US Army Corps of Engineers®

APPENDIX F: ECONOMICS

WACCAMAW RIVER,

HORRY COUNTY, SOUTH CAROLINA

FLOOD RISK MANAGEMENT STUDY INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

MAY 2026

MAIN REPORT SUMMARY

The Integrated Feasibility Report and Environmental Assessment (FR/EA), that this appendix addresses, details a collaborative study by the U.S. Army Corps of Engineers (USACE) and Horry County, South Carolina. It is aimed at reducing existing and future flood risks to communities and transportation infrastructure within the Waccamaw River Basin, with a focus on Horry County. The study identifies four key flood impact areas: Longs & Red Bluff, Conway, Bucksport, and Socastee.

The flood impacts in each of these areas were independent of each other, so solutions could be evaluated independently, making any proposed alternative plans separable. The study considered a range of structural, non-structural, and nature-based solutions while incorporating public feedback gathered during meetings. An environmental analysis was completed, and a Finding of No Significant Impact is included within the main report. The document completed a public review and comment period while also undergoing internal agency reviews and adapted to those concerns and suggestions. In addition to historical flooding, the report acknowledges the flooding event caused by Hurricane Debby in August 2024 during this study, and its impact was assessed to further inform the study's conclusions.

The Recommended Plan, based on an evaluation of alternatives, includes two separable elements that are incrementally justified: Relief Bridges (cross drains) in the Conway flood impact area and Barrier Removal in the Socastee flood impact area. The Recommended Plan is classified as the National Economic Development Plan and is also the plan that reasonably maximizes net economic benefits. No alternatives were justified for Federal investment for the Longs & Red Bluff and Bucksport flood impact areas. This Appendix provides detailed Economics information to support these recommendations.

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A BACKGROUND INFORMATION

A.1 INTRODUCTION

General This appendix presents an economic evaluation of the riverine flood risk reduction measures for the Waccamaw River Flood Risk Management study. The evaluation area includes four damage areas amongst them Bucksport, City of Conway, Socastee, and Longs/Red Bluff. The report was prepared in accordance with Engineer Regulation (ER) 1105-2-100, Planning Guidance Notebook, (ER) 1105-2-103, Policy for Conducting Civil Works Planning Studies, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the User's Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC-FDA).

The economic appendix consists of a description of the methodology used to determine National Economic Development (NED) damages under future without project conditions, Regional Economic Development (RED) values, and project costs. During 2024, the damages and costs of all alternatives in the final array were calculated using the FY 2024 Federal discount rate of 2.75 percent and a 50-year period of analysis with the year 2035 as the base year. Subsequent refinement of the alternatives that had positive net annual benefits resulted in updated costs which were calculated using October 2023 price levels and annualized using the FY 2024 Federal discount rate of 2.75 percent and a period of analysis of 50 years with the year 2035 as the base year. The expected annual damage and benefit estimates were compared to the annual construction costs and the associated OMRR&R costs for each alternative in the final array. Furthermore, in FY 2026, during optimization of the selected plans, the benefits and costs for the Recommended Plan were updated to FY 2026 price levels and annualized using the FY 2026 discount rate of 3.25 percent (refence Section G).

Past Flood Damages According to the National Center for Environmental Information (NCEI), Horry County and the participating jurisdictions have experienced 29 flood events since 1995 and an additional 60 flash floods. One of the most significant was Hurricane Floyd, which brought floods to three different locations in Horry County. More than 1,700 homes were damaged. Of those over 200 homes were substantially damaged which qualified them for assistance under the Hazard Mitigation Grant Program.

From 2015-2019 Horry County would experience flooding events each year. Flooding from the storm remnants of Hurricane Joaquin would affect the area in 2015, Hurricane Matthew in 2016, Hurricane Irma in 2017, Hurricane Florence in 2018, and Hurricane Dorian in 2019. Following the storm fragments of Hurricane Joaquin, Horry County received more than 20 inches of rain in 48 hours which overburdened drainage capabilities throughout the county resulting in flash flooding and ultimately the third highest crest on record for the Waccamaw River. Excessive rainfall once again caused record breaking flooding from Hurricane Matthew in 2016 and the National Weather Service in Wilmington issued its first-ever flash flood emergency for Horry County as flooding became widespread and life-threatening. Hurricane Florence in 2018 produced heavy rains throughout the County for 3 days and rain totals in the Loris area reached 23.63 inches causing major flooding issues. Brush trucks, small boats and the National Guard high-water vehicles were utilized to help get over 100 residents out of their flooded homes. In addition to residential homes being affected, Loris City Hall also had extensive damage as a portion of the roof collapsed due to the rainfall. The flood from Florence set the new record in Conway with a water surface elevation of 21.16 feet also surpassing the old record of 17.89 feet set by Hurricane Matthew. There were 1,941 homes impacted and the reported cost of damage from Hurricane Florence flooding was $41.5

Million in Horry County. Hurricane Dorian in 2019 produced heavy periods of rain, but not to the extent experienced in the prior two storms. Some low-lying areas of the County experienced flash flooding.

NED Benefit Categories Considered Per Planning Guidance ER 1105-2-100, Appendix E, Section E-19, "There are three primary benefit categories, reflecting three different responses to a flood hazard reduction plan". Inundation reduction benefits are the increases in net income generated by the affected land uses when the same land use pattern and intensity of use is assumed for both with- and without-project conditions. Intensification benefits are increases in net income generated by intensified floodplain activities when the floodplain use is the same with and without the project, but an activity (or activities) is more intense with the project. The third category of benefits is location benefits. If an activity is added to the floodplain because of a plan, the location benefit is the difference between aggregate net incomes (including economic rent) in the economically affected area with and without the project. The magnitude of location benefits that can be claimed is limited by policy. In general, the NED Plan will be formulated to protect existing development and vacant property that is interspersed with existing development. This analysis for Horry County analyzes only inundation reduction benefits related to depreciated structure values, contents values, and damages to automobiles associated with various structure types.

Additional NED Benefit Categories NOT Considered The NED benefit categories not addressed in this economic appendix:

- Emergency Cost Reduction Benefits- Emergency costs are those costs incurred by a community during and immediately following a major storm (Examples include travel, meal, cleanup supplies, unpaid labor, and vandalism costs)
- Indirect losses to the national economy because of disruptions in the production of goods and services by industries affected by the storm or riverine flooding
- Increased cost of operations for industrial facilities following a flood event relative to normal business operations
- Physical loss of agricultural crops grown to be sold for commercial profit
- Traffic detour time due to flooded roadways

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 RED account. The input-output macroeconomic model RECONS is used to address the impacts of the construction spending associated with the project alternatives.

Other Social Effects The other social effects (OSE) account includes impacts to life safety, vulnerable populations, local economic vitality, and community optimism. Impacts on these topics are a natural outcome of civil works projects and are often qualitatively discussed in the OSE account. These types of benefits were estimated using the C-Best tool and can be found in the Main Report Section 5.2.3 Other Social Effects.

A.2 DESCRIPTION OF THE STUDY AREA

A.2.1 Geographic Location

The study area is comprised of the Waccamaw River Basin within Horry County, South Carolina. The study area boundary is divided into four flood impact areas: Bucksport, Conway, Longs/Red Bluff, and Socastee as shown below in **Tables A-1** to **A-4.** These areas are based on jurisdictional boundaries but are also reflective of geographic and socioeconomic qualities unique to each. The study area is largely urban with mostly residential structures. An inventory of residential and non-residential structures was developed using the National Structure Inventory (NSI) 2022 for the portions of the county impacted by riverine flooding. The structure inventory for the economic analysis includes all structures within the extent of inundation for the 0.2% annual exceedance probability (AEP) event in the future without project condition.

Table A-1 to **Table A-4** show the structure inventory and the boundaries of the impact area within the 500-yr floodplain. **Table A-5**, depicts the number of structures and structure type count with respect to each impact area.

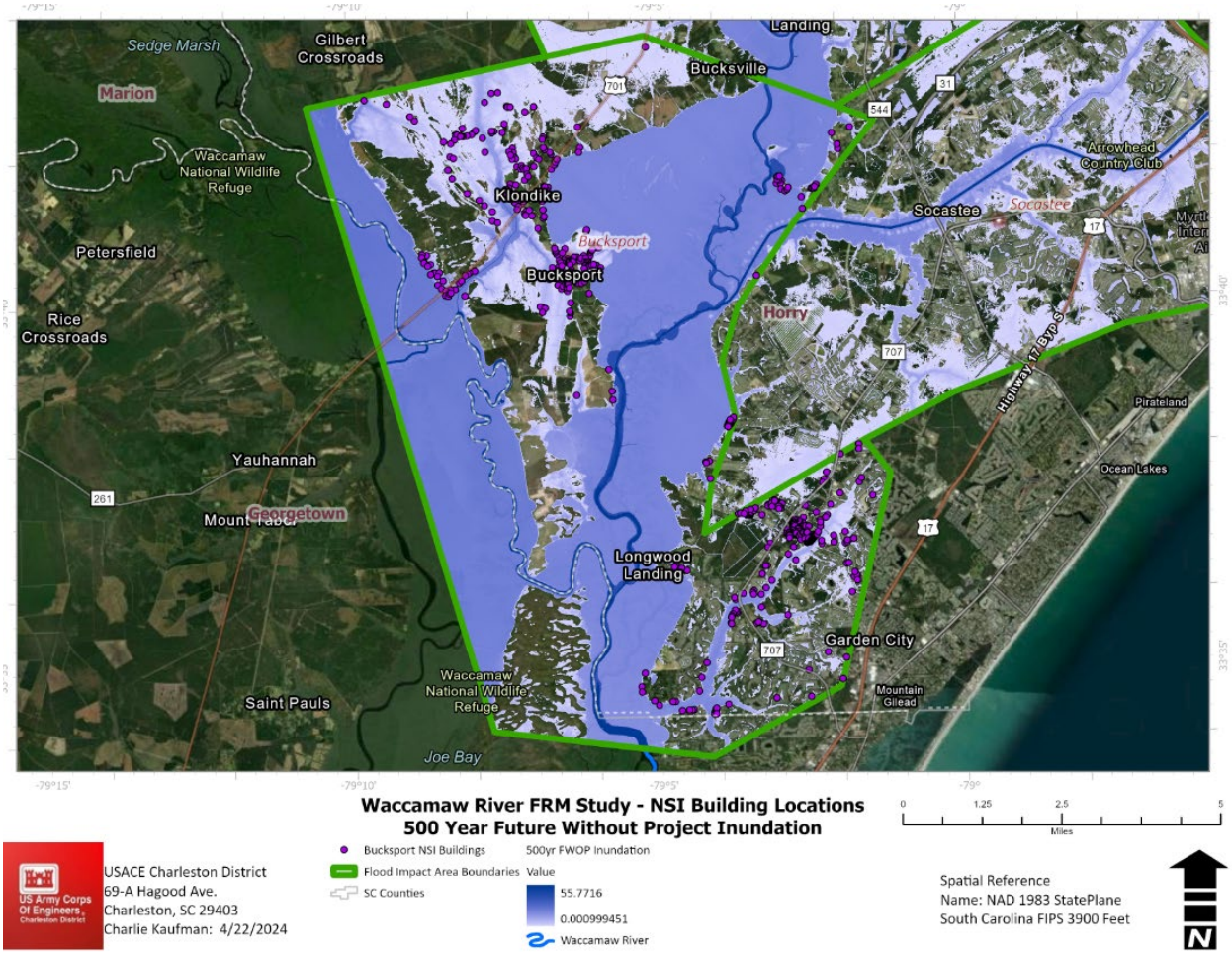

Figure A-1: Bucksport NSI Building Locations Within 500-year Floodplain.

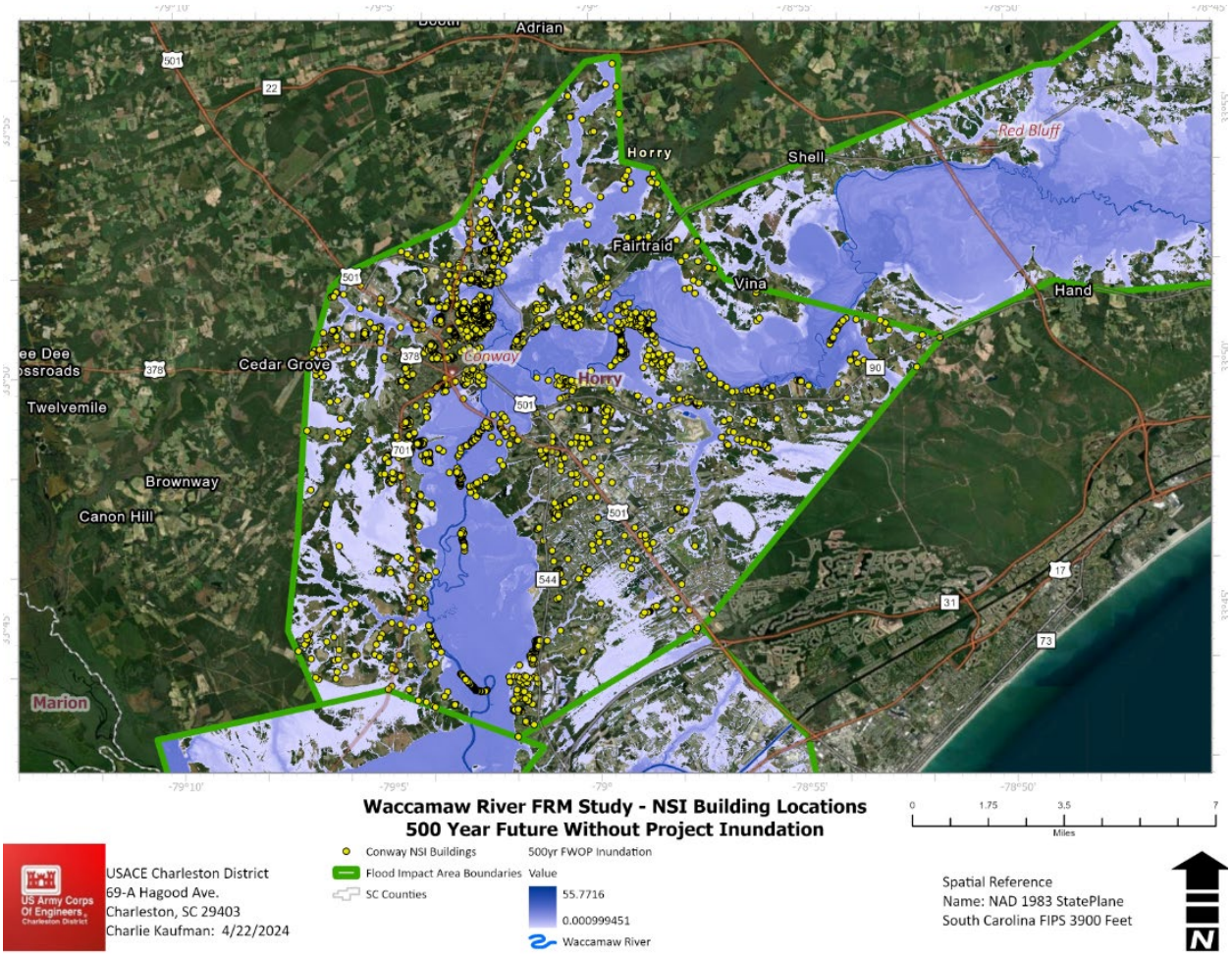

Figure A-2: Conway NSI Building Locations Within 500-year Floodplain

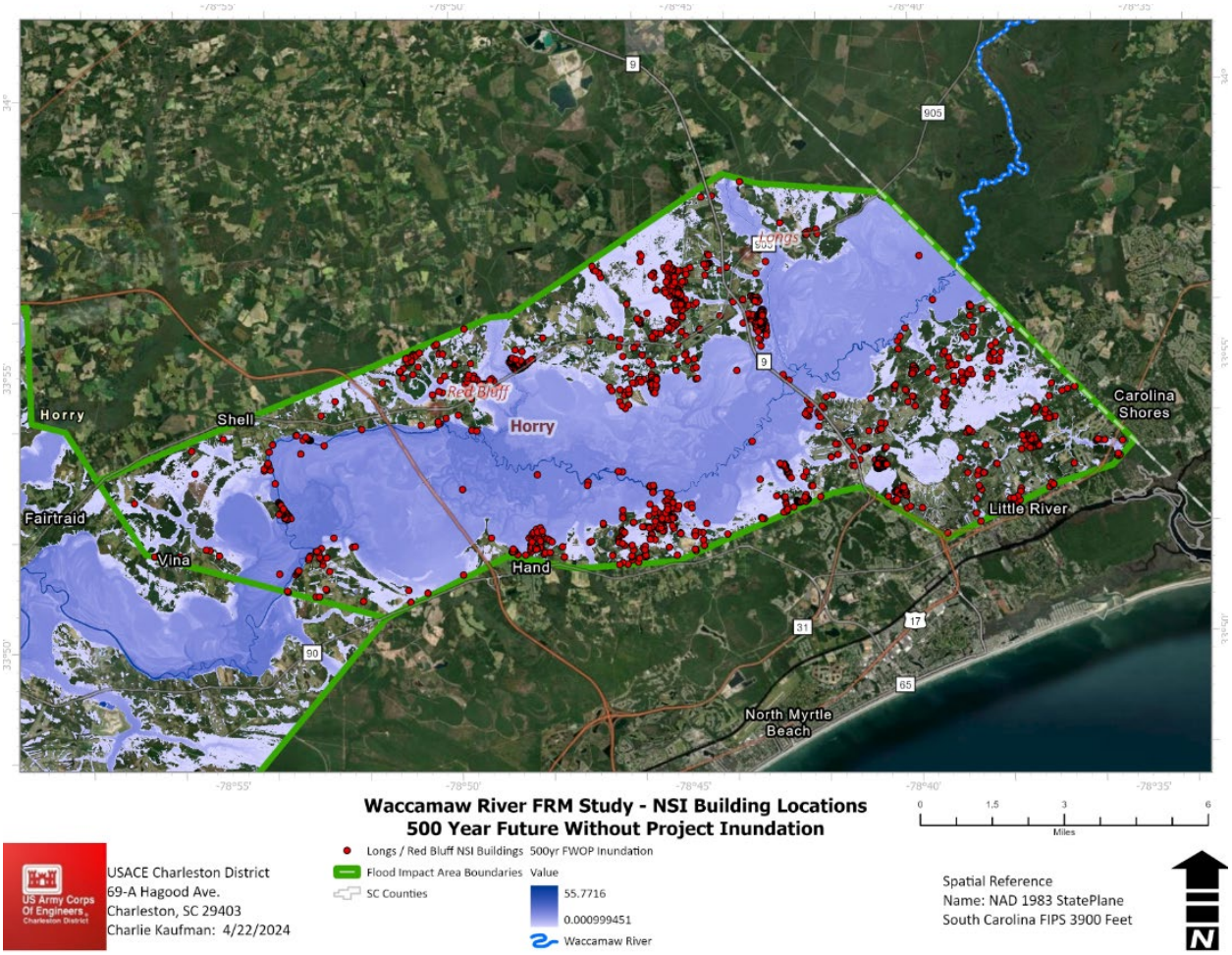

Figure A-3: Longs/Red Bluff NSI Building Locations Within 500-year Floodplain

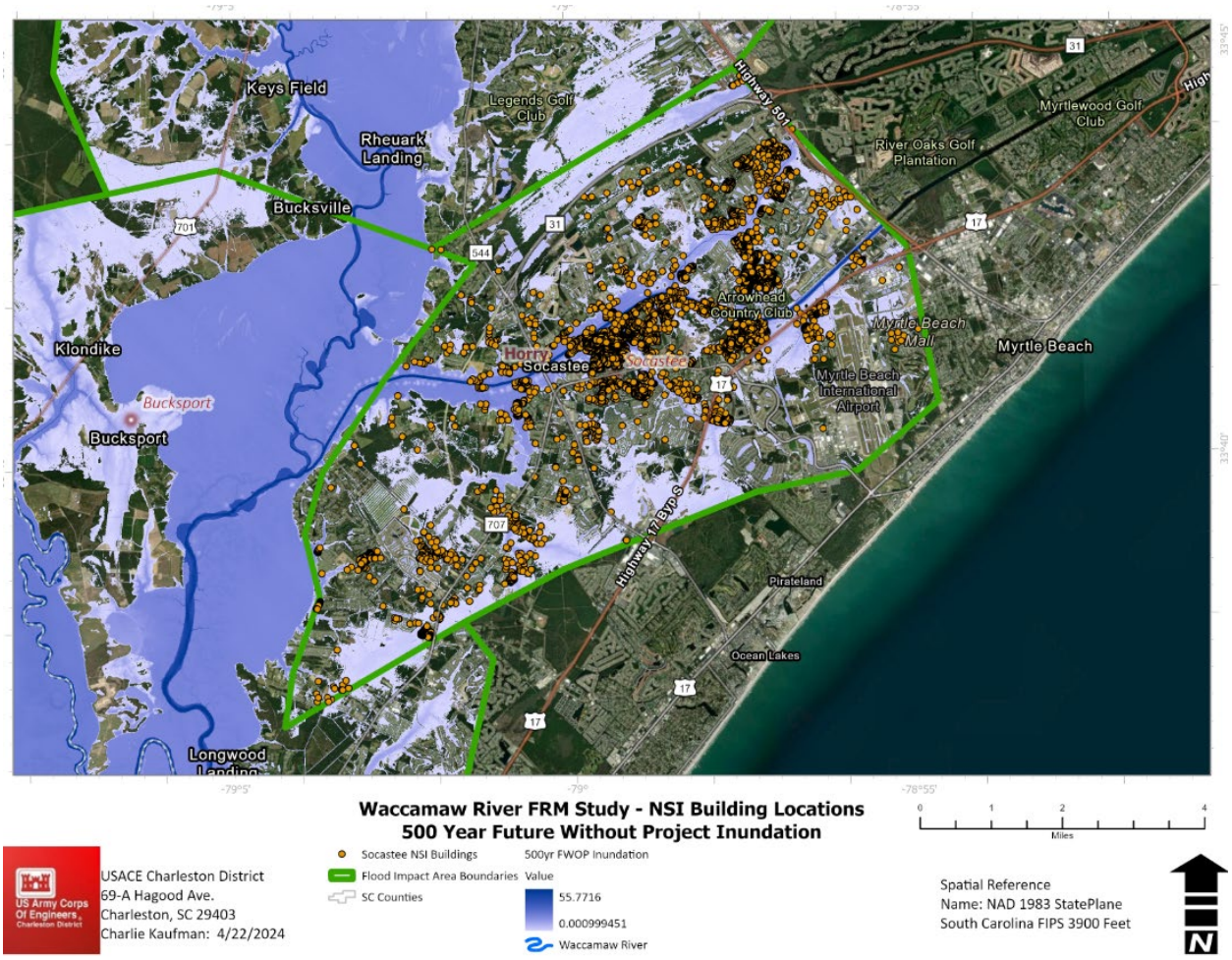

Figure A-4: Socastee NSI Building Locations Within 500-year Floodplain

Impact Areas The study area comprises four impact areas, which were identified by the full USACE team and the Flood Risk Management Planning Center of Expertise (FRM-PCX). The impact areas begin with Bucksport.

A.2.2 Bucksport

Residential and commercial establishments within this area branch off into distinct community sectors almost exclusively from HWY 701, Bucksport Road and the Pee Dee HWY. Flooding affects transportation along these routes, causing evacuation difficulties that lead to prolonged displacement. A considerable segment of the community contends with social vulnerabilities, stemming from historical underinvestment and limited economic opportunities.

A.2.3 Conway

Much of the City of Conway is composed of residential and commercial development including many historical structures and places. Residential and commercial establishments within this area are scattered across various distinct community sectors, primarily situated along, or in the immediate vicinity of, Historic HWY 501, HWY 501 Business, HWY 905, Mill Pond Road, Sherwood Drive, E Country Club, and the

Waccamaw Wildlife Refuge. Flooding not only affects the integrity of the natural and built environment, but it reduces reliability of these routes impeding emergency response services during and after storm events.

Many of Horry County's essential services are stationed in Conway, including Conway Medical Center, Horry County Police Department, Emergency Operating Center, and Emergency Management Office. Thus, impeding roadway access in Conway increases risk to residents via compromising the provision of these essential services in Conway, Socastee, Bucksport, and Myrtle Beach. A significant portion of the population in this community of the impact areas face social vulnerabilities, including factors such as age, income, and limited education, all of which magnify the challenges of recovery following a disaster. Additionally, these social attributes contribute to prolonged displacement for residents.

A.2.4 Longs and Red Bluff

Due to the shared hydraulic, social, and environmental characteristics, Longs and Red Bluff were investigated as a single population center. These unincorporated areas are situated just north of the Waccamaw River. The primary inflowing tributaries are Buck Creek, Simpson Creek, and Todd Swamp and can be characterized as predominately woody wetlands, evergreen forest, agricultural areas, and redevelopment scattered throughout. Homes and businesses in this reach of the Basin are spread out among diverse and independent community sectors primarily along HWY 905, HWY 9, HWY 90, Red Bluff Road (also referred to as HWY 31E), Old Reaves Ferry Road, and Lee's Landing Circle. Inundation disrupts transportation along these roadways which contributes to evacuation challenges resulting in long-term displacement. A large percentage of residents in this community exhibit social vulnerabilities such as age, income, and limited education that result in a disproportionate recovery period post disaster.

A.2.5 Socastee

Socastee is subject to inundation for weeks at a time as a result of the tidal and backwater effects from the Waccamaw, Atlantic Intracoastal Waterway (AIWW) and Socastee Creek. Within the unincorporated area, the built environment was carefully intertwined with the natural abundance of water resources. The Waccamaw River and adjacent floodplains border Socastee in the Northwest, including Carolina Bays and major tributaries like Socastee Creek, to the South, where Myrtle Beach abuts the Atlantic Ocean, and in the center, where the AIWW differentiates coastal and inland waters. This area is heavily populated with development that caters to the residential and commercial community. Flooding along the bridge crossing on HWY 544 and HWY 501, result in challenges and delay to residents' return and recovery, prolonging displacement.

Table A-5 shows the structure count by impact area and structure type (residential and non-residential). Non- residential structures include commercial, industrial, and public structures. The study area has a total of 7,267 structures.

Table A-1: Structure Count by Structure Type and Impact Area

Impact Area	Residential Count	Non-Residential Count	Total
Bucksport	537	26	563
Conway	2056	203	2259
Longs/Red Bluff	1090	60	1150

Impact Area	Residential Count	Non-Residential Count	Total
Socastee	3105	190	3295
Total	6788	479	7267

A.3 SOCIOECONOMIC SETTING

The four primary population centers of Bucksport, Socastee, Longs/Red Bluff, and Conway make up the study areas. The population in these study areas has remained stable and is expected to continue to do so. Compared to Conway, Longs/Red Bluff, and Socastee, Bucksport has experienced a population decline following the 2000 Census. The following table displays the population trend contextualizing population data on a countywide and on a statewide basis. The trends are analyzed from the year 1990 to 2020. The tables below indicate a population growth from all three levels. County and state levels have a higher growth rate, which can be explained by migration patterns.

Table A-22: Decennial Population

Area	1990	2000	2010	2020
Bucksport	1,022	1,117	876	745
Conway	9,819	12,722	17,103	24,849
Longs/Red Bluff	6,112	7,778	6,645	9,523
Socastee	10,426	14,295	19,952	22,213
Horry County	144,053	198,019	269,291	351,029
South Carolina	3,486,703	4,012,012	4,625,364	5,118,425

*Source: Social Explorer – ACS 2020 (5-year Estimates)

Table A-33: Race of Population

Area	White Alone	African American Alone	Asian Alone
Bucksport	7.0%	88.7%	0.0%
Conway	61.7%	29.6%	1.2%
Longs/Red Bluff	79.7%	18.0%	0.0%
Socastee	73.3%	7.5%	2.1%
Horry County	77.10%	11.4%	1.3%
South Carolina	63.4%	25.0%	1.8%

*Source: Social Explorer - ACS 2020 (5-Year Estimates) and 2020 Census Population and Race/Hispanic Origin

Table A-4 shows the number of households over the same period. The total number of households in the study areas has shown a steadily increasing trend from 1990 to 2020 except for Bucksport. Bucksport experienced an increase from 1990 to 2000 but declined by -35% from 2000 to 2020. **Table A-9** depicts the Median Household Income for the project area, Horry County, and the State of South Carolina.

Table A-44: Total Households

Area	2020	2010	2000	1990
South Carolina	1,961,481	1,741,994	1,533,854	1258044
Horry County, South Carolina	136,219	112,057	81,800	55764
Bucksport CDP, South Carolina	233	345	359	297
Conway city, South Carolina	8,247	6,375	4,259	3,655
Longs/Red Bluff CDP, South Carolina	3,707	2,857	4,189	2,306
Socastee CDP, South Carolina	9,308	7,220	5,593	3,789

*Source: ACS Survey Data

Table A-55: Median Household Income

Area	1990	2000	2010	2020
Bucksport	$ 12,540	$24,038	$25,417	$44,181
Conway	$21,241	$32,155	$35,999	$42,840
Longs/Red Bluff	$12,010	$37,736	$36,947	$59,070
Socastee	$28,381	$40,436	$42,452	$47,296
Horry County	$24,959	$36,470	$41,568	$51,570
South Carolina	$26,256	$37,082	$42,452	$54,864

*Source: ACS Survey Data

Table A-6 depicts civilian employed population 16 years and over. The leading employment sectors for the four study areas, include Educational Services, and Health Care and Social Assistance; Arts, Entertainment, and Recreation, and Accommodation and Food Services; and Retail Trade.

Table A-7 shows the labor force, employment, unemployment, and unemployment rate for the project areas, Horry County, and the State of South Carolina. The unemployment rate for Conway is the highest (11.8%) and doubles the unemployment rates for Horry County and the State of South Carolina.

Table A-66: Industry by Occupation for Employed Civilian Population 16 Years and Over

	South Carolina		Horry County, South Carolina		Bucksport CDP, South Carolina		Conway City, South Carolina		Longs/Red Bluff CDP, South Carolina		Socastee CDP, South Carolina	
Total Employed Population 16 Years and Over	2,312,831		150,783		339		10,082		3,735		11,835	
Agriculture Forestry, Fishing and Hunting, and Mining	21,707	0.9%	623	0.4%	0	0.0%	5	0.1%	37	1.0%	0	0.0%
Construction	159,136	6.9%	13,689	9.1%	0	0.0%	478	4.7%	259	6.9%	1,522	12.9%
Manufacturing	310,653	13.4%	5,903	3.9%	39	11.5%	591	5.9%	147	3.9%	354	3.0%
Wholesale Trade	55,126	2.4%	2,703	1.8%	0	0.0%	81	0.8%	27	0.7%	281	2.4%
Retail Trade	272,348	11.8%	24,404	16.2%	108	31.9%	1,789	17.7%	581	15.6%	1,886	15.9%
Transportation and Warehousing, and Utilities	121,924	5.3%	5,701	3.8%	24	7.1%	369	3.7%	176	4.7%	308	2.6%
Information	34,945	1.5%	2,437	1.6%	0	0.0%	276	2.7%	61	1.6%	210	1.8%
Finance and Insurance and Real Estate and Rental and Leasing	132,837	5.7%	9,772	6.5%	7	2.1%	546	5.4%	199	5.3%	746	6.3%
Professional, Scientific, and Management, and Administrative and Waste Management Services	242,008	10.5%	16,135	10.7%	28	8.3%	722	7.2%	230	6.2%	1,479	12.5%
Educational Services and Health Care and Social Assistance	510,174	22.1%	26,979	17.9%	87	25.7%	2,401	23.8%	504	13.5%	1,338	11.3%
Arts, Entertainment and Recreation and Accommodation and Food Services	231,450	10.0%	29,894	19.8%	37	10.9%	1,811	18.0%	645	17.3%	2,927	24.7%
Other Services, Except Public Administration	117,145	5.1%	8,194	5.4%	0	0.0%	754	7.5%	771	20.6%	619	5.2%
Public Administration	103,378	4.5%	4,349	2.9%	9	2.7%	259	2.6%	98	2.6%	165	1.4%

*Source: DP03 Selected Economic Characteristics 2022 ACS 5-year Estimates

Table A-7: Labor Force, Employment, Unemployment, and Unemployment Rate

	Bucksport	Conway	Longs/Red Bluff	Socastee	Horry County	State of South Carolina
Labor Force	339	11,435	3,908	12,451	160,352	2,448,315
Employment	339	10,082	3,735	11,835	150,783	2,312,831
Unemployment	0	1,353	173	616	9,569	135,484
Unemployment Rate	0%	11.8%	4.4%	0.50%	6.0%	5.5%

*Source: Census data ACS 2022 5-year unless noted

Compliance with Policy Guidance Letter (PGL) 25 and Executive Order 11988 Based on the socioeconomic data, Horry County has experienced tremendous population and employment growth. Given that dynamic, it is expected that development will occur in the study area with or without riverine flood risk reduction measures and will not conflict with PGL 25 and EO 11988, which states 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.

A.4 CRITICAL INFRASTRUCTURE

Bridges, communication towers, water treatment plant, Emergency Operations Center (EOC), hospitals, and government buildings are the identified critical infrastructure that may have flood risk, although flood depths are expected to remain at or just below the foundation at the 0.2% AEP event. **Figure A-5** shows the critical facilities/infrastructure for Horry County, which comprises all four damage centers of the study area.

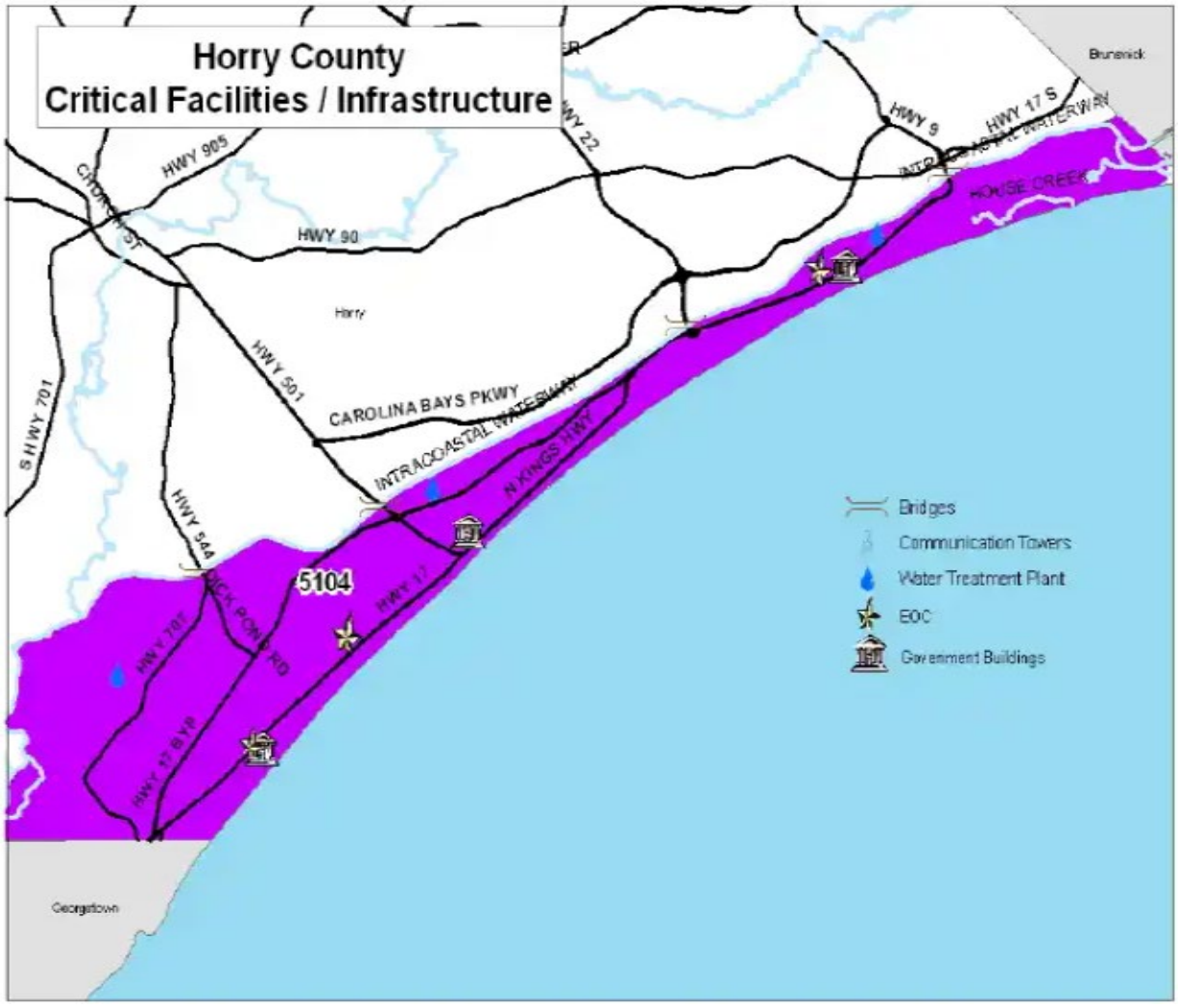

Figure A-5: Critical infrastructure.

A.5 SCOPE OF THE STUDY

As reported in the socioeconomics section, Horry County is home to over 350,000 people making it the fourth most populated county in South Carolina according to the U.S. Census Bureau. Between 2010 and 2020 the population of Horry County grew by 30%. This region has been identified as the second fastest growing metropolitan area in the nation in part due to its proximity to Myrtle Beach, but also its opportunity for further development. Expected population and economic growth in Horry County present a need for modifications or improvements to existing projects and infrastructure.

Problem Description. According to the National Center for Environmental Information (NCEI), Horry County and the participating jurisdictions have experienced 29 flood events since 1995 and an additional 60 flash floods. One of the most damaging was Hurricane Floyd (1999), which brought floods to three different locations in Horry County. During the storm, the intense rainfall could not drain away faster than it collected, flooding yards, parks, intersections, parking lots, building entrances and low-lying areas.

The flooding problem in the Waccamaw River poses the following risks: risk of damage to property and infrastructure; risk to life safety; risk to cultural heritage, population, and other social effects; risk of streambank erosion that damages private property and public infrastructure; risk of negative impacts to water quality; risk of environmental damages and human health safety impacts from industrial flooding; and national and regional economic impacts.

A.5.1 Array of Alternatives

Alternatives were strategically formulated under 5 alternative types: Flood Barriers, Detention and Diversion, Floodplain Relief, Nonstructural Only, and Comprehensive. The study team carefully assembled an initial array of alternatives for each impact area. Despite the deliberate assortment of alternatives by functionality, the study team incorporated nonstructural measures in each of the alternative type (aside for flood barriers) because field investigations suggested there would not be a "one size fits all" solution. The inclusion of nonstructural measures optimizes the opportunity for community resilience. **Table A-8** below depicts the Alternatives for each of the four impact areas with a brief description for each (reference integrated Feasibility Report and Environmental Assessment for the detailed description).

Table A-8: Array of Alternatives for the Four Impact Areas

Bucksport		
Plans	**Plan Type**	**Brief Plan Description**
B-NA	No Action	No Action
B-1	Structural	Floodgate
B-2	Structural	Pee Dee Hwy Elevation
BNS-2	Nonstructural	Structures Elevation and Acquisition
Conway		
Plans	**Plan Type**	**Brief Plan Description**
C-NA	No Action	No Action
C-3	Structural	Relief Bridges
C-5	Comprehensive	Relief Bridges, Structure Elevation, and Acquisition
CNS-1	Nonstructural	Acquisition and Structure Elevation
Longs Red Bluff		
Plans	**Plan type**	**Brief Plan Description**
LR-NA	No Action	No Action
LR-1	Flood Barriers	Levee/Floodwall along Buck Creek at Rolling Ridge and Cox Lane
LR-3	Floodplain Relief	Simpson Creek Benching, Relief Bridges
LR-6	Comprehensive	Levee/Floodwall along Buck Creek and Rolling Ridge, Benching, Relief Bridges
Socastee		
Plans	**Plan Type**	**Brief Plan Description**
S-NA	No Action	No Action
S-1	Structural	Floodwall and Barrier Removal
S-2	Structural	Detention Pond with Channel to Socastee Creek
S-3	Structural	Barrier Removal

S-4	Comprehensive	Floodwall, Barrier Removal, Detention Pond with Channel to Socastee Creek, and Structure Elevation
SNS-3	Nonstructural	Structure Elevation and Acquisition

B ECONOMIC AND ENGINEERING INPUTS TO THE HEC-FDA MODEL

B.1 HEC-FDA MODEL

Model Overview The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.4.3 USACE-certified model was used to calculate the damages and benefits for this evaluation. The economic and engineering inputs necessary for the model to calculate damages for the project base year (2035) include the existing condition structure inventory, contents-to-structure value ratios, first floor heights and water depths, depth-damage relationships, and without-project and with-project stage- probability relationships.

The uncertainty surrounding each of the economic and engineering variables was also entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. A 50-year period of record was used to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships in consultation with the H&H engineer. The following economic inputs section is divided into four primary components:

- **Structure Inventory** – discusses methodology, structural value estimation, content-to-structure value ratios, and flood related damages
- **Elevation Data & Sampling** – discusses ground surface elevation, foundation heights, first floor elevations, and sampling structural attributes
- **Structure Inventory Uncertainty** – discusses the uncertainty distributions surrounding structure values, content-to- structure value ratios, and flood related damages and costs, and how the distributions were generated
- **Depth Damage Relationships** – discusses the depth damage relationships, uncertainty and how the distributions were generated

B.2 ECONOMIC INPUTS TO THE HEC-FDA MODEL

Structure Inventory A structure inventory of residential and non-residential structures for the study area was obtained using the National Structure Inventory (NSI) 2022. The NSI was originally created by USACE to simplify the GIS pre-processing workflow for the Modeling Mapping and Consequence center (MMC) and was recently upgraded to version 2 using upgraded data sources and algorithms. The NSI 2022 database was significantly improved through various techniques described in subsequent sections.

NSI 2022 sources its structural attribute data from tax assessed parcel data (available through CoreLogic), business location data available through Esri/Infogroup, and HAZUS (where other datasets were unavailable). NSI 2022 data is not an exact representation of reality, but rather contains many county-level, state-level, or regional assumptions applied to individual structures, often by random assignment.

As such, while county or other large aggregations of structures will be accurate on average, individual structure characteristics may not be accurate. Although these and other accuracy issues exist, the NSI 2022 dataset functions as an available common and consistent standard for the United States. The chief advantage of NSI 2022 over other national datasets is its spatial accuracy, which is a significant improvement over the census block level accuracy that NSI version 1 relied on.

Occupancy Types The NSI 2022 database comes with its own list of occupancy types, which describes the type of structure more than simply residential or non-residential. Occupancy types are important because they are used to assign depth-damage relationships to determine the rate at which a structure is damaged given a depth of water. This study utilized these three different occupancy type categories including commercial, industrial, or residential. Two additional aspects to note include:

- **NSI 2022** – Occupancy type descriptions come with the original NSI 2022 data and were the starting point for the study. NSI 2022 occupancy types were verified during sampling.
    - **Depth-Damage Relationships** – The NSI 2022 occupancy types did not match the occupancy types required to use for the depth-damage relationships that were selected for the local flooding conditions. Professional judgment was used again to sort each structure type into the most representative occupancy type that the depth damage relationships offered.

The following table shows the occupancy type to depth-damage relationship assignment. Further descriptions of each occupancy type can be found in subsequent sections of the report.

Table B-1: Structure Types

NSI OccType	Depth-Damage OccType Assignment
COM1	Retail & Personal Services
COM3	Repairs and Home Use Groceries and Convenience Stores
COM4	Professional Services
COM8	Groceries, Convenience Stores, and Dining/Recreation
COM4	Retail and Personal Services
GOV1	Public Facilities
IND1	Warehouses and Contractors
RES1-1SNB	One Story Pier and Beam
RES1-2SNB	Two+ Stories Pier and Beam
RES1-3SNB	Three Stories Pier and Beam No Basement
RES1-SLNB	Split Level No Basement
RES1-1SWB	One Story w Basement
RES1-2SWB	Two Stories w Basement
RES1-3SWB	Three Stories w Basement
RES1-SLWB	Split Level w Basement
RES3	PT 1 Apt Building

Structure Values As previously identified in the description of NSI 2022, the national database has limitations and oversimplifications that lead to unacceptable levels of uncertainty for a feasibility level study. To overcome the limitations and reduce uncertainty, Horry County depreciated assessment values

for property improvements (separate from land) were obtained and used to adjust NSI 2022 values. Also, both the Producer Price Index values and the Civil Works Construction Cost Index System were used to reevaluate the depreciated replacement values referencing the state of South Carolina versus the US. Those two indices resulted in NSI 2022 values being reduced by 15% for inputs into the HEC-FDA 1.4.3 program.

Depth-Damage Relationships and Residential and Non-Residential Content-to-Structure Value Ratios Since site-specific residential and non-residential depth-damage relationships were not available for the study area, the long duration 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. These relationships were deemed appropriate because the two study areas have similar topography and hydrology and similar structure categories and occupancies (building types). The content-to-structure value ratios used were also obtained from this feasibility study. These damage curves were previously approved for use in both MVD and SWD for studies (Morganza FRM in coastal Louisiana and Texas Coastal Comprehensive Feasibility) that exhibited similar topographies, flooding characteristics, and building types. Specifically, the set of curves developed for Long Duration/Fresh Water were used because the type of flooding problem from the Waccamaw River was described by local residents as slow rising and slow falling. The Morganza curves consider the long duration of floodwaters when most other curves only account for depth.

Elevation Data & Sampling Elevation data associated with the ground surface, foundation heights, and first floors of structures are critical to the economic analysis and feasibility of projects/alternatives. Given the low-resolution of foundation height data provided with the NSI 2022 database, a statistically significant sample was calculated to inform a windshield survey to improve the estimates associated with foundation and subsequent first floor elevations. The sample was also utilized to measure a handful of other structural attributes, detailed later in this section.

Two “windshield” surveys were conducted:

- The first survey involved comparing foundation heights using Google Earth Street View and comparing those observations to the NSI 2022 foundation heights.
    - The second was with an engineering team driving throughout the damage areas, focusing on structures near the Waccamaw River to compare/verify attributes to those found in the NSI 2022 database.

The first (preliminary) survey in Google Street View included the maximum and minimum foundation height expected by occupancy type in this study area. Thirty residential and 30 non-residential structures for each damage area were included in the initial sample.

A second in-person windshield survey was conducted for further data refinement/ to ensure data accuracy. Approximately 350 structures were surveyed for foundation height, relative depreciated state, placement, and other structure characteristics by members of the study team—10 for Bucksport, 190 for Socastee, and 150 for Conway (Longs Red Bluff had already been screened out based upon benefits and costs developed for an initial set of HEC-FDA runs that did not adjust for structures affected by WRDA 1990 Section 308 requirements. Since these model results produced negative Net Annual Benefits, there was no need to rerun once post 1991 structures were adjusted by removal out of the 1% annual exceedance probability floodplains).

The variables sampled included:

- Foundation height – measured from the bottom of the front door to adjacent ground, each step was assumed to be 8 inches
    - Foundation type – designated as slab on grade, crawlspace, or pier and beam
- Story count – measured as either one, or two or more stories
- Existing condition – qualitative judgment of the condition of the exterior of the structure condition
- Verification of occupancy type – confirmation of the purpose and existence of occupancy

First Floor Height Uncertainty The uncertainty surrounding the foundation heights was determined by referencing the HEC-FDA user manual. A Google Street View survey was assumed to be less accurate than use of stadia, but more accurate than an aerial survey with a 5 ft contour interval. This resulted in the uncertainty around foundation height being determined as distributed normally with a .5 ft standard deviation.

B.3 ENGINEERING INPUTS TO THE HEC-FDA MODEL

Stage-Discharge Relationships Stage-discharge relationships were provided for the existing without-project condition (2035) and future without-project condition (2084). Future condition hydraulics were provided, as modest changes are expected during the period of analysis.

The H&H engineer provided water surface profiles from HEC-RAS for eight AEP events including the 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2%. The without-project water surface profiles were based on riverine flood events. Hydraulic data was provided in geo-referenced 2D format.

Uncertainty Surrounding the Stage-Discharge Relationships Stage-discharge uncertainty was evaluated independently from hydrologic uncertainty. Variability in hydraulic parameters, including Manning's roughness coefficients, was assessed consistent with EM 1110-2-1619 guidance. Standard deviations associated with roughness coefficients were estimated using reference relationships and applied within sensitivity analyses to evaluate the influence of hydraulic parameter variability on computed water surface elevations. These analyses produced bounding water surface profiles used to quantify hydraulic model uncertainty at the reach scale (reference Hydrology and Hydraulics - Appendix A1 for further details).

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

C.1 HEC-FDA MODEL CALCULATIONS

The HEC-FDA model was utilized to evaluate flood damages using risk-based analysis. Damages were reported for each of the 4 study areas. A range of possible values, defined by the probability distributions for each economic variable (first floor heights, structure and content values, and depth-damage relationships), were entered into the HEC-FDA model to calculate the uncertainty surrounding the elevation-damage, or stage-damage, relationships for structures and contents. The model also used the number of years that stages were recorded to determine the hydrologic uncertainty surrounding the stage-probability relationships.

The possible occurrences of each variable are determined through a Monte Carlo process, which samples random values from each defined probability distribution. 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 represent an estimate of the full set of possible outcomes.

C.2 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 the study area under both existing and future without project conditions. The possible occurrences of each economic variable were derived by Monte Carlo simulation.

C.3 STAGE-PROBABILITY RELATIONSHIPS WITH UNCERTAINTY

The HEC-FDA model used an equivalent record length of 50 years for this study area to generate a stage-probability relationship with uncertainty for the existing and future without project conditions by graphical analysis. 50 years was selected by the hydraulic engineer to represent the length of records analyzed during the calibration process that the hydraulic model underwent. 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. Moreover, the use of the stage-probability approach in HEC-FDA was considered appropriate due to the direct relationship between stage and flood risk as well as the availability of stage data for assessing floodplain inundation (reference Hydrology and Hydraulics- Appendix A1 for further details).

C.4 WITHOUT-PROJECT EXPECTED ANNUAL DAMAGES

The model used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of exceedance (probability). The following tables display the without project damages by probability (frequency) event for the base and future years without uncertainty.

Table C-1: Base Year Damages by Frequency Event ($ million)

Reach	Annual Exceedance Probability Event							
	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Bucksport	$0.6	$1.6	$2.5	$3.4	$4.1	$7.1	$12.4	$23.9
Conway	$5.8	$11.4	$19.9	$32.2	$41.9	$55.7	$106.9	$152.0
Socastee	$5.5	$8.5	$11.9	$18.0	$27.9	$70.7	$98.5	$135.8
Longs/Red Bl	$6.4	$9.3	$11.2	$14.1	$16.2	$19.0	$24.4	$34.5
Total	$18.3	$30.8	$45.5	$67.7	$90.1	$152.5	$242.2	$346.2

Table C-2: Future Year Damages by Frequency Event ($ million)

Reach	Annual Exceedance Probability Event							
	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Bucksport	$0.7	$1.9	$3.0	$4.0	$4.9	$7.1	$12.4	$24.6
Conway	$8.2	$11.4	$20.0	$32.4	$42.7	$79.9	$120.9	$194.5
Socastee	$5.6	$8.8	$12.1	$18.3	$27.9	$70.2	$99.7	$138.1
Longs/Red Bl	$6.5	$9.4	$11.3	$14.1	$16.3	$18.9	$24.7	$36.0
Total	$21.0	$31.5	$46.4	$68.8	$91.8	$176.1	$257.7	$393.2

*FY 2024 price levels

From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without- project alternative, the expected annual damages (EAD) were totaled for the study area to obtain the total without-project EAD under base year (2035) and most likely future year (2085) conditions. The following tables display the damages by reach and type of asset that are damaged for the base and future years, respectively, under the without-project conditions. The present value of the expected annual damages was then amortized over the 50-year period of analysis using the Federal discount rate of 2.75 precent to calculate the equivalent annual damages as shown in **Table C-5**.

Table C-3: Expected Annual Damages Base Year ($ millions)

Reach	Non-Residential	Residential	Autos	Total
Bucksport	$0.4	$0.9	$0.1	$1.4
Conway	$3.3	$7.0	$1.3	$11.6
Socastee	$1.3	$5.9	$0.7	$7.9
Longs/Red Bluff	$3.4	$3.1	$0.7	$7.2
Total	$8.4	$16.9	$2.8	$28.1

Table C-4: Expected Annual Damages Future Year Condition ($ millions)

Reach	Non-Residential	Residential	Autos	Total
Bucksport	$0.4	$0.9	$0.1	$1.4
Conway	$3.4	$7.1	$1.3	$11.8
Socastee	$1.4	$6.1	$0.7	$8.2
Longs/Red Bluff	$3.4	$3.2	$0.7	$7.3
Total	$8.6	$17.3	$2.8	$28.7

Table C-5: Equivalent Annual Damages Without Project Condition ($ millions)

Reach	Non-Residential	Residential	Autos	Total
Bucksport	$0.4	$0.9	$0.1	$1.4
Conway	$3.2	$7.1	$1.4	$11.7
Socastee	$1.4	$6.0	$0.7	$8.1
Longs/Red Bluff	$3.4	$3.2	$0.7	$7.3
Total	$8.4	$17.2	$2.8	$28.5

*FY 2024 price levels

C.5 WITH-PROJECT EXPECTED ANNUAL DAMAGES

The alternatives were run through HEC-FDA, which allows for determining damages reduced by damage category. The following table shows the damages reduced and residual damages for each plan.

Table C-6: With-Project Equivalent Annual Damages (Residual Damages) by Damage Category ($ millions)

Bucksport Alternatives	Total Without Equivalent Damages	Total With- Project Damages	Damages Reduced
No Action	$1.4	$1.4	$0
Floodgate	$1.4	$0.9	$0.5
Pee Dee Hwy Elevation	$1.4	$0.8	$0.6
Structures Elevation and Acquisition	$1.4	$1.2	$0.2
Conway Alternatives	**Total Without Equivalent Damages**	**Total With- Project Damages**	**Damages Reduced**
No Action	$11.7	$11.7	$0
Relief Bridges	$11.7	$10.2	$1.5
Relief Bridges, Structures Elevation, and Acquisition	$11.7	$9.9	$1.8
Acquisition and Structures Elevation	$11.7	$11.4	$0.3
Socastee Alternatives	**Total Without Equivalent Damages**	**Total With- Project Damages**	**Damages Reduced**
No Action	$8.1	$8.1	$0
Floodwall and Barrier Removal	$8.1	$7.4	$0.7
Detention Pond with Channel to Socastee Creek	$8.1	$7.7	$0.4
Barrier Removal	$8.1	$7.4	$0.7
Floodwall, Barrier Removal, Detention Pond with Channel to Socastee Creek, and Structure Elevation	$8.1	$7.1	$1.0
Structures Elevation and Acquisition	$8.1	$7.4	$0.7
Longs/Red Bluff Alternatives	**Total Without Equivalent Damages**	**Total With- Project Damages**	**Damages Reduced**
No Action	$7.3	$7.3	$0
Levee/Floodwall along Buck Creek at Rolling Ridge and Cox Lane	$7.3	$7.2	$0.1
Simpson Creek Benching, Relief Bridges	$7.3	$7.2	$0.1
Levee/Floodwall along Buck Creek and Rolling Ridge, Benching, Relief Bridges	$7.3	$7.1	$0.2

*FY 2024 price levels and 2.75% discount rate; 50-year period of analysis

The following tables display the with-project damages by probability (frequency) event for Conway Relief Bridges and Socastee Barrier Removal Alternatives. These were the only two alternatives to have positive net benefits (refence Section D).

Table C-7: Conway Relief Bridges – Base and Future Years Damages by Frequency Event ($ million)

Reach	Annual Exceedance Probability Event							
	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Conway	$5.2	$11.0	$18.0	$30.4	$40.7	$92.0	$92.0	$92.0

Table C-8: Socastee Barrier Removal- Base and Future Years Damages by Frequency Event ($ million)

Reach	Annual Exceedance Probability Event							
	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Socastee	$5.0	$7.7	$10.7	$18.0	$27.1	$68.7	$96.7	$135.7

*FY 2024 price levels

A comprehensive suite of flood risk reduction alternatives—encompassing both structural and nonstructural measures—was evaluated for the study area. As shown in the above table, these alternatives result in reductions in water surface elevation (WSE), as reflected in the "Damages Reduced" column. However, significant residual risk remains, as indicated by the residual damages, "Total With-Project Damages" column. This is likely due to the region's flat topography and expansive floodplain, which limit the effectiveness of structural measures. The low-gradient terrain hampers flow redistribution, reducing the hydraulic efficiency of structural solutions. As a result, during major flood events, natural floodplain dynamics are likely to overwhelm these interventions, leading to substantial residual flood risk. Additional details regarding residual risk with regards to formulation of alternatives for the study area are provided in Appendix A1- Hydrology and Hydraulics.

D PROJECT COSTS

Construction Schedule For the purposes of computing interest during construction (IDC), only the Socastee Barrier Removal and Conway Bridge Modifications were computed. These were the only two alternatives to have positive net benefits. IDC was less than $100,000 for each based upon durations of several months using a mid-year payment schedule and 2.75% discount rate. Cost estimates for the final array were developed by the Charleston Cost Engineering Branch.

Annual Project Costs. 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.

Table D-1: Summary of Costs for Each Alternative in Millions of Dollars at Each Project Area/Reach/Damage Area

Bucksport Alternatives			
	Floodgate	Pee Dee Hwy Elev	Acquisition & Elevation
Total Project Costs			
First Cost	$22.4	$80.5	$11.3
Interest During Construction	$0	$0	$0

Total Investment Cost	$22.4	$80.5	$11.3
Estimated Annual Costs			
Annualized Project Costs	$0.8	$3.0	$0.4
Annual OMRR&R	$0	$0	$0
Total Annual Costs	$0.8	$3.0	$0.4
Conway Alternatives			
	Relief Bridges	Relief Bridges, Structure Elevation, and Acquisition	Acquisition & Elevation
Total Project Costs			
First Cost	$7.4	$182.4	$175
Interest During Construction	$0.04	$0.04	$0
Total Investment Cost	7.4	$182	$175
Estimated Annual Costs			
Annualized Project Costs	$0.3	$6.7	$6.5
Annual OMRR&R	$0	$0	$0
Total Annual Costs	$0.3	$6.7	$6.5

Socastee Alternatives					
	Floodwall and Barrier Removal	**Detention Pond with Channel to Socastee Creek and Elevation**	**Barrier Removal**	**Floodwall, Barrier Removal, Detention Pond with Channel to Socastee Creek, and Structure Elevation**	**Structure Elevation and Acquisition**
Total Project Costs					
First Cost	$136.7	$96.8	$1.6	$310.9	$141.6
Interest During Construction	$0	$0	$0.01	$0	$0
Total Investment Cost	$136.7	$96.8	$1.6	$310.9	$141.6
Estimated Annual Costs					
Annualized Project Costs	$5.1	$3.6	$0.06	$11.5	$5.3
Annual OMRR&R	$0	$0	$0.01	$0	$0
Total Annual Costs	$5.1	$3.6	$0.07	$11.5	$5.3

Longs Alternatives			
	Floodwall	**Benching and Relief Bridges**	**Floodwall, Benching, Relief Bridges, and Non-Structural**
Total Project Costs			

First Cost	$79.1	$70.6	$184.0
Interest During Construction	$0	$0	$0.0
Total Investment Cost	$79.1	$70.6	$184.0
Estimated Annual Costs			
Annualized Project Costs	$2.9	$2.6	$6.8
Annual OMRR&R	$0	$0	$0.01
Total Annual Costs	$2.9	$2.6	$6.8

*FY 2024 price levels; 2.75% discount rate; 50-year period of analysis

E RESULTS OF THE ECONOMIC ANALYSIS

E.1 NET BENEFIT ANALYSIS

Calculation of Net Benefits The expected annual benefits attributable to the alternatives carried forward were compared to the annual costs to develop a benefit-to-cost ratio (BCR) for the alternatives (BCR = Average Annual Benefits/Average Annual Costs). The net benefits for the alternatives were calculated by subtracting the annual costs from the expected annual benefits. The net benefits were used to determine the economic justification of the alternatives. Net benefit calculations for the with-project condition were computed using the HEC-FDA that contained the stage frequency- damage relationships for the study. The following table shows the net benefits and benefit-cost ratio for the alternatives. The Average Annual Benefit for each alternative is equal to annual damages reduced (reference C.5).

Table E-1: Economic Net Benefits and BCR of Alternatives Carried Forward ($ millions)

Bucksport Alternatives	Average Annual Costs	Average Annual Benefits	Net Annual Benefits	Benefit to Cost Ratio
Floodgate	$0.8	$0.5	$ -0.3	0.6
Pee Dee Highway Elevation	$3.0	$0.6	$ -2.4	0.2
Acquisition and Elevation	$0.4	$0.2	$ -0.2	0.5
Conway Alternatives	**Average Annual Costs**	**Average Annual Benefits**	**Net Annual Benefits**	**Benefit to Cost Ratio**
Relief Bridges	$0.3	$1.5	$1.2	5.3
Relief Bridges, Structure Elevation, and Acquisition	$6.7	$1.8	$ -4.9	0.3
Acquisition and Elevation	$6.5	$0.3	$ -6.2	0.1
Socastee Alternatives	**Average Annual Costs**	**Average Annual Benefits**	**Net Annual Benefits**	**Benefit to Cost Ratio**
Floodwall and Barrier Removal	$5.1	$0.4	$ -4.7	0.1
Detention Pond with Channel to Socastee Creek and Elevation	$3.6	$0.4	$ -3.2	0.1

Barrier Removal	$0.07	$0.64	$0.6	9.1
Floodwall, Barrier Removal, Detention Pond with Channel to Socastee Creek, and Structure Elevation	$11.5	$1.0	$ -10.5	0.1
Structure Elevation and Acquisition	$5.3	$0.7	$ -4.6	0.1

Longs/Red Bluff Alternatives	Average Annual Costs	Average Annual Benefits	Net Annual Benefits	Benefit to Cost Ratio
Floodwall	$2.9	$0.1	$ -2.8	0.03
Benching and Relief Bridges	$2.6	$0.1	$ -2.5	0.04
Floodwall, Benching, Relief Bridges, and Non-Structural	$6.8	$0.2	$ -6.6	0.03

*FY 2024 price levels; 2.75% discount rate; 50-year period of analysis

In accordance with the Federal objective, the plan that reasonably maximizes net NED benefits has been formulated and is identified as the NED Plan. The alternatives that reasonably maximize net NED benefits are the Conway Relief Bridges and the Socastee Barrier Removal. These two alternatives are considered separable, as each can operate independently without causing externalities or affecting water surface elevations (WSE) at the other site. As a result, the NED Plan consists of two incrementally justified components. This plan is also identified as the Recommended Plan. A summary of the costs and benefits associated with the NED Plan is presented in the table below.

Table E-2: Summary of Costs and Benefits for the NED Plan

Conway Relief Bridges	
Total Project Costs	2.75%
First Cost	$7,386,000
Interest During Construction	$42,000
Total Investment Cost	$7,428,000
Estimated Annual Costs	
Annualized Project Costs	$275,000
Annual OMRR&R	$10,000
Total Annual Costs	$285,000
Average Annual Benefits	
Total Annual Benefits	$1,500,000
Net Annual Benefits	$1,200,000
Benefit to Cost Ratio	5.26
Residual Damages (With Project EAD)	87% ($10,200,000)
Socastee Barrier Removal	
Total Project Costs	2.75%
First Cost	$1,640,000
Interest During Construction	$3,700

Total Investment Cost	$1,643,700
Estimated Annual Costs	
Annualized Project Costs	$61,000
Annual OMRR&R	$10,000
Total Annual Costs	$71,000
Average Annual Benefits	
Total Annual Benefits	$648,000
Net Annual Benefits	$577,000
Benefit to Cost Ratio	9.13
Residual Damages (With Project EAD)	91% ($7,400,000)

*FY 2024 price levels; 2.75% discount rate; 50-year period of analysis

E.2 5.2 PROBABILISTIC VALUES OF EAD

Risk-informed planning should incorporate transparency in the estimation of benefits. The single value displayed for benefits has uncertainties associated with it. The mean (average) benefits usually do not equal the 50 percent quartile (median), which is the result of the distribution not being symmetrical due to uncertainties. Therefore, to better inform, taking risk and uncertainty into account, is to display the benefits as a range shown in the following table.

Table E-3 Expected Value and Probabilistic Values of EAD and EAD Reduced

Alternative	Benefits, Mean EAD Reduced ($ millions)	Probability Damage Reduced Exceeds Indicated Value			Annual Costs ($ millions)	Probability Benefit-to-Cost Ratio > 1
		0.75	0.5	0.25		
Conway- Relief Bridges	$1.5	$0.4	$0.8	$2.0	$0.3	Greater than 75 percent
Socastee-Barrier Removal	$0.7	$0.6	$0.7	$0.7	$0.1	Greater than 75 percent

Only the probabilistic benefits for the Socastee Barrier Removal and Conway Relief Bridges alternatives are presented. These two alternatives were the only alternatives to have positive net NED benefits. The benefits or damage reduced (without-project minus with-project EAD) for each alternative are reported with more information about its probability (uncertainty) distribution. The probability of each value (damage reduced) being exceeded is readily apparent as shown in the above table. From the modeling results, both alternatives have a greater than 75 percent chance that its net benefits will be greater than zero and that its benefits will exceed costs (i.e. BCR > 1). This is indicated by each of the alternatives' 1st quartile (i.e. probability damage reduced exceeds 0.75) being greater than its annual costs.

E.3 PROJECT PERFORMANCE

The economic analysis computed the NED Plan utilizing benefits at the mean of the probability distribution consistent with ER 1105-2-100. Since the NED plan has been identified, the project performance for the plan will be communicated in multiple ways: AEP, Long-Term Exceedance Probability (LTEP), and Assurance over a variety of flood events as shown in the following table. For the without-plan base year,

the performance target criteria were established at a stage corresponding to damages equal to 5 percent of those associated with the 0.01 AEP event. For the without project base year, the performance target in the HEC-FDA model was set at the point where damages equal to 5 percent of those associated with the 0.01 AEP event.

Table E-4: Project Performance

Alternative	AEP Event		LTEP			Assurance by Event				
	Median	**Expected**	**10yr**	**30yr**	**50yr**	**10%**	**2%**	**1%**	**0.4%**	**0.2%**
Conway Without Project Condition	0.6754	0.6745	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Conway Relief Bridges	0.6754	0.6734	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Socastee Without Project Condition	0.6490	0.6392	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Socastee Barrier Removal	0.6489	0.6391	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00

The table above presents the expected or mean AEP and LTEPs computed for each alternative. AEP and LTEP are useful tools to explain the residual probability of flooding for an alternative. AEP can represent the probability of any event equaling or exceeding a specified stage in any given year. The LTEP is the likelihood of exceedance at least once in the specified period. The table also contains the Assurance levels, for each alternative for various exceedance probabilities. These values describe the estimated likelihood that the project can prevent damage at the specified exceedance probability.

Therefore, given the inherent and irreducible uncertainties in flood frequency analysis, the NED plan is expected to pass flows associated with the 64–68% Annual Exceedance Probability (AEP) with 90% confidence. However, the project is anticipated to be exceeded at least once during any 10-, 30-, or 50-year period. Furthermore, there is a zero likelihood that the project will prevent damages during flood events corresponding to the 10%, 4%, 2%, 1%, 0.4%, or 0.2% AEP levels.

E.4 COMPLIANCE WITH SECTION 308 OF WRDA 1990

Section 308 of the Water Resource Development Act (WRDA) 1990 limits structures built or substantially improved after July 1, 1991, in designated floodplains not elevated to the 1% AEP flood elevation from being included in the benefit base of the economic analysis. Using the Horry County 1994 FEMA maps, structures built in 1994 and after that did not have a base flood elevation at least to the 1 percent AEP were not included in the benefit base of this economic analysis for the NED plan.

F RESULTS OF THE REGIONAL ECONOMIC DEVELOPMENT ANALYSIS (RED)

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 RED account. The input-output macroeconomic model USACE Regional Economic System (RECONS) can be used to address the impacts of the construction spending associated with the project alternatives. The RECONS model

utilizes a total construction cost of a project that is attributable to contracts being awarded to complete the construction of the project. This cost excludes USACE labor associated with planning, engineering, and design, as well as economic costs like interest during construction.

REGIONAL ECONOMIC SYSTEM (RECONS) ANALYSIS

The regional economic development (RED) account measures changes in the distribution of regional economic activity resulting from each alternative. Evaluations of regional effects are measured using nationally consistent projection of income, employment, output, and population.

The USACE Online Regional Economic System 2.0 (RECONS) is a system designed to provide estimates of regional, state, and national contributions of federal spending associated with Civil Works and American Recovery and Reinvestment Act (ARRA) Projects. It also provides a means for estimating the forward linked benefits (stemming from effects) associated with non-federal expenditures sustained, enabled, or generated by USACE Recreation, Navigation, and Formally Utilized Sites Remedial Action Program (FUSRAP). Contributions are measured in terms of economic output, jobs, earnings, and/or value added.

The RECONS model uses fixed allocations to local, state, and national sources to avoid double counting. RECONS uses the IMpact analysis for PLANning (IMPLAN©) software and data system, provided by the Minnesota IMPLAN Group, to estimate the economic impact or contribution of Civil Works spending and associated economic effects of USACE programs and infrastructure. IMPLAN created IO models for all the impact areas defined by the project team. The multipliers within these models were created with local purchase coefficient (LPCs) based on the trade flow dataset included in IMPLAN.

The RECONS model was run for all alternatives associated with the four focus areas: Bucksport, Conway, Longs/Red Bluff and Socastee. Results are shown for three levels of geography: local, state, and national impact areas. For example, in Longs/Red Bluff, the expenditures $70,617,962 (for Alternative LR3) support a total of 680.0 full-time equivalent jobs, $37,632,384 in labor income, $46,127,690 in the gross regional product, and $78,049,236 in economic output in the local impact area. More broadly, these expenditures support 1,227 full-time equivalent jobs, $84,690,534 in labor income, $111,854,061 in the gross regional product, and $191,860,096 in economic output in the nation.

Table F-1: RECONS Model Results

Bucksport				
Alternative	**Metric**	**Local**	**State**	**US**
Alternative B1: Floodgate on Pee Dee River to slow backwater, south of HWY 701	*Total Impact*	$24,760,717	$34,046,656	$60,866,626
	Value Added	$14,633,772	$20,421,216	$35,485,124
	Jobs Created	216	267	389
Alternative B2: Road elevation. Elevate/create levee out of Pee Dee HWY	*Total Impact*	$88,935,526	$122,288,752	$218,620,700
	Value Added	$52,561,570	$73,348,910	$127,455,440
	Jobs Created	775	958	1398
	Total Impact	$113,696,244	$156,335,409	$279,487,328
	Value Added	$67,195,342	$93,770,127	$162,940,565

Bucksport				
Alternative	**Metric**	**Local**	**State**	**US**
Alternative B3: Floodgate + Road Elevation	*Jobs Created*	991	1224	1787

Conway				
Alternative	**Metric**	**Local**	**State**	**US**
Alternative C3: Floodplain Relief (bridge relief)	*Total Impact*	$8,942,688	$12,296,438	$21,982,854
	Value Added	$5,285,196	$7,375,415	$12,815,961
	Jobs Created	78	96	141
Alternative C5: Comprehensive Structural (relief bridges) + Nonstructural Plan	*Total Impact*	$201,655,360	$277,281,571	$495,707,824
	Value Added	$119,179,846	$166,313,750	$2,888,996,691
	Jobs Created	1757	2172	3169

Longs-Red Bluff				
Alternative	**Metric**	**Local**	**State**	**US**
Alternative LR1: Floodwall. Levee/Floodwall along buck creek	***Total Impact***	$87,450,181	$120,246,363	$214,969,436
	Value Added	$51,683,720	$72,123,883	$125,328,761
	Jobs Created	762	942	1374
Alternative LR3: Floodplain benching and relief bridge	***Total Impact***	$78,049,236	$107,319,809	$191,860,096
	Value Added	$46,127,690	$64,370,523	$111,854,061
	Jobs Created	680	841.0	1,227.00
Alternative LR6: Comprehensive structural and nonstructural	***Total Impact***	$165,499,417	$227,566,172	$406,829,532
	Value Added	$97,811,410	$136,494,407	$237,180,821
	Jobs Created	1442	1782	2601

Socastee				
Alternative	**Metric**	**Local**	**State**	**US**
Alternative S1: Floodwall both sides of Socastee swamp and barrier removal (bridge relief)	**Total Impact**	$151,075,233	$207,732,529	$371,372,102
	Value Added	$89,286,752	$124,598,169	$216,509,209
	Jobs Created	1316	1627	2374
	Total Impact	$107,010,262	$147,142,003	$263,051,898
	Value Added	$63,243,876	$88,255,914	$153,358,739

Socastee				
Alternative	**Metric**	**Local**	**State**	**US**
Alternative S2: Detention with channel to Socastee swamp	**Jobs Created**	932	1152	1682
Alternative 3: Barrier Removal	**Total Impact**	$1,979,650	$2,722,073	$4,866,363
	Value Added	$1,169,988	$1,632,702	$2,837,080
	Jobs Created	17	21	31
Alternative S4: Comprehensive Structural + Non-Structural Plan	**Total Impact**	$260,065,145	$357,596,605	$639,290,358
	Value Added	$153,700,472	$214,486,784	$372,705,028
	Jobs Created	2266	2801	4087

G RECCOMENDED PLAN

The Recommended Plan (RP) includes C-3 in Conway (Relief Bridges (cross drains)) and S-3 in Socastee (Barrier Removal). These separable elements are incrementally justified and best meet the planning criteria, reduce flood risk, and meet criteria for selection under numerous plans including the NED. In Conway, the RP consists of adding relief bridges/culverts at Hwy 501 Business, Hwy 501 Bypass, and Hwy 905 to increase conveyance where floodwater bottlenecks and floods these roadways. In Socastee, the RP consists of the removal of two weirs within Socastee Creek that would increase hydrological conveyance in the creek and its tributaries. For more information regarding this plan selection, reference the integrated Feasibility Report and Environmental Assessment (FR/EA). Furthermore, after the release of the draft FR/EA for public and agency review, the costs and benefits were updated for the RP.

All benefits and costs are presented in FY26 price levels. For comparison with benefits, the first costs were annualized using the FY26 discount rate of 3.25% over a 50-year period of analysis. Additionally, interest during construction- based on durations of 29 months for the Relief Bridges and 15 months for the Barrier Removal was included, along with annual OMRR&R costs. The following table summarizes the updated net benefits and benefit-cost ratio for the RP.

Table G-1 Summary of Costs and Benefits for the Recommended Plan

Costs and Benefits	Conway Relief Bridges	Socastee Barrier Removal	Recommended Plan
First Cost	$6,344,000[1]	$1,078,000[2]	$7,421,000[3]
Interest During Construction	$252,000	$22,000	$274,000
Total Investment Cost	$6,596,000	$1,100,000	$7,696,000
Average Annual Costs			

[1] First Cost was rounded up from $6,343,604

[2] First Cost was rounded up from $1,077,608

[3] First Cost was rounded down from $7,421,212

Costs and Benefits	Conway Relief Bridges	Socastee Barrier Removal	Recommended Plan
Annualized Project Costs	$269,000	$45,000	$314000
Annual OMRR&R	$10,000	$0	$10,000
Total Annual Costs	$279,000	$45,000	$324,000
Average Annual Benefits			
Total Annual Benefits	$1,475,000	$726,000	$2,201,000
Net Annual Benefits	$1,196,000	$681,000	$1,877,000
Benefit to Cost Ratio	5.3	16.1	6.8

*FY26 price levels; 3.25% discount rate; 50-year period of analysis