APPENDIX A

ECONOMIC ANALYSIS

Augusta Rocky Creek, Georgia
Flood Risk Management
Section 205 Feasibility Study
Augusta-Richmond County, Georgia

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

TABLE OF CONTENTS

TITLE **PAGE**

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

TABLE OF CONTENTS (CONTINUED)

TITLE **PAGE**

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

TABLE OF CONTENTS (CONTINUED)

TITLE **PAGE**

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC

ANALYSIS LIST OF TABLES

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

LIST OF FIGURES

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

1.1 OVERVIEW OF STUDY

1.1 PURPOSE

The purpose of this appendix is to display the economic analysis conducted on Rocky Creek for the Augusta, Georgia Flood Risk Management Study.

1.1.1 General Legislation

The 1936 Flood Control Act established the nationwide policy that flood control, now known as flood risk management, on navigable waters and their tributaries is in the interest of the general public welfare and is, therefore, a proper activity of the Federal Government in cooperation with the states and local entities. This act, as well as subsequent Water Resource Development Acts (WRDAs), has established the scope of the Federal interest to include consideration of all alternatives in managing flood waters, reducing the susceptibility of property, and reducing human and financial losses to flood risks.

Reduction in inundation damages is the primary benefit category for the U.S. Army Corps of Engineers' (Corps) flood risk management studies. These benefits include reducing flood damages to structures and contents, savings in cleanup costs, savings in production losses, and savings in costs attributable to fighting floods, evacuation, and traffic rerouting.

1.1.2 Specific Authorization

This study is authorized under Section 205, 1948 FCA (P.L. 80-858), as amended. Section 105 of the Water Resources Development Act of 1986 (Public Law 99-662, as amended) specifies that cost sharing requirements are applicable to the study.

1.2 LOCATION

Richmond County is located along the Savannah River in the State of Georgia as can be seen in Figure 1. It is situated 133 miles north of Savannah, Georgia. Richmond County is bordered by Aiken County, South Carolina to the east, Columbia County, Georgia to the north, McDuffie County to the northwest, Jefferson County to the southwest, and Burke County to the South. The City of Augusta is the main population center in the county and forms the principal city for the Augusta-Richmond County, GA-SC Metropolitan Statistical Area (MSA). Other incorporated population centers within Richmond County are the Towns of Hephzibah and Blythe in conjunction with the Fort Gordon Military Installation that encompasses about 21 percent of the land area of the county. Richmond County is located in Georgia's 12th Congressional District, represented by Mr. Rick Allen. Senators David Perdue and Johnny Isakson represent the State of Georgia.

1.3 PROBLEMS AND OPPORTUNITIES

The Augusta area has a chronic flooding history. Large storm fronts lasting two to four days produce enough rainfall to cause flooding. Summer thunderstorms, that occur about 60 days a year, sometimes have high rainfall intensities that cause flash flood events. Additionally, every few years the area is vulnerable to heavy rainfall from storms associated with hurricanes and tropical storms or depressions that move through the area in late summer and early fall. These events result in extensive property damage and even closing and requiring extensive repair of Interstate I-20.

Numerous federal agencies maintain a variety of records regarding losses associated with natural hazards but no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The Corps and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Climatic Data Center of the National Oceanographic and Atmospheric Administration collects and maintains certain data in summary format, indicating injuries, deaths, and costs. The basis of the cost estimates, however, is not identified.

In the absence of definitive data on some of the natural hazards that may occur in Augusta, illustrative examples are useful. Drawing on several sources of data, Table A-1 provides brief descriptions of particularly significant natural hazard events occurring in the city’s recent history. Data on Presidential Disaster Declarations characterize some natural disasters that have affected the area. In 1965, the Federal Government began to maintain records of events determined to be significant enough to warrant declaration of a major disaster by the President of the United States. Two major flood disasters have been declared in Augusta.

Vicinity Map

Figure A-1. Vicinity Map

Table A-1. Selected Recent Floods and Declared Disasters

Date & Disaster (DR)	Nature of Event
October, 1990 (DR 880)	Flood: Flooding caused by convergence of Tropical Storms Klaus and Marco, causing two days of rain, with amounts as much as 15" measured in places. Estimates of damage exceeded $150 million.
October, 1990	Flood: Local rainfall exceeded 8.5 inches, producing flooding characterized as the 100-year flood.
August 1992	Flood: Intense rain caused rapid local flooding of homes and numerous roads, resulting in evacuations in the Hollywood Subdivision.
August, 1994	Flood: The Weather Bureau reported 4.2 inches in a 24-hour period.
September, 1995	Flood: 3.75 inches of rain, characterized as a 10-year storm, caused flooding, resulting in evacuations of 12 families in the Hollywood Subdivision and traffic accidents along Rocky Creek.
March, 1996	Flood: Thunderstorms in the Augusta area send several streams over their banks and into homes, including the Hollywood Subdivision. The flash flooding also closed several major highways, which were under water. Rainfall amounts of 2-4 inches occurred in a six to nine hour period over southern Columbia and northern Richmond counties.
December, 1997	Flood: Flash flooding along several creeks flooded several highways including Richmond Hill road.
March, 1998	Flood: Raes Creek flooded low lying areas and approached some homes but no flooding in homes was reported.
March, 1998 (DR 1209)	Flood and Winter Storm: More than 3-inches of rain fell on saturated ground, resulting in approximately 10-year flooding; residential and road flooding in the Rocky Creek area.
September, 1998	Flood: EPD reported 8.5 inches of rain from Tropical Storm Earl over a 14-hour period caused flash flooding along several streams. About five people were evacuated from two subdivisions, several streets were closed, and one shelter was opened to house 82 people.
June, 2000	Flood: After a prolonged dry period, more than 3-5 inches of rain fell over the area, flooding I-20 and other streets, forcing sewage backups; and inundating many homes along Rocky Creek and Raes Creek.
May, 2002	Flood: The Augusta Emergency Operations Center reported several streams flooding with water covering roadways and stranding cars.

Sources: NCDC Online (1950-2003; some data gaps and few descriptions); NWS Local Climatological Data; City's 1998 Mitigation Plan; FEMA records

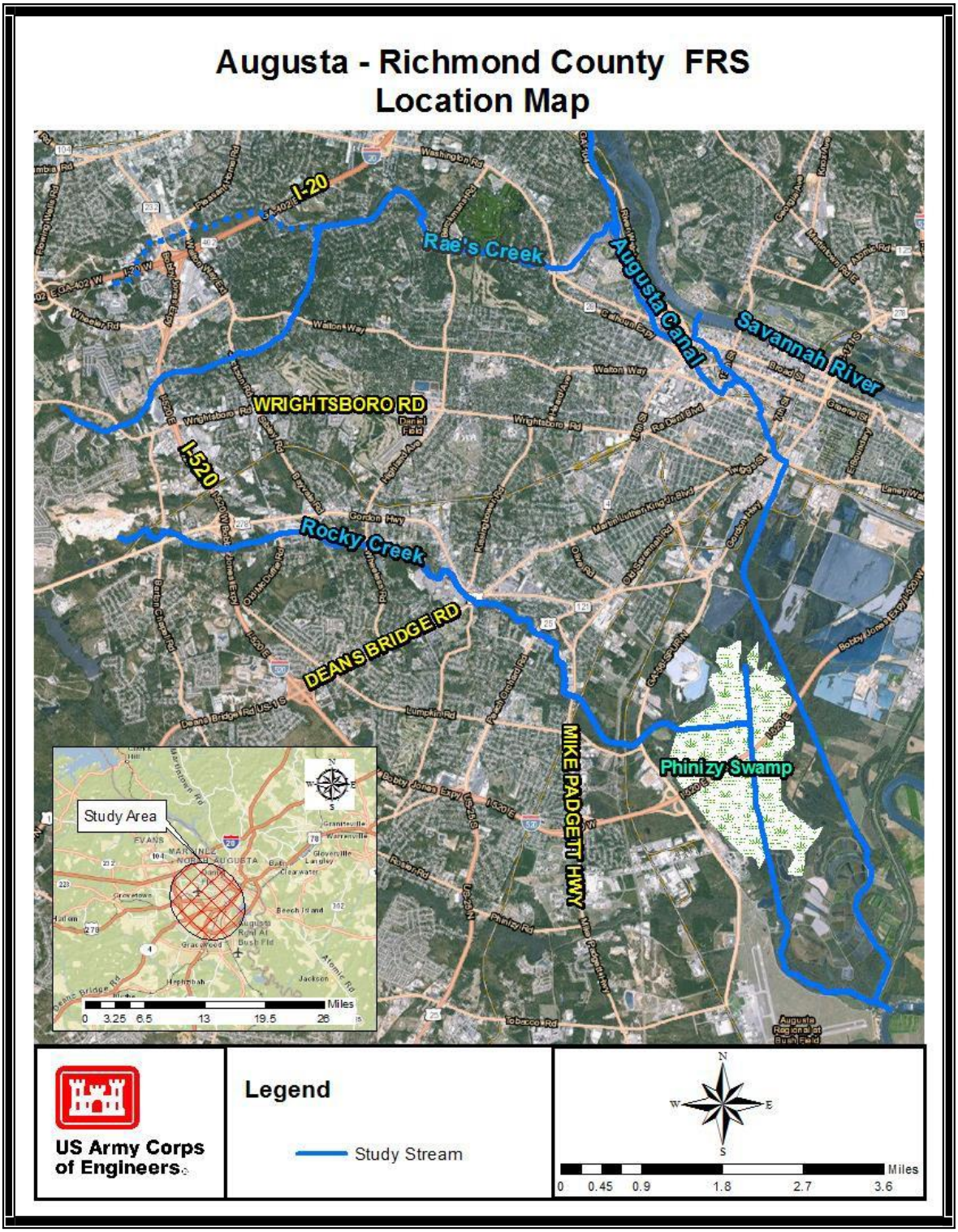


Figure A-2. Location Map

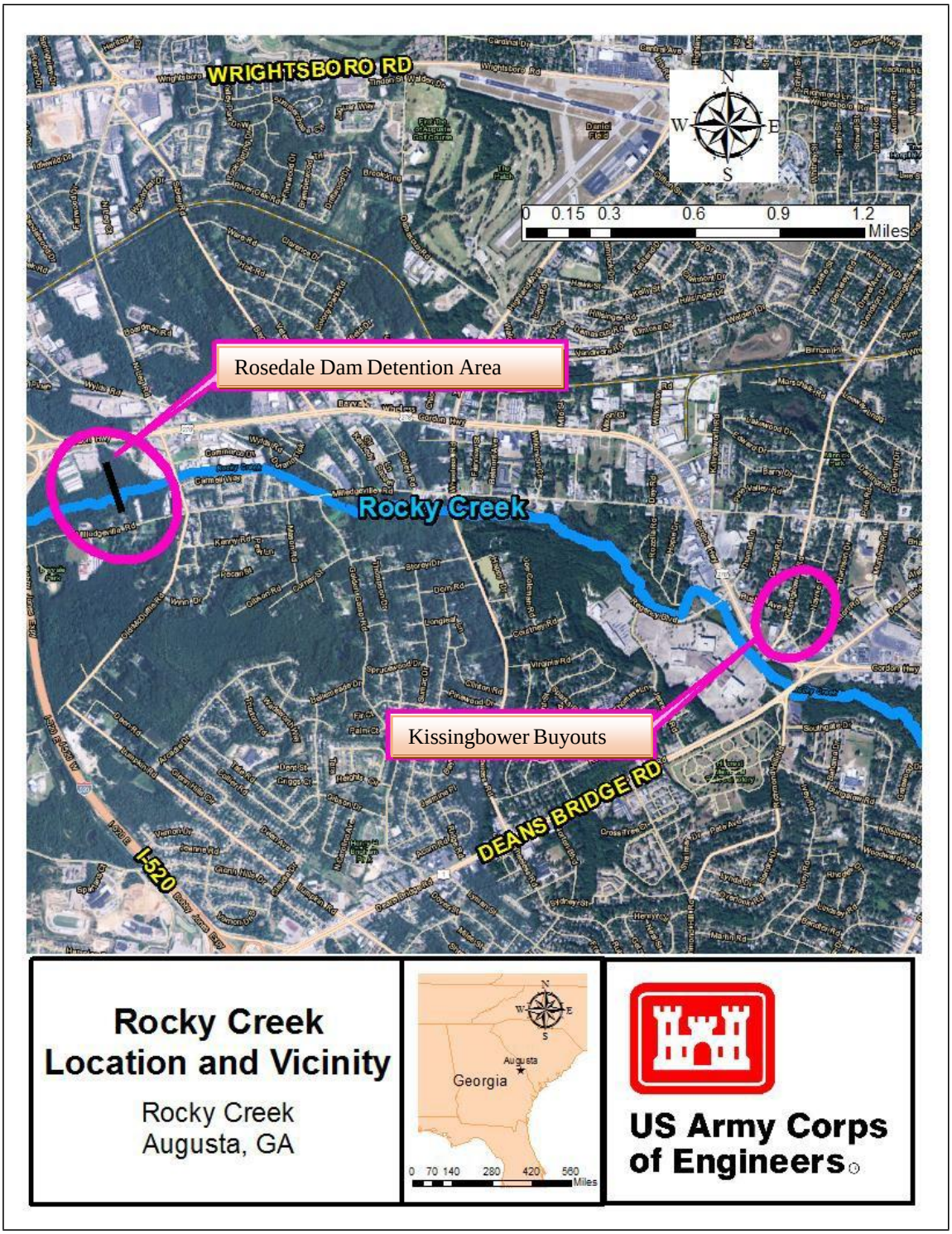


Figure A-3. Location of Management Measures Analyzed

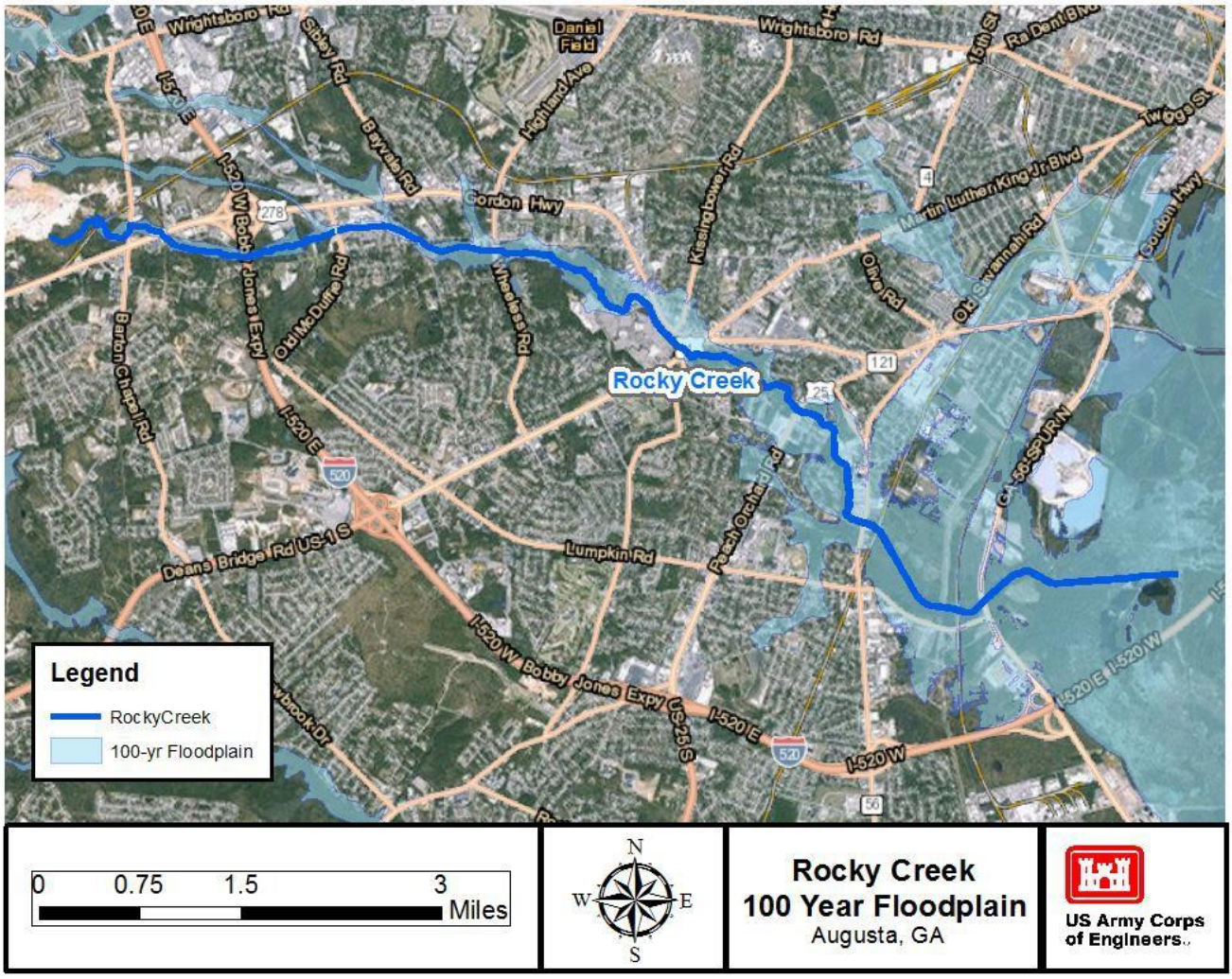


Figure A-4. 100-Year Floodplain

Figure A-4 depicts the inundated area from a 100-year (1 percent chance exceedance) flood event along the Rocky Creek.

2.1 SOCIO-ECONOMIC CHARACTERISTICS

The socioeconomic characteristics of the study area are important to understand in the process of alternative formulation and making choices among the alternatives. This section provides a qualitative and quantitative description of selected socioeconomic resources in the study area. The forecast of the future without-project condition provides the basis for formulating and assessing the impacts of alternatives that are proposed for reducing flood risks and enhancing recreation opportunities.

For socioeconomic analysis, the study area is defined as all five-digit zip code tabulation areas ("ZCTA5") that overlap the 500-year floodplain. These include ZCTA5 30906, 30904, 30909, and 30901. National and state figures are presented selectively for the purpose of comparison.

2.1 POPULATION

The American Community Survey estimated the 2014 population of Richmond County to be 201,244. This represents a growth of 0.74 percent from the population determined by the 2000 census. In the study area, the 2014 population was estimated to be 145,084. This constitutes a decrease of 1.52 percent from the population determined by the 2000 census. Table A-2 compares population characteristics of the study area, Richmond County, and the state of Georgia.

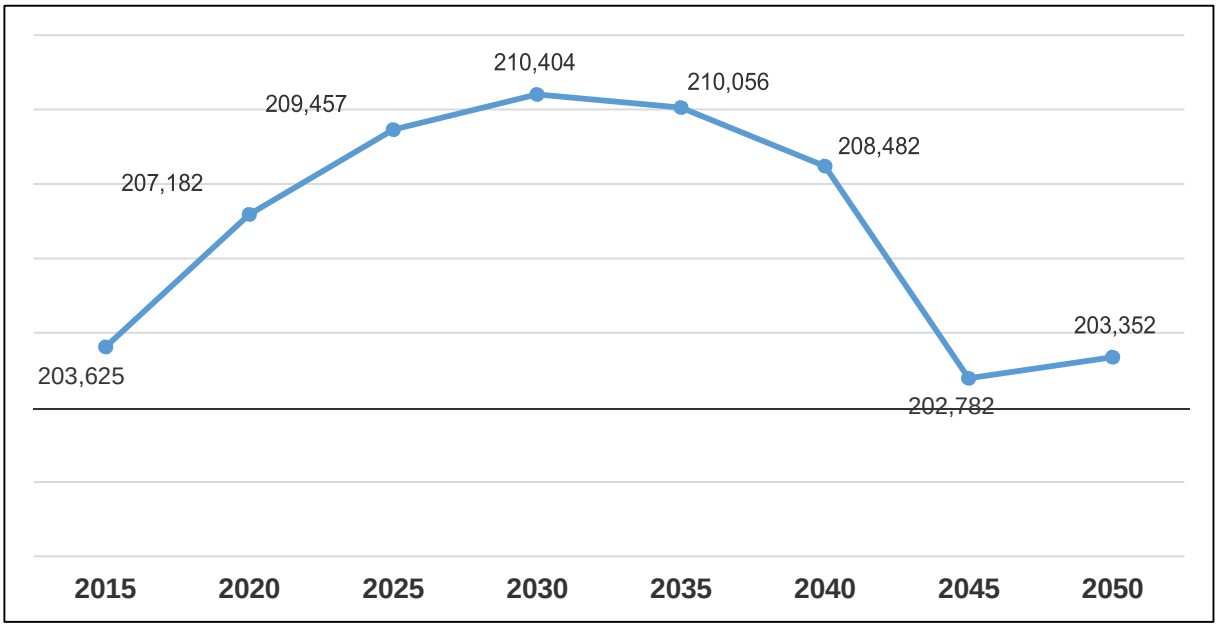
Table A-2: Population Development: 2000 - 2014

	2000	2014	Net Change	% Change
Georgia	8,186,453	9,907,756	1,721,303	21.03%
Richmond County	199,775	201,244	1,469	0.74%
ZCTA5 30906	59,540	60,111	571	0.96%
ZCTA5 30904	28,323	25,656	-2,667	-9.42%
ZCTA5 30909	35,295	40,507	5,212	14.77%
ZCTA5 30901	21,926	16,609	-5,317	-24.25%
Study Area	145,084	142,883	-2,201	-1.52%

Source: U.S. Department of Commerce, Bureau of the Census

Richmond County population projections offer insight into the course of future population changes in the study area. The Georgia Governor's Office of Planning and Budget 2015 population projections are displayed in Figure A-5.

Figure A-5: Richmond County Population Projections: 2015 - 2050



Source: GA Governor's Office of Planning and Budget, 2016 Population Projections

After steadily rising in the years leading into 2030, Richmond County's population is projected to plateau at 210,404. This is expected to be followed by a period of decline that will be most pronounced in the years between 2040 and 2045. By 2050, the county's population is projected to return to within 300 of its 2015 population.

2.1.1 RACIAL COMPOSITION

American Community Survey 2014 one-year estimates concerning population race or Hispanic origin are presented in Table A-3, Table A-4, and Figure A-6. Notably, this data describes race alone or in combination with one or more races. As such, multi-racial individuals are accounted within each racial group from which they attest ancestry.

Table A-3: Population Totals by Race and Hispanic Origin

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
White	20,607	13,310	22,175	1,864	57,956
Black or African American	39,274	11,773	17,060	14,641	82,748
American Indian and Alaska Native	395	227	264	119	1,005
Asian	1,046	604	1,468	84	3,202
Native Hawaiian and Other Pacific Islander	186	0	284	16	486
Some other race	357	133	505	44	1,039
Hispanic or Latino (of any race)	1,605	1,007	1,728	385	4,725

Source: U.S. Department of Commerce, Bureau of the Census

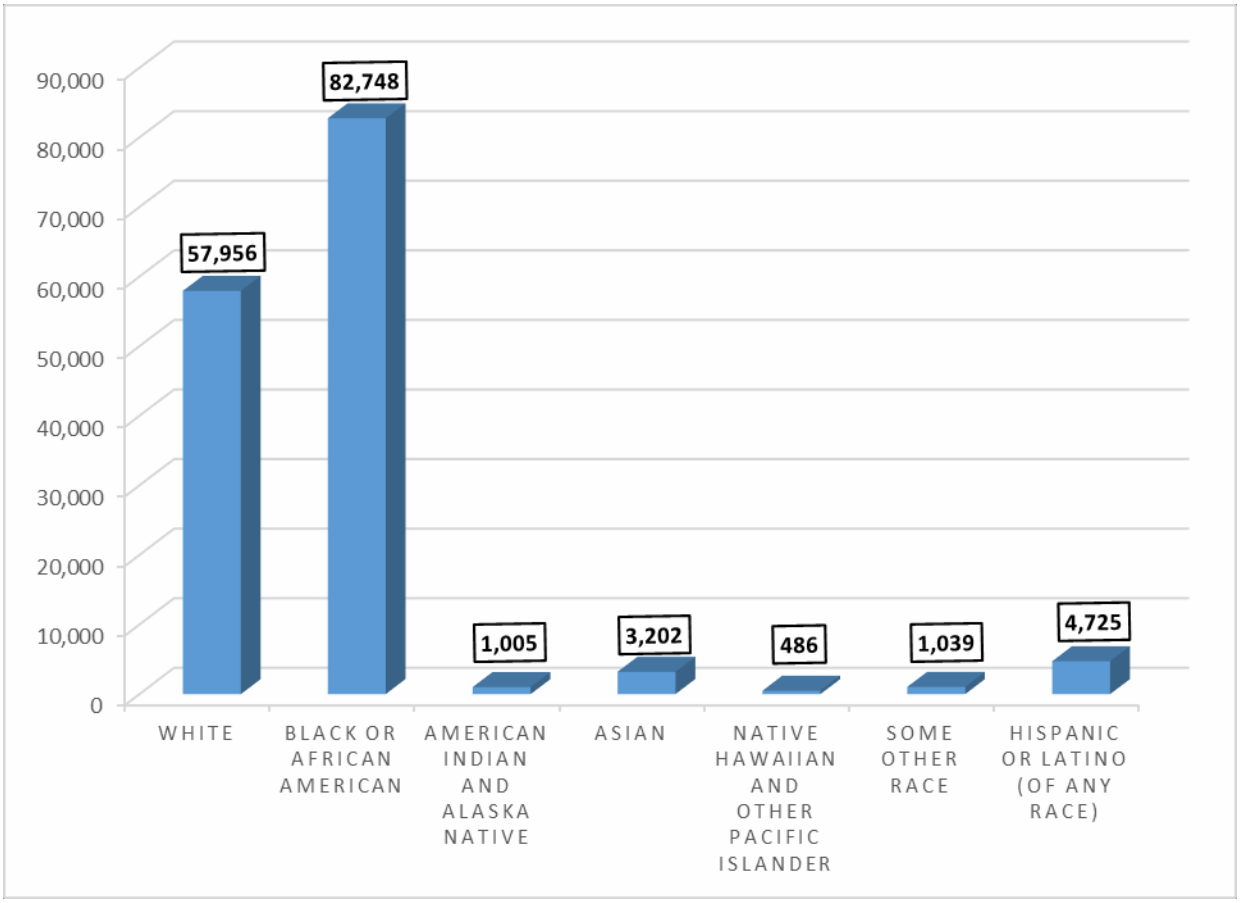


Figure A-6: Population Totals by Race and Hispanic Origin

Table A-4: Percent Total Population by Race

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
White	34.3%	51.9%	54.7%	11.2%	40.6%
Black or African American	65.3%	45.9%	42.1%	88.2%	57.9%
American Indian and Alaska Native	0.7%	0.9%	0.7%	0.7%	0.7%
Asian	1.7%	2.4%	3.6%	0.5%	2.2%
Native Hawaiian and Other Pacific Islander	0.3%	0.0%	0.7%	0.1%	0.3%
Some other race	0.6%	0.5%	1.2%	0.3%	0.7%
Hispanic or Latino (of any race)	2.7%	3.9%	4.3%	2.3%	3.3%

Source: U.S. Department of Commerce, Bureau of the Census

- The largest racial group in the study area was Black or African American, with an estimated 82,748 people or 57.9 percent of the population claiming ancestry. It was likewise the largest racial group in Richmond County, where Black or African American was estimated to constitute 56.5 percent of the population. These

percentages are well above state and national averages of 32.0 and 13.7 percent respectively.

- The second largest racial group in the study area was White, which had an estimated 57.956 people or 40.6 percent of the population claiming ancestry. It was likewise the second largest racial group in Richmond County, with 41.6 percent of the population. These rates are notably below the state and national averages of 62.1 and 76.3 percent respectively.
- Hispanic or Latino ancestry is non-specific in terms of race. In the study area, an estimated 4,725 people or 3.3 percent of the population fell into this group. This is below the Richmond County rate of 4.4 percent. Both Richmond County and the study area are significantly rates are significantly below state and national averages of 9.1 and 16.9 percent respectively.

2.2 HOUSING CHARACTERISICS

Table A-5 and A-6 provide 2014 housing characteristics from the 2014 American Community Survey estimates for the study area. Percentages presented by Table A-6 concern only occupied housing units. A location map of the study area with special attention to the property use, including residential housing, is given in Figure A-7.

Table A-5: Housing Units

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Total Housing Units	23,118	13,277	21,174	8,483	66,052
Occupied Housing Units	20,018	10,177	17,290	6,291	53,776
Owner-Occupied	11,874	4,908	8,179	1,771	26,732
Renter-Occupied	8,144	5,269	9,111	4,520	27,044

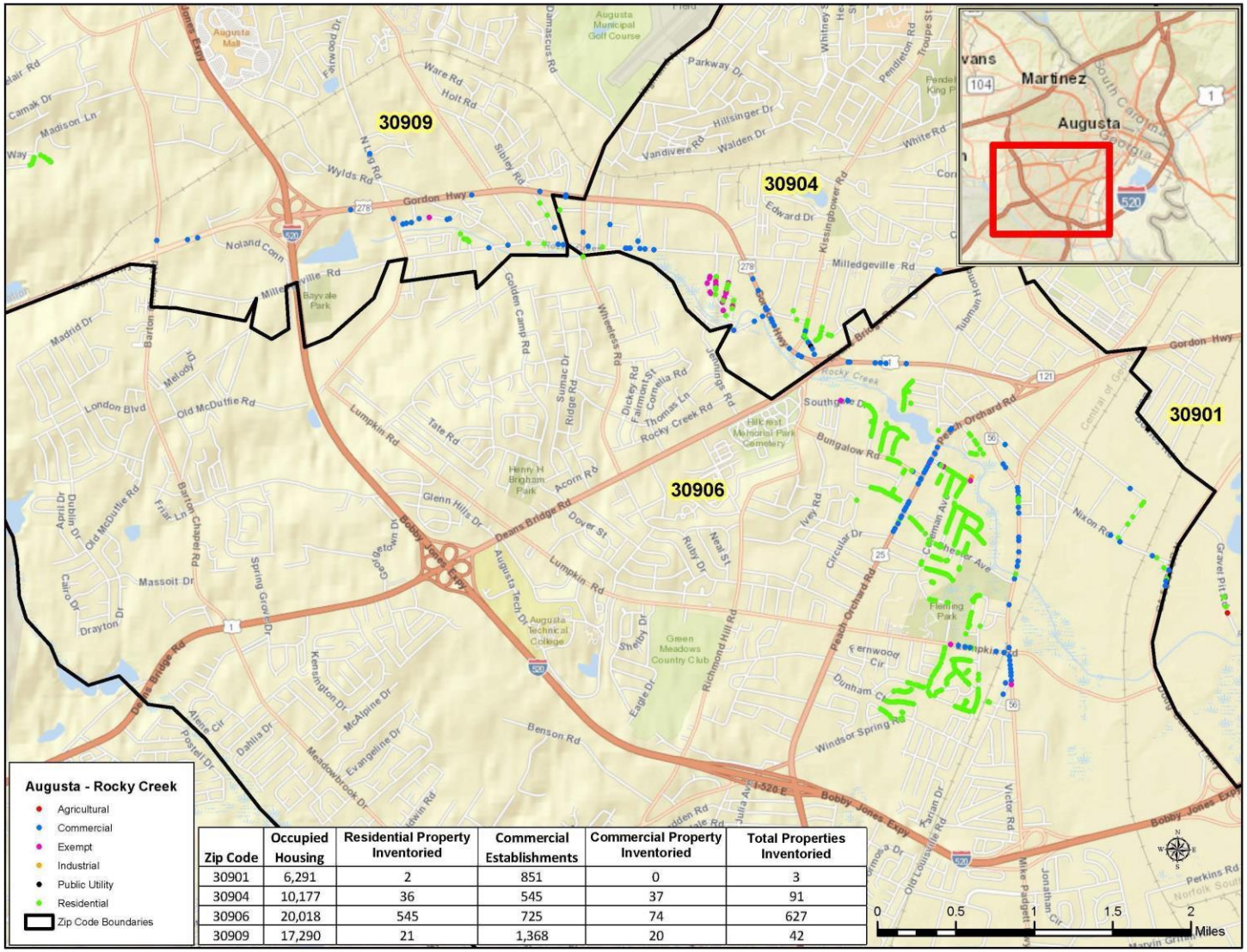
Source: U.S. Department of Commerce, Bureau of the Census

Table A-6: Percent Owner and Renter-Occupied Housing Units

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Owner-Occupied	59.3%	48.2%	47.3%	28.2%	49.7%
Renter-Occupied	40.7%	51.8%	52.7%	71.8%	50.3%

Source: U.S. Department of Commerce, Bureau of the Census

- In the study area, there were 66,052 housing units. Of these, 53,776 were occupied, equating to 81.4 percent. The remaining 12,276 housing units were vacant, which constitutes a vacancy rate of 18.6 percent.
- Of the occupied units, 49.7 percent were owner-occupied, while 50.3 percent were renter-occupied



Zip Code	Occupied Housing	Residential Property Inventoried	Commercial Establishments	Commercial Property Inventoried	Total Properties Inventoried
30901	6,291	2	851	0	3
30904	10,177	36	545	37	91
30906	20,018	545	725	74	627
30909	17,290	21	1,368	20	42

Figure A-7: Socioeconomic Study Area

2.3 EMPLOYMENT & UNEMPOYMENT

Table A-7 and A-8 provides labor force characteristics concerning employment status for the study area as estimated by the 2014 American Community Survey.

Table A-7: Employment Status

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Population 16 Years and Over	45,498	20,825	32,986	12,788	112,097
In Labor Force	25,850	12,220	21,291	6,331	65,692
Civilian Labor Force	25,523	12,121	20,460	6,306	64,410
Employed	22,329	10,175	18,540	4,659	55,703
Unemployed	3,194	1,946	1,920	1,647	8,707
Armed Forces	327	99	831	25	1,282
Not in Labor Force	19,648	8,605	11,695	6,457	46,405

Source: U.S. Department of Commerce, Bureau of the Census

Table A-8: Percent of Population 16 Years and Over by Employment Status

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
In Labor Force	56.8%	58.7%	64.5%	49.5%	58.6%
Civilian Labor Force	56.1%	58.2%	62.0%	49.3%	57.5%
Employed	49.1%	48.9%	56.2%	36.4%	49.7%
Unemployed	7.0%	9.3%	5.8%	12.9%	7.8%
Armed Forces	0.7%	0.5%	2.5%	0.2%	1.1%
Not in Labor Force	43.2%	41.3%	35.5%	50.5%	41.4%

Source: U.S. Department of Commerce, Bureau of the Census

- The study area had a labor force of 65,692, which represents 58.6 percent of the population aged sixteen years and over. This is below the Richmond County rate of 59.7 percent. It is also below the state and national averages of 63.3 and 63.9 percent respectively.
- The study area's labor force was composed of 64,410 civilians and 1,282 non-civilians.
- Non-civilians constituted 1.1 percent of the study area's population over the age of sixteen years. This is below the Richmond County rate of 3.4 percent. It is above the state and national rates of 0.6 percent and 0.4 percent respectively.
- The civilian labor force constituted 57.5 percent of the population aged 16 years and over. This is above the Richmond County rate of 56.3 percent. It is below the state and national averages of 62.6 percent and 63.5 percent respectively.

- Within the civilian labor force, 55,703 were employed. This equates to 49.7 percent of the population aged sixteen years and over. This is above the Richmond County rate of 49.0 percent, but below the state and national averages of 55.9 percent and 57.7 percent respectively.
- Within the civilian labor force, 8,707 were unemployed. This equates to 7.8 percent of the population aged sixteen years and over. This is above the Richmond County, Georgia, and national averages of 7.3 percent, 6.7 percent, and 5.8 percent respectively.
- Of the population over the age of sixteen, 46,405 were not in the labor force. This equates to a rate of 41.4 percent. This is above the Richmond County, Georgia, and national rates of 40.3 percent, 36.7 percent, and 36.1 percent respectively.

The unemployment rate is an economic indicator that is commonly used to describe an area. It is calculated as the percentage of the civilian labor force that is unemployed. Table A-9 presents information pertaining to the unemployment rate of the study area, and Table A-10 presents the unemployment rate of the United States, Georgia, and Richmond County.

Table A-9: Unemployment

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Civilian Labor Force	25,523	12,121	20,460	6,306	64,410
Unemployed	3,194	1,946	1,920	1,647	8,707
Unemployment Rate	12.5%	16.1%	9.4%	26.1%	13.5%

Source: U.S. Department of Commerce, Bureau of the Census

Table A-10: Unemployment Rates
U.S., Georgia, and Richmond County

	Unemployment Rate
United States	9.2%
Georgia	10.8%
Richmond County	13.0%

Source: U.S. Department of Commerce, Bureau of the Census

- The unemployment rate of the study area was 13.5 percent. This is above the unemployment rates of Richmond County, Georgia, and the United States of 13.0 percent, 10.8 percent, and 9.2 percent respectively.

2.4 CIVILIAN OCCUPATION

Tables A-11 and A-12 as well as Figure A-8 present civilian employment by occupation type for the study area based on 2014 American Community Survey data.

Table A-11: Number of Workers by Occupation Type

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Management, Business, Science, and Arts	4,941	3,316	7,110	979	16,346
Service	5,258	2,780	3,584	1,724	13,346
Sales and Office	5,934	2,258	5,076	930	14,198
Natural Resources, Construction, and Maintenance	2,067	774	1,153	282	4,276
Production, Transportation, and Material Moving	4,129	1,047	1,617	744	7,537

Source: U.S. Department of Commerce, Bureau of the Census

Table A-12: Percent of Civilian Employed Population by Occupation Type

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Management, Business, Science, and Arts	22.1%	32.6%	38.3%	21.0%	29.3%
Service	23.5%	27.3%	19.3%	37.0%	24.0%
Sales and Office	26.6%	22.2%	27.4%	20.0%	25.5%
Natural Resources, Construction, and Maintenance	9.3%	7.6%	6.2%	6.1%	7.7%
Production, Transportation, and Material Moving	18.5%	10.3%	8.7%	16.0%	13.5%

Source: U.S. Department of Commerce, Bureau of the Census

- Occupations related to management, business, science, and arts were the most numerous, with 16, 346 workers or 29.3 percent of the employed population in the study area. This is slightly below the average in Richmond County of 29.9 percent, as well as the state and national averages of 35.8 and 36.4 percent respectively.
- Sales and Office occupations were the second largest occupation group, with 14,198 workers or 25.5 percent of the employed population in the study area. This is slightly below the Richmond County rate of 25.6 percent, but above the state and national averages of 25.0 and 24.4 percent respectively.
- Service occupations were the third largest occupation group, with 13,346 workers or 24.0 percent of the employed population in the study area. This is above the Richmond County rate of 22.7 percent. It is also above the state and national averages of 17.0 and 18.2 percent respectively.

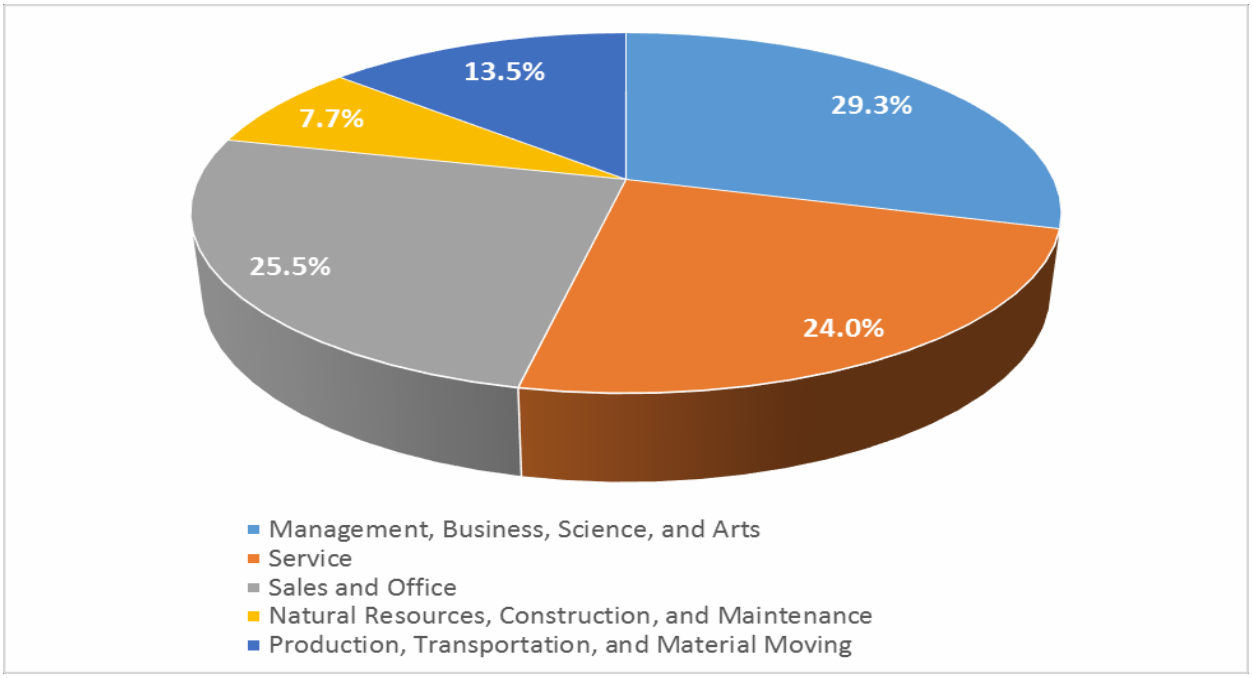


Figure A-8: Percent Civilian Employed Population by Occupation Type

- Occupations related to production, transportation, and material moving were the fourth largest group, with 7,537 workers or 13.5 percent of the employed population in the study area. This is below the Richmond County rate of 13.8, but above the state and national averages of 13.0 and 12.1 percent respectively.
- The smallest occupation group was natural resources, construction, and maintenance, with 4,276 workers or 7.7 percent of the employed population in the study area. This is below the Richmond County rate of 8.0 percent, and also below the state and national averages of 9.2 and 9.0 percent respectively.

2.5 INCOME & POVERTY

Table A-13 provides 2014 income characteristics for the study area based on 2014 American Community Survey data. National, state, and county information is included for the purpose of comparison.

Table A-13: Per Capita, Median Household, and Mean Household Income (2014 Inflation-Adjusted Dollars)

	Per Capita Income	Median Household Income	Mean Household Income
United States	$ 28,555	$ 53,482	$ 74,596
Georgia	$ 25,427	$ 49,342	$ 68,317
Richmond County	$ 20,549	$ 37,704	$ 51,724
ZCTA5 30906	$ 16,920	$ 33,909	$ 45,952
ZCTA5 30904	$ 20,259	$ 32,786	$ 47,462
ZCTA5 30909	$ 27,800	$ 41,716	$ 61,637
ZCTA5 30901	$ 12,122	$ 16,619	$ 27,194

Source: U.S. Department of Commerce, Bureau of the Census

- Per capita income in the study area was $20,046. This is $500 below that of Richmond County, $5,380 below that of Georgia, and $8,500 below the national per capita income.
- Median household income in the ZCTA5's that constitute the study area ranged from a low of $16,619 in ZCTA5 30901 to a high of $41,716 in ZCTA5 30909. With the exception of ZCTA5 30909, each ZCTA5 in the study area had a median household income below that of Richmond County, which was $37,704. The median household income for each ZCTA5 in the study area were also below that of Georgia and the United States, which were $49,342 and $53,482 respectively.
- Mean household income in the ZCTA5's that constitute the study area ranged from a low of $27,194 in ZCTA5 30901 to a high of $61,637 in ZCTA5 30909. With the exception of ZCTA5 30909, each ZCTA5 in the study area had a mean household income below that of Richmond County, which was $51,724. The median household income for each ZCTA5 in the study area were also below that of Georgia and the United States, which were $68,317 and $74,596 respectively.

Table A-14 displays the poverty characteristics of the study area population, based on 2014 American Community Survey data. Table A-15 displays figures for the United States, Georgia, and Richmond County for the purpose of comparison.

Table A-14: Poverty Status

	ZCTA5 30906	ZCTA5 30904	ZCTA5 30909	ZCTA5 30901	Study Area
Eligible Population*	58,683	24,839	40,151	15,901	139,574
Population below poverty level	17,153	7,442	6,572	8,143	39,310
Percent below poverty level	29.2%	30.0%	16.4%	51.2%	28.2%

*Population eligible for poverty status classification under U.S. census guidelines.
Source: U.S. Department of Commerce, Bureau of the Census

Table A-15: Percent below Poverty Level – U.S., Georgia, and Richmond County

	Percent Below Poverty Level
United States	15.6%
Georgia	18.5%
Richmond County	25.4%

Source: U.S. Department of Commerce, Bureau of the Census

- A total of 39,310 people in the study area fell below the poverty threshold. This constitutes 28.2 percent of the population eligible for poverty status classification under census guidelines. This is higher than the percent below poverty level within Richmond County, which was estimated to be 25.4 percent. The same is true to a greater magnitude when comparing the study area's percent below the poverty level to that in Georgia, which was 18.5 percent, and the United States, which was 15.6 percent.

3.0 HYDROLOGIC ENGINEERING CENTER-FLOOD DAMAGE ANALYSIS

The Hydrologic Engineering Center-Flood Damage Analysis (HEC-FDA) computer program was utilized to evaluate flood-related structure and content damages. The HEC-FDA program provides the capability of performing an integrated hydrologic engineering and economic analysis during the formulation and evaluation of flood risk management plans using risk-based analysis methods. The program quantifies the uncertainty in discharge-frequency, stage-discharge, and stage-damage functions and incorporates these uncertainties into economic and performance analyses of alternative flood risk management plans. Plans are evaluated by computing equivalent annual damage over the project life using expected annual damages associated with each year of the project life.

The HEC-FDA program is comprised of four main components: configuration, hydrologic engineering, economics, and evaluation. A brief description of each of these follows, with more detailed documentation of the economics element and the input data required and analyses performed.

3.1 STUDY LAYOUT AND CONFIGURATION

The HEC-FDA program's "Study Configuration" component contains data common to both the engineering and economic analyses conducted for a given project. Data requirements include defining the project's streams, damage reaches, analysis years, and plans.

3.1.1 Study Streams

The study streams evaluated for this analysis is Rocky Creek (Previously shown in Figure A-2).

3.1.2 Damage Reaches

Study damage reaches, defined by the beginning and ending stations (feet for Rocky Creek) of the river reach, are spatial floodplain areas that are used to define consistent data for plan evaluation. See Table A-16 below. Damage reaches, which extend into the 500-year floodplain of each study stream, are used to aggregate structure and other potential flood inundation damage information by stage of flooding.

Table A-16. Rocky Creek Reach Designation By Station

Damage Reach Name	Beginning Station	Ending Station	Length of Reach (In Feet)	Description
Reach 1	1698	45196	43,498	Phinizy Swamp to Upstream Limit of Study Area

3.1.3 Analysis Years

The period of analysis is 2020-2069. An analysis year represents a static time period or year for which the hydrologic engineering and economic data are developed. Analysis years define damage and project performance information for specific time periods during the project's life, such as the base year, the first year of operation for the plan(s) evaluated, or most likely future year. The *base year* for this study is 2020. The most likely future year is associated with a development projection for a specific future year (2033), after which conditions are expected to remain constant for the remaining project life (expected annual damage is assumed constant beyond this most likely future condition analysis year). The future conditions are based on land use data in the year 2033 that was developed by WSC using the Augusta-Richmond County planning and zoning maps.

3.1.4 Evaluation

The standard for damage-reduction benefit computation and for engineering performance evaluation is the without-project condition. Expected annual damage, annual exceedance probability, long-term risk, and conditional non-exceedance probability are computed for this standard for present and for future conditions. Data developed for the hydrologic engineering and economic components of the program represent best estimates of the median values of the exceedance probability, stage, and damage functions that are used to produce expected values.

HEC-FDA's evaluation component allows for reviewing the study's status, performing two types of analyses (plans by individual analysis years and/or plans by equivalent annual damage over the specified analysis period), and evaluating results. Plan performance is a function of damage reduction in the reach of the study. Average annual equivalent damages are calculated by discounting the expected annual damage stream to the beginning of the period of analysis (base year). Future year damages are linearly interpreted between the base and most likely future year condition (2033). Analysis results are available through the following output reports: damage by analysis year, equivalent annual damage, and project performance.

3.1.5 Plans

Each alternative plan is evaluated and compared to the future without-project condition. The *future without- project condition* constitutes the benchmark against which all plans are evaluated. Forecasts of future without-project conditions include consideration of all other actions, plans, and programs that would be implemented in the future in the absence of a Corps project to address the water resources related problems in the watershed. The *future with-project condition* consists of each flood damage reduction measure and action being evaluated. Both plans are evaluated for the stream and damage reach within the study area. Beginning with the base year of implementation and concluding with the specified future analysis year, the equivalent economic and engineering performance of each plan is evaluated.

The following approach was used in determining a solution to the Rocky Creek flooding problems:

- Analyze the flood-related problem(s) to identify opportunities for damage reduction;
- Formulate a set of damage-reduction alternatives;
- Evaluate each alternative in terms of economic and engineering performance, accounting for uncertainty in this evaluation;
- Display the results for comparison of alternatives; and
- Identify the National Economic Development (NED) Plan.

3.2 HYDROLOGIC ENGINEERING

Hydrologic engineering data required for plan evaluation includes water surface profiles, discharge functions with uncertainty and stage-discharge (rating) functions with uncertainty. This information was developed for each study plan, analysis year, stream, and damage reach.

3.2.1 Water Surface Profiles

A water surface profile is the stream water surface stage associated with discharge values of either a hypothetical or observed event. Discharge-probability water surface profiles (profiles based on discharge values) were developed for the Rocky Creek. For each station and exceedance probability event, discharge and associated stage values were developed.

Water surface profile data sets were estimated for the .5 (2-year), .2 (5-year event), .1 (10-year event), .04 (25-year event), .02 (50-year event), .01 (100-year event), .004 (250-year event), and .002 (500-year event) exceedance probability flood events. Stream stations, invert elevations (stage associated with zero discharge or the bottom of the channel), and discharge and stage values were developed for each profile set.

The water surface profiles were used to develop future without- and with-project condition discharge-probability functions and stage discharge functions at index location stations. Water surface profiles were also used to aggregate stage-damage uncertainty functions for individual structures the damage reach index location.

Water surface profiles used in the HEC-FDA model for Rocky Creek were provided by Savannah District Engineering. Further discussion of the profiles used can be found in the Engineering Appendix.

3.2.2 Exceedance Probability Functions with Uncertainty

Economics and performance analyses utilize exceedance probability functions, defined for each plan, analysis year, stream, and damage reach. Exceedance probability functions include the exceedance probability event and confidence limit curves for a given discharge (flow). The exceedance probability event is defined as the probability that a specific event will be exceeded in any given year.

In the HEC-FDA model, there is a choice of using a “graphical” or “analytical” method for exceedance probabilities. If the data conforms to a Log Pearson III distribution, the analytical method should be used since it reduces the uncertainty. The data does display this distribution and the analytical parameters are entered as input to the model. Frequency function estimation is based on a rainfall runoff routing model containing regional model parameters. Table 4-5 of EM 110-2-1619 recommends an equivalent record length of 10–30 years. The method of estimation included calibration of the model using extensive historical regional frequency function parameters. In consultation with the Hydrologic Engineer it was decided, given the availability and length of historical regional frequency records the record length should be set at 30.

3.2.3 Stage–Discharge Functions with Uncertainty

Stage-discharge relationships (rating curves) are functions that relate the amount of stream discharge (Q) to water surface elevations. By correlating discharge data with specific elevations, stage discharge functions are used in identifying areas that flood. Elevation is measured as the level of water above mean sea level (msl) or an established water surface level. Discharge is measured as the number of cubic feet of water that passes a gauging station in one second.

Stage discharge functions represent the relationship between stream flow or velocity and stage or water height in a described section of the study area. Factors contributing to the inherent uncertainty of modeling the stage discharge relationship include but are not limited to variations in bed formation, water temperature, sediment transport, presence of debris, unsteady flow effects or changes in the shape of the channel caused by a flood event. Discharge and stage estimates were pulled from the water surface profiles entered for each stream and year. It is assumed that these errors in estimation will approximate a normal distribution.

The HEC-FDA model requires two entered parameters for risk and uncertainty calculation: the stage at which error becomes constant and the standard deviation or error of that stage. The stage at which the error becomes constant was assumed to the hundred-year event. Uncertainty in stages was computed as prescribed for ungaged stream reaches. The result given, using equation 5-5 of EM 110-2-1619, was less than the minimum standard deviation of error in stage exhibited in Table 5-2 of the same guidance. Therefore, the minimum of standard deviation of error of .3 for cross sections based on field surveys was utilized.

3.3 ECONOMICS

The economic analysis was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the User's Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC- FDA).

The economic analysis focuses on flood damages to structures and contents for various frequency flood events in the Rocky Creek Drainage Basins. The flood frequency includes estimated damages for the 0.5, 0.2, .01, .04, .02, .01, .004, and .002 exceedance probability flood events. There is a mix of residential, commercial, industrial, and municipal structures.

Average annual damages are calculated using the HEC-FDA model (version 1.4.1). The difference in damages in the "with-project" and "without-project" conditions of the various alternatives determines the economic impact of making any change. Details of the use of this Monte Carlo simulation model may be found in HEC-FDA Flood Damage Reduction Analysis User's Manual version 1.4.1, April 2016. Existing conditions and future conditions under both with and without-project conditions are simulated. Existing conditions are considered to be those expected in 2020. The most likely future condition is measured to the year 2033.

The "Economics" component of the HEC-FDA program is used to aggregate stage-damage uncertainty functions by damage category, damage reach, stream, plan, and analysis year using structure inventory data and water surface profiles. Note, in the following paragraphs, specific database categories are indicated by italicized and underlined text.

3.3.1 Assumptions

- Real property will continue to be repaired to pre-flood conditions if the cost of reconstruction pursuant to a flood event is less than 50 percent of the structural value.

- All structures in the floodplain have a remaining physical life of at least 50 years.

- Floodplain residents will react to a floodplain management plan in a rational manner.

- Price Level – Generally, unless otherwise stated, Oct 15 (FY16) is the price level used throughout the flood damage analysis (see Section 3.3.5).

- Interest Rate – The federal discount rate of 2.875 (FY17) percent is used in this analysis.

3.3.2 Damage Categories

Damage categories are used to consolidate large numbers of structures into specific groups of similar characteristics. Buildings in the Rocky Creek Watersheds were identified as one of the following four damage categories – residential, commercial, industrial or municipal structures.

As shown in Table A-17, Structure Inventory, the floodplain contains 883 structures (residential, commercial, industrial, public, and municipal buildings).

Table A-17
Structure Inventory by Damage Category for Rocky Creek

Damage Category	Number of Rocky Creek Structures
Residential	646
Commercial	206
Industrial	1
Public Utility	2
Municipal	28
Total	883

Structures were assigned to one of four categories dependent upon use of the structure, and upon availability of depth damage curves, which would accurately describe damage in the structure in response to a flood event. All structures utilized as a residence, to include manufactured housing, permanent single family and multifamily dwellings, were assigned to the general category of 'Residential'. All structures utilized for the conduct of any business, including those businesses involved in the caring for or housing of persons, and having an appropriate depth damage curve available, were classified as 'Commercial'. All other structures utilized for the conduct of any type of business, that business being of a unique nature or not having a predefined depth damage curve, were assigned to the category of 'Commercial'.

Rocky Creek is composed of commercial, industrial, residential, and municipal facilities.

3.3.3 Structure Occupancy Types

Each structure was assigned to a structure occupancy type. Structure occupancy types are a subcategory of the individual damage categories. It should be noted that numerous structure occupancy types could be assigned to each damage category. For example, single-story residential structures with no basements, single-story residential structures with basements, two-story residential structures and apartments are different structure occupancy types that typically could be assigned to the residential damage category.

The structure occupancy type is used to define appropriate depth-percent damage functions as well as uncertainties in first floor elevation, structure value, and "other"

(damage)/structure ratio for similar structures. Each occupancy type has unique depth-damage curves and uncertainty parameters.

Structure occupancy types are used to refine the delineations created by structure assignment to a damage category. For each structure occupancy type, an appropriate depth damage curve was assigned, and measures of risk and uncertainty associated with measurement error of the first floor elevations and the structure, content and 'other' valuations.

3.3.4 Depth Damage Functions

A depth-damage function is a mathematical relationship between the depth of floodwater above the first floor of a building and the amount of damage that can be attributed to that water depth; the zero depth is assumed to coincide with the elevation of the first floor. Although many factors affect the amount of damages arising from a flood (depth of flooding, velocity of floodwater, duration of flooding, sediment load, etc.), most assessment procedures focus on the depth of flooding as its primary determinant.

Depth-damage relationships, often computed separately for structures and contents, are typically expressed with structure damage as a percentage of structure value and content damage as a percentage of content value for each foot of inundation. However, for this study, the generic depth damage curves for the residential damage category were used which base structure and content damage as a percent of the structure value.

Generic Depth Damage Relationships for residential structures without basements as contained in Economic Guidance Memorandum (EGM 01-03), dated 1 Dec 02, were utilized in this study. Uncertainty for residential depth damage curves were equal to standard deviations prescribed in the sited guidance. Commercial, industrial and municipal depth damage curves were taken from pre-existing functions compiled by Corps economists from Mobile, Tulsa and Galveston Districts; functions were developed from information furnished by commercial, public, and industrial floodplain occupants. The nonresidential depth-damage functions contain information about the susceptibility to flooding of these floodplain structures, their inventories and equipment. The mobile home depth-damage relationships developed by the New Orleans District for the Morganza to the Gulf of Mexico, LA evaluation were used for mobile homes and storage structures in the evaluation. The probability distributions representing the uncertainty surrounding the depth damage relationships were incorporated into the damage analysis.

Uncertainty in these depth damage curves were calculated based on a standard normal distribution. In a standard normal distribution, the first standard deviation (plus and minus one standard deviation) from the mean represents 68 percent of the distribution. For each foot of water over the first floor elevation the percentage damage was multiplied by 34 percent; half the area corresponding to plus and minus one standard deviation, to arrive at a stage event measure of uncertainty for each structure occupancy type.

3.3.5 Structure Inventory Data

To develop structure attribute information for flood damage reduction analysis, an inventory of floodplain structures was conducted. A method using the latest LIDAR data for the area was employed. This method allowed to team to resurvey the ground elevations, in conjunction with the latest Augusta and Richmond County tax data. This LIDAR data was then compared to the previous ground survey data for a reasonableness test, which generated like results. Data obtained during this inventory was entered into the HEC-FDA program for calculations that produced stage-damage uncertainty data for each damage reach index location.

3.3.5.1 General

The 500-year floodplain inventory includes detailed information regarding the location (*street address*) and physical attributes of each floodplain structure. Each building is assigned to a *damage category* and *occupancy type*. The *stream* along which each structure is located as well as the stream *bank* (looking downstream, either left or right bank), and corresponding *stream station* coordinates (In feet for Rocky Creek) were also cataloged.

3.3.5.2 Structure Value

The value of each structure was also recorded. The estimated *structure value* used in Corps flood damage reduction analyses is the structure's depreciated replacement cost (replacement cost less depreciation) to its existing, pre-flood condition. A structure's replacement cost is the cost of physically replacing (reconstructing) the structure only. Structure depreciation accounts for deterioration that occurred prior to flooding and variation in a structure's remaining useful life. Structure values are extracted from Augusta-Richmond's property tax records. Structure values reflected 2015 tax assessed value. All values used in the HEC-FDA model were indexed to reflect October 2015 (FY16) price level.

The State of Georgia requires that real estate appraisals be within plus or minus (+/-) five percent of fair market property values. Consequently, the HEC-FDA model includes a range of error for tax assessed structure values of +/- five percent. Savannah District Real Estate Division validated the accuracy of the indexed tax assessment value using the Marshall & Swift Valuation Service.

In compliance with Economic Guidance Memorandum (EGM 01-03) section 4C(2) on page 3 dated 4 December 2000 guidance, the content to structure value in the HEC-FDA model was set at 100 percent and the error associated with the content to structure value ratio was left blank. Thus, review of any output showing interim calculations of content values should take into consideration the change in modeling to accommodate the generic depth damage function for residential structures.

3.3.5.3 Content Value

The value of the contents of all floodplain structures was catalogued. The methods of obtaining values as well as the associated uncertainty estimates are documented below.

3.3.5.4 Residential Content Value

The content-to-structure value ratio (CSVR) and structure and content depth-damage relationships used for one-story residential without basement, two-story residential without basement, and split level without basement, are taken from EGM, 01-03, generic depth-damage relationships, dated 4 December 2000. This EGM is the most recent one available with depth-damage relationships for the types of structures that are found in this project. Based on EGM 01-03, a proxy 100 percent content-to-structure value ratio was used for residential content values.

3.3.5.5 Non-residential Inventory and Equipment Values

Non-residential inventory and equipment values were obtained from the Augusta-Richmond County tax assessor's office and have been adjusted based on the structure purpose.

3.3.5.6 Other Value

The FDA program was also used to estimate damages to automobiles located at residential structures. In order to compute flood damages to vehicles, the year, make, model, and parking elevation of vehicles were also recorded during residential surveys. Vehicle values were estimated to be $16,800 per household. This estimate was based on the mean residential vehicle value of $8,400 (average Blue Book trade-in value for area code 30805, 'good condition' for a 'medium' sized compact car) which was multiplied by an estimated 2.2 automobiles per household (2010, Census of Population and Housing for Georgia). Because no 'windshield' survey was conducted, 'Compact' car was used as the proxy representation of type of automobile in the area

3.3.5.7 Vehicle Depth-Damage Relationships

Automobile depth-percent damage curves developed by the New Orleans District, USACE (March 2006) were used to estimate automobile damages at various flood depths relative to the elevation of parking areas (see Table A-18). The FDA structure inventory database was appended to include an automobile entry for each residential structure. FDA output yielded expected damages for all vehicles in the study areas. Based on discussions FEMA personnel it was assumed that approximately 50 percent of the vehicles would be subject to flood damage and the remaining vehicles would be evacuated prior to inundation. Inundation reduction benefits based on FDA output were adjusted accordingly.

Table A-18. Vehicle Depth-Damage Relationships

Vehicle Type	Market Value (est)	Flood Depth (feet above road surface)									
		0.5		1.0		1.5		2.0		3.0	
Sub-Compact	$12,000	0.0	0.0	9.0	14.0	20.0	27.0	35.0	50.0	100.0	100.0
Compact	$16,000	0.0	0.0	5.0	9.0	15.0	19.0	20.0	25.0	100.0	100.0
Mid-Size	$22,000	0.0	0.0	4.0	8.0	13.0	17.0	18.0	21.0	100.0	100.0
Large	$31,000	0.0	0.0	3.0	5.0	11.0	16.0	17.0	19.0	100.0	100.0
Pick-Up Trucks/SUV	$26,000	0.0	0.0	2.0	4.0	10.0	15.0	15.0	18.0	100.0	100.0

3.3.6 First Floor Elevations

Estimation of flood damage using depth-damage relationships requires specification of the *first floor elevation* of floodplain structures. First floor elevations were derived from the 2015 GIS data.

Aerial photography was superimposed over a GIS shape file layer for the purpose of identifying the location and ground elevations of residential structures. Visual inspection was used to determine the height above ground. The error implicit in using the LIDAR data to estimate the ground elevation of each of the structures is normally distributed with a mean of zero and a standard deviation of 0.6 feet. The standard deviation of 0.6 feet was used to represent the uncertainty surrounding the first floor elevation of the structures.

3.3.7 Stage Damage Function

The stage damage function is a summary statement of the direct economic cost of floodwater inundation for a specified stream reach. Stage-damage functions for the future without-project condition for Rocky Creek is exhibited in Table A-19.

Table A-19. Rocky Creek Without Project Single Event Damages
FY16 Price Level and 2.875 Percent Discount Rate

Damage Category	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year	500-Year
Total	$1,125,244	$2,243,603	$3,960,491	$5,147,176	$7,810,208	$9,715,889	$13,126,052	$14,524,715
Commercial	$1,116,229	$1,823,968	$2,834,001	$3,461,765	$4,590,082	$5,277,363	$7,508,828	$8,044,687
Municipal	-	$231,152	$558,205	$734,529	$1,434,577	$2,047,344	$2,429,232	$2,778.937
Residential	$9,014	$188,482	$568,285	$950,881	$1,785,548	$2,391,181	$3,187,990	$3,701,090
Industrial	-	-	-	-	-	-	-	-
Public Utility	-	-	-	-	-	-	-	-

3.3.7.1 Stage-Damage Curve

The stage damage curve is a summary statement of the direct cost of floodwater inundation; stage damage curves were generated for each study area river reach. Depth-damage functions calculated for each floodplain structure are transformed to a stage-damage function at floodplain index locations using computed water surface profiles for reference floods. Estimated damages for all structures are then aggregated by category for common stages.

3.3.7.2 Stage-Damage Function With Uncertainty

Uncertainty in the stage-damage relationship is due to (1) errors in estimating structure elevations, (2) errors in assessing damage to structures, and (3) errors in assessing damage to contents. The various sources of risk and uncertainty in the individual stage damage curves are combined to derive the overall risk and uncertainty associated with the composite stage damage curve.

4.0 OVERVIEW OF THE 10-STEP NED BENEFIT EVALUATION PROCEDURE

USACE estimated flood damage benefits for the project following the NED benefit evaluation procedures for urban flood damage reduction. The ten-step process as outlined in appendix E of ER 1105-2-100 dated 22 April 2000 provides guidance for benefit evaluation. A brief description of the application of these steps to this project follows.

Step 1 - Delineate Affected Area.

H&H modeling of existing and projected future conditions for the 2-year through the 500-year events result in maps showing the extent of potential flooding. The 100-year and 500-year event water elevations are important. The flooded area for the 100-year event is important for the flood insurance program that is managed by FEMA. The 500-year event water levels represent the maximum area Corps studies focus on. Generally, there is not much elevation change (often less than one foot) between the 100-year and 500-year events in the basin analyzed. Since the Rocky Creek area is highly developed, there is not likely to be any major shift in the land use or intensification in the immediate or adjacent project area.

Step 2 - Determine Floodplain Characteristics.

1. Inherent Characteristics of the Floodplain

Flooding. Flashfloods from intense thunderstorms, accumulation of soil soaked conditions from winter rains with a burst of rainfall, and tropical storms or an occasional hurricane pose flood threats to the Richmond County area. Fortunately, loss of life has not been problematic, but extensive and sometimes repeated property damage does occur. In Upper Rocky Creek, the floodplain is generally 100 to 200 feet wide while in Lower Rocky Creek the floodplain varies between 500 to 2,000 feet in width.

Natural and Beneficial Values. The floodplain of the Rocky Creek exhibits extensive residential, commercial, and industrial development. Augusta-Richmond County's Green Space Program has identified Rocky Creek as a potential green space asset. However, at this time, the stream exhibits a degraded urban stream condition that needs ecosystem restoration.

2. Physical Characteristics.

Augusta Georgia is on the fall line or demarcation between the Piedmont area of rolling hills with occasional steep topography and the Coastal Plain, a much flatter environment. The Savannah River, which forms the boundary between Georgia and South Carolina, is the eastern boundary of Richmond County. The Augusta Levee on the western bank of the Savannah River has substantial direct and indirect impact on water levels of Rocky Creek.

Rocky Creek Basin parallels the Augusta Levee and flows into Phinizy Swamp, a large natural containment area that eventually discharges into the Savannah River. The Savannah River flows generally southeast from Augusta until it reaches the Atlantic Ocean in the vicinity of Savannah, Georgia about 130 miles downstream.

The topography of the Augusta-Richmond County area consists chiefly of rolling hills with occasional steep inclines. The soils within the watersheds and floodplains are composed of highly erodible, coarse sands. Elevations of the terrain vary from approximately 110 to 140 feet in the swampy areas adjacent to the Savannah River to a maximum of approximately 520 feet in the Fort Gordon area.

3. Available Services.

The floodplain is highly developed. Rocky Creek could possibly see some additional industrial development in the lower reach in the vicinity of Thermal Ceramics.

Rocky Creek is in the flood insurance program. Currently, by ordinance, the first floor elevation for all new construction within the high hazard areas must be three feet above the water surface elevation for the 100-year event in the FEMA designated flood areas. Consequently, no large shift in composition of commercial, industrial, nor residential housing in either basin is expected with the proposed flood reduction measures. No major competitive advantage returning to the floodplain is expected after project construction.

4. Existing Activities.

Table A-20 gives a summary of the occupancy types by number of structures, value of the structure, and a general indication of age. One noticeable characteristic is the average residential structure value for Rocky Creek is $44,110 and is mainly a group of homes built in the 1940s and early 1950s.

Table A-20. Activity Within the Floodplain With Selected Parameters
FY 16 Price Level

Occupancy Type	Number of Structures	Value	Age
Residential	646	$28,436,056	60-70 Years
Commercial	206	$90,690,781	Varies
Industrial	1	$32,539	0
Public Utility	2	$1	0
Municipal	28	$14,947,874	0
Total	883	$134,107,251	

Step 3 - Project Activities in Affected Area.

This information is a summary of the economic and demographic information found in more detail in specific sections within this report. Since the governing unit is a consolidated government consisting of the city and county, the demographic analysis focuses on county level data.

Generally, population of the county is expected to increase 6.9 percent by the year 2030 from the current 205,715 persons. Augusta has a diversified economy with approximately 64 percent of employment in the service, retail trade and manufacturing sectors. Manufacturing facilities produce textiles, paper products, chemicals, transportation equipment, and food products. Retail is concentrated downtown and in shopping centers on major roads, with some individual sites. The large commercial Augusta Mall and Augusta Exchange draw customers from throughout the region. Major employers in the service sector include health care and related facilities, educational institutions, and service businesses.

The basin is in the National Flood Insurance Program. Consequently, future development is required to be protected to the .01 probability event or 100-year discharge. In fact, the building ordinance is more stringent and requires construction to be three feet above the FEMA designated 100-year discharge water surface elevation. Consequently, the FDA model does not include any new structures in the future project conditions.

Steps 4 and 5 - Estimate Potential Land Use and Project Land Use.

A shift of nine percent from undeveloped to developed land use is expected. About six percent of the nine percent increase will likely occur in the residential, commercial, and industrial, and public/institutional land use types while the remaining three percent is forecast to occur in the park/recreation/conservation sector. These changes from the existing to future condition flood elevations can be seen in Table 5 of the Engineering Appendix. Though the hydrologic modeling has taken this change in land use into account, no economic benefits are claimed for any possible future development in line with direction set forth by EO 11988.

Step 6 - Determine Existing Flood Damages.

Average annual base year damages for the without project condition as well as implementation of each alternative plan is computed within the FDA model. The damages are derived from water surface profiles from H&H modeling as input to the FDA economic model.

Step 7 - Project Future Flood Damages

As discussed in the preceding step, the FDA model estimates the expected average annual flood damages for the most likely future scenario. The FDA model output contains similar information for each alternative plan that is modeled.

Step 8 - Determine Other Costs of Using the Floodplain

Changes in other costs of using the floodplain such as flood proofing and National Flood Insurance Costs are not expected to significantly change. With the modest number and value of structures being evacuated from the floodplain, insurance costs would not be noticeable in the overall project effort and therefore are not claimed as a benefit.

Step 9 - Collect Land Market Value and Related Data

Land use will change in the NED non-structural plan on Rocky Creek that includes construction of a recreation park at Kissingbower Road after evacuation. In this instance, recreation benefits are derived based on the unit day value method and recreation benefits are included as part of the net benefits to the project. Further details of this analysis are included in the non-structural section of the main report.

Step 10 - Compute NED Benefits

The Rocky Creek NED Plan maximizes NED net benefits based primarily on inundation reduction with recreation benefits also being associated with the non-structural solutions. Details on this analysis are contained in separate sections in this appendix on the NED Plans.

5.0 ROCKY CREEK

5.1 SPECIFIC PROBLEMS AND OPPORTUNITIES

The problems that have been identified in the Rocky Creek Basin are:

1) Risks of flooding of structures along the Rocky Creek from the Rosedale Detention Area to Phinizy Swamp
2) Lack of recreational opportunities along Rocky Creek.

5.2 REACH DESIGNATION

Rocky Creek has relatively homogeneous hydrologic characteristics from the Rosedale Dam Detention Area to Phinizy Swamp.

5.3 ALTERNATIVES

There is one structural and one non-structural management measure: Rosedale Dam Detention Area and Kissingbower Buyouts, respectively. Based on these two management measures, the following alternatives were formulated:

1. No Action
2. Rosedale Dam Detention Area Alone
3. Kissingbower Buyout Alone
4. Kissingbower Buyout with Park
5. Rosedale Dam Detention Area and Kissingbower Buyouts with Park

5.4 STRUCTURAL FLOOD RISK MANAGEMENT MEASURE

The following describes the structural management measure.

- Rosedale Detention Area improvement: An earthen dam at Rosedale; Low-level 5’ x 6’ culvert outlet set to channel invert – 216.7’; Spillway set to 232’; Top of dam set to 240’

5.5 NON-STRUCTURAL FLOOD RISK MANAGEMENT MEASURE

Evacuation is the permanent relocation of existing residents and structures to areas not prone to flooding. Relocation may be 1) physically moving the structure to a different location, 2) demolition of existing structures and construction of new structures in a different location, and 3) demolition of existing structures and providing funds for the purchase of new structures at a different location. In each type of mandatory relocation, PL 91-646 (Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970) requires that displaced residents be provided funds for moving and resettlement. The actions proposed in this project are mandatory relocations that demolish the existing structures and provide funds for the purchase of structure and relocation costs.

I. INTRODUCTION

Section 73 of the 1974 Water Resources Development Act (WRDA) requires equal consideration of structural and non-structural alternatives in flood damage reduction studies. Non-structural measures can be considered independently or in combination with structural measures. Non-structural measures reduce flood damages without significantly altering the nature or extent of flooding. They do this by changing the use made of the floodplains, or by accommodating existing uses to the flood hazard.

Section 219(a) of WRDA 99 directs that the U.S. Army Corps of Engineers (Corps) calculate benefits for non-structural flood damage reduction using methods similar to those used in calculating the benefits for structural projects. To achieve this objective, derivation of benefits and costs in this study followed the guidance in CECW-PG memorandum dated 14 April 2001, entitled "Implementation Guidance for Section 219 of the Water Resources Development Act of 1999, Non-structural Flood Control Projects". For the benefit calculation, flood damage reduction benefits for evacuation projects were calculated as the total flood damages reduced. No correction has been made to remove the internalized portion of flood damages. Also, the real estate costs in the economic analysis for evacuation features reflect flood-free property costs.

Permanent relocation/evacuation plans provide permanent evacuation and relocation/demolition of floodplain structures. Benefits from future use of the vacated floodplain, in this case recreation, will generally be the dominant NED benefit. For evacuation plans that are clearly formulated for flood damage reduction, there is no limitation on the amount of recreation benefits, as there is for structural projects. Thus, for these plans, the recreation benefits may exceed 50 percent of the benefits needed for justification.

To isolate the changes that are expected to occur as a result of an investment (future with-project condition) from changes that would occur if the investment were not undertaken (future without-project condition), flood damage reduction studies are evaluated over a 50-year planning horizon (2020–2069). The year 2033 was selected as the most likely future condition. In this analysis, the existing condition represents current geometric conditions observed in 2014.

II. ASSUMPTIONS

Real property will continue to be repaired to pre-flood conditions if the cost of reconstruction pursuant to a flood event is less than 50 percent of the structural value.

All structures in the floodplain have a remaining physical life of at least 50 years.

Floodplain residents will react to a floodplain management plan in a rational manner.

Floodplain development will conform to county or city building codes, which specify compliance with Federal Emergency Management Agency (FEMA) guidelines on floodplain construction elevations.

No new development will occur in the floodway (considered the natural storage area of the stream).

The first floor of all new *residential* development will be above the elevation of the one percent chance exceedance flood.

All new *non-residential* development will be above, or effectively flood-proofed to, the elevation of the one percent chance flood.

No major reconstruction or additions to an existing property (equaling 50 percent or more of the structure value) can occur without complying with the above.

Benefits and costs are expressed in October 2015 (Fiscal Year (FY) 2016) price levels, unless otherwise noted.

Interest Rate – Project interest rate for evaluation of NED benefits and costs is 2.875 (FY17 interest rate).

III. PROJECT FEATURES AND COMPARISON OF NON-STRUCTURAL ALTERNATIVES

1. Kissingbower Buyout Alone

a. Benefits

The estimated average annual flood damages as estimated by HEC-FDA for the three structures in the area across from Regency Mall in the Kissingbower Road area totaled $1,524 (Table A-21). The Kissingbower Road vicinity is a basin-like area that receives overflow from Rocky Creek. These damages are still being incurred after implementation of the NED structural plan of the upstream Rosedale Detention Area Improvements and the situation offers an additional opportunity for a non-structural solution.

Table A-21. Kissingbower Road Area
Estimated Average Annual Flood Damages
FY 18 Price Level and 2.875 Percent Discount Rate
50-Year Period of Analysis

Residential Structures	Total Value	Average Annual Damages	Present Value of Annual Damages
1960 Kissingbower	$0	$0	$0
1956 Kissingbower	$58,344	$247	$6,509
1956 1/2 Kissingbower	$83,038	$827	$21,793
1957 Haynie	$40,134	$450	$11,885
1958 Kissingbower	$0	$0	$0
Total	**$181,516**	**$1,524**	**$40,186**

When residential structures and land are purchased for the purpose of evacuating the floodplain, the structures are demolished and the land is no longer available for residential or commercial development. This non-developable land has a residual value in its alternate use. In this case, the residual value obtained from alternative use of the non-developable land is the recreation value of park facilities.

b. Costs

Structure evacuation and relocation involve costs which are included in the BCR calculation and some costs which are considered outside of the BCR. Costs which are not included in the economic evaluation are those costs associated with PL 91-646. PL 91-646 ensures that people whose real property is acquired, or who move as a result of projects receiving federal funds, will be treated fairly and equitably and will receive assistance in moving from the property they occupy.

The relocation costs are excluded, by policy, from the benefit to cost ratio. However, the relocation costs are included in the project costs and are a nonfederal sponsor responsibility for cost sharing of the project costs.

Paragraph 10-2c of EP 1165-2-1 (Policy Digest) discusses the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended. An extract from the paragraph follows:

“A replacement housing payment is also provided to enable the displaced person to be relocated in a comparable replacement dwelling. This payment (up to $7,500 for tenants and $31,000 for homeowners) is in addition to the purchase price paid for the property acquired for the Federal project. These costs are not included in the project benefit-cost ratio, but they are allocated to reimbursable purposes. (ER 1165-2-117; Chapter 6, ER 405-1-12)”

A similar discussion is contained in Appendix D, Amendment #1 of ER 1105-2-100 paragraph D-3e (7) as shown below.

"(7) The requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended, including real property acquisition relocation payments as applicable to a displaced person, business, or farm operation. Such payments include moving and related expenses for a displaced person, business, or farm operation; financial assistance for replacement housing for a displaced person who qualifies and whose dwelling is acquired because of the project; and termination payments for dislocated businesses whose owners choose to close out. Base the NED cost of replacement housing on replacement in kind. (Costs over and above replacement in kind are treated as financial costs for non-project purposes.) Base these costs on current market values."

Costs detailed in Table A-22 are those costs associated with PL 91-646; these costs are not included in the calculation of the BCR.

Table A-22. PL 91-646 Structure Evacuation Costs Excluded From BCR

Structure Evacuation Costs as required by Public Law 91-646

** Costs incurred under PL 91-646 are not included in calculation of the Benefit - Cost ratio. **

	Per Structure Cost
Administrative Relocation Cost	$8,400
Establish relocation requirements under PL 91-646	
Calculate Relocation Act benefits for the displaced residents	
Offer relocation counselor services for both owners and tenants	
Purchase of Replacement Housing Cost (Displaced Homeowner)	$31,000
Rental of Replacement Housing Cost (Displaced Tenant)	$7,500
Miscellaneous Reimbursements (moving, utility expenses, etc.)	$3,000

Under PL 91-646 each owner occupant is entitled to a maximum benefit of $31,000 for purchase or replacement housing and each tenant of a rented structure is allowed a maximum benefit of $7,500 for rental assistance or to be used as a down payment on a new home. Costs for replacement housing in excess of those costs specified in PL 91- 646 are included in the BCR. There are also miscellaneous reimbursements under PL 91-646 for moving, utility expenses, etc. The estimated costs of these miscellaneous reimbursements are $3,000 per structure.

Those costs included in the BCR are those costs associated with the purchase price of the land and structures plus estimated demolition costs. An assumed salvage value of four percent of the structure is deducted from the value of the structure. In addition to the cost of purchasing the structure and the land, there is an administrative relocation cost of $8,400 per ownership. This administrative cost will pay for the following:

- Prepare Real Estate Report and cost estimates,
- Determine number of ownerships,
- Prepare real estate descriptions,
- Prepare acquisition maps, and
- Obtain rights-of-entry if required

The cost for relocation was calculated by summing the purchase cost for structure and land and the demolition cost and, then, subtracting the structure salvage value. The evacuation cost is then annualized at a federal discount rate of 2.875 over a 50 year period of analysis. The structure evacuation costs are excluded from the costs and replacement housing costs are limited in accordance with EP 1165-2-1.

The estimated average annual cost for evacuating the 5 properties totaled $16,529 as shown in Table A-23. The Project First Cost or Investment Cost also includes real estate acquisition costs and is calculated with an escalation rate of 3.3 percent out to FY18 and a 25 percent contingency for a total project first cost estimated at $432,050. Interest During Construction (IDC), based on 6 months of construction, is added for a total investment cost of $435,568.

Table A-23. Average Annual Permanent Relocation Costs of Five Residential Properties (FY 18 Price Level)

Residential Structures	Structure Value	Land Value	Demolition Cost	Salvage Value	Cost Per Property	Escalated Cost with Contingency	Average Annual Cost Equivalent
1960 Kissingbower	$0	$7,500	$0	$0	$7,500	$9,684	$368
1956 Kissingbower	$36,200	$8,800	$5,000	$1,400	$48,600	$62,755	$2,381
19561/2 Kissingbower	$8,100	$6,900	$5,000	$300	$19,700	$25,438	$965
1957 Haynie	$32,600	$12,400	$5,000	$1,200	$48,800	$63,013	$2,391
1958 Kissingbower	$0	$7,500	$0	$0	$7,500	$9,684	$368
Acquisition	**-**	**-**	**-**	**-**	**-**	-	$9,923
IDC	-	-	-	-	-	-	$126
Total	**$76,900**	**$43,100**	**$15,000**	**$2,900**	**$132,100**	**$170,574**	**$ 16,529**

c. Benefit-to-Cost Ratio (BCR)

The average annual benefits are divided by the average annual costs to calculate the BCR for each structure. The BCR for evacuating all 5 properties is estimated at .09 which is derived from $1,524 in average annual benefits divided by $16,529 in average annual costs. The average annual net benefit is a negative $3,489 for all 5 properties. Hence, complete buyout alone is not economically justified.

2. Kissingbower Buyout with Recreational Park on Properties of Permanently Relocated/Evacuated Residents

At the outset of the project, the non-federal sponsor expressed interest in converting evacuated lands into recreational facilities. Current recreational facilities (without project condition) in the Augusta-Richmond County area do not fulfill the recreation demand for day use activities. Consequently, consideration of a day use park in conjunction with evacuation of some of the structures to moderate the flooding might meet several objectives of this study.

When the City of Augusta Parks and Recreation Department were asked if they would be interested in a small park at the location of the removed houses they expressed an interest. Although there is an existing public park about a mile North from this site, the Planning and Development Manager for the Recreation, Parks, and Facilities Department was confident that the park's close proximity to the Regency Mall would assure that it would be used by future visitors to the Mall, in addition to visitors from the immediate neighborhood. The city requested that this park be designed for passive recreation, such as picnicking and playground use and include a small parking area. The park design includes a picnic area, a playground, a trail, fencing and new lawn and trees.

The benefits of the recreation area were calculated by first determining the unit day value under guidelines contained in Economic Guidance Memorandum 16-03, Unit Day Values for Recreation, Fiscal Year 2016. As such, recreation benefit calculations are at a price level consistent with that of flood damage reduction benefit calculations. Point value assignments under the parameters set forth by EGM 16-03 as applies to this analysis are presented in Table A-24.

Table A-24. Unit Day Valuation Point Assignments by Criteria

Criteria	Judged Value	Designation Description	Designation Range
Recreation Experience	5	Several general activities	5 - 10
Availability of Opportunity	3	Several within 1 hr. travel time; a few within 30 min. travel time	0 - 3
Carrying Capacity	9	Optimum facilities to conduct activty at site potential	9 - 11
Accessibility	18	Good access, high standard road to site; good access within site	15 - 18
Environmental Quality	6	Average aestheic quality; factors exist that lower quality to minor degree	3 - 6
Total Points:	**41**		
FY16 Value:	**$7.42**		

The result of the analysis is a unit day value of $7.42. This unit day value is then multiplied by the number of annual activity occasions the park would generate which is explained under Park Plan A and Park Plan B below.

a. Recreation Demand and Needs

Bicycling, Jogging and Walking Demand:

According to the Georgia Statewide Comprehensive Recreation Plan, the demand and unmet need for multi-use trails for Augusta are high with a demand for 53 miles of bicycling trails and 1,035 miles of hiking and 195 miles of jogging. The need for these trails is also high since the City and Richmond County has only 12 miles of multi-use trails. However, due to the short length of a trail at this location, jogging and bicycling could not be accommodated and the focus for this day use park would be on walking, picnicking, and playground demand.

Playground Demand:

The recreational facility needs for playgrounds for Augusta-Richmond County were determined by multiplying the population (199,775) by the per capita participation rate for playgrounds (0.762). The result is 152,228 annual playground activity occasions for Augusta. The per capita participation rate comes from the 1984 Georgia Recreation Plan Table 4.7 page 53. Each playground generates an annual carrying capacity of 3,559 activity occasions per year (provided on page Table 4.11 on page 56 of the 1984 Georgia Recreation Plan). When the annual playground activity occasions of 152,228 are divided by the 3,559 playground annual carrying capacity, 43 playgrounds are demanded. Augusta has 35 playgrounds, leaving the unmet need to be eight. There is a small public park about a mile away from the proposed location. It has one school age playground and picnicking facilities and a community building that can be rented. It does not have trails or a tot lot.

Picnicking Demand:

The picnicking demand is determined by multiplying the city's population of 199,775 x 4.44 statewide participation rate for picnicking (from the 1977 GA SCORP - none is provided in the 1984 Georgia Recreation Plan) = 887,001 annual picnicking occasions. The carrying capacity of one picnic table is 495, which when divided into the annual picnicking occasions equals 1,792 picnic tables demanded. Augusta has 32 picnic areas with a total of 110 picnic tables. They have an unmet need for 1,682 picnic tables.

b. Park Plan A: Recreational Park on Properties of Residents Permanently Relocated/Evacuated

The new Park Plan A (Figure A-9) site consists of one acre originating from four parcels, with one church and three homes. Two of the homes and the church have four to five and a half feet of water in them during the 100-year flood. The third home receives two and a half feet of flooding, but in order to have a recreation site, this home must be purchased. These homes and the church would be demolished. The site's mature trees will be kept for the park, including one large Red Oak tree located on the church's parcel.

The concept design for Park Plan A in Figure A-8 include:

Playground

- Toddler linked play equipment on a sand surface with plastic playground edging
- School age linked play equipment on a sand surface with plastic edging
- Two swing sets (one for school age and one for toddlers)
- Four benches
- One picnic shelter provided by the city with four picnic tables and one trash container.
- Bike rack.

Fencing

- 560 feet of four feet high chain link fencing placed around the park. This is for the children's safety.

Picnic area

- 10 picnic tables, each two set on a concrete pad 15'x 15' (five pads)
- Five grills
- Five trash containers

Trail

- Asphalt multipurpose trail 10 foot wide x 450 feet long

Proposed landscaping consists of preserving the existing trees on site, adding shade trees where needed, ornamental trees, a shrub hedge along the fence to screen and buffer the park from the neighbors.

Recreation Park A includes the purchase of the parcel above the church for recreation. This proposed Neighborhood Park has a 10-foot wide by 450-foot long, multipurpose trail meandering through it. This provides annual use of 109 walkers. It has a playground with facilities for preschool and school age children. This provides 3,559 annual playground activity occasions. It has a picnicking area with 14 picnic tables. The 1984 Georgia Recreation Planning Process Report provides 495 annual activity occasions per table to provide a total of 6,930 annual activity occasions. The Park Plan A is estimated to provide a total use of 10,598 annual activity occasions.

The annual recreation benefits are calculated by multiplying the unit day value ($7.42) by the annual activity visitations (10,598). Annual recreation benefits are estimated at $78,637. Average annual flood damage reduction benefits are $1,073. This results in total benefits of $79,710 at the FY 16 price level. The cost to build this park includes the average annual cost (AAC) of buying out four properties, AAC of all the features of the park, annual operation and maintenance, and interest during construction. The total AAC is estimated at $36,724 at the FY18 price level. In compliance with ER 1105-2-100, which mandates that all costs and benefits be analyzed at a consistent price level, this cost is converted to the FY16 price level using Amendment 9 of EM 1110-2-1304. Using Civil Works Breakdown Structure (CWBS) feature code for Recreation Facilities (14), the total AAC at the FY16 price level is $34,510. The BCR for Recreation Plan A is estimated at 2.31 with net benefits of $45,201.

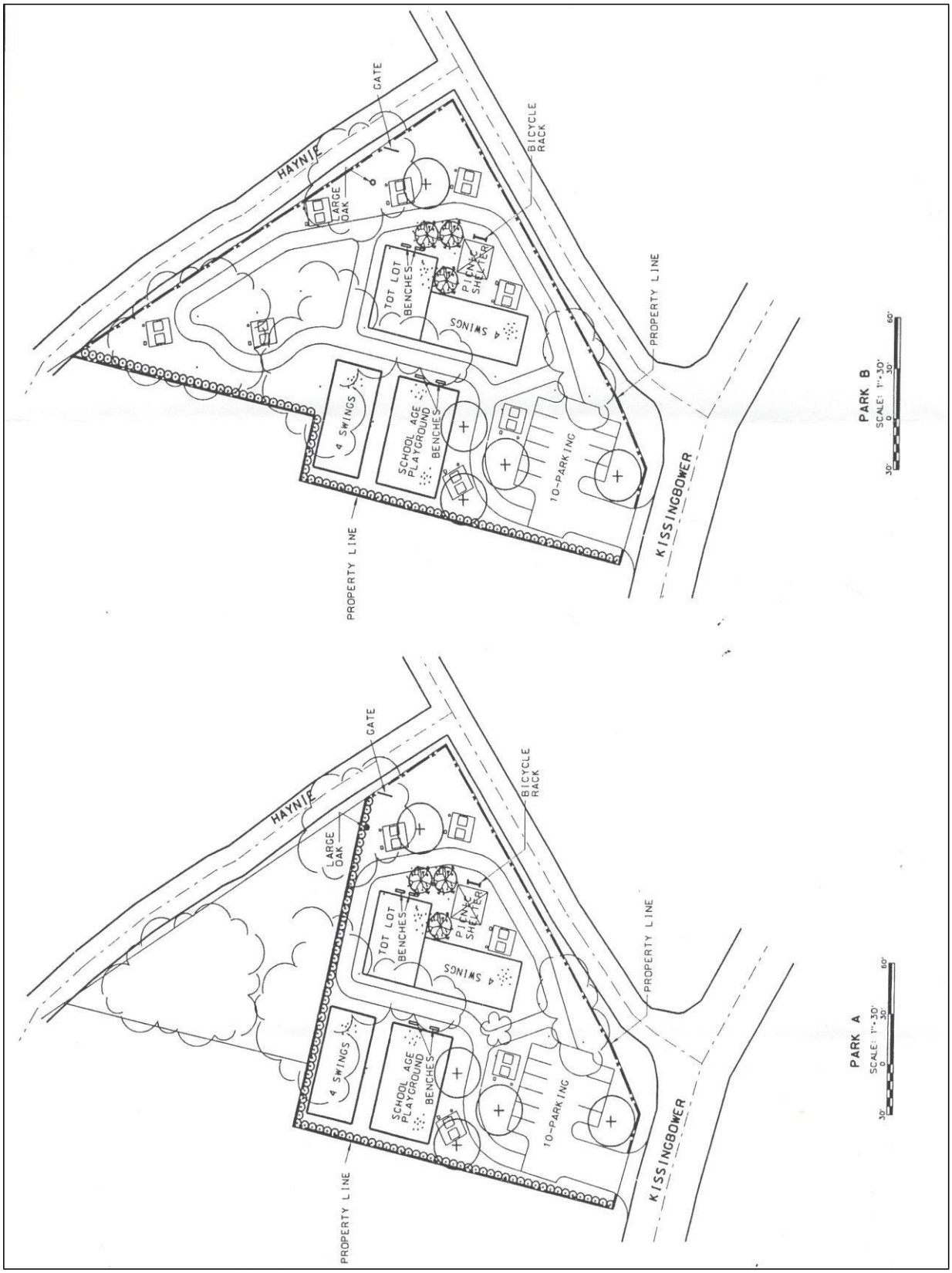


Figure A-9. Concept Design of Recreation Parks

Table A-25. Benefit-Cost Analysis
Park Plan A: Recreational Park on Properties of Residents Permanently Relocated/Evacuated

Alternative 3A			
	Participation Rate	Unit Day Value	Average Annual Benefit
Walkers	109	$7.42	$809
Playground Activity	3,559	$7.42	$26,408
Picnicing	6,930	$7.42	$51,421
Total Recreation Benefits (FY16)	10,598		$78,637
Flood Reduction Benefits (FY16)	Address		
	1956 Kissingbower		$247
	1956 1/2 Kissingbower		$827
	1958 Kissingbower		$0
	1960 Kissingbower		$0
Total Average Annual Benefits (FY16)			**$79,710**
Cost of property purchase	Address		Average Annual Cost
Buyouts	1956 Kissingbower		$2,205
	1956 1/2 Kissingbower		$735
	1958 Kissingbower		$368
	1960 Kissingbower		$368
	Sub-Total		**$3,675**
	RE Admin Acquisitions, Demolition, Salvage		$8,412
Park Construction			$13,145
Preconstruction Engineering and Design			$7,058
Construction Management			$1,480
	Sub-Total		**$21,683**
Interest During Construction			$454
Operation and Maintenance of Park			$2,500
Total Average Annual Costs (FY 18)			**$36,724**
Total Average Annual Costs (FY 16)			**$34,510**
Benefits to Cost Ratio			**2.31**
Average Annual Net Benefits			**$45,201**

c. Park Plan B: Recreational Park on Properties of Residents Permanently Relocated/Evacuated

Park Plan B (Figure A-10) includes the addition of the bottom triangular lot on Haynie Street to enhance the park and increase its size. This has a house that was to be raised but instead is to be bought out to enlarge the park. The purchase of this lot also provides more protection to the root system of the large existing Red Oak. The trail and picnic area are expanded into this area. The other facilities as provided in Park Plan A remain the same except the trail is another 210 feet longer, six more picnic tables are added and the fencing length is increased by another 230 feet.

The additional concept designs for Park Plan B in Figure A-8 include:

Fencing

- Additional 230 feet of 4' high chain link fencing placed around the park - 790 feet total

Picnic area

- 16 picnic tables, each two set on a concrete pad 15'x 15'– eight pads total
- Eight grills total
- Eight trash containers total

Trail

- Asphalt multipurpose trail 10-foot wide x 660 feet long

Park Plan B includes the purchase of the bottom triangular parcel as part of the non-structural plan and the parcel above the church for recreation. The park is the same as A except it has a longer multiuse trail of 660 feet in length, and a larger picnic area with 16 picnic tables. The longer trail provides a use of 189 walkers. The playground use is estimated at 3,559 annual activity occasions, and the picnicking is 16 tables times 619 to equal 9,900 annual picnicking activity occasion for an estimated 13,648 total annual activity occasions.

The annual recreation benefits are calculated by multiplying the unit day value ($7.42) by 13,648 annual activity occasions for a total of $101,268. Additionally, the average annual NED flood damage reduction that results from buying out five properties is $1,524. This results in total benefits of $102,792 at the FY 16 price level. The cost to build this park includes the average annual cost (AAC) of buying out five properties, AAC of all the features of the park, annual operation and maintenance, and interest during construction for a total AAC of $43,291 at the FY18 price level. In compliance with ER 1105-2-100, which mandates that all costs and benefits be analyzed at a consistent price level, this cost is converted to the FY16 price level using Amendment 9 of EM 1110-2-1304. Using Civil Works Breakdown Structure (CWBS) feature code for Recreation Facilities (14), the total AAC at the FY16 price level is $40,831. The BCR for Recreation Plan B is estimated at 2.53 with net benefits of $61,961.

Table A-26. Benefit-Cost Analysis
Park Plan B: Recreational Park on Properties of Residents Permanently Relocated/Evacuated

Alternative 3B			
	Participation Rate	Unit Day Value	Average Annual Benefit
Walkers	189	$7.42	$1,402
Playground Activity	3,559	$7.42	$26,408
Picnicing	9,900	$7.42	$73,458
Total Recreation Benefits	13,648		$101,268
Flood Reduction Benefits	Address		
	1956 Kissingbower		$247
	1956 1/2 Kissingbower		$827
	1958 Kissingbower		$0
	1960 Kissingbower		$0
	1957 Haynie		$451
Total Average Annual Benefits (FY16)			**$102,792**
Cost of property purchase	Address		Average Annual Cost
Buyouts	1956 Kissingbower		$2,205
	1956 1/2 Kissingbower		$735
	1958 Kissingbower		$368
	1960 Kissingbower		$368
	1957 Haynie		$2,205
	Sub-Total		**$5,880**
	RE Admin Acquisitions, Demolition, Salvage		$10,516
Park Construction			$15,293
Preconstruction Engineering and Design			$7,058
Construction Management			$1,480
	Sub-Total		**$23,831**
Interest During Construction			$528
Operation and Maintenance of Park			$2,500
Total Average Annual Costs (FY 18)			**$43,291**
Total Average Annual Costs (FY 16)			**$40,831**
Benefits to Cost Ratio			**2.52**
Average Annual Net Benefits			**$61,961**

In conclusion, Kissingbower Buyout with Park Plan B produces the highest average annual net benefits compared to Kissingbower Buyout with Park Plan A. Hence, it shall be carried forth as the design for the Kissingbower Buyout with Park alternative.

Figure A-10. Aerial Photograph of Non-Structural Project Site

5.6 ECONOMIC ANALYSIS FOR PLAN SELECTION

Table A-29 (Section 5.8) summarizes the benefits and costs used to derive the NED Plan. This table includes detailed data for each management measure and alternative of various costs including construction, planning and engineering during construction (PED), construction management, and real estate. It also includes interest during construction (IDC) as an economic cost of the project and associated annual operation and maintenance costs after construction is completed. Initial construction costs are converted to an equivalent average annual cost that is compared to average annual benefits to determine the net benefits and BCRs.

Relocation costs are a cost-shared item for the project but are not included in the BCR analysis. Paragraph 10-2c of EP 1165-2-1 (Policy Digest) discusses the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended. It indicates the relocation payment is excluded from the BCR calculations. An extract from the paragraph follows:

> *A replacement housing payment is also provided to enable the displaced person to be relocated in a comparable replacement dwelling. This payment (up to $7,500 for tenants and $31,000 for homeowners) is in addition to the purchase price paid for the property acquired for the federal project. These costs are not included in the project benefit-cost ratio, but they are allocated to reimbursable purposes.* (ER 1165-2-117; Chapter 6, ER 405-1-12)

A similar discussion is contained in Appendix D, Amendment #1 of ER 1105-2-100 paragraph D-3e (7):

> *(7) The requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended, including real property acquisition relocation payments as applicable to a displaced person, business, or farm operation. Such payments include moving and related expenses for a displaced person, business, or farm operation; financial assistance for replacement housing for a displaced person who qualifies and whose dwelling is acquired because of the project; and termination payments for dislocated businesses whose owners choose to close out. The NED cost of replacement housing is based on the replacement in-kind cost. (Costs over and above replacement in-kind are treated as financial costs for non-project purposes.) These costs are based on current market values.*

5.7 FLOOD DAMAGE REDUCTION BENEFITS OF ALTERNATIVES

Table A-27 displays the potential flood damages reduced and residual flood damages by alternative. The Rosedale Detention Area improvements alone will reduce flood damages by fifty percent or $766,536 on an average annual basis. The Kissingbower Buyout alone will permanently eliminate flood damages for 3 homes and is estimated to reduce flood damages $1,524 on an average annual basis. When the Rosedale Dam Detention Area Improvement and Kissingbower Buyout are combined, then the damages reduced are estimated to be $768,060 on an average annual basis. This leaves average annual residual damages totaling $778,964.

Table A-27 Rocky Creek Flood Damage Reductions (AAEQ) FY16 Price Level and 2.875 Percent Discount Rate

Alternatives	Damages Without Project	Damages With Project	Damages Reduced With Project
1. No Action	$1,547,024	$1,547,024	$0
2. Rosedale Detention Area Alone	$1,547,024	$780,488	$766,536
3. Kissingbower Buyout Alone	$1,547,024	$1,545,500	$1,524
4. Kissingbower Buyout with Park	$1,547,024	$1,545,500	$1,524
5. Rosedale Dam Detention Area combined with Kissingbower Buyout with Park	$1,547,024	$778,964	$768,060

5.8 NED PLAN

Overall, the most economically efficient plan (maximizes net benefits) is the combination of the Rosedale Dam Detention Area Improvements and the Kissingbower Buyouts with Recreation Park. This plan produces $887,344 in average annual benefits and $198,579 in average annual costs over the life of the project equaling average annual net benefits of $688,765. This yields a BCR of 4.47.

Table A-28 presents the costs associated with each alternative at the FY18 price level. Total project costs by alternative have been included as attachments to this appendix. That of Alternative 2 can be found in Attachment 1; those of Alternatives 3 and 4 in Attachment 2; and that of Alternative 5 in Attachment 3. In compliance with ER 1105-2-100, which mandates that all costs and benefits be analyzed at a consistent price level, these cost will converted to the FY16 price level using Amendment 9 of EM 1110-2-1304. The Civil Works Breakdown Structure (CWBS) feature code used to accomplish this is listed by alternative in Table A-28.

Table A-28. Costs by Alternative
FY18 Price Level and 2.875 Percent Discount Rate

Alternatives	CWBS Feature Code	First Cost	IDC*	Average Annual Investment Cost	Annual O&M Cost	Average Annual Cost
1.No Action						
2.Rosedale Detention Area Alone	04 - DAMS	$3,679,000	$48,230	$141,441	$15,000	$156,441
3.Kissingbower Buyout Alone	02 -RELOCATIONS	$433,000	$2,568	$16,529	$ -	$16,529
4.Kissingbower Buyout with Park	14 – RECREATION FACILITIES	$1,061,000	$13,909	$40,791	$2,500	$43,291
5.Rosedale Detention Area and Kissingbower Buyout with Park	04 – DAMS 14 – RECREATION FACILITIES	$4,710,000	$61,746	$181,079	$17,500	$198,579

*Interest during Construction

Table A-29 summarizes the costs and benefits for each alternative. Both flood damage reduction and recreation benefits are included. The NED Plan is selected based on maximizing average annual net benefits.

Table A-29. Net Benefits by Alternative FY16
Price Level and 2.875 Percent Discount Rate

	Investment Cost	IDC*	Total Investment Cost	AAE Investment Cost	Annual O&M Cost	AAE Cost	AAE Benefits	AAE Net Benefit	B C R
Rosedale Detention Basin Alone	$3,554,447	$46,598	$3,601,044	$136,653	$15,000	$151,653	$766,536	$614,883	5.05
K-bower Buyout Alone	$412,984	$2,449	$415,433	$15,765	$0	$15,765	$1,524	-$14,241	0.10
K-bower Buyout with Park	$997,025	$13,071	$1,010,096	$38,331	$2,500	$40,831	$102,792	$61,961	2.52
Rosedale Detention Basin and K-bower Buyout with Park	$4,550,542	$59,656	$4,610,198	$174,948	$17,500	$192,448	$869,301	$676,853	4.52

*Interest during Construction

When combining the Rosedale Detention Basin Alone Alternative with the Kissingbower Buyout with Park Alternative, the BCR decreases from 5.05 to 4.52. However, including the Kissingbower Buyout with Park reduces average annual damages by $1,524. It has the additional impact of providing $101,268 in average annual recreation benefits. This decrease in average annual damages increases the average annual net benefits for the combined alternative above that of the Kissingbower Buyout with Park Alternative. The additional investment is worth the additional cost from a NED perspective and is policy compliant.

Flood damage reduction benefits of the NED plan total $768,060. In order to account for the uncertainties inherent to the FDA model discussed in Section 3, Table A-30 is included below. There is a 75 percent probability that flood damage reduction benefits will exceed $694,718, a 50 percent probability it will exceed $760,482, and a 25 percent probability it will exceed $832,514.

Table A-30. Probability Exceedance of Flood Damages Reduced
FY16 Price Level and 2.875 Percent Discount Rate

Probability Damage Reduced Exceeds Indicated Value		
75%	**50%**	**25%**
$694,718	$760,482	$832,514

5.9 NED PLAN RESIDUAL DAMAGE ANALYSIS

Expected Annual Damages (EADs) by category for the without-project and the with- project conditions are provided in Table A-31. Figure A-11 and A-12 display this information in graphic format. Commercial EADs are reduced by the largest amount, falling by $573,330 with the implementation of the project, a 57.1 percent reduction. Residential EADs falls from $196,158 under the without-project condition to $84,169 under the with-project condition, a reduction of 48.5 percent. Municipal EAD is reduced by a considerable degree as well; decreasing by $81,214 or 48.0 percent.

Table A-31: Without and With Project Average Annual Equivalent Damages
FY16 Price Level and 2.875 Percent Discount Rate

	Without Project	With Project	Damage Reduction
Residential	$196,158	$82,645	$113,513
Commercial	$1,181,979	$608,649	$573,330
Public Utility	$1	$1	$0
Industrial	$4	$0	$3
Municipal	$168,883	$87,669	$81,214
Total:	**$1,547,024**	**$778,964**	**$768,060**

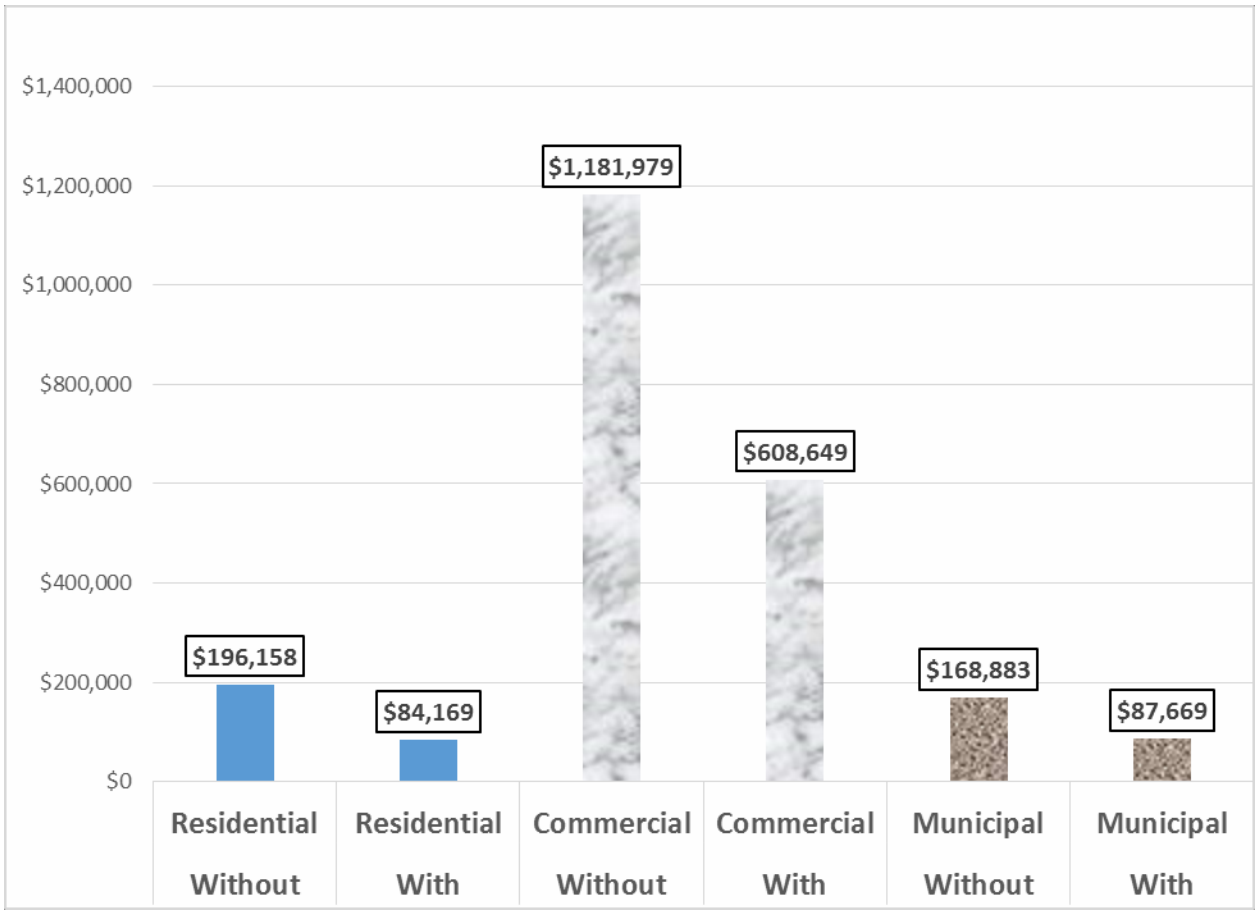


Figure A-11: Average Annual Equivalent Dollar Damage Without and With Project FY16 Price Level and 2.875 Percent Discount Rate

The commercial EAD reduction constitutes 74.8 percent of the total. Residential and municipal EAD reductions constitute 14.6 and 10.6 percent of the total, respectively.

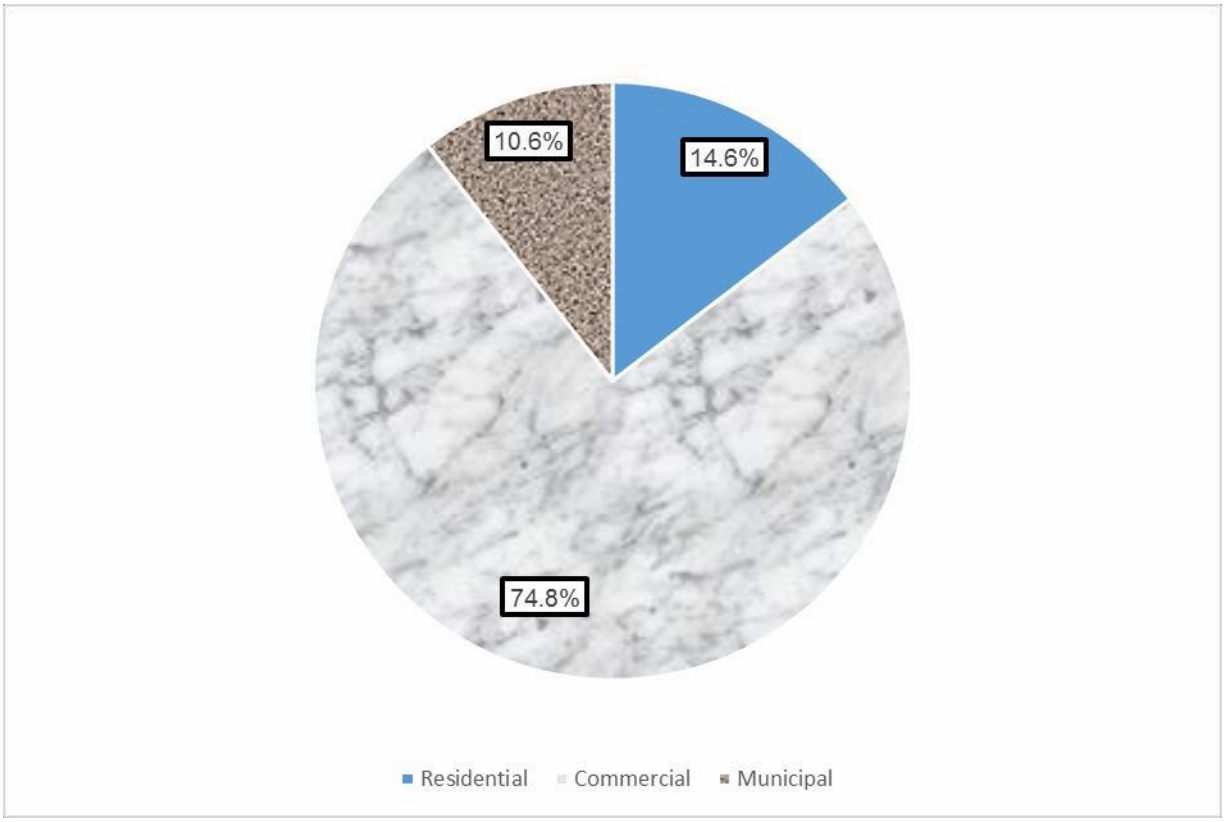


Figure A-12: Average Annual Equivalent Dollar Damage Reduced

The NED plan eliminates flood damages for 6 out of 14 structures for the 2-year event; 20 out of 52 structures for the 5-year event; 49 out of 114 structures for the 10-year event; 70 out of 162 structures for the 25-year event; 112 out of 233 structures for the 50-year event, 121 out of 279 structures for the 100-year event; 80 out of 326 structures for the 250-year event; and 64 out of 363 structures for the 500-year event (Table A-32). Sections 5.9.1 through 5.9.8 provide the locations of structures with damages eliminated and reduced by the NED plan for each storm event examined.

Table A-32: Residual Single Event Structure Damages

	Number of Structures Damaged							
	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**250-Year**	**500-Year**
Without Project	14	52	114	162	233	279	326	363
With Project	8	32	65	92	121	158	246	299
Delta	6	20	49	70	112	121	80	64
% Change*	42.9%	38.5%	43.0%	43.2%	48.1%	43.4%	24.5%	17.6%

*Calculated by dividing the change in number of structures damaged ('Delta NAA') by the number of structures damaged under the NAA.

The NED plan reduces flood damage by $985,000 out of $1,125,000 for the 2-year event; $1,103,000 out of $2,244,000 for the 5-year event; $1,376,000 out of $3960 for the 10-year event; $1,718,000 out of $5,147,000 for the 25-year event; $3,302,000 out of

$7,810,000 for the 50-year event; $4,192,000 for 100-year events; $4,720,000 out of $13,126,000 for the 250-year event; and $4,483,000 for 500-year event (Table A-33).

Table A-33: Residual Single Event Dollar Damages
FY16 Price Level and 2.875 Percent Discount Rate

	Dollar Damages ($K)							
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year	500-Year
Without Project	$1,125	$2,244	$3,960	$5,147	$7,810	$9,716	$13,126	$14,525
With Project	$141	$1,141	$2,585	$3,430	$4,509	$5,524	$8,406	$10,041
Delta	$985	$1,103	$1,376	$1,718	$3,302	$4,192	$4,720	$4,483
% Change*	87.5%	49.2%	34.7%	33.4%	42.3%	43.1%	36.0%	30.9%

*Calculated by dividing the change in dollar damages ('Delta NAA') by the dollar damages under the NAA.

Tables A-34 through A-39 provide summary information of the distribution of damage reductions among residential, commercial, and municipal structures. This information will be covered in greater depth in sections 5.9.1 through 5.9.8.

Table A-34: Residual Single Event Residential Structure Damages

	Number of Residential Structures Damaged							
Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year	500-Year
Without Project	4	34	73	114	161	199	235	263
With Project	3	17	40	53	75	102	171	216
Delta	1	17	33	61	86	97	64	47
% Change	25.0%	50.0%	45.2%	53.5%	53.7%	48.7%	27.2%	17.9%
% Total Reduction	16.7%	85.0%	67.3%	87.1%	77.7%	80.2%	80.0%	73.4%

Table A-35 Residual Single Event Residential Dollar Damages
FY16 Price Level and 2.875 Percent Discount Rate

	Residential Dollar Damages ($K)							
Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	250-Year	500-Year
Without Project	$9	$188	$568	$951	$1,788	$2,399	$3,203	$3,718
With Project	$6	$72	$243	$421	$631	$873	$1,708	$2,363
Delta	$3	$116	$325	$530	$1,157	$1,526	$1,495	$1,355
% Change	32.4%	61.8%	57.2%	55.8%	64.7%	63.6%	46.7%	36.5%
% Total Reduction	0.3%	10.6%	23.6%	30.9%	35.0%	36.4%	31.7%	30.2%

Table A-36: Residual Single Event Commercial Structure Damages

Number of Commercial Structures Damaged								
Storm Event	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**250-Year**	**500-Year**
Without Project	9	12	34	41	60	68	79	88
With Project	4	11	18	32	38	46	64	72
Delta	5	1	16	9	22	22	15	16
% Change	55.6%	8.3%	47.1%	22.0%	36.7%	32.4%	19.0%	18.2%
% Total Reduction	83.3%	5.0%	32.7%	12.9%	19.6%	18.2%	18.8%	25.0%

Table A-37: Residual Single Event Commercial Dollar Damages
FY16 Price Level and 2.875 Percent Discount Rate

Commercial Dollar Damages ($K)								
Storm Event	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**250-Year**	**500-Year**
Without Project	$1,116	$1,824	$2,834	$3,462	$4,588	$5,269	$7,493	$8,028
With Project	$134	$1,059	$1,989	$2,471	$3,126	$3,862	$5,479	$6,281
Delta	$982	$765	$845	$991	$1,462	$1,407	$2,015	$1,747
% Change	88.0%	41.9%	29.8%	28.6%	31.9%	26.7%	26.9%	21.7%
% Total Reduction	99.7%	69.3%	61.4%	57.7%	44.2%	33.5%	42.7%	39.0%

Table A-38: Residual Single Event Municipal Structure Damages

Number of Municipal Structures Damaged								
Storm Event	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**250-Year**	**500-Year**
Without Project	0	5	6	6	10	11	11	11
With Project	0	3	6	6	7	9	10	10
Delta	0	2	0	0	3	2	1	1
% Change	-	40.0%	0.0%	0.0%	30.0%	18.2%	9.1%	9.1%
% Total Reduction	0.0%	10.0%	0.0%	0.0%	2.7%	1.7%	1.3%	1.6%

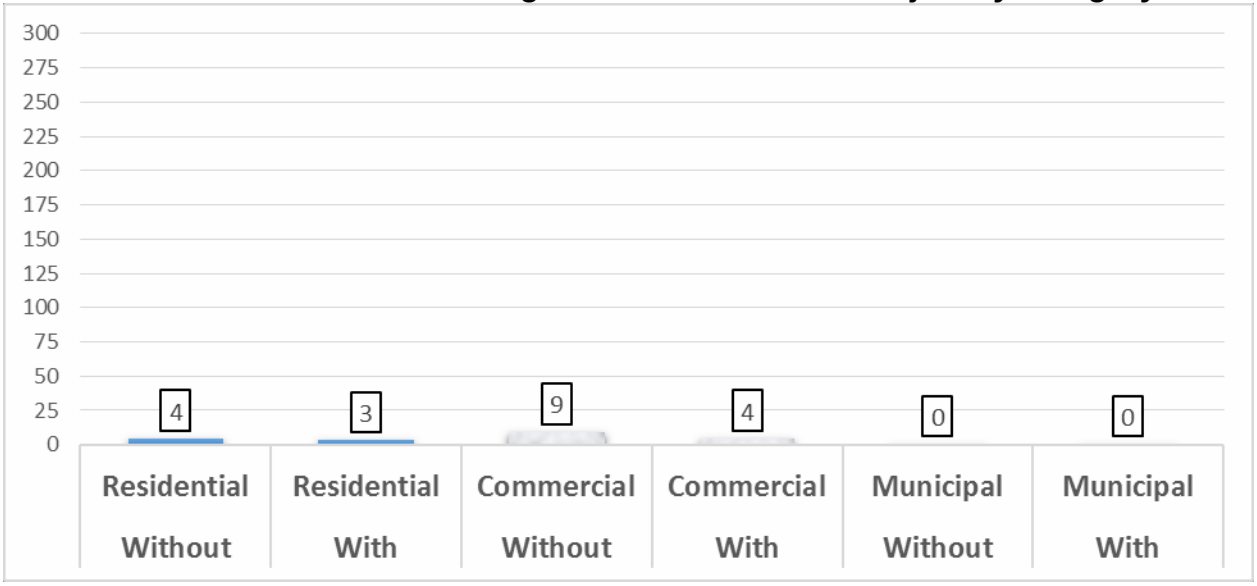
Table A-39: Residual Single Event Municipal Dollar Damages
FY16 Price Level and 2.875 Percent Discount Rate

Municipal Dollar Damages ($K)								
Storm Event	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**250-Year**	**500-Year**
Without Project	$0	$231	$558	$735	$1,435	$2,047	$2,429	$2,779
With Project	$0	$9	$352	$538	$752	$789	$1,219	$1,398
Delta	$0	$222	$206	$197	$682	$1,258	$1,210	$1,381
% Change	-	95.9%	36.9%	26.8%	47.6%	61.4%	49.8%	49.7%
% Total Reduction	0.0%	20.1%	15.0%	11.4%	20.7%	30.0%	25.6%	30.8%

5.9.1 NED PLAN 2-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-13 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.5 probability of occurrence (2-year) storm event under both the without-project and with-project conditions. Figure A-14 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-15 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

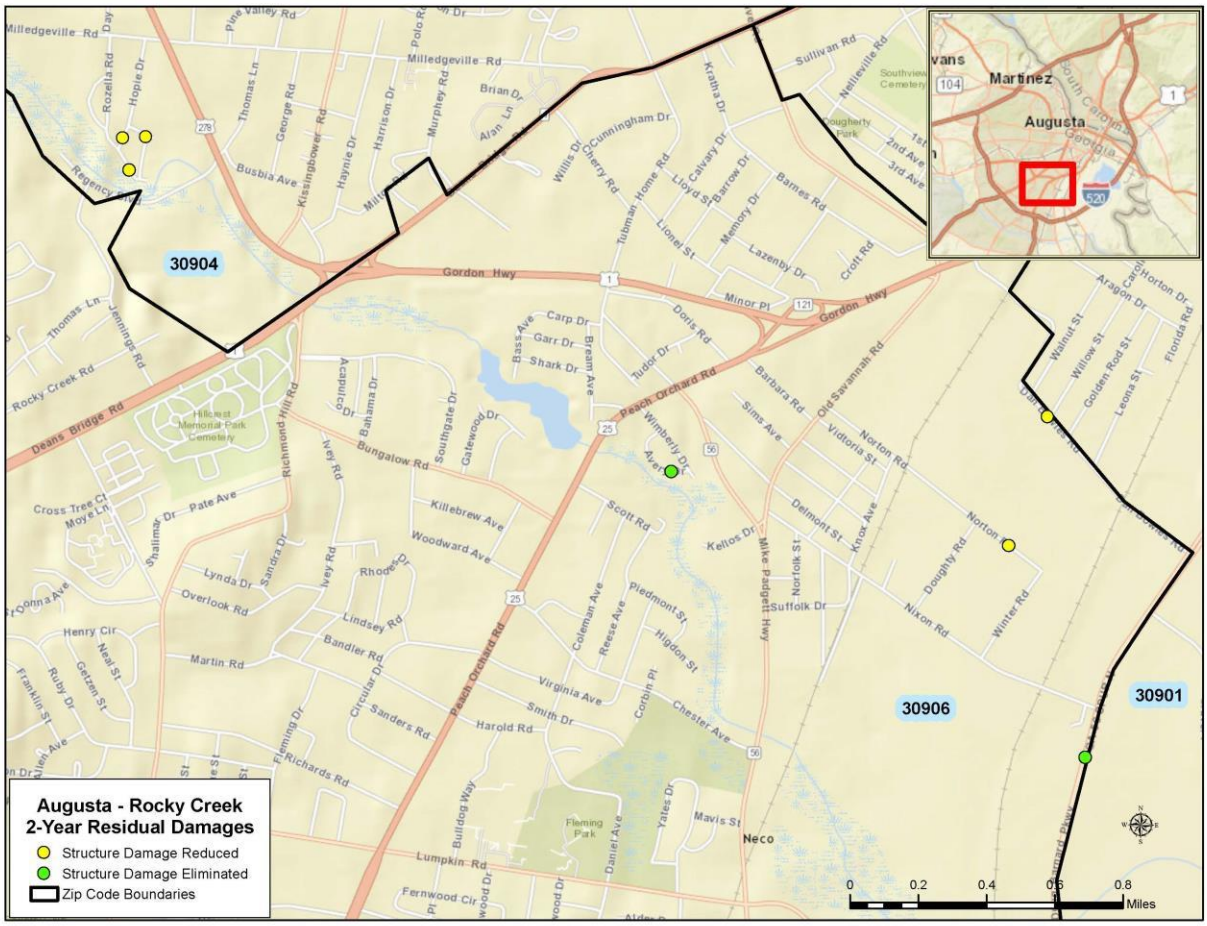
Figure A-13. Rocky Creek 2-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 14 structures receive damages in the without project condition. Of these, 9 are commercial and 4 are residential. One additional structure not included in Figure A-13, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage under the with-project and without-project conditions.

Under the with-project condition, 3 residential structures and 4 commercial structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 8. This constitutes a reduction of 42.9 percent between the with-project and without-project conditions. The number of residential structures damaged decreases by 25.0 percent, and the number of commercial structures damaged decreases by 55.6 percent. No municipal structures are predicted to incur damages in either the without-project or the with-project condition.

Figure A-14. Rocky Creek 2-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



A total of $1,125,244 in flood damages occur under the without-project condition. Of this, $9,014 of damage is to residential structures and their contents, which constitutes 0.80 percent of the without-project total dollar damages. Commercial damages are far more extensive, amounting to $1,116,229 or 99.2 percent of without-project total dollar damages.

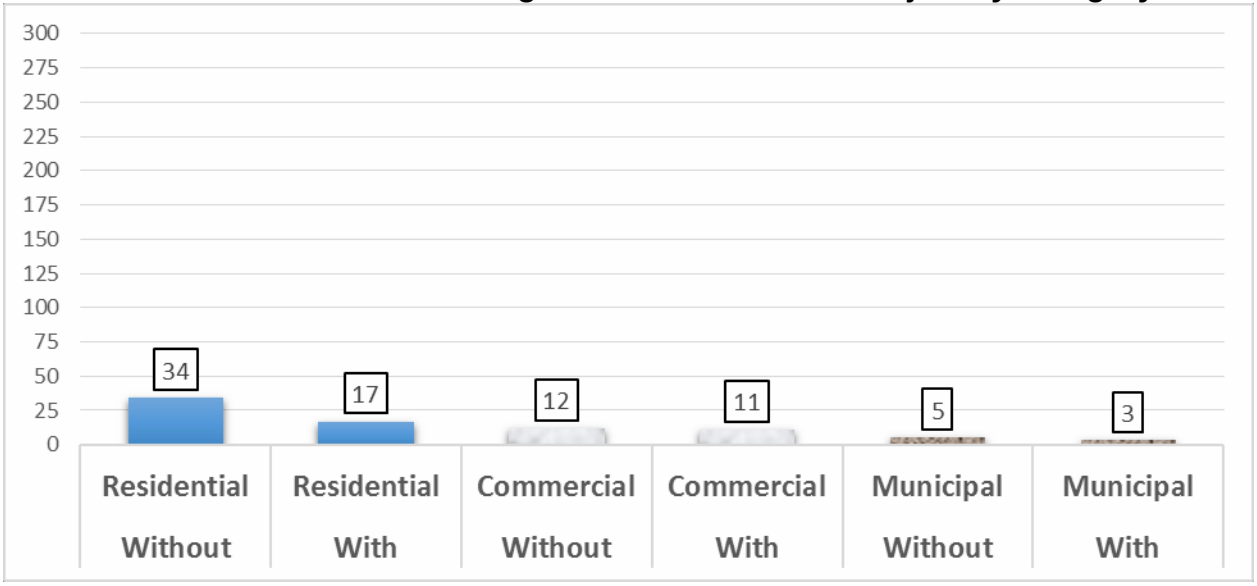
Under the with-project condition, total dollar damages are reduced to $140,500. This equates to a decrease of $984,701, or 87.5 percent of the total dollar damages incurred under the without-project condition. Residential damages are reduced by $2,923, a decrease of 32.4 percent of the without-project damages for that category. Commercial damages are reduced by $981,777. This decrease constitutes 99.7 percent of the total damage reduction, and 87.6 percent of commercial without-project damages for this event.

Figure A-15. Rocky Creek 2-Year Flood Event
Dollar Damages Without and With Project by Category

5.9.2 NED PLAN 5-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-16 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.2 probability of occurrence (5-year) storm event under both the without-project and with-project conditions. Figure A-17 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-18 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

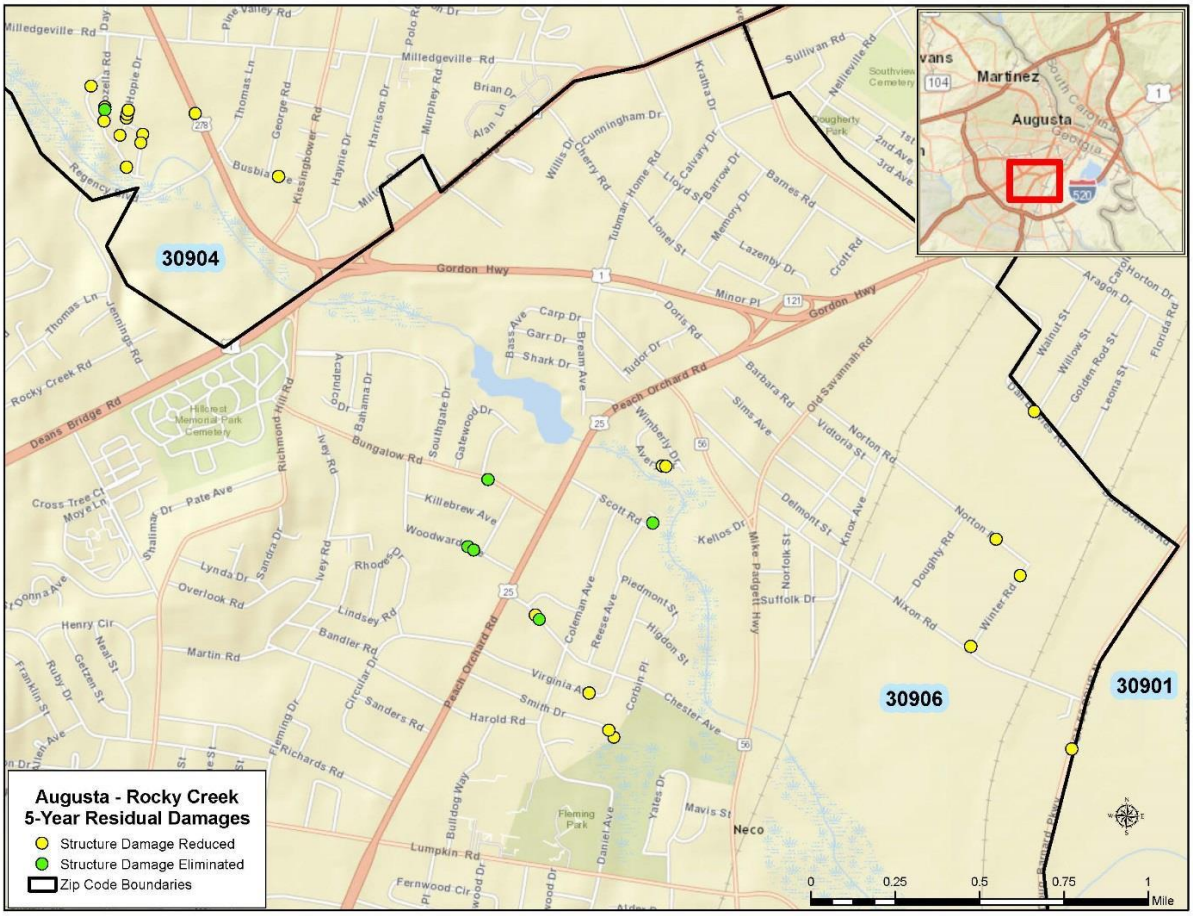
Figure A-16. Rocky Creek 5-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 52 structures receive damages in the without-project condition. Of these, 34 are residential, 12 are commercial, and 5 are municipal. One additional structure not incorporated in Figure A-16, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 17 residential structures, 11 commercial structures, and 3 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 32. This constitutes an overall reduction of 38.5 percent between the with-project and without-project conditions. The number of residential structures damaged decreases by 50.0 percent, the number of commercial structures damaged decreases by 8.3 percent, and the number of municipal structures damaged decreases by 40.0 percent.

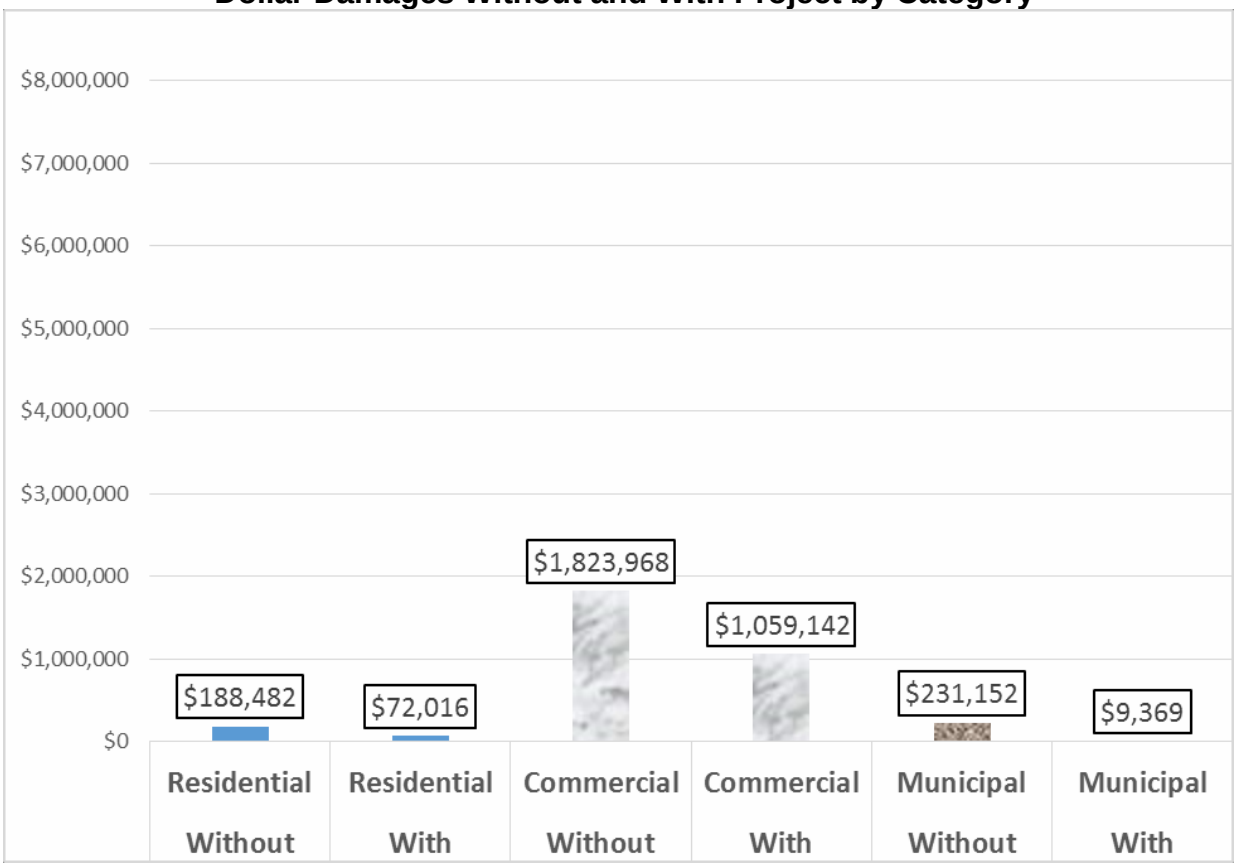
Figure A-17. Rocky Creek 5-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



A total of $2,243,603 in flood damages occur under the without-project condition. Of this, $188,482 of damage is to residential structures and their contents, which constitutes 8.40 percent of the without-project total dollar damages. Damages to municipal structures are greater, totaling $231,152 or 9.6 percent of total dollar damages. Commercial damages are the most extensive, amounting to $1,823,968 or 81.3 percent of the without-project total dollar damages.

Under the with-project condition, total dollar damages are reduced to $1,140,528. This equates to a decrease of $1,103,528, or 49.1 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by the greatest amount, dropping by $764,826. This decrease constitutes 69.3 percent of the total reduction in damage, and 41.9 percent of the without-project damages for that category. Residential damages are reduced by $116,465, a decrease of 8.4 percent of the without-project damages for that category. Municipal damages fall by $221,783, or 96.0 percent.

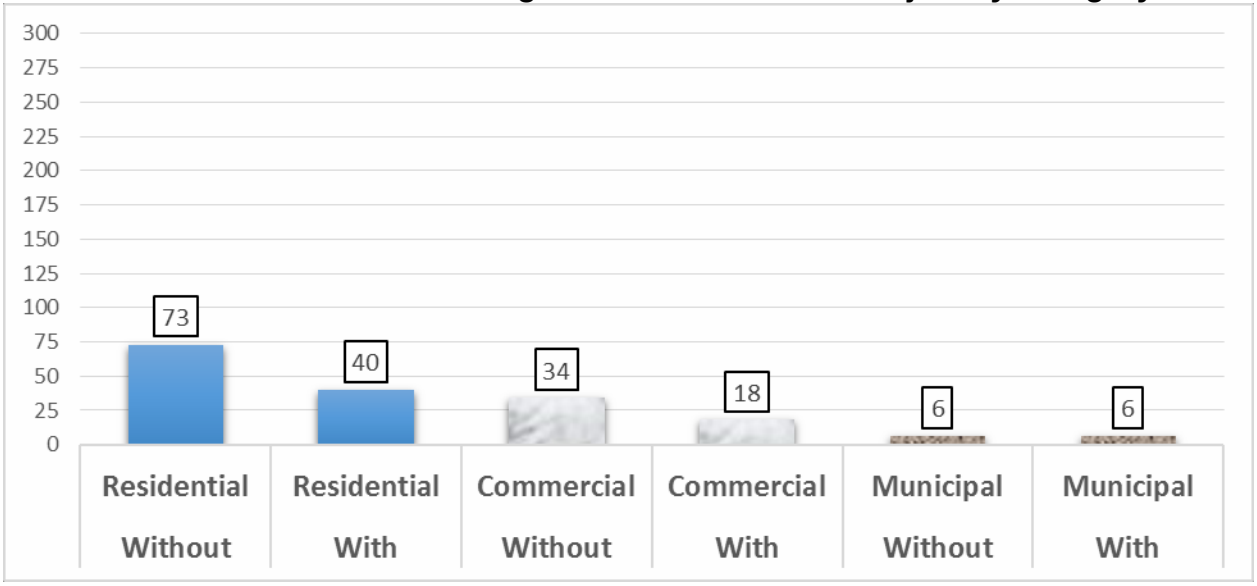
Figure A-18. Rocky Creek 5-Year Flood Event
Dollar Damages Without and With Project by Category



5.9.3 NED PLAN 10-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-19 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.1 probability of occurrence (10-year) storm event under both the without-project and with-project conditions. Figure A-20 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-21 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

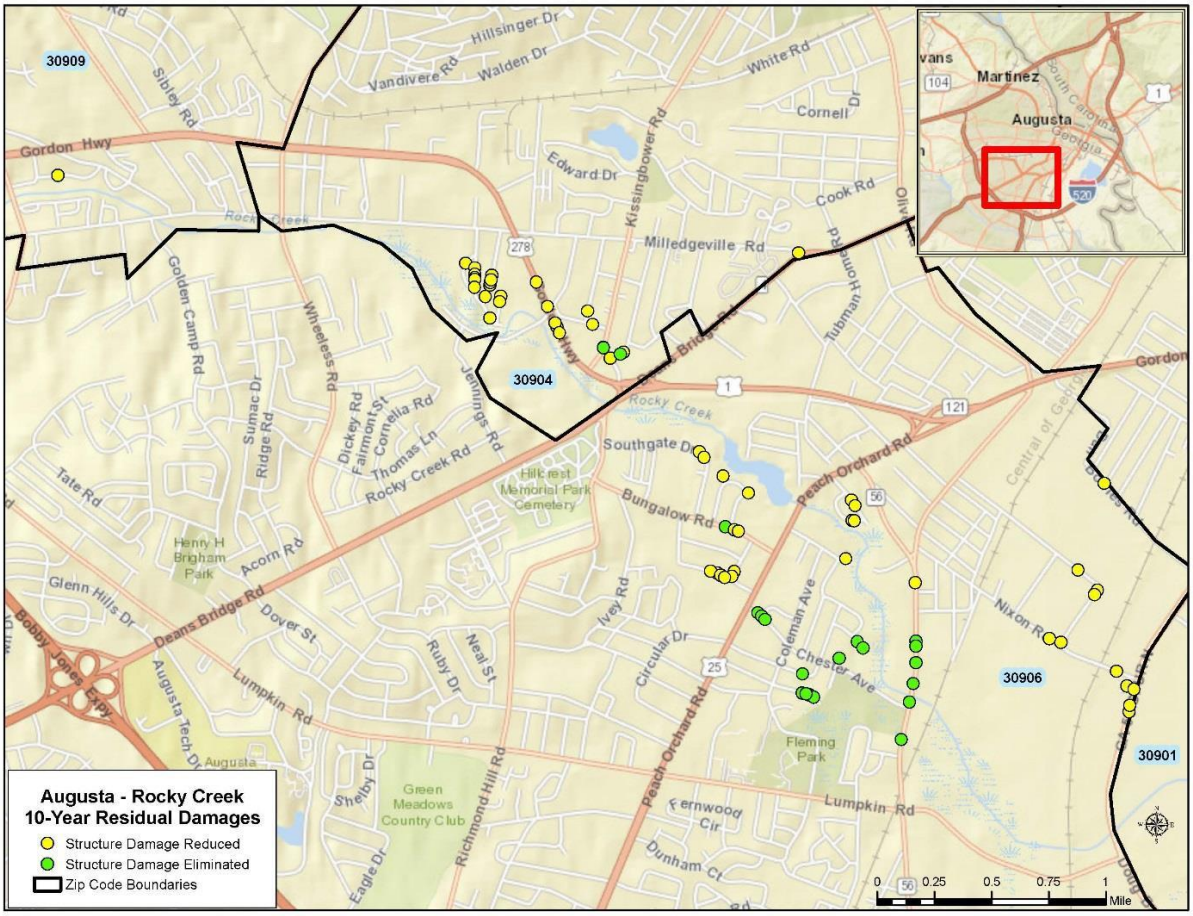
Figure A-19. Rocky Creek 10-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 114 structures receive damages in the without-project condition. Of these, 73 are residential, 34 are commercial, and 6 are municipal. One additional structure not incorporated in Figure A-19, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 40 residential structures, 18 commercial structures, and 6 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 65. This constitutes an overall reduction of 43.2 percent between the with-project and without-project conditions. The number of residential structures damaged decreases by 45.2 percent, the number of commercial structures damaged decreases by 47.1 percent, and the number of municipal structures damaged is unaltered.

Figure A-20. Rocky Creek 10-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites

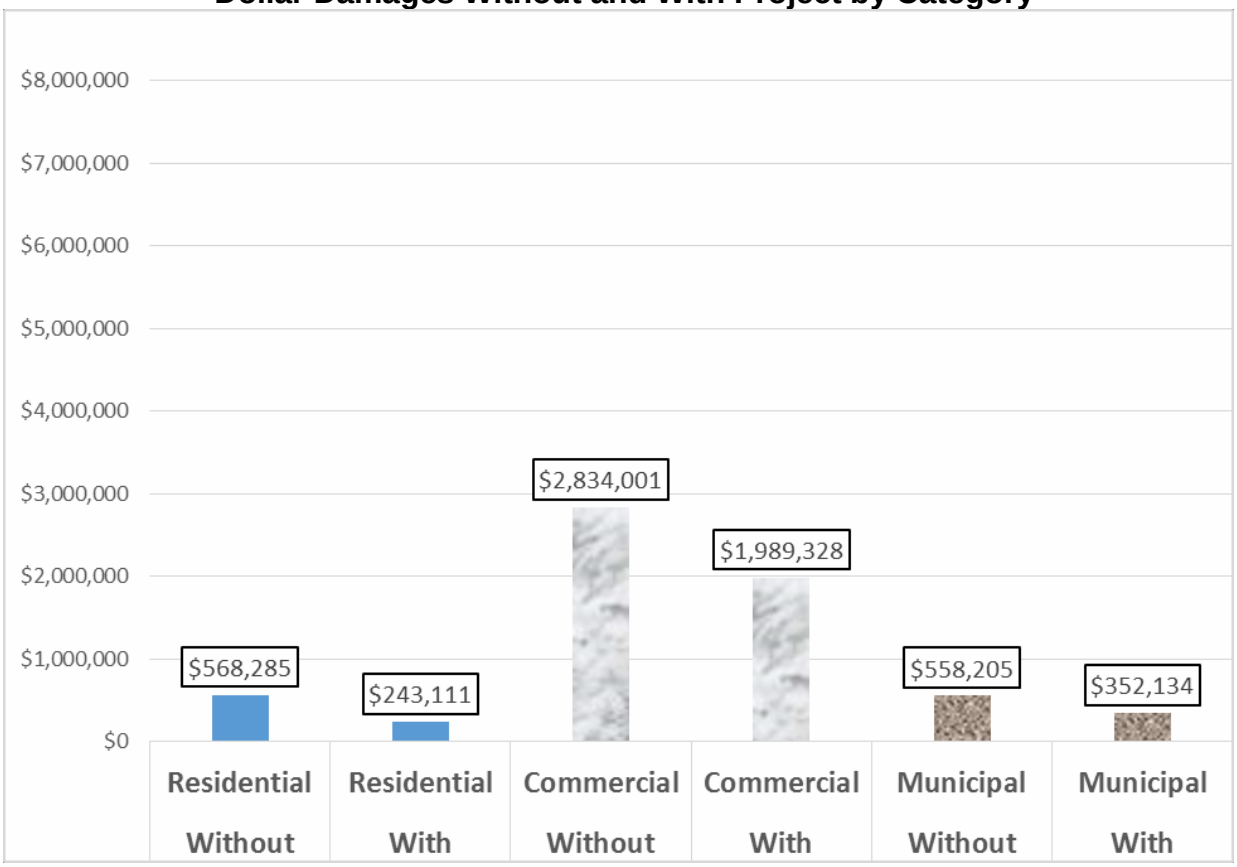


A total of $3,960,491 in flood damages occur under the without-project condition. Of this, $568,285 of damage is to residential structures and their contents, which constitutes 14.35 percent of the without-project total dollar damages. Damages to municipal structures total $558,205 or 14.1 percent of without-project total dollar damages. Commercial damages are the most extensive, amounting to $2,834,001, or 71.56 percent of the total dollar damages.

Under the with-project condition, total dollar damages are reduced to $2,584,573. This equates to a decrease of $1,375,918, or 34.7 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by the greatest amount, dropping by $884,673. This decrease constitutes 61.4 percent of the total reduction in damage, and 29.8 percent of without-project commercial damages. Municipal damages are reduced by $206,071, or 36.9 percent of the without-project damages of that category. Residential damages fall by $325,174, a reduction of 57.2 percent.

Two commercial structure will experience equivalent damages under both the without-project and the with-project conditions during this storm event.

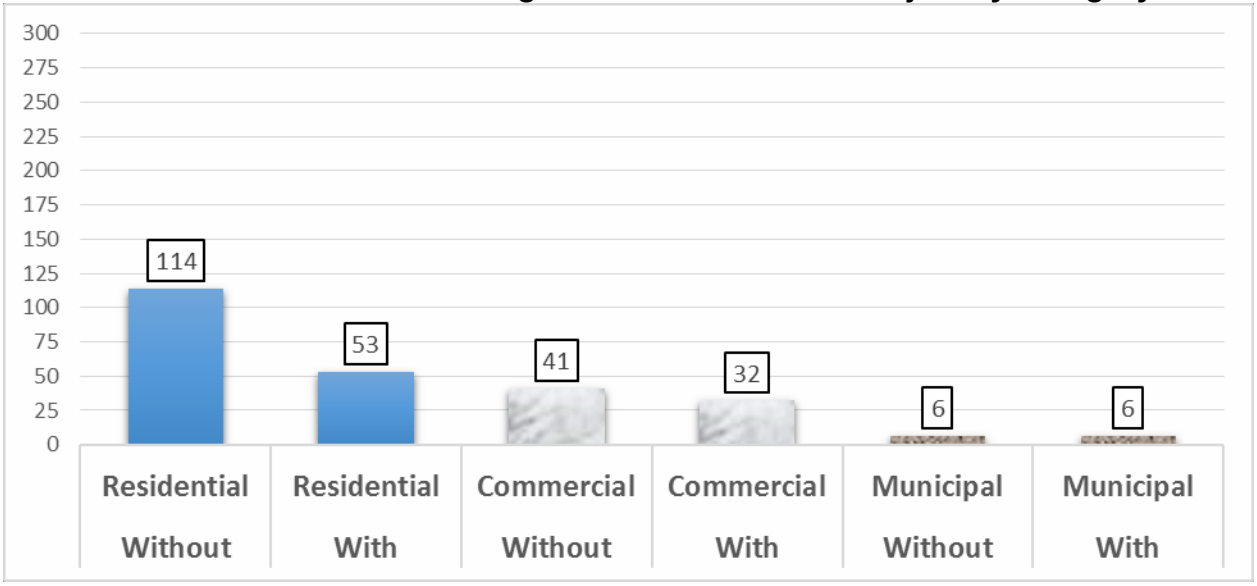
Figure A-21. Rocky Creek 10-Year Flood Event
Dollar Damages Without and With Project by Category



5.9.4 NED PLAN 25-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-22 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.04 probability of occurrence (25-year) storm event under both the without-project and with-project conditions. Figure A-23 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-24 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

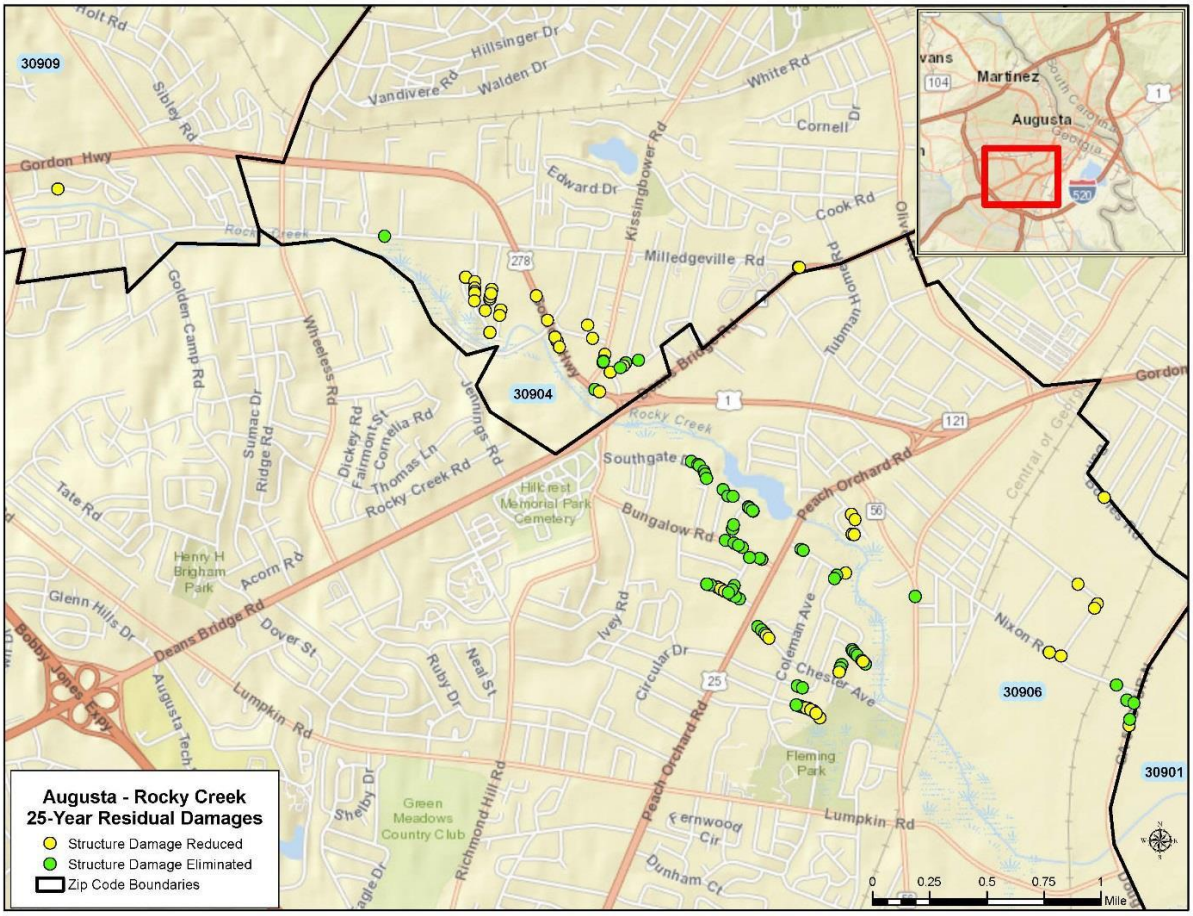
Figure A-22. Rocky Creek 25-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 162 structures receive damages in the without-project condition. Of these, 114 are residential, 41 are commercial, and 6 are municipal. One additional structure not incorporated in Figure A-22, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 53 residential structures, 32 commercial structures, and 6 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 92. This constitutes an overall reduction of 43.2 percent between the with-project and without-project conditions. The number of residential structures damaged decreases by 53.5 percent, the number of commercial structures damaged decreases by 22.0 percent, and the number of municipal structures damaged does not change.

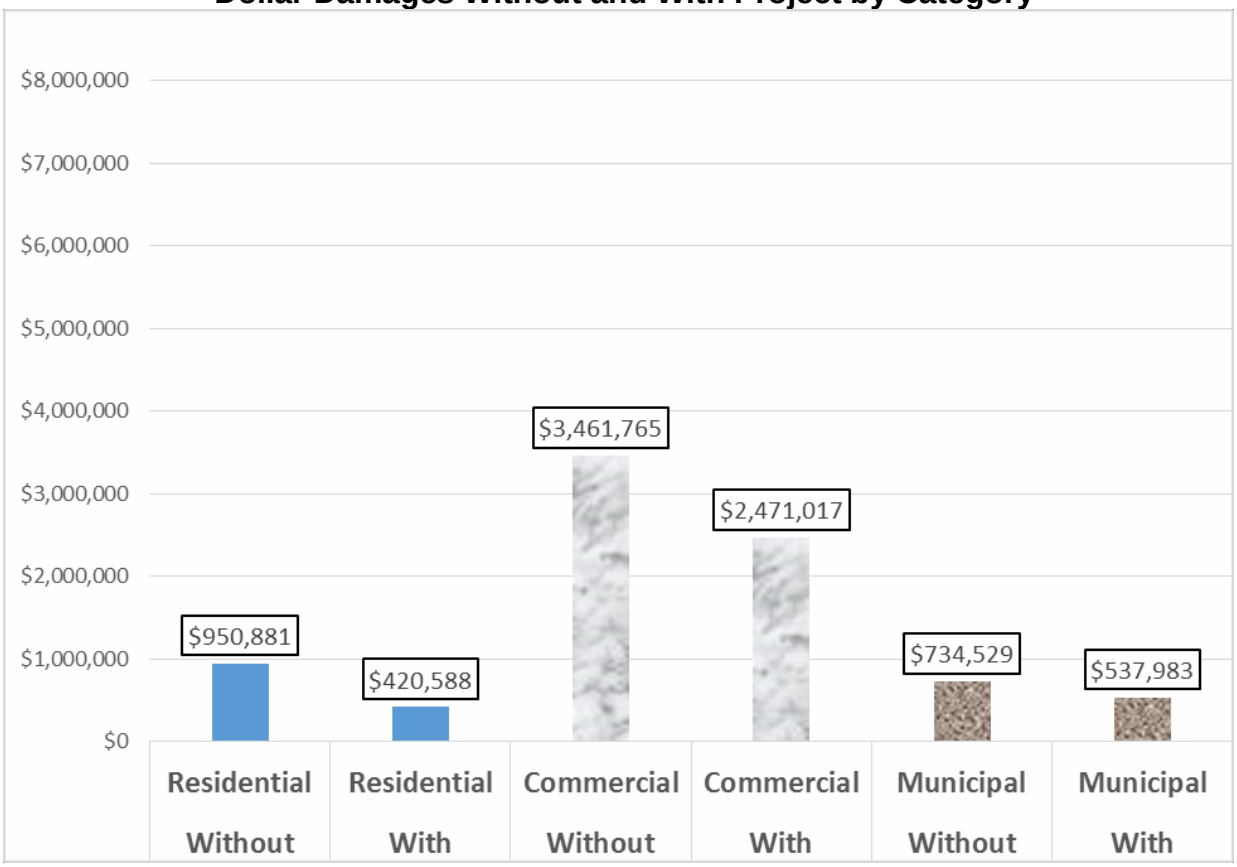
Figure A-23. Rocky Creek 25-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



A total of $5,147,176 in flood damages occur under the without-project condition. Of this, $950,881 of damage is to residential structures and their contents, which constitutes 18.5 percent of the without-project total dollar damages. Damages to municipal structures total $734,539 or 14.3 percent of without-project total dollar damages. Commercial damages are the most extensive, amounting to $3,461,765, or 67.26 percent of the without-project total dollar damages.

Under the with-project condition, total dollar damages are reduced to $3,429,589. This equates to a decrease of $1,717,587, or 33.3 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by the greatest amount, dropping by $990,748. This decrease constitutes 57.7 percent of the total reduction in damage, and 28.6 percent of the without-project damages for that category. Municipal damages are reduced by $196,545, or 26.7 percent of without-project municipal damages. Residential damages decrease by $530,293, representing a reduction of 55.7 percent.

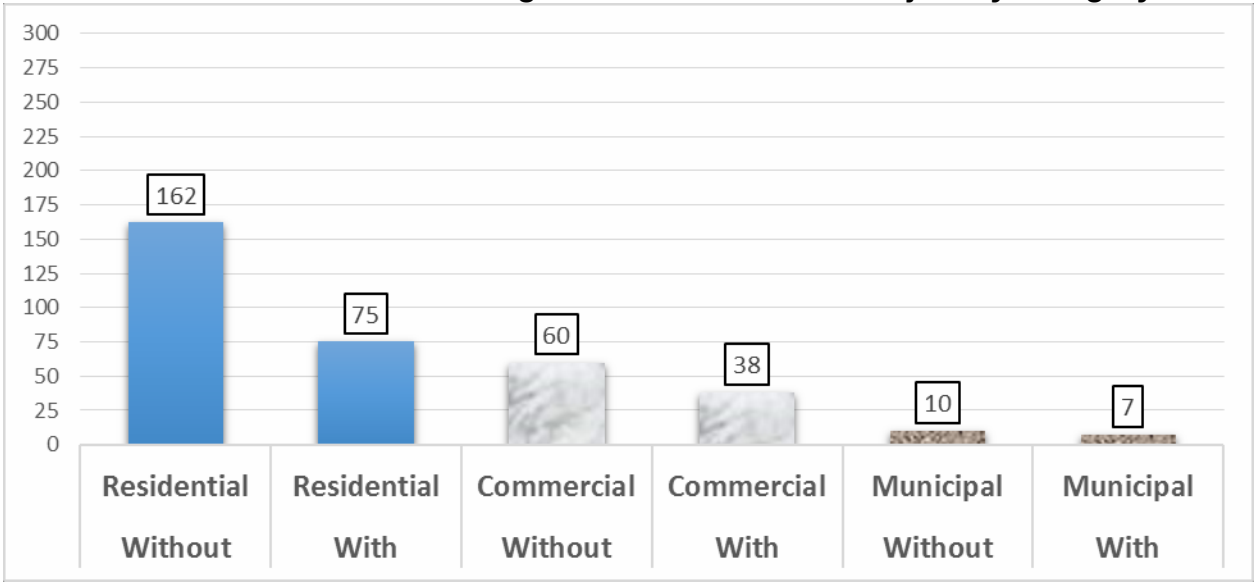
Figure A-24. Rocky Creek 25-Year Flood Event
Dollar Damages Without and With Project by Category



5.9.5 NED PLAN 50-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-25 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.02 probability of occurrence (50-year) storm event under both the without-project and with-project conditions. Figure A-26 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-27 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

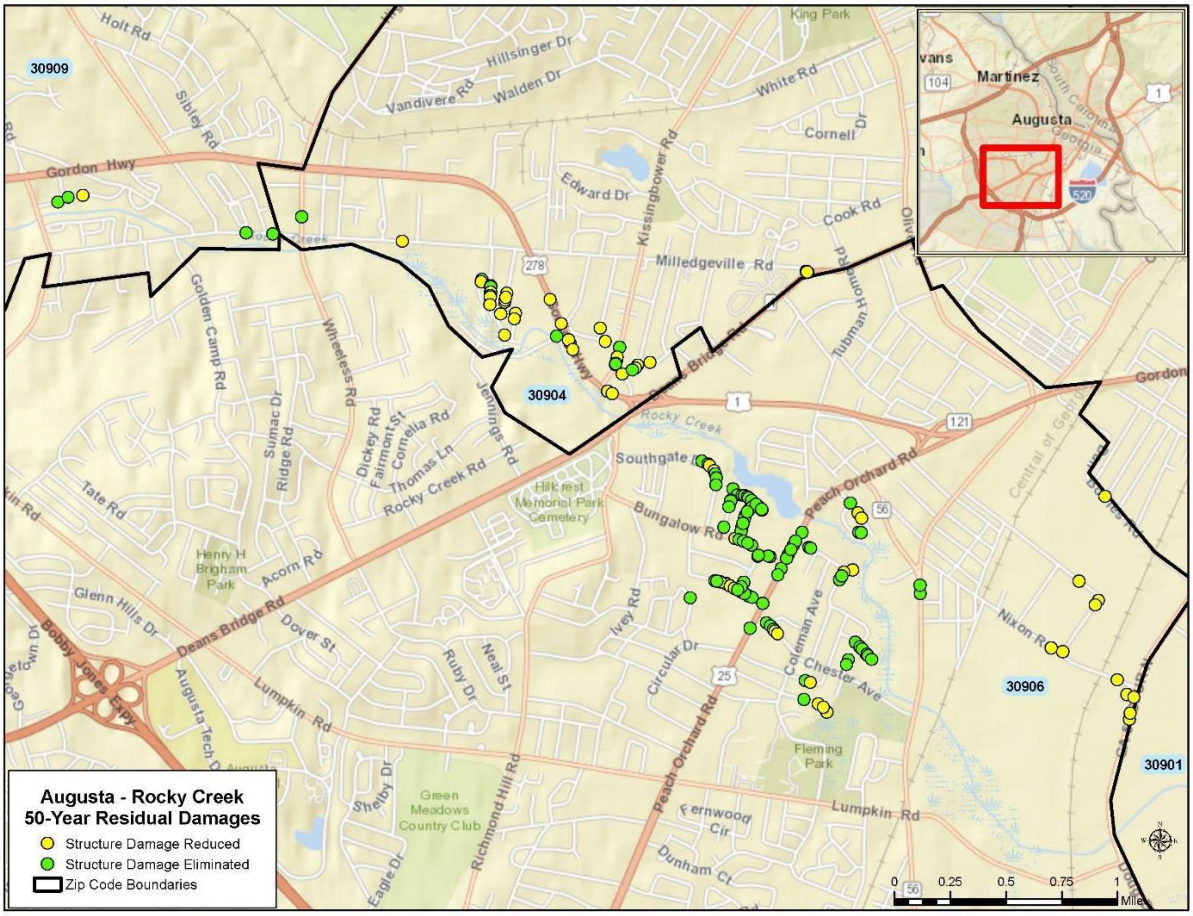
Figure A-25. Rocky Creek 50-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 233 structures receive damages in the without-project condition. Of these, 162 are residential, 60 are commercial, and 10 are municipal. One additional structure not incorporated in Figure A-25, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 75 residential structures, 38 commercial structures, and 7 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 121. This constitutes an overall reduction of 48.0 percent between the with-project and without-project conditions. The number of residential structures damaged decreases by 53.7 percent, the number of commercial structures damaged decreases by 36.7 percent, and the number of municipal structures damaged decreases by 30.0 percent.

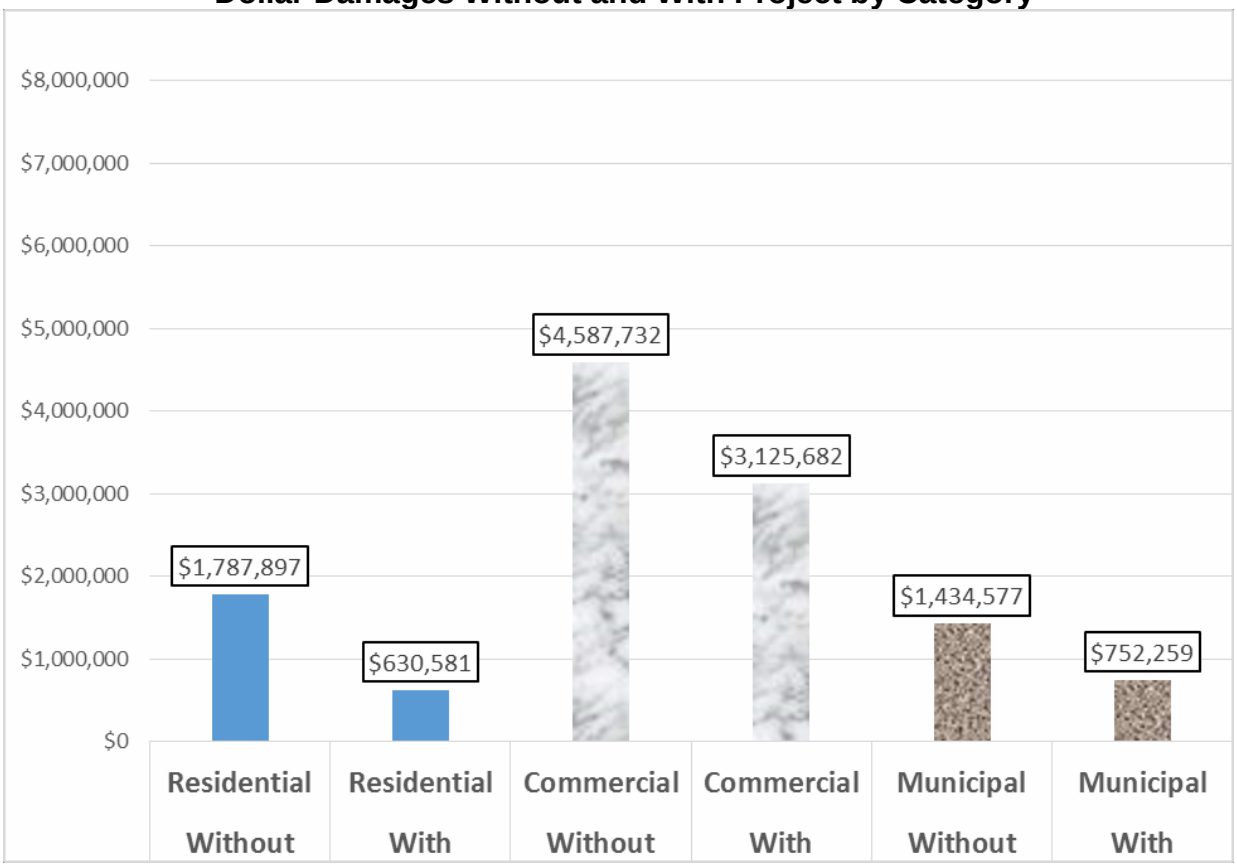
Figure A-26. Rocky Creek 50-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



A total of $7,810,208 in flood damages occur under the without-project condition. Of this, $1,787,897 of damage is to residential structures and their contents, which constitutes 22.9 percent of the without-project total dollar damages. Damages to municipal structures total $1,434,577 or 18.4 percent of without-project total dollar damages. Commercial damages are the most extensive, amounting to $4,587,732, or 58.7 percent of the without-project total dollar damages.

Under the with-project condition, total dollar damages are reduced to $4,508,522. This equates to a decrease of $3,301,686, or 42.3 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by the greatest amount, dropping by $1,462,051 or 31.9 percent. This constitutes 44.3 percent of the total reduction in damage. Municipal damages are reduced by $682,318, a decrease of 47.6 percent. Residential damages are reduced by $1,157,317, or 64.7 percent.

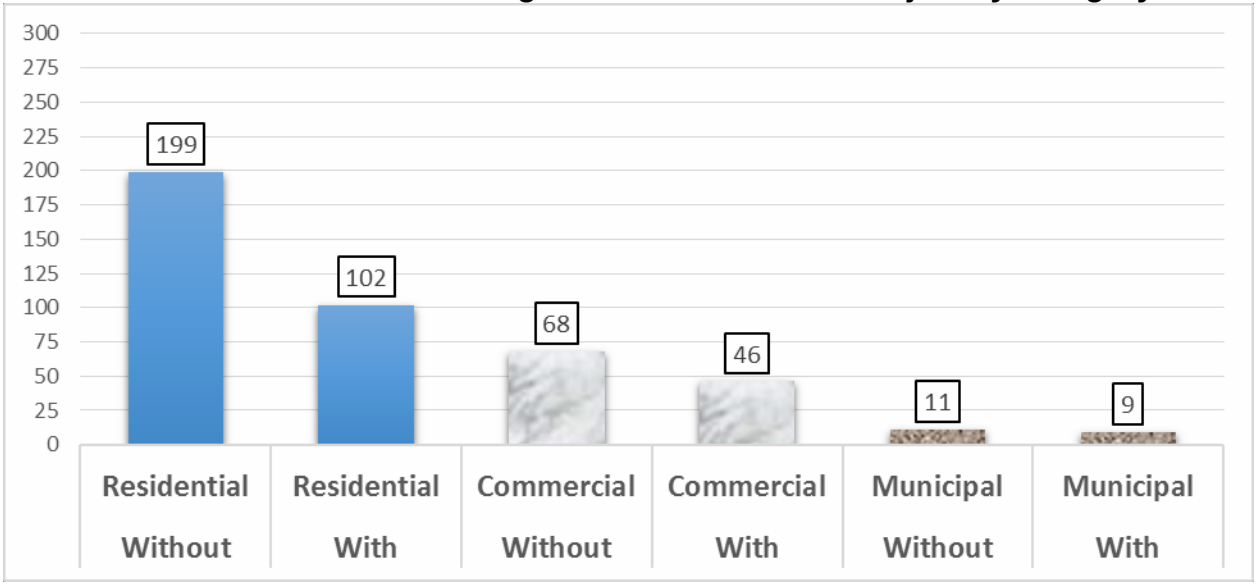
Figure A-27. Rocky Creek 50-Year Flood Event
Dollar Damages Without and With Project by Category



5.9.6 NED PLAN 100-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-28 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.01 probability of occurrence (100-year) storm event under both the without-project and with-project conditions. Figure A-29 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-30 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

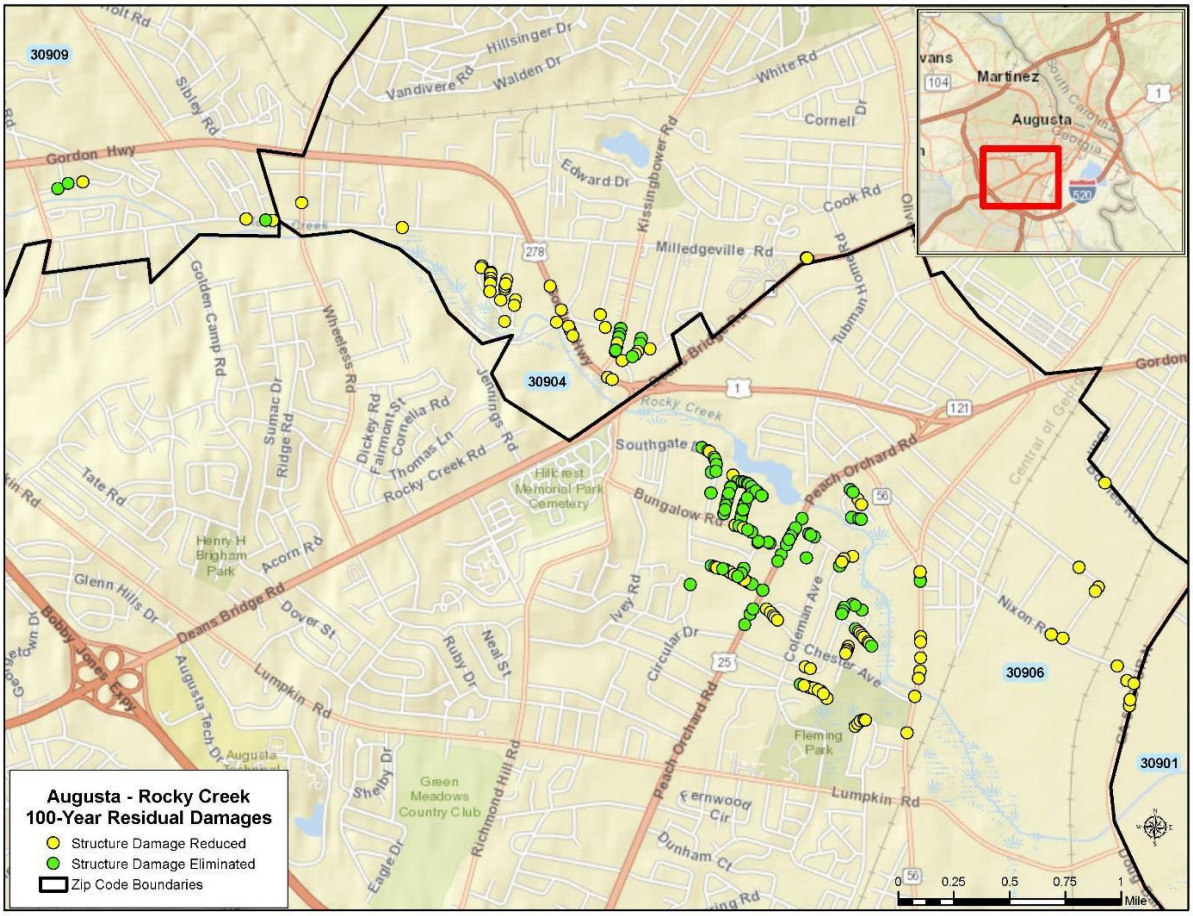
Figure A-28. Rocky Creek 100-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 279 structures receive damages in the without-project condition. Of these, 199 are residential, 68 are commercial, and 11 are municipal. One additional structure not incorporated in Figure A-28, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 102 residential structures, 46 commercial structures, and 9 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 158. This constitutes an overall reduction of 43.3 percent between the without-project and with-project conditions. The number of residential structures damaged decreases by 48.7 percent, the number of commercial structures damaged decreases by 32.4 percent, and the number of municipal structures damaged decreases by 18.2 percent.

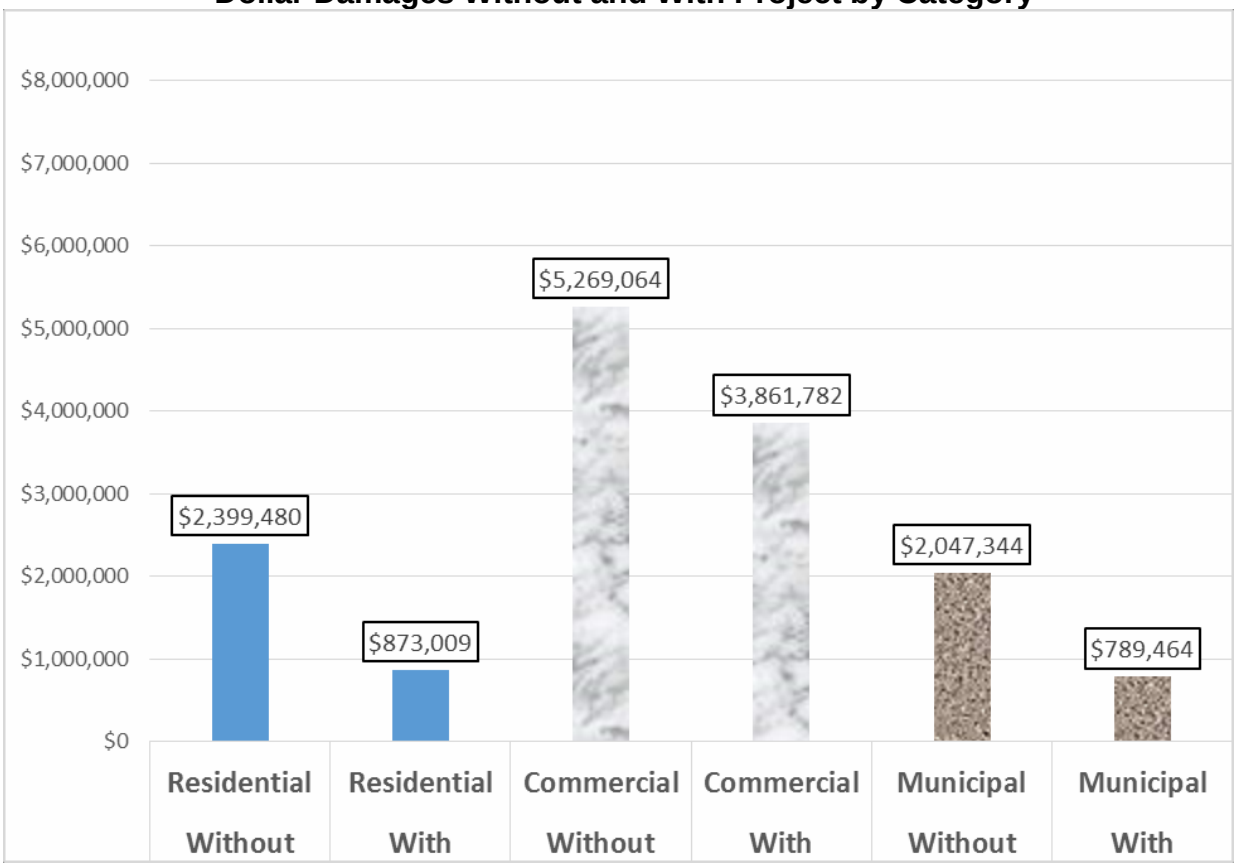
Figure A-29. Rocky Creek 100-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



A total of $9,715,889 in flood damages occur under the without-project condition. Of this, $2,399,480 of damage is to residential structures and their contents, which constitutes 24.7 percent of the without-project total dollar damages. Damages to municipal structures total $2,047,344 or 21.1 percent of the without-project total dollar damages. Commercial damages are the most extensive, amounting to $5,269,064, or 54.2 percent of the without-project total dollar damages.

Under the with-project condition, total dollar damages are reduced to $5,524,257. This equates to a decrease of $4,191,632, or 43.1 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by $1,407,282, or 26.7 percent. The reduction in commercial damages constitutes 33.6 percent of the total reduction in damage. Municipal damages are reduced by 61.4 percent, or $1,257,880. This constitutes 30.0 percent of the total damage reduction. The reduction in residential damages is the greatest, totaling $1,526,471 or 63.4 percent and representing 36.4 percent of the total damage reduction.

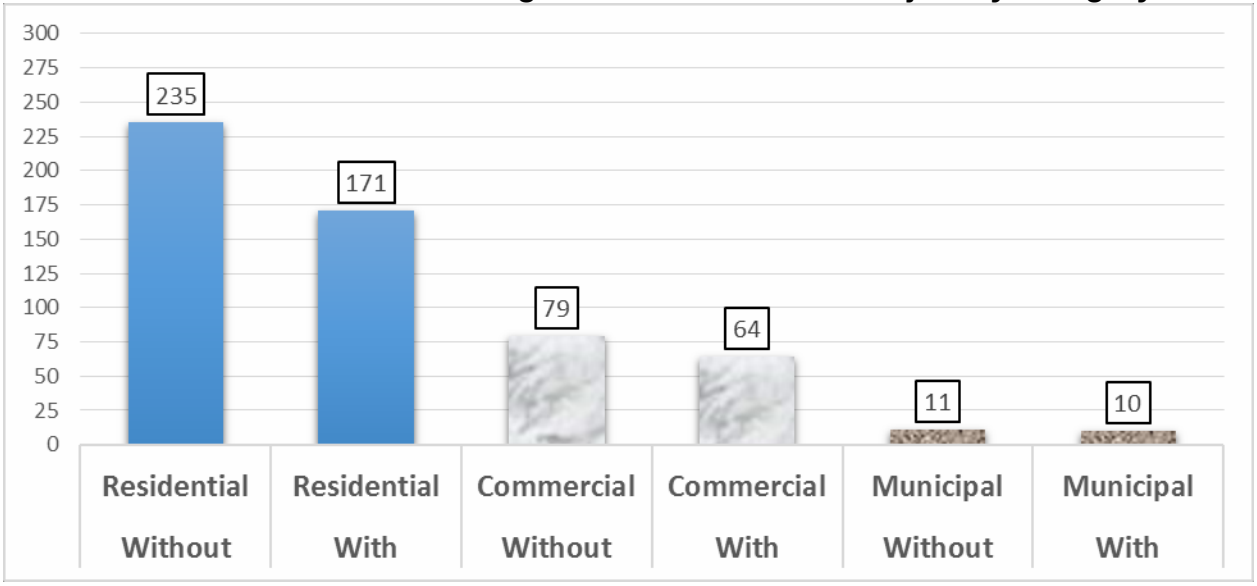
Figure A-30. Rocky Creek 100-Year Flood Event
Dollar Damages Without and With Project by Category



5.9.7 NED PLAN 250-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-31 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.004 probability of occurrence (250-year) storm event under both the without-project and with-project conditions. Figure A-32 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-33 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

Figure A-31. Rocky Creek 250-Year Flood Event
Number of Structures Damaged Without and With Project by Category

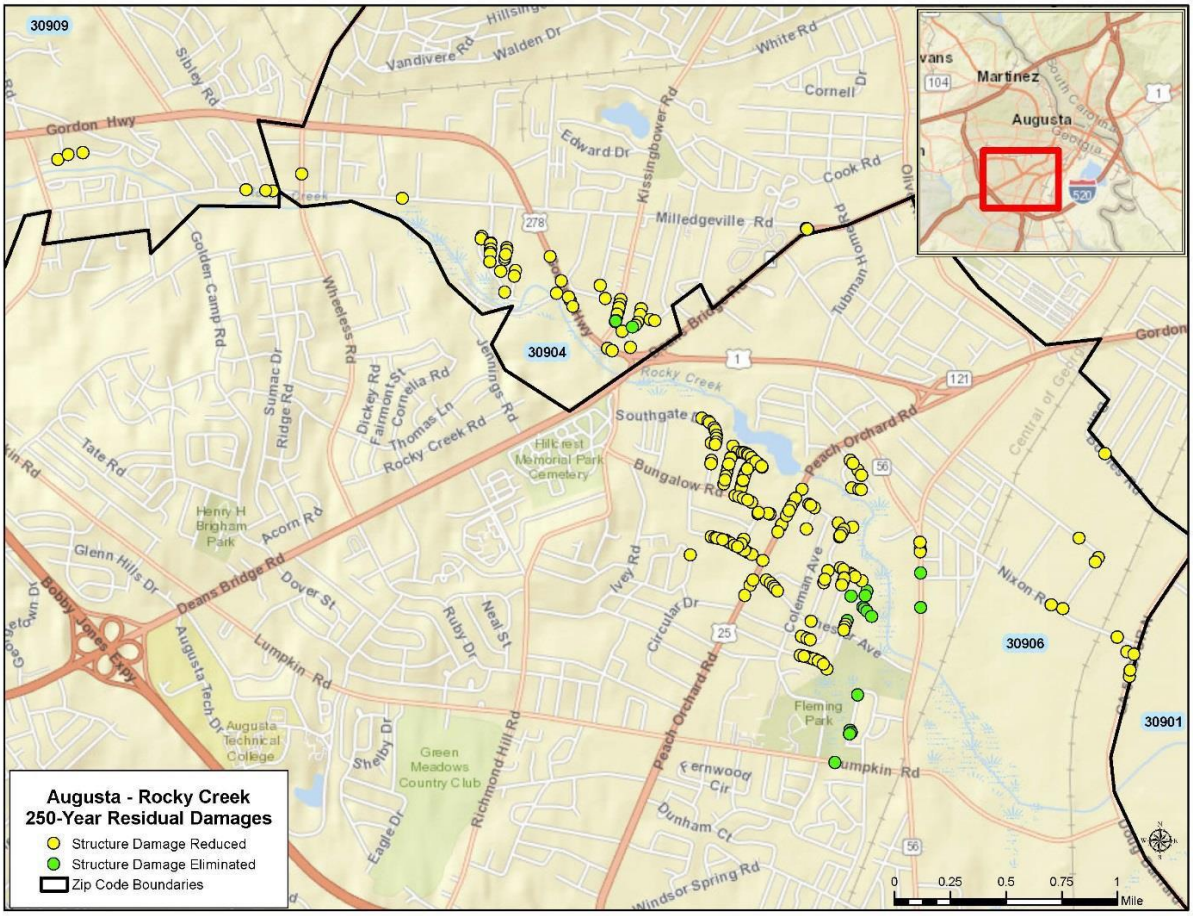


A total of 326 structures receive damages in the without-project condition. Of these, 235 are residential, 79 are commercial, and 11 are municipal. One additional structure not incorporated in Figure A-31, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 171 residential structures, 64 commercial structures, and 10 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 246. This constitutes an overall reduction of 24.5 percent. The number of residential structures damaged decreases by 27.2 percent, the number of commercial structures damaged decreases by 19.0 percent, and the number of municipal structures damaged decreases by 9.1 percent.

Two commercial structure will experience equivalent damages under both the without-project and the with-project conditions during this storm event.

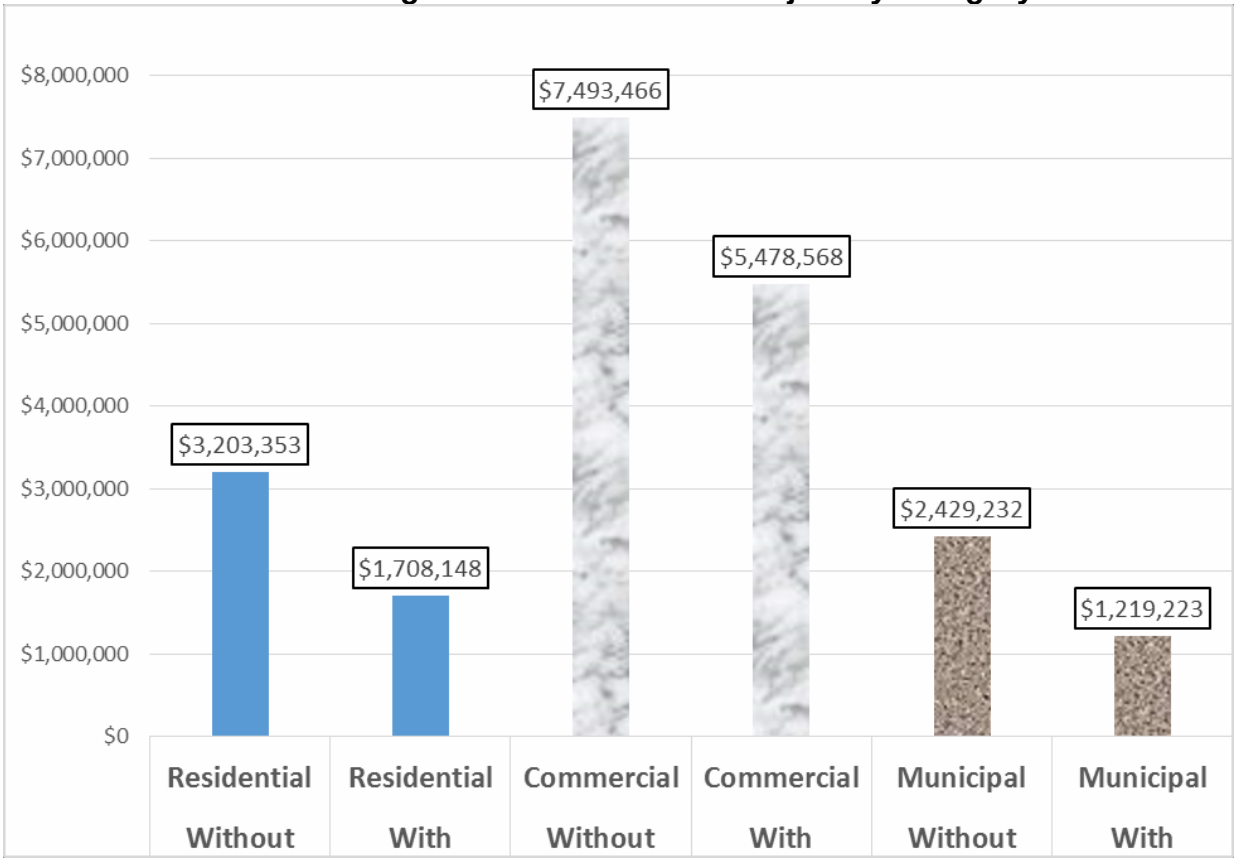
Figure A-32. Rocky Creek 250-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



A total of $13,126,052 in flood damages occur under the without-project condition. Of this, $3,203,353 of damage is to residential structures and their contents, which constitutes 24.4 percent of the without-project total dollar damages. Damages to municipal structures total $2,429,232 or 18.5 percent of the total dollar damages. Commercial damages are the most extensive, amounting to $7,493,466, or 57.1 percent of the total dollar damages.

Under the with-project condition, total dollar damages are reduced to $8,405,939. This equates to a decrease of $4,720,112, or 35.9 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by the greatest amount, dropping by $2,014,898 or 26.9 percent. This decrease constitutes 42.7 percent of the total reduction in damage. Municipal damages fall by $1,210,010 or 49.8 percent, which constitutes 25.6 percent of the total damage reduction. The reduction in residential damages is $1,495,205, or 46.6 percent, which represents 31.7 percent of the total reduction in damage.

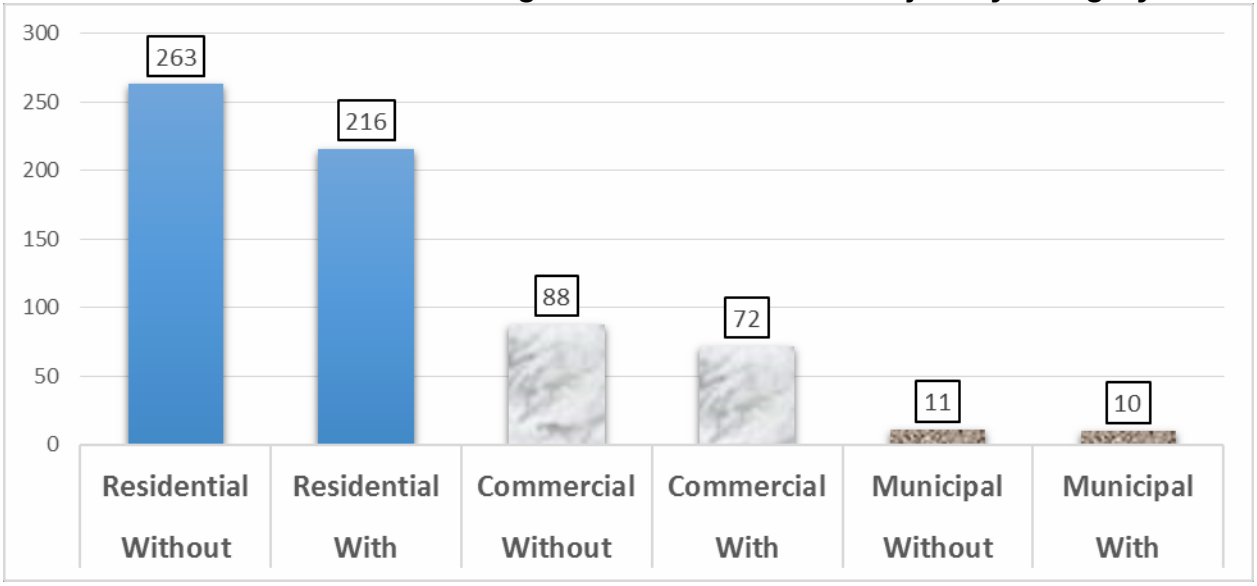
Figure A-33. Rocky Creek 250-Year Flood Event
Dollar Damages Without and With Project by Category



5.9.8 NED PLAN 500-YEAR EVENT RESIDUAL DAMAGE ANALYSIS

Figure A-34 illustrates the number of structures in the study area by category that will incur flood damages as a result of a 0.002 probability of occurrence (500-year) storm event under both the without-project and with-project condition. Figure A-35 provides the location of these structures, as well as those that will incur reduced damage under the with-project condition. Figure A-36 illustrates the dollar damages incurred in the study area under both the without-project and with-project conditions.

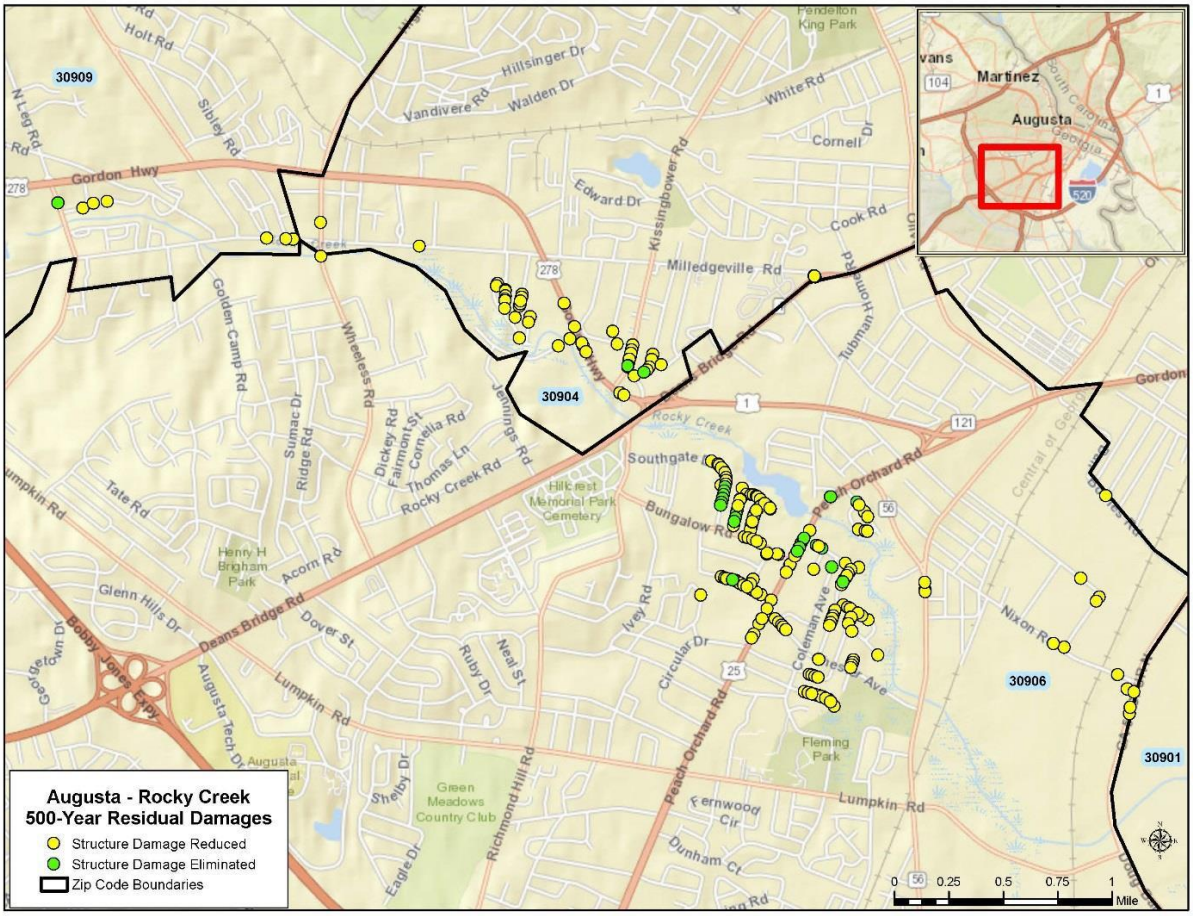
Figure A-34. Rocky Creek 500-Year Flood Event
Number of Structures Damaged Without and With Project by Category



A total of 363 structures receive damages in the without-project condition. Of these, 263 are residential, 88 are commercial, and 11 are municipal. One additional structure not incorporated in Figure A-34, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage during this flood event under both the with-project and without-project conditions.

Under the with-project condition, 216 residential structures, 72 commercial structures, and 10 municipal structures will incur flood damages. Including the electrical power station at 230 Dan Bowles Road, this brings the total number of structures damaged to 299. This constitutes an overall reduction of 17.6 percent between the with-project and without-project conditions. The number of residential structures damaged decreases by 17.9 percent, the number of commercial structures damaged decreases by 18.2 percent, and the number of municipal structures damaged decreases by 9.1 percent.

Figure A-35. Rocky Creek 500-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites

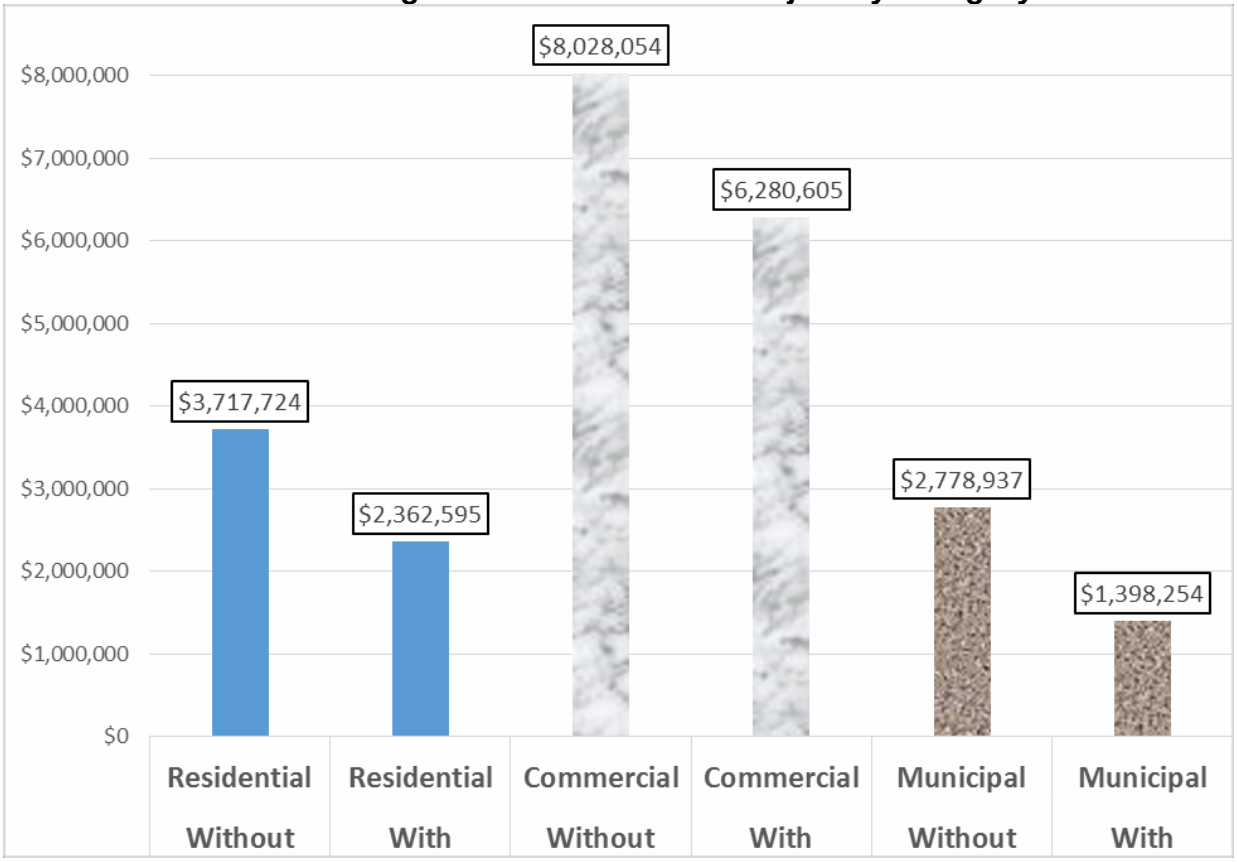


A total of $14,524,715 in flood damages occur under the without-project condition. Of this, $3,717,724 of damage is to residential structures and their contents, which constitutes 25.6 percent of the without-project total dollar damages. Damages to municipal structures total $2,778,937 or 19.1 percent of without-project total dollar damages. Commercial damages are the most extensive, amounting to $8,028,054, or 55.7 percent of the without-project total dollar damages.

Under the with-project condition, total dollar damages are reduced to $10,041,455. This equates to a decrease of $4,483,261, or 30.9 percent of the total dollar damages incurred under the without-project condition. Commercial damages are reduced by the greatest amount, dropping by $1,747,449 or 21.7 percent. This constitutes 39.0 percent of the total reduction in damage. Municipal damages are reduced by $1,380,682, a decrease of 49.6 percent. Residential damages are reduced by $1,355,129, or 36.45 percent.

One residential structure and one commercial structure will experience equivalent damages under both the without-project and the with-project conditions.

Figure A-36. Rocky Creek 500-Year Flood Event
Dollar Damages Without and With Project by Category



6.0 ABILITY TO PAY ANALYSIS AND FINANCIAL ASSESSMENT

ER 1105-2-100 requires an ability-to-pay analysis that determines if the non-federal sponsor is eligible for a lower alternative level of cost sharing than the standard percentage of 35 percent. In general, the ability-to-pay analysis determines if the non-federal sponsor can receive a price reduction based on benefit and income tests. This analysis is conducted independently of the financial analysis. The financial analysis focuses on the capability of the non-federal sponsor to finance its share of the project cost while the ability-to-pay analysis considers the underlying resource base at both the county and state levels.

Since the standard non-federal cost-share is substantially less than full costs, the ability-to-pay test is structured so that reductions in the level of cost sharing will be granted only in cases of severe economic hardship. The procedures to follow are discussed in more detail in ER 1165-2-121 entitled “Flood Control Cost-Sharing Requirements Under the Ability to Pay Provision-Section 103(m) of PL 99-662”. This reference is the primary guidance used in the analysis that follows.

Step one, the benefits test. This step determines the maximum possible reduction in the level of non-federal cost sharing for the project.

The procedure is to divide the BCR by 4. Next, convert the resulting decimal to a percentage. If the percentage is less than the standard 35 percent non-federal cost-share, the percentage sets the minimum non-federal share of the project costs. If the benefit test indicates qualification for a cost-share reduction, then step two, or the income test, is performed to determine the exact cost-shared non-federal sponsor’s percentage between the benefit test result and the standard 35 percent.

Based on the NED plan for Rocky Creek, (lower than the Augusta Canal and, hence, an indicator more of the potential for a price reduction), the benefit-cost ratio of 4.52 is divided by 4, which yields 1.13 or 113 percent. Since 113 percent is greater than the standard 35 percent cost sharing percentage, the project does not qualify for any reduction in cost sharing for the non-federal share.

Step two, the income test. If step one resulted in a possible price reduction, the income test would determine the amount of reduction based on per capita income at the county and state levels. Since no price reduction is justified from the preceding step, no income test is performed.

6.1 FINANCIAL ASSESSMENT

Augusta-Richmond County has been a non-federal sponsor with the Corps on several projects and studies since the early 1990s. The City of Augusta (now consolidated city and county) was the non-federal sponsor on the Oates Creek Project that was constructed in 1992. The total cost of about $14,000,000 had a non-federal share of about $4,000,000. They have performed the operation and maintenance of the project since construction. Also, Augusta-Richmond County has contributed 50 percent as their share of the feasibility phase of this flood risk management study.

Most funding is expected to come from a Special Purpose Local Option Sales Tax, SPLOST funding. This is a one-cent sales tax on goods in the county. SPLOST proceeds may be used for capital improvement projects that would otherwise be paid for with general fund and property tax revenues. Since 1985, Richmond County residents have voted four times to approve or extend the SPLOST on four different referendums. Some of these capital investment funds have been used for drainage projects on Rocky Creek, Raes Creek, the Wheeless Road area on Rocky Creek, and East Augusta drainage improvements. Table A-40 shows the funds generated.

Table A-40. Historical SPLOST Funding

Referendum	Years	Amount of Funds Generated
SPLOST I	1986-1990	$82,380,000
SPLOST II	1991-1995	$100,995,000
SPLOST III	1996-2000	$138,044,000
SPLOST IV	2001-2005	$120,233,000
SPLOST V	2006-2010	$160,000,000
SPLOST VI	2011-2015	$184,724,000
SPLOST VII	2016-2021	$215,550,000

As in each SPLOST proposal, there is risk the proposal will not get voter approval. Augusta has an A+ bond rating if it should choose this option.

7.0 ROCKY CREEK COST SHARING

Federal and non-Federal cost-share apportionments are based on the fully funded total project cost unlike the NED analysis which is based on the first cost. The fully funded costs are the current estimate of the costs at current price levels and inflated through the estimated mid-point of construction. Project fully funded costs by measure have been included as attachments to this appendix. The structural measure can be found in Attachment 1. The non-structural measure can be found in Attachment 4. The recreation measure can be found in Attachment 5. The NED plan is in Attachment 6.

Cost sharing percentages are shown in Table A-40 by project purpose. However, additional considerations affecting the distribution include Lands, Easements, Rights-of-way, Relocations, and Disposal sites (LERRDs) paid by the non-federal sponsor, limits on cost increases on certain purposes such as recreation, and minimum cash contribution requirements by the non-federal sponsor.

Table A-41. Cost Sharing Distribution by Purpose

Purpose	Federal	Non-federal
Flood Risk Management[1]	65%	35%
Recreation	50%	50%

65/35 is the minimum cost-share percentage. It could be as high as 50/50 depending on LERRDs, but this does not influence this study since LERRDs will not exceed 35 percent of the total project cost.

7.1. COST SHARING OF STRUCTUAL MEASURE

1. Total project cost (TPC) for structural management measures is $3,786,000 (see Attachment 1) and includes Design and Implementation (D/I), construction management, and LERRDs (“Lands & Damages”) and construction features.

2. 35 percent of structural TPC

.35 x $3,786,000 = $1,325,100

3. LERRDs for structural:

$208,000 Total
$196,000 non-Federal (NF)

4. Minimum of five percent cash contribution for structural Flood risk management measures of TPC by non-Federal sponsor:

.05 x $3,786,000 = $189,300

5. LERRDs (NF) plus five percent cash contribution by non-Federal sponsor:

$196,000+ $189,300 = $385,300

6. Since LERRDs plus five percent, or $385,300 is less than 35 percent of structural TPC of $1,325,100, the non-Federal sponsor must provide an additional $939,800 in cash required for the structural flood risk management measure.

7. A summary of the NED structural flood risk management cost-share allocation is contained in Table A-39.

Table A-42. Cost Sharing of Structural Flood Risk Management Measure Oct 17 Price Level (FY18)

Item	Non-Federal Cost	Federal Cost	Total Cost
D/I[1]	$239,050	$443,950	$683,000
CONSTRUCTION MGMT[1]	$37,100	$68,900	$106,000
LANDS & DAMAGES	$196,000	$12,000	$208,000
Construction Features[2]	$852,950	$1,936,050	$2,789,000
Total	**$1,325,100**	**$2,460,900**	**$3,786,000**
(Percent)	***35%***	***65%***	
Min 5% Cash Rqmnt[3]	$189,300		
LERRD Cost	$196,000		
Additional Non-Fed Cash for 35%	$939,800		

[1] D/I and Construction Management costs are 65/35 percent Federal/non-Federal.
[2] Adjustment to limit non-Federal sponsor to 35 percent maximum.
[3] Five percent Cash Contribution by non-federal sponsor.

7.2. COST SHARING OF NON-STRUCTURAL MEASURE

Nonstructural flood risk management measures are proved methods and techniques for reducing flood risk and flood damages incurred within floodplains. They are permanent or contingent measures applied to a structure and/or its contents that prevent or provide resistance to damage from flooding. Nonstructural flood risk management measures differ from structural measures in that they focus on reducing the consequences of flooding instead of the probability of flooding. Nonstructural management measures reduce human exposure or vulnerability to a flood hazard without altering the nature or extent of that hazard.

Section 219(c) of WRDA 1999 requires that at any time during construction of a nonstructural project, if the Corps determines that the costs of land, easements, rights-of-way, dredged material disposal areas, and relocations (LERRDS) for the project, in

combination with other project costs contributed by the non-Federal sponsor, will exceed 35 percent, any additional costs for the project (not to exceed 65 percent of the total costs of the project) shall be a Federal responsibility and shall be contributed during construction as part of the Federal share. The purpose of this provision is to make clear that the Government should not wait until the final accounting is completed to reimburse the non-Federal sponsor for costs it has contributed above its 35 percent share of total project costs.

Current Corps policy is that the Federal Government, through reimbursements, direct financing of construction, and/or the assumption of LERRD financing responsibilities becomes responsible for all additional project costs as soon as the Government determines that the value of the non-Federal sponsor's contributions has reached 35 percent of total project costs.

1. Total project cost (TPC) for non-structural management measures is $584,000 (see Attachment 4) and includes Design and Implementation (D/I), construction management, and LERRDs ("Lands & Damages").

2. 35 percent of non-structural TPC

.35 x $584,000 = $204,400

3. LERRDs for non-structural:

$558,000 Total
$533,950 non-Federal (NF)

4. Since sponsor non-structural cost are greater than 35 percent of TPC, Federal reimbursement of difference is required, amounting to $338,650.

$543,050 - $204,400 = $338,650

5. A summary of the NED non-structural flood risk management cost-share allocation is contained in Table A-43.

Table A-43. Cost Sharing of
Non-Structural Flood Risk Management Measure
Oct 17 Price Level (FY18)

Item	Non-Federal Cost	Federal Cost	Total Cost
D/I[1]	$7,000	$13,000	$20,000
CONSTRUCTION MGMT	$2,100	$3,900	$6,000
LANDS & DAMAGES	$533,950	$24,050	$558,000
Construction Features	-	-	-
Total sans Reimbursement	$543,050	$40,950	$584,000
(Percent)	*93%*	*7%*	
35% Maximum NF Contribution	$204,400		
Reimbursement Amount:		$338,650	
Total	**$204,400**	**$379,600**	**$584,000**
(Percent)	***35%***	***65%***	

7.3. COST SHARING OF RECREATION

1. Total project cost (TPC) for recreation is $591,000 (see Attachment 5) and includes Design and Implementation (D/I), construction management, and construction features.

2. 50 percent of recreation TPC is $295,500

.50 x $591,000 = $295,500

3. A summary of the NED recreation cost-share allocation is contained in Table A-44.

Table A-44. Cost Sharing of Recreation Measure Oct 17 Price Level (FY18)

Item	Non-Federal Cost	Federal Cost	Total Cost
D/I	$70,500	$70,500	$141,000
CONSTRUCTION MGMT	$17,500	$17,500	$35,000
LANDS & DAMAGES	-	-	-
Construction Features	$207,500	$207,500	$415,000
Total	**$295,500**	**$295,500**	**$591,000**
(Percent)	***50%***	***50%***	

7.4. COST SHARING OF NED PLAN

1. Total project cost (TPC) for the NED plan include all costs pertaining to structural management measures, non-structural management measures, and recreation (see sections 7.1 through 7.3) TPC is $4,962,000 (see Attachment 6) and includes preconstruction engineering and design (PED), construction management, and LERRDs ("Lands & Damages") and construction features.

2. 35 percent of structural TPC

.35 x $3,786,000 = $1,325,100

3. Minimum of five percent cash contribution for structural flood risk management measures of TPC by non-Federal sponsor:

.05 x $3,786,000 = $189,300

4. Structural LERRDs (NF) plus five percent cash contribution by non-Federal sponsor (see Section 7.1):

$196,000+ $189,300 = $385,300

5. Since LERRDs plus five percent, or $385,300 is less than 35 percent of structural TPC of $1,325,100, the non-Federal sponsor must provide an additional $939,800 in cash required for the structural flood risk management measure.

6. Since sponsor non-structural cost are greater than 35 percent of non-structural TPC, Federal reimbursement of difference is required, amounting to $338,650 (see section 7.2).

$543,050 - $204,400 = $338,650

7. A summary of the NED structural flood risk management cost-share allocation is contained in Table A-45.

Table A-45. Cost Sharing of NED Plan
Oct 17 Price Level (FY18)

Item	Non-Federal Cost	Federal Cost	Total Cost
D/I	$316,550	$527,450	$844,000
CONSTRUCTION MGMT	$56,700	$90,300	$147,000
LANDS & DAMAGES	$729,950	$37,050	$767,000
Construction Features	$1,060,450	$2,143,550	$3,204,000
Total Costs before Federal Reimbursement	$2,163,650	$2,798,350	$4,962,000
(Percent)	*44%*	*56%*	*100%*
Non-Structural Cost Federal Reimbursement to Sponsor	*-($338,650)*	$338,650	
Total Project Costs:	**$1,825,000**	**$3,137,000**	**$4,962,000**
(Percent)	***37%***	***63%***	
Min 5% Cash Rqmnt[2] (Structural)	$189,300		
Additional Non-Fed Cash for 35% (Structural)	$939,800		