,936	$71,269

SECTION 4
Project Costs

4.1 PROJECT COSTS

Nonstructural cost estimates for the final array were developed through a joint effort between the New Orleans District Economics and Cost Engineering branches. Contingency was applied to all nonstructural cost estimates to represent the uncertainty regarding the cost and schedule risk of these measures.

Nonstructural cost estimates for the recommended plan (Plan 4) were developed by the New Orleans Cost Engineering Branch and were approved by the Walla Walla Cost Engineering Mandatory Center of Expertise as a certified estimate on 8/26/2024. The costs were certified with an effective price date of 01-OCT-2024 (FY25) with a Total First Cost of $1,049,321,000. The cost estimate had a contingency on nonstructural costs of 42 percent, and an average total project cost contingency of 40.7 percent when incorporating real estate, PED, and construction management. The only Alternative with a certified cost estimate is Plan 4, as represented in Table G:4-2.

4.1.1 Annual Project Construction Costs

The initial construction costs (first costs) were used to determine the interest during construction and gross investment cost at the end of the installation period (2028). Interest during construction was calculated in accordance with PB 2019-03 guidance for calculating interest during construction on a nonstructural project. The construction schedule for each of the ART nonstructural plans was assumed to be 3 months, which is the average time within the Louisiana area of elevating a residential home. For comparisons with alternative plans whose less detailed estimates were derived at earlier stages of the study, the FY 2024 Federal interest rate of 2.75 percent was used to discount the costs to the base year and then amortize the costs over the 50-year period of analysis using midyear discounting. The annualization of costs provided for each plan of the final array is shown in Table G:4-1.

Table G:4-1 Summary of Project Costs for Final Array
(2024 Price Level; FY24 Federal Discount Rate; $1,000s)

Final Array	Plan 2 (NED)	Plan 3 (NED+OSE1)	Plan 4 (NED+OSE2)
Construction First Cost	$897,497	$1,068,167	$1,097,921
Interest During Construction	$3,049	$3,628	$3,729
Total Construction Cost	$900,546	$1,071,795	$1,101,650
Average Annual Total Construction Cost	$33,400	$39,700	$40,800

Once the final array was determined and the study received the ASA-CW's approved exception, Plan 4 was determined to be the recommended plan. Table G:4-2 below displays the final annual costs for the recommended plan using the Cost Mandatory Center of Expertise Certified Estimate. Given the selection of Plan 4 as the recommended plan, its costs and interest rate have been updated and are displayed at FY25 price levels and discounted with the FY25 rate of 3.00 percent.

4.1.2 Annual Project Operations, Maintenance, Repaor, Replacement, and Rehabilitation Costs

There are Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs for the NFS and the property owners of nonresidential structures which are anticipated to begin in fiscal year 2035, which is 5 years after the first MATOC completion. On a rotating schedule, every 5 years, the NFS will conduct physical inspections, expected to cost approximately $1,200 per structure, from the street of 10 percent of the structures that have participated in the project, approximately 205 structures, to ensure that the owners, their heirs, and assigns, are following the terms and conditions of the executed agreements. Nonresidential property owners are expected to perform regular maintenance tasks, such as cleaning weep holes, inspecting and replacing deployable system components, and reapplying sealant coatings every 5-10 years, to ensure the effectiveness and longevity of floodproofing measures. It will be essential for the property owner to follow the manufacturer's recommendations and develop a routine maintenance schedule to ensure the floodproofing system remains effective and functional over time. The estimated costs for OMRR&R for the nonresidential property owner includes $720 for sealing coating reapplication and $144 for sealing materials every 10 years, to maintain the functionality of the floodproofing system over time.

4.1.3 Total Annual Project Costs

Table G:4-2 Summary of Project Costs for the Recommended Plan (2025 Price Level; FY25 Federal Discount Rate; $1,000s)

Recommended Plan	Plan 4 (NED+OSE2)
Construction First Cost	$1,049,321
Interest During Construction	$3,884
Total Construction Cost	$1,053,205
Average Annual Construction Cost	$40,933
Average Annual Maintenance Cost	$65 (sixty-five thousand)
Total Average Annual Cost	$40,998

SECTION 5
Results of the Economic Analysis

5.1 NET BENEFIT ANALYSIS

5.1.1 Calculation of Net Benefits

The equivalent annual benefits were compared to the annual costs to develop a benefit-to-cost ratio for each of the plans in the final array. The net benefits for the plans were calculated by subtracting the annual costs from the base year equivalent annual benefits. Table G:5-1 shows the average annual costs, benefits, net benefits, and benefit-to-cost ratios for the plans in the final array. Table G:5-1 presents information in 2024 price levels and discount rate (2.75 percent) to be consistent across all three plans. The National Economic Development (NED) plan is the plan that reasonably maximizes net benefits. While this analysis found Plan 2 to be the NED plan, the team has identified Plan 4 as the recommended total net benefits plan. The total net benefits plan and a formal exception to the NED plan was approved by the Assistant Secretary of the Army for Civil Works on 23-AUG-2024. Each plan's costs were developed and assume the same S&A, P&D, and contingency.

Table G:5-1. Final Array Annual Costs and Benefits Summary (2024 Price Level; FY24 Discount Rate; $1000s)

Final Array	Plan 2 (NED)	Plan 3 (NED+OSE1)	Plan 4 (NED+OSE2)
Construction First Cost	$897,497	$1,068,167	$1,097,921
Interest During Construction	$3,049	$3,628	$3,729
Total Construction Cost	$900,546	$1,071,795	$1,101,650
Average Annual Construction Cost	$33,400	$39,700	$40,800
Equivalent Annual Benefits	$53,358	$57,678	$58,123
Annual Net Benefits	$19,958	$19,977	$17,323
Benefit-to-Cost Ratio (BCR)	1.59	1.45	1.42

Once the final array was determined and the study received the ASA-CW's approved exception, Plan 4 was determined to be the recommended plan. Table G:5-2 displays the final annual costs and benefits summary for the recommended plan using the Cost Mandatory Center of Expertise Certified Estimate, which was done at 2025 price levels and with FY2025's discount rate (3.00 percent).

Table G:5-2. Recommended Plan Annual Costs and Benefits Summary (2025 Price Level; FY25 Discount Rate; $1000s)

Recommended Plan	Plan 4 (NED+OSE 2)
Construction First Cost	$1,049,321
Interest During Construction	$3,884
Total Construction Cost	$1,053,205
Average Annual Construction Cost	$40,933
Average Annual OMRR&R Cost	$65 (sixty-five thousand)
Total Annual Average Cost	$40,998
Equivalent Annual Benefits	$58,035
Annual Net Benefits	$17,037
Benefit-to-Cost Ratio (BCR)	1.42

5.2 RISK ANALYSIS

5.2.1 Benefit Exceedance Probability Relationship

The HEC-FDA model incorporates the uncertainty surrounding the economic and engineering inputs to generate results that can be used to assess the performance of proposed plans. The HEC-FDA model was used to calculate expected annual without-project and with-project damages and the damages reduced for each of the plans in the final array. Table G:5-3 shows the benefit exceedance probability relationship for each of the plans compared to the point estimate of the average annual cost. As benefits exceeding costs translates to a benefit-to-cost ratio of 1 or more, the table can also be translated as the probability the plan will produce a positive net benefit and BCR greater than 1.

Table G:5-3. Probability Equivalent Annual Benefits Exceed Annual Costs (2024 Price Level; FY24 Federal Discount Rate; $1000s)

Plan	Probability Benefits Exceeds Indicated Values			Annual Costs	Probability Benefits Exceed Cost
	75%	50%	25%		
Plan 2 (NED)	$39,200	$50,760	$65,701	$37,800	> 75%
Plan 3 (NED+OSE1)	$42,644	$54,521	$70,650	$39,700	> 75%
Plan 4 (NED+OSE2)	$42,874	$54,936	$71,269	$39,000	> 75%

5.2.2 Residual Risk

The ART study area is impacted by riverine flooding and coastal storm surge. The ART study is authorized as a flood risk reduction study, therefore nonstructural plans were developed using riverine water surface elevation. This excludes structures impacted solely by coastal storm surge from inclusion in the final array. Table G:5-4 shows the number of structures with first-floor flooding by flood source and frequency. The final array of plans, developed using riverine water surface elevations, reduces approximately 40 percent of the existing condition damages.

Table G:5-4 Number of Structures with First-floor Flooding Based on Source of Flooding

Year	Floodplain	Rainfall	Predominate	Difference
2028	0.1 AEP (10 year)	294	1,443	1,149
	0.04 AEP (25 year)	793	3,349	2,556
	0.02 AEP (50 year)	1,445	5,864	4,419
	0.01 AEP (100 year)	3,024	9,612	6,588
	0.005 AEP (200 year)	5,927	14,667	8,740
	0.002 AEP (500 year)	12,792	23,298	10,506
2078	0.1 AEP (10 year)	857	3,368	2,511
	0.04 AEP (25 year)	1,447	6,284	4,837
	0.02 AEP (50 year)	2,150	9,544	7,394
	0.01 AEP (100 year)	3,911	13,428	9,517
	0.005 AEP (200 year)	6,930	18,341	11,411
	0.002 AEP (500 year)	14,046	27,388	13,342

From a traditional residual risk perspective, Table G:5-5 provides a basis for how effective each of the plans are in the context of residual damages. For consistent comparison between plans, all prices and discount rates are at the 2024 levels from the last update of the alternative plans. Residual damages are the amount of base year, future year, and equivalent annual damages that are left unmitigated as a result of implementing one of the plans. In the case of the recommended Plan (Plan 4), it reduces damages by $58M, which is a 29 percent reduction in damages, and leaves 71 percent of the equivalent annual damages unaddressed. Updating the recommended plan to FY25 prices and interest rate does not have a significant effect and the residual risk remains at 71 percent.

Table G:5-5 Amite Residual Damages

Plan	Damages	Benefits	Residual Damage as % of EAD
Base Year 2028			
Plan 1 (No action)	$162,845	$0	100%
Plan 2 (NED)	$113,610	$49,235	70%
Plan 3 (NED+OSE1)	$109,311	$53,534	67%
Plan 4 (NED+OSE2)	$108,868	$53,977	67%
Future Year 2078			
Plan 1 (No action)	$266,598	$0	100%
Plan 2 (NED)	$206,522	$60,077	77%
Plan 3 (NED+OSE1)	$202,169	$64,429	76%
Plan 4 (NED+OSE2)	$201,721	$64,878	76%
Equivalent at 2.75% FY24 Interest Rate			
Plan 1 (No action)	$202,305	$0	100%
Plan 2 (NED)	$148,947	$53,358	74%
Plan 3 (NED+OSE1)	$144,628	$57,678	71%
Plan 4 (NED+OSE2)	$144,183	$58,123	71%

According to Table G:5-5, Plan 2 (NED) has the highest equivalent annual residual damages of $148.9M. The recommended plan of NED+OSE2 reduces the residual damages by an additional $4.7M. Table G:5-6 shows the increment of structures mitigated between Plan 2 and Plan 4, and where this $4.7M of additional incremental equivalent annual damages prevented is coming from. While this table shows exclusively NED damages, it should be noted that all 308 added structures represent socially vulnerable structures, providing additional OSE benefits in addition to its NED benefits.

Table G:5-6 Amite Residual Damages

	308 Structures - Incremental Difference Between the NED and OSE 2 Plans							
	Count of Structures Damaged at Each Frequency							
AEP	0.5	0.2	0.1	0.04	0.02	0.01	0.004	0.002
Year	2	5	10	25	50	100	250	500
Count	0	0	2	54	117	308	308	308
Avg Depth, ft (relative to FFE)	0	0	0.5	0.8	1.05	1.2	2.2	3.5

5.2.3 Nonstructural Participation Rate Sensitivity Analysis

Since nonstructural measures are voluntary, participation can have a significant impact on the residual risk associated with the plans. A participation rate sensitivity analysis was conducted using the HEC-FDA Structure Detail Output following the Scenario Approach recommended in the National Nonstructural Committee's BPG 2020-03. This approach is meant to provide an expected “best case” and “worst case” scenario from the aspect of net benefits and potential project justification. This analysis does not include risk or uncertainty and uses the parametric costs utilized in the formulation of the plans in the final array. Since there are nonstructural projects ongoing that could help inform future participation in this study’s plans, data associated with 25 percent, 50 percent, and 75 percent participation rates were provided as well as 100 percent as a basis of comparison. Table G: 5-7 provides structure counts for each rate for both Plan 2 (the NED plan) and Plan 4 (the recommended plan). Table G: 5-8 displays the potential net benefits and associated BCRs for each rate by plan.

Table G:5-7 Number of Structures by Participation Rate and Plan

Plan	**Structure Count**			
	25%	**50%**	**75%**	**100%**
Plan 2 (NED)	436	872	1,307	1,743
Plan 4 (Recommended)	513	1,026	1,538	2,051

Table G:5-8 Net Benefits and BCRs by Participation Rate and Plan (2024 Price Level; FY24 Federal Discount Rate; $ Thousands)

Plan	Net Benefits (Thousands)						
	25% Participation Rate		50% Participation Rate		75% Participation Rate		100%
	Worst Case	Best Case	Worst Case	Best Case	Worst Case	Best Case	
Plan 2	-$1,325	$19,003	$3,060	$29,020	$13,076	$33,404	$32,080
Plan 4	-$5,279	$21,040	-$3,066	$31,465	$7,360	$33,679	$28,399
Plan	**Benefit-to-Cost Ratios**						
	25% Participation Rate		50% Participation Rate		75% Participation Rate		100%
	Worst Case	Best Case	Worst Case	Best Case	Worst Case	Best Case	
Plan 2	0.73	3.42	1.31	3.16	1.85	2.81	2.38
Plan 4	0.36	3.42	0.77	3.06	1.37	2.66	1.99

Due to the nature of the nonstructural measures included in this analysis, there is no reduction in residual risk to roads, railways, or vehicles. There is also no reduction in damages associated with debris cleanup or other emergency costs. In addition to the residual risk associated with dollar damages, life safety concerns are not addressed for individuals outside of the structures where nonstructural measures are planned to be implemented. This also applies to individuals who decide not to participate since the measures proposed are voluntary. There is no expected transformed risk with the construction of the proposed measures for any plans in the final array.

5.2.4 Project Performance

ER 1105-2-101, Risk Assessment for Flood Risk Management Studies, provides the requirement to describe project performance by annual exceedance probability (AEP), assurance (conditional non-exceedance probability), and long-term exceedance probability (LTEP). Project performance describing these attributes is computed within HEC-FDA and is based on a target stage (traditionally the 0.01 AEP). Table G:5-9 shows the project performance table consistent with ER 1105-2-101 for the existing project condition. The with project condition (Plan 4) was not shown in this appendix because it did not impact the stages of the study. Without a change in hydraulic stages, Table G:5-9 will not show a benefit in project performance.

Table G:5-9 Project Performance (Existing Condition, 2028)

		AEP		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
1	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
3	2.4	0.12	0.13	0.75	0.99	1.00	0.20	0.00	0.00	0.00	0.00	0.00
4	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
6	12.1	0.07	0.07	0.54	0.90	0.98	0.79	0.23	0.10	0.08	0.02	0.01
7	2.0	0.02	0.02	0.21	0.52	0.70	0.50	0.92	0.42	0.21	0.08	0.02
9	0.1	0.02	0.05	0.39	0.77	0.91	0.53	0.47	0.00	0.10	0.04	0.02
10	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.9	0.03	0.03	0.23	0.54	0.73	0.50	0.85	0.36	0.20	0.07	0.03
12	5.4	0.05	0.05	0.41	0.80	0.93	0.94	0.42	0.19	0.13	0.04	0.01
13	7.8	0.05	0.06	0.47	0.85	0.96	0.88	0.33	0.15	0.10	0.03	0.01
14	1.9	0.03	0.03	0.25	0.57	0.76	1.00	0.74	0.33	0.16	0.06	0.03
15	1.0	0.04	0.05	0.38	0.76	0.91	0.95	0.45	0.20	0.11	0.04	0.01
16	2.6	0.10	0.11	0.68	0.97	1.00	0.44	0.01	0.00	0.00	0.00	0.00
17	3.8	0.13	0.13	0.76	0.99	1.00	0.20	0.00	0.00	0.00	0.00	0.00
18	1.6	0.12	0.13	0.75	0.98	1.00	0.21	0.00	0.00	0.00	0.00	0.00
19	3.8	0.10	0.10	0.66	0.96	1.00	0.50	0.06	0.02	0.02	0.01	0.00
20	1.4	0.11	0.12	0.71	0.98	1.00	0.40	0.01	0.01	0.00	0.00	0.00
21	1.8	0.05	0.05	0.42	0.81	0.94	0.93	0.40	0.18	0.13	0.04	0.01
22	3.9	0.07	0.08	0.56	0.91	0.98	0.74	0.20	0.10	0.08	0.03	0.01
23	1.5	0.10	0.11	0.69	0.97	1.00	0.44	0.01	0.00	0.00	0.00	0.00

		AEP		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
24	0.6	0.03	0.03	0.25	0.58	0.76	1.00	0.74	0.39	0.25	0.09	0.04
25	1.7	0.04	0.04	0.35	0.73	0.89	1.00	0.50	0.21	0.11	0.04	0.02
26	2.0	0.11	0.12	0.73	0.98	1.00	0.32	0.00	0.00	0.00	0.00	0.00
27	2.1	0.02	0.02	0.19	0.47	0.65	0.50	0.97	0.50	0.31	0.13	0.06
28	1.4	0.03	0.03	0.25	0.58	0.77	1.00	0.74	0.39	0.23	0.09	0.04
29	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.3	0.03	0.02	0.22	0.52	0.70	0.52	0.86	0.39	0.17	0.07	0.03
31	5.5	0.03	0.04	0.31	0.67	0.84	0.99	0.59	0.28	0.15	0.05	0.02
32	12.7	0.03	0.03	0.29	0.65	0.82	0.99	0.65	0.33	0.16	0.07	0.03
33	2.7	0.09	0.09	0.62	0.95	0.99	0.61	0.10	0.03	0.02	0.02	0.00
34	1.0	0.01	0.01	0.10	0.28	0.42	0.50	0.52	0.94	0.44	0.31	0.23
35	0.9	0.01	0.02	0.15	0.39	0.56	0.51	1.00	0.65	0.42	0.21	0.11
36	0.6	0.05	0.06	0.47	0.85	0.96	0.89	0.32	0.13	0.09	0.02	0.01
37	4.0	0.10	0.11	0.69	0.97	1.00	0.45	0.03	0.01	0.01	0.00	0.00
		AEP		Long Term Risk			Conditional Non-Exceedance Probability					
Reach	Target Stage	Median	Expected	10	30	50	0.1	0.04	0.02	0.01	0.004	0.002
38	1.0	0.04	0.04	0.31	0.68	0.85	1.00	0.57	0.28	0.19	0.06	0.02
39	2.7	0.11	0.12	0.72	0.98	1.00	0.38	0.00	0.00	0.00	0.00	0.00
40	2.8	0.05	0.06	0.44	0.82	0.94	0.90	0.35	0.15	0.06	0.02	0.01
41	2.7	0.12	0.13	0.76	0.99	1.00	0.17	0.00	0.00	0.00	0.00	0.00
42	8.7	0.05	0.06	0.47	0.85	0.96	0.89	0.32	0.10	0.03	0.01	0.00
43	1.7	0.02	0.02	0.21	0.50	0.68	0.50	0.95	0.45	0.24	0.09	0.03

		AEP		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	Target Stage	Median	Expected	10	30	50	0.1	0.04	0.02	0.01	0.004	0.002
44	2.1	0.16	0.15	0.81	0.99	1.00	0.03	0.00	0.00	0.00	0.00	0.00
45	1.7	0.12	0.13	0.75	0.98	1.00	0.21	0.00	0.00	0.00	0.00	0.00
46	2.2	0.02	0.02	0.20	0.48	0.66	1.00	0.86	0.53	0.31	0.13	0.05
47	8.1	0.11	0.13	0.74	0.98	1.00	0.28	0.00	0.00	0.00	0.00	0.00
48	7.3	0.04	0.04	0.33	0.71	0.87	0.98	0.55	0.27	0.18	0.06	0.02
49	3.8	0.11	0.11	0.69	0.97	1.00	0.42	0.04	0.00	0.00	0.00	0.00
50	3.0	0.10	0.10	0.66	0.96	1.00	0.54	0.06	0.02	0.01	0.03	0.01
51	6.9	0.05	0.05	0.43	0.81	0.94	0.92	0.39	0.18	0.08	0.03	0.01
52	2.9	0.13	0.14	0.77	0.99	1.00	0.16	0.00	0.00	0.00	0.00	0.00
53	9.7	0.08	0.09	0.60	0.94	0.99	0.66	0.15	0.07	0.03	0.01	0.00
54	12.8	0.10	0.10	0.65	0.96	0.99	0.56	0.09	0.04	0.01	0.00	0.00
55	3.6	0.05	0.05	0.43	0.82	0.94	0.91	0.37	0.17	0.07	0.03	0.01
56	7.1	0.08	0.09	0.59	0.93	0.99	0.67	0.16	0.08	0.04	0.01	0.00
57	4.5	0.11	0.12	0.73	0.98	1.00	0.30	0.00	0.00	0.00	0.00	0.00
58	4.4	0.10	0.11	0.67	0.97	1.00	0.46	0.05	0.05	0.04	0.02	0.01
59	4.6	0.12	0.13	0.74	0.98	1.00	0.25	0.00	0.00	0.00	0.00	0.00
60	3.0	0.14	0.14	0.78	0.99	1.00	0.10	0.00	0.00	0.00	0.00	0.00
61	3.6	0.12	0.12	0.74	0.98	1.00	0.28	0.01	0.01	0.01	0.01	0.00
62	2.0	0.12	0.13	0.74	0.98	1.00	0.25	0.00	0.00	0.00	0.00	0.00
63	2.1	0.10	0.11	0.69	0.97	1.00	0.42	0.03	0.01	0.01	0.00	0.00
64	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
65	1.1	0.04	0.05	0.39	0.78	0.92	0.95	0.44	0.16	0.08	0.02	0.01
66	2.0	0.11	0.12	0.73	0.98	1.00	0.30	0.00	0.00	0.00	0.00	0.00

		AEP		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
67	0.6	0.11	0.12	0.73	0.98	1.00	0.34	0.00	0.00	0.00	0.00	0.00
68	0.7	0.01	0.01	0.12	0.32	0.48	0.50	0.52	0.82	0.39	0.18	0.09
69	1.3	0.02	0.02	0.21	0.50	0.68	0.50	0.94	0.44	0.24	0.10	0.05
70	6.7	0.06	0.07	0.50	0.88	0.97	0.84	0.28	0.13	0.10	0.03	0.01
71	2.2	0.13	0.14	0.78	0.99	1.00	0.11	0.00	0.00	0.00	0.00	0.00
72	2.0	0.15	0.15	0.81	0.99	1.00	0.07	0.00	0.00	0.00	0.00	0.00
73	4.7	0.07	0.08	0.56	0.92	0.98	0.79	0.20	0.09	0.08	0.02	0.01
74	1.0	0.05	0.05	0.41	0.79	0.93	0.93	0.41	0.18	0.12	0.04	0.01
75	1.1	0.12	0.13	0.75	0.98	1.00	0.23	0.00	0.00	0.00	0.00	0.00
76	1.4	0.10	0.11	0.69	0.97	1.00	0.43	0.04	0.02	0.01	0.00	0.00
77	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
78	1.0	0.04	0.04	0.32	0.69	0.86	0.98	0.57	0.29	0.19	0.06	0.01
79	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
81	2.7	0.12	0.13	0.75	0.98	1.00	0.24	0.01	0.01	0.00	0.00	0.00
82	2.3	0.03	0.03	0.26	0.60	0.78	1.00	0.69	0.34	0.21	0.08	0.03
83	3.1	0.13	0.13	0.76	0.99	1.00	0.19	0.00	0.00	0.00	0.00	0.00
84	2.4	0.09	0.10	0.63	0.95	0.99	0.54	0.10	0.08	0.06	0.02	0.01
86	3.0	0.14	0.14	0.79	0.99	1.00	0.08	0.00	0.00	0.00	0.00	0.00
88	1.8	0.12	0.13	0.74	0.98	1.00	0.25	0.01	0.01	0.01	0.01	0.00
89	4.6	0.08	0.09	0.59	0.93	0.99	0.66	0.15	0.11	0.08	0.02	0.01
90	5.5	0.07	0.08	0.58	0.93	0.99	0.71	0.16	0.06	0.04	0.01	0.00
92	2.6	0.11	0.11	0.70	0.97	1.00	0.38	0.03	0.03	0.03	0.01	0.00

		AEP		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Reach	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**0.1**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
93	1.3	0.02	0.02	0.21	0.50	0.68	1.00	0.90	0.44	0.27	0.11	0.05
94	3.7	0.12	0.13	0.74	0.98	1.00	0.25	0.00	0.00	0.00	0.00	0.00
95	7.7	0.07	0.08	0.55	0.91	0.98	0.78	0.22	0.11	0.06	0.02	0.00
96	2.6	0.02	0.02	0.17	0.42	0.59	1.00	0.92	0.63	0.37	0.17	0.06
97	2.3	0.12	0.13	0.74	0.98	1.00	0.28	0.00	0.00	0.00	0.00	0.00
98	0.8	0.11	0.12	0.72	0.98	1.00	0.34	0.01	0.00	0.00	0.00	0.00
99	1.2	0.12	0.13	0.75	0.98	1.00	0.23	0.00	0.00	0.00	0.00	0.00
100	1.5	0.11	0.12	0.74	0.98	1.00	0.27	0.00	0.00	0.00	0.00	0.00
101	1.7	0.02	0.02	0.21	0.50	0.69	0.50	0.93	0.43	0.25	0.11	0.06
102	2.7	0.05	0.06	0.45	0.83	0.95	0.90	0.36	0.14	0.08	0.02	0.01
103	0.0	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
104	4.2	0.12	0.13	0.75	0.99	1.00	0.20	0.00	0.00	0.00	0.00	0.00

SECTION 6
Regional Economic Development

6.1 RECONS ANALYSIS

6.1.1 Background

The U.S. Army Corps of Engineers (USACE) Institute for Water Resources developed a regional economic impact modeling tool, Regional Economic Systems (RECONS), that provides estimates of jobs and other economic measures such as labor income, value-added, and sales that are supported by USACE programs, projects, and activities. This modeling tool automates calculations and generates estimates of jobs, labor income, value-added, and sales using IMPLAN®'s multipliers and ratios, customized impact areas for USACE project locations, and customized spending profiles for USACE projects, business lines, and work activities. There are three categories of economic impacts that RECONS outputs including the direct effects, indirect effects, and induced effects. Direct effects represent the proportions of USACE expenditure that flows to material and service providers within a given impact area. Indirect effects are the backward-linked suppliers for goods and services used by the directly affected activities. Lastly, induced effects come from household expenditures that are associated with the direct and indirectly affected workers. These measures are collectively identified as secondary effects which include number of jobs, employment earnings, sales, and value added. RECONS allows the USACE to evaluate the regional economic impact and contribution associated with USACE expenditures, activities, and infrastructure.

In order to interpret the results, a description of the metrics is provided:

Output: The total transactions resulting from the construction project. This includes both the value added and intermediate goods purchased in the economy.
Labor Income: All forms of employment income including employee compensations (wages and benefits) and proprietor income.
Value Added: This is also known as the Gross Regional Product and represents the value-added output of the study regions. It captures all final goods and services produced in the study areas due to the project. One dollar of a final good or service can have multiple transactions.
Jobs: The estimated worker-years of labor required to build the project.

The input-output analysis is based on the following set of assumptions:

- The production functions of industries have constant returns to scale, so if the output increases, inputs will increase in the same proportion.
- Industries face no supply constraints; they have access to all the materials they can use.

- Industries have a fixed commodity input structure; they will not substitute any commodities or services used in the output production in response to price changes.
- Industries produce their commodities in fixed proportions; therefore, an industry will only increase the production of a commodity if it increases production in every other commodity it produces.
- Industries are assumed to use the same technology to produce all their commodities.

6.1.2 Results

The expenditures associated with the RECONS analysis are estimated to be $800,840,173. This estimated cost is of the total construction cost and excludes PED, S&A, and real estate. Of this total expenditure, $507,367,446 will be captured within the local impact area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in the following tables. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $800,840,173 support a total of 6,411.7 full-time equivalent jobs, $361,602,986 in labor income, $451,700,609 in the gross regional product, and $736,565,718 in economic output in the local impact area. More broadly, these expenditures support 13,117.1 full-time equivalent jobs, $884,931,513 in labor income, $1,218,000,521 in the gross regional product, and $2,050,116,346 in economic output in the nation. A summary of the results for Plan 2 can be found in Table G:6-1.

Table G:6--1. Plan 4: Nonstructural NED+OSE2 Plan Overall Summary

Area	Local Capture	Output	Jobs*	Labor Income	Value Added
Local					
Direct Impact		$507,367,446	4,906.9	$297,858,284	$324,547,140
Secondary Impact		$229,198,272	1,504.7	$63,744,702	$127,153,469
Total Impact	$507,367,446	$736,565,718	6,411.7	$361,602,986	$451,700,609
State					
Direct Impact		$637,668,099	5,994.3	$398,718,869	$427,866,873
Secondary Impact		$533,679,444	3,077.7	$165,063,563	$297,699,564
Total Impact	$637,668,099	$1,171,347,543	9,072.0	$563,782,432	$725,566,437
US					
Direct Impact		$764,285,551	7,159.5	$474,053,187	$515,742,597
Secondary Impact		$1,285,830,794	5,957.6	$410,878,325	$702,257,924
Total Impact	$764,285,551	$2,050,116,346	13,117.1	$884,931,513	$1,218,000,521

** Jobs are presented in full-time equivalence (FTE)*

SECTION 7
Other Social Effects

7.1 BACKGROUND

According to the memorandum for the Comprehensive Documentation of Benefits, water resource projects conducted by USACE are to comprehensively evaluate the impact on social well-being within a community. Communities impacted by hazardous events, including frequent and/or severe inundation experience effects both during and after related to their resilience, overall well-being, community cohesion, and their quality of life. Other Social Effects of the ART Plans are evaluated based on their performance across applicable subthemes, including Social Vulnerability & Resiliency, Health & Safety, Economic Vitality, Social Connectedness, Participation, and Leisure & Recreation.

7.1.1 Basic Social Statistics

Population

The ART study area is home to nearly 800,000 residents spanning from the Mississippi-Louisiana state line at St. Helena Parish in the north, to St. James and St. John the Baptist Parishes in the south. The majority of the population impacted by the ART study is located in East Baton Rouge Parish. Table G:7-1 provides a breakdown of population in the area estimated out to 2045. Table G:7-2 provides a breakdown by number of households in the area estimated out to 2045 and Table G:7-3 provides a breakdown by per capita income in the area estimated out to 2045.

Table G:7-1. Population (2000 - 2045) by Parish/County

Parish	2000	2010	2017	2025	2045
Ascension	76,627	107,215	122,948	136,988	161,973
East Baton Rouge	412,852	440,171	446,268	441,495	415,720
East Feliciana	21,360	20,267	19,412	18,140	15,910
Iberville	33,320	33,387	33,027	31,166	27,428
Livingston	91,814	128,026	138,228	150,306	166,260
St. Helena	10,525	11,203	10,363	9,681	8,592
St. James	21,201	22,006	21,790	22,599	23,727
St. John the Baptist	43,248	45,621	44,078	45,713	47,995

Sources: 2000, 2010, 2017 from U.S. Census Bureau; 2025, 2045 from Moody's Analytics (ECCA) Forecast

Households

Table G:7-2. Households (2000 - 2045) by Parish/County

Parish	2000	2010	2017	2025	2045
Ascension	26,995	38,050	44,890	51,815	66,244
East Baton Rouge	156,740	172,440	179,910	184,008	186,082
East Feliciana	6,694	6,996	6,922	6,752	6,411
Iberville	10,697	11,075	11,229	11,137	10,643
Livingston	32,997	46,297	52,184	57,891	69,149
St. Helena	3,890	4,323	4,116	3,995	3,810
St. James	7,002	7,691	7,945	8,561	9,727
St. John the Baptist	14,381	15,875	16,005	17,249	19,602

Sources: 2000, 2010 from U.S. Census Bureau; 2017, 2025, 2045 from Moody's Analytics (ECCA) Forecast

Income

Table G:7-3. Per Capita Income ($) by Parish/County

Parish/County	2000	2010	2017	2025
Ascension	24,052	39,416	47,628	60,180
East Baton Rouge	27,228	39,651	48,120	60,048
East Feliciana	20,049	33,122	39,908	53,331
Iberville	18,681	32,342	38,960	50,288
Livingston	21,521	32,621	39,883	51,341
St. Helena	16,821	34,136	41,273	55,046
St. James	18,722	38,421	45,219	60,576
St. John the Baptist	20,002	33,894	41,505	57,423

7.2 OTHER SOCIAL EFFECTS BY THEME

7.2.1 Social Vulnerability and Resiliency

Social vulnerability is described by 09-R-4 (IWR) as the capacity to be disproportionately damaged or impacted by hazardous events. Certain characteristics relating to a community's population are indicators as to whether a community is more socially vulnerable. The term resiliency refers specifically to a community's ability to cope and recover from hazards or impacts.

Center for Disease Control's Social Vulnerability Index

The CDC's Social Vulnerability Index (SVI) uses American Community Survey (BOC) to quantify a community's ability to respond and cope with a hazardous event. Figure G:7-1 displays the overall vulnerability of the ART Study Area. Within the overall SVI, there are four subthemes that are incorporated, which include Socioeconomic Status, Household Characteristics, Racial & Ethnic Minority Status, and Housing Type & Transportation. In order to identify areas experiencing social vulnerability, a 90th percentile threshold was applied across the four themes in addition to the overall vulnerability. Out of 191 Louisiana Census Tracts within the ART study area, there were 46 that were identified as experiencing social vulnerability.

In order to incorporate social vulnerability into economic benefit analysis, economic subunits, or reaches, were delineated based on the same criteria shown in Figure G:7-1. Structures in these areas are within the 90th percentile or higher for any of the CDC's Social Vulnerability Index themes. Through this process, an additional 46 areas were identified as socially vulnerable reaches.

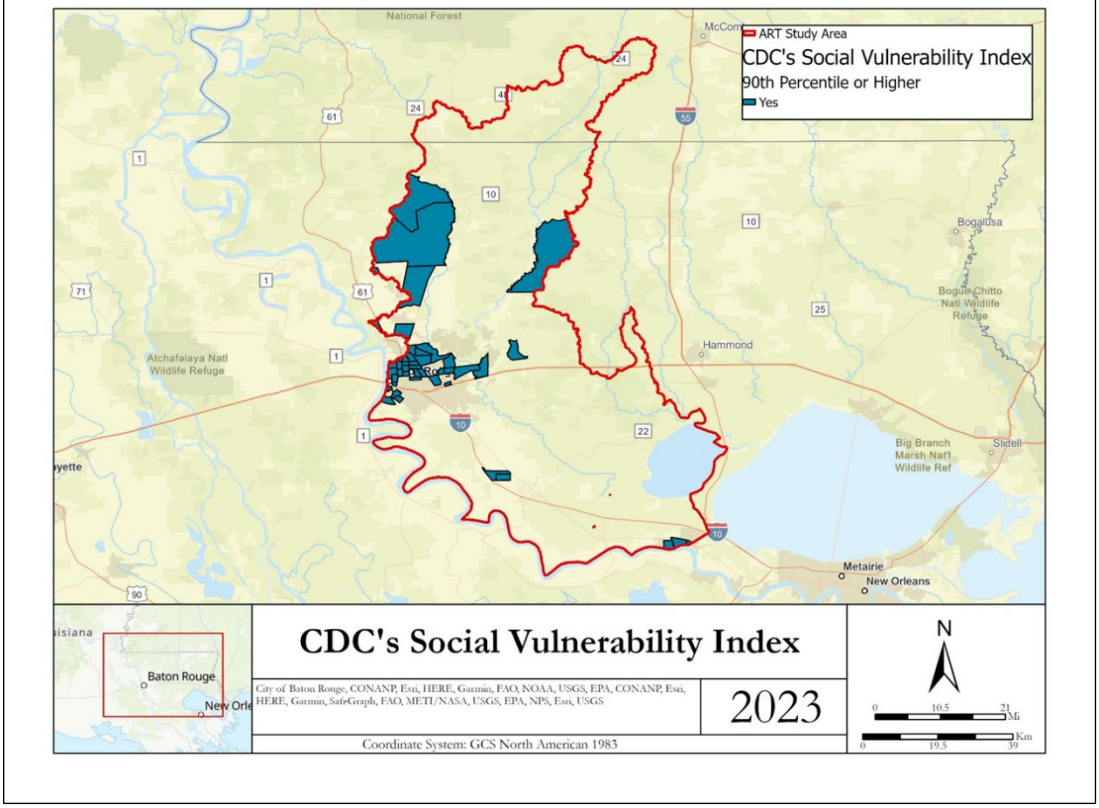

Figure G:7-1. Social Vulnerability in the ART Study Area

7.2.2 Health & Safety

According to 09-R-4 (IWR) personal and group safety is a basic human need. Any conditions that are perceived to affect personal health and safety implicate personal stress and dissatisfaction. Areas that are prone to flooding, such as the ART study area, have an increased risk of adverse effects on health and safety.

Life Safety

High flood depths and velocities at structures and on roadways during a flooding event can pose a risk to human life safety. Life loss modeling software such as HEC-LifeSim can be used to estimate potential life loss from flood hazards. For the purposes of this study, life safety risk was evaluated using assumptions from the HEC-LifeSim software.

Risk to human life safety during a major flooding event in the ART study area was evaluated using submergence criteria assumptions from the LifeSim technical manual, future without project hydraulic depth grids, and the ART structure inventory. Submergence is defined as a water level at a structure that can affect probability of survival. Submergence criteria are used to define the threshold between high hazard and low hazard conditions when people are trapped in a flooded structure (USACE 2020). Structures were considered to be

experiencing ‘high hazard conditions’ if the structure exceeded thresholds in any of the three high hazard conditions defined in Table G:7-4. The numbers of structures in high hazard conditions are listed in Table G:7-5.

Table G:7--4. Submergence Criteria (LifeSim Technical Manual)

Submergence criteria	Description	Applied to	Default Values
A. High hazard depth from floor	If depth from floor is above the threshold, then people will be place in the high hazard zone.	Limited mobility occupants	4-6 feet, triangular distribution with 5ft best estimate
B. High hazard depth from ceiling	If depth from top of ceiling is above the threshold, then people will be placed in the high hazard zone.	Able-bodied occupants	0.5 - 1.5 feet, Triangular distribution with 1 ft best estimate
C. High hazard depth on roof	If depth over the roof is greater than the threshold, then people caught on roof will be placed in the high hazard zone.	Able-bodied occupants	3-5 feet, Triangular distribution with 4ft best estimate

Table G:7--5. Number of Structures in High Hazard Conditions

Without Project 2028						
	0.1 AEP	**0.04 AEP**	**0.02 AEP**	**0.01 AEP**	**0.005 AEP**	**0.002 AEP**
Limited Mobility	3	6	31	181	622	1943
Depth from Ceiling	0	1	3	3	6	99
Depth on Roof	0	0	0	0	0	0
Without Project 2078						
	0.1 AEP	**0.04 AEP**	**0.02 AEP**	**0.01 AEP**	**0.005 AEP**	**0.002 AEP**
Limited Mobility	3	70	336	971	2012	3995
Depth from Ceiling	0	1	3	9	122	681
Depth on Roof	0	0	0	0	0	0

Critical Infrastructure

Critical infrastructure includes hospitals, emergency services such as EMT, fire stations, and police stations. Flooding impacts to critical infrastructure pose a risk to the health and safety within the study area at the time of inundation via the inability to access individuals in need of assistance. Figure G:7-2 represents critical infrastructure situated within the ART study area.

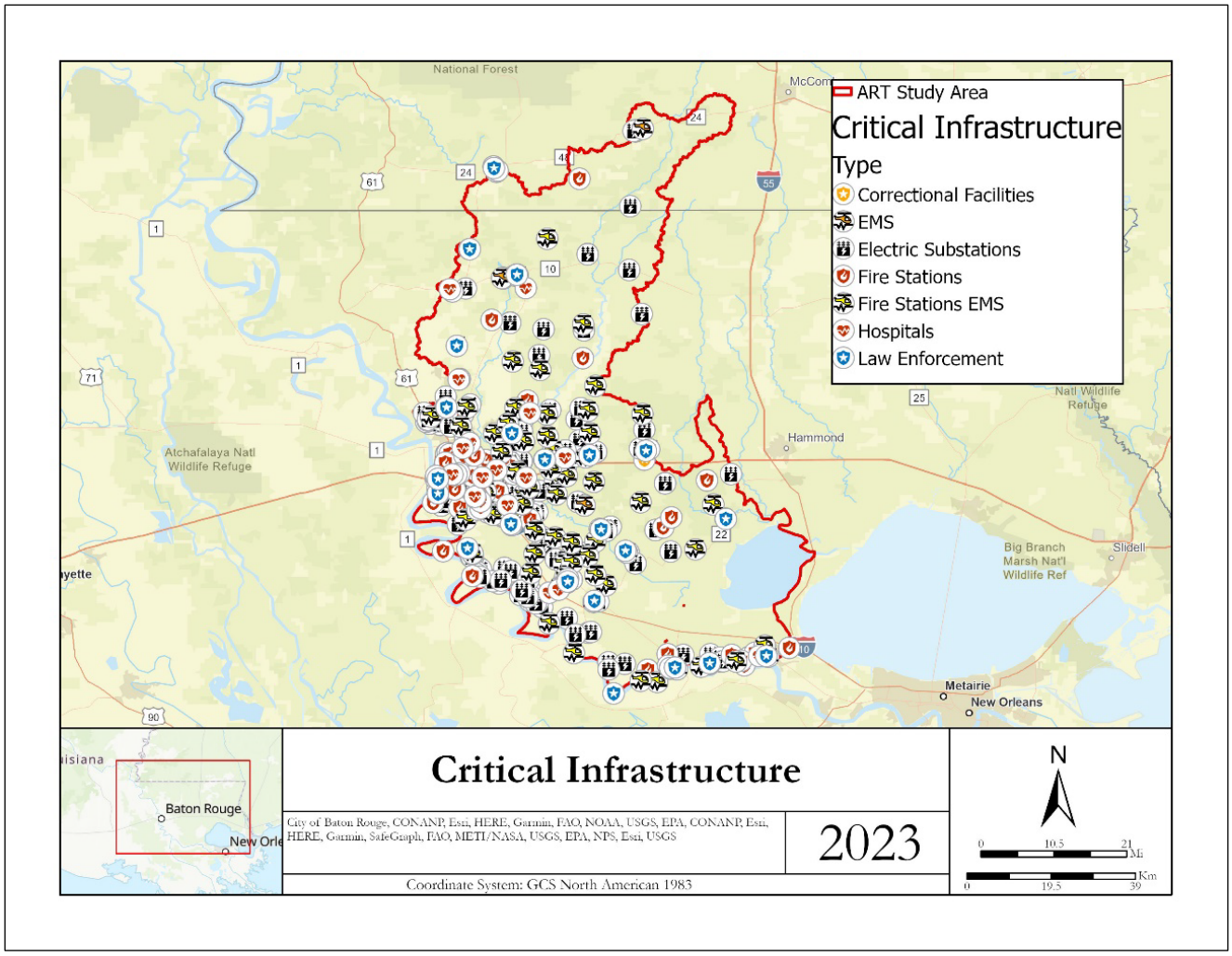

Figure G:7-2. Critical Infrastructure in ART Study Area

Food Insecurity

The Food Access Research Atlas from the US Department of Agriculture details census tracts that are determined to be low income and low access to fresh food and grocers. In communities where residents do not have grocers within a reasonable distance, for urban areas, 1 mile, there is often a surplus of convenience stores and gas stations that are present to try and fill some nutritional needs. These locations are typically less healthy and more expensive.

Figure G:7-3 details the census tracts in the ART study area that are low income and low access. During inundation events, there would be additional strain on the grocers that are within a walking or commutable distance as a result of increased inundation on roadways as well as damages to grocery structures themselves.

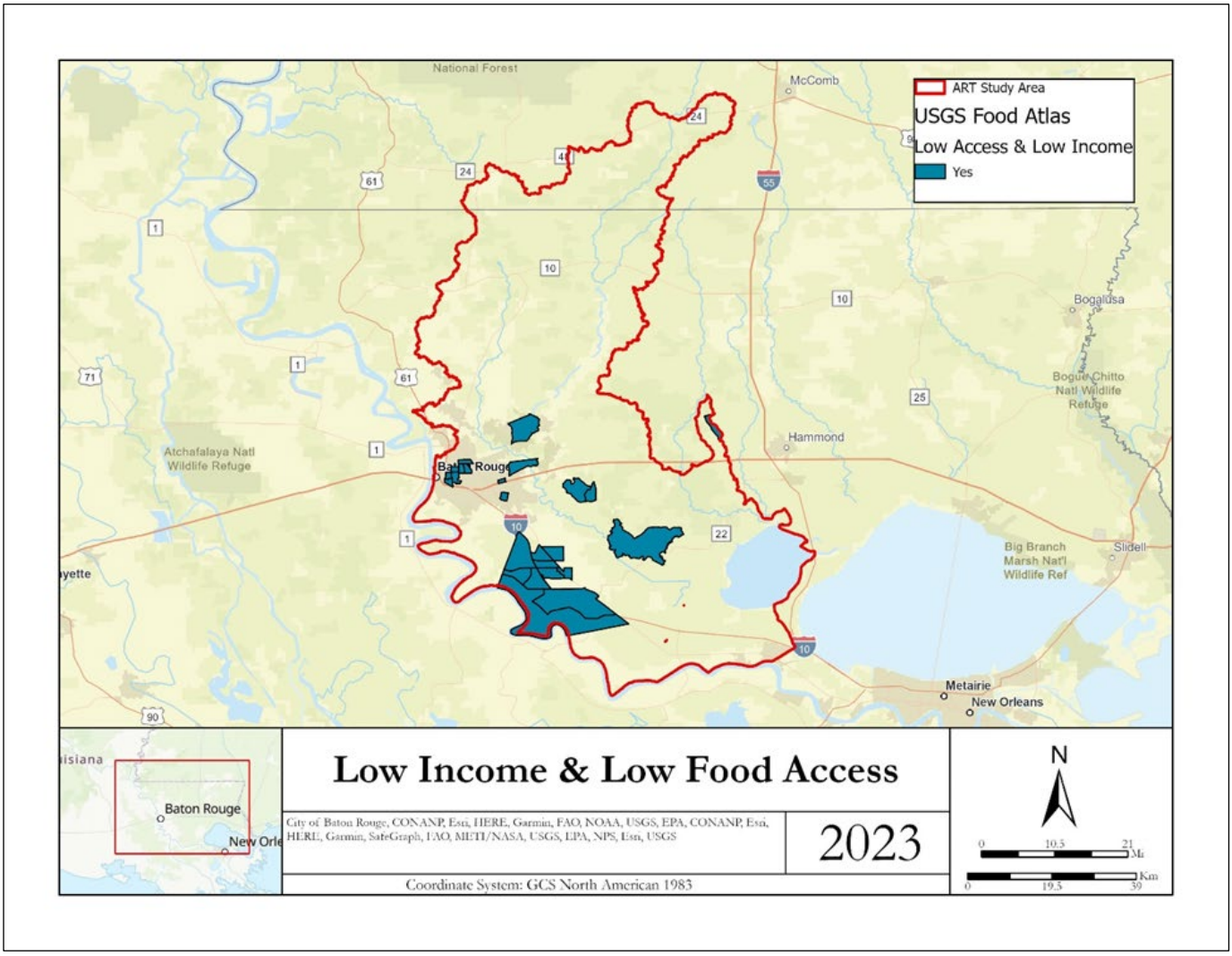

Figure G:7-3. Food Insecurity in the ART Study Area

7.2.3 Economic Vitality

Economic vitality refers to the quality of life of the affected population. This is influenced by the economy's ability to provide a good standard of living. There are several factors within the ART study area that exemplify a lower-than-average quality of life.

Employment Activity

Employment activity indicates how efficiently a community can respond to hazardous events and is an overall indicator for economic health. Figure G:7-4 shows the aggregated employment between all of the counties within the ART study area. Following 1990, the largest employment industry shifted from manufacturing to trade, transportation, and utilities. Between 1990 and 2000, local government surpassed that of manufacturing to become the second largest industry for employment.

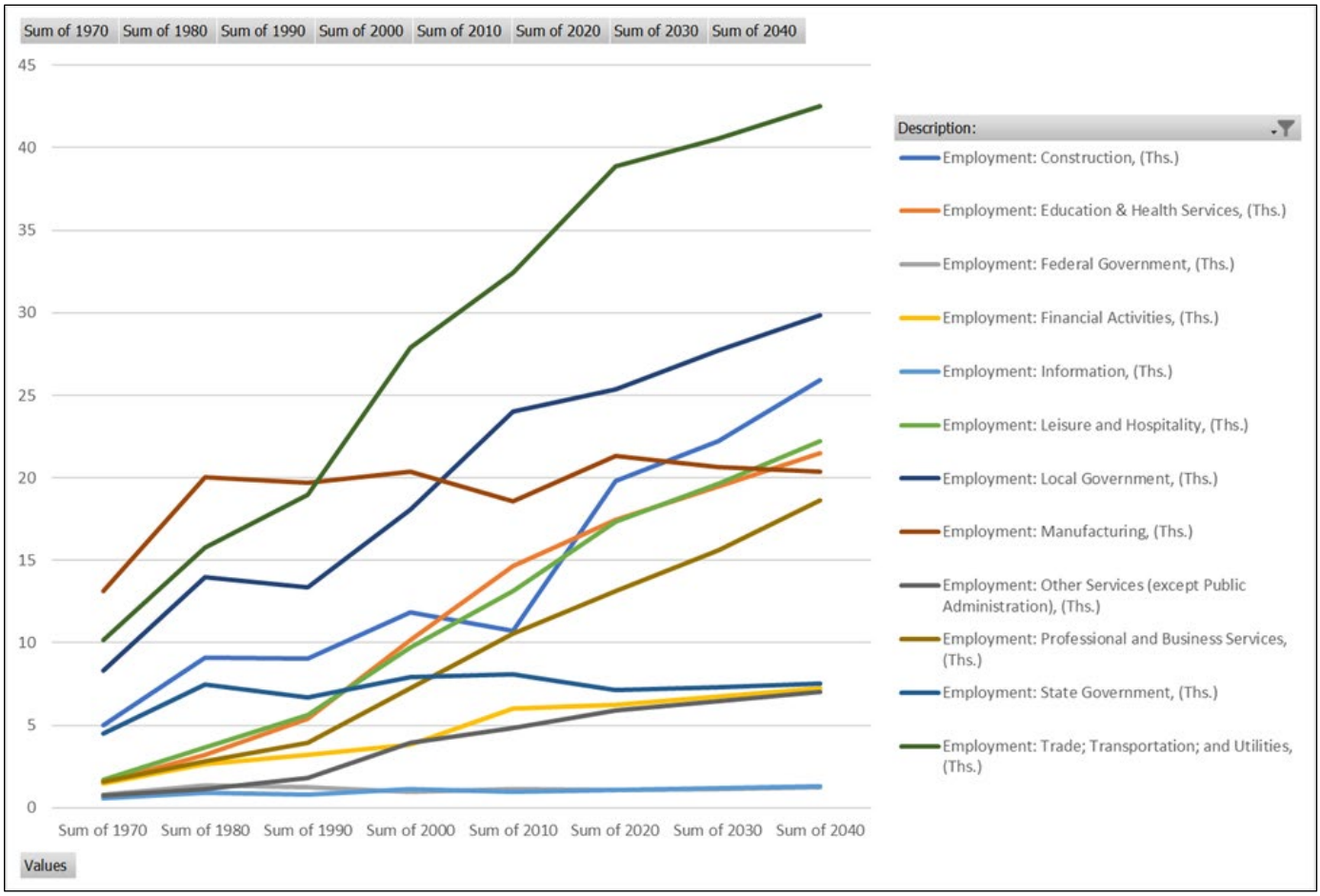

Figure G:7-4. Employment by Industry (1970 - 2045)

7.2.4 Social Connectedness

Social Connectedness refers to social networks where community members interact. Strong social connectedness supports meaning and structure to one's life. In addition to social connectedness, identity of an individual or a community provides a sense of self as a member of a group, distinct from other groups.

Civic Infrastructure

Figure G:7-5 shows a map of physically located civic infrastructure, which includes places of worship, community centers, and parks that receive any inundation in the 1 percent event in the without project condition. In addition to community services that occupy physical space and are affected by inundation, there are community projects and activities that are supported by state and local government, including recreation activities for children and adults, as well as events in support of music and culture within the region. These activities are likely also impacted by inundation in the existing condition via inundation on roadways and recovery delays.

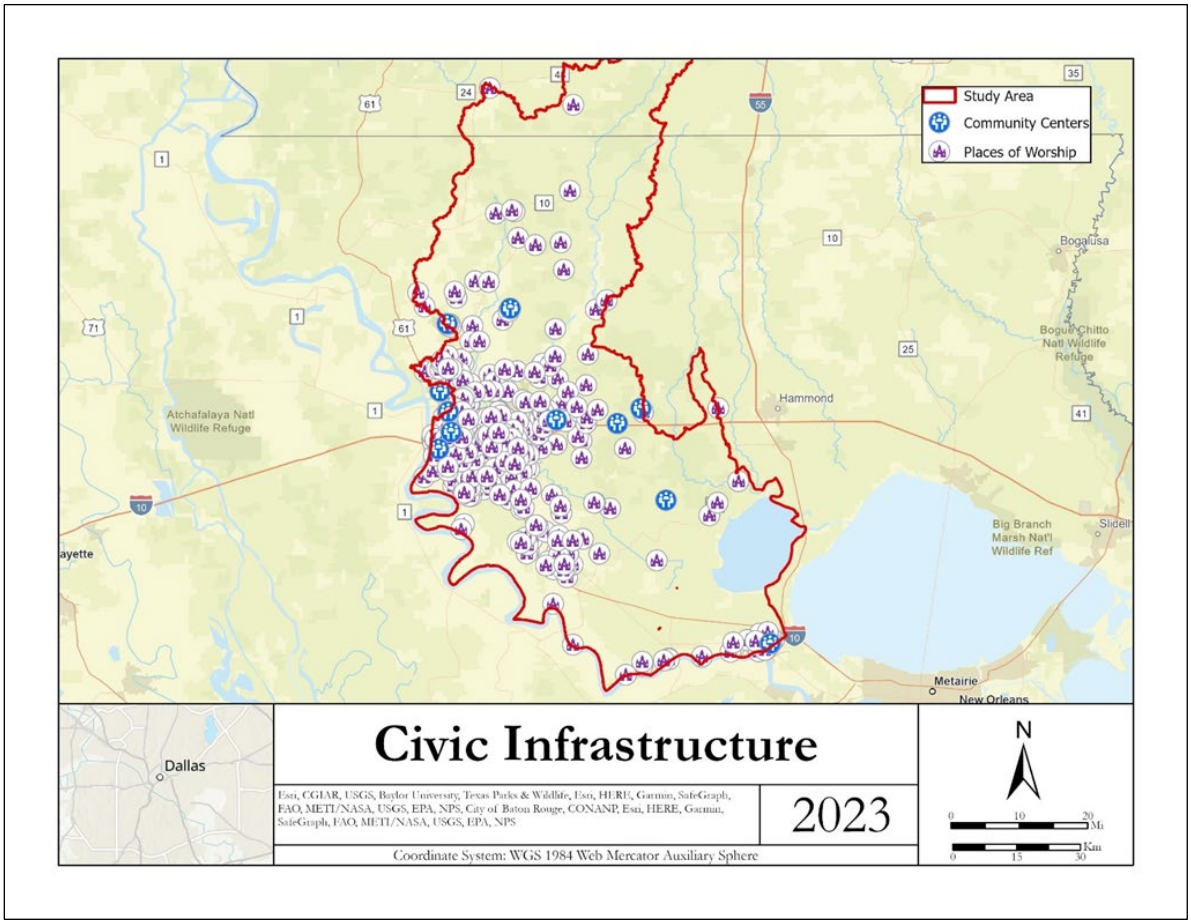

Figure G:7-5. Civic Infrastructure in the ART Study Area

7.3 IMPACT ANALYSIS: FINAL ARRAY

7.3.1 Impact of Plans on Other Social Effect Themes

Table G:7-6 provides a summary of the "other social effects themes."

Table G:7-6. Other Social Effects Theme Summary Table

OSE Theme	Indicator	Plan 2	Plan 3	Plan 4
Social Vulnerability & Resiliency	Structures included in SV Areas	+	++	++
Health & Safety	Life Safety	+	+	+
	Critical Infrastructure	+	+	+
	Food Insecurity	+	++	++
Economic Vitality	Employment Activity	+	+	+
Social Connectedness	Civic Infrastructure	+	+	+

Legend:
(+): Minor Positive Benefits
(++): Moderate Positive Benefits
(+++): Significant Positive Benefits

7.3.2 Social Vulnerability & Resiliency

Table G:7-7 presents a summary of benefits to areas experiencing social vulnerability. Individuals in these communities are historically overburdened by excessive costs related to both hazard mitigation and hazard response. In addition to monetary benefits from flood damage mitigation, community members benefit by decreased recovery time after flooding events and the expenditures associated with displacement. Participants also benefit from stability and increased safety of their home, and decreased flood insurance premiums from hazard mitigation.

Table G:7--7. Summary of Benefits to Areas Experiencing Social Vulnerability (2024 Price Level; FY24 Federal Discount Rate; $ Millions)

	Plan 2 (NED)	Plan 3 (NED+OSE1)	Plan 4 (NED+OSE2)
Total Number of Structures	1,743	1,971	2,051
Structures in Areas of Social Vulnerability	124	352	432
Percentage of Total Structures	7%	18%	21%
Total Benefits	$53.4	$57.7	$58.1
Benefits in Areas of Social Vulnerability	$3.1	$7.4	$7.8
Percentage of Total Benefits	6%	13%	14%

7.3.3 Health & Safety

Life Safety

Nonstructural measures included in the plans are voluntary and this analysis assumes 100 percent participation.

Nonstructural measures included in this plan do not mitigate life safety risk on roadways. High depths and velocities associated with hazardous driving conditions would remain with the construction of the plans.

Plan 2: Nonstructural NED Plan

Plan 2 is a nonstructural only plan that includes the elevation of 1,554 residential structures and dry floodproofing 189 commercial and industrial structures. Table G:7-8 shows the number of structures no longer experiencing high hazard conditions with the construction of nonstructural measures in Plan 2.

Table G:7-8. Plan 2: Number of Structures in High Hazard Conditions

Plan 2 (NED) 2028 Number of Structures in High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	0	0	1	5	62	1078
Depth from Ceiling	0	0	0	0	1	1
Depth on Roof	0	0	0	0	0	0
Plan 2 (NED) 2078 Number of Structures in High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	0	0	8	252	1218	3089
Depth from Ceiling	0	0	0	0	3	76
Depth on Roof	0	0	0	0	0	0
Plan 2 (NED) 2028 Number of Structures Removed From High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	3	6	30	176	560	865
Depth from Ceiling	0	1	3	3	5	98
Depth on Roof	0	0	0	0	0	0
Plan 2 (NED) 2078 Number of Structures Removed From High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	3	70	328	719	794	906
Depth from Ceiling	0	1	3	9	119	605
Depth on Roof	0	0	0	0	0	0

Plan 3: Nonstructural NED + OSE Increment 1

Plan 3 is a nonstructural only plan that includes the elevation of 1,755 residential structures and dry floodproofing 216 commercial and industrial structures. Table G:7-9 shows the number of structures no longer experiencing high hazard conditions with the construction of nonstructural measures in Plan 3.

Table G:7-9: Plan 3: Number of Structures in High Hazard Conditions

Plan 3 (NED+OSE1) 2028 Number of Structures in High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	0	0	1	4	55	1066
Depth from Ceiling	0	0	0	0	1	1
Depth on Roof	0	0	0	0	0	0
Plan 3 (NED+OSE1) 2078 Number of Structures in High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	0	0	8	251	1211	3077
Depth from Ceiling	0	0	0	0	3	76
Depth on Roof	0	0	0	0	0	0
Plan 3 (NED+OSE1) 2028 Number of Structures Removed From High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	3	6	30	177	567	877
Depth from Ceiling	0	1	3	3	5	98
Depth on Roof	0	0	0	0	0	0
Plan 3 (NED+OSE1) 2078 Number of Structures Removed From High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	3	70	328	720	801	918
Depth from Ceiling	0	1	3	9	119	605
Depth on Roof	0	0	0	0	0	0

Plan 4: Nonstructural NED + OSE increment 2

Plan 4 is a nonstructural only plan that includes the elevation of 1,810 residential structures and dry floodproofing 241 commercial and industrial structures. Table G:7-10 shows the number of structures no longer experiencing high hazard conditions with the construction of nonstructural measures in Plan 4.

Table G:7-10. Plan 4: Number of Structures in High Hazard Conditions

Plan 4 (NED+OSE2) 2028 Number of Structures in High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	0	0	1	4	55	1060
Depth from Ceiling	0	0	0	0	1	1
Depth on Roof	0	0	0	0	0	0
Plan 4 (NED+OSE2) 2078 Number of Structures in High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	0	0	8	251	1211	3071
Depth from Ceiling	0	0	0	0	3	76
Depth on Roof	0	0	0	0	0	0
Plan 4 (NED+OSE2) 2028 Number of Structures Removed From High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	3	6	30	177	567	883
Depth from Ceiling	0	1	3	3	5	98
Depth on Roof	0	0	0	0	0	0
Plan 4 (NED+OSE2) 2078 Number of Structures Removed From High Hazard Conditions						
	0.10 (10 yr)	**0.04 (25 yr)**	**0.02 (50 yr)**	**0.01 (100 yr)**	**0.005 (200 yr)**	**0.002 (500 yr)**
Limited Mobility	3	70	328	720	801	924
Depth from Ceiling	0	1	3	9	119	605
Depth on Roof	0	0	0	0	0	0

Critical Infrastructure

Critical infrastructure receiving benefits is shown on Figure G:7-6.

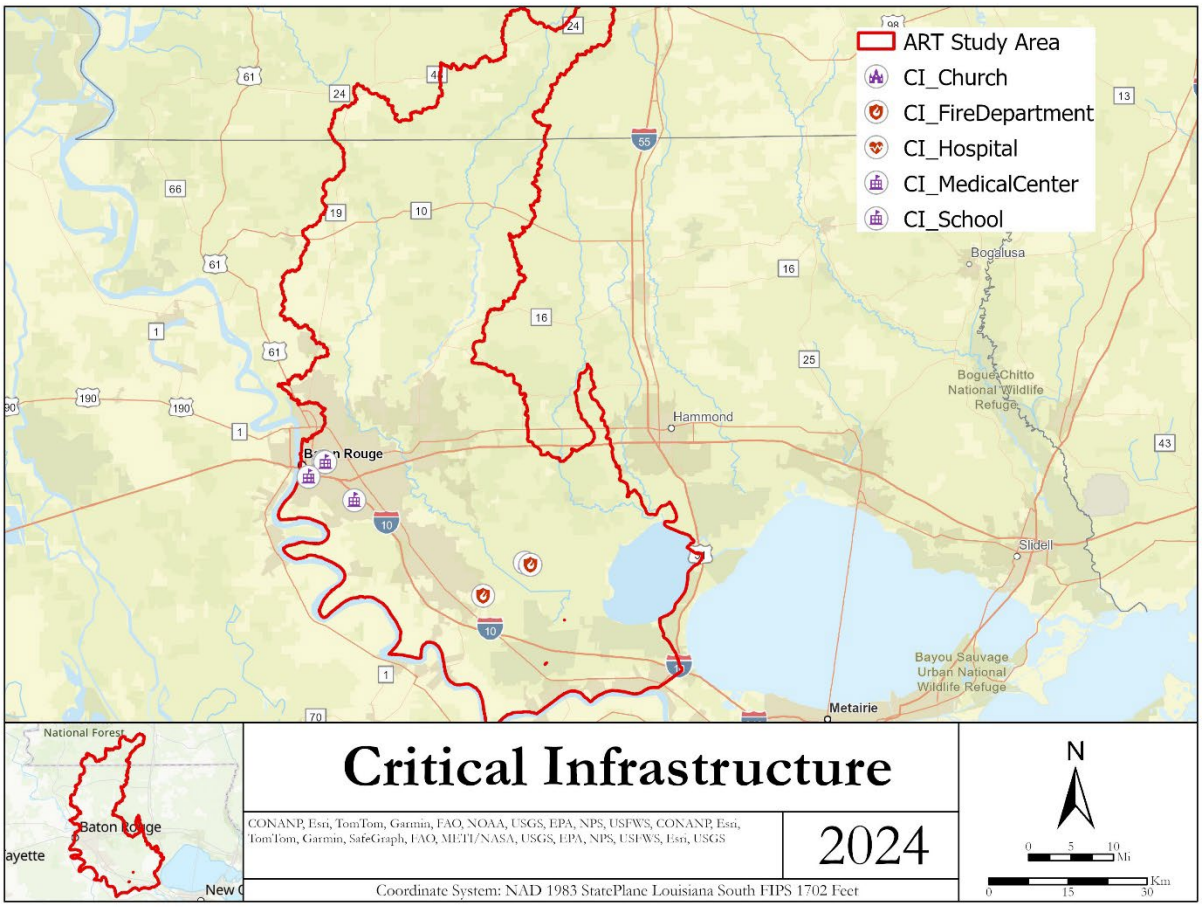

Figure G:7-6. Critical Infrastructure Receiving Benefits (Plan 2)

Plan 2: Nonstructural NED Plan

Under Plan 2, there are seven critical infrastructure facilities included for floodproofing mitigation. Two of these facilities are medical centers, two of them are fire departments, one church, one school, and the remaining is a hospital. In an inundation event, facilities would be able to return to operation quicker and thus be able to provide emergency services and care to community members who have previously and will continue to need assistance. Reference Figure G:7-6 for the physical location of mitigated critical infrastructure.

Plan 3: Nonstructural NED + OSE Increment 1

Plan 3 does reduce risk to an animal shelter that is not present in Plan 2. The eight total facilities would experience a shorter pause on operation, allowing services and assistance to be resumed for community members. Having the additional animal shelter would provide benefits in the immediate aftermath of a flood by giving area residents the ability to shelter animals or find animal related resources, such as emergency care. Reference Figure G:7-6 for the physical location of mitigated critical infrastructure.

Plan 4: Nonstructural NED + OSE Increment 2

Plan 4 does not present any additional protection to critical infrastructure facilities than is presented in Plan 3. The eight facilities would experience a shorter pause on operation, allowing services and assistance to be resumed for community members. Reference Figure G:7-6 for the physical location of mitigated critical infrastructure.

Food Insecurity

Plan 2: Nonstructural – Optimized NED Plan

In the with project condition of Plan 2, there are 10 grocery stores that are included. Two of these grocery stores are within areas that are considered low access and low income according to the USGS Food Atlas. Increased protection from inundation damages for these grocery stores would lead to a shorter recovery period, allowing community members to access fresh food and grocers following an inundation event.

Plan 3: Nonstructural - NED Plan + OSE Increment 1

In the with project condition of Plan 3, there is one additional grocery store that is included as a part of the plan, mitigating for a total of 11 grocery stores, with increased risk reduction for an additional facility in an area that experiences social vulnerability. Two stores remain included in areas identified as low income and low access according to the USGS Food Atlas. Impacts of these measures would include a shorter recovery period following inundation in several areas within the ART study area, but specifically allow accessibility to communities that are experiencing food insecurity.

Plan 4: Nonstructural NED + OSE Increment 2

In the with project condition of Plan 4, there is one additional grocery store that is included as a part of the plan, mitigating for a total of 12 grocery stores, with increased risk reduction for an additional facility in an area that experiences social vulnerability. Two stores remain included in areas identified as low income and low access according to the USGS Food Atlas. The same grocers would benefit and be able to resume service to community members that have limited geographical access to fresh food. Figure G:7-7 represents identified grocery stores for mitigation and their proximity to communities experiencing food insecurity.

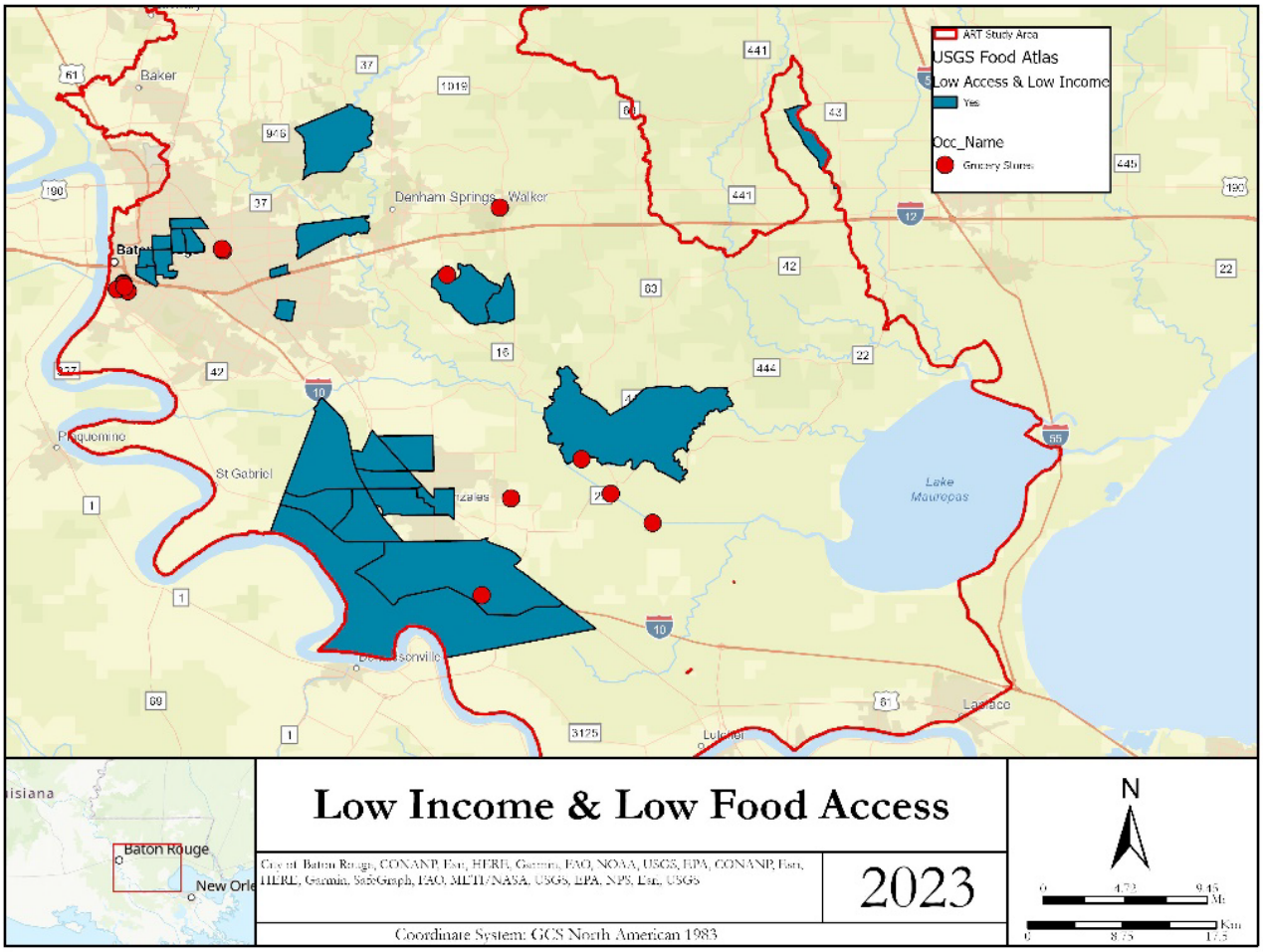

Figure G:7-7. Benefits to Food Insecurity (Plan 4)

7.3.4 Economic Vitality

Plan 2: Nonstructural – Optimized NED Plan

Under Plan 2, it would be expected that the trade, transportation, and utilities sector would continue to be impacted. These impacts would be from continued inundation on roadways and for those structures that remain unmitigated in the with project condition. There are 189 commercial structures that are included as a part of this plan that would have increased risk reduction via floodproofing and therefore experience less of a pause in operation when inundation occurs. This would directly translate to continued consumption for those business. Employees would also be able to continue working for those businesses that are included in Plan 2.

Plan 3: Nonstructural - NED Plan with increased eligibility for positive net benefits

Under Plan 3, the number of commercial structures included in commercial mitigation increases to 216. The increase in floodproofed commercial structures would allow more businesses to return to operation following an inundation event. This would directly decrease the amount of time that employees are temporarily unemployed, and therefore lost personal income, in the study area.

Plan 4: Nonstructural – NED Plan with increased eligibility for all SV reaches

Under Plan 4, the number of commercial structures included in commercial mitigation increases to 241. The increase in floodproofed commercial structures would allow more businesses to return to operation following an inundation event. This would directly decrease the amount of time that employees are temporarily unemployed, and therefore lost personal income, in the study area.

7.3.5 Social Connectedness

Plan 2: Nonstructural – Optimized NED Plan

Under Plan 2, there is one civic infrastructure facility included, of which is a place of worship. In this with-project condition, the civic infrastructure facility would be floodproofed, allowing for protection of the structure and its contents. This risk reduction measure would decrease the length of time that operations occur; thus, encouraging and sustaining community places of gathering and increasing opportunities for connectedness and identity among individuals. Reference Figure G:7-8 for the location of civic infrastructure included in all three of the plans in the final array.

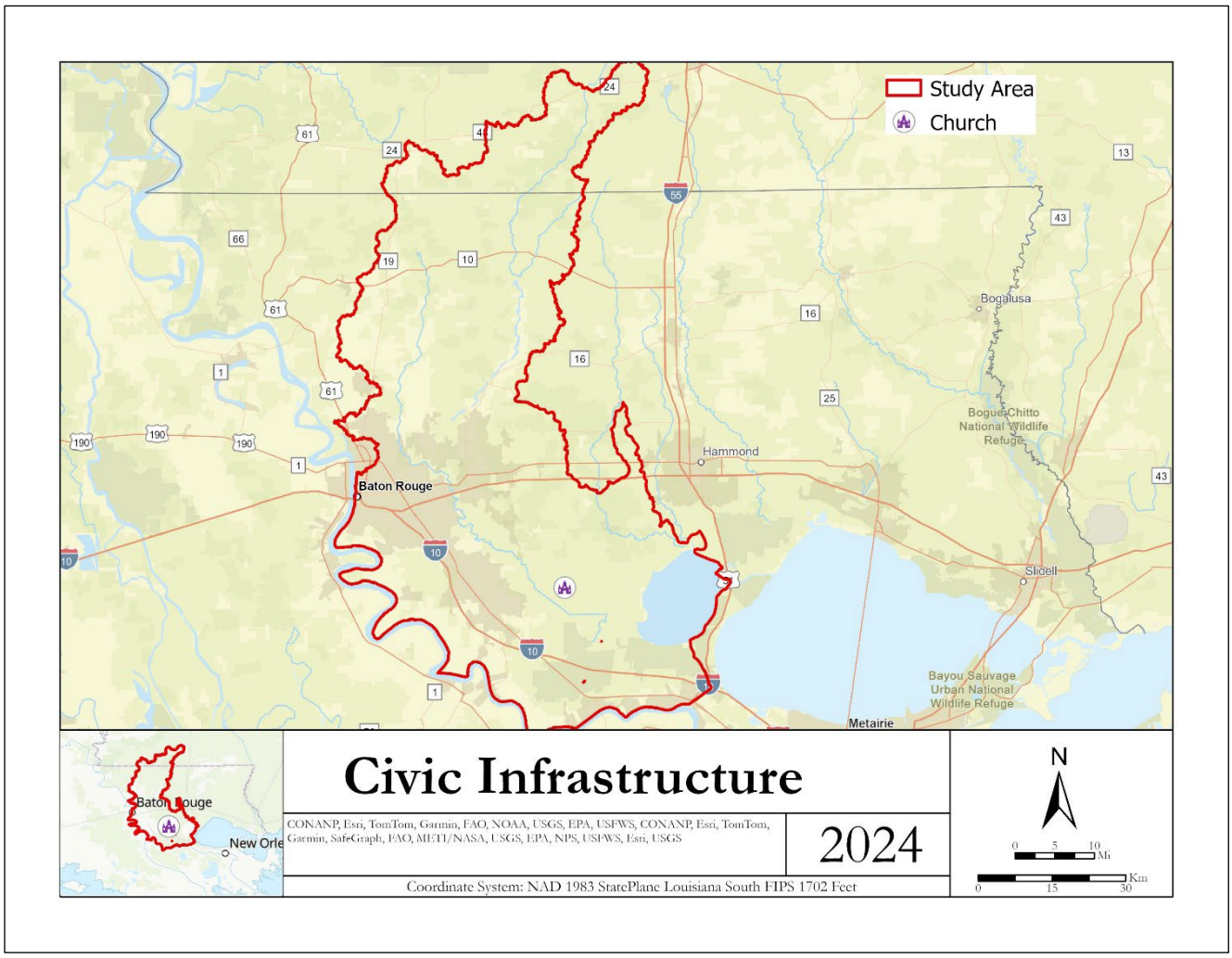

Figure G:7-8. Civic Infrastructure Receiving Benefits (All Plans)

Plan 3: Nonstructural - NED + OSE Increment 1

Under Plan 3, there would not be any additional positive or negative impacts to social connectedness from what is included in Plan 2. This plan would present the same level of opportunity for community cohesion and gathering. Reference Figure G:7-8 for the location of civic infrastructure included in all three of the plans in the final array.

Plan 4: Nonstructural – NED + OSE Increment 2

Under Plan 4, there would not be any additional positive or negative impacts to social connectedness from what is included in Plan 2. This plan would present the same level of opportunity for community cohesion and gathering. Reference Figure G:7-8 for the location of civic infrastructure included in all three of the plans in the final array.

Addendum A: Structures, Damages by Reach

Table G:A-12. Structures by Category and Reach

Reach Name	Residential	Commercial	Industrial	Public	Total Structures
1	154	1	3	5	163
2	242	2	3	5	252
3	1,411	154	87	36	1,688
4	651	16	4	2	673
5	312	6	38	2	358
6	141	3	20	1	165
7	308	4	27	0	339
8	23	0	1	2	26
9	1,751	76	223	17	2,067
10	569	43	92	4	708
11	266	19	32	2	319
12	474	14	33	0	521
13	846	41	11	2	900
14	1,299	83	5	6	1,393
15	160	3	0	1	164
16	468	4	0	2	474
17	485	15	1	5	506
18	1,701	206	16	32	1,955
19	4,410	140	10	22	4,582
20	520	11	3	1	535
21	2,934	134	7	12	3,087
22	3,475	205	6	38	3,724
23	4,695	213	28	34	4,970
24	1,105	29	0	1	1,135
25	543	4	2	0	549
26	3,795	395	25	40	4,255
27	682	44	2	5	733
28	3,138	186	18	26	3,368
29	202	5	4	0	211
30	676	99	29	15	819
31	13,869	743	64	92	14,768
32	1,953	130	6	21	2,110
33	2,537	160	8	19	2,724
34	7,200	403	69	27	7,699
35	6,500	1,067	208	69	7,844
36	8,244	909	64	62	9,279

Table G:A-13. Structures by Category and Reach

Reach Name	Residential	Commercial	Industrial	Public	Total Structures
37	8,575	965	55	140	9,735
38	77	8	0	1	86
39	6,965	930	49	95	8,039
40	456	4	0	0	460
41	7,089	606	30	161	7,886
42	10,175	1,197	207	65	11,644
43	1,039	124	2	15	1,180
44	2,617	255	14	28	2,914
45	280	1	1	1	283
46	57	2	0	0	59
47	145	2	3	1	151
48	397	26	2	0	425
49	17,463	621	43	64	18,191
50	1,055	17	4	3	1,079
51	428	17	4	1	450
52	4,458	620	91	37	5,206
53	238	5	5	0	248
54	5,852	307	295	22	6,476
55	589	17	13	4	623
56	4,841	96	329	17	5,283
57	4,679	299	218	43	5,239
58	759	47	17	4	827
59	885	25	3	2	915
60	23	0	0	0	23
61	1,594	97	3	19	1,713
62	4,985	211	15	21	5,232
63	2,748	70	5	6	2,829
64	1,658	57	4	2	1,721
65	1,083	31	4	3	1,121
66	3,216	327	27	28	3,598
67	454	22	0	5	481
68	728	13	79	6	826
69	788	93	98	13	992
70	469	9	77	2	557
71	8,967	1,166	89	121	10,343
72	2,254	72	15	19	2,360
73	516	6	7	8	537
74	363	14	78	8	463
75	315	13	23	0	351
76	1,617	114	12	13	1,756
77	436	59	2	6	503
78	448	54	3	4	509
79	228	7	0	1	236
81	10,768	505	758	40	12,071
82	5,845	204	380	17	6,446

Table G:A-14. Structures by Category and Reach

Reach Name	Residential	Commercial	Industrial	Public	Total Structures
83	4,864	396	259	64	5,583
84	3,505	275	228	41	4,049
85	0	0	0	0	0
86	16	0	0	0	16
87	0	0	0	0	0
88	4	5	2	1	12
89	1,233	36	141	7	1,417
90	206	1	32	1	240
92	526	31	43	2	602
93	21	6	3	0	30
94	417	38	8	2	465
95	291	9	3	2	305
96	194	3	1	1	199
97	833	67	1	6	907
98	1,260	65	2	8	1,335
99	1,165	90	7	13	1,275
100	2,057	262	20	18	2,357
101	2,521	427	25	28	3,001
102	1,423	81	9	15	1,528
103	503	28	5	3	539
104	38	11	8	0	57
Total	227,438	16,733	5,010	1,866	251,047

Table G:A-2. Equivalent Annual Damages and Benefits by Plan and Reach (2024 Price Level; FY24 Federal Discount Rate; $Thousands)

Reach Name	Without Project Damages	Plan 2 (NED)		Plan 3 (NED+OSE1)		Plan 4 (NED+OSE2)	
		Residual Damages	Benefits	Residual Damages	Benefits	Residual Damages	Benefits
3	$966	$151	$815	$151	$815	$151	$815
6	$70	$44	$26	$44	$26	$44	$26
7	$120	$120	$0	$120	$0	$120	$0
9	$118	$118	$0	$118	$0	$88	$31
11	$102	$91	$11	$91	$11	$91	$11
12	$19	$19	$0	$19	$0	$19	$0
13	$79	$79	$0	$79	$0	$72	$7
14	$549	$549	$0	$549	$0	$512	$36
15	$2	$2	$0	$2	$0	$2	$0
16	$83	$54	$29	$54	$29	$54	$29
17	$297	$169	$127	$169	$127	$169	$127
18	$288	$288	$0	$288	$0	$288	$0
19	$1,965	$1,965	$0	$1,965	$0	$1,965	$0
20	$14	$14	$0	$14	$0	$14	$0
21	$96	$96	$0	$96	$0	$96	$0
22	$1,275	$1,275	$0	$1,275	$0	$1,202	$72
23	$353	$353	$0	$353	$0	$353	$0
24	$2	$2	$0	$2	$0	$2	$0
25	$229	$229	$0	$229	$0	$229	$0
26	$1,732	$1,628	$104	$1,525	$206	$1,386	$346
27	$298	$298	$0	$298	$0	$298	$0
28	$186	$171	$14	$171	$14	$140	$46
29	$18	$18	$0	$18	$0	$18	$0
30	$161	$161	$0	$161	$0	$161	$0
31	$9,339	$8,130	$1,209	$4,219	$5,121	$4,219	$5,121
32	$1,460	$1,460	$0	$1,460	$0	$1,460	$0
33	$2,375	$2,375	$0	$2,375	$0	$2,375	$0
34	$688	$436	$251	$405	$283	$425	$263
35	$319	$319	$0	$319	$0	$312	$7
36	$229	$135	$94	$135	$94	$135	$94
37	$890	$659	$231	$659	$231	$659	$231
38	$13	$13	$0	$13	$0	$13	$0
39	$1,263	$574	$689	$501	$763	$501	$763
40	$11	$11	$0	$11	$0	$11	$0
41	$10,377	$1,775	$8,602	$1,671	$8,705	$1,671	$8,705
42	$2,494	$2,176	$318	$2,176	$318	$2,176	$318
43	$80	$80	$0	$80	$0	$80	$0
44	$1,028	$793	$236	$793	$236	$793	$236
45	$6	$6	$0	$6	$0	$6	$0
46	$4	$4	$0	$4	$0	$4	$0
47	$452	$289	$163	$289	$163	$289	$163
48	$328	$328	$0	$328	$0	$328	$0
49	$1,923	$1,679	$245	$1,679	$245	$1,679	$245
50	$258	$258	$0	$258	$0	$258	$0
51	$519	$519	$0	$519	$0	$519	$0
52	$1,599	$544	$1,056	$544	$1,056	$544	$1,056

Reach Name	Without Project Damages	Plan 2 (NED)		Plan 3 (NED+OSE1)		Plan 4 (NED+OSE2)	
		Residual Damages	Benefits	Residual Damages	Benefits	Residual Damages	Benefits
53	$251	$251	$0	$251	$0	$251	$0
54	$3,485	$2,402	$1,083	$2,402	$1,083	$2,402	$1,083
55	$252	$252	$0	$252	$0	$252	$0
56	$587	$388	$198	$388	$198	$388	$198
57	$238	$238	$0	$238	$0	$238	$0
58	$2,962	$2,092	$870	$2,092	$870	$2,092	$870
59	$7,731	$5,463	$2,268	$5,463	$2,268	$5,463	$2,268
60	$532	$22	$509	$22	$509	$22	$509
61	$3,541	$2,550	$990	$2,550	$990	$2,550	$990
62	$436	$436	$0	$436	$0	$433	$2
63	$113	$113	$0	$113	$0	$113	$0
64	$1	$1	$0	$1	$0	$1	$0
65	$46	$46	$0	$46	$0	$46	$0
66	$236	$236	$0	$236	$0	$235	$1
67	$18	$18	$0	$18	$0	$18	$0
68	$289	$289	$0	$289	$0	$281	$8
69	$161	$161	$0	$161	$0	$161	$0
70	$93	$93	$0	$93	$0	$93	$0
71	$1,493	$732	$761	$646	$847	$646	$847
72	$1,835	$1,588	$248	$1,588	$248	$1,588	$248
73	$16	$16	$0	$16	$0	$16	$0
74	$3	$3	$0	$3	$0	$3	$0
75	$66	$10	$56	$10	$56	$10	$56
76	$362	$362	$0	$362	$0	$265	$97
78	$22	$22	$0	$22	$0	$22	$0
81	$38,847	$27,833	$11,013	$27,833	$11,013	$27,833	$11,013
82	$2,294	$2,294	$0	$2,294	$0	$2,294	$0
83	$56,271	$40,283	$15,988	$40,283	$15,988	$40,283	$15,988
84	$11,409	$11,126	$283	$11,126	$283	$11,126	$283
86	$523	$33	$490	$33	$490	$33	$490
88	$244	$182	$62	$182	$62	$182	$62
89	$3,150	$2,662	$488	$2,651	$499	$2,637	$513
90	$282	$230	$52	$230	$52	$230	$52
92	$8,260	$6,389	$1,871	$6,389	$1,871	$6,389	$1,871
93	$122	$122	$0	$122	$0	$122	$0
94	$3,570	$2,521	$1,049	$2,521	$1,049	$2,521	$1,049
95	$282	$282	$0	$282	$0	$282	$0
96	$16	$16	$0	$16	$0	$16	$0
97	$91	$67	$24	$67	$24	$67	$24
98	$125	$125	$0	$125	$0	$125	$0
99	$109	$109	$0	$109	$0	$109	$0
100	$1,750	$1,443	$307	$1,443	$307	$1,443	$307
101	$3,070	$3,057	$12	$3,057	$12	$3,039	$31
102	$541	$453	$88	$453	$88	$453	$88
104	$1,905	$1,476	$429	$1,476	$429	$1,476	$429
Total	$202,305	$148,947	$53,358	$144,628	$57,678	$144,183	$58,123

Note: Reaches with zero damages in the without project condition are not shown

Addendum B: Depth Damage Functions

1STY-PIER							
1 Story Pier - M2G Long Fresh S pg17 C pg57							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1.5	0	0	0	-1	0	0	0
-1	1.1	1	1.4	-0.5	0	0	0
-0.5	5.5	5	6.9	0	0	0	0
0	11.7	10.5	14.6	0.5	78.5	61.7	86.7
0.5	41.7	37.5	52.1	1	83.3	71.1	91.1
1	41.7	37.5	52.1	1.5	85.3	79.7	91.1
1.5	63.9	57.5	79.8	2	88.6	84.7	96.7
2	67.4	60.6	84.2	3	92.8	86.7	96.7
3	71.2	64.1	89	4	94.4	91.7	96.7
4	71.2	64.1	89	5	94.7	91.9	97.2
5	79.2	71.3	99	6	94.8	92	100
6	79.2	71.3	99	7	94.8	92	100
7	79.2	71.3	99	8	94.8	92	100
8	79.2	71.3	99	9	94.8	92	100
9	81.5	73.3	100	10	94.8	92	100
10	81.5	73.3	100	11	94.8	92	100
11	81.5	73.3	100	12	94.8	92	100
12	81.5	73.3	100	13	94.8	92	100
13	81.5	73.3	100	14	94.8	92	100
14	81.5	73.3	100	15	94.8	92	100
15	81.5	73.3	100				

1STY-PIER_SALTY							
1 Story Pier - M2G Long Salt S pg18 C pg57							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1.5	0	0	0	-1.5	0	0	0
-1	1.1	1	1.7	-1	0	0	0
-0.5	12.2	11	18.3	-0.5	0	0	0
0	15.2	13.7	22.8	0	0	0	0
0.5	49.4	44.4	74	0.5	95	90	98
1	50.1	45.1	75.1	1	95	90	98
1.5	66.7	60	100	1.5	95	90	98
2	70.2	63.2	100	2	95	95	98
3	71.2	64.1	100	3	95	95	98
4	97.5	87.7	100	4	98	98	100
5	97.5	87.7	100	5	98	98	100
6	97.5	87.7	100	6	98	98	100
7	97.5	87.7	100	7	98	98	100
8	97.5	87.7	100	8	98	98	100
9	97.5	87.7	100	9	98	98	100
10	97.5	87.7	100	10	98	98	100
11	97.5	87.7	100	11	98	98	100
12	97.5	87.7	100	12	98	98	100
13	97.5	87.7	100	13	98	98	100
14	97.5	87.7	100	14	98	98	100
15	97.5	87.7	100	15	98	98	100

1STY-SLAB							
1 Story Slab - M2G Long Fresh S pg22 C pg57							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1	1.4	0	0	0	0
0.5	22.4	20.1	28	0.5	78.5	61.7	86.7
1	22.4	20.1	28	1	83.3	71.1	91.1
1.5	37.2	33.5	46.6	1.5	85.3	79.7	91.1
2	38.7	34.9	48.4	2	88.6	84.7	96.7
3	42.1	37.9	52.7	3	92.8	86.7	96.7
4	43.6	39.3	54.5	4	94.4	91.7	96.7
5	47.9	43.2	59.9	5	94.7	91.9	97.2
6	47.9	43.2	59.9	6	94.8	92	100
7	47.9	43.2	59.9	7	94.8	92	100
8	47.9	43.2	59.9	8	94.8	92	100
9	55.9	50.3	69.9	9	94.8	92	100
10	55.9	50.3	69.9	10	94.8	92	100
11	58.1	52.3	72.6	11	94.8	92	100
12	58.1	52.3	72.6	12	94.8	92	100
13	58.1	52.3	72.6	13	94.8	92	100
14	58.1	52.3	72.6	14	94.8	92	100
15	58.1	52.3	72.6	15	94.8	92	100

1STY-SLAB_SALTY							
1 Story Slab - M2G Long Salt S pg23 C pg57							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	1.1	1	1.7	-0.5	0	0	0
0	1.1	1	1.7	0	0	0	0
0.5	23.3	21	35	0.5	95	90	98
1	23.3	21	35	1	95	90	98
1.5	37.2	35.5	55.9	1.5	95	90	98
2	41.9	37.7	62.9	2	95	95	98
3	45.3	40.8	68	3	95	95	98
4	92	82.8	100	4	98	98	100
5	92	82.8	100	5	98	98	100
6	92	82.8	100	6	98	98	100
7	92	82.8	100	7	98	98	100
8	92	82.8	100	8	98	98	100
9	92	82.8	100	9	98	98	100
10	92	82.8	100	10	98	98	100
11	92	82.8	100	11	98	98	100
12	92	82.8	100	12	98	98	100
13	92	82.8	100	13	98	98	100
14	92	82.8	100	14	98	98	100
15	92	82.8	100	15	98	98	100

2STY-PIER							
2 Story Pier - M2G Long Fresh S pg26 C pg64							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1.5	0	0	0	-1	0	0	0
-1	1.4	1.2	1.7	-0.5	0	0	0
-0.5	2.2	2	2.7	0	0	0	0
0	5.7	5.2	7.2	0.5	67.1	61.9	69.6
0.5	18.3	16.5	22.9	1	67.1	61.9	69.6
1	18.3	16.5	22.9	1.5	72.6	70.3	74.7
1.5	31.2	28.1	39	2	72.6	70.3	74.7
2	31.9	28.7	39.9	3	76.4	74	78.5
3	32.6	29.3	40.8	4	77.7	75.3	79.9
4	35.7	32.1	44.6	5	78	75.6	83.2
5	40.4	36.3	50.5	6	78	75.6	83.2
6	40.4	36.3	50.5	7	78	75.6	83.2
7	40.4	36.3	50.5	8	78	75.6	83.2
8	42.4	38.2	53	9	78	75.6	83.2
9	42.4	38.2	53	10	78	75.6	83.2
10	55.7	50.2	69.7	11	91.4	88.5	97.5
11	58.5	52.7	73.1	12	91.7	88.8	97.8
12	58.5	52.7	73.1	13	92.4	89.5	98.5
13	70.9	63.8	88.7	14	92.4	89.5	98.5
14	70.9	63.8	88.7	15	92.4	89.5	98.5
15	70.9	63.8	88.7				

2STY-PIER_SALTY							
2 Story Pier - M2G Long Salt S pg27 C pg64							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1.5	0	0	0	-1.5	0	0	0
-1	1.4	1.2	2.1	-1	0	0	0
-0.5	2.2	2	3.3	-0.5	0	0	0
0	6.4	5.8	9.6	0	0	0	0
0.5	19	17.1	28.5	0.5	69.6	66.2	73.1
1	19	17.1	28.5	1	69.6	66.2	73.1
1.5	31.9	28.7	47.9	1.5	74.7	70.9	78.4
2	32.6	29.3	48.9	2	74.7	70.9	78.4
3	33.3	30	49.9	3	78.5	74.6	82.5
4	93.4	84	100	4	79.9	75.9	83.9
5	93.4	84	100	5	83.2	79	87.3
6	93.4	84	100	6	83.2	79	87.3
7	93.4	84	100	7	83.2	79	87.3
8	93.4	84	100	8	83.2	79	87.3
9	93.4	84	100	9	83.2	79	87.3
10	93.6	84.2	100	10	83.2	79	87.3
11	93.6	84.2	100	11	97.5	92.6	100
12	93.6	84.2	100	12	97.8	92.9	100
13	96.6	86.9	100	13	98.5	93.6	100
14	96.6	86.9	100	14	98.5	93.6	100
15	96.6	86.9	100	15	98.5	93.6	100

2STY-SLAB							
2 Story Slab - M2G Long Fresh S pg30 C pg64							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.2	1.1	1.5	0	0	0	0
0.5	15	13.5	18.8	0.5	67.1	61.9	69.6
1	15	13.5	18.8	1	67.1	61.9	69.6
1.5	26.1	23.5	32.6	1.5	72.6	70.3	74.7
2	27.1	24.4	33.9	2	72.6	70.3	74.7
3	28.5	25.7	35.7	3	76.4	74	78.5
4	29.4	26.5	36.8	4	77.7	75.3	79.9
5	34.5	31	43.1	5	78	75.6	83.2
6	34.5	31	43.1	6	78	75.6	83.2
7	34.5	31	43.1	7	78	75.6	83.2
8	35.4	31.8	44.2	8	78	75.6	83.2
9	37.8	34	47.2	9	78	75.6	83.2
10	47	42.3	58.8	10	78	75.6	83.2
11	50.6	45.6	63.3	11	91.4	88.5	97.5
12	52.6	47.3	65.7	12	91.7	88.8	97.8
13	56.6	50.9	70.8	13	92.4	89.5	98.5
14	56.6	50.9	70.8	14	92.4	89.5	98.5
15	56.6	50.9	70.8	15	92.4	89.5	98.5

2STY-SLAB_SALTY							
2 Story Slab - M2G Long Salt S pg31 C pg64							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	1.2	1.1	1.8	-0.5	0	0	0
0	1.2	1.1	1.8	0	0	0	0
0.5	16.1	14.5	24.2	0.5	69.6	66.2	73.1
1	16.1	14.5	24.2	1	69.6	66.2	73.1
1.5	26.1	23.5	39.1	1.5	74.7	70.9	78.4
2	27.1	24.4	40.7	2	74.7	70.9	78.4
3	28.5	25.7	42.8	3	78.5	74.6	82.5
4	80	72	100	4	79.9	75.9	83.9
5	80	72	100	5	83.2	79	87.3
6	80	72	100	6	83.2	79	87.3
7	80	72	100	7	83.2	79	87.3
8	80	72	100	8	83.2	79	87.3
9	80	72	100	9	83.2	79	87.3
10	80.3	72.3	100	10	83.2	79	87.3
11	80.3	72.3	100	11	97.5	92.6	100
12	80.3	72.3	100	12	97.8	92.9	100
13	83.2	74.9	100	13	98.5	93.6	100
14	83.2	74.9	100	14	98.5	93.6	100
15	83.2	74.9	100	15	98.5	93.6	100

EAT							
Eatery - M2G Long Fresh S pg43 C pg71							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.6	1.5	1.9	0	0	0	0
0.5	12	11.2	14.4	0.5	37.5	33.7	46.8
1	12	11.2	14.4	1	41.4	37.3	51.8
1.5	17.2	15.5	20.6	1.5	66.6	59.9	83.3
2	17.4	15.6	21.4	2	68	61.2	85
3	22.4	19.7	26.9	3	84	75.6	100
4	26.3	22.4	32.9	4	92.4	83.1	100
5	29.5	25.1	36.9	5	94.8	85.3	100
6	29.5	25.1	36.9	6	95.5	85.9	100
7	29.5	25.1	36.9	7	97.8	88	100
8	31.9	27.1	39.9	8	97.8	88	100
9	42.3	35.9	52.8	9	97.8	88	100
10	48.4	41.2	60.6	10	97.8	88	100
11	48.4	41.2	60.6	11	97.8	88	100
12	52.4	44.6	65.5	12	97.8	88	100
13	52.4	44.6	65.5	13	97.8	88	100
14	52.4	44.6	65.5	14	97.8	88	100
15	52.4	44.6	65.5	15	97.8	88	100

EAT_SALTY							
Eatery - M2G Long Salt S pg44 C pg71							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	6.6	6.2	7.6	0	0	0	0
0.5	19.8	18.4	22.8	0.5	41.2	39.2	51.5
1	19.8	18.4	22.8	1	45.6	43.3	57
1.5	24.5	22.8	28.2	1.5	73.3	69.6	91.6
2	24.5	23.1	29.5	2	74.8	71.1	93.5
3	29.6	26.6	37	3	92.4	87.8	100
4	34.7	31.2	43.4	4	100	95	100
5	37.9	34.1	47.4	5	100	95	100
6	37.9	34.1	47.4	6	100	95	100
7	37.9	34.1	47.4	7	100	95	100
8	63.3	57	79.2	8	100	95	100
9	63.3	57	79.2	9	100	95	100
10	63.3	57	79.2	10	100	95	100
11	63.3	57	79.2	11	100	95	100
12	63.3	57	79.2	12	100	95	100
13	63.3	57	79.2	13	100	95	100
14	63.3	57	79.2	14	100	95	100
15	63.3	57	79.2	15	100	95	100

GROC							
Grocery - M2G Long Fresh S pg43 C pg 73							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.6	1.5	1.9	0	0	0	0
0.5	12	11.2	14.4	0.5	90.1	81.1	100
1	12	11.2	14.4	1	91.5	82.3	100
1.5	17.2	15.5	20.6	1.5	91.7	82.5	100
2	17.4	15.6	21.4	2	91.8	82.6	100
3	22.4	19.7	26.9	3	93.9	84.5	100
4	26.3	22.4	32.9	4	95.2	85.6	100
5	29.5	25.1	36.9	5	95.2	85.6	100
6	29.5	25.1	36.9	6	95.9	86.3	100
7	29.5	25.1	36.9	7	95.9	86.3	100
8	31.9	27.1	39.9	8	95.9	86.3	100
9	42.3	35.9	52.8	9	95.9	86.3	100
10	48.4	41.2	60.6	10	95.9	86.3	100
11	48.4	41.2	60.6	11	95.9	86.3	100
12	52.4	44.6	65.5	12	95.9	86.3	100
13	52.4	44.6	65.5	13	95.9	86.3	100
14	52.4	44.6	65.5	14	95.9	86.3	100
15	52.4	44.6	65.5	15	95.9	86.3	100

GROC_SALTY							
Grocery - M2G Long Salt S pg44 C pg73							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	6.6	6.2	7.6	0	0	0	0
0.5	19.8	18.4	22.8	0.5	99.1	94.1	100
1	19.8	18.4	22.8	1	100	95	100
1.5	24.5	22.8	28.2	1.5	100	95	100
2	24.5	23.1	29.5	2	100	95	100
3	29.6	26.6	37	3	100	95	100
4	34.7	31.2	43.4	4	100	95	100
5	37.9	34.1	47.4	5	100	95	100
6	37.9	34.1	47.4	6	100	100	100
7	37.9	34.1	47.4	7	100	100	100
8	63.3	57	79.2	8	100	100	100
9	63.3	57	79.2	9	100	100	100
10	63.3	57	79.2	10	100	100	100
11	63.3	57	79.2	11	100	100	100
12	63.3	57	79.2	12	100	100	100
13	63.3	57	79.2	13	100	100	100
14	63.3	57	79.2	14	100	100	100
15	63.3	57	79.2	15	100	100	100

MOBILE							
Mobile Home - M2G Long Fresh S pg34 C pg67							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1.5	0	0	0	-1	0	0	0
-1	6.4	6.1	8.3	-0.5	0	0	0
-0.5	7.3	6.9	9.5	0	0	0	0
0	9.9	9.4	12.9	0.5	85	75	90
0.5	43.4	41.2	56.4	1	85	80	95
1	44.7	42.5	58.1	1.5	90	85	98
1.5	45	42.8	58.5	2	95	95	100
2	45.7	43.4	59.4	3	99	95	100
3	96.5	91.6	100	4	99	95	100
4	96.5	91.6	100	5	99	95	100
5	96.5	91.6	100	6	99	95	100
6	96.5	91.6	100	7	99	95	100
7	96.5	91.6	100	8	99	95	100
8	96.5	91.6	100	9	99	95	100
9	96.5	91.6	100	10	99	95	100
10	96.5	91.6	100	11	99	95	100
11	96.5	91.6	100	12	99	95	100
12	96.5	91.6	100	13	99	95	100
13	96.5	91.6	100	14	99	95	100
14	96.5	91.6	100	15	99	95	100
15	96.5	91.6	100				

MOBILE_SALTY							
Mobile Home - M2G Long Salt S pg35 C pg67							
Residential Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1.5	0	0	0	-1.5	0	0	0
-1	6.4	6.1	8.6	-1	0	0	0
-0.5	7.3	6.9	9.8	-0.5	0	0	0
0	9.9	9.4	13.4	0	0	0	0
0.5	43.4	41.2	58.6	0.5	95	90	100
1	44.7	42.5	60.3	1	96	92	100
1.5	97.6	92.7	100	1.5	97	94	100
2	97.6	92.7	100	2	98	96	100
3	97.6	92.7	100	3	99	98	100
4	97.6	92.7	100	4	100	100	100
5	97.6	92.7	100	5	100	100	100
6	97.6	92.7	100	6	100	100	100
7	97.6	92.7	100	7	100	100	100
8	97.6	92.7	100	8	100	100	100
9	97.6	92.7	100	9	100	100	100
10	97.6	92.7	100	10	100	100	100
11	97.6	92.7	100	11	100	100	100
12	97.6	92.7	100	12	100	100	100
13	97.6	92.7	100	13	100	100	100
14	97.6	92.7	100	14	100	100	100
15	97.6	92.7	100	15	100	100	100

MULTI							
Multifamily - M2G Long Fresh S pg43 C pg75							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.6	1.5	1.9	0	0	0	0
0.5	12	11.2	14.4	0.5	17.4	13.7	19.3
1	12	11.2	14.4	1	22.8	19.5	24.9
1.5	17.2	15.5	20.6	1.5	29.1	27.2	30.6
2	17.4	15.6	21.4	2	36.9	35.2	40.2
3	22.4	19.7	26.9	3	43.3	40.5	44.7
4	26.3	22.4	32.9	4	45	43.7	46.1
5	29.5	25.1	36.9	5	45	43.7	46.2
6	29.5	25.1	36.9	6	45	43.7	47.5
7	29.5	25.1	36.9	7	45	43.7	47.5
8	31.9	27.1	39.9	8	45	43.7	47.5
9	42.3	35.9	52.8	9	45	43.7	47.5
10	48.4	41.2	60.6	10	62.4	49.1	69
11	48.4	41.2	60.6	11	74.1	69.2	77.9
12	52.4	44.6	65.5	12	88.3	82.6	91.2
13	52.4	44.6	65.5	13	90	87.5	92.2
14	52.4	44.6	65.5	14	90	87.6	92.3
15	52.4	44.6	65.5	15	90	87.7	94.9

MULTI_SALTY							
Multifamily - M2G Long Salt S pg44 C pg75							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	6.6	6.2	7.6	0	0	0	0
0.5	19.8	18.4	22.8	0.5	20.1	15.8	22.2
1	19.8	18.4	22.8	1	26.2	22.4	28.7
1.5	24.5	22.8	28.2	1.5	33.5	31.2	35.2
2	24.5	23.1	29.5	2	42.4	40.5	46.2
3	29.6	26.6	37	3	49.8	46.6	51.4
4	34.7	31.2	43.4	4	51.7	50.3	53
5	37.9	34.1	47.4	5	51.7	50.3	53.1
6	37.9	34.1	47.4	6	51.7	50.3	54.6
7	37.9	34.1	47.4	7	51.7	50.3	54.6
8	63.3	57	79.2	8	51.7	50.3	54.6
9	63.3	57	79.2	9	51.7	50.3	54.6
10	63.3	57	79.2	10	71.8	56.4	79.3
11	63.3	57	79.2	11	85.2	79.6	89.5
12	63.3	57	79.2	12	100	93.5	100
13	63.3	57	79.2	13	100	97.1	100
14	63.3	57	79.2	14	100	97.1	100
15	63.3	57	79.2	15	100	97.1	100

PROF							
Professional - M2G Long Fresh S pg43 C pg77							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.6	1.5	1.9	0	0	0	0
0.5	12	11.2	14.4	0.5	22.8	20.5	28.5
1	12	11.2	14.4	1	28.3	25.4	35.3
1.5	17.2	15.5	20.6	1.5	37.1	33.4	46.3
2	17.4	15.6	21.4	2	41.8	37.6	52.2
3	22.4	19.7	26.9	3	66	59.4	82.5
4	26.3	22.4	32.9	4	81.3	73.2	100
5	29.5	25.1	36.9	5	83	74.7	100
6	29.5	25.1	36.9	6	90.7	81.6	100
7	29.5	25.1	36.9	7	91.8	82.7	100
8	31.9	27.1	39.9	8	91.8	82.7	100
9	42.3	35.9	52.8	9	91.8	82.7	100
10	48.4	41.2	60.6	10	91.8	82.7	100
11	48.4	41.2	60.6	11	91.8	82.7	100
12	52.4	44.6	65.5	12	91.8	82.7	100
13	52.4	44.6	65.5	13	91.8	82.7	100
14	52.4	44.6	65.5	14	91.8	82.7	100
15	52.4	44.6	65.5	15	91.8	82.7	100

PROF_SALTY							
Professional - M2G Long Salt S pg44 C pg77							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	6.6	6.2	7.6	0	0	0	0
0.5	19.8	18.4	22.8	0.5	35	30	50
1	19.8	18.4	22.8	1	43.3	37.1	61.8
1.5	24.5	22.8	28.2	1.5	56.7	48.6	81
2	24.5	23.1	29.5	2	63.9	54.8	91.3
3	29.6	26.6	37	3	100	85.7	100
4	34.7	31.2	43.4	4	100	100	100
5	37.9	34.1	47.4	5	100	100	100
6	37.9	34.1	47.4	6	100	100	100
7	37.9	34.1	47.4	7	100	100	100
8	63.3	57	79.2	8	100	100	100
9	63.3	57	79.2	9	100	100	100
10	63.3	57	79.2	10	100	100	100
11	63.3	57	79.2	11	100	100	100
12	63.3	57	79.2	12	100	100	100
13	63.3	57	79.2	13	100	100	100
14	63.3	57	79.2	14	100	100	100
15	63.3	57	79.2	15	100	100	100

PUBL							
Public - M2G Long Fresh S pg47 C pg79							
Public Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1	1.3	0	0	0	0
0.5	22.3	20.8	26.8	0.5	70.6	52.9	77.6
1	23.7	22.1	28.5	1	75	56.3	82.5
1.5	25.8	23.2	31	1.5	75.6	56.7	83.1
2	32.7	29.5	40.3	2	76.4	57.3	84
3	34.4	30.3	41.3	3	97.2	72.9	100
4	39.8	33.8	49.8	4	100	75	100
5	44.5	37.9	55.7	5	100	75	100
6	44.5	37.9	55.7	6	100	75	100
7	46.2	39.3	57.8	7	100	75	100
8	56	47.6	70	8	100	75	100
9	60.4	51.4	75.6	9	100	75	100
10	60.4	51.4	75.6	10	100	75	100
11	60.4	51.4	75.6	11	100	75	100
12	66	56.1	82.5	12	100	75	100
13	66	56.1	82.5	13	100	75	100
14	66	56.1	82.5	14	100	75	100
15	66	56.1	82.5	15	100	75	100

PUBL_SALTY							
Public - M2G Long Salt S pg48 C pg79							
Public Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1.1	1.3	0	0	0	0
0.5	22.3	20.8	25.7	0.5	80	60	88
1	23.7	22.1	27.3	1	85	63.8	93.5
1.5	25.8	24	29.7	1.5	85.7	64.3	94.2
2	32.7	29.5	39.3	2	86.6	65	95.3
3	34.4	31	43	3	100	75	100
4	79.1	71.2	100	4	100	75	100
5	79.1	71.2	100	5	100	75	100
6	79.1	71.2	100	6	100	75	100
7	79.1	71.2	100	7	100	75	100
8	79.1	71.2	100	8	100	75	100
9	79.1	71.2	100	9	100	75	100
10	79.1	71.2	100	10	100	75	100
11	79.1	71.2	100	11	100	75	100
12	80.5	72.4	100	12	100	75	100
13	80.5	72.4	100	13	100	75	100
14	80.5	72.4	100	14	100	75	100
15	80.5	72.4	100	15	100	75	100

REPA							
Repair - M2G Long Fresh S pg47 C pg81							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1	1.3	0	0	0	0
0.5	22.3	20.8	26.8	0.5	30.3	27.3	37.9
1	23.7	22.1	28.5	1	31.2	28.1	39
1.5	25.8	23.2	31	1.5	31.2	28.1	39
2	32.7	29.5	40.3	2	62.9	56.6	78.6
3	34.4	30.3	41.3	3	64.2	57.8	80.3
4	39.8	33.8	49.8	4	65.6	59	82
5	44.5	37.9	55.7	5	73.3	66	91.6
6	44.5	37.9	55.7	6	76.1	68.5	95.2
7	46.2	39.3	57.8	7	76.1	68.5	95.2
8	56	47.6	70	8	76.1	68.5	95.2
9	60.4	51.4	75.6	9	76.1	68.5	95.2
10	60.4	51.4	75.6	10	76.1	68.5	95.2
11	60.4	51.4	75.6	11	76.1	68.5	95.2
12	66	56.1	82.5	12	76.1	68.5	95.2
13	66	56.1	82.5	13	76.1	68.5	95.2
14	66	56.1	82.5	14	76.1	68.5	95.2
15	66	56.1	82.5	15	76.1	68.5	95.2

REPA_SALTY							
Repair - M2G Long Salt S pg48 C pg81							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1.1	1.3	0	0	0	0
0.5	22.3	20.8	25.7	0.5	33.3	31.7	41.7
1	23.7	22.1	27.3	1	34.3	32.6	42.9
1.5	25.8	24	29.7	1.5	34.3	32.6	42.9
2	32.7	29.5	39.3	2	69.2	65.7	86.5
3	34.4	31	43	3	70.6	67.1	88.3
4	79.1	71.2	100	4	72.1	68.5	90.2
5	79.1	71.2	100	5	80.6	76.6	100
6	79.1	71.2	100	6	83.7	79.6	100
7	79.1	71.2	100	7	83.7	79.6	100
8	79.1	71.2	100	8	83.7	79.6	100
9	79.1	71.2	100	9	83.7	79.6	100
10	79.1	71.2	100	10	83.7	79.6	100
11	79.1	71.2	100	11	83.7	79.6	100
12	80.5	72.4	100	12	83.7	79.6	100
13	80.5	72.4	100	13	83.7	79.6	100
14	80.5	72.4	100	14	83.7	79.6	100
15	80.5	72.4	100	15	83.7	79.6	100

RETA							
Retail - M2G Long Fresh S pg47 C pg83							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1	1.3	0	0	0	0
0.5	22.3	20.8	26.8	0.5	33.3	29.9	41.6
1	23.7	22.1	28.5	1	55	49.5	68.8
1.5	25.8	23.2	31	1.5	55	49.5	68.8
2	32.7	29.5	40.3	2	68.5	61.7	85.7
3	34.4	30.3	41.3	3	77.4	69.6	96.7
4	39.8	33.8	49.8	4	85.9	77.3	100
5	44.5	37.9	55.7	5	94.4	85	100
6	44.5	37.9	55.7	6	94.4	85	100
7	46.2	39.3	57.8	7	94.4	85	100
8	56	47.6	70	8	94.4	85	100
9	60.4	51.4	75.6	9	97	87.3	100
10	60.4	51.4	75.6	10	97	87.3	100
11	60.4	51.4	75.6	11	97	87.3	100
12	66	56.1	82.5	12	97	87.3	100
13	66	56.1	82.5	13	97	87.3	100
14	66	56.1	82.5	14	97	87.3	100
15	66	56.1	82.5	15	97	87.3	100

RETA_SALTY							
Retail - M2G Long Salt S pg48 C pg83							
Commercial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1.1	1.3	0	0	0	0
0.5	22.3	20.8	25.7	0.5	36.6	34.8	45.7
1	23.7	22.1	27.3	1	60.5	57.5	75.7
1.5	25.8	24	29.7	1.5	60.5	57.5	75.7
2	32.7	29.5	39.3	2	75.4	71.6	94.2
3	34.4	31	43	3	85.1	80.8	100
4	79.1	71.2	100	4	94.5	89.7	100
5	79.1	71.2	100	5	100	95	100
6	79.1	71.2	100	6	100	95	100
7	79.1	71.2	100	7	100	95	100
8	79.1	71.2	100	8	100	95	100
9	79.1	71.2	100	9	100	95	100
10	79.1	71.2	100	10	100	95	100
11	79.1	71.2	100	11	100	95	100
12	80.5	72.4	100	12	100	95	100
13	80.5	72.4	100	13	100	95	100
14	80.5	72.4	100	14	100	95	100
15	80.5	72.4	100	15	100	95	100

WARE							
Warehouse - M2G Long Fresh S pg47 C pg85							
Industrial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1	1.3	0	0	0	0
0.5	22.3	20.8	26.8	0.5	16	14.4	20
1	23.7	22.1	28.5	1	20.1	18.1	25.2
1.5	25.8	23.2	31	1.5	20.1	18.1	25.2
2	32.7	29.5	40.3	2	26.6	23.9	33.2
3	34.4	30.3	41.3	3	30.9	27.8	38.7
4	39.8	33.8	49.8	4	39	35.1	48.7
5	44.5	37.9	55.7	5	46.2	41.6	57.7
6	44.5	37.9	55.7	6	53.4	48.1	66.8
7	46.2	39.3	57.8	7	60.6	54.6	75.8
8	56	47.6	70	8	67.9	61.1	84.8
9	60.4	51.4	75.6	9	72.5	65.2	90.6
10	60.4	51.4	75.6	10	72.5	65.2	90.6
11	60.4	51.4	75.6	11	72.5	65.2	90.6
12	66	56.1	82.5	12	72.5	65.2	90.6
13	66	56.1	82.5	13	72.5	65.2	90.6
14	66	56.1	82.5	14	72.5	65.2	90.6
15	66	56.1	82.5	15	72.5	65.2	90.6

WARE_SALTY							
Warehouse - M2G Long Salt S pg48 C pg85							
Industrial Category							
Structure Damage Percentage				Content Damage Percentage			
Stage	Expected	Lower	Upper	Stage	Expected	Lower	Upper
-1	0	0	0	-1	0	0	0
-0.5	0	0	0	-0.5	0	0	0
0	1.1	1.1	1.3	0	0	0	0
0.5	22.3	20.8	25.7	0.5	17.6	16.8	22
1	23.7	22.1	27.3	1	22.1	21	27.7
1.5	25.8	24	29.7	1.5	22.1	21	27.7
2	32.7	29.5	39.3	2	29.2	27.8	36.6
3	34.4	31	43	3	34	32.3	42.5
4	79.1	71.2	100	4	42.8	40.7	53.6
5	79.1	71.2	100	5	50.8	48.3	63.5
6	79.1	71.2	100	6	58.7	55.8	73.4
7	79.1	71.2	100	7	66.7	63.4	83.4
8	79.1	71.2	100	8	74.6	70.9	93.3
9	79.1	71.2	100	9	79.7	75.7	99.6
10	79.1	71.2	100	10	79.7	75.7	99.6
11	79.1	71.2	100	11	79.7	75.7	99.6
12	80.5	72.4	100	12	79.7	75.7	99.6
13	80.5	72.4	100	13	79.7	75.7	99.6
14	80.5	72.4	100	14	79.7	75.7	99.6
15	80.5	72.4	100	15	79.7	75.7	99.6