US Army Corps of Engineers®

AUGUSTA ROCKY CREEK GEORGIA
FLOOD RISK MANAGEMENT
SECTION 205 FEASIBILITY STUDY

Rocky Creek Flood Event in 1990

Revised
June 2017

FINAL

EXECUTIVE SUMMARY

Augusta-Richmond County asked the U.S. Army Corps of Engineers, Savannah District for assistance in reducing flood risks along Rocky Creek. Under the Section 205 Continuing Authority Program, the study team identified the best course of action to reduce flood risks.

The Savannah District and Augusta-Richmond County considered numerous ways to reduce flood risks to the residential, public, commercial and industrial properties along Rocky Creek and reduce the potential for loss of life. The team considered the following five alternatives in detail:

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

They then evaluated and compared the alternatives to determine the most economically efficient way of reducing flood risks. The report recommends Alternative 5 as the selected plan. It consists of constructing a detention area at Rosedale Dam, acquiring 5 residential parcels in the Kissingbower Road area, and converting those parcels into a recreational park. It improves the area's resiliency and sustainability for future flood events while complying with environmental laws and regulations. This plan builds on the previous actions of Augusta-Richmond County and substantially reduces flood risks to residents and businesses along Rocky Creek.

The selected plan would reduce flood risks and damages more than any of the other four alternatives evaluated. It would eliminate flood damages to 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.

The selected plan has the highest net benefits (average annual benefit minus average annual cost) of those alternatives that were considered in detail. It would produce $869,301 in average annual benefits with $192,448 in average annual costs over the 50-year period of analysis at the Fiscal Year (FY) 2016 price level. The resulting net benefit would be $676,853 each year. The benefit-to-cost ratio, a measurement of the investment, is $4.52 in benefits gained per $1.00 spent on the project.

The fully funded cost of the recommended plan is $4,962,000 at the FY 2018 price level. The Federal share is $3,137,000. Augusta-Richmond County's share of the project would be $1,825,000. The cost share split between the Federal Government and Augusta-Richmond County would be approximately 63 percent and 37 percent, respectively.

AUGUSTA ROCKY CREEK GEORGIA
FLOOD RISK MANAGEMENT
SECTION 205 FEASIBILITY STUDY

TABLE OF CONTENTS

Page No.

EXECUTIVE SUMMARY ---------- i
TABLE OF CONTENTS ---------- ii
1.0 STUDY AUTHORITY ---------- 1
2.0 STUDY PURPOSE AND SCOPE ---------- 1
2.1 PURPOSE ---------- 1
2.2 SCOPE/DESCRIPTION OF STUDY AREA ---------- 1
3.0 PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS ---------- 6
3.1 PRIOR STUDIES AND REPORTS IN THE AUGUSTA AREA ---------- 6
4.0 PLAN FORMULATION ---------- 9
4.1 ASSESSMENT OF WATER AND RELATED LAND RESOURCES PROBLEMS AND OPPORTUNITIES ---------- 9
4.1.1 Rocky Creek Flooding: Historic and Existing Conditions ---------- 9
4.1.2 Climate Change ---------- 14
4.1.3 Flooding Problems in the Rocky Creek Basin ---------- 14
4.1.4 Opportunities in the Rocky Creek Basin ---------- 15
4.2 PLANNING OBJECTIVES AND CONSTRAINTS ---------- 15
4.2.1 Study Planning Objectives ---------- 15
4.2.2 Study Planning Constraints ---------- 15
4.3 FORMULATION OF ALTERNATIVE PLANS FOR ROCKY CREEK FLOODING PROBLEMS ---------- 18
4.3.1 Alternatives ---------- 18
4.3.2 Formulation Criteria ---------- 26
4.3.3 Hydrologic and Hydraulic Analysis ---------- 27
4.3.4 Anticipated Environmental Impacts ---------- 27
4.3.5 Cultural Resources ---------- 29
4.3.6 Economic Comparison ---------- 30
4.3.7 NED Plan ---------- 32
5.0 DESCRIPTION OF THE SELECTED PLAN ---------- 32
5.1 ROCKY CREEK PLAN COMPONENTS AND CONSTRUCTION CONSIDERATIONS ---------- 32
5.1.1 Structural Component – Rosedale Dam Detention Area ---------- 32
5.1.2 Non-structural Component – Kissingbower Buyouts and Recreational Park 33
5.2 OPERATION AND MAINTENANCE ---------- 34
5.3 PLAN ACCOMPLISHMENTS ---------- 34
5.4 REAL ESTATE REQUIREMENTS ---------- 35
5.5 COST SHARING ---------- 36
5.5.1 Cost Sharing by Project Purpose ---------- 36
5.5.2 Cost Sharing of Structural Measure ---------- 36
5.5.3 Cost Sharing of Non-Structural Measure ---------- 38
5.5.4 Cost Sharing of Recreation ---------- 39
5.5.5 NED Plan Cost Sharing ---------- 40

6.0 PLAN IMPLEMENTATION ----------41
6.1 PROJECT PARTNERSHIP AGREEMENT ----------41
6.2 FINANCIAL ASSESSMENT ----------42
7.0 CONCLUSION AND RECOMMENDATIONS ----------42
7.1 CONCLUSIONS----------43
7.2 RECOMMENDATIONS ----------44

TABLES

Table 1: Flood Insurance Studies for Augusta/Richmond County..... 8
Table 2. Documented Flood and Declared Disasters 1990-2002 10
Table 3. Summary of Impact of Alternatives……..28
Table 4. Costs by Alternative..... 30
Table 5. Net Benefit Analysis by Alternative..... 31
Table 6. Cost Sharing Distribution by Purpose 36
Table 7. Cost Sharing of Structural FRM Measure 37
Table 8. Cost Sharing of Non-Structural FRM Measure 39
Table 9. Cost Sharing of Recreation..... 40
Table 10. Cost Sharing of NED Plan 41
Table 11. Historical SPLOST Funding..... 42

FIGURES

Figure 1. Vicinity Map..... 3
Figure 2. Location Map..... 4
Figure 3. Flood Damage Reduction Measures in Urban Area 5
Figure 4. Pictures of Flooding Experienced in the Rocky Creek Basin During 1990 Storm Event 11
Figure 5. Rocky Creek 100-Year Floodplain 13
Figure 6. Damage Centers ..... .17
Figure 7. Location of Management Measures Analyzed..... 19
Figure 8. Plan View of the Existing Dam & Proposed Modification……..…….....23
Figure 9. Profile Rosedale Dam Centerline...……24

LIST OF APPENDICES

APPENDIX A ECONOMIC ANALYSIS
APPENDIX B ENGINEERING APPENDIX
APPENDIX C REAL ESTATE APPENDIX
APPENDIX D PUBLIC INVOLVEMENT/CORRESPONDENCE
APPENDIX E PLAN FORMULATION FROM 2005 DRAFT REPORT
APPENDIX F COST ENGINEERING

ACRONYMNS

Average Annual Cost - AAC
Articulated Concrete Blocks - ACB
Base Flood Elevation - BFE
Benefit-to-Cost Ratio - BCR
Certified Floodplain Manager - CFM
Continuing Authority Program - CAP
Design/Implementation - D/I
Engineering and Design - E&D
Environmental Assessment - EA
Environmental Protection Agency - EPA
Finding of No Significant Impact - FONSI
Flood Damage Analysis - FDA
Flood Insurance Rate Maps - FIRM
Flood Insurance Study - FIS
Flood Reduction Management - FRM
Flood Reduction Study - FRS
General Investigation - GI
Hydrologic Modeling System - HMS
Lands, Easements, Rights-of-way, Relocations, and Disposal Areas - LERRD
Metropolitan Statistical Area - MSA
National Flood Insurance Program - NFIP
National Economic Development - NED
National Register of Historic Places - NRHP
North American Vertical Datum 1988 - NAVD 88
Operation and Maintenance - O&M
Operation, Maintenance, Repair, Replacement, and Rehabilitation - OMRR&R
Project Delivery Team - PDT
Project Management Plan - PMP
Project Partnership Agreement - PPA
River Analysis System - RAS
South Atlantic Division - SAD
Special Flood Hazard Area - SFHA
Special Purpose Local Option Sales Tax - SPLOST
Supervision and Administration - S&A
Total Project Cost - TPC
U.S. Army Corps of Engineers - USACE
Water Surface Elevation - WSE

AUGUSTA ROCKY CREEK GEORGIA
FLOOD RISK MANAGEMENT
SECTION 205 FEASIBILITY STUDY

1.0 STUDY AUTHORITY

This study is authorized under Section 205, 1948 Flood Control Act (P.L. 80-858), as amended.

2.0 STUDY PURPOSE AND SCOPE

2.1 PURPOSE

The joint government of the City of Augusta and Richmond County (Augusta-Richmond County) has requested that the U.S. Army Corps of Engineers (USACE) study the flooding risks in the area drained by Rocky Creek, with particular attention to the populated areas within the Rocky Creek Basin.

The purpose of this study is to assess and recommend solutions to flooding risks along the Rocky Creek Basin. The problem is flood risks to residential, public, commercial, and industrial properties and the potential for loss of life. The opportunity is to reduce flood risks to properties and loss of life. The objective is to reduce flood risks within the Rocky Creek Basin downstream of the Rosedale Dam Detention Area. The constraint is avoiding induced flooding upstream.

2.2 SCOPE/DESCRIPTION OF STUDY AREA

The City of Augusta is located on the eastern edge of the State of Georgia and is 110 miles northwest of Savannah, Georgia (See Figure 1). The City of Augusta is the main population center in Richmond County and forms the center for the Augusta-Richmond County, Georgia-South Carolina Metropolitan Statistical Area (MSA). Other significant population centers in the area of concern are the towns of Hephzibah, Blythe, and Fort Gordon Military Reservation. Richmond County is located in Georgia's 12th Congressional District, which is represented by Honorable Rick Allen.

This report responds to Augusta-Richmond County's (the non-Federal sponsor's) request to reduce flooding risks within the Rocky Creek Basin, which is located in the central portion of the City of Augusta (See Figure 2). The majority of the stream is south of U.S. Route 78 (Gordon Highway) and north of Interstate 520 (Bobby Jones Expressway). Rocky Creek has numerous small tributaries flowing into it, and eventually empties into Phinizy Swamp, which is approximately 1.2 miles downstream of Georgia Highway 56 Spur (Doug Barnard Parkway). Rocky Creek's drainage area is approximately 11,024 acres (17.23 square miles). The Creek is 8.91 miles in length

from its headwaters located north of Gordon Highway to its mouth at Phinizy Swamp. Elevations within the Rocky Creek Basin range from a high of about 490 feet North American Vertical Datum 1988 (NAVD 88) to as low as 115 feet NAVD 88 at Phinizy Swamp. The channel has an average slope of 11 feet/mile downstream of Milledgeville Road. As Rocky Creek travels upstream of Milledgeville Road the channel quickly rises to an average slope of 63 feet/mile.

Engineering Regulation ER 1165-2-21 provides USACE guidance concerning flood damage reduction measures in urban areas. It establishes criteria to distinguish between improvements to be accomplished by the Corps under its flood risk management authorities and storm sewer systems to be accomplished by local interests. Urban water damage problems associated with a natural stream may be addressed under the flood risk management authority from the point where the flood discharge of such a stream within an urban area is greater than 800 cubic feet per second for the 10-percent flood (one chance in ten of being equaled or exceeded in any given year) under conditions expected to prevail during the period of analysis. On Rocky Creek, this point is just downstream of the North Leg Road approximately 1,100 feet downstream of the detention area (Figure 3). In general, USACE may perform work downstream of the 800 cubic feet per second (CFS) discharge point to reduce flooding or flood risks. However, it may perform work upstream of that location if that is the best site for an action that would reduce flood risks downstream of that 800 CFS location.

Figure 1. Vicinity Map

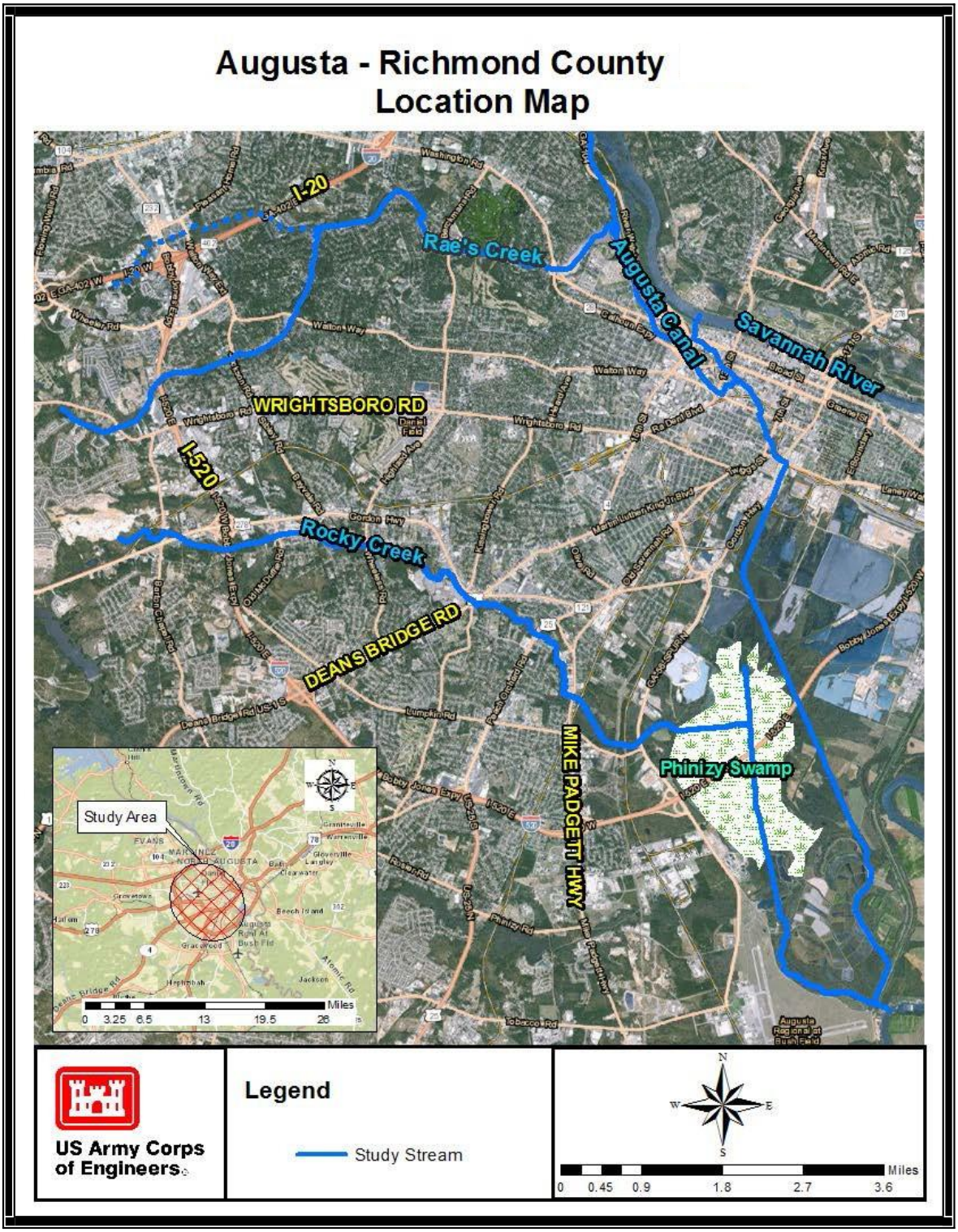


Figure 2. Location Map

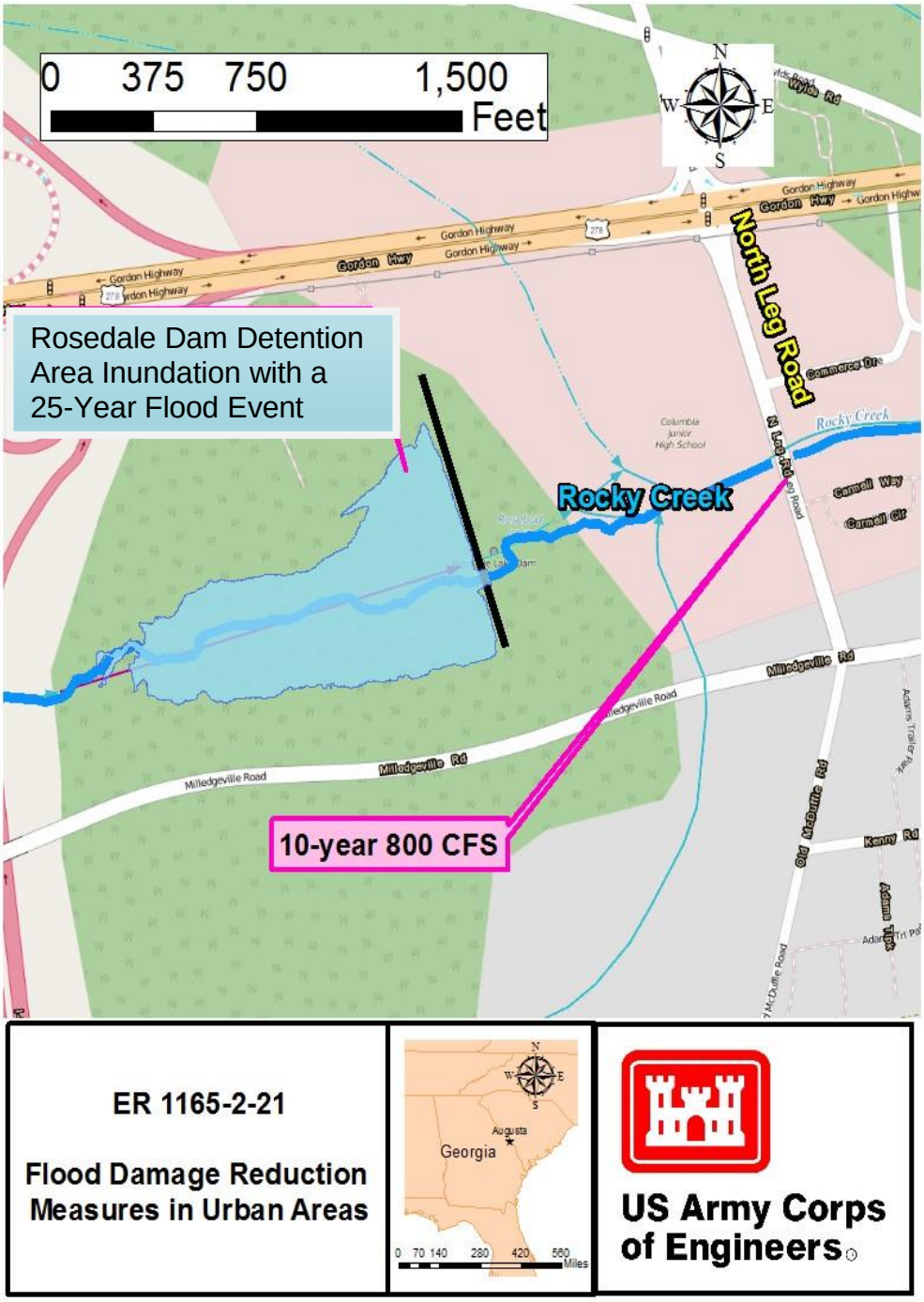


Figure 3: Flood Damage Reduction Measures in Urban Areas

3.0 PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS

The Project Delivery Team (PDT) relied upon prior reports and studies such as the Flood Insurance Study (FIS) for Richmond County and project specific reports completed for drainage canals and creeks within the study area.

3.1 PRIOR STUDIES AND REPORTS IN THE AUGUSTA AREA

Augusta, Georgia Levee. The project was authorized by the 1936 Flood Control Act. The project provides flood protection to the City of Augusta from the Savannah River. The project was completed in 1941 and turned over to the Augusta-Richmond County for operation and maintenance.

Draft EA/FONSI for Augusta Flood Control Study. Savannah District USACE. April 2005. The Corps prepared a draft Environmental Assessment (EA) to analyze the alternatives presented in the Draft Feasibility Report for Augusta-Richmond County Regional Flood Control Draft Interim Feasibility Report. The EA was not finalized.

Draft Interim Feasibility Report, Flood Reduction Study, Augusta – Richmond County, Georgia. September 2005. Under the General Investigations (GI) program the Corps prepared a draft feasibility report to assess and recommend solutions to flooding problems in Richmond County, Georgia. The draft report addressed degraded ecosystem and recreation problems throughout the study area. The Rocky Creek Basin and the Augusta Canal Basin were included in the study. The study identified 17 structural and 2 non-structural measures for consideration to reduce flood damages along Rocky Creek. Of those 17 structural and 2 non-structural measures, only Rosedale Dam Detention Area Improvements and Kissingbower Buyouts with a recreation Park remained as viable opportunities to study in the feasibility phase. The study halted in 2006 and no further work was conducted due to liability issues and a lack of funding. Additional descriptions of alternatives studied during the 2005 draft report are contained in Appendix E. In 2013, South Atlantic Division (SAD) approved further study of the Rosedale Dam Detention Area Improvements and Kissingbower Buyouts and Recreation Park measures under the Continuing Authorities Program. Based on the 2013 approval, the Project Management Plan (PMP) scope of work, the approved Review Plan, and non-Federal project request letters included these two measures and the No Action alternative.

Federal Emergency Management Agency. Table 1 presents a listing of the Federal Emergency Management Agency flood insurance studies for Augusta-Richmond County, Georgia.

Final HTRW Site Investigation Report. Engineering Division, Savannah District USACE; October 2003. A historical database search was conducted in 2003 to determine whether the potential for contamination existed for the planned construction areas of the Augusta Flood Control Project. The database search showed no major historical factors, but several possible minor contamination issues in the areas

downstream of Regency Mall, which is 2.5 miles downstream from the subject site. Based on these issues, as well as a site visit, it was determined that extensive sampling along the five Rocky Creek detention areas that were analyzed in 2003 and the Nixon Street levee alternative should be conducted. Subsequent analytical results (including Rosedale Dam area) indicated that no contamination exists that would interfere with any future construction activities (USACE 2003) within this study.

J. Strom Thurmond Dam and Lake, Georgia and South Carolina. The project was built because of historical flooding, particularly in Richmond County and adjacent areas, and was authorized by the 1944 Flood Control Act. The completed project is located 22 miles north of Augusta, Georgia on the Savannah River.

Savannah River Basin Comprehensive (SRBC) Study. The SRBC study is evaluating the Corps' multi-purpose projects in the river basin. Actions potentially taken at those projects would not directly impact Rocky Creek. Similarly, any work conducted in Rocky Creek would not measurably impact flows in the Savannah River. The Corps is currently conducting a basin-wide water resources analysis of the Savannah River. The present interim study is focusing on alternate drought management scenarios. The Savannah River Basin Comprehensive study's focus is on current operational plans for three Federal reservoirs (Hartwell Lake and Dam, J. Strom Thurmond Lake and Dam and Richard B. Russell Lake and Dam). The study will determine if changes or reallocations are warranted to meet current and future needs for flood control, water supply, fish and wildlife enhancement, drought control, water quality, recreation, and other related purposes. The study is being jointly sponsored by the Georgia Department of Natural Resources, the South Carolina Department of Natural Resources, and The Nature Conservancy.

Additional Floodplain Reports. Additional reports prepared for FEMA, such as the 1995 Augusta-Richmond County Comprehensive Land Use Plan, are listed in the September 1998 Section 905(b) Analysis and included herein by reference (Table 1).

Table 1: Flood Insurance Studies for Augusta-Richmond County

Published	Title	Computations
September 25, 2009	Augusta-Richmond County GA – All Jurisdictions 13245CV000A (Countywide maps and FIS) The consolidated government of Augusta-Richmond County and including the Cities of Blythe and Hephzibah	Revisions and updated information on the existence and severity of flood hazards in the geographic area of Augusta-Richmond County, GA to include H&H Computations obtained from prior studies, some updates and additions. (Work completed by PBS&J in Jan 2006) Vertical datum converted from NGVD29 to NAVD88; UTM coordinates now referenced to NAD83. DFIRM and FIS produced in digital form. Prepared by FEMA.
March 23, 1999	City of Augusta (Prepared to include City of Augusta and Unincorporated Areas into one Flood Insurance Study)	H&H Computations for Oates Creek by USACE, Savannah District (work completed Aug 1994). Also included updated flood hazard data for Butler Creek and Rocky Creek, and revised backwater data for Rocky Creek Trib 2 and Trib 4, completed by GA DOT. Prepared by FEMA.
January 19, 1995	City of Augusta	Hydrology by USACE, Savannah District – Hydraulics by FEMA
January 19, 1995	Richmond County and Unincorporated Areas	Hydrology for the Savannah River by USACE, Savannah District – Hydraulics for the Savannah River by FEMA
January 3, 1994	FIS – Revisions to Oates Creek and Oates Creek Tributary following construction of Oates Creek Flood Reduction Project.	USACE, Savannah District
February 4, 1987	Richmond County and Unincorporated Areas	H&H by USACE, Savannah District (Work completed Sept 1984)
April 1, 1982	City of Augusta – FIS	H&H for the Savannah River by USACE, Savannah District (Work completed in March 1977)
January 1974	Special Flood Hazard Information Report, Raes Creek, Augusta and Richmond County, GA	USACE, Savannah District
August 1971	Special Flood Hazard Information Report, Savannah River at Augusta, GA.	USACE, Savannah District

4.0 PLAN FORMULATION

Plan formulation is the process of building solutions to ameliorate problems, meet planning objectives, and avoid planning constraints.

4.1 ASSESSMENT OF WATER AND RELATED LAND RESOURCES PROBLEMS AND OPPORTUNITIES

4.1.1 ROCKY CREEK FLOODING: HISTORIC AND EXISTING CONDITIONS

Historically, flooding in Richmond County has primarily been the result of severe thunderstorm activity. Flooding problems in Augusta have resulted in property damage and reduced public safety. The Augusta-Richmond County Hazard Mitigation Plan adopted in 1998 estimated that floods had caused over $150,000,000 in damages since October 1990, and that floods affected 30 percent of the county in this time frame.

The City of Augusta is largely an urban area which has experienced much growth over the last 40 years. Within this time frame, many residences and commercial structures have been built within the Floodplain. As a result of this growth, the rate of storm water runoff has increased, as have incidents of flooding. Channel dredging, bridge construction and other storm water control practices have not kept pace with the increased storm run-off.

Topography contributes to flooding of the area. Particularly, flooding is related to the sudden change in stream slope, and to the bowl-shaped area adjacent to the stream near Nixon Road.

Prompted by several devastating floods (Table 2), most recently in 1990 as a result from the convergence of Tropical Storms Marco and Klaus, Augusta-Richmond County has been working to implement flood risk management measures. Augusta-Richmond County, has constructed or is in the process of constructing several flood risk management projects in the Rocky Creek Basin. Rocky Creek is also included in the National Flood Insurance Program (NFIP). The Augusta-Richmond County Flood Reduction Program seeks to purchase repetitively-flooded structures. After the structures are purchased, Augusta-Richmond County demolishes the structures, and places the land in permanent conservation as green space/open space. In support of this effort, the local Flood Damage Prevention Ordinance requires new first floor elevation for new construction within the high hazard areas to be three feet above the Base Flood Elevation (BFE) based on the Flood Insurance Rate Maps (FIRM).

Pictures in Figure 4 illustrate the 1990 flood.

Table 2. Documented Flood and Declared Disasters 1990-2002

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 4. Pictures of Flooding Experienced in the Rocky Creek Basin During 1990 Storm Event

Augusta-Richmond County divides the Special Flood Hazard Area (SFHA) outside of the regulatory floodway into upper and lower floodway fringes and regulates the lower floodway fringe as floodway. Any property containing more than one acre of SFHA is regulated as floodway and requires an engineered No Rise Certification to make sure that proposed development does not affect the SFHA either upstream or downstream. Additionally, Augusta-Richmond County does not allow offsite fill material to be brought into the SFHA. Augusta-Richmond County allows grade changes of +/- two feet without a No Rise Certification. Augusta Richmond County has addressed flooding in their Comprehensive Zoning Ordinance, which contains a section to address Conservation Subdivisions. In short, if floodplain, wetlands or other similar sensitive areas are permanently protected, the developer is allowed to increase the density (units per acre) of structures constructed on the remaining buildable property, such that the overall yield is basically the same as if the developer constructed on the land this ordinance seeks to protect – namely, floodplain, wetlands, riparian buffers and other similar sensitive areas. Augusta-Richmond County's Stormwater Management Ordinance has additional storage requirements and design considerations in sensitive basins such as Rocky Creek and does not allow stormwater storage facilities (detention ponds) resulting from new development to be located in the SFHA. USACE considers the proposed Rosedale Detention Dam Area Alternative to comply with the ordinance because it is a stormwater enhancement that reduces flood risks and improves resiliency and sustainability. Augusta-Richmond County employs a Certified Floodplain Manager (CFM) on staff and has a full-time Floodplain manager as part of their Stormwater Utility program. Overall, Augusta-Richmond County's Flood Management Program is a comprehensive program focused on reducing the risk of flooding (particularly catastrophic flood events) in the community and is aimed at breaking the build-damage- rebuild cycle found elsewhere in the nation.

Figure 5 displays the 100-year floodplain on a street map of Rocky Creek.

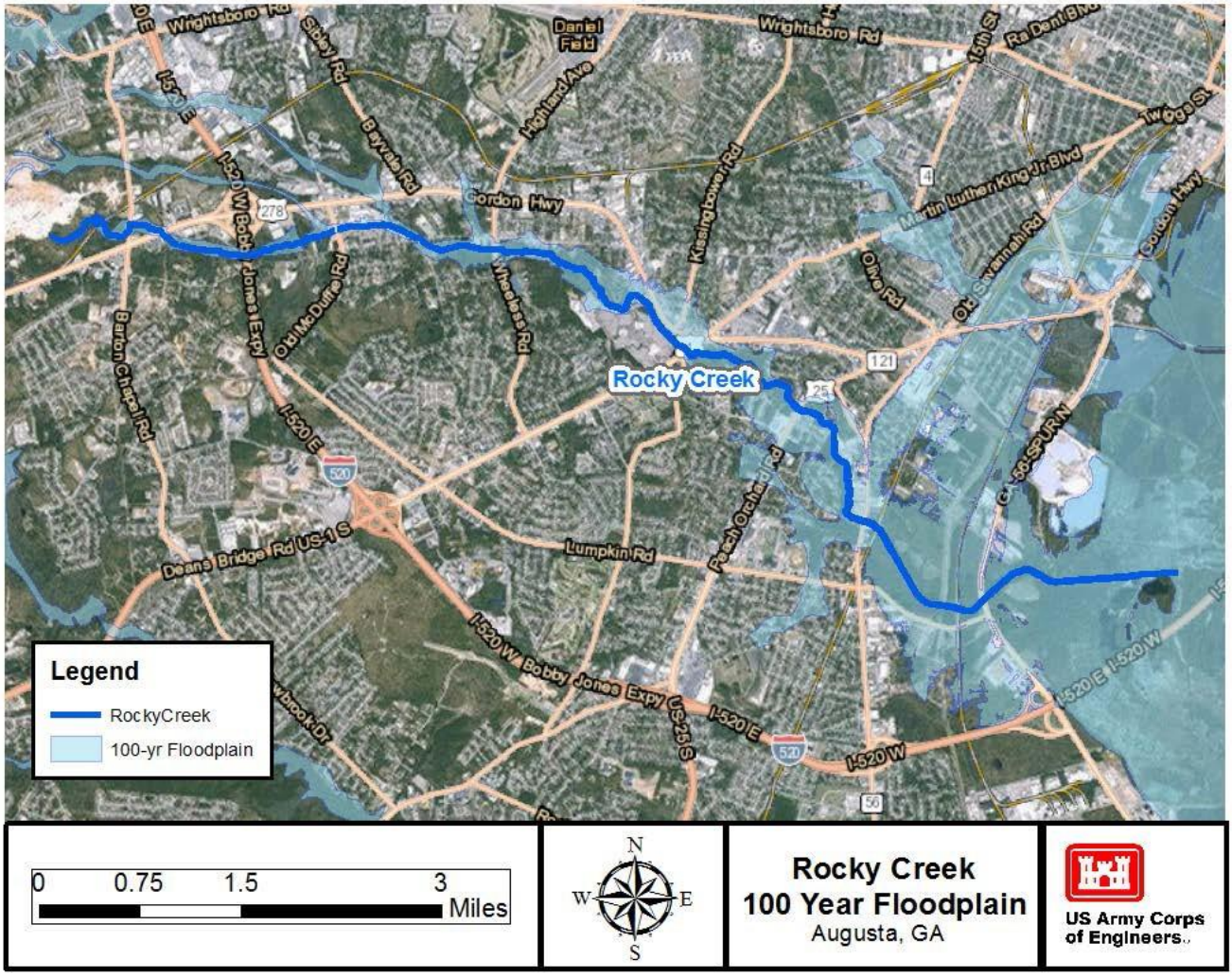


Figure 5. Rocky Creek 100-Year Floodplain

4.1.2 CLIMATE CHANGE

Analysis of the possible effects of climate change is included in the Engineering Appendix. That analysis concludes that this watershed as a whole is at low risk for climate change effects on flooding. Potential changes in future condition flows from increased rainfall as a result of climate changes were not included because they are not expected to change the study recommendations or the design of the recommended plan.

The analysis of future condition flows incorporated increased runoff due to land development expected through year 2030. Historic precipitation-frequency data used in this Section 205 Study were based on TP40 rainfall distributions. Since that time, new rainfall distributions have been published in TP14. The 2, 5, 10, 25, and 50-year rainfall estimates decreased from TP40 to TP14. The 100 and 500-year rainfall estimates increased from 8.00” to 8.18” and from 9.7” to 10.7”, respectively. All of the TP40 data used in this study’s analysis are within the 90% confidence intervals for the new TP14 estimates. There is no value in using the new rainfall distribution in the hydrologic analysis since it would result in no change in the study recommendations or the design of the recommended plan.

The USACE screening level climate change vulnerability assessment (VA) tool was utilized to assess the potential impacts and likelihood of climate change impacts to this region. The tool indicted that the Savannah-Ogeechee Basin was at relatively low risk for climate change to cause a substantial negative impact on flood risk reduction type projects. More information regarding climate change may be found in Appendix B Section C-2.5

4.1.3 FLOODING PROBLEMS IN THE ROCKY CREEK BASIN

The problem is that residential, public, commercial, and industrial structures are at risk of flooding and there is a potential for loss of life. The locations of affected structures inventoried are included in Figure 6 and listed below:

- The first area affected by risk of flooding is near the outfall at Phinizy Swamp, on the north bank of Rocky Creek between Old Savannah Road and Phinizy Swamp. Over 45 percent of the inventoried structures in the entire basin are located in this area. Flooding is caused by backwater from Rocky Creek entering into Phinizy Swamp.

- The second area affected by risk of flooding is immediately above Old Savannah Road. Flooding occurs on both sides of Chester Avenue in the vicinity of Smith Drive, Virginia Avenue, Higdon Street, and Piedmont Street. A combination of low terrain and flooding along a tributary of Rocky Creek can affect properties in this area. About 25 percent of the inventoried structures in the basin are located in this area.

- The third area affected by risk of flooding is north of the Regency Mall site which is located in the vicinity of Kissingbower Road. Single-family structures (less than 4 percent of basin flooding) are subject to flooding in this area. The mall itself is located on high ground, but the houses on the opposite side of Rocky Creek are susceptible to flood risks. The floodwaters overflow the north side of the bank since the south side (Regency Mall side) is high. Augusta-Richmond County has purchased and removed most of the subdivision located slightly upstream from the former Regency Mall.

- The fourth area affected by risk of flooding is located in the vicinity of Rozella Road. Approximately 7 percent of the inventoried structures in the basin are located in this area. Flooding occurs from the overflow from Rocky Creek.

4.1.4 Opportunities in the Rocky Creek Basin

There are opportunities in the Rocky Creek Basin to reduce flood risks and provide passive recreation experiences.

4.2 Planning Objectives and Constraints

The Federal objective of water and related land resources planning is to contribute to National Economic Development (NED) while protecting the Nation's environment. These contributions will be in accordance with national environmental statutes, applicable executive orders, and other Federal planning requirements. Project plans shall be formulated to alleviate the stated problems and will take advantage of opportunities that contribute to study planning objectives and, ultimately, the Federal objective.

4.2.1 Study Planning Objectives

The objective of this study is to reduce flood risks within the 500-year floodplain of the Rocky Creek Basin in an economically justified, environmentally sound, and technically feasible manner.

4.2.2 Study Planning Constraints

Unlike planning objectives that represent desired positive changes, planning constraints that represent restrictions should be avoided. The planning constraints identified in this study are as follows:

- Avoid or minimize environmental impacts from flood risk management measures.

- Minimize induced damages resulting from the implementation of flood risk reduction measures.

- USACE may address urban flooding problems with a natural stream under the flood risk management authority from the point where the flood discharge is greater than 800 cubic feet per second for the 10-percent flood (one chance in ten of being equaled or exceeded in any given year) under conditions expected to prevail during the period of analysis. On Rocky Creek, this point is just downstream of the North Leg Road approximately 1,100 feet downstream of the Rosedale Dam Detention Area (Figure 3). In general, USACE may perform work downstream of the 800 CFS discharge point to reduce flooding or flood risks. However, it may perform work upstream of that location if that is the best site for an action that would reduce flood risks downstream of that 800 CFS location.

Rocky Creek Basin
Damage Centers

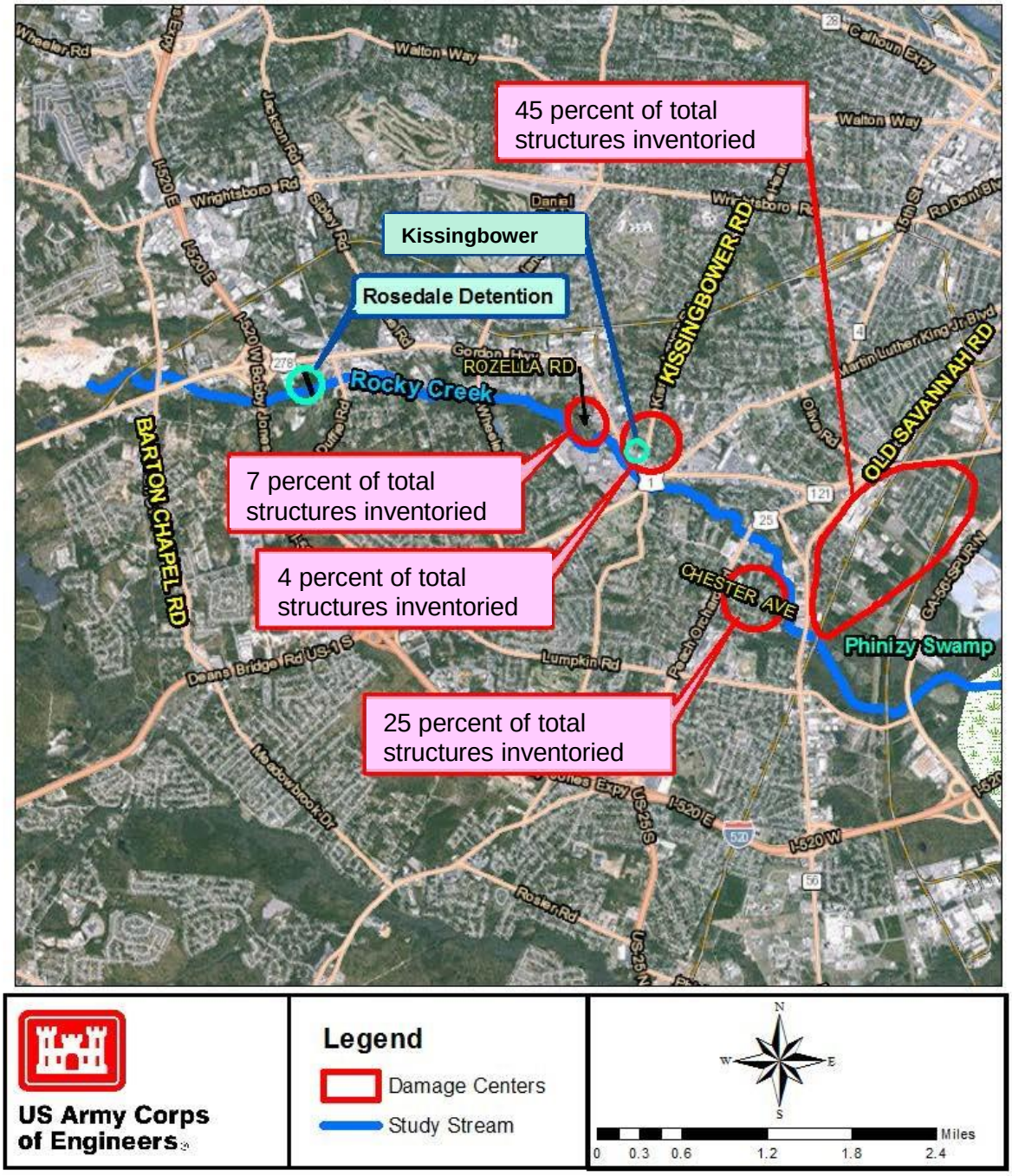


Figure 6. Damage Centers

4.3 FORMULATION OF ALTERNATIVE PLANS FOR ROCKY CREEK FLOODING PROBLEMS

Solutions to the problem are achieved by way of formulating management measures and alternatives that meet the planning objective and avoid the constraints. A management measure is a feature or activity that can be implemented at a specific site that addresses the planning objective. An alternative can be one management measure or a combination of management measures that address the planning objective.

Flood risk management measures are categorized as either structural or nonstructural. Structural measures are physical modifications designed to reduce the frequency of damaging levels of flood inundation. Non-structural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use made of floodplains, or by accommodating existing uses to the flood hazard. Section 73 of the Water Resources Development Act of 1974 mandates consideration of nonstructural alternatives in flood damage reduction studies.

This study evaluates two management measures for flood risks in the Rocky Creek Basin: one structural and one non-structural. The non-structural management measure could include a path dependent measure for recreation which can only occur after the buyouts. The structural management measure is the Rosedale Dam Detention Area improvement. The non-structural management measures are the Kissingbower Buyouts Alone and the Kissingbower Buyouts with a recreation park. The location of the management measures can be seen on Figure 7.

4.3.1 ALTERNATIVES

Based on these two management measures, the following alternatives were formulated:

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

4.3.1.1 NO ACTION ALTERNATIVE

The Council on Environmental Quality (CEQ) regulations prescribe inclusion of the No Action Alternative as the benchmark against which proposed Federal actions are evaluated. Without any action, the Rocky Creek drainage basin would continue to be subjected to frequent flooding resulting in substantial losses to properties. Subsequently, property values would be expected to decrease in the vicinity. Additional information quantifying property losses are in the economic analysis (Appendix A) of the Feasibility Report.

Properties on Kissingbower Road that have been subjected to past damage from flooding would continue to deteriorate with future storm events. These structures located within the floodplain would continue to occupy the floodplain resulting in an incompatible land use.

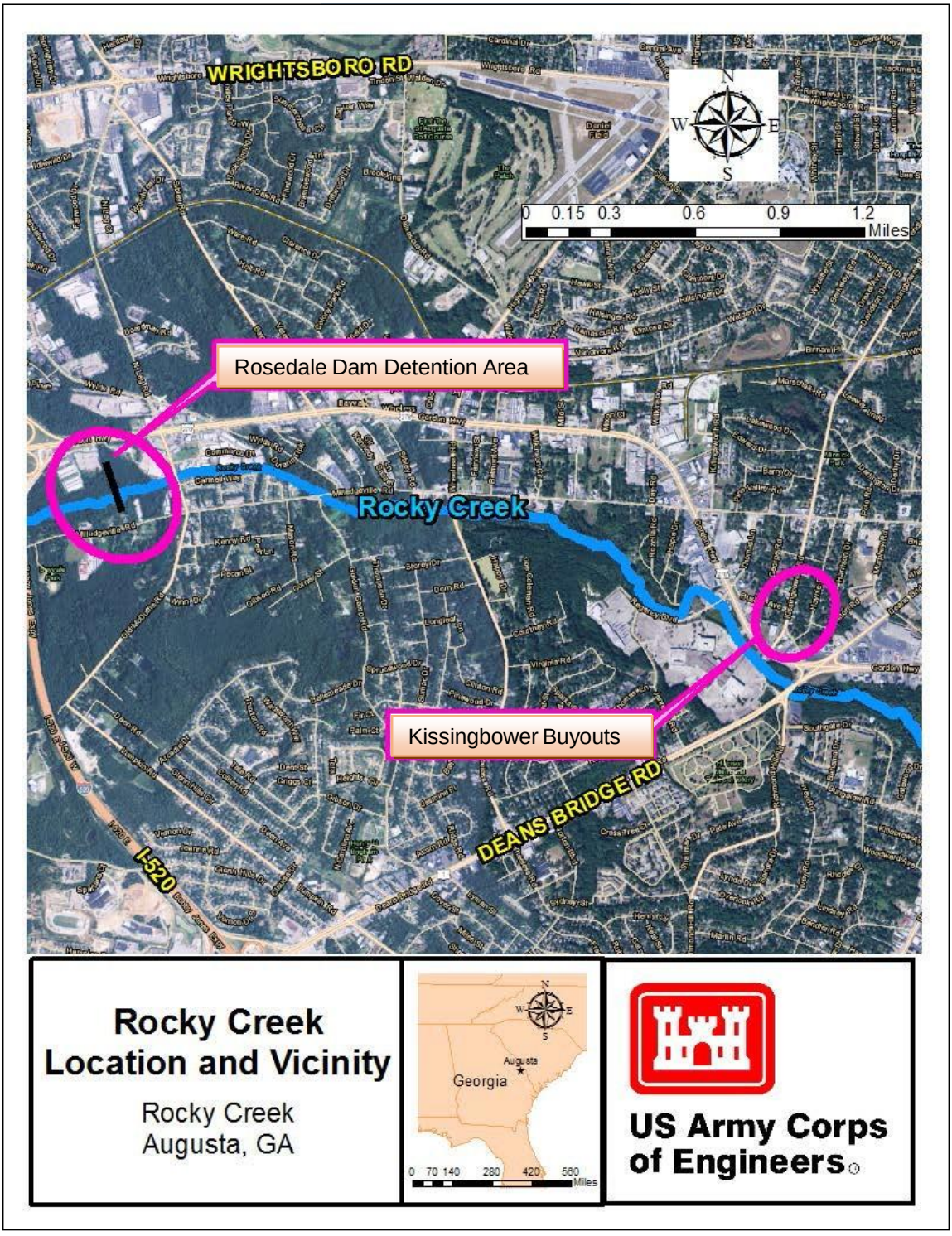


Figure 7. Location of Management Measures Analyzed

The future without-project condition (which is the No Action Alternative) is the most likely condition expected to exist in the future in the absence of a flood risk management project or program. The future without-project condition constitutes the benchmark against which flood reduction alternatives are evaluated. Forecasts of future without-project conditions consider all other practicable actions, plans and programs that could be implemented in the future to address the problems and opportunities in the study area.

Rocky Creek is included in the flood insurance program. In support of this effort, the local ordinance requires the lowest floor elevation of new construction within the high hazard areas to be three feet above the base flood elevation on the Flood Insurance Rate Map. In addition, Augusta-Richmond County has an ongoing Flood Hazard Mitigation Program that includes the purchase of structures in high hazard areas. Additionally, no residential structures shall be constructed within a dam break flood zone. These measures will aid in reducing future flood risks.

Since the floodplain is close to being fully developed, no changes in property density or location are anticipated. For purposes of this analysis, the Flood Damage Analysis (FDA) modeling focuses on the floodplain structures within the .002 exceedance probability (500-year) event. Expected annual damages for each year in the analysis period were computed, discounted back to present value, and annualized at the Fiscal Year (FY) 2017 Federal discount rate of 2.875 percent to determine equivalent annual damages over the 50-year period of analysis (2020-2069). It is estimated that the Rocky Creek study area will incur $1,547,024 in average annual damages in the future without-project condition.

4.3.1.2 ROSEDALE DAM DETENTION AREA

The structural alternative, Rosedale Dam Detention Area Improvement, would convert the former earthen dam to a detention structure. The renovations proposed at this location include placing a reinforced concrete box culvert through the existing breached embankment in the creek bed for normal creek flow. This would consist of a culvert for low flow which consists of a 5 feet wide x 6 feet high culvert outlet, approximately 150 linear feet in length, set to a culvert invert elevation of 215.7 feet NAVD 88. See Figure 8. There will be 1’ of fill and a controlling invert elevation of 216.7 feet NAVD 88. Because this is an inline detention structure, the outlet is set equal to the existing channel invert (1 foot below channel surface) so that there is no impoundment of water during normal low flow, and no barrier to movement of aquatic life during normal flow. The embankment will then be reconstructed to form the new embankment with an overflow weir. At flows of the 10-year flood event and greater, the overflow weir will be engaged and pass water in addition to culvert flow. The detention structure will reduce downstream peak flows and water surface elevations at flows greater than the 10-year event, but the incremental reduction in water surface elevation will decrease as flow increases.

The spillway crest elevation (notch) would be set to elevation 232 feet NAVD 88. The top of the detention structure would be set to elevation 240 feet NAVD 88, and protected against overtopping with a hardened structure. The bottom width of the overflow notch will be 50 feet, and the top width will be 82 feet. The side slopes will be at 2H:1V. The crest and downstream slope at the weir will be protected from erosion with about 7,000 square feet of articulated concrete block (ACB) slope protection or cast in place concrete. Both the inlet and the outfall of the culvert and weir will be protected from flow erosion. The downstream side contains a stilling basin made of rock riprap to dissipate energy when returning the flow into the creek bed. For outfall protection, approximately 150 CY (250 tons) of GADOT Type 1 riprap will be placed downstream of the reinforced concrete box culvert.

The entire structure will require clearing/grubbing and reconstruction of the embankment. Earthwork operations will require the use of an off-site borrow source for the newly constructed embankment and an off-site disposal area for soils excavated from the existing embankment which are not suitable for re-use in the new embankment. The construction contractor will be responsible for ensuring the borrow material is obtained from a source that is free of hazardous materials, cultural resources and wetlands. The proposed renovations will also include installation of riprap outfall protection, and establishment of grass cover for approximately 3 acres. The suggested plan will require acquisition of real estate in the impoundment area, but there will be no other real estate impacts upstream of the impoundment area.

A box culvert would be sunk 1 foot below grade to allow development of a natural stream channel through the culvert and facilitate passage of wildlife. The box culvert has been designed to approximate the existing channel width, to allow normal low flow and bed load sediment to pass unimpeded. This design would allow the upstream detention area to remain dry under normal weather conditions, with only normal creek flows passing through it.

This detention area does not involve excavation and is designed to utilize the natural existing flood storage capacity of the existing floodplain/wetland areas for floodwater detention. The detention area as designed is expected to hold water 3-4 hours during an average summer rain event; approximately 12 hours during typical flood events; and approximately 21 hours (no more than 36 hours) during the 25-year flood event (over an approximate area of 21 acres). The detention of water for longer periods in the detention area may create or enhance some wetland functions and values like the filtering of excessive nutrients and other pollutants from runoff, decreasing sedimentation/erosion, and enhancing wetland vegetation.

As designed, the Rosedale Dam Detention Area would limit downstream scour and loss of aquatic habitat by reducing the peak flow rate and energy of storm water discharges

to the receiving stream (USEPA 1999). Subsequent to this reduction to downstream erosion, benefits may occur to wetlands, floodplains, riparian vegetation, and bottomland hardwoods.

The sunken box culvert at the Rosedale Dam would prevent the potential for scouring of the channel bottom along the edge of the culvert, which would create a barrier to wildlife passage through the culvert. This barrier would have created hazards by forcing wildlife to go around the culvert instead of utilizing the safety of the creek for movement/migration through this area. In addition to improving the conditions for wildlife passage along the canal greenway, this culvert modification would provide a more suitable substrate for wildlife that may inhabit or pass through the culvert.

A plan view of the existing dam and proposed modifications and a profile of the dam are shown in Figures 8 and 9. Additional details are also located in the Engineering Appendix, which is Appendix B.

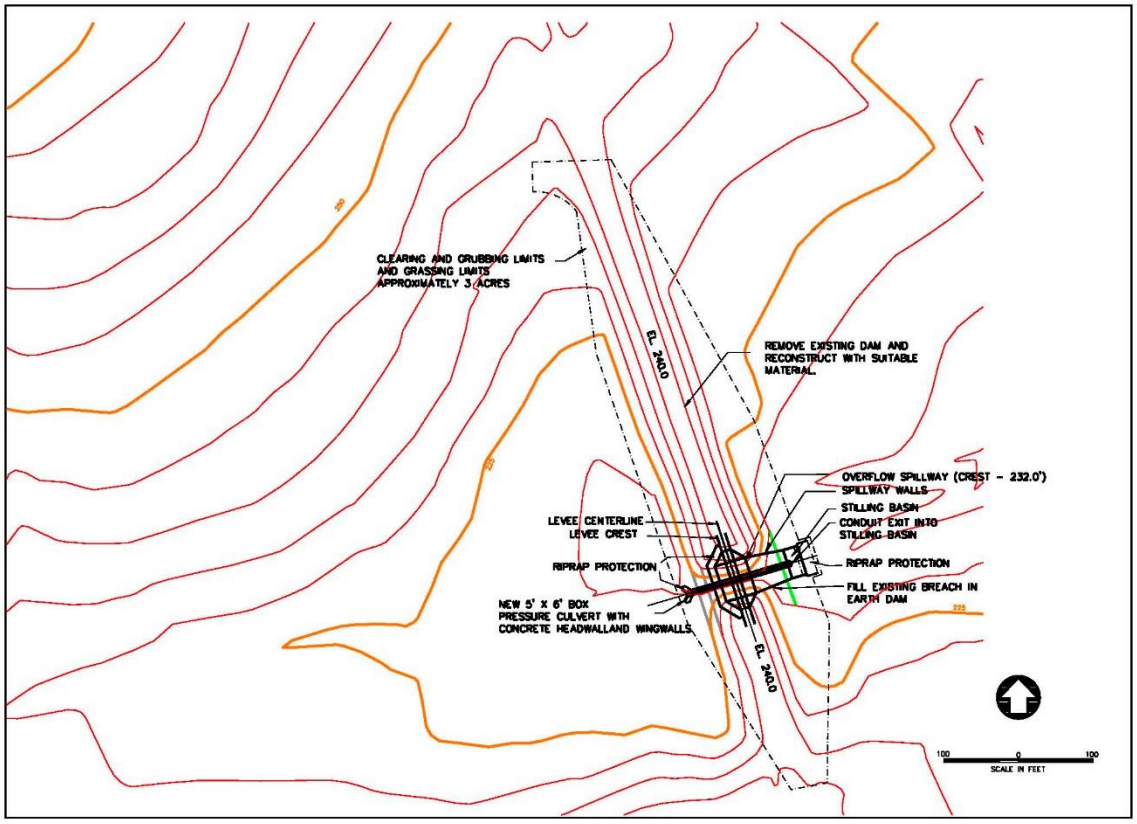


Figure 8: Plan View of the Existing Breached Dam and Proposed Modifications

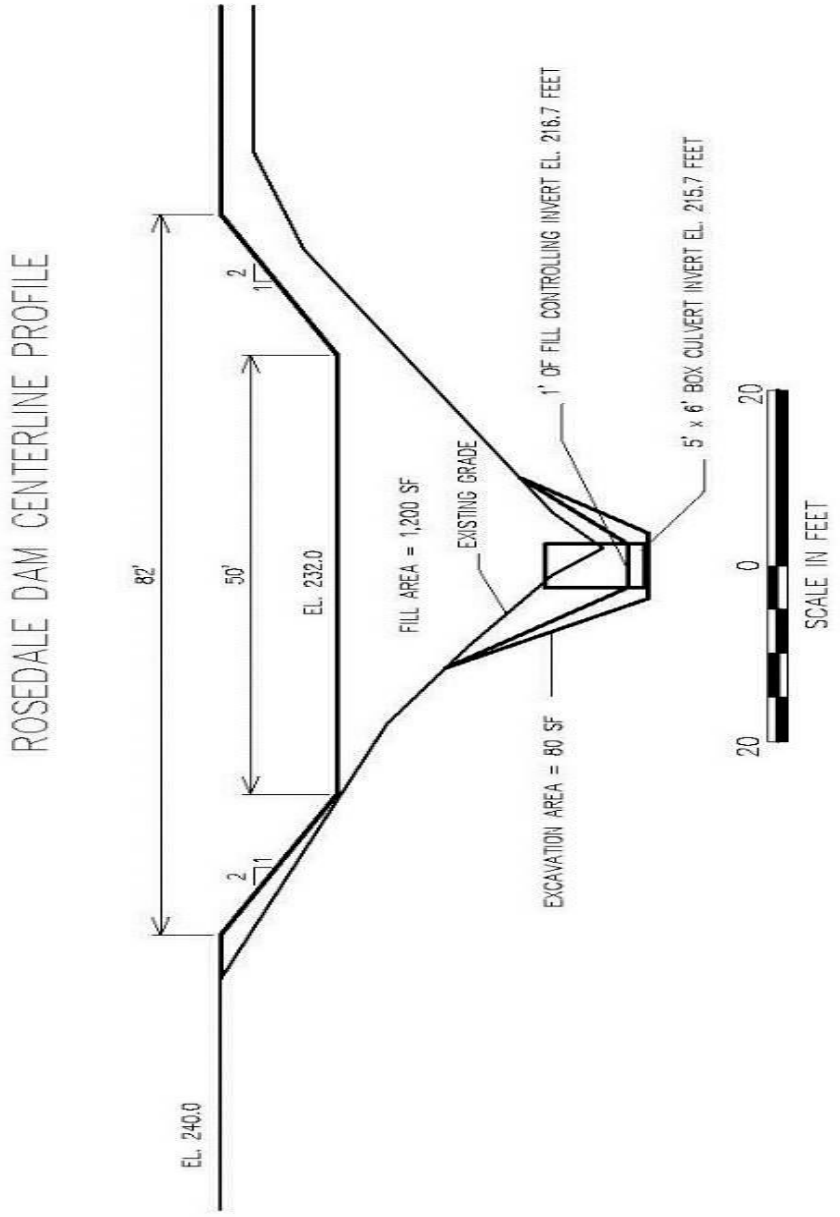


Figure 9: Profile Rosedale Dam Centerline

4.3.1.3 KISSINGBOWER BUYOUTS

This non-structural measure would require mandatory acquisitions of five properties; two are vacant and three each have a structure on them (refer to Section 5.4 "Real Estate Requirements" for more detail). By demolishing these structures, they will be eliminated from the floodplain. The remaining land would be, in perpetuity, converted to greenspace. PL 91-646 (Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970) requires that displaced residents be provided benefits for moving and resettlement.

4.3.1.4 KISSINGBOWER BUYOUTS WITH RECREATIONAL PARK

This alternative includes the non-structural Kissingbower buyouts with the added feature of a recreation park that would provide passive recreation benefits to the area. The proposed recreational park would require acquisition of five residential properties; two are vacant and three that have structures. Two of the houses were inundated with 4 to 5 ½ feet of water during the 100-year flood; the third house received 2.5 feet of flooding above the first floor elevation. By eliminating these structures from the floodplain and converting the remaining open property to a passive recreation facility, future flood damages would be eliminated and local residents would benefit from the recreational facility.

This recreation facility would consist of approximately 1.32 acres within the floodplain from the acquisition of these 5 parcels, which includes the bottom vacant triangular lot (0.3 of an acre) on Haynie Street. The purchase of this lot also provides more protection to the root system of the large existing Red Oak to be preserved for the recreational park. The site's mature trees would be left for the park. The properties would be purchased by the Non-Federal sponsor in fee.

The concept design includes the following items; 2 playgrounds, 2 swing sets, 4 benches, 1 picnic shelter (provided by the city) with 4 picnic tables, one trash container, and a bike rack (Appendix A; Figure A-8). A picnic area is provided with 16 picnic tables, each set on a concrete pad, with a grill and trash container. Landscaping would consist of preserving the existing trees on site and adding where needed shade trees, ornamental trees, a shrub hedge along the fence to screen and buffer the park from the neighbors. Fencing would be provided around the park for the children's safety.

At the onset of this study, the non-Federal sponsor expressed interest in converting evacuated lands into recreational facilities. Current recreational facilities 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/demolition of some of the structures subjected to moderate flooding would meet the objective of supplying some of the demands of the recreation shortages. ER-1105-2-100, section E-17 (2), acknowledges USACE's support that most of the benefits for the non-structural project will be associated with new uses of the vacated land. Recreational use is one of the most common post-project uses. The benefits from

future use of the vacated floodplain for recreation will generally be the dominant NED benefit for the non-structural alternative. The benefits of the recreation area are explained in detail in the Appendix A (Economics Analysis), in Section 5.5. In conclusion, by adding a recreational park area, the land use changes for that flood prone area from residential use to recreational use.

4.3.1.5 ROSEDALE DAM DETENTION AREA AND KISSINGBOWER BUYOUTS WITH PARK

This alternative would consist of a combination of both the structural improvements at Rosedale Dam and the non-structural improvements in Kissingbower Park. Impacts would be a combination of those for the detention area and the buyouts.

4.3.2 FORMULATION CRITERIA

The final array of alternative plans is compared using four formulation criteria required by the U.S. Water Resources Council. This criteria was released by the CEQ and is the "Principles and Requirements for Federal Investment in Water Resources," which was established pursuant to the Water Resources Planning Act of 1965 (Pub. Law 89-81), as amended by 42 U.S.C. 1962a-2 and consistent with section 2031 of the 2007 WEDA (Pub. Law 110-114). These criteria are completeness, effectiveness, efficiency and acceptability.

(1) Completeness

Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the actions of others.

(2) Effectiveness

All of the plans in the final array provide some contribution to the planning objectives. Effectiveness is a measure of the extent to which a plan achieves its objectives.

(3) Efficiency

All of the plans in the final array provide net benefits. Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits.

(4) Acceptability

Acceptability is the extent to which the alternative plans are implementable in terms of feasibility from technical, environmental, economic, financial, legal, institutional, and social perspectives. If it is not feasible due to any of these factors, then it cannot be implemented, and therefore is not acceptable. However, just because a plan is not the preferred plan of a non-Federal sponsor, it does not make it infeasible or unacceptable. The other dimension of acceptability is the satisfaction that a particular plan brings to government entities and the public. The degree of support can help planners evaluate whether to carry the plan forward or screen it out.

4.3.3 HYDROLOGIC AND HYDRAULIC ANALYSIS

As part of the evaluation of measures and alternatives, flood risk reduction is a major factor. Flood risk reduction is evaluated through the use of hydrologic and hydraulic models for the Rocky Creek Basin. The Hydrologic Modeling System (HMS) and River Analysis System (RAS) models were developed for the Augusta-Richmond County Study. The models were updated based on the latest hydrologic and survey information available, as well as modifying for the specific alternatives that would be utilized in the current study. A full suite of runs was utilized to capture the hydrologic loading condition of the basin from the 2-year to the 500-year recurrence intervals. The results of these model runs were utilized to evaluate the flood risk reduction effectiveness of the measures and alternatives for screening and final plan selection. Specific information and input/output of the HMS/RAS models are contained in Appendix B (Engineering Appendix). It should be noted that none of these measures, or combinations of measures, provide complete protection from flood risks nor provide a uniform level of flood protection throughout the basin.

4.3.4 ANTICIPATED ENVIRONMENTAL IMPACTS

Land use throughout this portion of the Rocky Creek Basin is typical of urban streams and has been developed primarily for residential subdivisions; while some is occupied by commercial and industrial property. This development involved much fill material that destroyed most of the natural flood storage of the original floodplain and wetland ecosystems. The combination of the Rosedale Dam Detention Area with the Kissingbower Buyouts and Recreation Park would restore some of this lost natural flood storage capacity and reduce economic damages from flooding in some of the developed areas of the drainage basin.

The Corps has assessed the environmental impacts of the all alternatives in the attached EA. Appendix A includes a detailed demographic and economic assessment of the existing condition in the study area. Environmental justice communities are present. However, USACE has not identified any significant adverse environmental impacts to any such community. All alternatives would comply with all applicable laws and regulations and would be expected to result in beneficial impacts and not have any significant adverse impacts. More detail regarding environmental impacts from alternatives in this study may be found in the EA, which is incorporated by reference.

Substantial coordination with the USFWS and GADNR has already occurred and is referenced in the EA. The GADNR issued a Water Quality Certification when the Corps considered this same project design in 2005. The USFWS has reviewed this proposed action and has been supportive both formally (Appendix D, Fish and Wildlife Coordination Act Report) and informally (phone and email). This coordination is described in more detail and is referenced throughout the EA.

A summary of the overall impacts of the all alternatives are contained in Table 2 of the attached EA and summarized in the table below. Since no significant adverse impacts have been identified in this study, environmental mitigation would not be required.

Table 3: Summary of Impacts of Alternatives

	FACTORS	NO ACTION	DETENTION AREA	BUYOUTS	BUYOUTS/ PARK	DETENTION AREA AND BUYOUTS/ PARK
1.	Economics/Social	A	B	b	b	B
2.	Recreation	--	--	--	b	b
3.	Historical/Archaeological/ Architectural	--	a	U	U	U
4.	Land Use	--	b	b	B	B
5.	HTRW	--	--	--	--	--
6.	Soil Conservation	--	B	--	--	B
7.	Stream/Wetlands Ecosystem	--	b	--	--	b
8.	Water Quality	--	b	--	--	b
9.	Air Quality	--	--	--	--	--
10.	Noise Levels	--	--	--	--	--
11.	Public Safety/Health	--	b	b	b	b
12.	Floodplain	--	b	b	b	b
13.	Flora/Fauna	--	b	--	--	b
14.	Threatened & Endangered Species	--	--	--	--	--
15.	Environmental Justice	--	b	b	b	b
16.	Cumulative Impacts	a	b	--	--	b

(A – Significant adverse impact) (a – Minor adverse impact)*
(B – Significant beneficial impact) (b – Minor beneficial impact)
(--- None or negligible) (U - Undetermined)
*a - Reference EA section 4.15

4.3.5 CULTURAL RESOURCES

No National Register of Historic Places (NRHP)-listed or eligible properties are located within or near the 100-year floodplain. Cultural resources surveys were conducted of selected areas along Rocky Creek in 2005. Six cultural resources sites were identified during the survey. One of the historic sites, Rosedale Dam (9RI1099), is located within the area of potential effect. The dam was constructed between 1928 and 1933 and consists of the earthen dam and concrete and metal water control features. Consultation with the Georgia State Historic Preservation Office (SHPO) in 2016 determined the site is not eligible for the National Register of Historic Places.

The structures that would be affected by the Kissingbower Buyouts non-structural alternative have not been recorded or formally evaluated for the NRHP. Based on an initial review of tax records, all are over 50 years old. A historic building inventory would be conducted during the next phase to record and evaluate the structures. Should the structures be determined eligible for the National Register, a Memorandum of Agreement would be executed with the GA SHPO to mitigate adverse effects. If the structures are determined not eligible, no further cultural resources investigations or agreements would be required. Based on the information obtained from the database search, there would be minimal risk to project cost and schedule in delaying the field assessment for the Kissingbower buildings until the next phase as the buildings will most likely be determined not eligible for the NHRP due to extensive modifications.

4.3.6 ECONOMIC COMPARISON

Table 4 presents the investment costs associated with each alternative 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, those costs are converted to the FY16 price level using Amendment 9 of EM 1110-2-1304. Deflation factors are derived from the appropriate feature code of the Civil Works Cost Construction Index System (CWCCIS). Further detail regarding this analysis is available in Appendix A.

Table 4. Costs by Alternative
2.875 Percent Discount Rate

	Investment Cost FY18 Price Level	CWCCIS Deflation Factor	Investment Cost FY16 Price Level
Rosedale Detention Basin Alone	$ 3,679,000	0.966	$ 3,554,447
Kissingbower Buyout Alone	$ 433,000	0.954	$ 412,984
Kissingbower Buyout with Park	$ 1,061,000	0.940	$ 997,025
Rosedale Detention Basin and Kissingbower Buyout with Park	$ 4,710,000	0.966	$ 4,550,542

The final economic comparison of the alternatives is illustrated in Table 5, which summarizes the costs and benefits for each alternative at the FY 16 price level. Both flood damage reduction and recreation benefits are included, as is the ratio of average annual benefits to average annual costs (BCR) for each plan. The NED Plan is the alternative that maximizes average annual net benefits.

Table 5. Net Benefit Analysis 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	BCR
Rosedale Detention Basin Alone	$3,554,447	$46,598	$3,601,044	$136,653	$15,000	$151,653	$766,536	$614,883	5.05
Kissingbower Buyout Alone	$412,984	$2,449	$415,433	$15,765	$0	$15,765	$1,524	-$14,241	0.10
Kissingbower Buyout with Park	$997,025	$13,071	$1,010,096	$38,331	$2,500	$40,831	$102,765	$61,934	2.52
Rosedale Detention Basin and Kissingbower 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**
****Note: An overview of the average annual benefit calculation procedure can be found in Appendix A**

The alternative that maximizes net benefits, the NED plan, is the combination of the Rosedale Dam Detention Area Improvements with the Kissingbower Buyouts and Recreation Park. This plan produces $869,301 in average annual benefits and $192,448 in average annual costs over the life of the project equaling average annual net benefits of $676,853. This yields a BCR of 4.52. 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.

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 $101,241 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.

4.3.7 NED PLAN

The NED plan maximizes net benefits. The combination of the Rosedale Dam Detention Area with the Kissingbower Buyouts and Recreation Park is the NED plan and; hence, the Selected Plan.

The uncertainty surrounding the economic and engineering input proves to have a greater than 75 percent probability of the annual benefits exceeding the annual cost and being economically justified. The details of the uncertainty analyses can be found in the economic and engineering appendices.

5.0 DESCRIPTION OF THE SELECTED PLAN

The selected plan is alternative 5, consisting of the Rosedale Dam Detention Area and Kissingbower Buyouts with the Recreation Park.

5.1 ROCKY CREEK PLAN COMPONENTS AND CONSTRUCTION CONSIDERATIONS

The main components of the selected plan include the following elements:

- Structural Component
- Non-Structural Component

5.1.1 STRUCTURAL COMPONENT – ROSEDALE DAM DETENTION AREA

The structural component would include the following:

- Conversion of the existing breached Rosedale dam to a storm water detention structure (Figures 8 and 9).
- A low-level 5 feet wide x 6 feet high culvert outlet set to 1 foot below the controlling invert elevation of 216.7 feet NAVD 88.
- A spillway crest set (notch) at elevation 232 feet NAVD 88.
- A detention structure set at elevation 240 feet NAVD 88.
- Installation of riprap inlet and outfall protection.

The structural plan includes placing a reinforced concrete box culvert approximately 150 feet in length through the breach in the dam for normal creek flow. The dam will be reconstructed to an elevation of 240.0 feet NAVD 88 with a hardened weir with a crest (notch) elevation of 232.0 feet NAVD 88. The culvert will pass all flows up to the 10-year flood event. At flows larger than the 10-year flood event, the overflow weir would engage and pass water in addition to the culvert flow. The detention structure would still

provide a reduction in peak flows and water surface elevations downstream at flows greater than the 25-year event. However, the incremental water surface elevation reduction would decrease as flow increases. At no time should the entire structure be overtopped. The crest and downstream slope at the notch would be covered with articulated concrete blocks (ACB) or a cast-in-place reinforced concrete apron for slope protection.

The Engineering Appendix includes more detailed descriptions of the dam. The impoundment area would not change the highest and best use of the lands upstream since they are currently subject to periodic flooding.

5.1.2 NON-STRUCTURAL COMPONENT – KISSINGBOWER BUYOUTS AND RECREATIONAL PARK

The non-structural portion of the recommended plan is located north of Gordon Highway on Kissingbower Road and Haynie Street, across from the Regency Mall. There are three structures presently located on five parcels (refer to section 5.4 "Real Estate Requirements" for more detail regarding real estate issues). Two of the structures were inundated with 4 to 5 ½ feet of water while the third house received 2.5 feet of flooding during the 100-year flood. Those occupying the houses would be relocated and the structure would be demolished. The properties would be purchased by the local sponsor in fee. All 5 parcels would be acquired, which includes the bottom vacant triangular lot (0.3 of an acre) on Haynie Drive. The proposed recreational park would use the vacated lands of these five parcels. The park would consist of approximately 1.32 acres within the floodplain. The purchase of these parcels also provides more protection to the root system of the large existing Red Oak that would be preserved for the recreational park. The site's other mature trees would also be left for the park also (Appendix B, Engineering Appendix; Figure 24).

The concept design for the recreational park includes the following items: swing sets, benches, a picnic shelter (provided by the city) with picnic tables, a trash container, multi-use trail, and a bike rack. Two concept designs can be found in Appendix A. Concept 3B was chosen.

A picnic area is provided with 16 picnic tables, each set on a concrete pad, with a grill and trash container. Landscaping would consist of preserving the existing trees on site and adding where needed shade trees, ornamental trees, a shrub hedge along the fence to screen and buffer the park from the neighbors. Fencing would be provided around the park for public safety.

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 $102,792 in total benefits at the FY16 price level. The cost to build this park includes the average annual cost (AAC) of buying out five properties ($16,396), AAC of constructing the park ($23,831), annual operation and maintenance ($2,500), and interest during construction ($528) for a total AAC of $43,255 at the FY18 price level. Using the Civil Works

Breakdown Structure (CWBS) feature code for Recreation Facilities Amendment 9 of EM 1110-2-1304 to index these costs to the FY16 price level yields average annual costs of $40,831. The net benefits are $61,934. For additional information, see section 5.5 of the Economics Appendix A.

5.2 Operation and Maintenance

Based on implementation of the recommended plan and current policy and guidance, operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) is the responsibility of the non-Federal sponsor. Maintenance of the evacuated residential sites would be minimal and consist of periodic mowing and landscaping. Operation and Maintenance of the recreational park is estimated to cost $2,500 per year. Operation and Maintenance (O&M) cost of the Rosedale Dam Detention Area is estimated at $15,000 per year.

5.3 Plan Accomplishments

The Rosedale Dam Detention Area would primarily provide temporary storage for small (2-year) to medium (10-year) size flood events. Once constructed, the area would provide additional attenuation time for rainfall runoff (primarily for less than 25-year flows), and the peak downstream flow would be reduced by 200-250 CFS. Flood elevations would be reduced immediately downstream. The Rosedale Dam Detention Area would reduce the peak flow downstream for all rain events. The structure design is targeted to have the largest flood reduction impact up to the 25-year flood event. At flows larger than the 10-year flood event, the overflow weir would be engaged and pass water in addition to culvert flow. The detention structure would still provide a reduction in peak flows and water surface elevations downstream at flows greater than the 10-year event. However, the incremental water surface elevation reduction will decrease as flow increases.

The following flood reductions result from the Rosedale Dam Detention Area, and not the non-structural plan. The area between Wheeless Road and Regency Mall has flooding risks reduced by about 0.25 feet for the 25-year event and 0.21 feet for the 10-year event. The area between Peach Orchard Road and Mike Padgett Highway has flooding reduced by about 0.7 feet for the 25-year event and 0.85 feet for the 10-year event. The area between Peach Orchard and Deans Bridge shows approximately a 1.5 feet Water Surface Elevation (WSE) reduction.

The Kissingbower property buyouts would include the purchase of five parcels that include three structures in the floodplain. The Kissingbower properties sustain water damage on a fairly frequent interval due to their proximity to Rocky Creek and experience up to 5 feet of flooding with the 100-year flood event. The property buyouts and demolition of the structures would eliminate the potential for future flood damages on these properties. Converting the use of these lands to a recreational park would provide unmet recreational demands in the Kissingbower Road area. More importantly, owners of purchased properties would have the opportunity to relocate to an area less prone to flooding. In addition, the floodplain would be restored on these properties in perpetuity.

The selected plan which includes the Rosedale Dam Detention Area and the Kissingbower Buyouts with the Recreation Park reduces flood damages for 258 structures within the 500-year floodplain. Three of these structures would be completely removed from the floodplain in the non-structural alternative. The non-structural alternative eliminates 100 percent of the average annual damages to the structures and contents while the structural alternative would reduce average annual damages by approximately 50 percent. The residual damages would be approximately 50 percent.

The USACE screening level climate change vulnerability assessment (VA) tool was utilized to assess the potential impacts and likelihood of climate change impacts to this region. The tool indicated that the Savannah-Ogeechee Basin was at relatively low risk for climate change to cause a substantial negative impact on flood risk reduction type projects. More information regarding climate change may be found in Appendix B Section C-2.5.

There are no significant adverse environmental impacts caused by the project. The description of water detention periods is located in the EA under project description: "This detention area does not involve excavation and is designed to utilize the natural existing flood storage capacity of the existing floodplain/wetland areas for floodwater detention. The detention area as designated is expected to hold water 3-4 hours during an average summer rain event; approximately 12 hours during typical flood events; and approximately 21 hours (no more than 36 hours) during the 25-year flood event (over an approximate area of 21 acres)…"

The EA includes a discussion of stream impacts using the "waters of the US" criteria and discusses jurisdictional wetland impacts (0.4 acre of wetland within project impact area) using the definition for wetlands. The 55 cubic yards of fill for renovating the Rosedale Dam is within the stream channel, which are waters of the US (but are not jurisdictional wetlands). The 55 cubic yards of fill for renovating Rosedale Dam is located a significant distance from the 0.4 acre wetland (as illustrated in EA Figure 4; Appendix A) and therefore would not impact the wetland.

5.4 Real Estate Requirements

The requirements for lands, easements, rights-of-way and relocations, and disposal/borrow areas (LERRD) would include the right to construct, maintain, repair, operate, patrol and replace a flood protection levee and weir, including all appurtenances, and for the location, construction, operation, maintenance, and alteration/ replacement of a road and appurtenances. Five parcels that lie within the floodplain in the Kissingbower area would be purchased in fee estate. A Real Estate Plan is included as Appendix C.

The Flowage Easement for Occasional Flooding (approximately 17.19 acres) would be used for the detention area and the Flood Protection Levee Easement (approximately 1.80 acres) will be used for the berm/levee. The Temporary Work Area Easement (approximately 2.20 acres) would be used for staging area and a Perpetual Road Easement (approximately 0.3 acres) would be used for the access road to the levee.

The five privately owned parcels (approximately 1.32 acres) located on Kissingbower Road and Haynie Drive in the area of Gordon Highway and Kissingbower Road would be bought out. Two of the parcels are vacant and three of the properties have structures. Of those, one appears to be owner occupied and the other two are assumed to be tenant occupied. Relocation assistance would be available for eligible displaced persons. After acquisition of the property and relocation of the owner/tenants, the parcels would be cleared and would be used to construct a public recreation park.

Nine landowners and ten parcels would be impacted by construction of the two features of the project. It is estimated that real estate could be acquired within 12 months. Real estate cost including land value, administrative cost and relocation assistance is estimated at $613,200. It is noted that the real estate costs in the following cost tables reflect the fully funded Total Project Cost (TPC), and do not match the estimated real estate costs provided for inclusion in the TPC.

5.5 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.

5.5.1 Cost Sharing by Project Purpose

Cost sharing percentages are shown in Table 5 by project purpose. However, additional considerations affecting the distribution include lands, easements, rights-of-way, relocations, and disposal areas (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 6. Cost Sharing Distribution by Purpose

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

[1]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.

5.5.2 Cost Sharing of Structural Measure

1. Total Project Cost (TPC) for structural management measures is $3,786,000 and includes Design and Implementation (D/I); construction management; Lands, Easements, Rights-of-way, Relocations, and Disposal Areas (LERRDs); 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 $1,362,200, 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 7.

Table 7. Cost Sharing
of Structural Flood Risk Management Measure
FY18 Price Level

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
LERRDs	$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.

5.5.3 COST SHARING OF NON-STRUCTURAL MEASURE

1. TPC for non-structural management measures is $584,000, and includes D/I, construction management, and LERRDs.

2. 35 percent of non-structural TPC

    0.35 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 8.

Table 8. Cost Sharing of Non-Structural Flood Risk Management Measure FY18 Price Level

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
LERRDs	$533,950	$24,050	$558,000
Construction Features	-	-	-
Total without 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%***	

5.5.4 COST SHARING OF RECREATION

1. Total project cost (TPC) for recreation is $591,000 and includes preconstruction engineering and design (PED), construction management, and construction features.

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

0.50 x $591,000 = $295,500

3. A summary of the NED recreation cost-share allocation is contained in Table 9.

Table 9. Cost Sharing of Recreation Measure FY18 Price Level

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

5.5.5 NED Plan Cost Sharing

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 5.5.2 through 5.5.4) TPC is $4,962,000 and includes preconstruction engineering and design (PED), construction management, and LERRDs ("Lands & Damages") and construction features.

2. 35 percent of structural TPC

0.35 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:

0.05 x $3,786,000 = $189,300

4. Structural LERRDs (NF) plus five percent cash contribution by non-Federal sponsor (see Section 5.5.2):

$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 5.5.3).

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

7. A summary of the NED structural flood risk management cost-share allocation is contained in Table 10.

Table 10. Cost Sharing of NED Plan FY18 Price Level

Item	Non-Federal Cost	Federal Cost	Total Cost
D/I	$316,550	$527,450	$844,000
Construction Mgmt	$56,700	$90,300	$147,000
LERRDs	$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		

6.0 PLAN IMPLEMENTATION

6.1 PROJECT PARTNERSHIP AGREEMENT

The description of Federal and non-Federal responsibilities would be legally defined in the Project Partnership Agreement (PPA). The PPA would not be executed nor will construction be initiated on this project until the National Environmental Policy Act, the Clean Water Act, the Endangered Species Act, the Fish and Wildlife Coordination Act and the National Historic Preservation Act planning phase requirements are met.

These requirements are met for the Augusta-Richmond County project once the draft EA has been coordinated, responses to comments prepared, and a Final Environmental Assessment and Finding of No Significant Impact (FONSI) is signed.

PPA negotiations with the non-Federal project sponsor would be conducted, and the draft PPA package submitted to higher authority for review and approval once the feasibility report is approved and the project is budgeted for construction. In accordance with CAP policies, an initial allocation of $100K in D/I phase funds would be made available to negotiate and execute the PPA.

6.2 FINANCIAL ASSESSMENT

Augusta-Richmond County has been a non-Federal sponsor with the Corps of Engineers on several projects and studies since the early 1990's. The City of Augusta (now consolidated city and county and referred to Augusta-Richmond County) was the non-Federal sponsor on the Oates Creek Flood Control Project that was constructed in 1992. The total cost was around $14,000,000 of which the non-Federal share was about $4,000,000. They have performed the operation and maintenance of the project since construction. Also, Augusta-Richmond County has contributed 50% as their share of the feasibility phase of this Section 205 flood risk management study.

Most of the funding for this project 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 seven times to approve or extend the SPLOST on seven 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 11 shows the funds generated.

Table 11. 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

SPLOST VII project list was approved by the Augusta Commission on August 18, 2015. Augusta has an A+ bond rating if it should choose this option.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

This report assesses the feasibility of providing flood risk management for the Rocky Creek Basin through a combined structural and non-structural plan. The structural plan includes constructing a flood reduction feature along Rocky Creek. The non-structural plan includes purchasing properties in a portion of the basin prone to repetitive flooding.

Structural Alternative: The entire existing embankment would be cleared of all vegetation and de-constructed. A new embankment would then be reconstructed back to a crest elevation of 240 feet. A new 150 foot long reinforced concrete box culvert would be placed in the creek bed and the area that was previously breached would be filled to an elevation of 232.0 feet to form a weir for all flows in excess of the 10-year event. The bottom width of the overflow weir would be 50 feet, and the top width would be 82 feet. The side slopes would be at 2H:1V. The crest and downstream slope at the weir would be protected from erosion with about 7,000 square feet of Articulated Concrete Block (ACB) slope protection or cast in place concrete. For outfall protection, approximately 150 CY (250 tons) of GADOT Type 1 riprap would be placed downstream of the reinforced concrete box culvert.

Non-Structural Alternative: The proposed non-structural plan would require acquisition of five residential properties. The acquired properties would be converted into a recreational park.

Selected Plan: Based on the results found in this feasibility report, the selected plan includes both the structural and non-structural alternatives. Alternative 5, Rosedale Dam Detention Area and Kissingbower Buyouts with Recreation Park, produces the highest average annual net benefits of all the alternatives while sustaining environmental resources.

The conclusions contained herein reflect the information available at this time and current Department of Army policies governing formulation of individual projects. The selected plan is in accordance with current Department of the Army budgetary policy.

7.2 RECOMMENDATIONS

I recommend that the selected plan for the management of flood risks along Rocky Creek in Augusta-Richmond County, Georgia as described in Section 5.0 be authorized for implementation as a Federal project. The selected plan includes the construction of the Rosedale Dam Detention Area, the acquisition of five properties in the Kissingbower Road Area, and the construction of a recreational park in the Kissingbower Road Area.

Date: 25 Apr 2017

Marvin L. Griffin, P.E.
Colonel, US Army
Commanding

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**

1.0 OVERVIEW OF STUDY A-1
1.1 PURPOSE A-1
1.1.1 General Legislation A-1
1.1.2 Specific Authorization A-1
1.2 LOCATION A-1
1.3 PROBLEMS AND OPPORTUNITIES A-2

2.0 SOCIO-ECONOMIC CHARACTERISTICS A-8
2.1 POPULATION A-8
2.1.1 Racial Composition A-9
2.2 HOUSING CHARACTERISTICS A-11
2.3 EMPLOYMENT & UNEMPLOYMENT A-13
2.4 CIVILIAN OCCUPATION A-15
2.5 INCOME & POVERTY A-16

3.0 HYDROLOGIC ENGINEERING CENTER-FLOOD DAMAGE ANALYSIS A-19
3.1 STUDY LAYOUT AND CONFIGURATION A-19
3.1.1 Study Streams A-19
3.1.2 Damage Reaches A-19
3.1.3 Analysis Years A-20
3.1.4 Evaluation A-20
3.1.5 Plans A-20
3.2 HYDROLOGIC ENGINEERING A-21
3.2.1 Water Surface Profiles A-21
3.2.2 Exceedance Probability Functions With Uncertainty A-22
3.2.3 Stage – Discharge Functions With Uncertainty A-22
3.3 ECONOMICS A-23
3.3.1 Assumptions A-23
3.3.2 Damage Categories A-24
3.3.3 Structure Occupancy Types A-24
3.3.4 Depth Damage Functions A-25

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

TABLE OF CONTENTS (CONTINUED)

TITLE **PAGE**

3.3.5 Structure Inventory Data A-26
3.3.5.1 General A-26
3.3.5.2 Structure Value A-26
3.3.5.3 Content Value A-27
3.3.5.4 Residential Content Value A-27
3.3.5.5 Non-residential Inventory and Equipment Values A-27
3.3.6 First Floor Elevations A-27
3.3.7 Stage Damage Function A-27
3.3.7.1 Stage-Damage Curve A-29
3.3.7.2 Stage-Damage Function With Uncertainty A-29

4.0 OVERVIEW OF THE 10-STEP NED BENEFIT EVALUATION PROCEDURE A-30

5.0 ROCKY CREEK A-34
5.1 SPECIFIC PROBLEMS AND OPPORTUNITIES A-34
5.2 REACH DESIGNATION A-34
5.3 ALTERNATIVES A-34
5.4 STRUCTURAL FLOOD RISK MANAGEMENT MEASURE A-34
5.5 NON-STRUCTURAL FLOOD RISK MANAGEMENT MEASURES A-34
5.6 ECONOMIC ANALYSIS OF PLAN SELECTION A-47
5.7 FLOOD DAMAGE REDUCTION BENEFITS OF ALTERNATIVES A-48
5.8 NED PLAN A-49
5.9 NED PLAN RESIDUAL DAMAGE ANALYSIS A-50
5.9.1 NED Plan 2-Year Event Residual Damage Analysis A-56
5.9.2 NED Plan 5-Year Event Residual Damage Analysis A-59
5.9.3 NED Plan 10-Year Event Residual Damage Analysis A-62
5.9.4 NED Plan 25-Year Event Residual Damage Analysis A-65
5.9.5 NED Plan 50-Year Event Residual Damage Analysis A-68
5.9.6 NED Plan 100-Year Event Residual Damage Analysis A-71
5.9.7 NED Plan 250-Year Event Residual Damage Analysis A-74
5.9.8 NED Plan 500-Year Event Residual Damage Analysis A-77

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

TABLE OF CONTENTS (CONTINUED)

TITLE **PAGE**

6.0 ABILITY TO PAY ANALYSIS AND FINANCIAL ASSESSMENT A-80
6.1 Financial Assessment A-80

7.0 ROCKY CREEK COST SHARING A-82
7.1 COST SHARING OF STRUCTURAL MEASURE A-82
7.2 COST SHARING OF NON-STRUCTURAL MEASURE A-83
7.3 COST SHARING OF RECREATION A-85
7.4 COST SHARING OF NED PLAN A-86

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC

ANALYSIS LIST OF TABLES

Table		Page
1	Selected Recent Floods and Declared Disaster	A-4
2	Population Development	A-8
3	Population Totals by Race and Hispanic Origin	A-9
4	Percent Total Population by Race	A-10
5	Housing Units	A-11
6	Percent Owner and Renter-Occupied Housing Units	A-11
7	Employment Status	A-13
8	Percent Population 16 Years and Over by Employment Status	A-13
9	Unemployment	A-14
10	Unemployment Rate - U.S., GA, and Richmond County	A-14
11	Number of Workers by Occupation Type	A-15
12	Percent Civilian Employed Population by Occupation Type	A-15
13	Per Capita, Median Household, and Mean Household Income	A-17
14	Poverty Status	A-17
15	Percent below Poverty Level - U.S., GA, and Richmond County	A-18
16	Rocky Creek Reach Designation by Station	A-19
17	Structure Inventory by Damage Category for Rocky Creek	A-24
18	Vehicle Depth-Damage Relationships	A-28
19	Rocky Creek Without Project Single Event Damages	A-29
20	Activity Within the Floodplain With Selected Parameters	A-32
21	Kissingbower Road Areaa Estimated Average Annual Flood Damages	A-38
22	P.L. 91-646 Evacuation Costs Excluded from BCR	A-39
23	Average Annual Permanent Relocation/Evacuation Costs of Five Residential Properties	A-40
24	Unit Day Valuation Point Assignments by Criteria	A-41
25	Benefit-Cost Analysis Park Plan A	A-46
26	Benefit-Cost Analysis Park Plan B	A-48
27	Rocky Creek Flood Damage Reductions (AAEQ)	A-51
28	Costs by Alternative (FY18 Price Level)	A-52
29	Net Benefits by Alternative	A-52
30	Probability Exceedance of Flood Damages Reduced	A-53
31	Without and With Project Damages	A-53
32	Residual Single Event Dollar Damages	A-55
33	Residual Single Event Structure Damages	A-56

34	Residual Single Event Residential Structure Damages	A-56
35	Residual Single Event Residential Dollar Damages	A-56
36	Residual Single Event Commercial Structure Damages	A-57
37	Residual Single Event Commercial Dollar Damages	A-57
38	Residual Single Event Municipal Structure Damages	A-57
39	Residual Single Event Municipal Dollar Damages	A-58
40	Historic SPLOST Funding	A-84
41	Cost Sharing Distribution by Purpose	A-85
42	Cost Sharing of Structural Flood Risk Management Measure	A-86
43	Cost Sharing of Non-Structural Flood Risk Management Measure	A-88
44	Cost Sharing of Recreation Measure	A-89
45	Cost Sharing of NED Plan	A-90

AUGUSTA ROCKY CREEK FLOOD RISK MANAGEMENT SECTION 205 FEASIBILITY STUDY

APPENDIX A – ECONOMIC ANALYSIS

LIST OF FIGURES

Figure		Page
1	Vicinity Map	A-3
2	Location Map	A-5
3	Location of Management Measures Analyzed	A-6
4	100-Year Floodplain	A-7
5	Population Development	A-9
6	Population Totals by Race and Hispanic Origin	A-10
7	Socioeconomic Study Area	A-12
8	Percent Civilian Employed Population by Occupation Type	A-16
9	Concept Design of Recreation Park	A-45
10	Aerial Photograph of Non-Structural Project Site	A-49
11	Average Annual Equivalent Dollar Damage With and Without Project	A-54
12	Average Annual Equivalent Dollar Damag Reduced	A-55
13	2-Year Flood Event Number of Structures Damaged by Category	A-59
14	2-Year Flood Event Damage Reduction and Elimination Sites	A-60
15	2-Year Flood Event Dollar Damages	A-61
16	5-Year Flood Event Number of Structures Damaged by Category	A-62
17	5-Year Flood Event Damage Reduction and Elimination Sites	A-63
18	5-Year Flood Event Dollar Damages	A-64
19	10-Year Flood Event Number of Structures Damaged	A-65
20	10-Year Flood Event Damage Reduction and Elimination Sites	A-66
21	10-Year Flood Event Dollar Damages	A-67
22	25-Year Flood Event Number of Structures Damaged by Category	A-68
23	25-Year Flood Event Damage Reduction and Elimination Sites	A-69
24	25-Year Flood Event Dollar Damages	A-70
25	50-Year Flood Event Number of Structures Damaged by Category	A-71
26	50-Year Flood Event Damage Reduction and Elimination Sites	A-72
27	50-Year Flood Event Dollar Damages	A-73
28	100-Year Flood Event Number of Structures Damaged by Category	A-74
29	100-Year Flood Event Damage Reduction and Elimination Sites	A-75
30	100-Year Flood Event Dollar Damages	A-76
31	250-Year Flood Event Number of Structures Damaged by Category	A-77

32	250-Year Flood Event Damage Reduction and Elimination Sites	A-78
33	250-Year Flood Event Dollar Damages	A-79
34	500-Year Flood Event Number of Structures Damaged	A-80
35	500-Year Flood Event Damage Reduction and Elimination Sites	A-81
36	500-Year Flood Event Dollar Damages	A-82

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

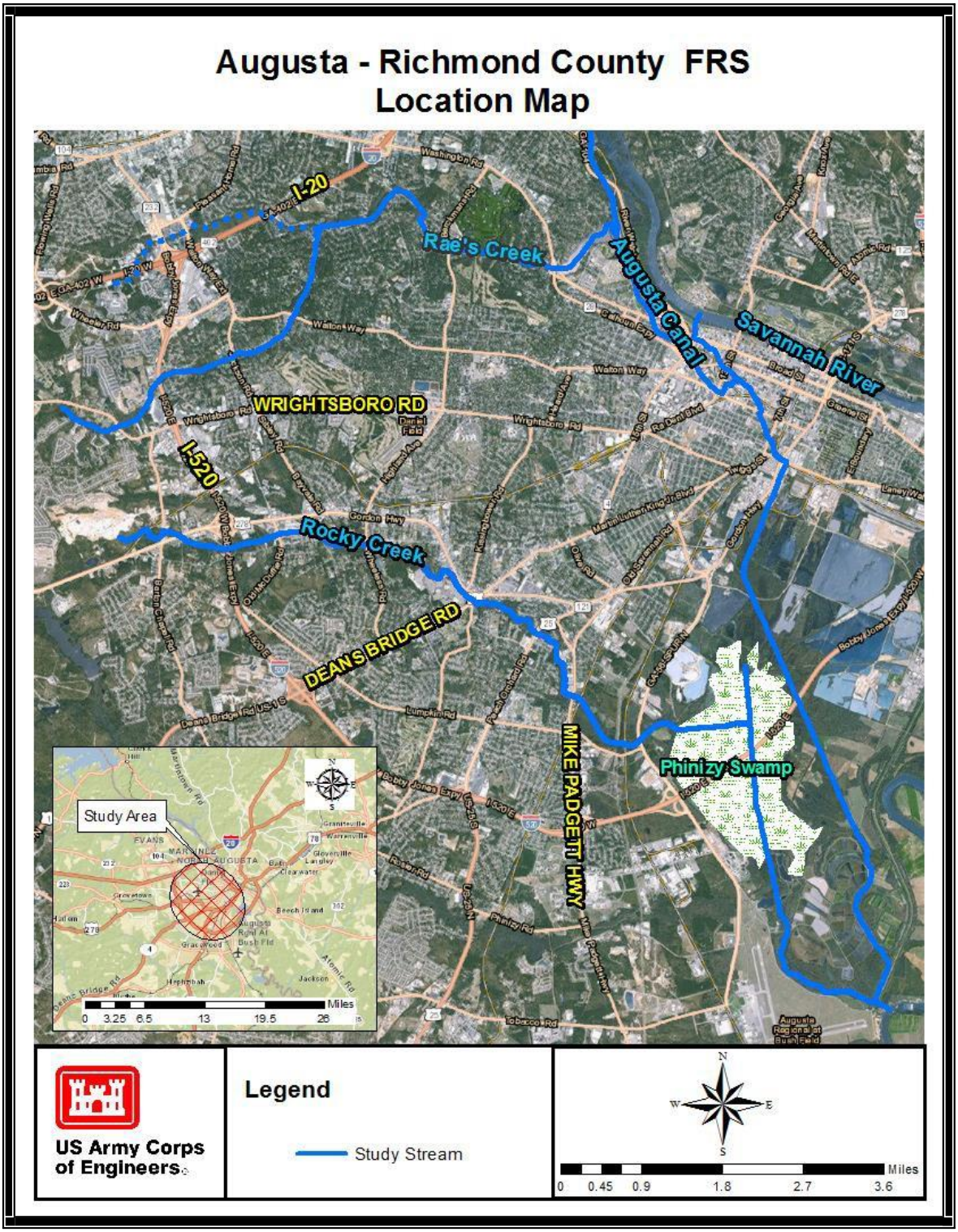


Figure A-2. Location Map

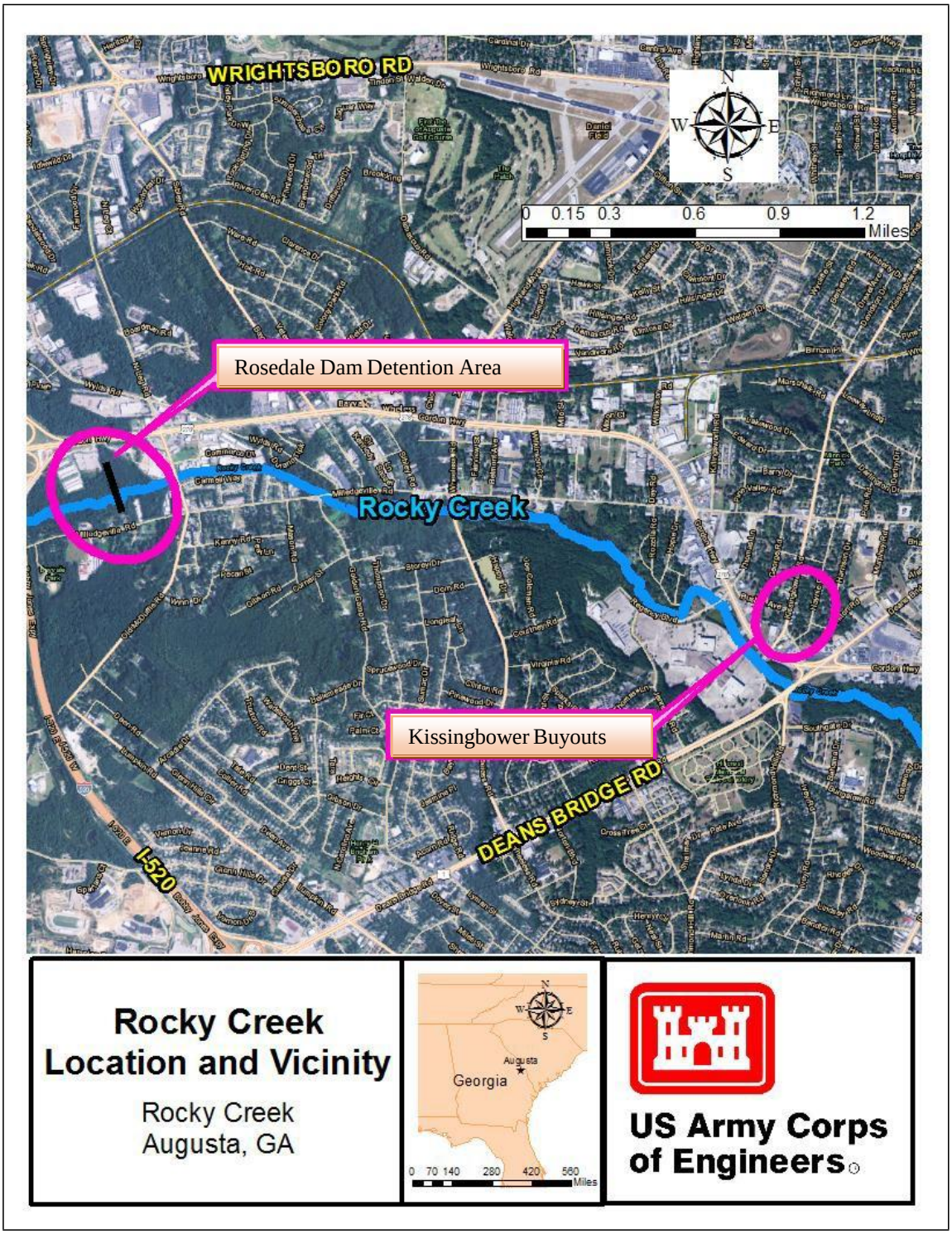


Figure A-3. Location of Management Measures Analyzed

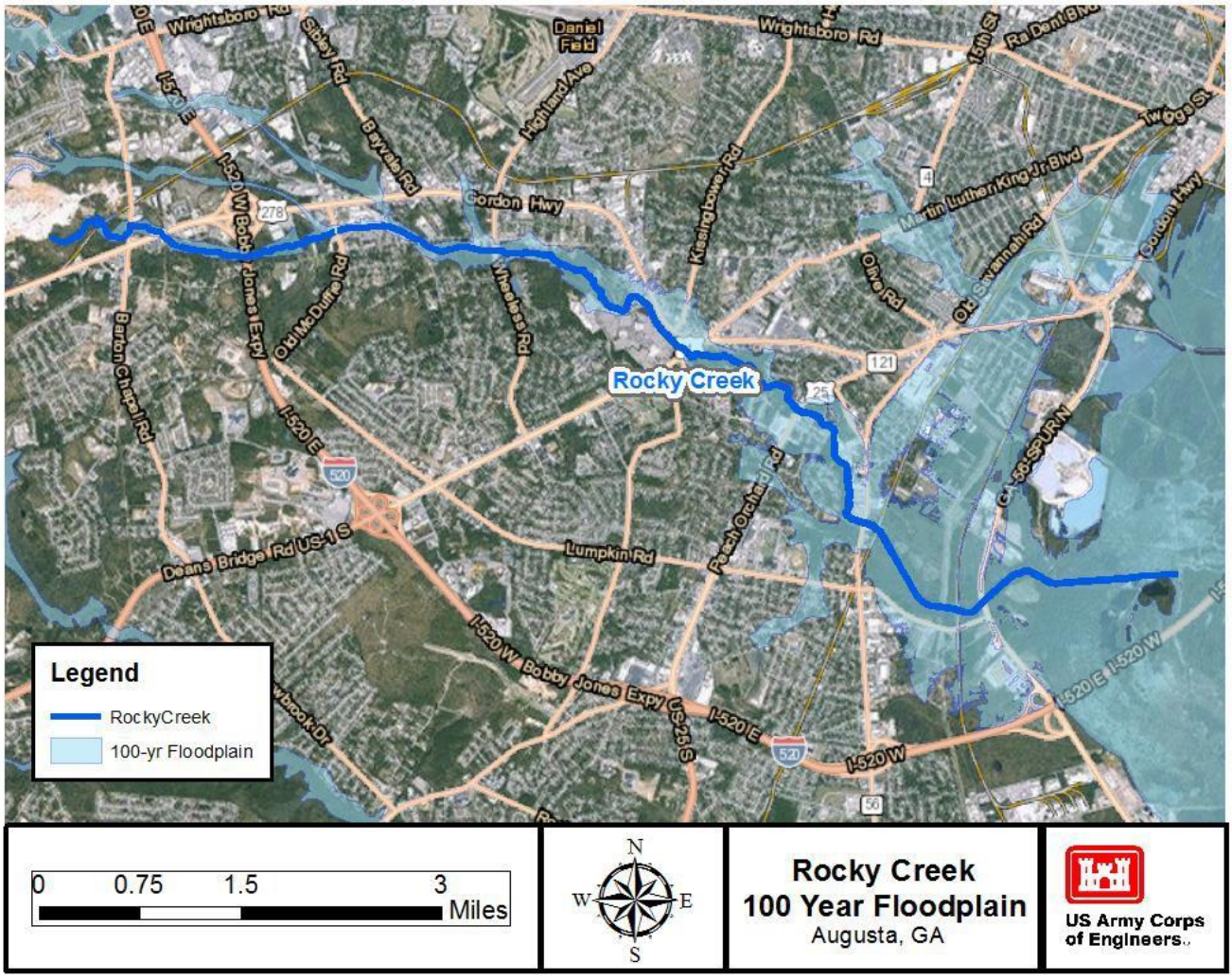


Figure A-4. 100-Year Floodplain

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.

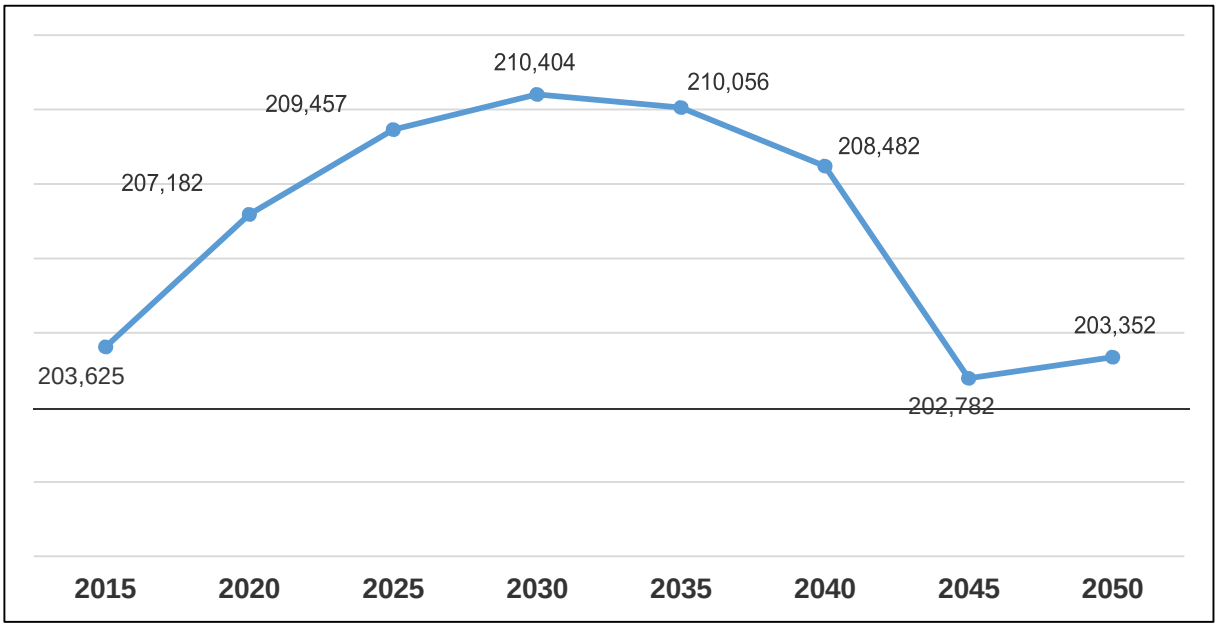
Table A-2: Population Development: 2000 - 2014

	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

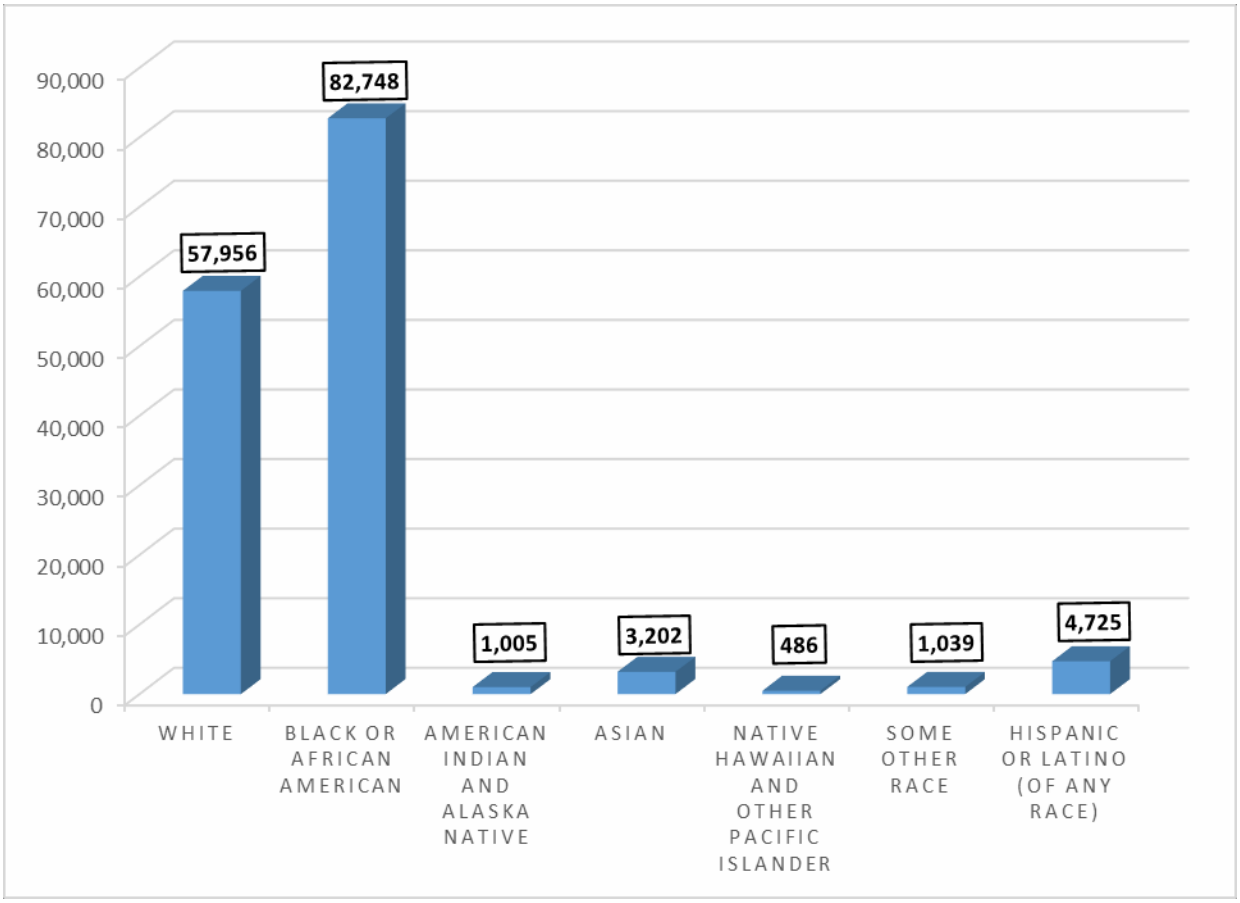


Figure A-6: Population Totals by Race and Hispanic Origin

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

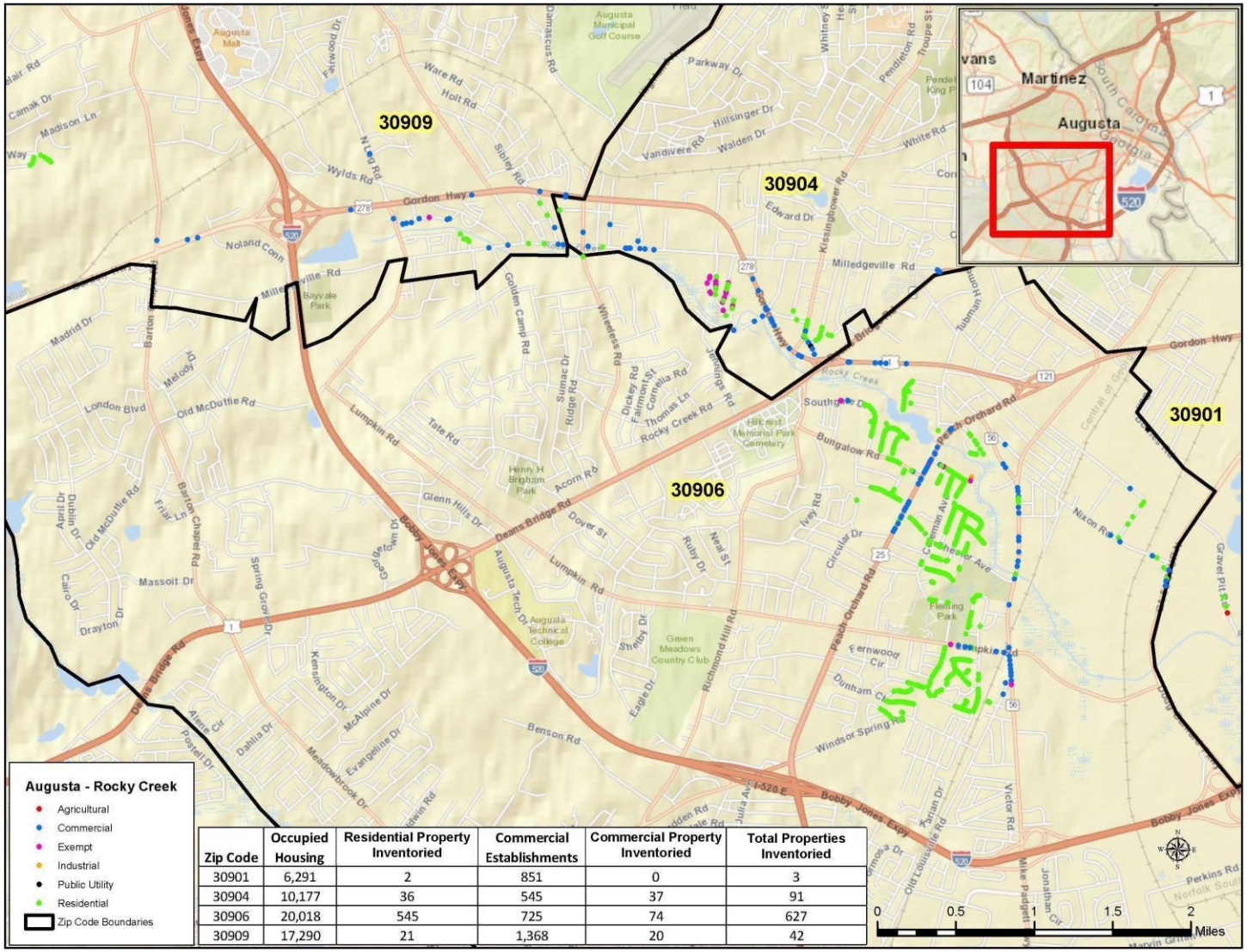
Source: U.S. Department of Commerce, Bureau of the Census

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.

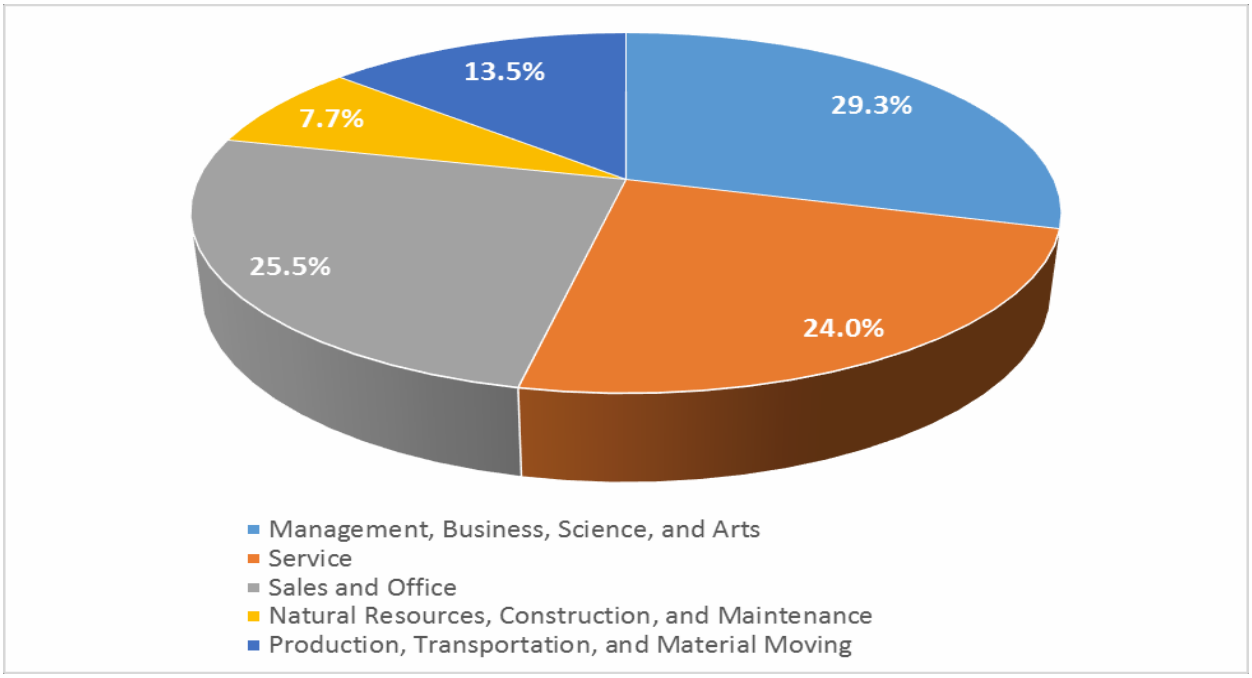


Figure A-8: Percent Civilian Employed Population by Occupation Type

- 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.

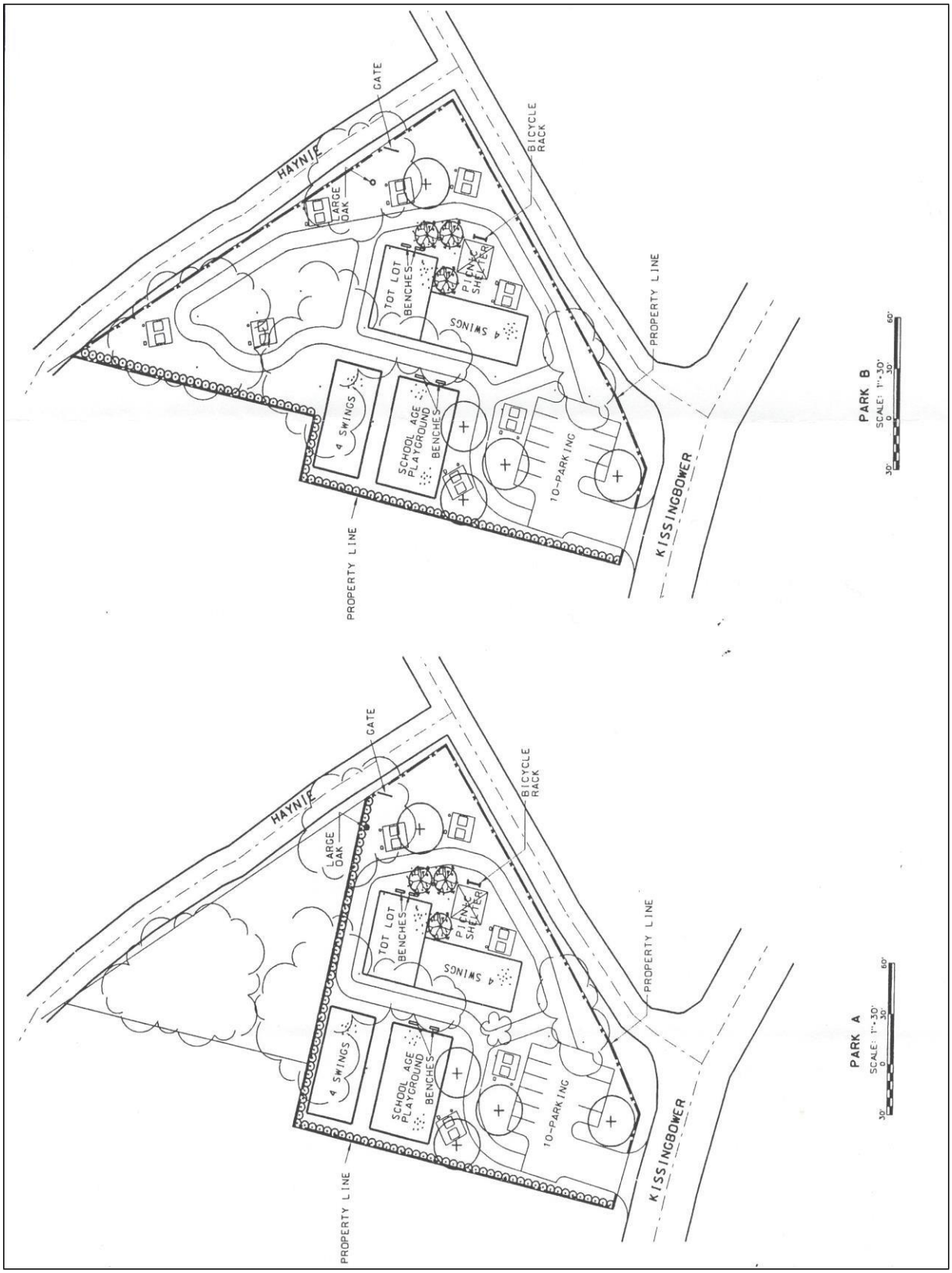


Figure A-9. Concept Design of Recreation Parks

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**

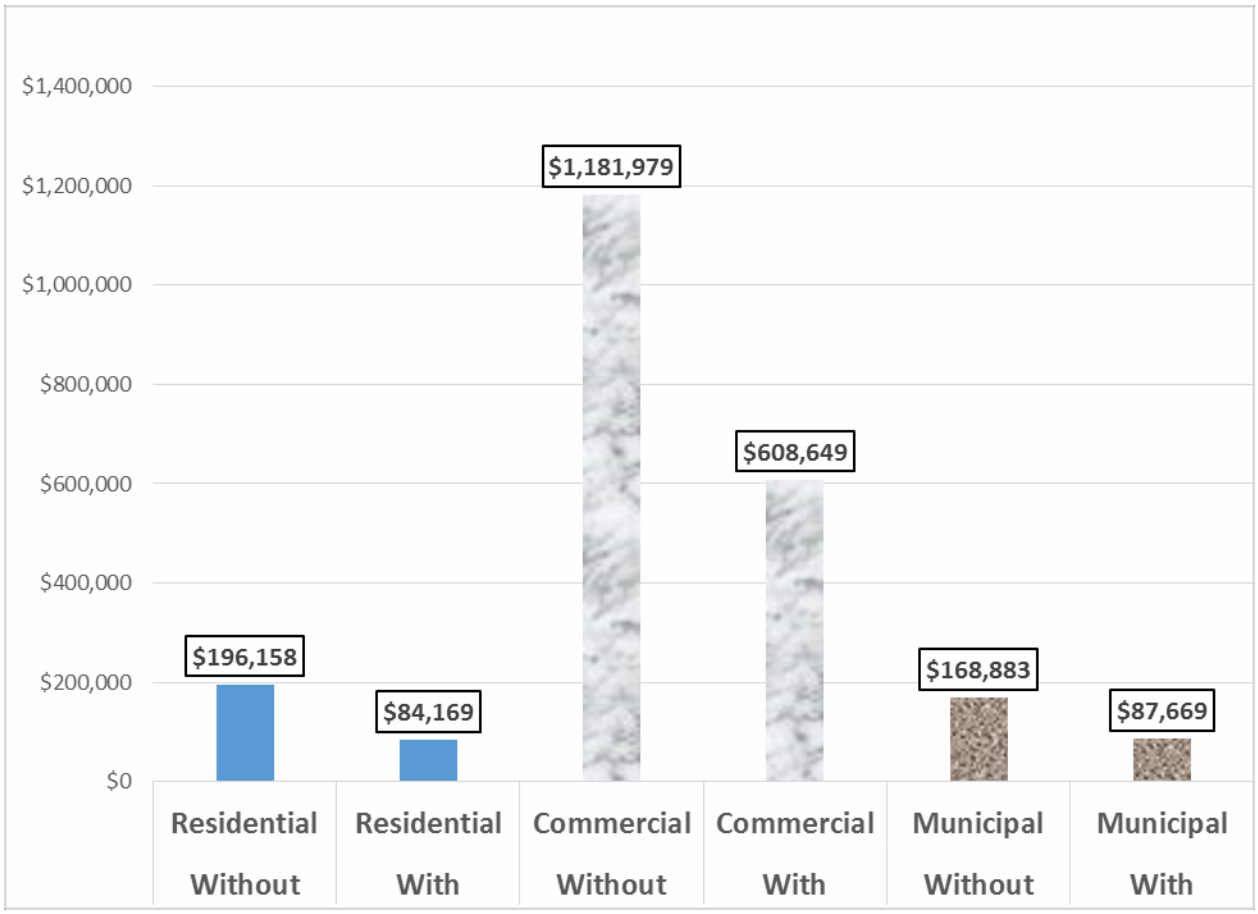


Figure A-11: Average Annual Equivalent Dollar Damage Without and With Project FY16 Price Level and 2.875 Percent Discount Rate

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.

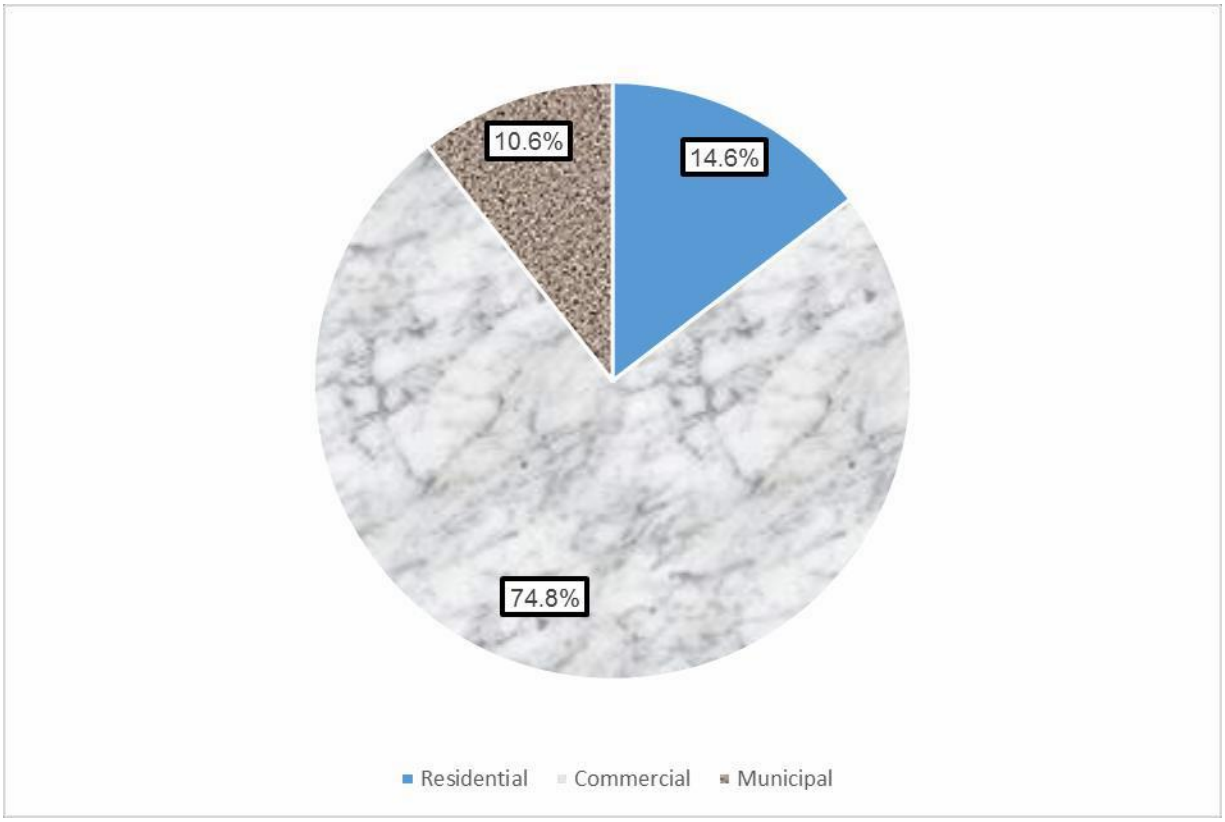


Figure A-12: Average Annual Equivalent Dollar Damage Reduced

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%

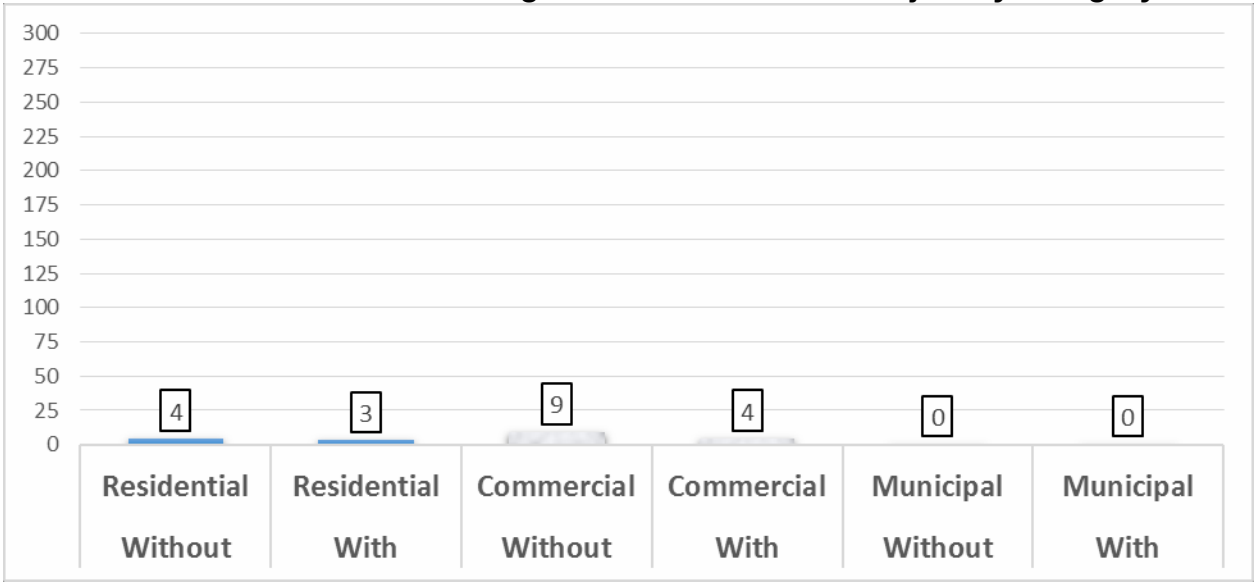
Table A-39: Residual Single Event Municipal Dollar Damages
FY16 Price Level and 2.875 Percent Discount Rate

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.

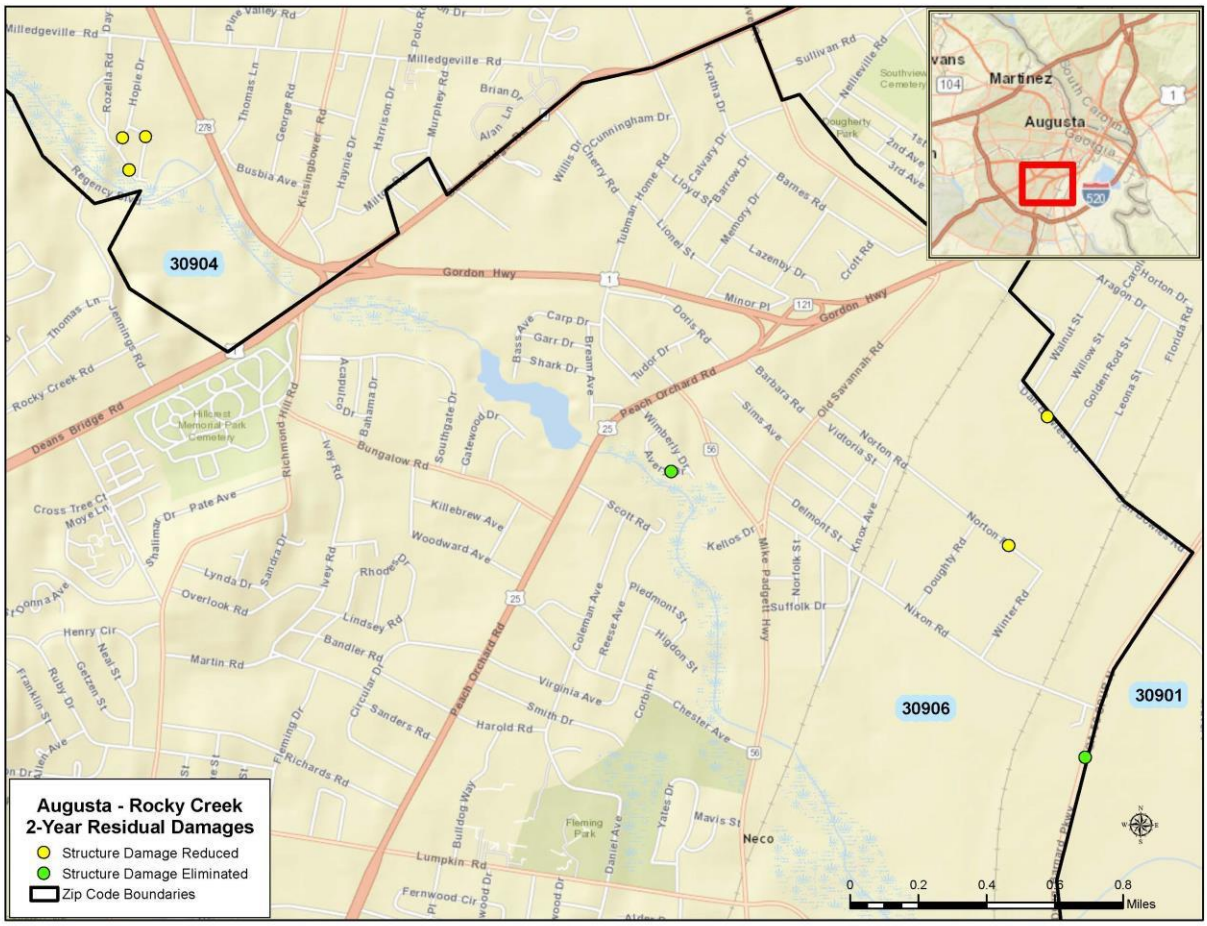
Figure A-13. Rocky Creek 2-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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.

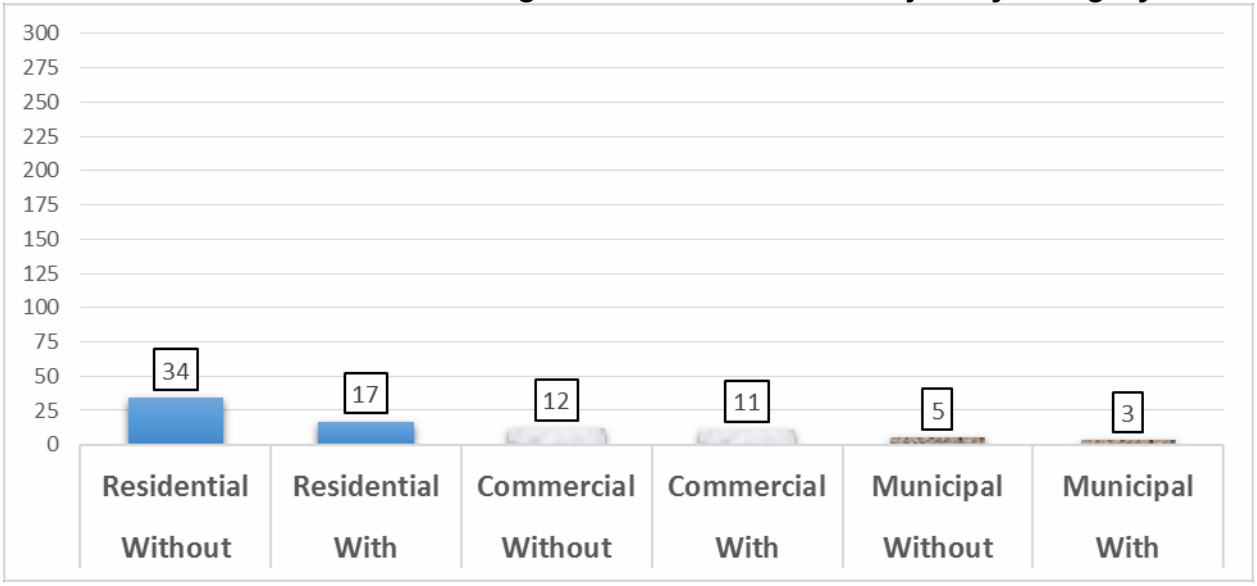
Under the with-project condition, total dollar damages are reduced to $140,500. This equates to a decrease of $984,701, or 87.5 percent of the total dollar damages incurred under the without-project condition. Residential damages are reduced by $2,923, a decrease of 32.4 percent of the without-project 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.

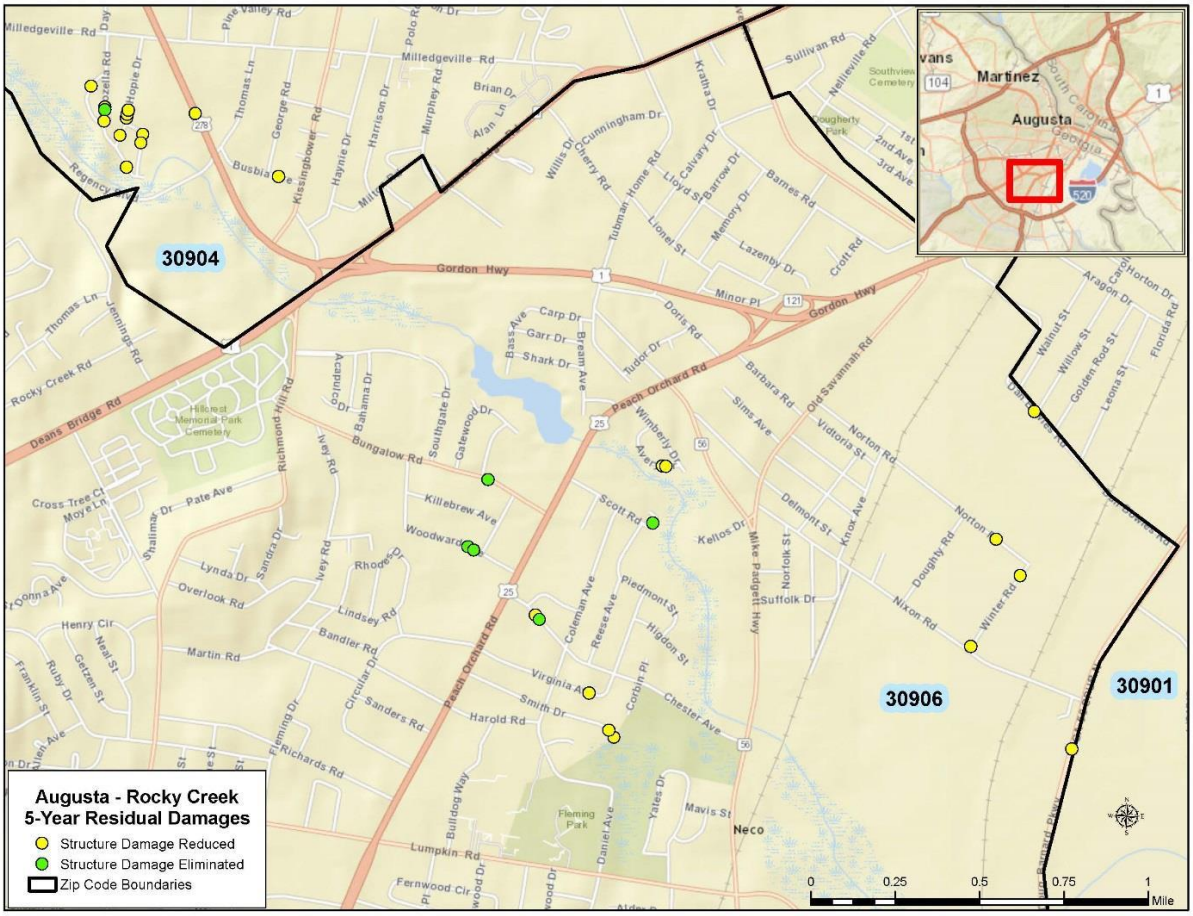
Figure A-16. Rocky Creek 5-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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.

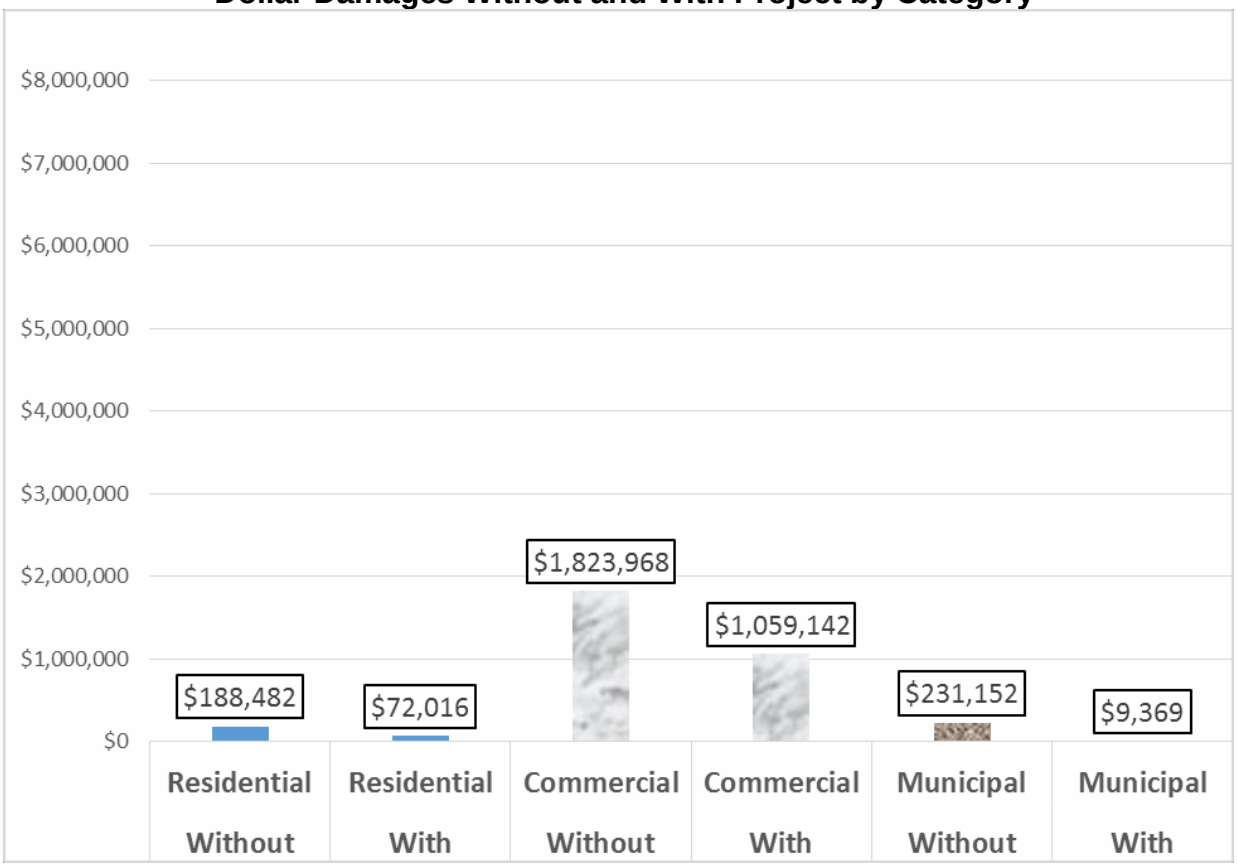
Figure A-17. Rocky Creek 5-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



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.

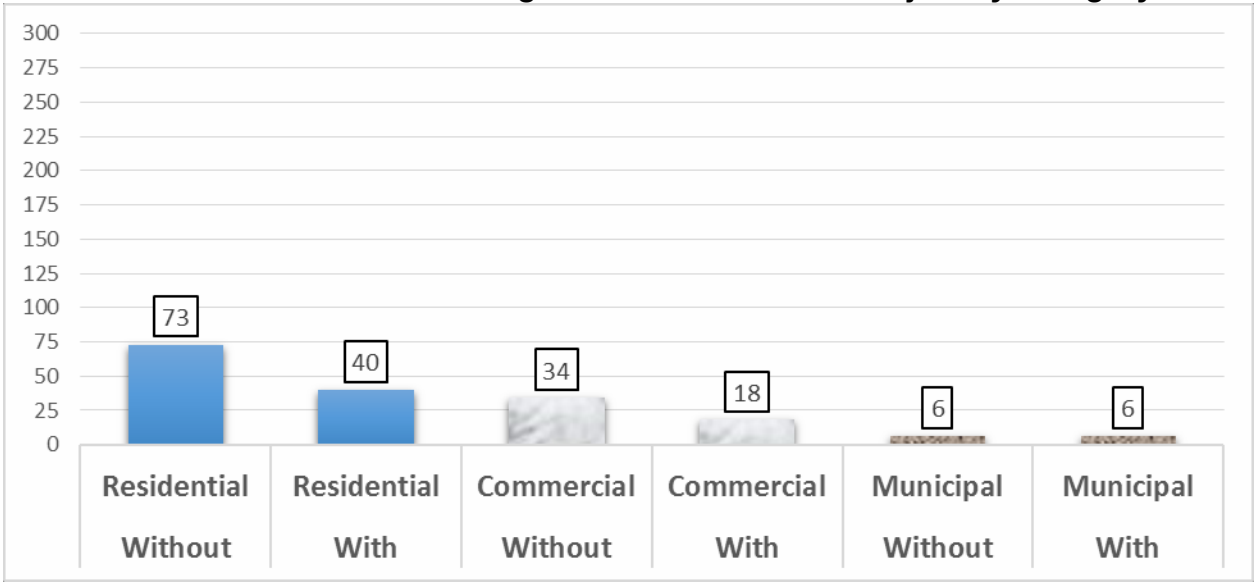
Figure A-18. Rocky Creek 5-Year Flood Event
Dollar Damages Without and With Project by Category



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.

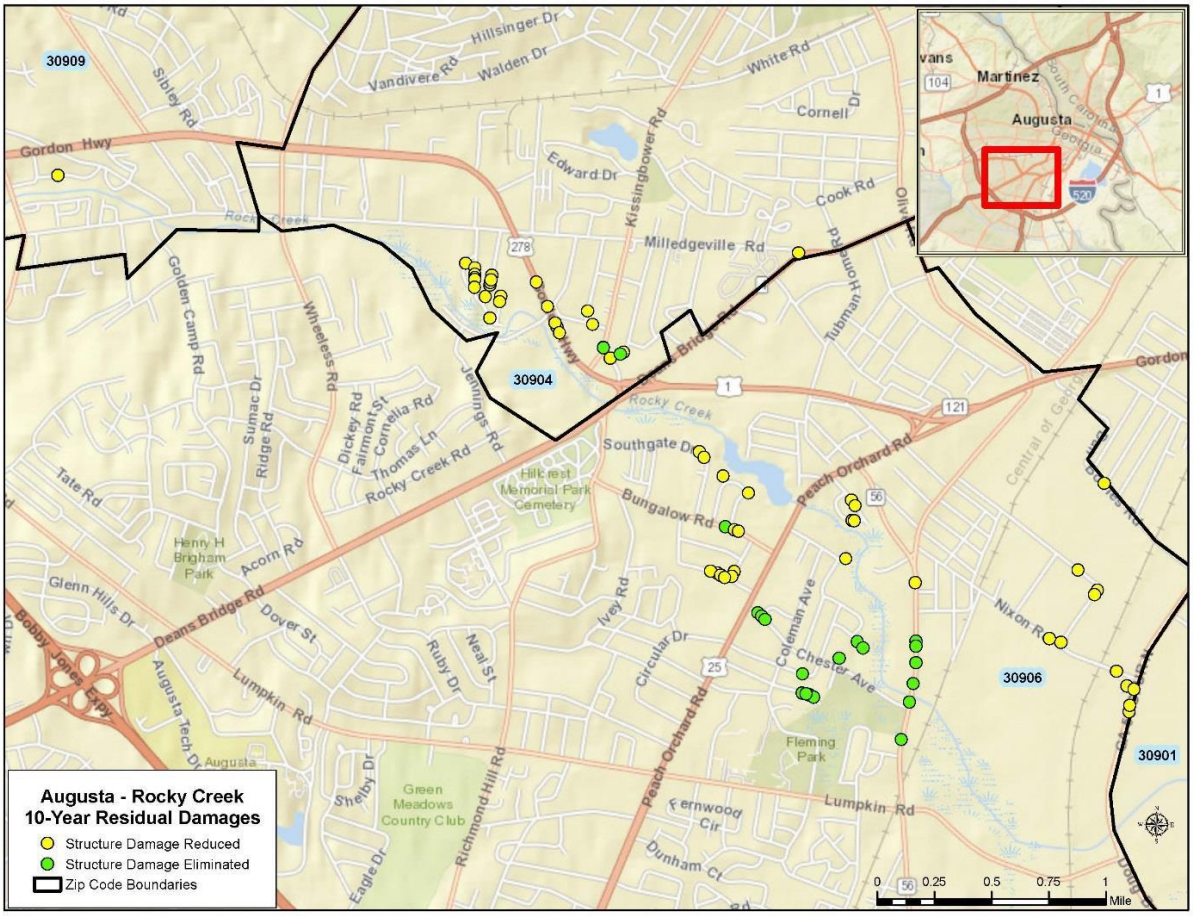
Figure A-19. Rocky Creek 10-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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

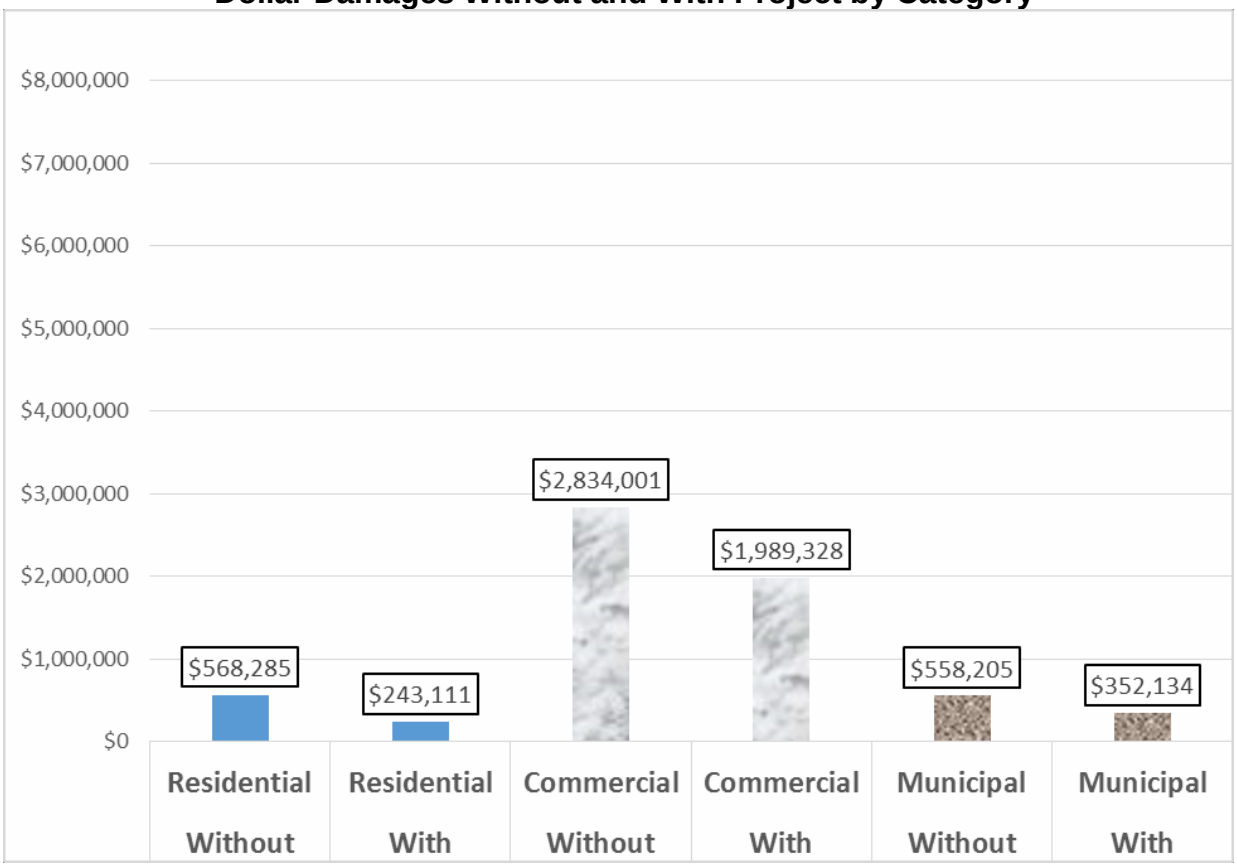


A total of $3,960,491 in flood damages occur under the without-project condition. Of this, $568,285 of damage is to residential structures and their contents, which constitutes 14.35 percent of the without-project total dollar damages. Damages to municipal structures total $558,205 or 14.1 percent of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

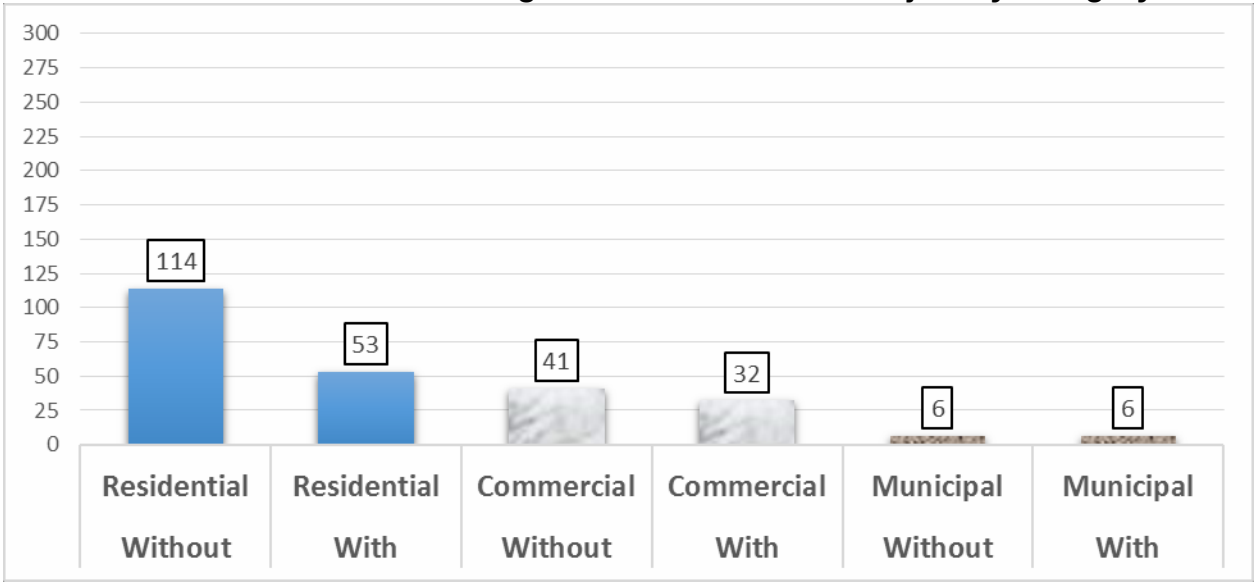
Figure A-21. Rocky Creek 10-Year Flood Event
Dollar Damages Without and With Project by Category



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.

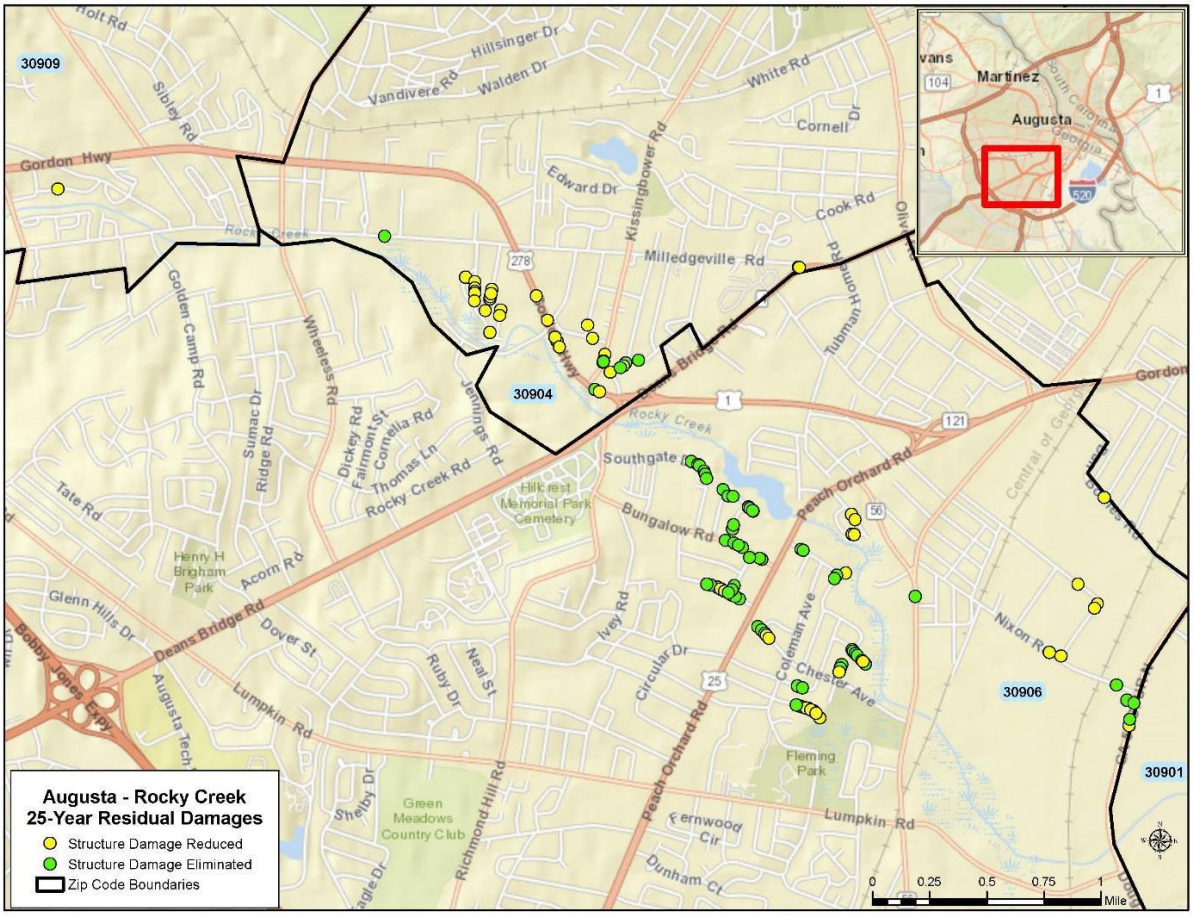
Figure A-22. Rocky Creek 25-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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.

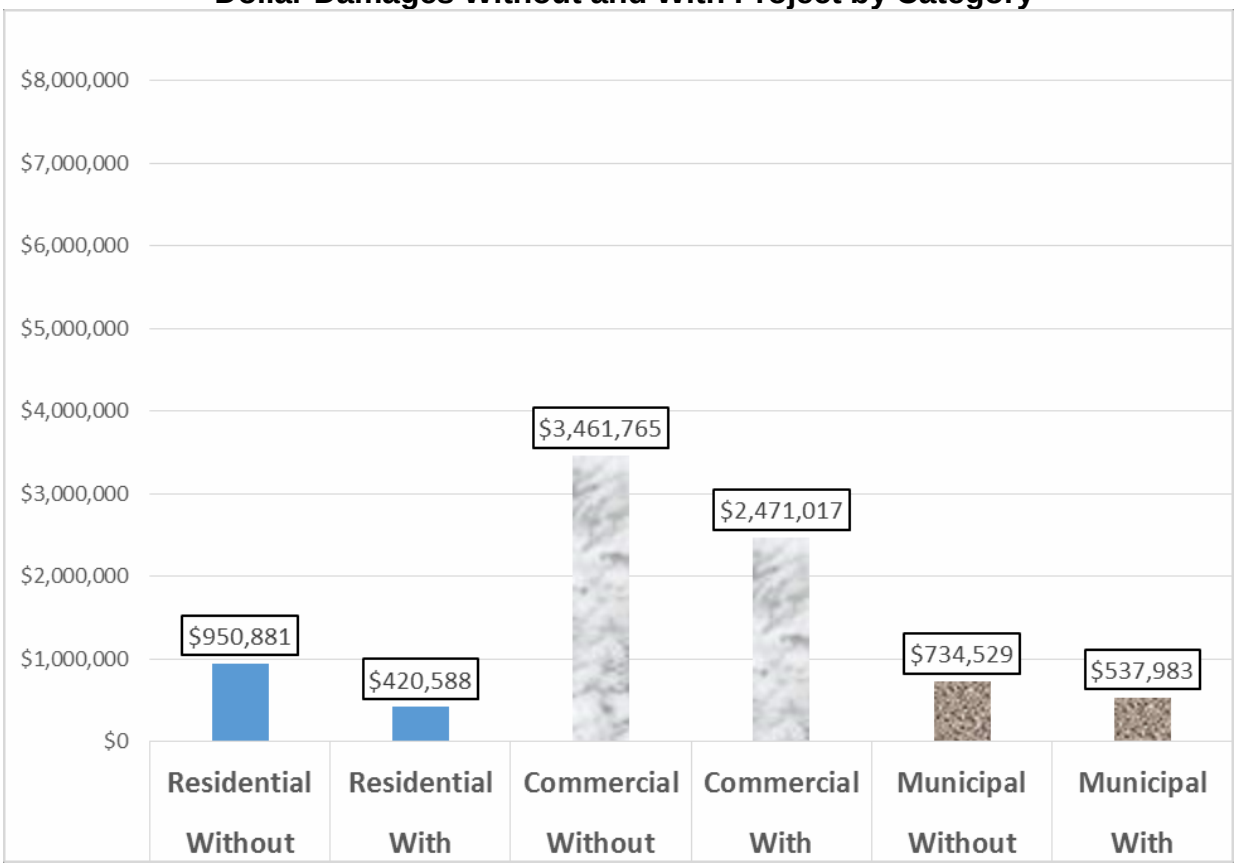
Figure A-23. Rocky Creek 25-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



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.

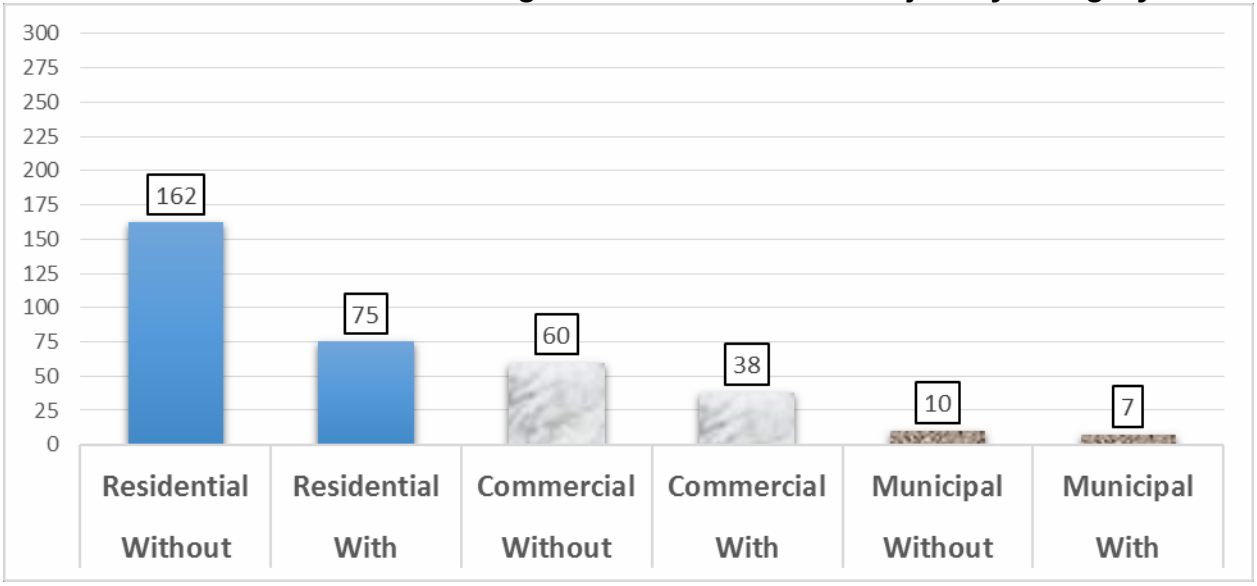
Figure A-24. Rocky Creek 25-Year Flood Event
Dollar Damages Without and With Project by Category



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.

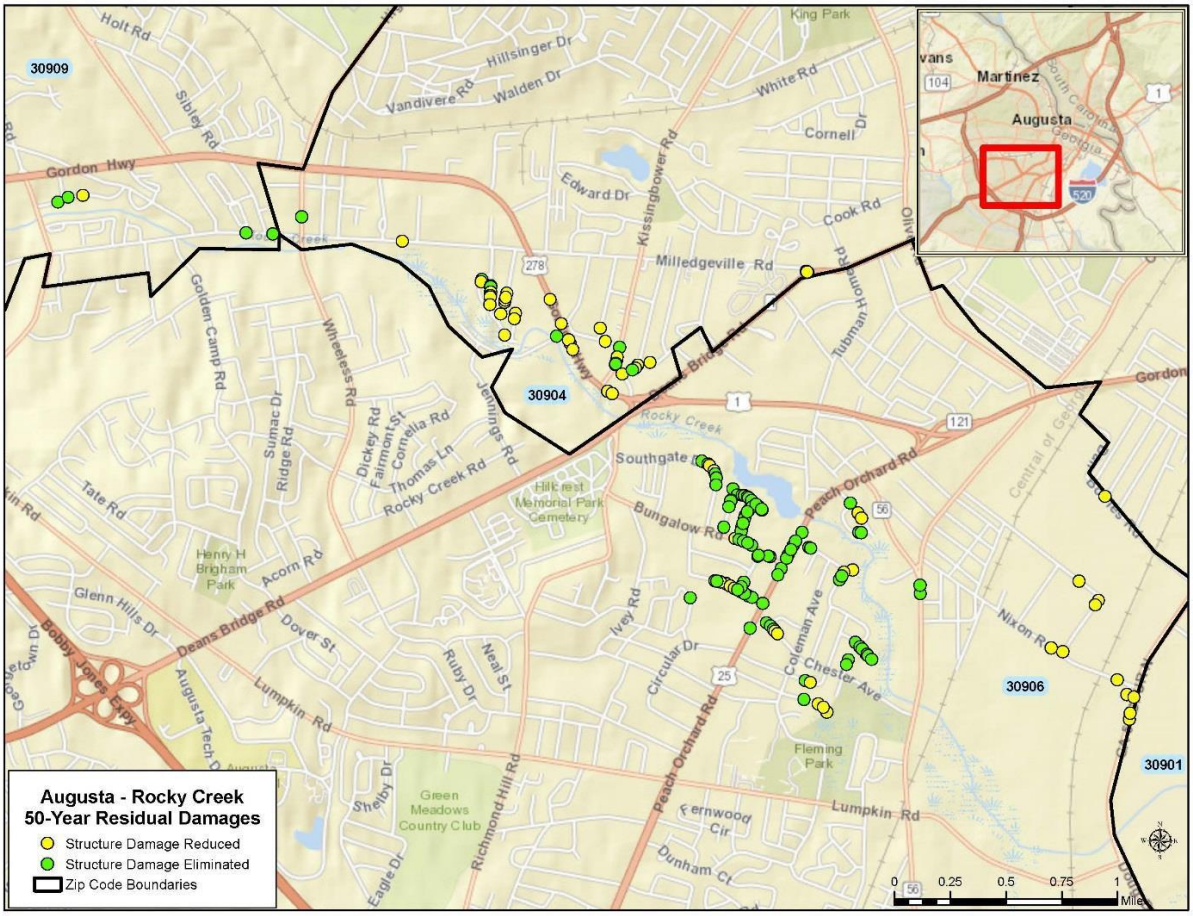
Figure A-25. Rocky Creek 50-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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.

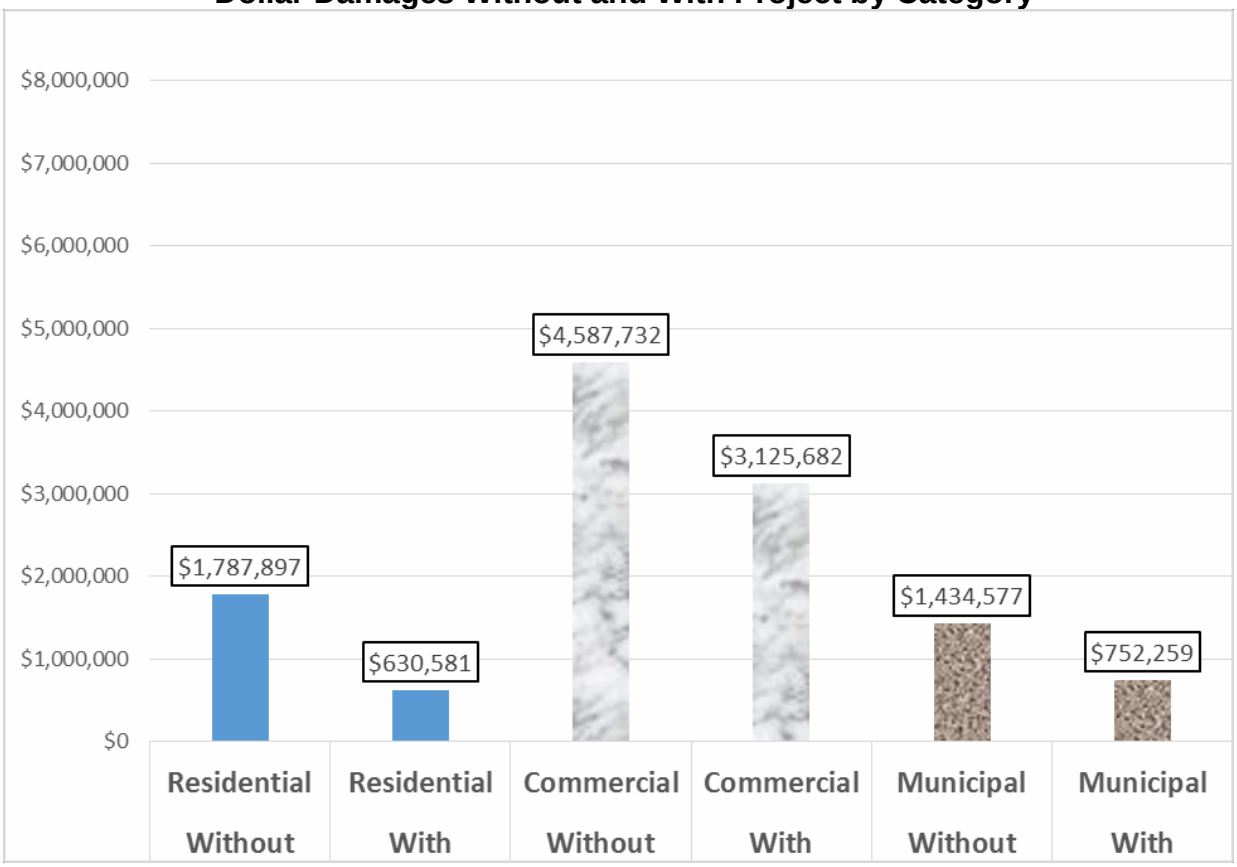
Figure A-26. Rocky Creek 50-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



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.

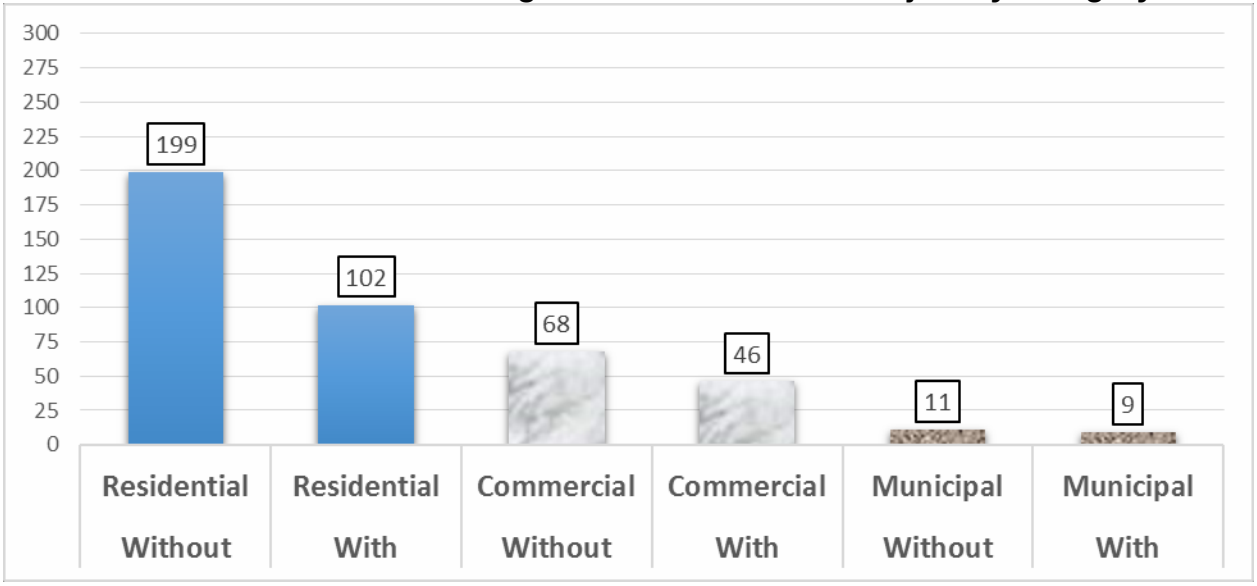
Figure A-27. Rocky Creek 50-Year Flood Event
Dollar Damages Without and With Project by Category



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.

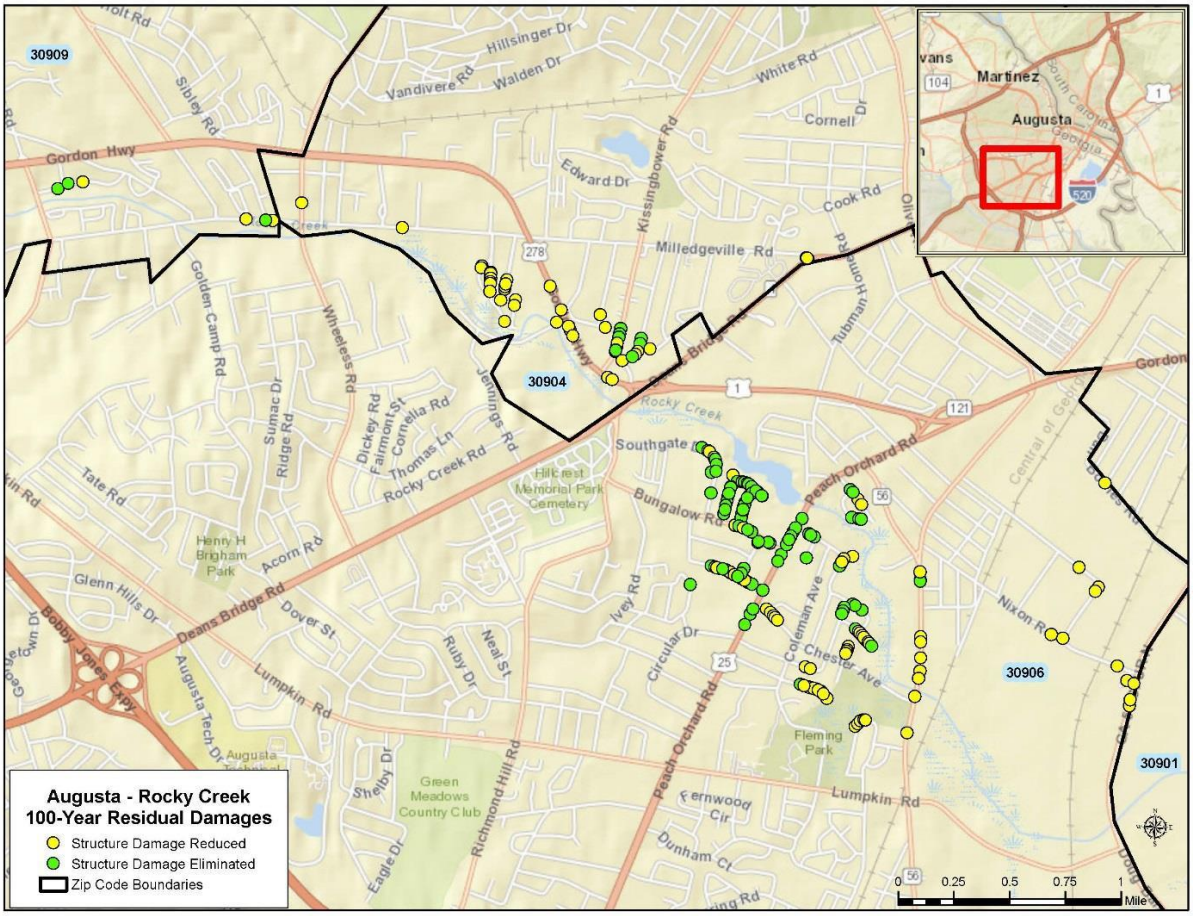
Figure A-28. Rocky Creek 100-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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.

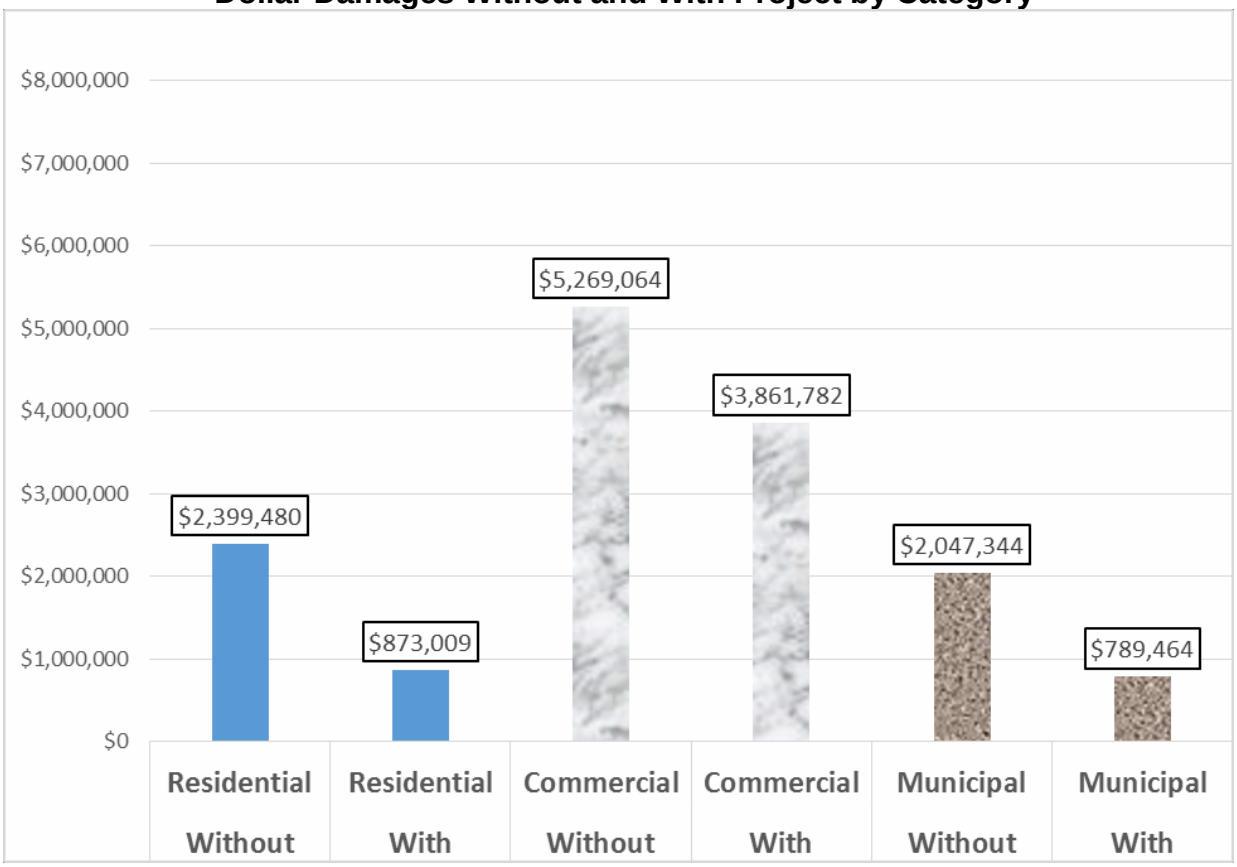
Figure A-29. Rocky Creek 100-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



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.

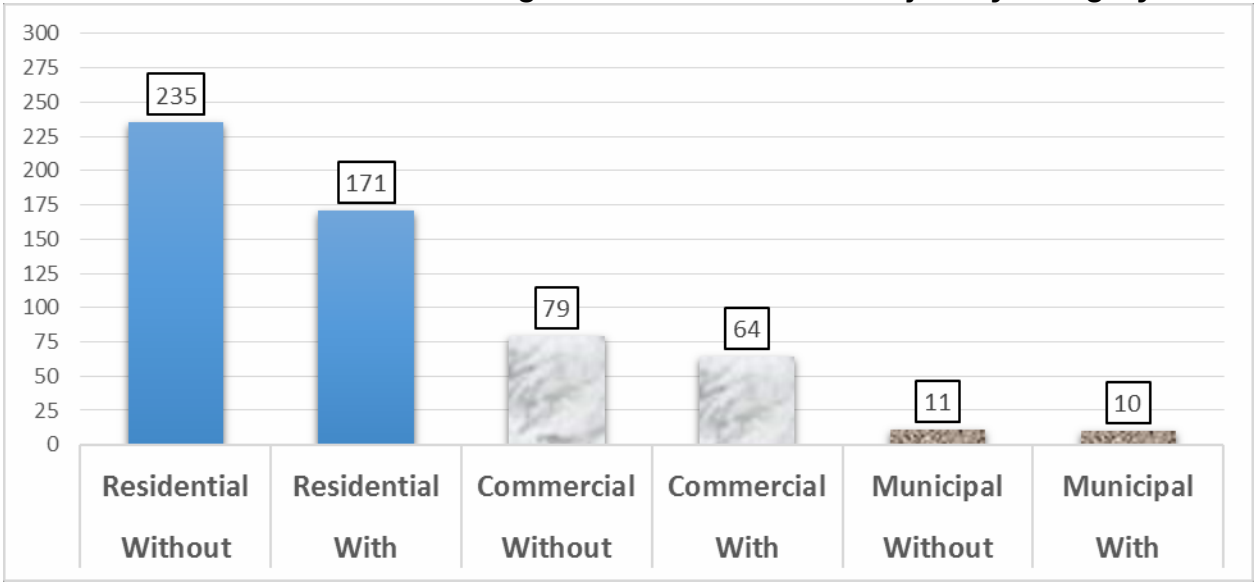
Figure A-30. Rocky Creek 100-Year Flood Event
Dollar Damages Without and With Project by Category



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

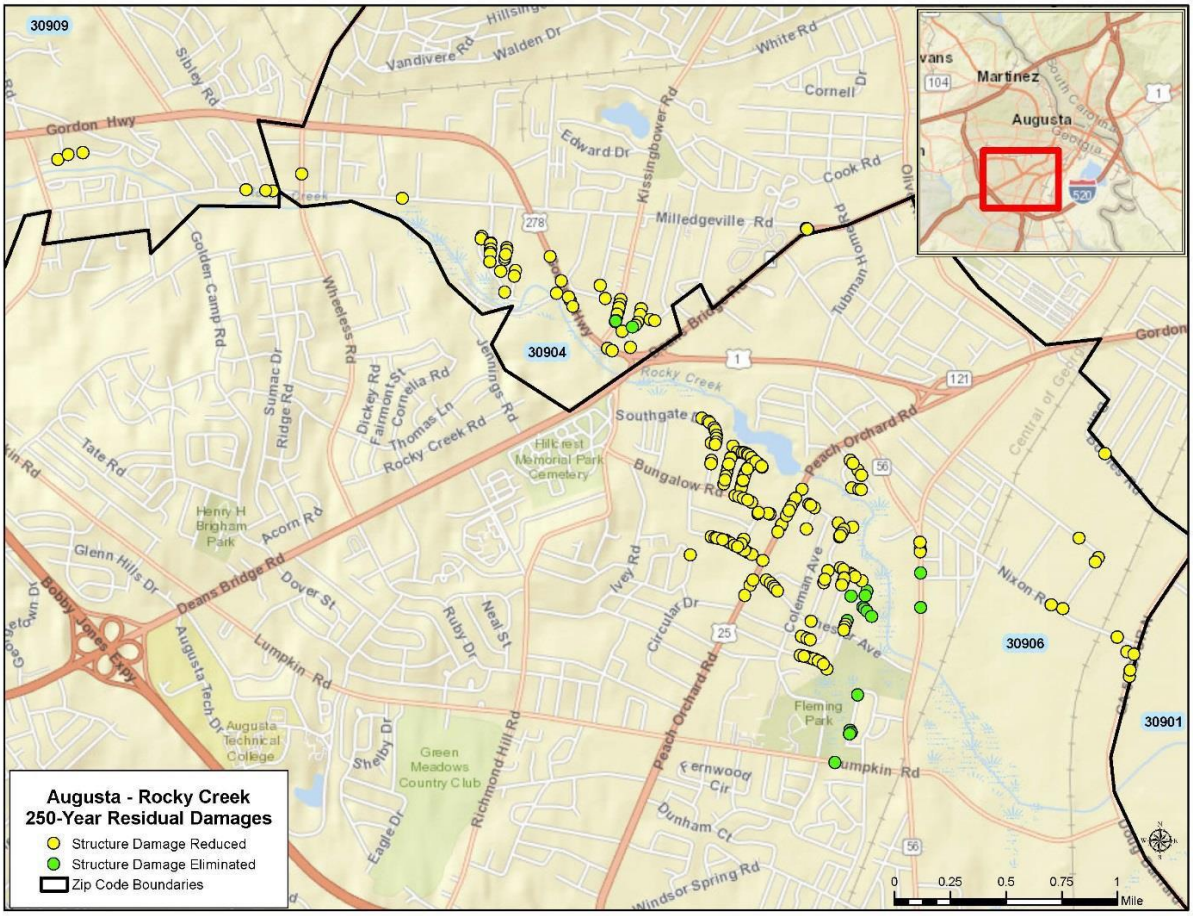


A total of 326 structures receive damages in the without-project condition. Of these, 235 are residential, 79 are commercial, and 11 are municipal. One additional structure not incorporated in Figure A-31, the electrical power station located at 230 Dan Bowles Road, will incur minor (under $1) damage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

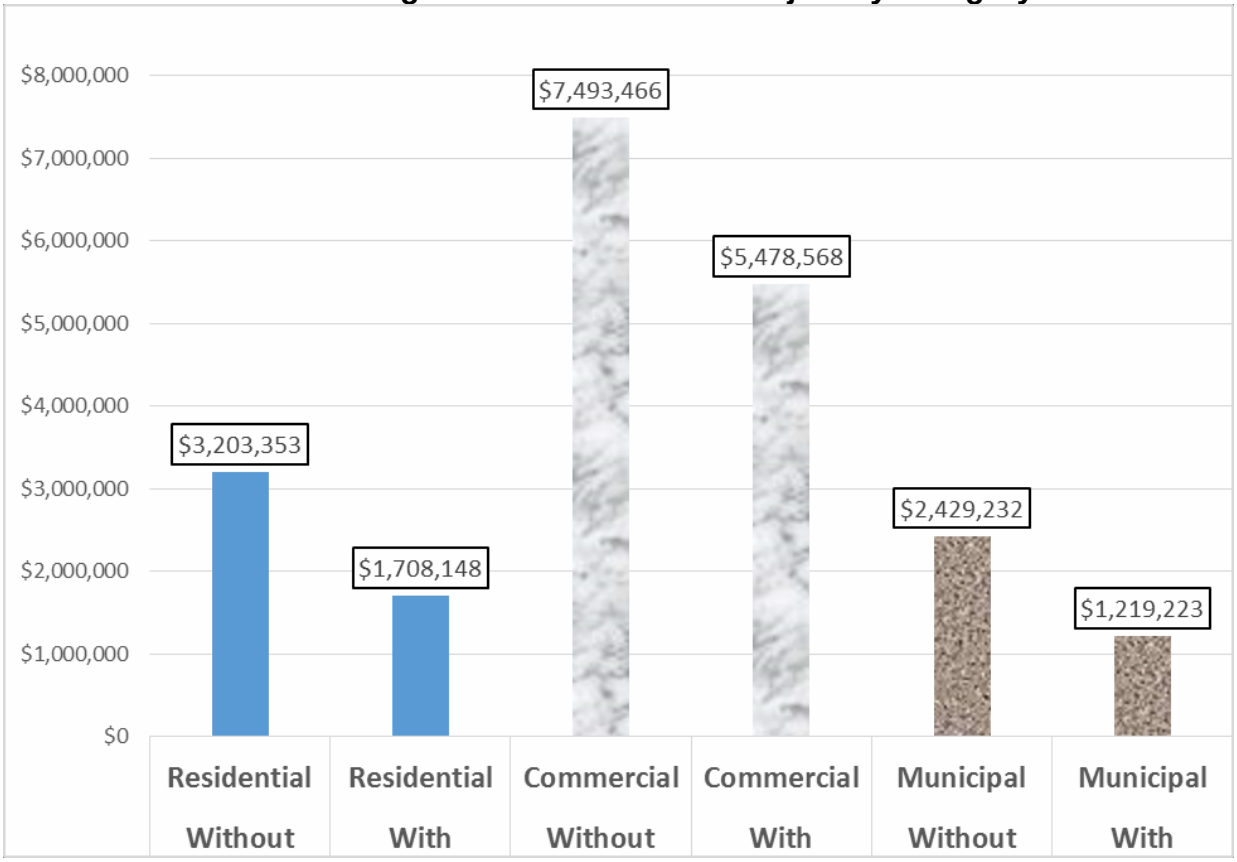
Figure A-32. Rocky Creek 250-Year Flood Event
With Project Damage Reduction and Damage Elimination Sites



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.

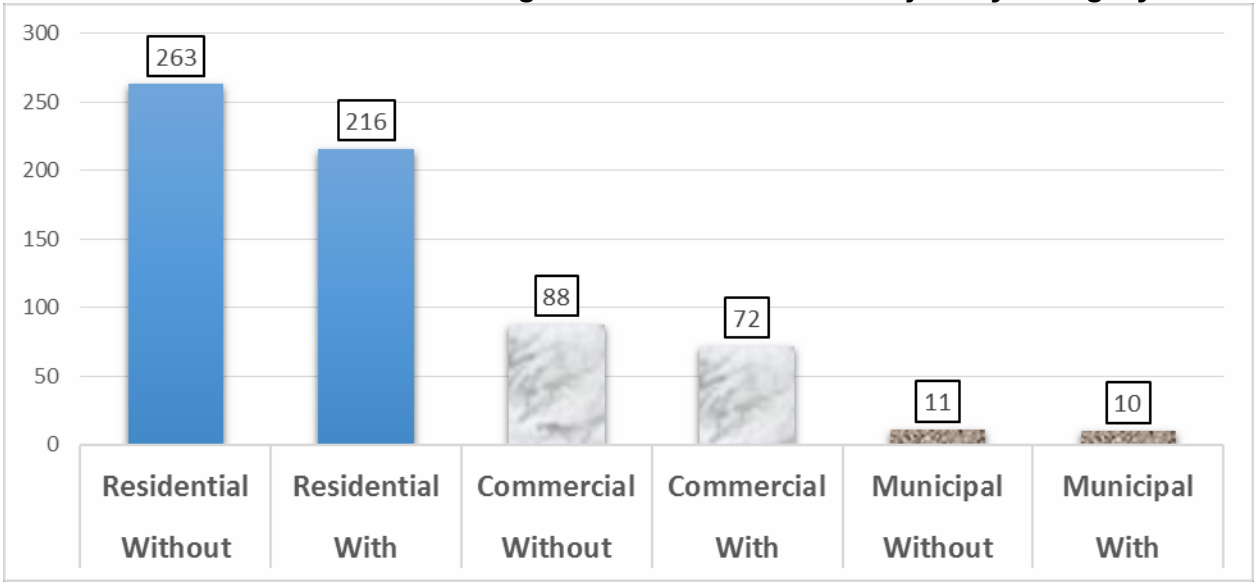
Figure A-33. Rocky Creek 250-Year Flood Event
Dollar Damages Without and With Project by Category



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.

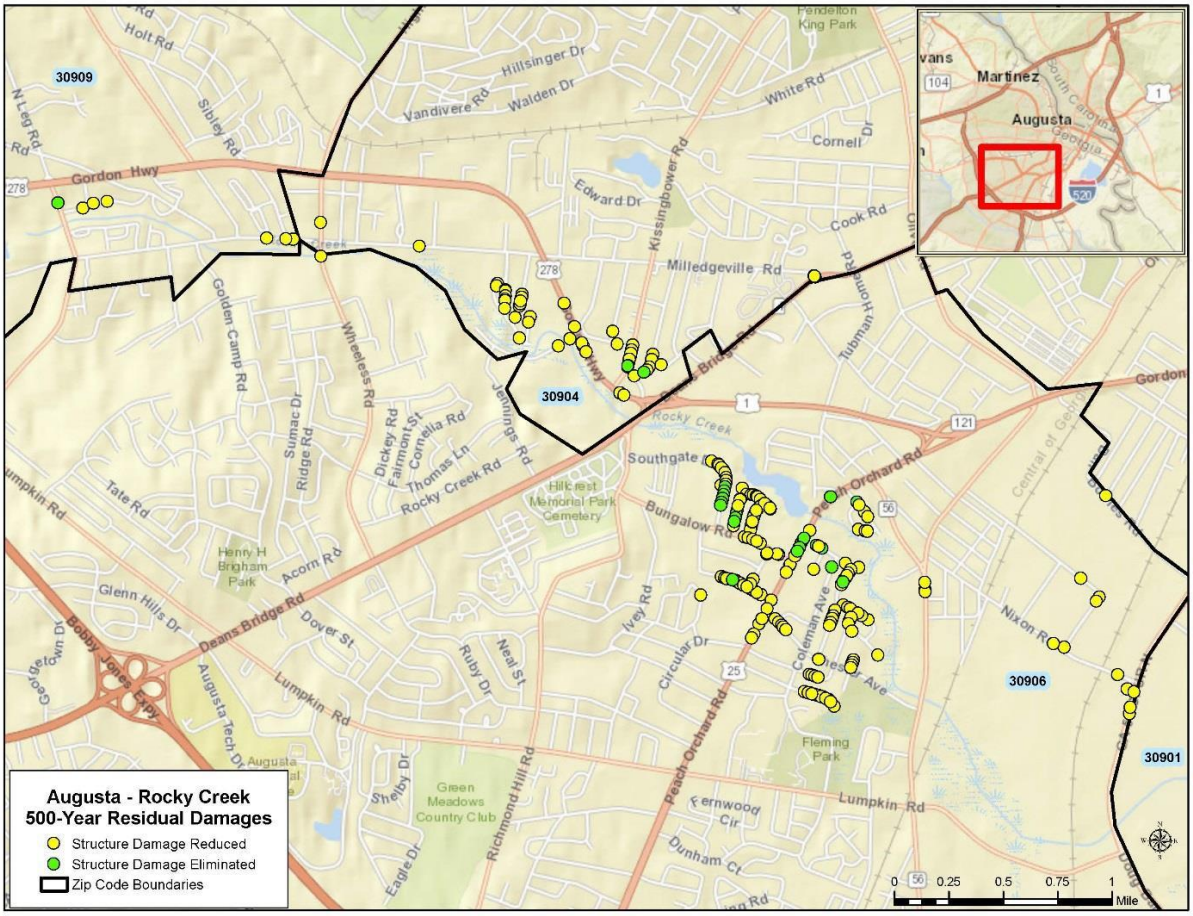
Figure A-34. Rocky Creek 500-Year Flood Event
Number of Structures Damaged Without and With Project by Category



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

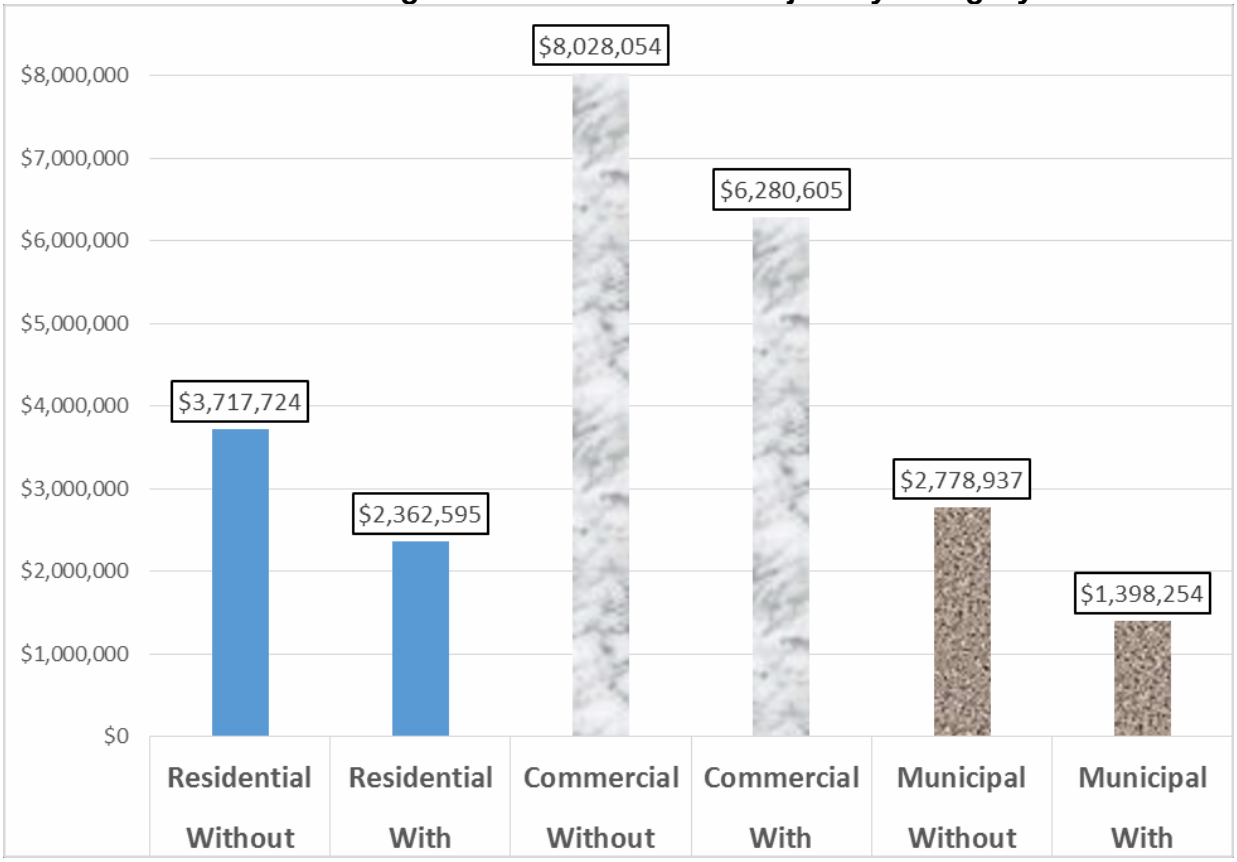


A total of $14,524,715 in flood damages occur under the without-project condition. Of this, $3,717,724 of damage is to residential structures and their contents, which constitutes 25.6 percent of the without-project total dollar damages. Damages to municipal structures total $2,778,937 or 19.1 percent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

APPENDIX B

ENGINEERING APPENDIX

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

June 2017

TABLE OF CONTENTS

C-1. GENERAL SUMMARY 5

C-2. HYDROLOGY AND HYDRAULICS 5

C-2.1 INTRODUCTION 5
C-2.2 PHYSICAL DESCRIPTION 6
C-2.3 PLAN ACCOMPLISHMENTS 8
C-2.4 HYDROLOGY 8
C-2.5 CLIMATE CHANGE 13
C-2.6 HYDRAULICS 16
C-2.6.1 2015 UPDATED HYDRAULIC MODEL 18
C-2.6.2 DETENTION AREA SIZE AND HAZARD CLASSIFICATION 21
C-2.7 SELECTED AND ELIMINATED ALTERNATIVES 22
C-2.7.1 SUMMARY OF RESULTS 26
C-2.7.2 ROSEDALE WETTING DURATION 28
C-2.7.3 PROFILE PLOTS 32
C-2.7.4 IMPOUNDMENT MAPPING PLOTS 36
C-2.7.5 REAL ESTATE SUMMARY 38

C-3. SURVEYING, MAPPING, AND OTHER GEOSPATIAL DATA 39

C-4. GEOTECHNICAL 41

C-4.1 DESIGN REQUIREMENTS: 41
C-4.2 SITE GEOLOGY: 41
C-4.3 ROSEDALE SUBSURFACE EXPLORATION 42
C-4.4 BORROW/DISPOSAL SITES 43
C-4.5 SLOPE STABILITY AND SEEPAGE 43

C-5. ENVIRONMENTAL ENGINEERING 43

C-6. CIVIL DESIGN ROCKY CREEK PROJECT FEATURES 44

C-6.1 DESIGN REQUIREMENTS 44
C-6.2 OUTLET DISCHARGE VELOCITIES 44
C-6.3 ROSEDALE DETENTION STRUCTURE 45
C-6.4 QUANTITY ESTIMATE SUMMARY 48

C-7. NON-STRUCTURAL FEATURES 50

C-8. HAZARDOUS AND TOXIC MATERIALS 52

C-9. OPERATION AND MAINTENANCE 52

C-10. HISTORICAL PHOTOGRAPHS 52

C-11. RECENT PHOTOGRAPHS 57

C-12. GEOTECH EXPLORATION RESULTS 59

C-12.1 CONE PENETRATION TEST LOGS 59
C-12.2 GRADATION CURVES 59
C-12.3 PARTICLE SIZE DISTRIBUTION REPORT 59
C-12.4 LIQUID AND PLASTIC LIMIT 59

LIST OF FIGURES

Figure 1 : Rocky Creek Vicinity Map 7
Figure 2 : Project Location Map 7
Figure 3 : Current Regression Equations 12
Figure 4 : HUC0306 Summary Results 13
Figure 5 : Nationwide HUC Comparison 14
Figure 6 : HUC Vulnerability over time 15
Figure 7 : Stream Crossing Structures 20
Figure 8 : Dam Profile Sketch 28
Figure 9 : 2-year Impoundment Hydrograph 29
Figure 10 : 5-year Impoundment Hydrograph 29
Figure 11 : 10-year Impoundment Hydrograph 30
Figure 12 : 25-year Impoundment Hydrograph 30
Figure 13 : 50-year Impoundment Hydrograph 31
Figure 14 : 100-year Impoundment Hydrograph 31
Figure 15 : 2-Year with and without Profiles 32
Figure 16 : 10-Year with and without Profiles 33
Figure 17 :25-Year with and without Profiles 34
Figure 18 : 100-Year with and without Profiles 35
Figure 19 : 100-YR Impoundment Extents 36
Figure 20 : 500-YR Impoundment Extents 37
Figure 21 : Flowage Easements 38
Figure 22 : LiDAR 40
Figure 23 : Boring Locations (2009) 42
Figure 24 : Rosedale Detention Structure Renovations 47
Figure 25 : Rosedale Center Line Dam Profile 47
Figure 26 : Kissingbower Vicinity 50
Figure 27 : Kissingbower Park Parcels 51

LIST OF TABLES

Table 1 : TP-40 Rainfall 8
Table 2 : Hydrologic Parameter Summary 9
Table 3 : Discharge Calibration Comparison (Existing Conditions) 11
Table 4 : Rocky Creek Base Condition Discharges (CFS) 11
Table 5 : Rocky Creek Base Condition Flood Elevations (feet NAVD) 17
Table 6 : Rocky Creek Structure Crossings 19
Table 7 : USACE Hazard Potential Classification 21
Table 8 : HMR51 Rainfall 21
Table 9 : Sub-Reaches 24
Table 10 : Improvement Alternative Combinations 25
Table 11 : Rosedale Detention Improvement Discharges (CFS) 26
Table 12 : Rosedale Improvement Flood Elevations (feet NAVD) 27
Table 13 : Rosedale Impoundment Duration Summary 28
Table 14 : Parcel Easement Areas 38
Table 15 : Minimum Factor of Safety 43
Table 16 : Outlet Velocity 45
Table 17: Water Surface Elevations at Kissingbower 50
Table 18 : Kissingbower addresses and parcel names 51

C-1. GENERAL SUMMARY

In 2004, USACE and selected contractors underwent a detailed feasibility study to evaluate many different alternatives to reduce flooding impacts in Augusta, Georgia. USACE studied Rocky Creek, Rae's Creek, Augusta Canal and Phinizy Swamp. Upon the completion of this study, USACE and the City of Augusta discussed which of these alternatives would be feasible for construction. The majority of the recommended solutions were decided against, for reasons such as low BCR ratio, HTRW issues, and others. The purpose of this Engineering Appendix is to re-evaluate and expand upon specific selected alternatives from the 2004 feasibility study for Rocky Creek, and to provide concept designs and ROM (Rough Order of Magnitude) cost estimates for each of the project features that are considered to be feasible potential solutions. The flood improvement features for Rocky Creek have been carried over from the previous feasibility study. Rae's Creek, Augusta Canal and Phinizy Swamp will not be evaluated in this appendix. Engineering recommendations are based on the analysis of data acquired through field investigation and from existing data provided by Augusta – Richmond County and from Corps of Engineers archive files. The engineering investigations and evaluations meet the requirements for a section 205 Feasibility Study. All elevations within this report are stated in NAVD88.

C-2. HYDROLOGY AND HYDRAULICS

C-2.1 INTRODUCTION

In 2004, HEC-RAS and HEC-HMS modeling were performed by Engineering Methods & Applications, Inc./Watershed Concepts, (WSC), as part of the Corps of Engineers (Savannah District) Augusta-Richmond County Flood Control Project. The purpose of this portion of the overall study was to develop hydrologic models of both existing and future conditions for Rocky Creek and to evaluate improvement alternatives. The results of all the models are tied to economic models in order to quantify the existing and future impacts of flood events, and then to select which alternatives would be most beneficial to the Community.

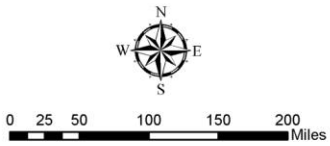
This CAP study has used the previous modeling as a baseline to update and validate specific selected design alternatives with new data and information. The alternatives that were selected for construction are the Rosedale Detention area, and Kissingbower home property buyouts. The Rosedale Detention Area project will consist of installing a new weir/box culvert structure in-line with the existing creek and partially re-constructing an existing earth embankment which is approximately 900 feet in length and about 20 feet in height.

Technical details of the model development conducted in 2004 have been condensed in this report, but can be found in full in the 2004 reports.

C-2.2 PHYSICAL DESCRIPTION

Rocky Creek lies in the central portion of the City of Augusta (
Figure 1). The project area is in the headwaters of Rocky Creek, as shown in **Figure 2** The majority of the stream is south of U. S. Route 78 (Gordon Highway) and north of Interstate 520 (Bobby Jones Expressway). Rocky Creek has numerous small tributaries flowing into it, eventually emptying into Phinizy Swamp approximately 1.2 miles downstream of Georgia Highway 56 Spur (Doug Barnard Parkway). Rocky Creek drains approximately 11,024 acres (17.23 square miles) of Augusta. The Creek is 47,030 feet (8.91miles) in length from its headwaters north of Gordon Highway to its mouth at Phinizy Swamp. Elevations within the Rocky Creek basin range from a high of about 490' to as low as 115' at Phinizy Swamp. The channel has a slope of 0.0021 ft/ft downstream of Milledgeville Road; upstream of Milledgeville Road the channel quickly rises to a slope of 0.012 ft/ft.

Vicinity Map



US Army Corps of Engineers®

Figure 1 : Rocky Creek Vicinity Map

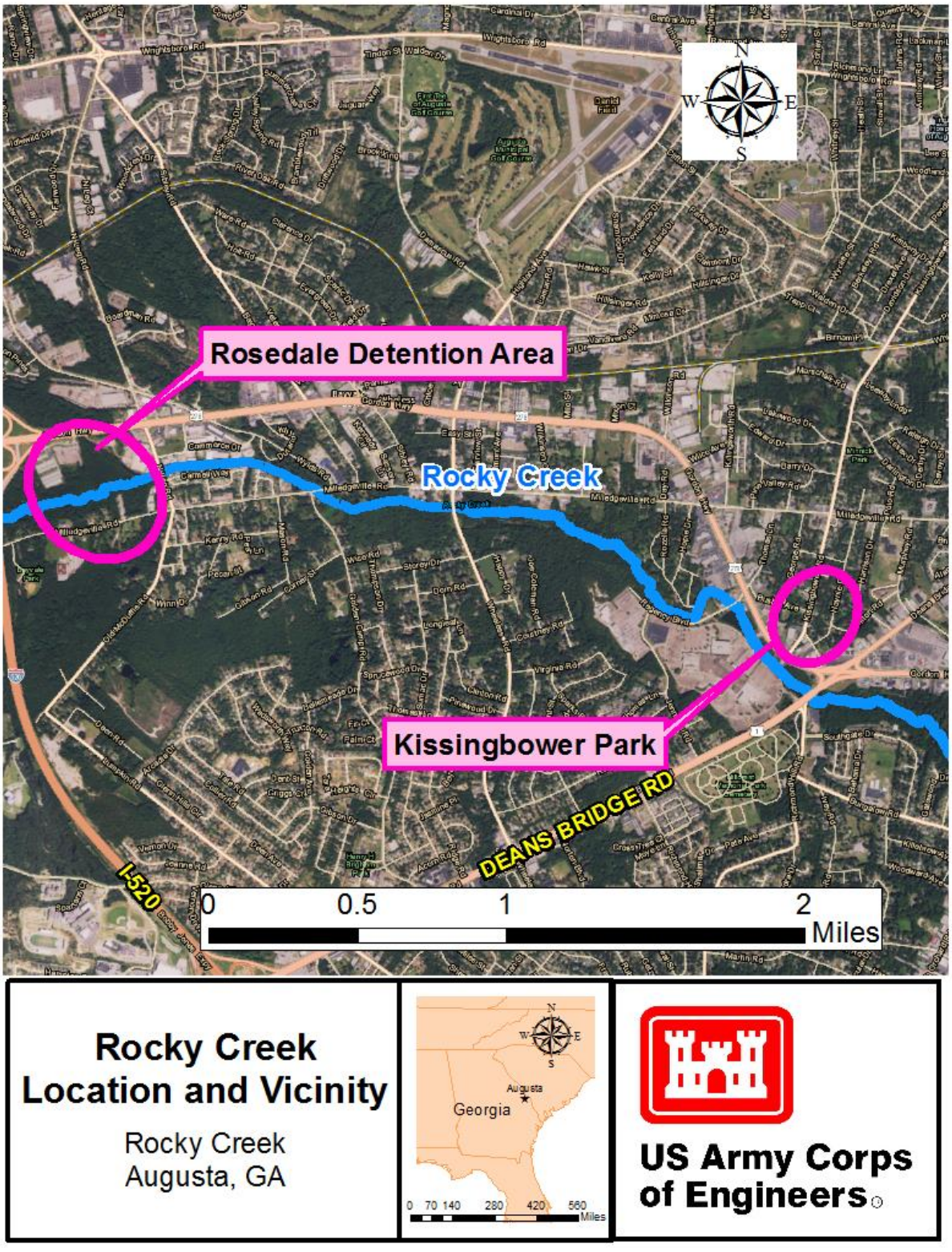


Figure 2 : Project Location Map

C-2.3 PLAN ACCOMPLISHMENTS

The Rosedale Detention area will primarily provide temporary storage for small to medium size flood events. Once constructed, the area will provide additional attenuation time for rainfall runoff, and the peak downstream flow will be reduced by 200-250 CFS, with the most reduction observed at the 25-year event. Exact peak reductions are shown in **Table 11.** Flood elevations will be reduced downstream, particularly immediately downstream. The Kissingbower property buyouts will remove five residential structures from the floodplain. The Kissingbower properties sustain water damage on a fairly frequent interval due to the proximity to Rocky Creek. Residents will be relocated to more suitable location(s), and the area will be converted to recreation such that flooding will not cause further damages to property.

The selected Rosedale Detention area will reduce the peak flow downstream for all rain events. The structure design is targeted to have the largest flood reduction impact up to the 10-year and 25-year flood event. At flows of the 10 year flood event and greater, the overflow weir will be engaged and pass water in addition to culvert flow. The detention structure will still provide a reduction in peak flows and water surface elevations downstream at flows greater than the 10 year event, however the incremental water surface elevation reduction will decrease as flow increases.

C-2.4 HYDROLOGY

Topographic data consisted of digital files with 1-foot interval contours in some areas and 5-foot interval contours elsewhere. WSC was also provided a 30-meter Digital Elevation Model, GIS soils coverage, land use coverage, transportation coverage, and digital aerial images. The Savannah District Corps of Engineers provided the existing conditions hydrology for the Rocky Creek basin for the 2-, 5-, 10-, 25-, 50-, 100-, 250-, and 500-year 24-hour storm events. Calculations of future conditions are based on these models; existing conditions are assumed to reflect land uses in the year 2005, and future conditions are based on estimated land uses in the year 2030. Rainfall totals were obtained from TP-40; a summary is shown in **Table 1.**

Table 1 : TP-40 Rainfall

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	250-yr	500-yr
5 min	0.50	0.56	0.61	0.69	0.75	0.81	0.89	0.95
15 min	1.05	1.21	1.33	1.51	1.66	1.80	2.00	2.20
1 hr	1.90	2.36	2.69	3.17	3.53	3.90	4.35	4.70
2 hr	2.20	2.75	3.20	3.60	4.00	4.40	4.90	5.30
3 hr	2.45	3.00	3.50	3.90	4.35	4.80	5.20	5.65
6 hr	2.70	3.60	4.25	4.90	5.50	5.90	6.70	7.25
12 hr	3.30	4.25	4.80	5.75	6.15	6.95	7.70	8.40
24 hr	3.75	4.75	5.80	6.60	7.40	8.00	8.90	9.70

For this analysis, the Rocky Creek basin was divided into 33 subbasins - 24 subbasins by the Savannah District (SBx) and 9 subbasins by WSC (ROCKYx) - using the Corps' HEC Geo-HMS GIS extension. For each subbasin, SCS Curve Numbers (CN) were calculated based on land use and soil types assuming Type II antecedent moisture

conditions (average conditions). The Rocky Creek basin is composed primarily of Type C soils (98%) and only 2% of Type B soils. Type C soils are characterized by clay loams, shallow sandy loam, soils low in organic content, and soils usually high in clay, while Type B soils are characterized by shallow loess and sandy loam.

Table 2 shows a hydrologic parameter summary for current and future basin conditions, generated with the GIS datasets described above.

Table 2 : Hydrologic Parameter Summary

Basin	Area (sq. mi.)	Tc (hrs)	CN (existing)	CN (future)
SB1a	0.14	1.5	67	70
SB1b	0.14	1.3	67	70
SB1c	0.10	1.2	67	70
SB2	0.62	1.9	72	76
SB3	0.43	1.9	75	79
SB4	0.16	1.4	70	73
SB5	1.05	3.0	66	69
SB6	0.63	2.0	67	70
SB7	1.65	3.0	77	81
SB8	0.11	1.7	80	84
SB9	0.54	1.7	69	72
SB10	0.18	1.3	72	76
SB11	0.23	1.5	67	70
SB12	1.39	2.8	73	77
SB13	0.08	1.0	74	78
SB14	1.51	2.7	77	81
SB15	0.28	1.4	74	78
SB16	0.57	1.6	82	86
SB17	0.58	2.1	73	77
SB18	0.81	3.0	74	78
SB19	4.06	4.0	76	80
SB20	0.83	1.9	73	77
SB21	0.47	2.7	78	82
SB22	0.67	4.8	74	78
ROCKY1	0.10	0.32	90	95
ROCKY2	0.33	0.97	84	88
ROCKY3	0.87	0.76	84	88
ROCKY4	0.13	0.97	76	80
ROCKY5	0.14	0.73	76	80
ROCKY6	0.43	0.71	76	80
ROCKY7	1.22	1.90	81	85
ROCKY8	0.16	0.15	71	75
ROCKY9	0.11	0.15	76	80

The Rocky Creek basin is well developed. Approximately 58 percent of the basin is either residential or commercial development.

The Curve Numbers were obtained by combining the soils and land use datasets, and then calculating a Curve Number for each combination. As expected from the degree of development, the average existing conditions Curve Number for Rocky Creek is 75.

The future conditions Curve Numbers were calculated by WSC from the same soils coverage, but the land use coverage was adjusted to reflect future Augusta-Richmond County planning and zoning maps (year 2030). The average future conditions Curve Number is 79.

The Hydrologic Engineering Center's *Hydrologic Modeling System* (HEC-HMS) version 2.2.2 was used to calculate runoff and to generate hydrographs. Within HEC-HMS, hydrograph generation was based on the NRCS (SCS) Lag Method.

The Lag Time parameters, T_L , for the "SBx" subbasins were calculated based on the relationship given in the USGS publication, *Lagtime Relations for Urban Streams in Georgia:*

$$T_L = 7.86 * DA^{0.35} * TIA^{-0.22} * S^{-0.31} * QV$$

T_L = lagtime (hrs)
DA = drainage area (sq mi)
TIA = measured total impervious area (%)
S = channel slope (ft/mi)
QV = qualitative variable (set to 1)

The Lag Time parameters for the "ROCKYx" subbasins were calculated from the empirical formula,

$$T_L = 3/5 * T_c$$

where T_L = Lag Time and T_c = Time of Concentration.

The times of concentration were calculated using the NRCS (SCS) velocity method. The different flow regimes in the velocity method include:

sheet flow:

$$T_c \text{ (hours)} = 0.007(nL)^{0.8} / (P_2)^{0.5} S^{0.4}$$

T_c = time of concentration
n = manning's n for sheet flow
L = length of sheet flow path (ft); note: this is typically less than 200 feet
P_2 = 2-year 24-hour rainfall (in)
S = slope of path (ft/ft)

shallow concentrated flow (unpaved):

$$T_c \text{ (hours)} = L / 16.1345(S)^{0.5}$$

T_c = time of concentration
L = length of shallow concentrated flow path (ft)
S = slope of path (ft/ft)

channel flow:

$$T_c \text{ (hours)} = L / ((1.49R^{0.67}S^{0.5})/n)$$

T_c = time of concentration
L = length of channel flow path (ft)
R = hydraulic radius (ft)
S = slope of path (ft/ft)
n = manning's n for channel flow

The total time of concentration for a subbasin is the sum of the individual times.

The Rocky Creek existing conditions model was compared to regional regression equations adjusted for urbanization by the Savannah District. The comparison location was selected so the effects of backwater from Phinizy Swamp would not influence the results. The location of comparison is just downstream of Wheeless Road, just upstream of the abandoned Regency Mall, and at the headwater of SB18. The sum of these subbasins is approximately 9.8 mi^2. A comparison of flows calculated by both HMS and regression equations from 2002 are shown in **Table 3.** Discharges at various locations are given in **Table 4.** Detailed HMS output is available in USACE archives.

Table 3 : Discharge Calibration Comparison (Existing Conditions)

	10-yr	50-yr	100-yr	500-yr
Regression (2002) (cfs)	3121	4435	5028	6612
HEC-HMS (cfs)	3017	4441	5023	6576
% Error	3.3	-0.1	0.1	0.5

Table 4 : Rocky Creek Base Condition Discharges (CFS)

Location	*2-yr ex*	*2-yr fu*	*10-yr ex*	*10-yr fu*	*100-yr ex*	*100-yr fu*	*500-yr ex*	*500-yr fu*
Mike Padgett Hwy	1187	1677	3452	4814	5766	7002	7532	8363
Dean's Bridge Rd	1102	1373	3034	3410	5051	5482	6616	7121
Wheeless Rd	786	985	2247	2526	3799	4123	4998	5334
North Leg Rd	221	283	603	680	1008	1086	1301	1377
Barton Chapel Rd	33	51	110	133	187	195	226	238

During the 2014-2015 CAP study, the HEC-HMS basin model was not adjusted, enhanced, or recalibrated in any way. Previous modeled flows were assumed to be adequate and accurate for this design. Various different versions of the HMS model were available for analysis. Each of these models produced similar output to the table above, however none of the model configurations were able to exactly reproduce the outputs. However, since no modifications were made to the HMS model, the outputs don't change, and therefore the inputs into HEC-RAS do not change either.

Regression equations have been updated using data through 2006. New regression equations output could be useful if the basin model were to be recalibrated. Impervious area data would have to be obtained and calculated for each sub basin, and input into the following equations for region 3. Regression values will be re-computed as part of updating the hydrology during additional studies.

Recalculation of regression flows was not done as part of this effort due to 1) limited availability of basin delineations used in previous studies 2) high average standard error (54% to 74.5%) associated with output. 3) Augusta located right on the border of Region 3 and Region 1 (to the north) and Region 4 (to the south).

Percent annual exceedance probability	3
	0.20 mi^2 < DRNAREA < 5.5 mi^2
50	$35.2(DRNAREA)^{0.632}10^{(0.0297IMPNLCD01)}$
20	$56.1(DRNAREA)^{0.634}10^{(0.0270IMPNLCD01)}$
10	$72.1(DRNAREA)^{0.636}10^{(0.0257IMPNLCD01)}$
4	$94.6(DRNAREA)^{0.637}10^{(0.0243IMPNLCD01)}$
2	$113(DRNAREA)^{0.639}10^{(0.0234IMPNLCD01)}$
1	$132(DRNAREA)^{0.639}10^{(0.0227IMPNLCD01)}$
0.5	$153(DRNAREA)^{0.641}10^{(0.0220IMPNLCD01)}$
0.2	$184(DRNAREA)^{0.642}10^{(0.0212IMPNLCD01)}$

Figure 3 : Current Regression Equations

According to the 2002 WCS report, the year 2030 land use data was developed by WSC using the Augusta-Richmond County planning and zoning maps. There is no Future land use dataset available for download on the MRLC (Multi-Resolution Land Characteristics Consortium.) New existing Land Use datasets for 2006 & 2011 are available. An analysis could be done on those differences and further projected than year 2030, and to see if the difference between year 2001 and year 2011 was more or less than previously projected. Additional studies and completely updated hydrology could be done considering new land use data in the future.

C-2.5 CLIMATE CHANGE

USACE screening level climate change vulnerability assessment (VA) tool was utilized to assess the potential impacts and likelihood of climate change impacts to this region. The tool operates on a HUC-4 level spatial scale, and it used to quickly assess climate change vulnerably. The tool can be found on https://maps.crrel.usace.army.mil/apex/f?p=170:2:963367691217::NO:::

The parameters that were used are as follows:
Division: South Atlantic
District: Savannah
Business line: Flood Risk Reduction
Indicators under selected business line: Annual Cov, Runoff Precipitation, Flood Magnification C & L, Urban 500 Yr Floodplain area.
Climactic Data Source: CMIP-5 (2014)
Threshold: 20%
ORness: .7[1]

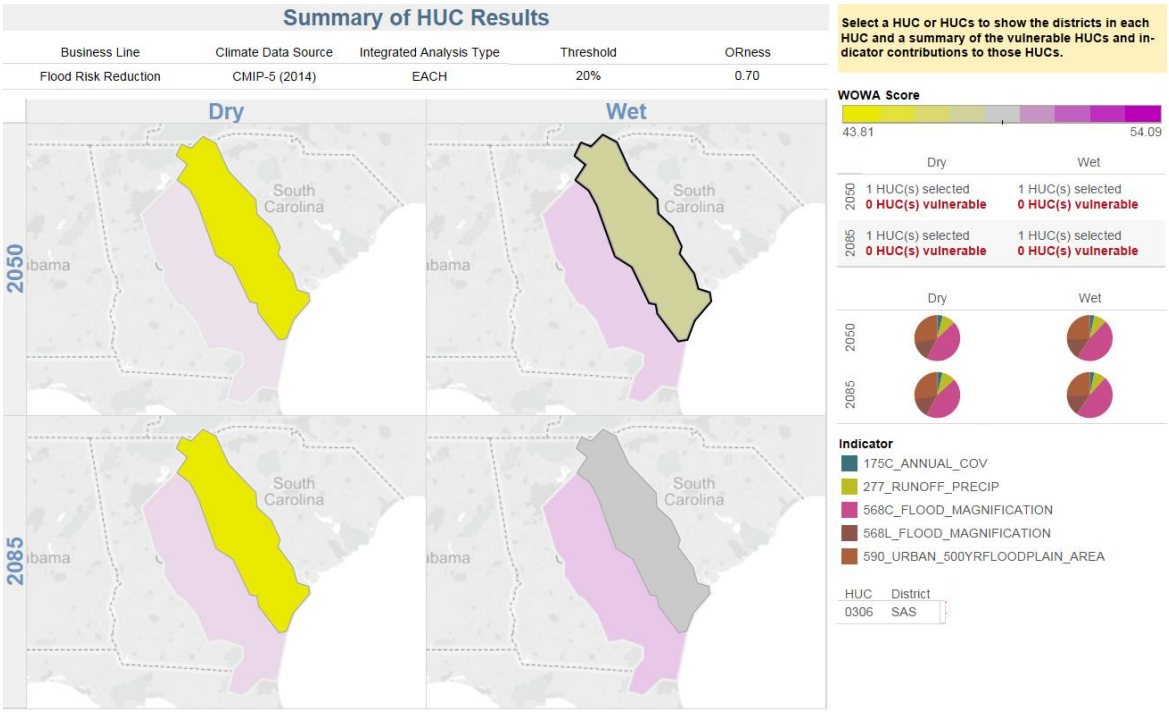


Figure 4 : HUC0306 Summary Results

WOWA Score[2]: 46.17

[1] Specifies how risk-averse the analysis should be. Value should be between 0.5 and 1.0. Higher ORness values weigh the more vulnerable indicators more heavily, resulting in greater perceived vulnerability overall (more risk-averse). Lower ORness values weigh all indicators in a business line more equally, resulting in lower perceived vulnerability overall because less vulnerable indicators average out more vulnerable indicators (less risk-averse). Typical value is 0.7

[2] WOWA stands for "Weighted Ordered Weighted Average," which reflects the aggregation approach used to get the final score for each HUC. After normalization and standardization of indicator data, the data are weighted with "importance weights" determined by the Corps (the first "W"). Then, for each HUC-epoch-scenario, all indicators in a business line are ranked according to their weighted score, and a second set of weights (which are the OWA weights," are applied, based on the specified ORness level. This yields a single aggregate score for each HUC-epoch-scenario called the WOWA score. WOWA contributions/indicator contributions are calculated after the aggregation to give a sense of which indicators dominate the WOWA score at each HUC.

The WOWA Score of the Savannah-Ogeechee watershed is a standardized way to compare climate change vulnerability to other basins throughout the United States. The WOWA score for the basins throughout the country under the Flood Risk Reduction Business line ranges from 35.15 to 92.85. **Figure 5** shows how the project basin is related to the rest of the country.

The Savannah-Ogeechee watershed is at a relatively low risk for impacts to climate change within Flood Risk Reduction projects, compared to the rest of the continental United States.

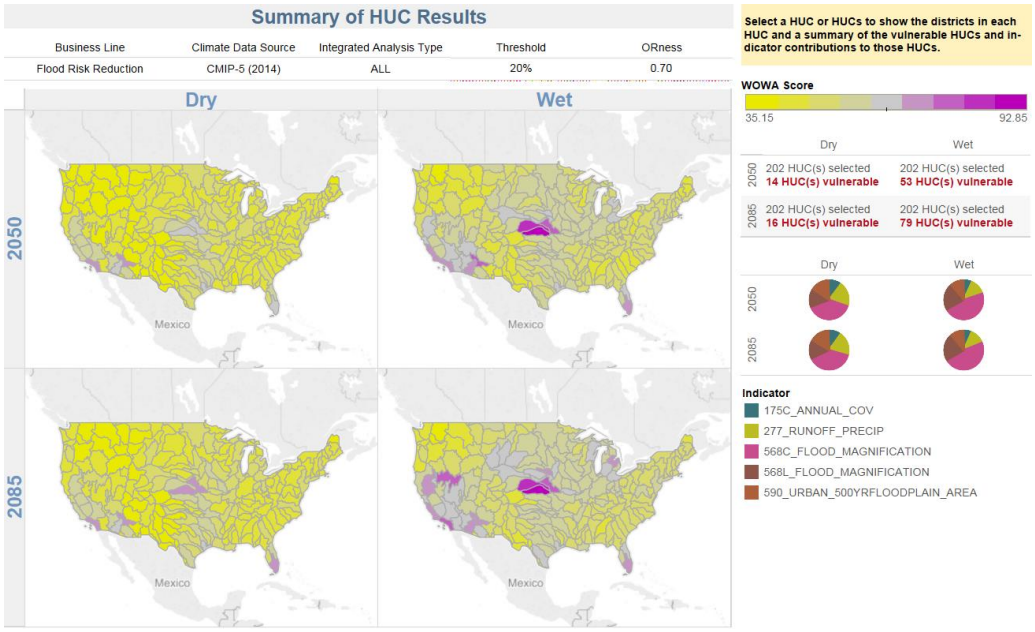


Figure 5 : Nationwide HUC Comparison

The vulnerability WOWA score was also evaluated over time, from the period 2050 to 2085. During a wet hypothetical future scenario, the WOWA score can be expected to increase approximately 1.93%. Suring a dry hypothetical future scenario, the WOWA score can be expected to increase by 0.91%.

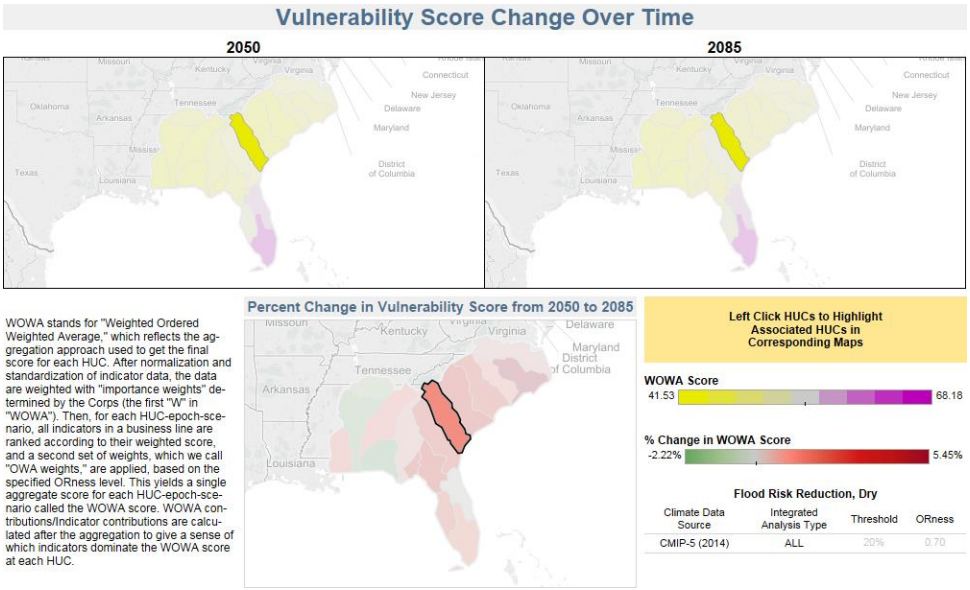


Figure 6 : HUC Vulnerability over time

C-2.6 HYDRAULICS

The Hydrologic Engineering Center River Analysis System (HEC-RAS) version 3.0.1 and 3.1.1, in conjunction with the Corps' HEC Geo-RAS GIS extension were used to calculate the water surface elevations for each storm event. WSC was provided the steady-state existing conditions RAS model for Rocky Creek along with survey data for natural cross-sections and structures at stream crossings from the Savannah District, and additional cross-sections were interpolated based on these surveyed cross-sections and digital topographic data.

The HEC-RAS model was used with the discharges from the HEC-HMS model taking in to account existing and future land use. The HEC-RAS model extended from the outfall at Phinizy Swamp to a point approximately 1,500 feet upstream of Barton Chapel Road. Due to the dramatic difference in channel slope downstream of Doug Bernard Parkway, where the slope is 0.0021 ft/ft compared to 0.012 ft/ft further upstream, both the steady and unsteady options were utilized within HEC-RAS.

The entire stream was initially modeled in steady-state assuming initial conditions at Phinizy Swamp which were based on the flood levels published in the effective Flood Insurance Study for the City of Augusta. The downstream portion of Rocky Creek, from approximately 3,150 feet upstream of Doug Bernard Parkway to the confluence with Phinizy Swamp, was included in an unsteady HEC-RAS model of Phinizy Swamp (Note that details of the Phinizy Swamp modeling can be found in the 2004 Engineering Appendix).

A steady-state methodology assumes that peak flood levels are coincident with peak runoff discharges. This is applicable for most of Rocky Creek, except the lower section. Lower Rocky Creek is flat enough where the backwater effects of Phinizy Swamp will dictate the flooding characteristics. In this lower section, an unsteady HEC-RAS model allows for peak flood stages to occur independent of the time of peak discharge. With flood stage results of the entire stream from the steady-state model, and flood stages for the lower section from the unsteady model, the total picture of the Rocky Creek flooding is a combination of the two methods.

The flood profiles and inundation mapping for the existing and future conditions for Rocky Creek are given in the 2004 Feasibility Study Engineering Appendix. All elevations are referenced to the North American Vertical Datum of 1988, and in units of US Survey Feet. Flood elevations for the base condition at specific points along the stream are shown in **Table 5.** This data is directly from the 2004 Feasibility Study. Detailed digital HEC-RAS outputs are available in USACE archives.

Table 5 : Rocky Creek Base Condition Flood Elevations (feet NAVD)

Location	*2-yr ex*	*2-yr fu*	*10-yr ex*	*10-yr fu*	*100-yr ex*	*100-yr fu*	*500-yr ex*	*500-yr fu*
Mike Padgett Hwy U/S	130.8	132.1	134.5	135.7	136.3	136.5	136.6	136.8
Dean's Bridge Rd U/S	151.9	152.6	155.9	156.4	158.6	160.3	162.6	162.6
Wheeless Rd U/S	172.8	173.6	176.9	177.4	180.7	180.9	181.4	181.5
North Leg Rd U/S	204.8	205.7	209.7	210.6	213.8	214.6	216.0	216.2
I-520 (Bobby Jones Expwy) U/S	241.9	242.2	243.9	244.3	245.5	245.8	246.4	246.7
Nolan Connector U/S	243.2	243.5	244.5	244.8	246.0	246.2	246.9	247.1
Gordon Highway U/S	285.6	286.2	288.0	288.6	289.9	290.1	290.8	291.0
Barton Chapel Rd U/S	301.2	301.9	306.4	307.1	307.3	307.4	307.5	307.5

C-2.6.1 2015 UPDATED HYDRAULIC MODEL

The HEC-RAS modeling done in 2004 was obtained from archives and deciphered. There were hundreds of different combinations of geometric data and flow data to represent all of the previously analyzed alternatives. However, since all of the structural alternatives except for the Rosedale detention area have been eliminated, those plans are not relevant for this study. The relevant geometry and flow files below were copied over into a new project, as the base conditions to begin model updates.

- Plan: Existing conditions 2004 w/o project, 2004 geometry with 2004 flow.
- Plan: Future conditions 2030 w/o project, 2004 geometry with 2030 flow
- Plan: Future Rosedale CEO 2004, 2004 geometry with 2004 dam design recommendation, with modified 2030 flow to simulate routing.

Since the HEC-HMS computed flows did not change, the primary element of the model that was revised was the geometry. It was necessary to go revisit all of the structure crossings on Rocky Creek to validate that they did still in fact exist. Additionally, aerial imagery suggested that there had been some additional crossings constructed since 2004. All modeled crossings were photographed and measured; new data was incorporated into the 2014 geometric conditions. See **Figure 7 and Table 6**, in order beginning in Phinizy swamp and progressing upstream.

Additional cross sections were extracted from new LiDAR data in the following locations:

- Behind Rosedale detention area to define ponded area as accurately as possible
- Downstream of model Station 15000 (or ½ mile downstream of Peach Orchard Road) for more accurate mapping
- Various locations on the reach when prior sections were spaced >1000 ft apart.

See section **C-3.** For additional details regarding LiDAR Data.

Table 6 : Rocky Creek Structure Crossings

Structure Name	2004 Model	2014 Model	Update Notes
Gravel Pit Road	Yes	Yes	No change
Doug Barnard Road	Yes	Yes	Added Pier caps, channel realignment, and smaller abutments
N & S RR Bridge #1	Yes	Yes	Added Pier Caps
N&S Bridge #2	Yes	Yes	Added culvert obstruction due to siltation, and additional culverts off main channel
Mike Padgett Hwy	Yes	Yes	Added Pier Caps, abutments, and additional culverts off main channel
Peach Orchard Rd	Yes	Yes	Added pier caps and guardrail
Deans Bridge Road	Yes	Yes	Added 1.5' to guardrail
Regency Mall East Entrance	Yes	Yes	Added abutments and 1' to guardrail
Regency Mall Middle Entrance	Yes	Yes	Added 1' to guardrail
Regency Mall West Entrance	Yes	Yes	No change
Wheeless Rd	Yes	Yes	Added 1' to guardrail
Milledgeville Rd	Yes	Yes	No change
North Leg Road	Yes	Yes	No change
I-520	Yes	Yes	No change
Nolan Connector	Yes	Yes	Siltation blockage removed
American Tire Distribution Driveway	No	Yes	New construction. Added 3 RCP, wing walls, sedimentation blockage and road deck.
Gordon Hwy	Yes	Yes	Box culvert dimension change
Barton Chapel Road	Yes	Yes	Roadway width updated
Mobile Home Park	Yes	No	Mobile home park no longer exists
SBD RR	Yes	Yes	Blocked conveyance updated

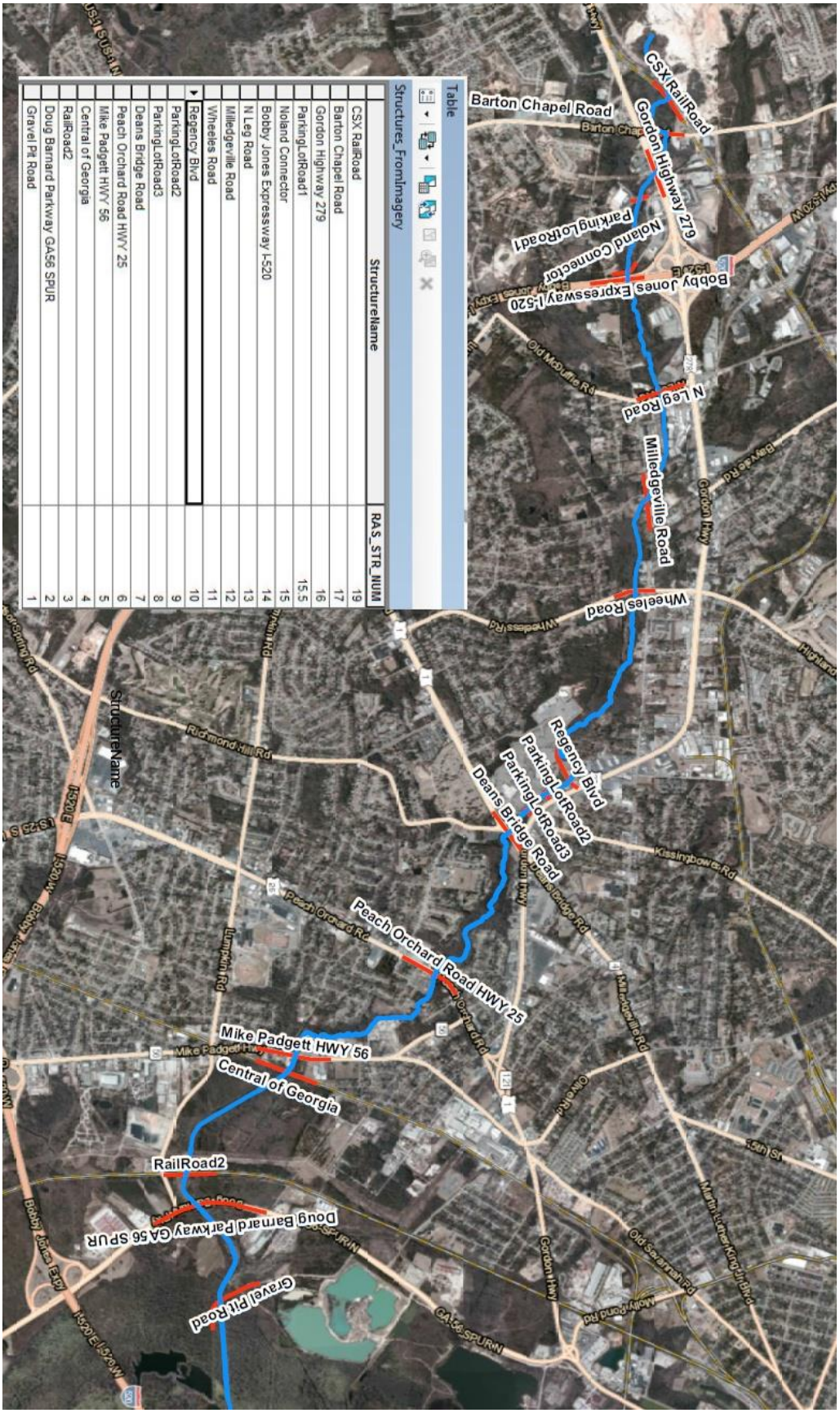


Figure 7 : Stream Crossing Structures

C-2.6.2 DETENTION AREA SIZE AND HAZARD CLASSIFICATION

According to USACE publication ER_1110-2-1156: Engineering and Design, Safety of Dams Policy and Procedures, any artificial barrier constructed for the control of water which is either 1) 25' in height from natural stream bed or 2) has an impounding capacity of 50 ac-ft or greater is considered to be a dam. This definition applies whether the dam is a permanent reservoir or a detention dam for temporary storage of floodwaters. The Rosedale detention area will not be a permanent impoundment of water, but rather a dry storage area to temporarily impound storm water and reduce the peak flow loading downstream.

Table 7 : USACE Hazard Potential Classification

Category	Rating	Description
Direct Loss of Life	Low	No direct loss of life is expected
Lifeline Losses	Low	No disruption of services can be expected. Repairs would be cosmetic and rapidly repairable
Property Losses	Low	Isolated buildings and equipment.
Environmental Losses	Low	Minimal incremental damage

In order to confidently assign a DSAC rating to the completed dam, additional modeling, mapping and investigations must be done, including a dam breach analysis. However, due to the small size, no permanent impounding, and new construction with suitable soils and riprap, a DSAC 5 rating would be the likely recommendation.

The Rosedale detention area would have approximately 161 ac-ft of storage and 23.3' foot head height under full pool conditions. According to Georgia Safe Dams criteria, a "small dam" will have between 100 ac-ft and 500 ac-ft of storage capacity, and not more than 25' of head differential. The Rosedale detention area would fall into this category. The required design storm for a "small dam" is 25% of the PMP.

HMR-51 records for the PMP rainfall for 10 square miles at Augusta Georgia are shown below in **Table 8.** The 6-hr rainfall depths are very similar, within ½" of rainfall. The HEC-RAS model was run with flows generated for the 500-yr and 24-hr duration, or 9.7" rainfall. The water surface elevation within the detention area during this case was 235.44, still over 4.5' of freeboard to the top of dam elevation of 240'. During final design, the 25% PMP can be modeled to ensure that the dam will not be overtopped, and even that 3' of freeboard will remain.

Table 8 : HMR51 Rainfall

	HMR51 PMP	25%PMP	500-yr
6-hour	31"	7.75"	7.25"
12-hour	37"	9.25"	8.4"
24-hour	44"	11"	9.7"

C-2.7 SELECTED AND ELIMINATED ALTERNATIVES

The 2004 Feasibility Study utilized the base condition HEC-RAS model to identify areas of high flooding potential. A total of seventeen potential actions for improvement were identified. To quantify the effectiveness of the alternatives, Rocky Creek was divided into seven distinct sub-reaches. These sub-reaches and the possible improvement alternatives in each are described in **Table 9.**

Initial models were constructed for each alternative to gage its effectiveness. Channel improvements were initially modeled for all reaches, except for R7, as stand-alone models. Structural (culvert, bridge, and levee) improvements were then modeled for each relevant reach. Finally, possible detention ponds were modeled to determine their effectiveness in attenuating the floods downstream. If the initial modeling produced favorable results, three other alternative design plans were modeled. Based on the most promising plans, combinations of channel improvements, structural improvements, and detention ponds were considered. This produced combination improvement models with the contribution of each component to be evaluated once again.

These modeling efforts produced eleven combinations of detention ponds, structural improvements, and channel improvements based on flood prevention and cost. The combinations are shown in **Table 10.** Details regarding each potential improvement can be found in the 2004 Feasibility Report.

During the course of the last ten years, virtually all of these alternatives were eliminated for a variety of reasons; most commonly the flood reduction benefits were nominal or negligible. A brief summary of reasons for elimination of alternatives are shown below.

The modeling analysis for each of these improvements was performed in the previous 2004 Feasibility study, and was not part of this section 205 effort. This section 205 study includes the evaluation of measures that were included in the project management plan (PMP).

Eliminated Due to nominal or negligible flood benefits

- Gravel Pit Road Culvert/Bridge
- Norfolk & Southern Railroad #2
- Chester St Levee
- Dean's Bridge Improvements
- Rozella Berm
- Wheeless Rd Culverts
- Milledgeville Rd Culvert/Bridge Replacement
- North Leg Rd Culvert Replacement
- Barton Chapel Rd Culvert Replacement
- Channel improvement along Rocky Cr.
- Barton Chapel Rd Trailer Park
- Noland Detention Basin

Eliminated Due to Cost

- North Leg Rd Detention Basin

Eliminated due to Sponsor request

- Wheeless Rd Detention Basin

Eliminated due to HTRW issues

- Nixon Street Levee

The remaining alternatives that are being reevaluated for construction include:

- Rosedale Detention Area
- Kissingbower home property buyouts.

Table 9 : Sub-Reaches

Stream	Sub reach	Improvement
Rocky	R1 – mouth to Mike Padgett Hwy	- Channel improvements - Improve culvert at Gravel Pit Rd - Levee along Suffolk Rd and Nixon Rd - Bridge improvements at Mike Padgett Hwy and D/S RR - Non-structural buyout along Dan Bowles Rd area
Rocky	R2 – Mike Padgett Hwy to Regency Mall	- Repair Old Mill Dam - Channel improvements - Improve/Remove three bridges at Regency Mall - Berm along Chester Avenue - Berm along Gordon Highway opposite mall
Rocky	R3 – Regency Mall to Wheeless Rd	- Detention pond U/S of mall (at Rozella Road) - Channel improvements - Buy out homes
Rocky	R4 – Wheeless Rd to Rosedale Dam	- Bridge improvements at Wheeless Rd - Detention pond and buyout of residential and commercial structures U/S of Wheeless Rd - Channel improvements - Culvert improvements at Milledgeville Rd - Culvert improvements at North Leg Rd - Detention pond U/S of North Leg Rd
Rocky	R5 – Rosedale Dam to Bobby Jones Expwy	- Rosedale Dam repair or rebuild - Channel improvements
Rocky	R6 – Bobby Jones Expwy to Barton Chapel Rd	- Detention pond U/S of Nolan Connector - Culvert improvements at Nolan Connector - Channel improvements
Rocky	R7 – Barton Chapel Rd to U/S limit	- Culvert improvements at Barton Chapel Rd - Develop relocation or buyout plan for trailer park at Barton Chapel Rd - Establish maintenance program

Table 10 : Improvement Alternative Combinations

Rocky Creek Features	RY1	RY2	RY3	RY4	RY5	RY6	RY7	RY8	RY9	RY10	RY11
Lombard Detention Pond		X									
Rozella Detention Pond	X	X	X	X	X	X	X	X			
Wheeless Detention Pond	X	X	X	X	X	X	X	X	X	X	X
Rosedale Dam Detention Area	X	X		X	X	X	X	X			X
Nolan Connector Detention Basin		X									
Excavation & Berm at Regency Mall							X	X			
Bridge/Culvert Improvement at Milledgeville	X	X									
Culvert Improvements at North Leg	X	X				X	X	X			
Bridge Improvements at Wheeless	X	X									
Culvert Improvements at ‘s’s Chapel	X	X	X	X	X	X	X	X			
Nixon Street Levee	X	X	X	X	X	X	X	X	X	X	X
Chester Avenue Berm					X	X	X	X			
Remove 3 Mall Crossings								X			
Channel Improvements	X	X									
Clear & Even Channel Inverts at Dean’s Bridge and Peach Orchard	X	X	X	X	X	X	X	X			X
Priority III Channel Improvements U/S and D/S of Peach Orchard			X	X	X	X	X	X			
Priority III Channel Improvements with Meandering between Wheeless and Milledgeville			X	X	X	X	X			X	

C-2.7.1 SUMMARY OF RESULTS

The resulting flood discharge reductions at several locations along Rocky Creek are shown in **Table 11** for the with-project improvement condition.

The Rosedale-only detention area produced positive, yet somewhat limited flood reduction benefits. There are critical levels that the flood elevations would have to be below to capture visible improvements in areas not targeted by the Nixon Levee. One critical elevation is based on the overflow level between Deans Bridge Road and Peach Orchard Road. Both the stand-alone detention pond options still result in overflow across Bungalow Road and continued residential flooding, as compared to the RY11 results, which prevent overflow. The economic calculations should support these conclusions.

Table 11 : Rosedale Detention Improvement Discharges (CFS)

	Future without-project	Future with-project	Delta
2-year	282.6	257	25.6
10-year	680.1	445	235.1
25-year	825	580	245
100-year	1086.1	913	173.1

With the decrease in flood discharges from the proposed Rosedale Detention area, flood elevations at critical locations were reduced as shown in **Table 12.**

Table 12 : Rosedale Improvement Flood Elevations (feet NAVD)

		2-year future		10-year future		25-year future		100-year future	
Downstream → Upstream	Location	w/o Project	w/ project	w/o Project	w/ project	w/o Project	w/ project	w/o Project	w/ project
	Barton Chapel Rd U/S	301.43	301.43	304.15	304.15	305.82	305.82	308.13	308.13
	Gordon Highway U/S	286.19	286.19	288.58	288.58	289.25	289.25	289.89	289.89
	Nolan Connector U/S	243.33	243.33	244.72	244.72	245.30	245.30	246.14	246.14
	I-520 (Bobby Jones Expwy) U/S	242.21	242.21	244.25	244.25	244.87	244.87	245.78	245.77
	Rosedale	Dam is approx 1/3 miles down from I-520 and ¼ mile up from North Leg Road							
	North Leg Rd U/S	205.74	205.28	210.56	207.78	212.06	209.36	214.55	212.79
	Wheeless Rd U/S	174.07	174.07	178.08	177.63	178.99	178.38	180.99	180.71
	Dean's Bridge Rd U/S	152.62	152.50	156.39	156.09	157.47	157.10	160.28	159.57
	Mike Padgett Hwy U/S	135.61	135.54	136.13	135.93	136.25	136.08	137.02	136.29

Although the flood reduction improvements for the various combination scenarios are evident based on direct comparisons of water surface profiles, the true evaluation of the resulting benefits can only be seen in the analysis of its economic impact, which is discussed in a separate section.

C-2.7.2 ROSEDALE WETTING DURATION

Although there were not any parameter updates done to the HMS basin model for future (2030) and existing (2004) flow calculations, additional model runs were developed to determine the duration of wetting that could be expected during various hypothetical events. The following hydrographs were calculated utilizing future conditions curve numbers, a 5x5 effective flow box culvert and a 50' overflow weir at an elevation of 232', and a top of dam crest at elevation 240'. A sketch of the proposed structure is shown in **Figure 8**. The impoundment duration summary is shown below in **Table 13,** and the hydrographs are shown in **Figure 9 - Figure 14.** Impoundment durations were calculated using synthetic 24-hour storms, over a 48-hour simulation window to capture the whole hydrograph.

Table 13 : Rosedale Impoundment Duration Summary

Frequency	Hypothetical Event Duration	Peak Inflow (CFS)	Peak Outflow (CFS)	Peak detention elevation (NAVD88-ft)*	Total impoundment duration (hours)
2-Yr	24-hour	286	256	222.5	~18
5-Yr	24-hour	504	371	231.24	~18.5
10-Yr	24-hour	687	442	233.12	~21
25-Yr	24-hour	835	487	233.68	~21
50-Yr	24-hour	976	591	234.15	~21.5
100-Yr	24-hour	1098	666	234.52	~22

* HEC-RAS Elevations

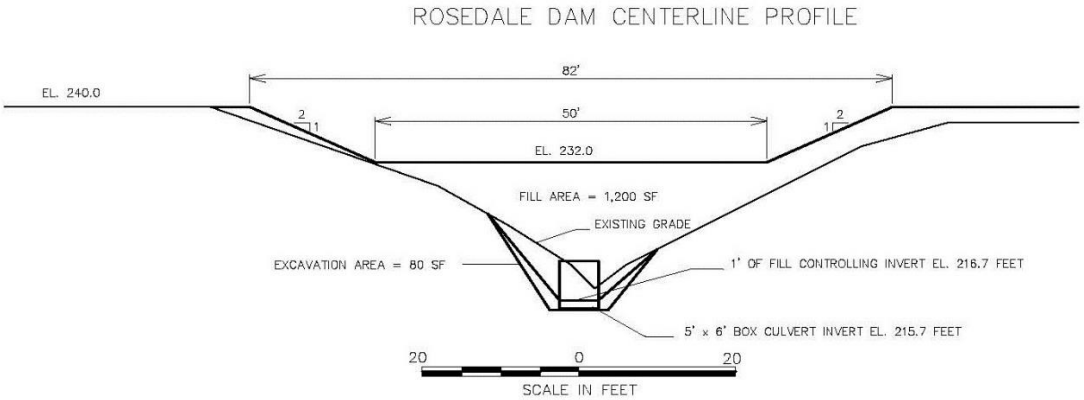


Figure 8 : Dam Profile Sketch

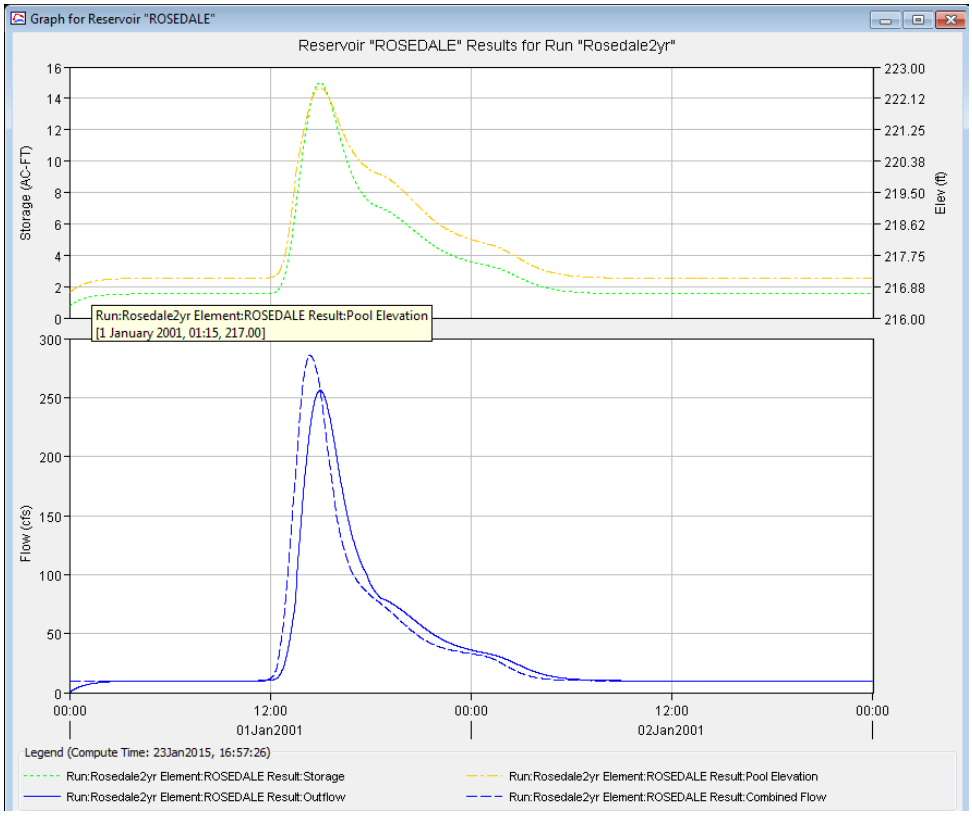


Figure 9 : 2-year Impoundment Hydrograph

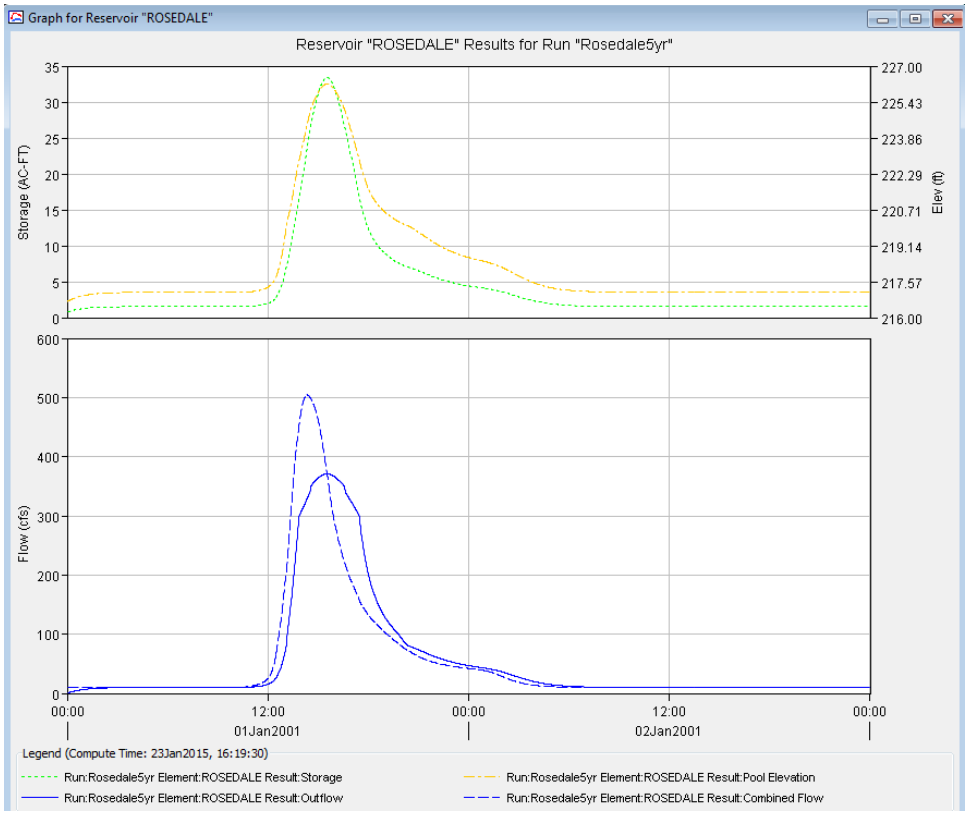


Figure 10 : 5-year Impoundment Hydrograph

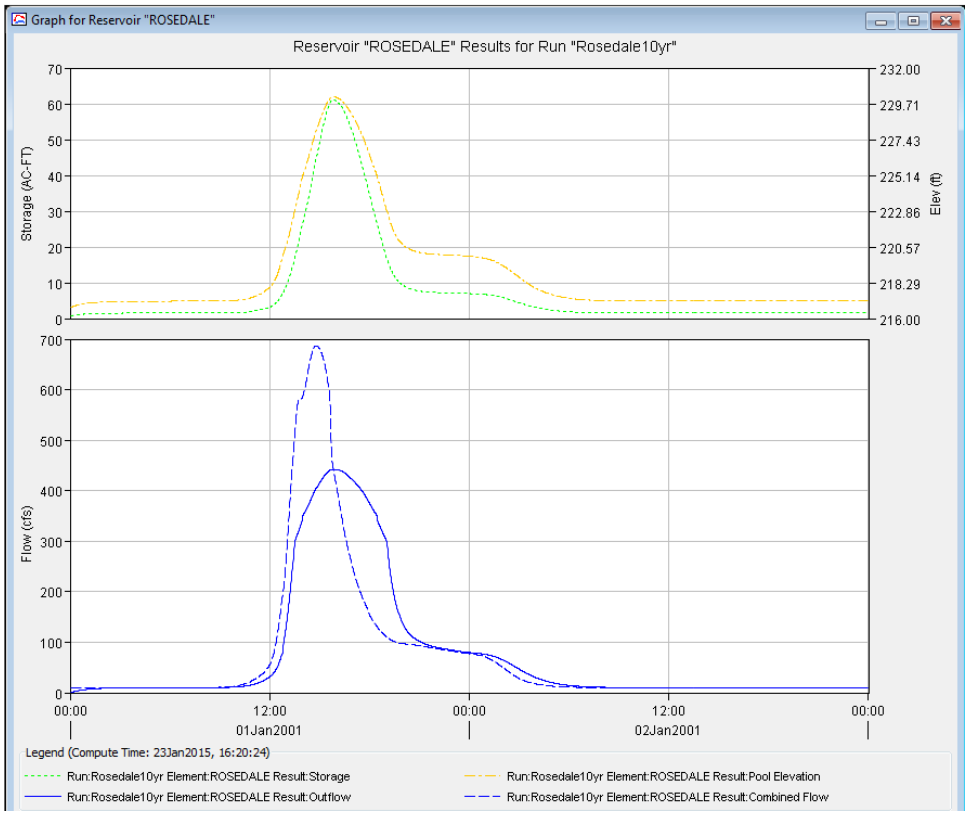


Figure 11 : 10-year Impoundment Hydrograph

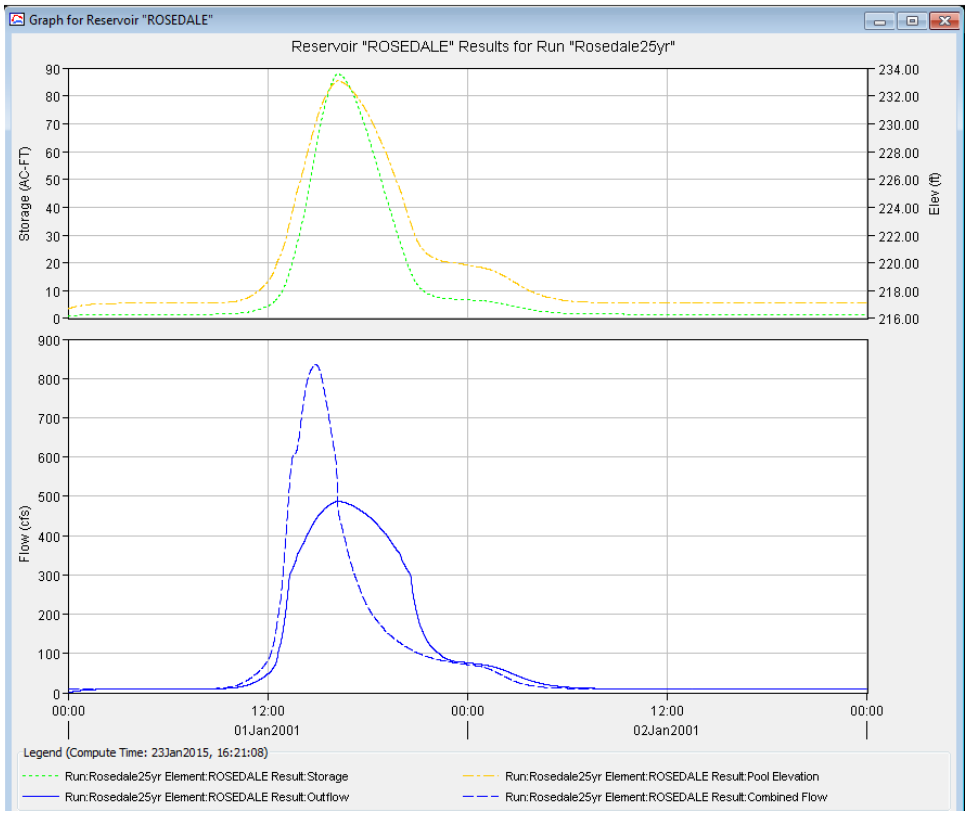


Figure 12 : 25-year Impoundment Hydrograph

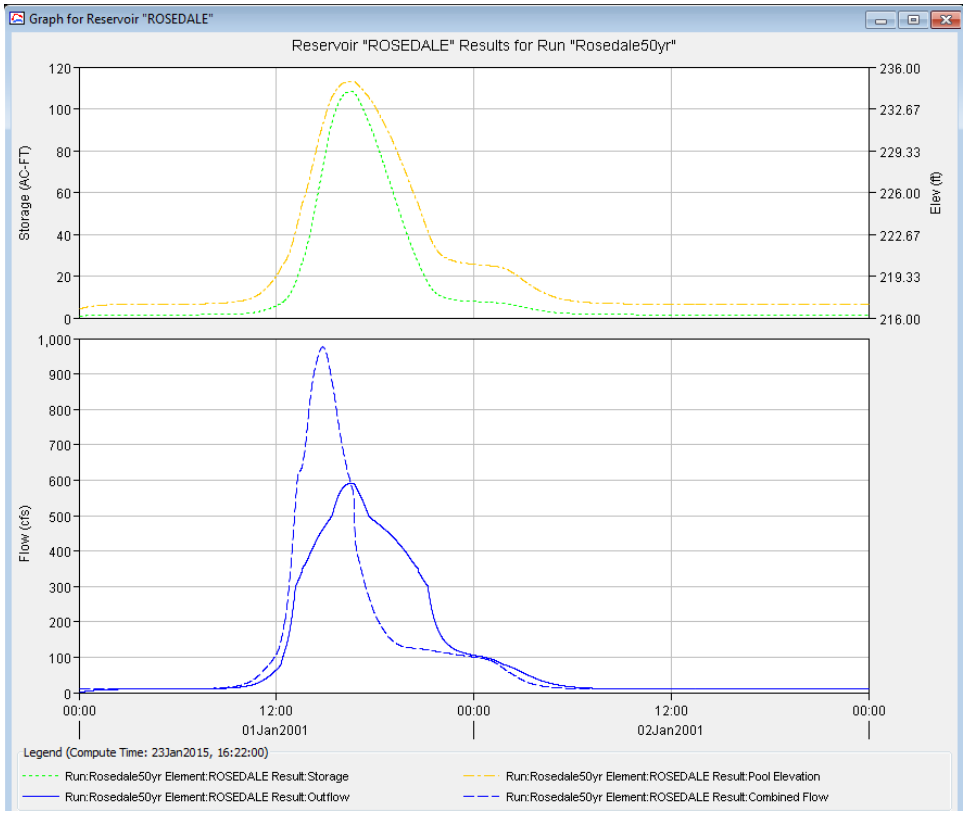


Figure 13 : 50-year Impoundment Hydrograph

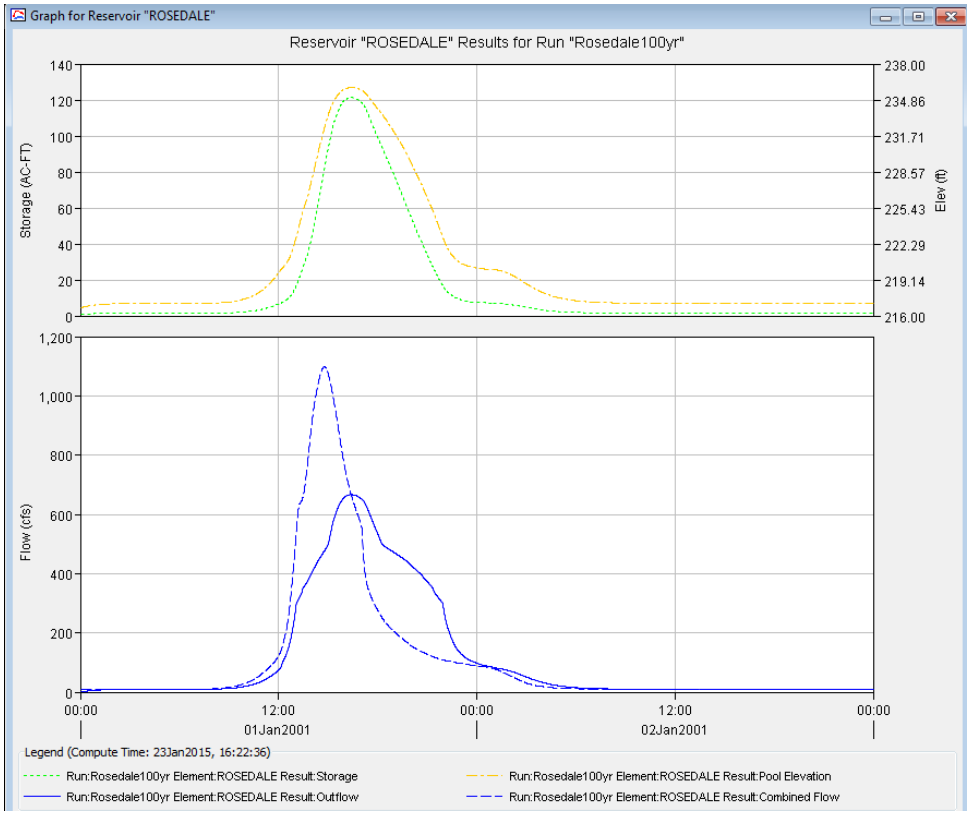


Figure 14 : 100-year Impoundment Hydrograph

C-2.7.3 PROFILE PLOTS

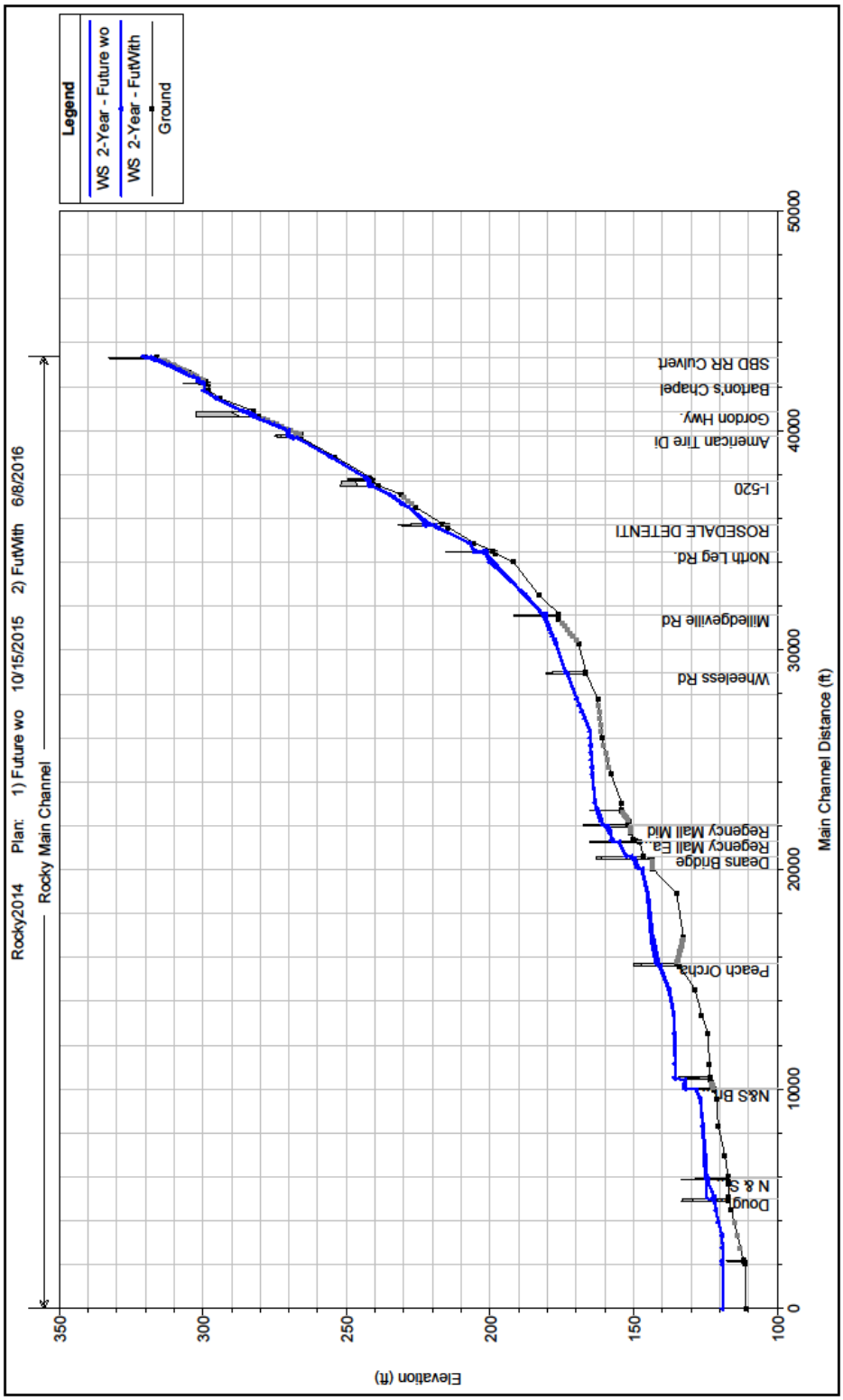


Figure 15 : 2-Year with and without Profiles

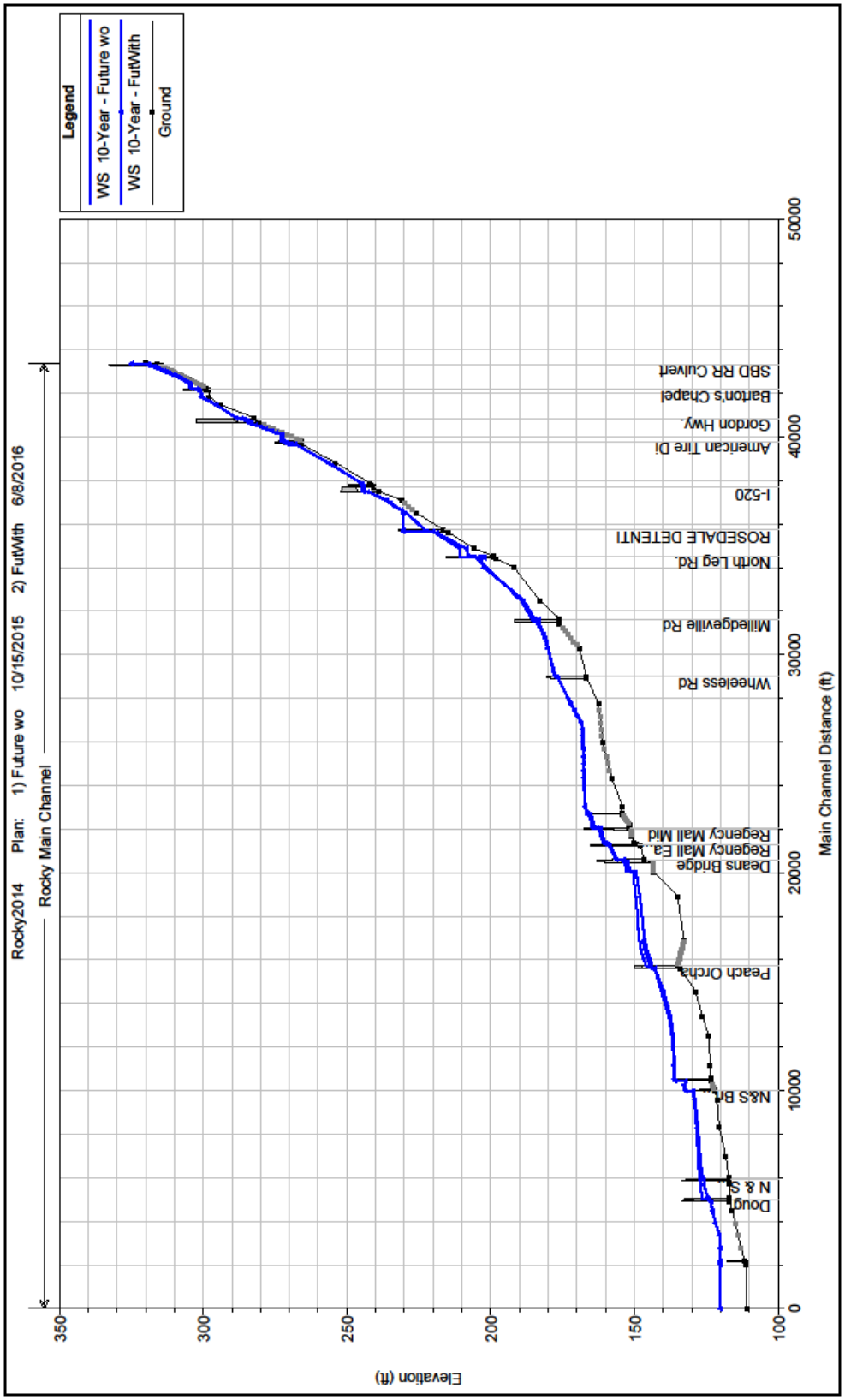


Figure 16 : 10-Year with and without Profiles

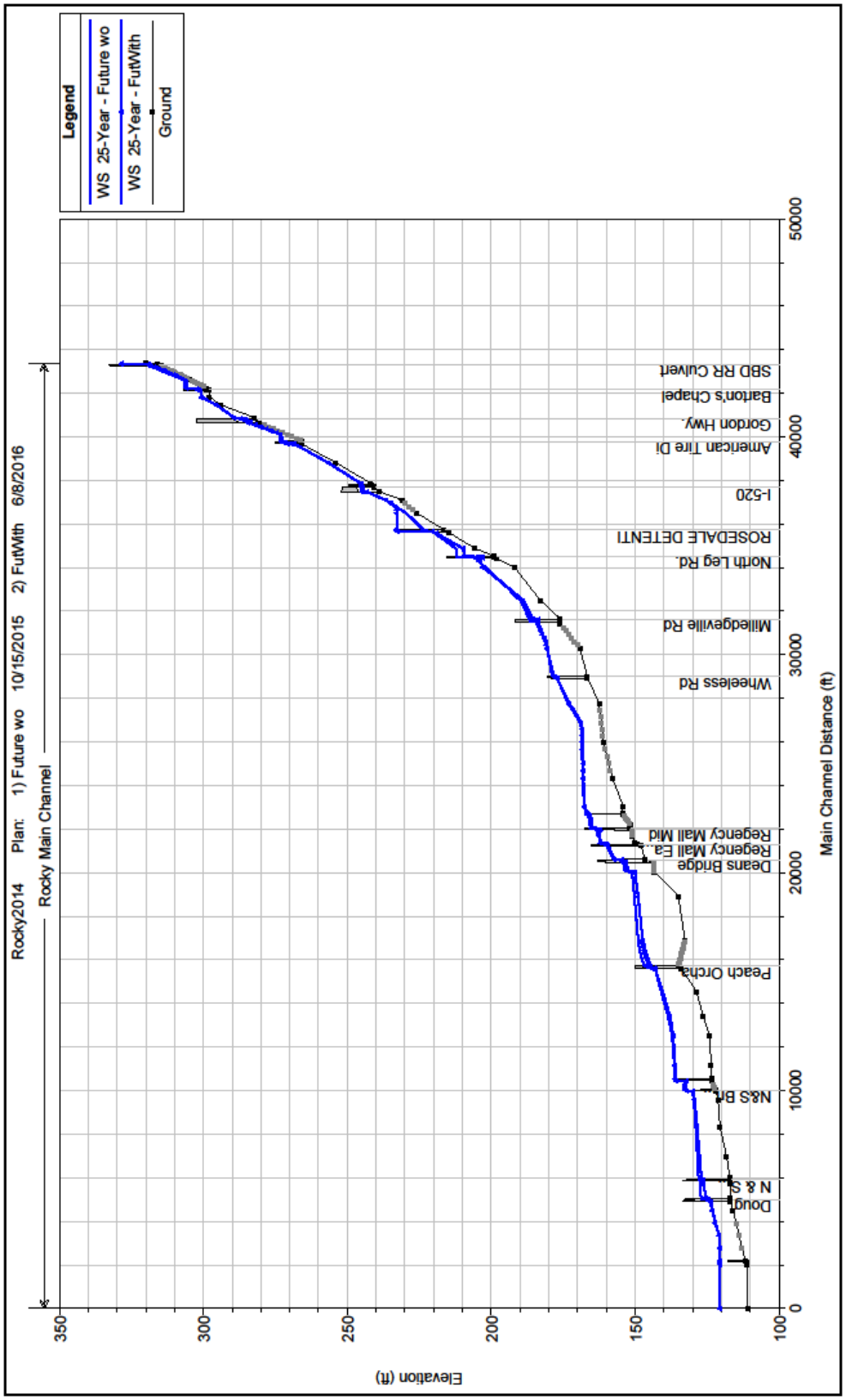


Figure 17 :25-Year with and without Profiles

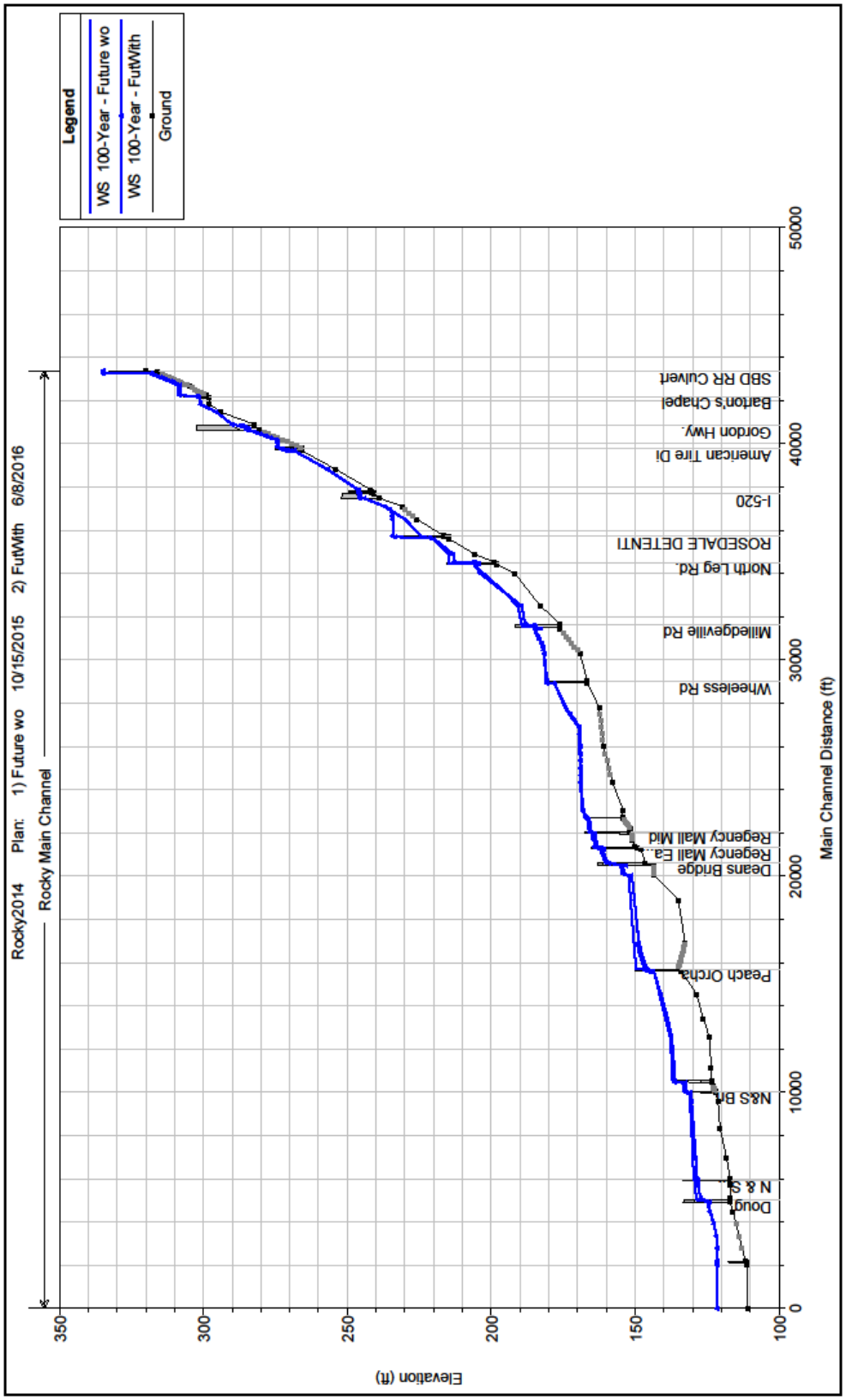


Figure 18 : 100-Year with and without Profiles

C-2.7.4 IMPOUNDMENT MAPPING PLOTS

Shown below in **Figure 19** is the amount of ponding that can be expected behind the structure during a 100-year flood event. Inundation limits below the dam were not mapped. At the deepest portion of the pond, the upstream toe of the structure, the water surface elevation will increase from approximately 224.5'. to 234.5'. Shown in **Figure 20** is the 500-year mapping and 100-year mapping, illustrating the minimal difference between the two.

Figure 19 : 100-YR Impoundment Extents

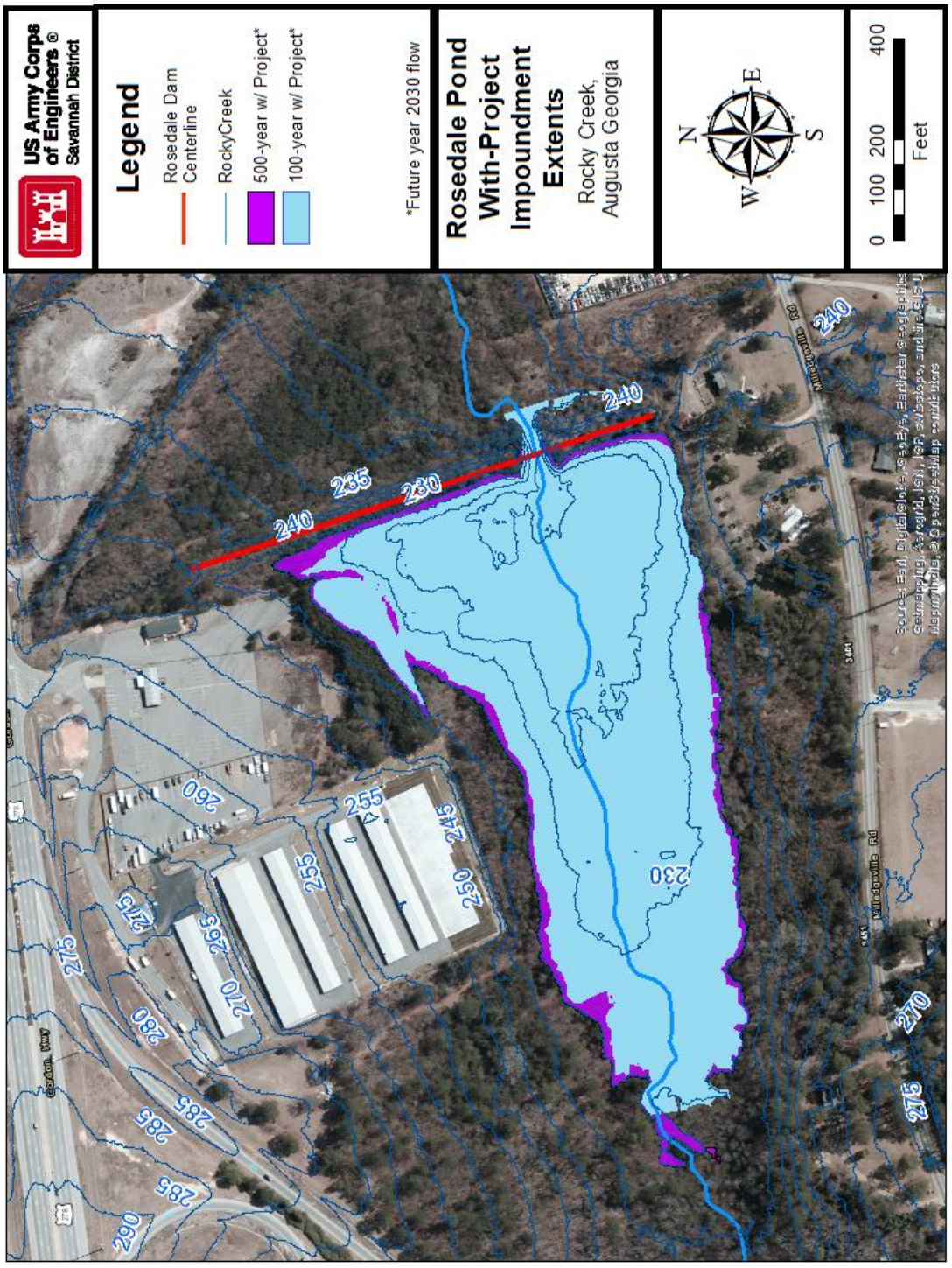


Figure 20 : 500-YR Impoundment Extents

C-2.7.5 REAL ESTATE SUMMARY

Areas behind the dam that are going to be inundated at various event levels must have real estate easements purchased from the parcel owners. A detailed evaluation of these takings can be found in the Real Estate Appendix. A brief summary of impacted parcels can be seen below in **Table 14** and **Figure 21.**

Table 14 : Parcel Easement Areas

Impacted Parcel	Total Area (AC)	100-yr w/o Area (AC)	100-yr w Area (AC)	Increase (AC)
680029000	6.34	0	0.61	0.61
680030000	10.18	4.48	7.73	3.25
694001000	4.12	1.29	1.96	0.67
691012000	10.58	.08	0.41	0.33
690015000	6.5	1.45	2.45	1

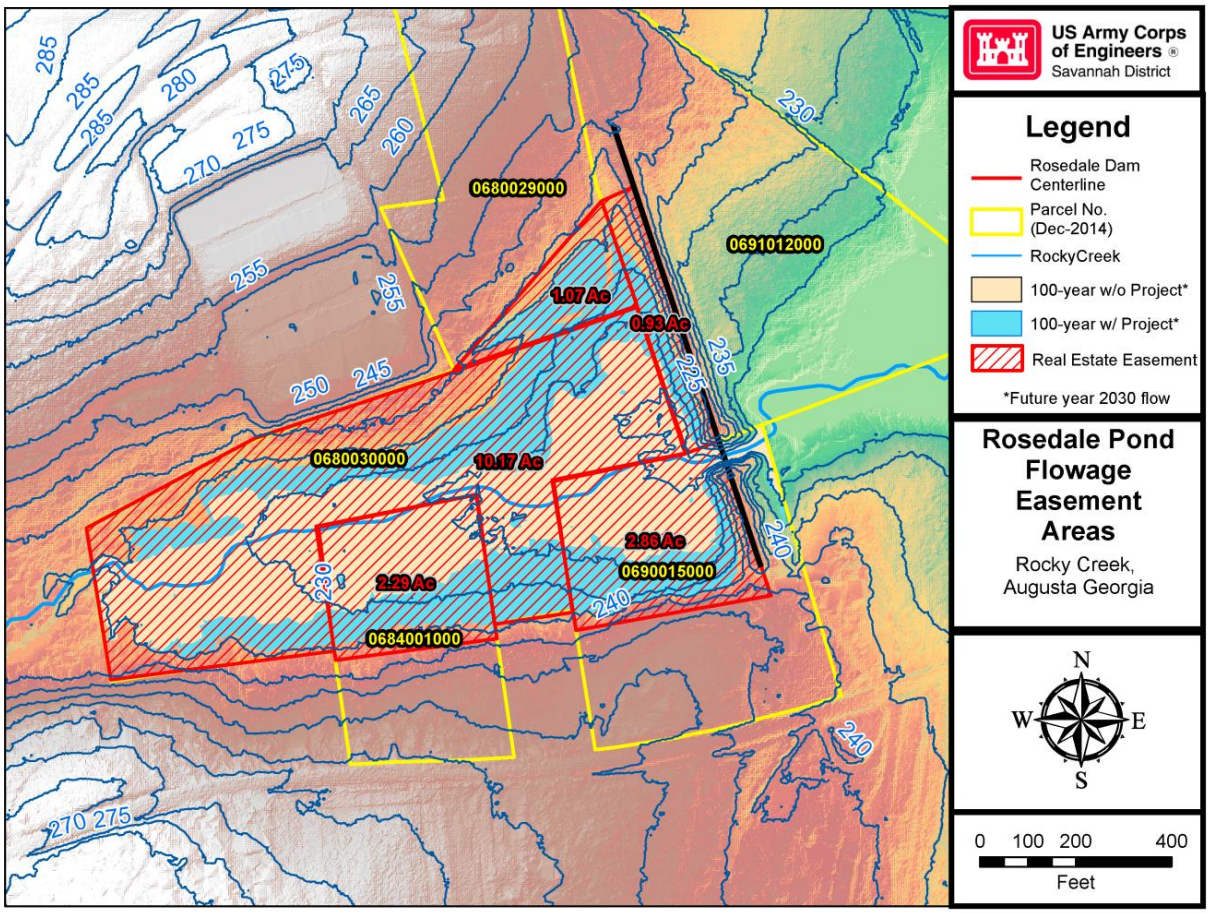


Figure 21 : Flowage Easements

C-3. SURVEYING, MAPPING, AND OTHER GEOSPATIAL DATA

Aerial photography was flown in 2000, digital orthophotos were produced, and 1-foot interval topographic contours developed for the lowland portion of Rocky Creek and Phinizy Swamp. Cross-sections and stream structures were surveyed in January 2001 by Continental Aerial Surveys, Inc., all under contract DACW21-98-D-0017. The Savannah District in-house survey crew surveyed first floor elevations of all structures in the Rocky Creek 500 year flood plain. The GIS database developed and maintained by the City of Augusta, which contains data on topography, structure location, vegetation, roads, etc., was used as the base information for the flood maps and concept design layouts. The additional topographic and structure elevation data collected as part of this study will be added to the GIS database and provided back to Augusta – Richmond County for their future use.

Terrain data was also updated and validated using new LiDAR data. Initially, Army Geospatial Center data (AGC) was used. New cross sections were cut and compared to the current model. Some of the sections were very similar in shape, but not in absolute magnitude. Some sections and top-of-road data was close, but some were off by 5ft +/-. High accuracy overbank data is important for mapping and accurate water surface profile computations. Published benchmarks in the domain of the dataset were analyzed and compared to the data. It became clear that the errors were not systematic errors, such as a datum conversion, but simply low quality data collection techniques, resulting in random error within every data point. The AGC was contacted, and noted that errors of +/- 3 feet were not unheard of, and that the terrain was better used for other purposes where this level of error was not as critical as H&H applications.

An alternate source of LiDAR terrain data was located in the USACE-SAS database. The data was collected for a GADNR project in 2012. The point cloud was processed for the Rocky Creek project area, and a DEM was created at a resolution of 3.28ft grid cell resolution, in NAD_1983_StatePlane_Georgia_East_FIPS_1001_Feet datum. The data had previously undergone rigorous QA/QC from the data collection contractor. However, given the problems with the AGC dataset, it was also compared to benchmarks and to existing model cross sections. The standard error was within ~.1 ft +/-, increasing confidence in this dataset for use. An overview of the terrain data used is shown in **Figure 22.**

In accordance with SMART planning guidance, the data that was used consisted predominately of readily available data. No additional survey grade data was collected as part of this Section 205 study. USACE conducted field reconnaissance to assure that all of the structures in the old model were ground truthed to make sure they were still in place and there were no large obvious discrepancies. Tape down measurements were also taken at any new structures that have been constructed since the 2004 model.

Given the availability of two separate LiDAR datasets to choose from, the ability to compare the LiDAR to a maintained benchmark database published by the National Geodetic Survey, and the ability to compare cross sections to the old model (which contained some surveyed sections), there is a high level of confidence in the terrain

data used. This data is considered fit for this level of hydraulic analysis, and is not a significant source of uncertainty in the hydraulic analysis.

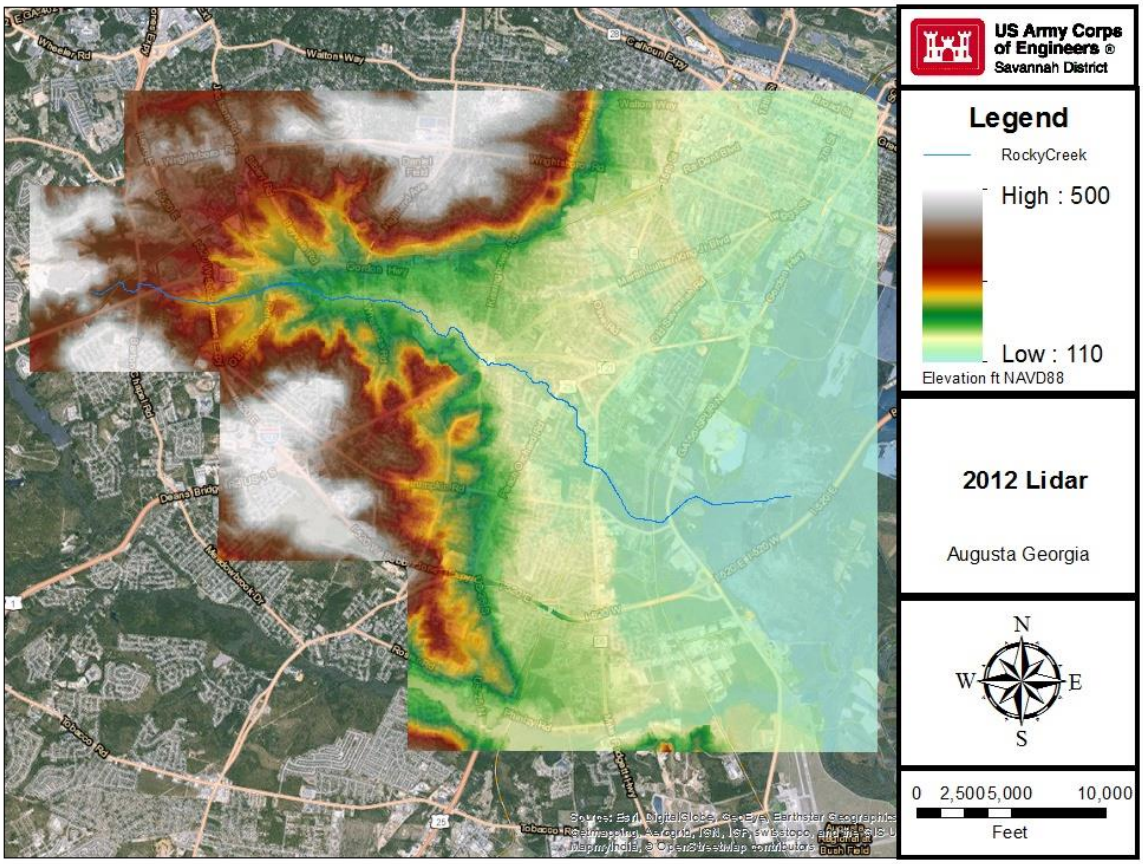


Figure 22 : LiDAR

C-4. GEOTECHNICAL

C-4.1 DESIGN REQUIREMENTS:

In 2002, Savannah District Geotechnical and HTRW Branch performed subsurface exploration and prepared a geotechnical assessment of soil conditions for a number of the alternative project sites identified at that time. Standard Penetration Test borings were drilled at the proposed locations of Lombard, Rozella, Wheeless, and Noland Connector detention basin. However, none of these sites were selected for construction. Those boring locations, drilling log sheets and approximate soil profiles can be found in the 2004 Engineering Appendix. In 2009, Savannah District Geotechnical and HTRW Branch mobilized to the proposed Rosedale Detention Structure location to perform subsurface exploration for geotechnical assessment. Presented in this report are the results of the field and laboratory investigation. The geotechnical information obtained regarding site and soil conditions were used to determine the retaining structure type and size and estimate material quantities for a rough order magnitude cost estimate.

C-4.2 SITE GEOLOGY:

The headwaters of the Rocky Creek basin start in the southeast edge Piedmont area of Georgia. The basin ends in Phinizy Swamp which is in the northwestern edge of the upper Coastal Plain area of Georgia.

The Fall Line is the boundary between the Piedmont and the Coastal Plain. Its name arises from the occurrence of waterfall and rapids that are the inland barriers to navigation on Georgia's major rivers. The Fall Line is a boundary of bedrock geology, but it can also be recognized from stream geomorphology. Upstream from the Fall Line, rivers and streams typically have very small floodplains, if they have any at all, and they do not have well-developed meanders. Within approximately a mile downstream from the Fall Line, rivers and streams typically have floodplains or marshes across which they flow, and within three or four miles they meander. The most pronounced example of this is in the Savannah River's course at Augusta.

The Coastal Plain is a region of Cretaceous and Cenozoic sedimentary rocks and sediments. These strata dip toward the southeast, and so they are younger nearer the coast. At least near the Fall Line, they are ultimately underlain by igneous and metamorphic rocks like those of the Piedmont. The sedimentary rocks of the Coastal Plain partly consist of sediment eroded from the Piedmont over the last 100 million years or so, and partly of limestone generated by marine organisms and processes at sea. One could generalize that buried Triassic rocks in the subsurface are various rift-basin siliciclastics, the Cretaceous strata are sandstones and shales, the Tertiary strata are limestones and shales, and that the Quaternary strata are sands and muds.

The outcrops near the Phinizy Swamp area are mostly Quaternary alluvium composed of unconsolidated sand and gravel located primarily on the river's flood plain. Underlying the alluvium are sediments of Cretaceous to Eocene in age. They are dominantly terrestrial to shallow marine in origin and consist of sand, kaolinitic sand, kaolin, and pebbly sand. The sediments are underlain by metamorphic and igneous rocks including granite, biotite gneiss, granite gneiss, and amphibolite.

C-4.3 ROSEDALE SUBSURFACE EXPLORATION

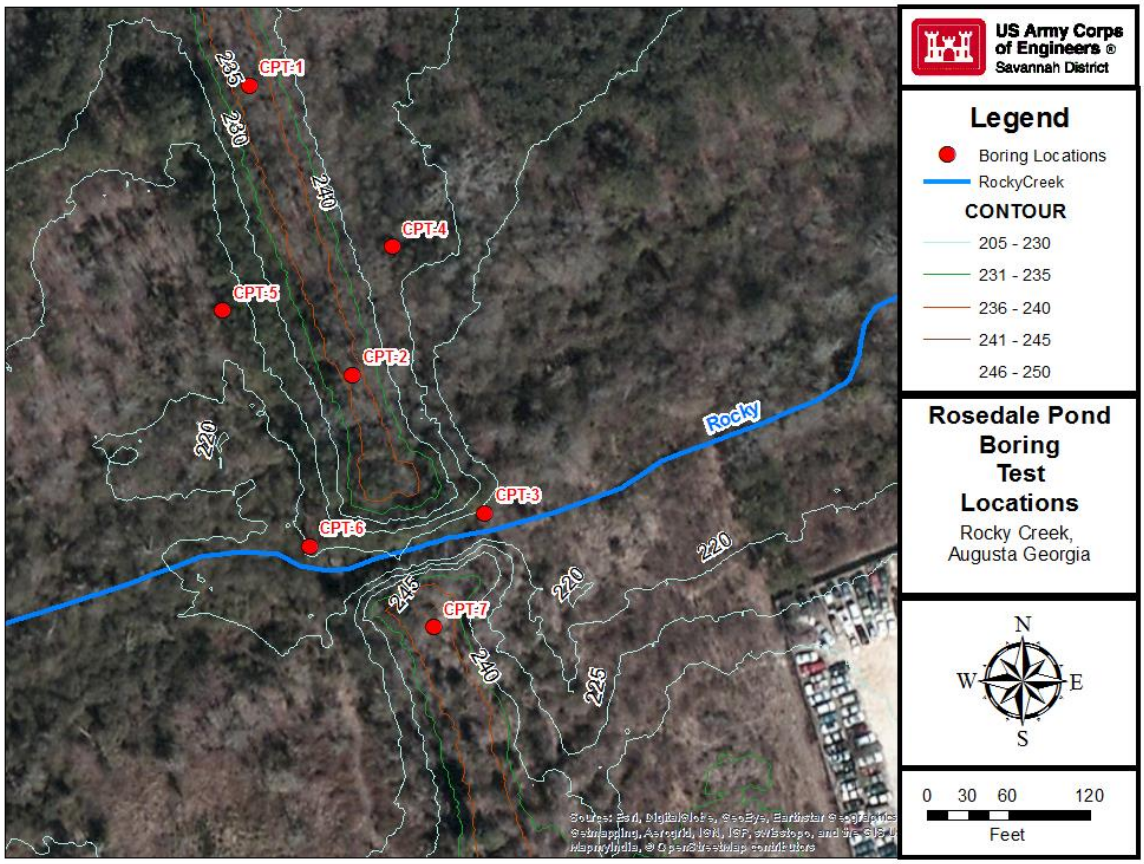


Figure 23 : Boring Locations (2009)

In 2002, the Rosedale detention area was unable to be tested for soils due to right of entry obstacles. In 2009, Savannah District Geotechnical and HTRW Branch completed seven Cone Penetrometer Tests (CPT) and obtained soil samples for lab analysis. The locations for the CPT tests are shown in **Figure 23**. Grain Size Distribution analysis, gradation curves, and liquid limit/plastic limit tests were performed at the Environmental Testing Unit lab in Marietta, Georgia. The results from these tests are attached in section **C-12. GEOTECH EXPLORATION RESULTS .**

C-4.4 BORROW/DISPOSAL SITES

Based on the geotechnical assessment it is anticipated that borrow materials will be required for construction of the new Rosedale storm water detention structure. These materials will come from required excavations on-site and also from City/County owned borrow sources. Haul distances for borrow and disposal are assumed to be between five and ten miles.

C-4.5 SLOPE STABILITY AND SEEPAGE

The Rosedale detention basin embankment was analyzed and designed for slope stability in accordance with EM 1110-2-1902. The factor of safety for slope stability was higher than the minimum requirements identified.

The detention area does not hold a permanent pool, as such a transient analysis was utilized for seepage and embankment design in accordance with EM 1110-2-1901.

EM 1110-2-1902
31 Oct 03

Table 3-1
Minimum Required Factors of Safety: New Earth and Rock-Fill Dams

Analysis Condition[1]	Required Minimum Factor of Safety	Slope
End-of-Construction (including staged construction)[2]	1.3	Upstream and Downstream
Long-term (Steady seepage, maximum storage pool, spillway crest or top of gates)	1.5	Downstream
Maximum surcharge pool[3]	1.4	Downstream
Rapid drawdown	1.1-1.3[4,5]	Upstream

[1] For earthquake loading, see ER 1110-2-1806 for guidance. An Engineer Circular, "Dynamic Analysis of Embankment Dams," is still in preparation.

[2] For embankments over 50 feet high on soft foundations and for embankments that will be subjected to pool loading during construction, a higher minimum end-of-construction factor of safety may be appropriate.

[3] Pool thrust from maximum surcharge level. Pore pressures are usually taken as those developed under steady-state seepage at maximum storage pool. However, for pervious foundations with no positive cutoff steady-state seepage may develop under maximum surcharge pool.

[4] Factor of safety (FS) to be used with improved method of analysis described in Appendix G.

[5] FS = 1.1 applies to drawdown from maximum surcharge pool; FS = 1.3 applies to drawdown from maximum storage pool.

For dams used in pump storage schemes or similar applications where rapid drawdown is a routine operating condition, higher factors of safety, e.g., 1.4-1.5, are appropriate. If consequences of an upstream failure are great, such as blockage of the outlet works resulting in a potential catastrophic failure, higher factors of safety should be considered.

Table 15 : Minimum Factor of Safety

C-5. ENVIRONMENTAL ENGINEERING

The majority of the environmental enhancement features were in the form of channel improvements and restoration measures that have been eliminated as alternatives.

The box culvert that would be installed as part of the Rosedale detention structure would be buried 1 foot below grade to avoid the potential for scouring of the channel bottom along the edge of the culvert that would create a barrier to wildlife passage through the culvert. The required conveyance area is 25 square feet, which is

accomplished with a 5x5 culvert. However, with the invert being buried, the culvert will need to be 5'x6' to achieve the required flow.

Rock cross vanes were part of the channel improvement alternatives that were previously evaluated and eliminated. The proposed detention structure is not intended to change (increase or decrease) typical daily stream flows. A stone/rip rap apron will be included at the discharge point of the culvert to reduce scour potential and protect the structure from undermining.

C-6. CIVIL DESIGN ROCKY CREEK PROJECT FEATURES

C-6.1 DESIGN REQUIREMENTS

The proposed project features presented in this section are limited to the concept level of the Rosedale Detention area. Prior alternatives in the 2002 Feasibility Report have been eliminated from consideration, such as retaining structures, culverts, and channel improvements. The designs were developed to a sufficient level that cost could be reasonably estimated. This section discusses all structural features considered for Rocky Creek. Non-structural features are discussed in section C-7.

C-6.2 OUTLET DISCHARGE VELOCITIES

HEC-RAS model output data from the future conditions with-project plan were used to determine a range of expected discharge velocities from the box culvert at Rosedale. Culvert discharge flows for each simulated event were taken from the model, and the Hazen-Williams friction loss method was used to predict velocities. The Hazen-Williams method is valid for water flowing at ordinary temperatures of 40 to 75 ^{o}F through pressurized pipes. Therefore, this approximation is valid when the culvert is submerged on the upstream side and acting as orifice flow, at the 10-year event and higher. The Hazen Williams equation is shown below.

$V = k*C*(D/4)^{0.63}S^{0.54}$

Where
k = conversion factor for English units = 1.318
C = Hazen Williams roughness coefficient for concrete pipes = 130
D= equivalent circular diameter = 5.64'
S = energy slope = h_f/L
L = pipe length = 150'

Table 16 : Outlet Velocity

Frequency	HEC-RAS flow through culvert (CFS)	Hazen Williams velocity (ft/s)	Hazen Williams head loss (ft)
25-Yr	483	19.3	1.77
50-Yr	495	19.81	1.85
100-Yr	502	20.1	1.9
250-Yr	510	20.41	1.95
500-Yr	517	20.7	2.00

C-6.3 ROSEDALE DETENTION STRUCTURE

The Rosedale Dam embankment is located along Rocky Creek between Milledgeville Road and Gordon Highway upstream of North Leg Road. Many years ago the owners deliberately breached the dam in a controlled manner at the approximate location of the creek channel. It is understood that after the owners were made aware of deficiencies regarding insufficient/undersized outlet works a decision was made to breach the dam instead of making repairs to bring the in-place outlet works into compliance with the current dam safety regulations at the time. The remaining embankment is approximately 800 linear feet in length. The existing crest width is approximately 15-20 feet and the height of the embankment is approximately 20-25 feet. Results of the CPT soundings and laboratory tests indicate that the top 5-10 feet of the existing embankment is constructed of predominantly sand with the rest of the embankment consisting of clays and clayey silts. The CPT results also indicate that the embankment is founded on medium to dense silty sands and very stiff fine grained soils. The renovations proposed include placing a reinforced concrete pipe or box culvert through the breach in the embankment, at the location of the creek bed for normal flow. The culvert invert will be at an elevation of 215.7', with 1' of backfill to minimize biological impacts. The controlling hydraulic elevation will be 216.7'. The breach will then be filled to elevation 232.0 to form a notch for all flows between the 10- and 500-year flood events. The bottom width of the overflow notch will be 50', and the tope width will be 82'. The side slopes will be at 2:1. At no time should the entire structure be overtopped. The entire structure will require clearing and grubbing and establishment of grass cover. A plan view of the existing dam and proposed modifications and a profile of the dam are shown on **Figure 24** and **Figure 25** respectively.

The majority of the existing embankment will be deconstructed and reconstructed according to USACE publication ER_1110-2-1156: Engineering and Design, Safety of Dams Policy and Procedures. Unsuitable material will be disposed of, and suitable

material will be reused. Additional fill will be brought in to replace unsuitable material. These quantities estimates are reflected in C-6.4 Quantity Estimate Summary.

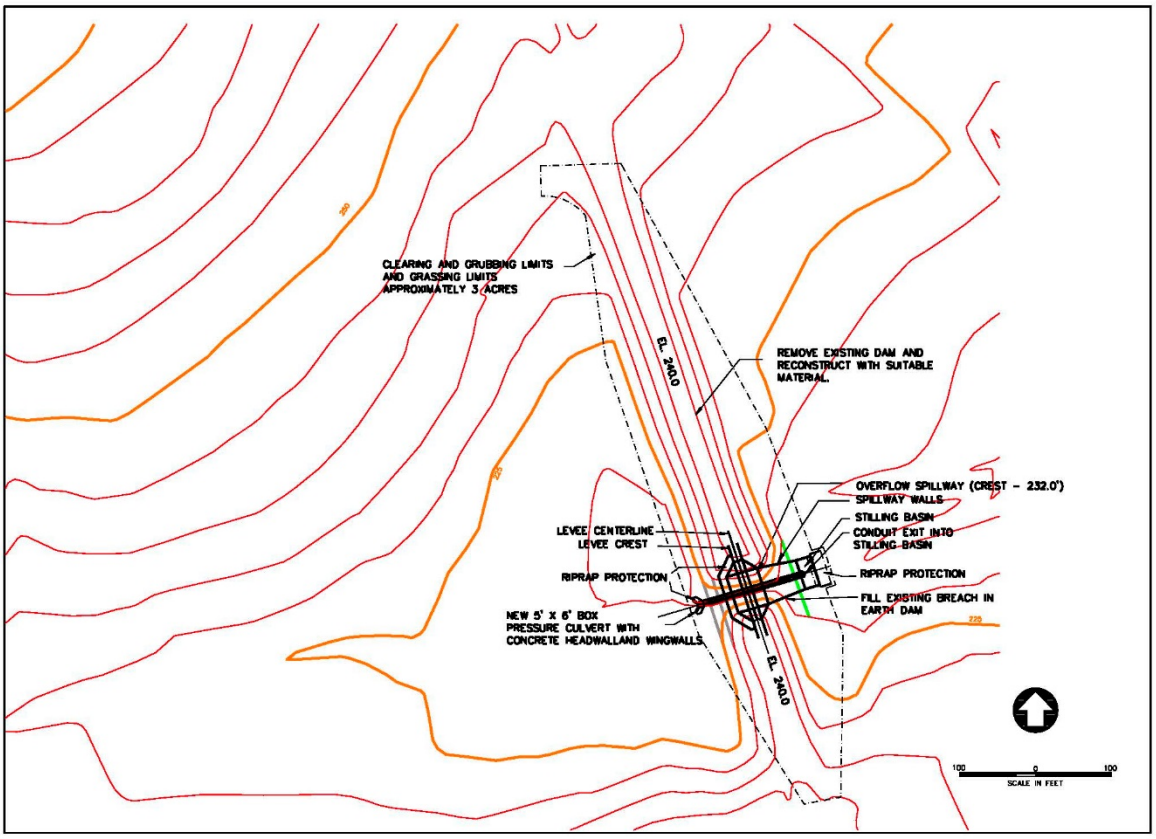


Figure 24 : Rosedale Detention Structure Renovations

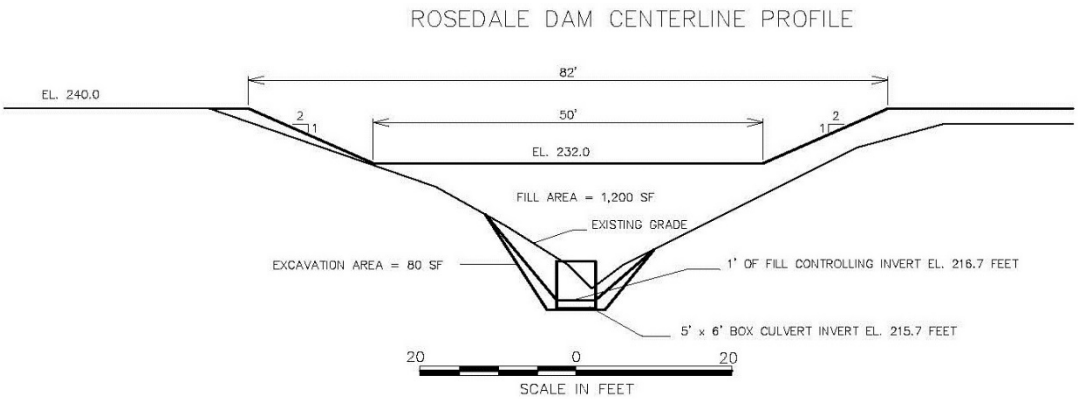


Figure 25 : Rosedale Center Line Dam Profile

C-6.4 QUANTITY ESTIMATE SUMMARY

Rosedale Dam is an existing earth dam that was breached at the creek channel many years ago. The renovations proposed include placing a reinforced concrete pipe or box culvert through the breach in the embankment, at the location of the creek bed for normal flow. The breach will then be filled to elevation 232.0 to form an overflow weir for all flows from the 10 to the 500-year flood event. The crest and downstream slope at the notch will be protected from erosion with articulated concrete blocks (ACB) slope protection or cast in place concrete. The entire structure will require clearing and grubbing and establishment of grass cover.

Clearing and Grubbing:

Clearing and grubbing will include trees of all sizes (up to 40-inch diameter) and woody vegetation. Clearing and grubbing will occur within the footprint of the new embankment, as well as area as required for ingress and egress.

Stripping & Hauling:

The area is heavily wooded and vegetated. Stripping and hauling quantity of material estimates are assumed to fairly high due to dense vegetation.

Excavation:

Common excavation quantities were estimated using readily available topographical data and concept design parameters discussed within this document. The entire existing embankment will be excavated and rebuilt, to assure structure stability. Cone Penetrometer Test results indicate that approximately 20% of excavated material will be suitable for reuse.

Dewatering/Diversion of Water:

During construction, assume temporary coffer dikes will be built both upstream and downstream of the existing breach and tied to the embankment at both ends. The common existing low flow rate is approximately 25-40 CFS. The existing creek flow can be pumped around the dam during construction. Within the fill placement area, water can be controlled by temporary ditches and sumps. Water from sumps will be pumped downstream of construction area. The volume of material used to construct coffer can later be used as fill in the permanent construction once the fill is several feet above the new RCP.

Reinforced Concrete Pipe, Wing Walls, and Slabs:

The design incorporates a reinforced 5' X 6' box culvert. New concrete wing walls will be required on both ends of the culvert. Wing walls can be precast or cast-in-place. A concrete apron/slab will also be required between the wing walls.

Earthwork:

Backfill will be placed and compacted in layers to 95% standard proctor density. Spreading and compaction will require both conventional earthwork equipment and hand placement and compaction around the RCP. Moisture control will be required. Compaction of the surface of the entire dam will be required after clearing and grubbing is complete and prior to seeding. Suitable material from the construction of the coffer dike can be included in the quantity.

Outfall Protection:

A stilling basin with riprap protection will be placed at the downstream toe of the emergency spillway and at the outfall of the concrete box culvert to prevent scour and undercutting.

Geotextile:

Geotextile will be required beneath the concrete spillway and between the riprap and existing ground.

Reinforced Concrete Spillway

The reinforced concrete spillway area as described in the concept design is assumed to be 12” thick. The concrete spillway will be cast in place concrete.

Topsoil, Grassing, Mulching, Fertilizing:

Topsoil will be stockpiled separately from other excavation (but is included in excavation volume). Topsoil will be considered the top four inches of existing grade. Topsoil placement will only be required in areas of fill placement. All disturbed areas will be grass seeded, fertilized, and mulched. There will be no topsoil or grassing required inside the dry impoundment area.

Maintenance:

Regular maintenance will include items such as mowing, reseeding, and minor earthwork to repair rutting and erosion as needed. Vegetation removal and herbicide application within the riprap outfall protection will be required. Inspections of the embankment should be scheduled periodically and should also occur after large rain events.

C-7. NON-STRUCTURAL FEATURES

The only nonstructural feature proposed for Rocky Creek are home buyouts at Kissingbower, near the Regency Mall. This feature provides for the removal of five residential buildings within the existing floodplain. See the Economics Appendix for the full description of this feature, with a full analysis of benefits, costs and B/C ratio. A general vicinity location map of the parcels, with the existing FEMA 100-year floodplain can be seen in **Figure 26.**

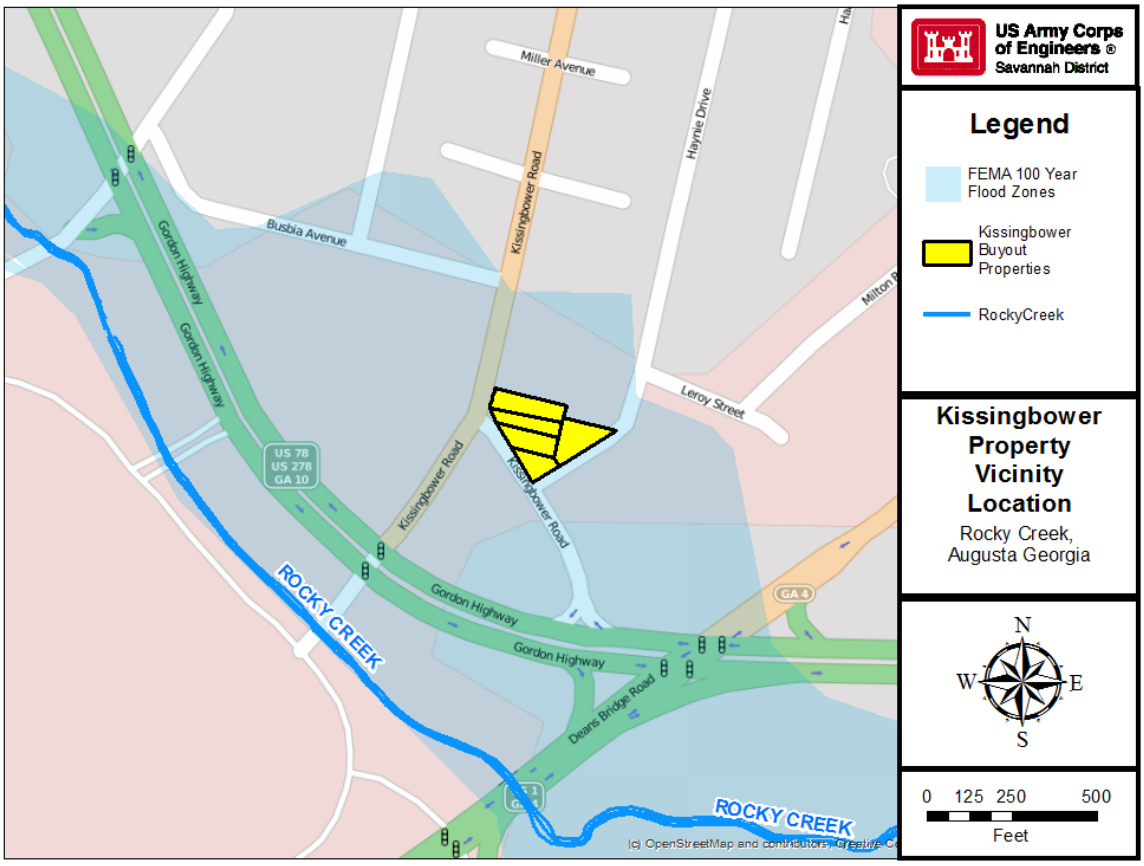


Figure 26 : Kissingbower Vicinity

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	250-yr	500-yr
Future with Project	155.1	157.12	158.46	159.37	160.78	161.49	163.82	164.19
Future Without Project	155.29	157.45	158.87	160.22	161.06	162.33	164.09	164.45
Existing	154.51	156.72	158.23	159.25	160.42	161.16	163.31	163.56

Table 17: Water Surface Elevations at Kissingbower[3]

[3] HEC-RAS Station 23210

A zoomed in view of the five parcels, with parcel numbers can be seen in **Figure 27**. HEC-RAS river stationing is also shown for reference. Kissingbower is approximately 700 feet south of the Regency Mall Middle Entrance, and 500 feet north of the Dean's Bridge Road crossing. Rocky Creek is about 300 feet to the west, other the other side of Gordon Highway. See **Table 18** for a list of parcels and addresses. Full appraisals can be found in the Real Estate Appendix.

Table 18 : Kissingbower addresses and parcel names

Parcel Number	Address	Parcel Acreage
086-1-023-00-0	1956 ½ Kissingbower Rd	.2
086-1-022-00-0	1958 Kissingbower Rd	.22
086-1-024-00-0	1956 Kissingbower Rd	.27
086-1-020-00-0	1957 Haynie Dr	.28
086-1-021-00-0	1960 Kissingbower Rd	.16

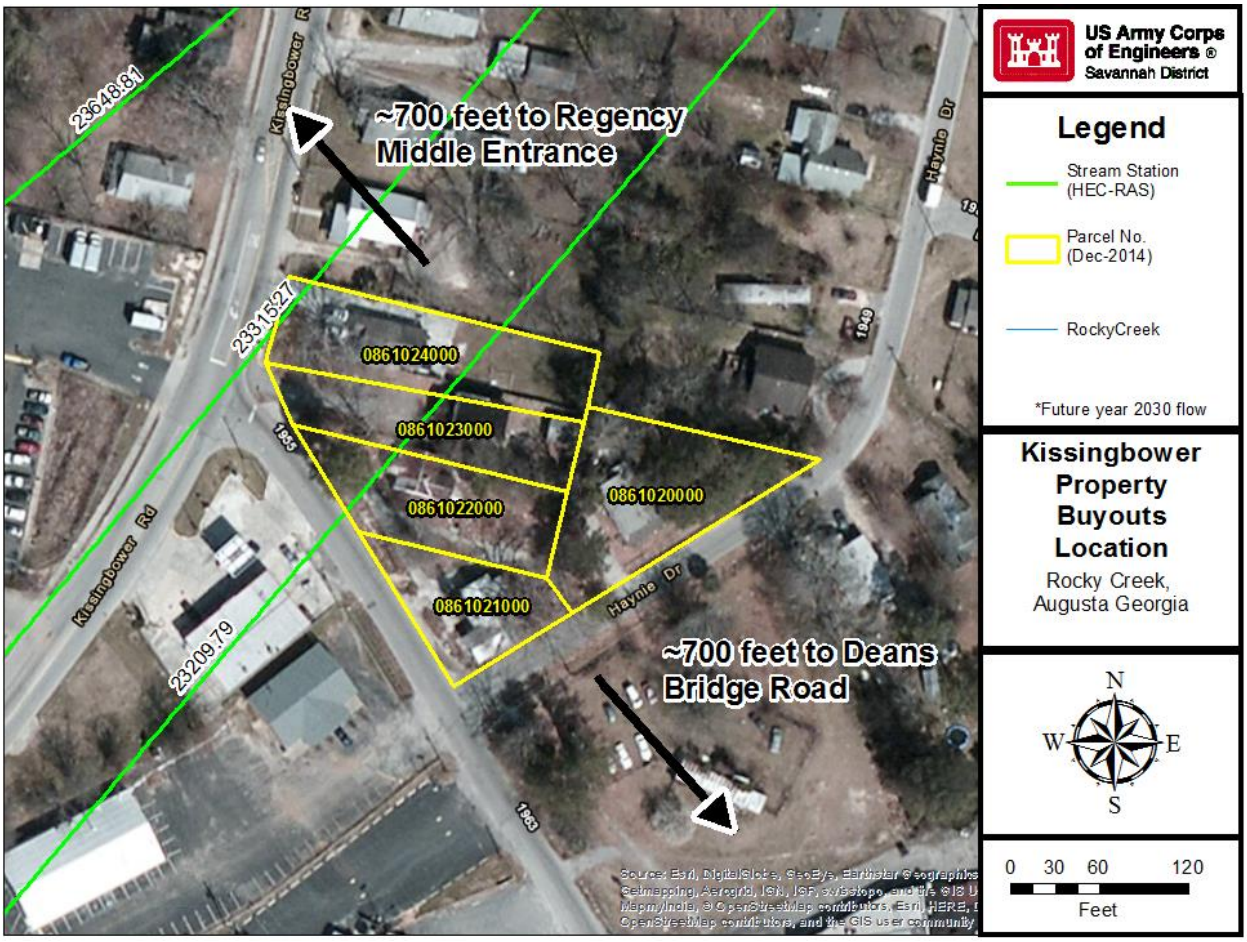


Figure 27 : Kissingbower Park Parcels

C-8. HAZARDOUS AND TOXIC MATERIALS

A historical database search was done to determine whether an expectation of contamination existed for the planned construction areas of the Augusta Flood Control Project. The database search showed no major historical factors, but several possible minor contamination issues. Based on these issues, as well as, an inclusive site visit, it was determined that extensive sampling along the planned Rocky creek detention pond area should be conducted. Analytical results indicated that no contamination exists that should interfere with planned construction activities. Therefore, it was recommended that flood control activities should continue as planned. Please refer to the "Environmental Assessment Augusta Canals" report sections 3 & 4 for summaries of hazardous waste issues. The HTRW report will be made available upon request.

C-9. OPERATION AND MAINTENANCE

In 2002, the design team, with input from the local sponsor on some issues, analyzed each project feature and determined what would be their individual operation and maintenance requirements as well as what would be the frequency of maintenance. A full matrix of O&M requirements can be found in the 2004 Engineering Report. In the case of the Rosedale detention structure, it was estimated that the following maintenance was required

- Mowing of 6.5 acres x 7 times per year
- Debris removal of 10 cy per year
- Erosion repair @ 50 sq yard seeding and 15 cy soil per 5 years

The cost engineer estimated the annual costs of these requirements, as well as contingency and construction management, the estimated cost of O&M was approximately 10,000 $ /year in 2002 These costs were not escalated to 2015 dollars.

C-10. HISTORICAL PHOTOGRAPHS

The following photographs are scanned images from USACE archives. They are associated with a Phase I Inspection Report as part of the national dam safety efforts conducted in the late 1970's and early 1980's. These photographs are from prior to the designed breach, and still show the spillway and low level control structures.

Photo 1: Overview from right side of Reservoir

Photo 2 : Dam Crest view from left end of dam

Photo 3 : Dam Crest view from right end of dam

Photo 4 : Upstream slope

Photo 5 : Downstream Slope

Photo 6 : Downstream Slope

Photo 7 : Spillway entrance viewed from spillway channel

Photo 8 : Low flow outlet

C-11. RECENT PHOTOGRAPHS

These photographs were taken by EN-GS on 20 March 2015. Additional photos from the trip can be accessed in the Savannah District archives.

Photo 9 : Old Outlet Structure

Photo 10

Photo 11

C-12. GEOTECH EXPLORATION RESULTS

C-12.1 CONE PENETRATION TEST LOGS

C-12.2 GRADATION CURVES

C-12.3 PARTICLE SIZE DISTRIBUTION REPORT

C-12.4 LIQUID AND PLASTIC LIMIT

Chow, Ven Te, *Handbook of Applied Hydrology – A Compendium of Water-Resources Technology*, McGraw-Hill, Inc., New York, 1964.

Cranston, Robertson & Whitehurst, P. C., *Rae's Creek Basin Engineering Study*, 1988, Augusta, Georgia.

Federal Emergency Management Agency, *Flood Insurance Study – City of Augusta*, 1999.

Harman, W. A. et al., *Bankfull Hydraulic Geometry Relationships for North Carolina Streams*, AWRA Wildland Hydrology Symposium Proceedings – AWRA Summer Symposium, Bozeman, Montana, 1999.

McCuen, Richard H., *A Guide to Hydrologic Analysis Using SCS Methods,* Prentice-Hall, Inc., Englewood Cliffs, N. J., 1982.

National Oceanic and Atmospheric Administration, National Weather Service, *Rainfall-Frequency Atlas of the United States,* Technical Paper 40, 1961.

U. S. Army Corps of Engineers Hydrologic Engineering Center, *Geospatial Hydrologic Modeling Extension HEC-GeoHMS User's Manual*, version 1.0, July 2000.

U. S. Army Corps of Engineers Hydrologic Engineering Center, *HEC-GeoRAS An extension for support of HEC-RAS using ArcView User's Manual*, version 3.1, October 2002.

U. S. Army Corps of Engineers Hydrologic Engineering Center, *HEC-RAS River Analysis System User's Manual*, version 3.1, November 2002.

U. S. Army Corps of Engineers Hydrologic Engineering Center, *Hydrologic Modeling System HEC-HMS User's Manual*, version 2.1, January 2001.

U. S. Army Corps of Engineers, Savannah District, *Augusta City Levee, Augusta, Georgia – Project Operations – Operations & Maintenance Manual*, 1984, Savannah, Georgia.

U. S. Army Corps of Engineers, Savannah District, *Appendix C: Engineering Appendix – Augusta-Richmond County Flood Control Project – Rocky Creek*, May 2004, Savannah, Georgia.

U. S. Army Corps of Engineers, Savannah District, *Interim Feasibility Report and Environmental Assessment – Flood Reduction Study – Augusta, Richmond County,* March 2005, Savannah, Georgia.

U. S. Army Corps of Engineers, Savannah District, *Lake Thumond Dam – Savannah River Basin – Phase I Inspection Report – National Dam Safety Program*, 1980, Savannah, Georgia.

U. S. Army Corps of Engineers, Savannah District, *Special Flood Hazard Information – Rae's Creek*, 1974, Savannah, Georgia.

U. S. Geological Survey, *Annual Peak Discharges and Stages for Gaging Stations in Georgia Through September 1990,* by Glen W. Hess and Timothy C. Stamey, Open-File Report 92-113, 1993, Atlanta, Georgia.

U. S. Geological Survey, *Flood Characteristics of Urban Watershed in the United States*, by V. B. Sauer et al., Water-Supply Paper 2207, 1983, Alexandria, Virginia.

U. S. Geological Survey with U. S. Army Corps of Engineers, *Flood Frequency of the Savannah River at Augusta, Georgia*, by Curtis L. Sanders, Jr., Harold E. Kubik, Joseph T. Hoke, Jr., and William H. Kirby, Water-Resources Investigations Report 90-4024, 1990, Columbia, South Carolina.

U. S. Geological Survey, *Flood-Frequency Relations for Urban Streams in Georgia – 1994 Update,* by Ernest J. Inman, Water-Resources Investigations Report 95-4017, 1995, Atlanta, Georgia.

U. S. Geological Survey with U. S. Army Corps of Engineers, *Floods on Selected Streams in the Vicinity of Augusta, Georgia, October 12-13, 1990*, by Glen W. Hess and Timothy C. Stamey, Open-File Report 92-37, 1992, Doraville, Georgia.

U. S. Geological Survey with Georgia Department of Transportation, *Lagtime Relations for Urban Streams in Georgia*, by Earnest J. Inman, Water-Resources Investigations Report 00-4049, 2000, Atlanta, Georgia.

U. S. Geological Survey, *Preliminary Flood-Frequency Relations for Urban Streams, Metropolitan Atlanta, Georgia,* by H. G. Golden, Water-Resources Investigations Report 77-57, 1977, Augusta, Georgia.

U. S. Geological Survey, *Regional Analysis of Streamflow Characteristics*, 1973, Washington, D. C.

U. S. Geological Survey with Georgia Department of Transportation, *Techniques for Estimating Magnitude and Frequency of Floods in Rural Basins in Georgia*, Water-Resources Investigations Report 93-4016, 1993, Atlanta, Georgia.

U. S. Geological Survey with State of Georgia Department of Transportation, *Verification of Regression Equations for Estimating Flood Magnitudes for Selected Frequencies on Small Natural Streams in Georgia*, by McGlone Price and Glen W. Hess, Water-Resources Investigations Report 86-4337, 1986, Doraville, Georgia.

Zimmerman, Evans and Leopold, Inc., *Phinizy Swamp Basin Report for Street and Drainage Improvements for the Board of Commissioners of Richmond County, Georgia*, 1988, Augusta, Georgia.

APPENDIX C
REAL ESTATE APPENDIX

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

REAL ESTATE APPENDIX

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

REAL ESTATE SUMMARY

Table of Contents

Appendix C i

REAL ESTATE APPENDIX II

Rocky Creek, Augusta Georgia, Flood Risk Management, Section 205 Feasibility Study ii

REAL ESTATE SUMMARY I

THE REAL ESTATE REPORT 1

1. Statement of Purpose 1
2. Study Authority 1
3. Project Location 1
4. Project Description 3
5. Real Estate Requirements 3
6. Utility/Facility Relocation 10
7. Existing Projects 10
8. Environmental Impacts 10
9. Project Sponsor Responsibilities and Capabilities 10
10. Government Owned Property 11
11. Land Owned by the Non-Federal Sponsor 11
12. Historical Significance 11
13. Mineral Rights 11
14. Hazardous, Toxic, and Radioactive Waste (HTRW) 11
15. Navigation Servitude 11
16. Zoning Ordinances 11
17. Induced Flooding 11
18. Public Law 91-646, Relocation Assistance Benefits 11
19. Attitude of Property Owners 12
20. Acquisition Schedule 12
21. Estates for Proposed Project 12
22. Real Estate Estimate 14
23. Chart of Accounts 15

Exhibits 17

Figures:

Figure 3-1 - Project Vicinity/Location Map 2
Figure 4-1 - Project Map 4
Figure 5-1 – Rosedale Detention Area – Flowage Easement Areas 7
Figure 5-2 – Access for Staging, Temporary Work Area and Access 8
Figure 5-3 – Five Buyouts in Kissingbower Area 9

Tables:

Real Estate Requirements 6
Table 5-1 6
Table 22-1. 14
Real Estate Estimate 14
Table 23-1. 15
Chart of Accounts 15

THE REAL ESTATE REPORT

1. Statement of Purpose

This report, for planning purposes only, focuses on the Tentatively Selected Plan (TSP). There may be modifications to the plans that occur during the Design/Implementation (D/I) phase which change the final acquisition area(s) and/or administrative and land cost. The Real Estate Appendix is intended to support the Feasibility Report for the Augusta, Georgia, Rocky Creek, Section 205 Flood Risk Management project. The author of this report is familiar with the Project area. Augusta-Richmond County is the non-Federal (NFS) sponsor for the project. Date of this report is February 2016.

2. Study Authority

Section 205, 1948 FCA (P.L. 80-858), as amended provided authority for this study.

3. Project Location

Augusta is situated in the east central section of the state and is approximately 150 miles east of Atlanta on Interstate 20. The Savannah River serves as the boundary between Augusta and Aiken County, South Carolina. Augusta forms part of the Augusta-Aiken Metropolitan Statistical Area (MSA), consisting of the five counties of Columbia, McDuffie and Richmond in Georgia and Aiken and Edgefield in South Carolina. In the 2005 census, this MSA had a population of 520,700. The projected population for 2020 is 596,500.

The MSA has an extensive base of manufacturers, a core of technology based employers, and an expanding service sector. The diverse industrial base includes production of medical products, pharmaceuticals, golf carts, chemicals, industrial tools, and textiles among others.

Health care employs more than 25,000 medical professionals. The Medical College of Georgia (MCG) ranks as one of the top 20 medical schools in the nation and is Georgia's Health Sciences University. MCG has schools of dentistry, allied health sciences, nursing and graduate studies, as well as medicine. More than a dozen other major medical facilities are located in the region.

The U.S. Army Signal Center and Fort Gordon, the largest communications electronics training center in the world, rounds out Augusta's technology based economy. At the center of the technology based employers is the Savannah River Site (SRS), a U.S. Department of Energy (DOE) facility. SRS comprises a majority of the MSA's economy with more than 13,000 employees.

The Rocky Creek Basin encompasses the central portion of the City of Augusta, mostly south of Gordon Highway (U.S. Route 78) and north of Bobby Jones Expressway (Interstate 520). Rocky Creek drains about 17 square miles and is about nine miles long from its headwaters north of Gordon Highway, to its mouth at Phinizy Swamp, where it joins the Augusta Canal. The project location is shown at Figure 3-1.

Rosedale dam is located between Milledgeville Road and Gordon Highway upstream of North Leg Road in Augusta.

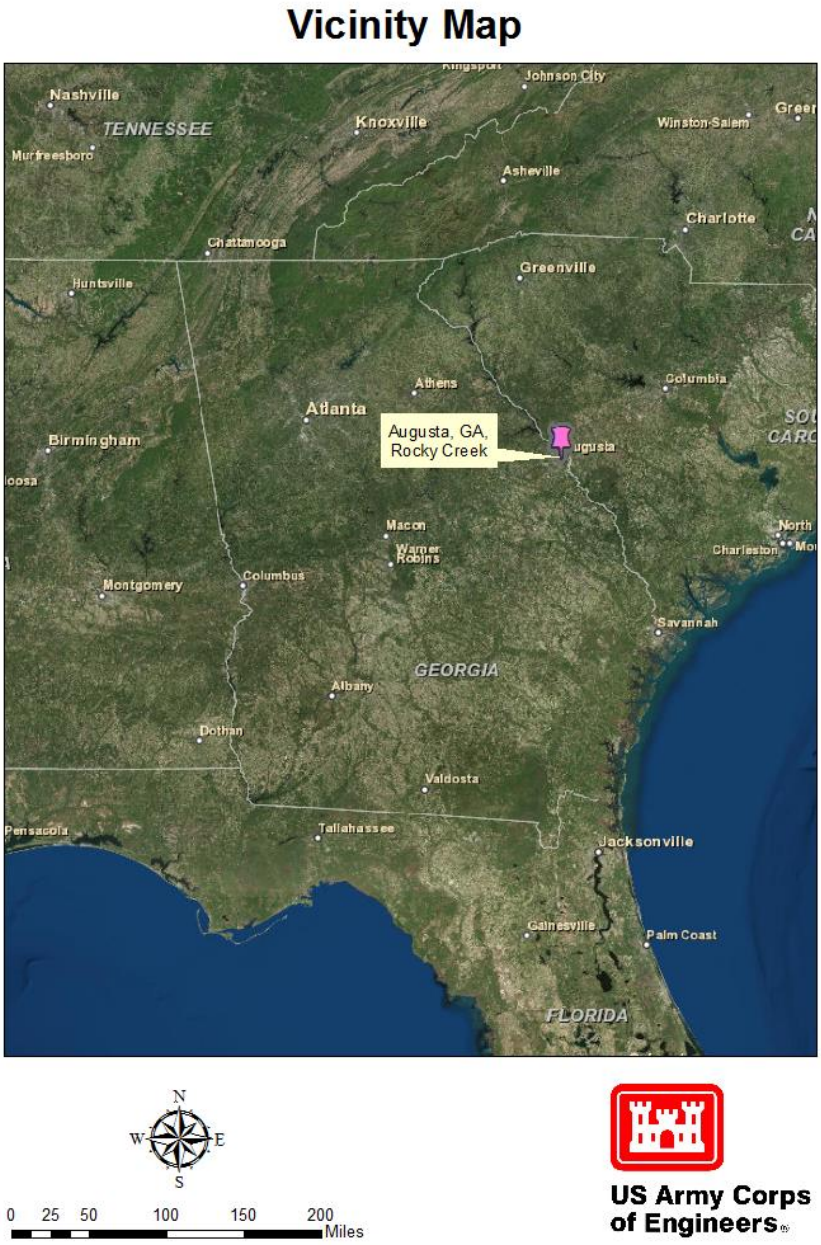


Figure 3-1 - Project Vicinity/Location Map

4. Project Description

Rosedale Dam is a pre-existing earthen dam that was breached at the creek channel more than 30 years ago. The original construction date of Rosedale Dam is unknown. A Phase I Inspection by the Savannah District determined the dam was unsafe due to an inadequate spillway. Because the dam was privately owned, the owner chose to breach the structure rather than modify it to comply with dam safety requirements. The dam crest elevation is approximately 240 feet mean sea level (MSL) with approximate maximum 1V on 2H ratio upstream and downstream slopes. The remaining portions of the dam are currently overgrown with large trees and shrubs.

The TSP is to rehabilitate the earthen berm remaining from the Rosedale Dam breach and use the area for storm water detention. The proposed modifications include placing a reinforced concrete box culvert through the breach in the creek bed for normal flow conditions. The breach will then be filled to elevation 232.0 to form a notch for all flows beyond the 10-year flood event. The crest and downstream slope at the notch will be covered with articulated concrete blocks (ACB) slope protection or some other type of erosion protection revetment material. The entire structure will require clearing, grubbing, reshaping of the earthen embankments, and establishment of vegetative cover. The box culvert will allow the upstream area to remain dry under normal weather conditions, with only the creek flow passing through. The project area is shown in Figure 4-1.

A nonstructural feature is also proposed for Rocky Creek at Kissingbower, near the Regency Mall. This feature would consist of purchasing five privately owned parcels and demolishing three structures. Two of the parcels remain vacant. Once cleared, those parcels will form a recreation area.

5. Real Estate Requirements

The requirements for lands, easements, rights-of-way and relocations, and disposal/borrow areas (LERR) will include the right to construct, maintain, repair, operate, patrol and replace a flood protection levee and weir, including all appurtenances. The requirements also cover the location, construction, operation, maintenance, alteration/ replacement of a road and appurtenances. Real Estate requirements are summarized at Table 5-1.

Five parcels that lie within the flood plain in the Kissingbower area will be purchased in fee. The Rosedale Detention area is shown at Figures 5-1 and 5-2.

The proposed modifications include placing a reinforced concrete box culvert through the breach in the earthen embankment for normal flow conditions. The breach will then be filled to elevation 232.0 to form a notch for all flows beyond the 25-year flood event. The crest and downstream slope at the notch will be covered with articulated concrete blocks (ACB) slope protection or some other type of erosion protection revetment material. The entire structure will require clearing, grubbing, reshaping of the earthen embankments, and establishment of vegetative cover. The box culvert will allow the

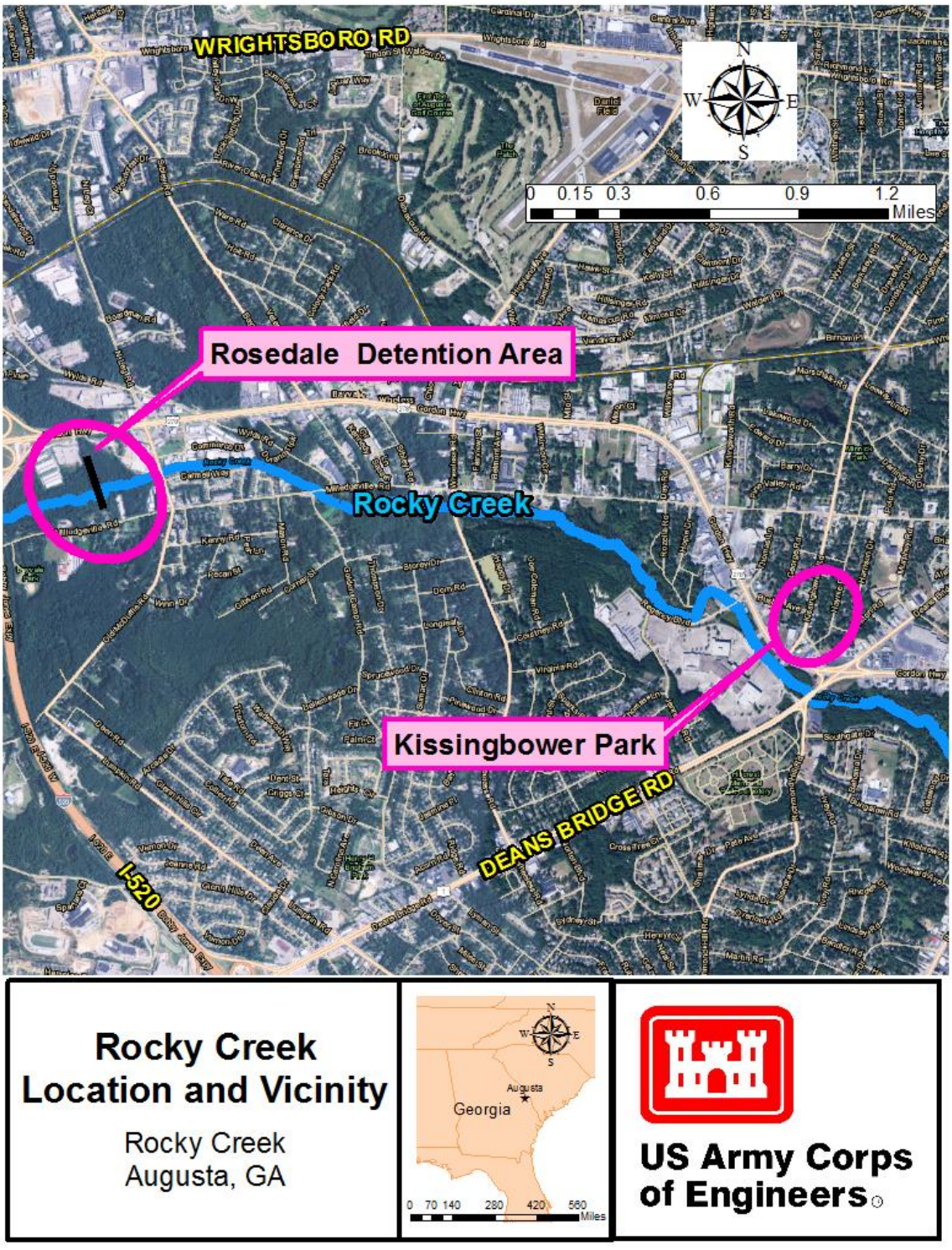


Figure 4-1 - Project Map

upstream area to remain dry under normal weather conditions, with only the creek flow passing through. The flowage easement for occasional flooding (approximately 17.19 acres) will be used for the detention area and the flood protection levee easement (approximately 1.80 acres) will be used for the berm/levee. The temporary work area easement (approximately 2.20 acres) will be used for staging area and a perpetual road easement (approximately 0.3 acres) will be used for the access road to the levee. Two areas have been mapped for staging, but the preferred location is the 2.2 acre site so that is used for planning purposes. Five parcels are impacted in the Rosedale detention area. A takings analysis determined whether the acquisition of flowage easements is required for the Rosedale detention area.

Proposed modifications to the Rosedale detention area are projected to increase the frequency and depth of flood inundation behind the dam. The resulting increased flooding will cover the parcels identified in the report both more frequently and with deeper flood water than currently occurs. The increased inundation would invade the property interests protected by the Takings Clause of the Fifth Amendment to the Constitution, and the increased flooding would clearly be "the direct, natural, or probable result of" the project's modification to the Rosedale detention area. The induced flooding behind the dam, while intermittent, will be inevitably recurring after the project's construction. Intermittent, but inevitably recurring, induced flooding can rise to a taking. This is especially true where, as in this case, benefits in reduced flooding on the property concerned do not offset increased flooding. In this case, a taking will likely occur as the natural and probable result of the project construction will cause intermittent but inevitably recurring flooding without providing any flood protection benefits to the property.

Based upon the facts presented above, the legal opinion is that the proposed modifications to the Rosedale detention area would create a taking of property rights protected by the Takings Clause. As such, the government should undertake such steps necessary to acquire the appropriate estates in the property identified in the feasibility study before initiating project construction.

The buyouts of five privately owned parcels (approximately 1.32 acres) on Kissingbower Road and Haynie Drive are located in the area of Gordon Highway and Kissingbower Road (Figure 5-3). These parcels are situated within a flood plain. After acquisition of the property and relocation of the owner/tenants, the parcels will be cleared with plans to construct a public recreation area. The fee estate will be used for acquisition of the properties. Two of the parcels are vacant and three of the properties have structures. Of those one appears to be owner occupied and the other two are assumed to be tenant occupied. Relocation assistance is discussed at Section 18.

A commercial landfill will be used for disposal of debris. Cost analysis supports use of a landfill as more cost effective than the purchase of a disposal area. A borrow site has not been identified. A commercial borrow site will likely be used for borrow required for construction in the detention area. A cost analysis will be completed by Cost Engineering during D/I Phase to determine whether is it more cost effective to use a commercial source for fill or purchase a borrow area.

In summary, the project impacts nine landowners, 10 parcels and 22.81 acres with a total estimated land value of $191,000. Easement value is estimated at $71,000 and fee value at $120,000. Total Real Estate cost with administrative costs included: $613,200.

Real Estate Requirements

Table 5-1

Private Owners Impacted	Parcels Impacted	Temp Work Area Acreage	Levee/ Berm Acreage	Flowage Easement	Perpetual Road Acreage	Total Easement Acreage	Buyouts	Land Cost	
4	5			17.19				32,200	
			1.80					4,300	
					0.30			13,500	
		2.20						21,000	
4	5	2.2	1.8	17.19	0.3	21.49		71,000	Easement subtotal
5	5						120,000	120,000	Fee subtotal
						Fee Acreage 1.32		191,000	TOTAL

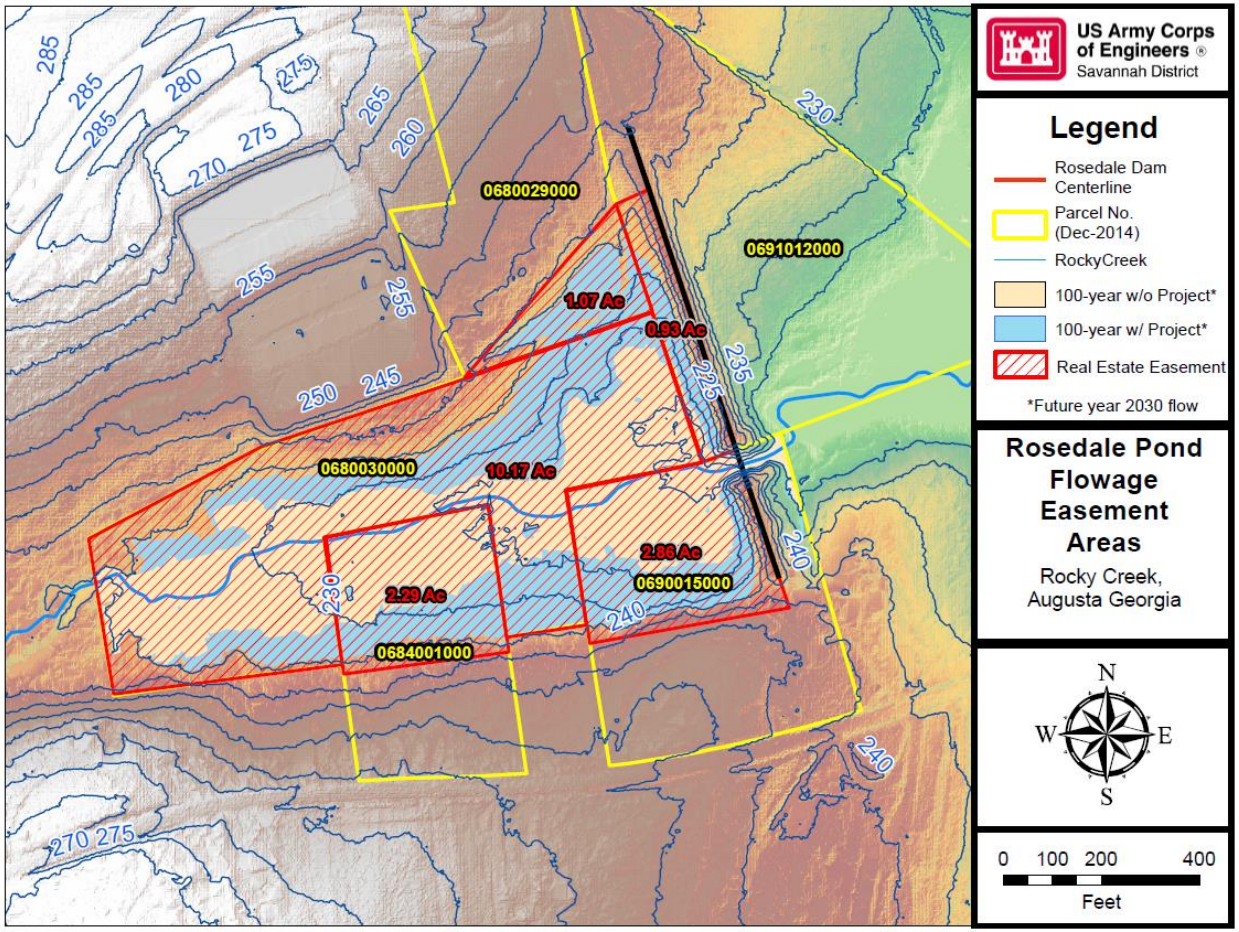


Figure 5-1 – Rosedale Detention Area – Flowage Easement Areas

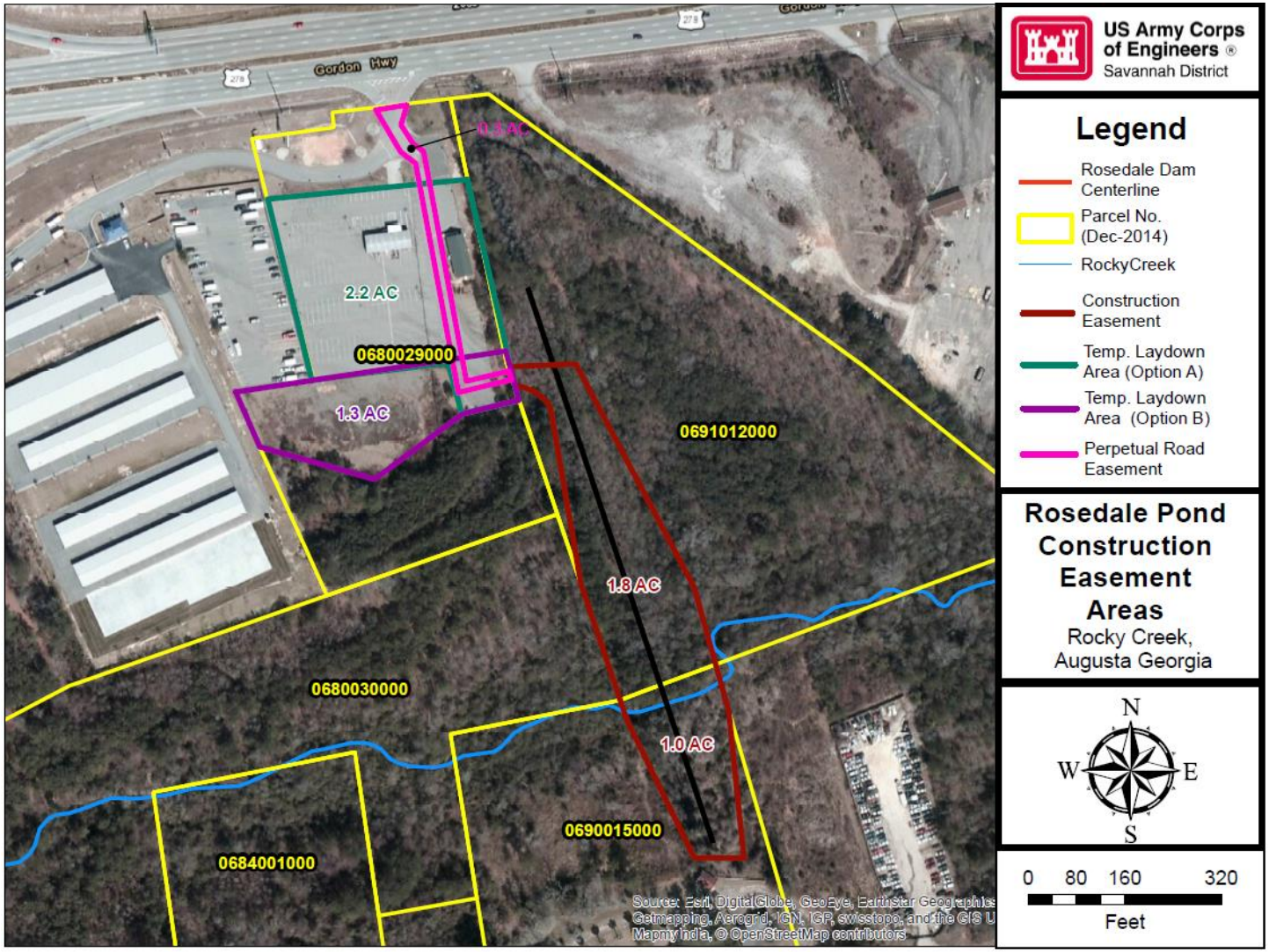


Figure 5-2 – Access for Staging, Temporary Work Area and Access

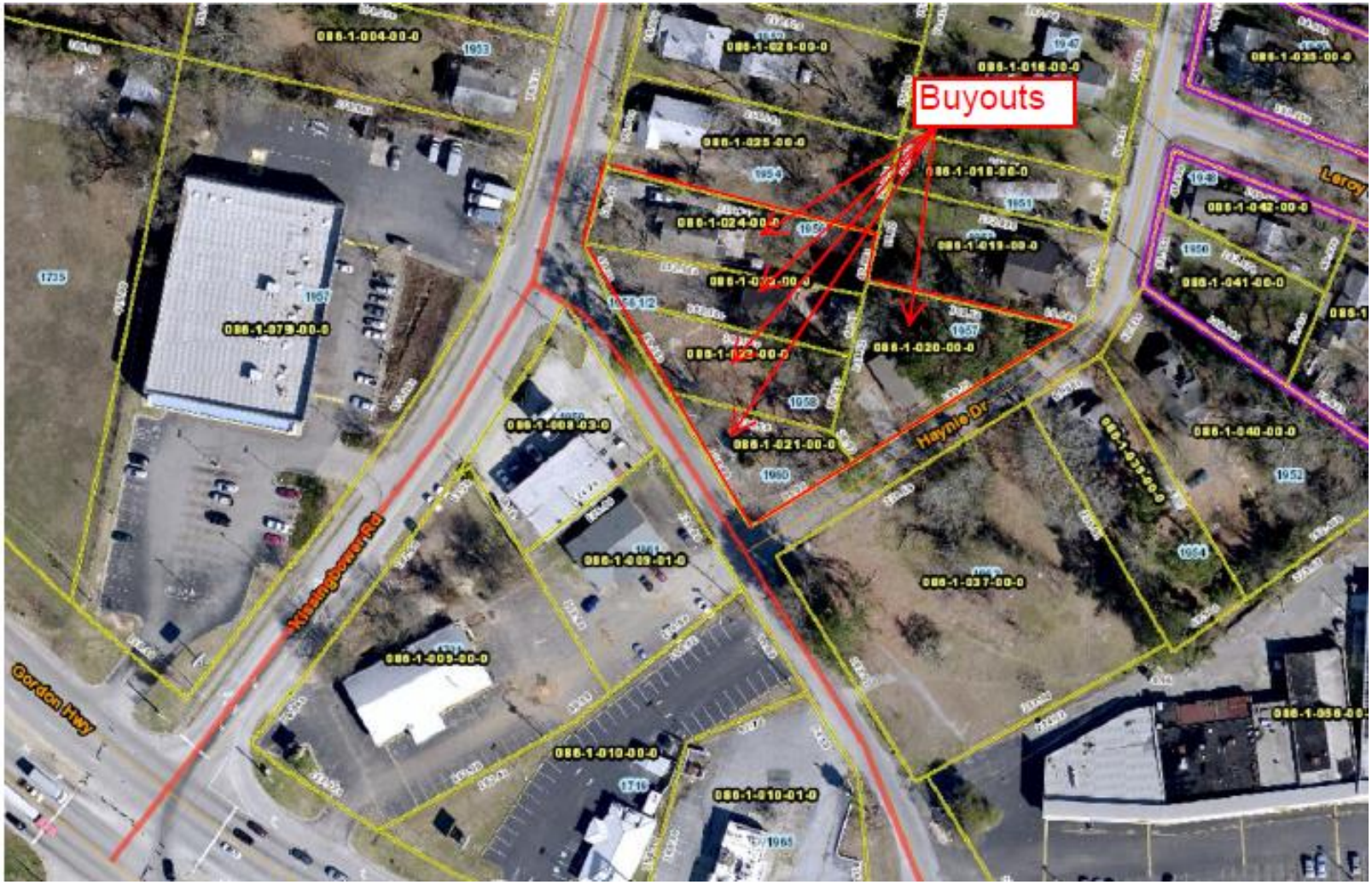


Figure 5-3 – Five Buyouts in Kissingbower Area

6. Utility/Facility Relocation

No utility/facility relocations are required for construction of this project.

7. Existing Projects

No existing Federal projects exist within the project area.

8. Environmental Impacts

No substantial adverse impacts to the environment are anticipated to result from construction of this project.

9. Project Sponsor Responsibilities and Capabilities

Augusta-Richmond County will be the non-federal project sponsor (NFS). The NFS has the responsibility to acquire all real estate interests required for the project. The NFS shall accomplish all alterations and relocations of facilities, structures and improvements determined by the government to be necessary for construction of the project. The sponsor will have operation and maintenance responsibility for the project after construction is completed.

Title to any acquired real estate will be retained by the NFS and will not be conveyed to the United States government. Before advertisement of any construction contract, the NFS shall furnish to the government an Authorization for Entry for Construction (Exhibit "A" to the Real Estate Appendix) to all lands, easements and rights-of-way, as necessary. The NFS will also furnish to the government evidence supporting their legal authority to grant rights-of-way to such lands. The NFS shall comply with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved 2 January 1971, and amended by Title IV of the Surface Transportation Uniform Relocation Assistance Act of 1987, Public Law 100-17, effective 2 April 1989, in acquiring real estate interests for the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act(s). An Assessment of the non-federal sponsor's capability to acquire real estate is at Exhibit "B" to the Real Estate Appendix

The non-federal sponsor is entitled to receive credit against its share of project costs for the value of lands it provides and the value of the relocations that are required for the project. Generally, for the purpose of determining the amount of credit to be afforded, the value of the LER is the fair market value of the real property interest, plus certain incidental costs of acquiring those interests, that the non-federal sponsor provided for the project as required by the government.

The NFS should not acquire lands required for the project before execution of the Project Partnership Agreement (PPA). Should the NFS proceed with acquisition of lands before execution of the PPA, it is at the risk of not receiving credit or reimbursement for any costs incurred in the connection with the acquisition process should the PPA not be signed. There is also risk in acquiring lands either not needed for the project or not acquired in compliance with requirements for crediting purposes in

accordance with 49 CFR Part 24, dated March 2, 1989. S letter dated October 12, 2015 at Exhibit C, was sent to the NFS to identify the risks of early acquisition.

10. Government Owned Property

No Federally owned land lies within the area proposed for construction of the project.

11. Land Owned by the Non-Federal Sponsor

No lands owned by the non-federal sponsor lie within the proposed project area.

12. Historical Significance

There are no known historic sites in the areas proposed for project construction.

13. Mineral Rights

There are no mineral activities noted in the area and no rights to be acquired within the scope of the proposed project.

14. Hazardous, Toxic, and Radioactive Waste (HTRW)

No hazardous or toxic waste sites are known to occur in the project area, nor will any toxic substances be introduced as a part of this project

15. Navigation Servitude

Navigation Servitude is not applicable to this project.

16. Zoning Ordinances

Zoning ordinances are not of issue with this project. Application or enactment of zoning ordinances are not to be used in lieu of acquisition.

17. Induced Flooding

Construction, operation and maintenance of the project will induce. A takings analysis was performed that determines the level of induced flooding rises to the level of takings and supports the requirement for flowage easements.

18. Public Law 91-646, Relocation Assistance Benefits

Public Law 91-646, Uniform Relocation Assistance provides entitlement for various payments associated with federal participation in acquisition of real property. Title II makes provision for relocation expenses for displaced persons, and Title III provides for reimbursement of certain expenses incidental to transfer of property.

Five properties are proposed for buyout, two of which are vacant lots. Of the remaining three, it appears that two are rentals and the third is owner occupied. Replacement

housing and rental assistance payments are estimated at $46,000 and fixed moving payments are estimated at $9,000 for a total of $55,000. Administrative cost for relocation assistance is estimated at $42,000 for a total relocation cost of $97,000.

19. Attitude of Property Owners

The project is fully supported. There are no known objections to the project from landowners within the project area.

20. Acquisition Schedule

The project sponsor is responsible for acquiring real estate interests required for the project. It is projected that acquisitions will take approximately 12 months, and can begin when final plans and specifications have been completed and the PPA has been executed. The project sponsor, project manager and real estate technical manager will formulate the milestone schedule upon project approval to meet dates for advertisement and award of a construction contract. An example of a milestone schedule that identifies the action items in the acquisition process and the party responsible for each action is included as Exhibit D.

21. Estates for Proposed Project

The following standard estates are suggested for use in the project. The temporary work area easement will be used for staging areas and for access purposes. The flood protection levee easement will be used for the Rosedale berm. The perpetual flowage easement will be acquired over the Rosedale detention area where induced flooding is expected. A temporary road easement will be used for construction of the access road to the Rosedale berm area. The fee estate will be used for the buyouts of the Kissingbower properties. No non-standard estates are required for the project.

FLOOD PROTECTION LEVEE EASEMENT.

A perpetual and assignable right and easement in (the land described in Schedule A) (Tracts Nos, ____, ____ and ____) to construct, maintain, repair, operate, patrol and replace a flood protection (levee) (floodwall)(gate closure) (sandbag closure), including all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

TEMPORARY WORK AREA EASEMENT.

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed _____, beginning with date possession of the land is granted to Augusta Richmond County, for use by the United States of America, the State, their representatives, agents, and contractors as a work area, including the right to deposit fill

thereon, move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Princeville Flood Risk Management Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

ROAD EASEMENT.

A (perpetual [exclusive] [non-exclusive] and assignable) (temporary) easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

FLOWAGE EASEMENT (Occasional Flooding).

The perpetual right, power, privilege and easement occasionally to overflow, flood and submerge (the land described in Schedule A) (Tracts Nos. ____, ____ and ____). (and to maintain mosquito control)in connection with the operation and maintenance of the project as authorized by the Act of Congress approved _____, together with all right, title and interest in and to the structure; and improvements now situate on the land, except fencing (and also excepting _____ (here identify those structures not designed for human habitation which the District Engineer determines may remain on the land)); provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution.

FEE.

The fee simple title to (the land described in Schedule A) (Tracts Nos.____ , ___ and __), Subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

22. Real Estate Estimate

A gross appraisal was performed in March 2015 to determine land costs and cost of buyouts. The estimated real estate costs include the land cost for acquisition of land, relocation costs, and federal and non-federal administrative costs. Administrative costs are those costs incurred for verifying ownership of lands, certification of those lands required for project purposes, legal opinions, analysis or other requirements that may be necessary during (D/I). A 25 percent contingency is applied to the estimated total for these items. Table 22-1 is a summary of the real estate cost by measure.

Table 22-1.

Real Estate Estimate

a. Lands and Improvements/Permits					
17.19 ac Flowage Easement					32,200
1.80 ac Earthen Berm					4,300
2.20 ac Temp Work Area Easement					21,000
0.30 ac Perpetual Road Easement					13,500
Buyouts					120,000
9 owners impacted			**subtotal**		**191,000**
b. P.L. 91-646 Relocations					
Replacement Housing Payments (1)					31,000
Rental Assistance Payments (2)					15,000
Fixed Moving Payments (3)					9,000
			subtotal		**55,000**
c. Administrative Cost					
	Fed	Non - Fed	Total		
Acquisition	22,500	180,000	202,500		
Relocation Assistance	6,000	36,000	42,000		
Total	28,500	216,000	244,500		
			subtotal		**244,500**
Sub-Total					**490,500**
Contingencies (25%)					**122,625**
TOTAL					**613,125**
ROUNDED					**613,200**

23. Chart of Accounts

The cost estimate for all Federal and non-Federal real estate activities necessary for implementation of the project after completion of the feasibility study for land acquisition, construction, LERRD, and other items are coded as delineated in the Cost Work Breakdown Structure (CWBS). This real estate cost estimate is then incorporated into the total current working estimate using the Microcomputer Aided Cost Engineering System (MCACES).

Table 23-1.

Chart of Accounts

		FEDERAL	NON-FEDERAL	TOTALS
01B	LANDS AND DAMAGES			
01B20	Acquisition by NFS		216,000	216,000
01B40	Acq/Review of NFS	28,500		28,500
01BX	Contingencies (25%)	7,125	54,000	61,125
	Subtotal	35,625	270,000	305,625
01G	TEMPORARY PERMIT/LICENSE/ROE			
01G20	By NFS			
01GX	Contingencies (25%)			
	Subtotal			
02100	UTILITY RELOCATION			
	Relocation Agreements			
	Relocation Costs			
02100X	Contingencies (25%)			
	Subtotal			
01R	REAL ESTATE LAND PAYMENTS			
01R1B	Land Payments by NFS		191,000	191,000
01R2B	PL91-646 Relocation Assistance Payments		55,000	55,000
01R2D	Review of NFS			
01RX	Contingencies (25%)		61,500	61,500
	Subtotal		307,500	307,500
	TOTALS	35,625	577,500	613,125
	ROUNDED TO			**$613,200**

This Real Estate Appendix has been prepared in accordance with policy and guidance set forth in
ER 405-1-12, Chapter 12, Real Estate Planning and Acquisition Responsibilities for Civil Works Projects.

Prepared by:

Belinda Estabrook

Realty Specialist

Reviewed and approved by:

Ralph J. Werthmann
Chief, Real Estate Division

Exhibits

Exhibit A - Authorization For Entry For Construction

Exhibit B – Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability

Exhibit C – Risk of Early Acquisition Letter to Sponsor

Exhibit D – Milestone Schedule

AUTHORIZATION FOR ENTRY FOR CONSTRUCTION

I _____, _____ for the
(Name of accountable official) (Title)

(Sponsor Name) ___, do hereby certify that the (Sponsor Name) has acquired the real property interest required by the Department of the Army, and otherwise is vested with sufficient title and interest in lands to support construction for (Project Name, Specifically identified project features, etc.). Further, I hereby authorize the Department of the Army, its agents, employees and contractors, to enter upon _____
(identify tracts)

to construct (Project Name, Specifically identified project features, etc.) as set forth in the plans and specifications held in the U. S. Army Corps of Engineers' (district, city, state)

WITNESS my signature as _____ for the
(Title)

(Sponsor Name) this _____ day of _____, 20_____.

BY: _____
(Name)

_____
(Title)

ATTORNEY'S CERTIFICATE OF AUTHORITY

I, _____ , _____ for the
(Name) (Title of legal officer)

(Sponsor Name), certify that _____ has
(Name of accountable official)

authority to grant Authorization for Entry; that said Authorization for Entry is executed by the proper duly authorized officer; and that the Authorization for Entry is in sufficient form to grant the authorization therein stated.

WITNESS my signature as _____ for the
(Title)

(Sponsor Name), this_____day of_____, 20____.

BY: _____
(Name)

_____
(Title)

Exhibit A

Assessment of Non-Federal Sponsor's
Real Estate Acquisition Capability
Rocky Creek, Flood Risk Management Section 205

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? (yes/no) **YES**

b. Does the sponsor have the power to eminent domain for this project? (yes/no) **YES**

c. Does the sponsor have "quick-take" authority for this project? (yes/no) **YES**

d. Are any of the land/interests in the land required for this project located outside the sponsor's political boundary? (yes/no) **NO**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? (yes/no) **NO**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P. L. 91-646, as amended? (yes/no) **NO** [although not completed projects with USACE but worked with GDOT and FHA on numerous projects]

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? (yes/no) **NA**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? (yes/no) **YES**

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? (yes/no) **YES**

e. Can the sponsor obtain contractor support, if required in a timely fashion? (yes/no) **YES**

f. Will the sponsor likely request USACE assistance in acquiring real estate? (yes/no) **NO**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? (yes/no) **YES**

b. Has the sponsor approved the project/real estate schedule/milestones? (yes/no) **NO** Schedule will be developed at completion of design work

Exhibit B

IV. Overall Assessment:

a. Has the sponsor performed satisfactory on other USACE projects? (yes/no/not applicable) NA

b. With regard to the project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. Highly Capable

V. Coordination:

a. Has this assessment been coordinated with the sponsor? (yes/no) **YES**

b. Does the sponsor concur with this assessment? (yes/no) (If "no", provide explanation) **YES**

Prepared by:

Hameed Malik, Assist. Director Engineering
City of Augusta

Prepared by:

Belinda S. Estabrook
Senior Realty Specialist

Reviewed and approved by:

Ralph J. Werthmann
Savannah District
Chief, Real Estate Division
Real Estate Contracting Officer

DEPARTMENT OF THE ARMY
SAVANNAH DISTRICT, CORPS OF ENGINEERS
100 W. OGLETHORPE AVENUE
SAVANNAH, GEORGIA 31401-3640

REPLY TO
ATTENTION OF:

October 13, 2015

Real Estate Division

SUBJECT: Rocky Creek- Augusta, Georgia Flood Risk Management Section 205 Feasibility Study

Ms. Janice Jackson, Administrator
City of Augusta
535 Telfair Street, Suite 910
Augusta, Georgia 30901

Dear Ms. Jackson:

The intent of this letter is to formally advise the City of Augusta, as the potential non-Federal sponsor for the proposed project, of the risks associated with land acquisition prior to the execution of the Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a non-Federal sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the non-Federal sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

Generally, these risks include, but may not be limited to, the following:

a. Congress may not appropriate funds to construct the proposed project;

b. The proposed project may otherwise not be funded or approved for construction;

c. A PPA mutually agreeable to the non-Federal sponsor and the Government may not be executed and implemented;

d. The non-Federal sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended;

e. The non-Federal sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project;

f. The non-Federal sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under P.L. 91-646 as well as the payment of additional fair market

Exhibit C

value to affected landowners which could have been avoided by delaying acquisition until after PPA execution and the Government's notice to commence acquisition and performance of LERRD; and

g. The non-Federal sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or PPA.

We appreciate the City's participation in this project. Should you have questions or concerns pertaining to this letter please feel free to contact Ms. Belinda Estabrook at (912) 652-5667.

Sincerely,

Robert M. Jewell
Acting Chief, Real Estate Division
Savannah District

Real Estate Milestones

_____, 2016

PROJECT: Augusta Rocky Creek, Flood Risk Management Section 205

REQUIREMENTS: Acquisition of Real Estate Interests from 9 Landowners. Estimated acquisition time is 12 months

DATE Projected	Actual	REQUIREMENT	RESPONSIBLE PARTY
		Plans & Specs Provided to Sponsor	CESAS-PM
		Sponsor Notified of Risks for RE Acquisition Prior to Execution of PPA	CESAS-RE
		PPA Executed	CESAS & Sponsor
		Final ROW drawings to Sponsor	CESAS-PM
		Estates provided to Sponsor	CESAS-RE
		Surveys Initiated	Sponsor
		Surveys Complete	Sponsor
		Survey Maps Submitted to SAS-RE for Review and Approval	Sponsor
		Maps Reviewed and Approved	CESAS-RE
		Title Evidence Initiated	Sponsor
		Title Evidence Complete	Sponsor
		Title Evidence Submitted to CESAS-RE for Review	Sponsor
		Title Evidence Reviewed	CESAS-RE

Exhibit D
Page 1 of 2

	Appraiser's Resume' Submitted for Approval	Sponsor
	Appraiser Approved	CESAS-RE
	Appraisals Initiated	Sponsor
	Appraisals Submitted to CESAS-RE for Review and Approval	Sponsor
	Appraisals Approved	CESAS-RE
	Initiate Negotiations for Acquisition	Sponsor
	Complete Acquisitions	Sponsor
	Submit LERRDs for Review	Sponsor
	Review LERRDs	CESAS-RE
	Initiate Condemnations if Required	Sponsor
	Review Condemnations	CESAS-RE
	Complete Condemnations (Obtain Possession)	Sponsor
	Complete PL 91-646 Assistance	Sponsor
	Review PL 91-646 Payments	CESAS-RE
	Review & Certify Real Estate	CESAS-RE
	Advertise for Construction	CESAS-PM
	Submit Credit Request	Sponsor
	Review Credit Request	CESAS-RE
	Approve Crediting	CESAS-RE

Schedule will be completed as soon as PPA is executed. Realty Specialist, Project Manager and Sponsor will develop schedule to allow adequate time to obtain real estate and to meet schedule set for advertisement for construction.

Exhibit D
Page 2 of 2

APPENDIX D

PUBLIC INVOLVEMENT/CORRESPONDENCE APPENDIX

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

Augusta GEORGIA

Office of the Administrator

Frederick L. Russell, Administrator

Tameka Allen, Deputy Administrator
William Shanahan, Deputy Administrator

Room 801 - Municipal Building
530 Greene Street - AUGUSTA, GA. 30901
(706) 821-2400 - FAX (706) 821-2819
www.augustaga.gov

August 15, 2013

Colonel Thomas J. Tickner
US Army Corps of Engineers
Savannah District
100 W. Oglethorpe Ave
Savannah, GA 31402

Dear Colonel Tickner:

On August 12, 2013, members of your Planning and Project Management Staff met with Mr. Fred Russell, me and other members of the City of Augusta's (City) management team. The meeting was held to discern the City's continuing interest in maintaining the Congressionally authorized Augusta Flood Risk Management Study in the Investigation program. In addition, the concept of converting the Rocky Creek portion of the Augusta Flood Control study to a Continuing Authorities Program study was discussed. We fully support maintaining the existing study authorization and applaud the initiative to convert a portion of the existing study to allow the Rocky Creek feature to be addressed expeditiously. This approach will yield needed improvements now while also maintaining the flexibility to address other requirements that may arise in the near term.

The City understands that both Federal and City funds remain on the Augusta Flood Risk Management Study in the investigation program and would request they continue to be held to meet future study requirements. Furthermore, the City is receptive to entering into a Feasibility Cost Share Agreement (FCSA) with USACE in Fiscal Year 2014 for the CAP study. Funds for the CAP study have been requested in the City budget for 2014.

If you have any questions, please contact Abie L. Ladson, Director of Engineering Department at (706)796-5040 or (706) 796-5070.

Sincerely,

Frederick L. Russell
Administrator

cc: Mr. Abie Ladson, P.E., Director, Augusta Engineering Department
Mr. Hameed Malik, Ph.D., P.E., Augusta Engineering Department

Copy

DEPARTMENT OF THE ARMY
SAVANNAH DISTRICT, CORPS OF ENGINEERS
100 W. OGLETHORPE AVENUE
SAVANNAH, GEORGIA 31401-3640

Reply to
Attention of:

NOV 21 2012

Executive Office

Mr. Fred Russell
Administrator
Augusta-Richmond County
530 Greene Street
Augusta, Georgia 30911

Dear Mr. Russell:

On October 15, 2012, the Savannah District, US Army Corps of Engineers (Corps) held a teleconference with you and your staff concerning the Rocky Creek portion of the Augusta Flood Damage Reduction Study and the City of Augusta's (City) non-Federal plans for flood risk management on Rocky Creek.

The discussion resulted in the following determinations regarding the Federal study:

a. The City has requested removal of Nixon Street levee from the Federal study, and opts not to pursue alternative alignments. The only remaining features in the Federal study would then be the Rosedale Detention Pond and Kissingbower non-structural option.

b. The City stated they have independently pursued a strategy to divert water through a proposed relief channel to a detention area to be constructed in the Hyde Park area. The City also discussed a second independent strategy to construct a diversion structure on Rocky Creek to flood three proposed ponds in the Hollywood Subdivision area.

c. We request that the City determine if there is still interest in pursuing the remaining features of the Federal study. Hydrologic and hydraulic (H&H) modeling will be performed by our staff to determine whether the independent features proposed by the City will impact the viability of the remaining features of the Federal study. We request that the City provide details of the newly proposed project features, to include H&H modeling parameters and project schedules, to the Corps as soon as possible to facilitate for future budgetary planning.

In addition, a Department of the Army permit will be required for any work the City proposes that would result in a discharge of dredged or fill material into waters of the United States. This applies not only to the Rocky Creek diversion to the Hollywood Subdivision, but would also apply to the Hyde Park proposal, if outside the Federal flood control study.

If you have questions regarding the Department of the Army permit process, please contact Ms. Kelly Finch, Chief, Coastal Branch, Regulatory Division at 912-652-5503. For questions regarding the Federal project, contact Mr. Bob Sirard, Project Manager at 912-652-5804.

Sincerely,

Jeffrey M. Hall
Colonel, US Army
Commanding

Augusta GEORGIA

Office of The Administrator

Frederick L. Russell, Administrator

Tameka Allen, Interim Deputy Administrator
Robert Leverett, Interim Deputy Administrator

Room 801 – Municipal Building
530 Greene Street - AUGUSTA, GA. 30901
(706) 821-2400 - FAX (706) 821-2819
www.augustaga.gov

~~DE~~
PM-C

November 4, 2010

Col. Jeffery Hall, Commander
Savannah District Army Corps of Engineers
100 W Oglethorpe Ave.
Savannah, GA 31404-3604

G. BE
DP
DX

Dear Colonel Hall:

This letter is in response to US Army Corps of Engineers (Corps) letter dated October 5, 2010 that requested confirmation of the City of Augusta's, Georgia (City) continued support for the Augusta Flood Control Project (Project. On 29 July 2010, the Corps and City representatives met to discuss the status of on-going Study efforts and reviewed many of the critical decisions now being faced by the Project Delivery Team (PDT). The subject matter was further discussed at a follow-up teleconference on September 22, 2010. This letter outlines the City's desires related to the Augusta Canal, Rae's Creek and Rocky Creek Flood Control Projects and provides a path forward for completion of this work.

The City has limited funds to complete this Study and consequently we feel the best use of these available funds would be to use them as outlined below:

1. Augusta Canal Flood Control Project: The City is currently unable to provide the additional funds necessary to continue work on the Feasibility Study for Augusta Canal drainage basin and therefore request that the Corps discontinue any additional work on this project except for the documentation of work performed to date as outlined below. The City requests that the Corps provide an interim report that summarizes the analysis of all work completed to date and provide a copy (hard and electronic) of all raw data, including hydrologic and hydraulic modeling (input data files, assumption used and results files) data, surveys, maps, cost estimates, specifications of proposed equipment, etc. This information should be sent to the Augusta Engineering Department, attention, Mr. Abie Ladson, Director of Engineering.

2. Rocky Creek Flood Control Project: The Corps recommended key components for the Rocky Creek improvements include the Rosedale Detention Basin, Peach Orchard Road 1.5 Bench Cut Ecosystem Restoration, and Kissingbower Road non-structural purchases of five frequently flooded homes. The City supports these three features. The City desires that as a cost saving measure and to use available funds effectively, the Corps evaluate the necessity of the Peach Orchard Road Bench Cut Ecosystem Restoration improvement. Also, there are two additional locally sponsored flood reduction projects in this Basin and the City desires that the Corps consider these projects when evaluating project features to be included in the overall Rocky Creek Basin Flood Control Study hydraulic modeling. These two projects are Regency Mall/Hollywood Subdivision Flood Management and Recreational facility and Hyde Park Regional Detention facility. The City does not seek Federal funds to design and construct these two projects; however, it is City desire that Corps provide assistance in the permitting process.

Also, the City confirms that it no longer desires to pursue construction of the Wheeless detention basin as a locally preferred plan in the Rocky Creek basin. The City requests the Corps perform engineering analysis necessary to prepare a concept design for this basin and to prepare a construction cost estimate, construction plan and final report.

3. Rae's Creek Flood Control Project: The Corps recommended components for Rae's Creek includes only non-structural features such as raising of home, flood proofing of structures, etc. The City does not desire to pursue any of these non-structural alternatives in this basin. As such, the City requests that the Corps discontinue work on Rae's Creek basin. However, the City requests that the Corps provide an interim report that summarizes the analysis of all work completed to date and provide a copy (hard and electronic) of all raw data, including hydrologic and hydraulic modeling (input data files, assumption used and results files) data, surveys, maps, cost estimates, specifications of proposed equipment, etc. This information should be sent to the Augusta Engineering Department, attention, Mr. Abie Ladson, Director of Engineering.

4. The City understands that the President's budget for Fiscal Year (FY) 2011 includes $578,000 for continuation of the Augusta Flood Control Study. The City agrees to provide non-Federal funds required to match the final appropriated federal 2011 funds up to $578,000 in accordance with the Feasibility Cost Share Agreement (FCSA). The City requests that the Corps use the available funds to focus their efforts on completing the work as outlined above.

Again we'd like to express the City's continued support as midified in this letter of the Augusta Flood Control Project. The City assumes that the actions requested above will not delay completion of the final Feasibility Report. The City believes these improvement features will ultimately result in a better performing and more aesthetically pleasing Flood Control Project.

If you have any questions, please feel free to contact this office or Director Augusta Engineering Department, Abie Ladson, P.E. at (706)796-5040.

Sincerely,

Frederick L. Russell
Administrator

cc: Hameed Malik, Ph.D., P.E.
Assistant Director Engineering

DEPARTMENT OF THE ARMY
SAVANNAH DISTRICT, CORPS OF ENGINEERS
100 W. OGLETHORPE AVENUE
SAVANNAH, GEORGIA 31401-3640

REPLY TO
ATTENTION OF:

OCT 5 2010

Programs and Project Management

Mr. Frederick L. Russell
Administrator
Augusta-Richmond County
530 Greene Street
Augusta, Georgia 30911

Dear Mr. Russell:

On September 22, 2010, the US Army Corps of Engineers (Corps) held a teleconference with City of Augusta (City) representatives to discuss the status and direction of the Augusta Flood Control Study (Study). The Corps presented the current alternatives for flood risk management in the Augusta Canal and Rocky Creek basins and based on the discussion, it was apparent that the City had been investigating additional options regarding the direction of the project. At the conclusion of the meeting, it was agreed that the City would conduct further internal discussions and then provide the Corps a written detailed description of their desired path forward for this Study. The purpose of this letter is to clarify our understanding of the outstanding items (by major project feature) that require a decision and/or direction from the City for continuation of the study effort.

Augusta Canal

The plan for Augusta Canal now includes construction of a 450-foot overflow spillway on the canal bank located near the City's raw water pump station at the historic Works Progress Administration (WPA) site, and automation of 12 bulkhead gates with controls/monitoring at the City pump station.

During our teleconference, we reviewed the current Canal Spillway concept design, location, and cost. Much discussion revolved around other alternatives available for removal of water from the Canal. Some of the alternatives discussed included:

a. Relocating the Canal Spillway from its current location downstream to the old Raes Creek outfall.

b. Relocating the Canal Spillway from its current location upstream to reach 7 where the City recently constructed a buttress berm to increase Canal bank stability.

c. Automation of multiple waste gates combined with a siphon system and/or spillway. The Corps investigated adding additional gated openings to the Tin House Gate early in our study, but it did not achieve significant benefits. Additionally, during the design phase of the City's

water pump plant expansion, ZEL Engineering suggested adding a flood bypass gate and channel to the intake design. City representatives stated that they wanted a passive overflow design, and not another gate structure that required action by an operator. At that point the Corps did not pursue further gate outlet alternatives.

The major item in the Augusta Canal basin needing confirmation and/or clarification from the City is concurrence with the Augusta Canal improvement features as currently designed/outlined above or identification of other alternatives the City desires to be evaluated as part of this Study.

Rocky Creek

The plan for Rocky Creek now includes Rosedale Detention Basin, Peach Orchard Road 1.5 miles Bench Cut Ecosystem Restoration and Kissingbower Road non-structural purchase of five frequently flooded homes

During the teleconference, the City indicated they are moving forward with the design, permitting and construction of two projects in the Rocky Creek basin. These include a detention basin/park at the old Regency Mall/Hollywood Subdivision and a 42-acre regional flood control basin at the Hyde Park Subdivision. The Corps must consider construction of these projects when evaluating project features to be included in the overall Rocky Creek Basin Flood Control Study. The major items in the Rocky Creek basin needing confirmation and/or clarification from the City are as follows:

a. The City is moving forward with design, permitting, and construction of the Hollywood and Hyde Park Subdivision detention basins and the proposed timeframes for major actions. The City does not desire for these two projects to be included in the Federal Flood Control Project, nor does the City seek Federal funds to construct these projects as part of the Flood Control Project.

b. The City no longer desires to pursue construction of the Wheless detention basin as a locally preferred plan in the Rocky Creek basin.

c. The City supports the three features currently included in the Rocky Creek plan as listed above.

d. The City does not want to pursue additional work or study efforts associated with a levee alternative to protect the Virginia Subdivision area.

With respect to project funding, the President's budget for Fiscal Year (FY) 2011 includes $578,000 for continuation of the Augusta Flood Control Study. The City has agreed to provide non-Federal funds required to match the Federal 2011 funds up to $578,000 in accordance with the Feasibility Cost Share Agreement (FCSA). Once Congress passes an FY 2011 Energy and Water Development appropriations bill, the Corps will notify the City of the final amount

appropriated for the Study and the amount of matching non-Federal funds required in accordance with the FCSA.

The Corps will not proceed with any new investigations and/or analyses of the items above until receipt of written clarification from the City on their desired direction forward. Upon receipt of direction the Corps will evaluate the time and cost impacts of those changes and will provide City with assessment. As always, my staff and I stand ready to meet and discuss any of these issues with you if so desired.

If you have any questions, please feel free to contact me at 912-652-5220 or the Project Manager, Hampton Spradley at 912-652-5581.

Sincerely,

Jeffery M. Hall
Colonel, US Army
Commanding

APPENDIX E

PLAN FORMULATION APPENDIX

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

APPENDIX E

PLAN FORMULATION

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

1.0 Overview

The 2016 Augusta Rocky Creek Flood Risk Management (FRM) Continuing Authorities Program (CAP) Section 205 Feasibility Study leveraged the knowledge gained from the 2005 Augusta, Georgia Investigations Draft Feasibility Report.

Specific, Measurable, Attainable, Risk-Informed, and Timely (SMART) Planning prescribes three to five alternatives as sufficient for comparing alternatives and identifying a recommended plan. The 2005 Draft Feasibility Report examined, in detail, 17 structural management measures and two non-structural management measures. An initial screening evaluation of these alternatives revealed that most of them would likely not be selected as the recommended plan because of engineering, environmental, or economic shortcomings or lack of effectiveness toward reducing flood risk. Hence, thirteen of these management measures were eliminated from further consideration. The seven remaining management measures were used to develop 20 alternatives in the 2005 study.

To minimize the duration and cost of the 2016 Augusta Rocky Creek FRM CAP Section 205 Feasibility Study, Savannah District used information from the 2005 Augusta, Georgia Investigations Draft Feasibility Report on the best management measures and the NED plan to formulate the alternatives for this (2016) study. As a result, four future with-project condition alternatives were developed and evaluated in the 2016 Augusta Rocky Creek FRM CAP Section 205 Draft Feasibility Study using two of the management measures from the 2005 Augusta, Georgia Investigations Draft Feasibility Report NED plan: the Rosedale Dam Detention Area and the Kissingbower Buyout with a Recreational Park.

2.0 2005 Augusta, Georgia Draft Feasibility Study: Management Measures

The 2005 Augusta, Georgia Feasibility Study authorized in Section 414 of the 1996 Water Resources Development Act (WRDA), 104th Congress 2d Session, Public Law 104-303, evaluated a broad range of potential management measures to reduce damages from flooding in the Rocky Creek Basin. These measures ranged from structural (those that physically alter the flows) to non-structural measures (those that do not physically alter the floodplain but reduce damages by means of management techniques such as removing structures, elevating structures, flood-proofing of

structures, insurance against damage, and other means). The management measures that were studied and documented in the 2005 Draft Feasibility Report are as follows:

2.1 Structural Management Measures

- Gravel Pit Road Culvert / Bridge – This plan included replacing the existing pair of 72-inch reinforced concrete pipes with large box culverts or a prefabricated concrete arch bridge. A box culvert design would require four 8-foot X 10-foot culverts placed side by side. A bridge design would include two 7-foot X 20-foot prefabricated concrete brides.

- Norfolk and Southern Railroad #2 – This plan included expanding the size of the channel beneath the existing bridge. The bridge would either be replaced or the existing bridge could be improved.

- Nixon Street Levee - The Nixon Street Levee is an earthen structure that will be constructed between Mike Padgett Highway and Doug Barnard Parkway. The levee would be approximately 5,100 feet long with a maximum height of 9.5 feet, and an average height of 5.5 feet. The levee would run along Nixon Street and turn 90 degrees at Mike Padgett Highway for the last 650 feet. The levee would cross two railroads and a couple of dirt roads. The levee will tie into the railroad embankments and the dirt roads will ramp up and over the levee.

- Chester Street Levee – This plan would consist of a new earthen structure that would be constructed along Chester Street to prevent overflow of this area adjacent to Rocky Creek. The levee would be approximately 1,440 feet long with an average height of 7.5 feet. This levee does not cross any existing roads and would tie into Mike Padgett Highway at the downstream end.

- Lombard Detention Basin - The proposed Lombard Detention Structure is located just east of Deans Bridge Road. The structure would include the construction of a sheet pile or concrete retaining wall that spans Rocky Creek. Each end of the retaining wall will tie into earth berms that would extend to the existing grade at the top of the structure elevation. The top elevation of the structure would be at elevation 145.0. Normal creek flow would be unimpeded through a 20-foot wide notch in the retaining wall. This notch would be set at the bottom of the channel or approximately elevation 134.7. The retaining wall would also have a 58-foot notch at elevation 143.0 that would be used at five-year event and greater. The top of the structure would be kept at a minimum, at elevation 145.0, to prevent additional local flooding immediately upstream during larger storm events, and it would be overtopped by flooding from storms greater than the 5-year event. The earth berms would have a 10-foot crest width with side slopes of 1V:2H on each side and at the junction of the retaining wall.

- Dean’s Bridge Improvements - The areas beneath the bridges at Deans Bridge and Peach Orchard Road have accumulated substantial sediment and vegetation over the years. To avoid these two areas from being restrictions, 1 to 3 feet of excavation would be required beneath both bridges. The bridge decks are high enough that the excavation can be accomplished with small track mounted equipment.

- Rozella Berm - One of the areas identified as having flooding problems is north of Regency Mall on the opposite side of Gordon Highway. This plan consisted of constructing a 1,800-foot berm along the south side of Gordon Highway and excavate a bench on the south side of Rocky Creek floodplain. The location of the berm and excavation are shown on Figure C-6-11 in the Engineering Appendix. The berm would be relatively small with maximum height 4.5 feet.

- Rozella Road Detention Basin - The proposed Rozella Detention Structure is located just west of Gordon Highway and north of Regency Mall. The structure would include the construction of a sheet pile or concrete retaining wall that spans Rocky Creek. Each end of the retaining wall would tie into earth berms that will extend to existing grade at the top of structure elevation. The top elevation of the structure would be at elevation 167.0. Normal creek flow would flow unimpeded through a 6-foot wide notch in the retaining wall. This notch would be set at the bottom of the channel or approximately elevation 153.8. The retaining wall would also have a 30-foot notch at elevation 162.0. The notch would be used starting at the future conditions two-year event, with the entire structure being overtopped at events greater than the five-year event. The earth berms would have a 10-foot crest width with side slopes of 1V:2H on each side and at the junction of the retaining wall.

- Wheeless Road Culverts. Some of the original hydraulic model runs indicated that the bridge opening at Wheeless Road was a restriction during the design storm. This plan would install several culverts beneath the road adjacent to the bridge. This would include the addition of a small overflow basin, drain pipes under the existing road, and a concrete culvert on the opposite side of the road.

- Milledgeville Road Culvert / Bridge Replacement - The bridge considered for replacement is located where Milledgeville Road crosses Rocky Creek. The construction would include removal of the existing three 10-foot by 8-foot box culverts. The culverts would be replaced by a standard T-beam supported bridge (Georgia Department of Transportation design). Based on evaluation of the hydraulic models, the benefits of a larger opening at Milledgeville Road creek crossing would provide only minimal flood reduction benefits.

- Wheeless Road Detention Basin - The proposed Wheeless Detention Structure is located adjacent to Wheeless Road near the intersection with Milledgeville Road. The structure would include the construction of a sheet pile or concrete retaining wall that spans Rocky Creek. Each end of the retaining wall will tie into earth berms that will extend to existing grade at the top of structure elevation. The top elevation of the structure would be at elevation 178.0. Normal creek flow would be unimpeded through a 6-foot wide notch in the retaining wall. This notch would be set at the bottom of the channel or approximately elevation 166.0. The retaining wall will also have a 30-foot notch at elevation 174.0 that will be utilized at events starting at the two-year storm. The entire structure will be overtopped by storms greater than the two-year event. The earth berms would have a 10-foot crest width with side slopes of 1V:2H on each side and at the junction of the retaining wall.

- North Leg Road Culvert Replacement - The proposed North Leg culvert replacement is located where North Leg Road crosses Rocky Creek. The construction

would include replacement of the existing 9-foot by 10-foot culvert with a new 12-foot by 12-foot culvert. The new culvert would be embedded approximately one-foot into the creek bed to provide a more natural channel bottom.

- North Leg Road Detention Basin- The proposed North Leg Detention Structure is located adjacent to North Leg Road near the intersection with Milledgeville Road. The structure would include the construction of a sheet pile or concrete retaining wall that spans Rocky Creek.

- Rosedale Detention Area - The Rosedale Dam (downstream of Bobby Jones Expressway) is an existing earth dam that was breached at the creek channel many years ago. The dam is located between Milledgeville Road and Gordon Highway upstream of North Leg Road. Renovations to the existing dam would include placing a reinforced concrete box culvert through the breach in the creek bed for normal creek flow. The breach would then be filled to elevation 232.0-foot to form a notch for all flows between the 10- and 500-year flood events. At no time would the entire structure be overtopped. The crest and downstream slope at the notch will be covered with articulated concrete blocks (ACB) for slope protection. The entire structure would require clearing and grubbing and establishment of grass cover.

- Noland Connector Detention Basin – This plan is located adjacent to Noland Connector just upstream (west) of Bobby Jones Expressway. The structure would include the construction of a sheet pile or concrete retaining wall that spans Rocky Creek. Each end of the retaining wall will tie into earth berms that will extend to the existing grade at the top of structure elevation. The top elevation of the structure would be at elevation 260.0. Normal creek flow would be unimpeded through a 3-foot wide notch in the retaining wall.

- Barton Chapel Road Culvert Replacement - The proposed Barton Chapel Road culvert replacement is located where Barton Chapel Road crosses Rocky Creek. The construction would include removal of the existing reinforced concrete pipe, corrugated metal pipe, and concrete junction boxes that are located beside and beneath Barton Chapel Road. The existing drainage structures would all be replaced by new concrete box culverts. Barton Chapel Road would need to be closed during construction. The new culvert would be embedded approximately one-foot into the creek bed to provide a more natural channel bottom.

- Channel Improvements along Rocky Creek – This plan included excavating a trapezoidal channel through approximately 19,600 linear feet (3.7 miles) of the Rocky Creek channel. Based on several factors including the number of parcels/property owners involved, the amount of excavation required, and the anticipated adverse impacts to the local ecosystem, the channel improvements were determined to be both economically and environmentally undesirable.

2.2 Non-Structural Management Measures

- Kissingbower Road Non-Structural Alternative – Non-structural measures for this area located across from the Regency Mall would consist of purchasing five properties and demolishing all five structures. Development of a recreational park on the site of the purchased structures would also be included in this alternative.

- Barton Chapel Road Trailer Park – This alternative would consist of a buyout of manufactured homes that are affected by flooding. Of the 27 mobile homes in the Barton Chapel Mobile Home Country Club, 14 of them are impacted by the 100-year flood event.

3.0 Screening of Management Measures Considered in 2005 Draft Report

Table 1 summarizes the results of the 2005 screening of the management measures.

Table 1. Screening of Management Measures Considered

Management Measures	Effects	Eliminated from Further Consideration	Selected for Formulation of Alternatives
1.No Action		N/A	**Yes**
Structural			
2.Gravel Pit Road Culvert/Bridge	**Nominal Flood Reduction**	**Yes**	**No**
3.Norfolk & Southern Railroad #2	**Nominal Flood Reduction**	**Yes**	**No**
4.Nixon St Levee	Flood Risks Reduced	**No**	**Yes**
5.Chester St Levee	**Negligible Flood Reduction**	**Yes**	**No**
6.Lombard Detention Basin	Flood Risks Reduced	No	**Yes**
7.Dean's Bridge Improvements	**Negligible Flood Reduction**	**Yes**	**No**
8.Rozella Berm	**Negligible Flood Reduction**	**Yes**	**No**
9. Rozella Rd Detention Basin	Flood Risks Reduced	No	**Yes**
10. Wheeles Rd Culverts	**Negligible Flood Reduction**	**Yes**	**No**
11.Milledgeville Rd Culvert/Bridge Replacement	**Negligible Flood Reduction**	**Yes**	**No**
12. Wheeless Rd Detention Basin	Flood Risks Reduced	No	**Yes**
13. North Leg Rd Culvert Replacement	**Negligible Flood Reduction**	**Yes**	**No**
14. North Leg Rd Detention Basin	**large warehouse & several stores removed – too small of a basin**	**Yes**	**No**
15. Rosedale Detention Dam Area	Flood Risks Reduced	**No**	**Yes**
16. Noland Connector Detention Basin	**Real Estate is no longer available- a large industrial building is newly built in area of proposed pond.**	**Yes**	**No**
17. Barton Chapel Rd Culvert Replacement	**Negligible Flood Reduction**	**Yes**	**No**
18.Channel improvement along Rocky Cr.	**Negligible Flood Reduction**	**Yes**	**No**
Non-Structural			
1.Kissingbower	Flood Impacts Reduced	No	**Yes**
2.Barton Chapel Rd Trailer Park	**Nominal Flood Reduction – minimal upstream drainage**	**Yes**	**No**

*Negligible means very little benefit

*Nominal means it has some benefits, but not enough, relative to cost.

4.0 Screening of Management Measures Considered in 2016 Draft Report

As Table 1 above shows, thirteen management measures were eliminated and 7 management measures (including the No Action Alternative) remained for further analysis. The 7 final management measures in the 2005 Draft Feasibility Report were No Action; Nixon Street Levee; Lombard Detention Basin; Rozella Road Detention Basin; Wheeless Road Detention Basin; Rosedale Dam Detention Area; and Kissingbower Buyouts. They were re-examined during development of the Project Management Plan (PMP) for the 2016 Section 205 Study.

No Action Alternative

In the No Action Alternative, severe flooding would continue in the future in the Rocky Creek Basin without alterations or additions to flood risk management. Flooding would result in substantial losses to property. Subsequently, property values would be expected to decrease in the vicinity. Properties on Kissingbower Road that have been subjected to past damage from flooding would continue to deteriorate with future storm events. Homes located within the floodplain would continue to represent an incompatible land use. Significant changes from the existing condition are not expected without implementation of additional flood risk management measures. The No Action Alternative is not a practicable option. It was included in the 2016 Augusta Rocky Creek FRM Feasibility Study to serve as the basis for comparing with-project condition alternatives.

Nixon Street Levee

The 2005 Draft Report concluded that the Nixon Street Levee would provide the highest Benefit-to-Cost (BCR) ratio of all the remaining six management measures. In combination with the Rosedale Dam Detention Area, the Nixon Street Levee produced the highest average annual net benefits of all the remaining structural alternatives. However, the original placement of the Nixon Street Levee crossed the former Southern Wood Piedmont (SWP) facility, where wood-treating operations were conducted from 1923 until 1988. Operations at the facility were regulated under a Resource Conservation and Recovery Act (RCRA) Corrective Action. As originally designed, the levee would have intersected the southeast portion of the designated Hazardous, Toxic and Radioactive Waste (HTRW) site, destroying a portion of the remediation system. In 2012, the PDT identified an alternative location which was thought to be free of HTRW contamination. The location would adversely impact jurisdictional wetlands and would require a wetland mitigation plan, requiring significant additional costs. While the location is not within the identified HTRW SWP site, contamination concerns exist due to the close proximity. Because of this, the Nixon Street Levee was considered an impracticable alterative and was not considered in the 2016 Augusta Rocky Creek Flood Risk Management Draft Feasibility Study.

Lombard Detention Basin

The Lombard Detention Basin as a stand-alone alternative in the 2005 Draft Report would provide net benefits of $92,000 and a BCR of 5.4-to-1. It was also combined together with the other five management measures and would provide net benefits of $358,000 and a BCR of 1.39-to-1. A review of aerial imagery shows that between 1999 and 2014 the footprint of residential areas near the detention basin area remained the same. However, since the 2005 Draft Report, 40 houses have been constructed on Gatewood Drive and Guy Way. Those roads were in place in 1999, but the houses were not yet developed. The new houses on Guy Way and Gatewood Drive are outside the 145-foot contour elevation, which represents the top of the detention structure elevation, and do not appear to be built in the detention basin area. Although the footprint of the Lombard Detention Basin area appears to have remained intact, it was not selected as an alternative for analysis in the 2016 Augusta Rocky Creek Flood Risk Management Study.

Rozella Road Detention Basin

The Rozella Road Detention Basin as a stand-alone alternative in the 2005 Draft Report would provide net benefits of $90,000 and a BCR of 2.15-to-1. The Rozella Road Detention Basin would consist of a 34.3-acre detention basin with a capacity of 178.6 acre-feet and require the purchase of 28 parcels with houses on each property. A review of the county tax assessor's online database revealed that they were constructed in the 1950s. Cultural resources investigations would be required to identify and evaluate the buildings for the National Register of Historic Places. For these reasons, this alternative was not considered in the 2016 Augusta Rocky Creek Flood Risk Management Study.

Wheeless Detention Basin

The Wheeless plan consisted of a 21.5-acre detention basin with a capacity of 64.7 acre-feet. A review of 2014 aerial imagery showed recent construction in the vicinity of this proposed measure. Extensive residential construction occurred north of Milledgeville Road on Kennedy Circle and Sasser Drive from 2010 to 2013. New development in the floodplain adjacent to the footprint of the detention area increases risk of collateral damage that may require protection from nuisance flooding. Additionally, this alternative would require buyout and acquisition of 4 commercial automotive properties that may have HTRW issues. Because of this, the Wheeless Detention Basin alternative was not considered in the 2016 Augusta Rocky Creek Flood Risk Management Study.

Rosedale Detention Dam Area

The Rosedale Detention Dam Area as a stand-alone alternative or management measure in the 2005 Draft Report provided net benefits of $76,000 and a BCR of 2.3-to-1. This alternative was a 14.2-acre detention basin with a capacity of 94.4 acre-feet. A review of aerial imagery showed that minimal construction had taken place in the vicinity of the proposed measure location and sufficient acreage still existed to construct this detention basin. New construction since 2005 is limited to a warehouse and church. Neither of these would be affected by this management measure nor alter the

effectiveness of this management measure. This management measure was carried forward for analysis in the 2016 Augusta Rocky Creek Flood Risk Management Study.

Kissingbower Road Buyout with Recreational Park

This non-structural management measure would remove existing structures and restore the land to the floodplain. This management measure would require the acquisition of five privately owned parcels and demolition of three buildings. A review of 2014 aerial imagery and the county tax assessor's database showed that no new development had occurred on these parcels or in the vicinity. The dates of construction for the buildings are listed as the 1950s. Cultural resources investigations would be required to identify and evaluate the buildings for the National Register of Historic Places. This management measure was carried forward for analysis in the 2016 Augusta Rocky Creek Flood Risk Management Study.

4.1 Summary

After evaluating in detail the seven management measures in the 2005 report, only one structural and one non-structural management measure were accepted for further analysis in the 2016 study. The structural measure was the Rosedale Dam Detention Area and the non-structural measure was the Kissingbower Buyout with Recreational Park. These two management measures were included in the PMP for the current study and four alternatives were derived from these two management measures.

APPENDIX F

COST APPENDIX

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

Cost Engineering Appendix

1.0 Cost Methodology

The goal of the cost appendix is to present a Total Project Cost (construction and non-construction costs) for the Tentatively Selected Plan(s) at the constant dollar price level to be used for project justification/authorization and to escalate costs for budgeting purposes. In addition, the costing efforts are intended to produce a final product (cost estimate) that is reliable and accurate, and that supports the definition of the Government's and the non-Federal sponsor's obligations.

The preparation of cost estimate for planning purposes are in accordance with guidelines and policies included in:

- Engineering Regulation (ER) 1110-1-1300 - Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302 - Civil Works Cost Engineering, 15 September 2008
- ER 1105-2-100 – Planning Guidance Notebook, 22 April 2000
- Engineering Manual (EM) 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region III, April 2014
- EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS), 31 March 2012 (tables updated 30 September 2015)
- Engineering Technical Letter (ETL) 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 Sept 2008
- Cost and Schedule Risk Analysis Process, March 2008

The estimate was prepared using MCACES/MII Version 4.2 Unit Price Books, labor rates, and equipment rates to apply unique crews to detailed work items and obtaining material and supply quotes where possible for significant cost items. The resulting estimate is shown in the Total Project Cost Summary (TPCS).

2.0 Project Alternatives

ROM, rough order of magnitude, estimates were developed to help Planning Division evaluate the three alternatives. There is more on these alternatives in the planning section of this report.

3.0 Tentatively Selected Plan

The Tentatively Selected Plan consists of two (2) measures. The first is the rehabilitation of the Rosedale Detention facility located in the Rocky Creek basin in Augusta, GA. The Rosedale

Detention area consists of an existing dry stormwater detention facility with an outlet control structure and dam that was breached some time ago.

During a brief site visit, the area was observed to have been a dumping grounds for home construction/renovation debris including old carpet, drywall, bricks, CMU, etc. The dam structure itself is heavily overgrown but appears to be fairly intact. The outlet works are non-functioning and cannot be repaired.

Rehabilitation of the facility will include erosion control, clearing and grubbing, earthwork, construction of a new outlet works, and grassing of the embankments.

The second measure consists of demolishing several small homes and building a playground facility for the neighborhood.

4.0 Major Cost Assumptions

Quantities were developed by Savannah District Soils Section. A 10% factor was added to earthwork and grassing quantities to account for minor variations in quantities. Earthwork quantities are based on bank volume calculations.

Although the estimate relied upon the unit price book, the accuracy of these numbers have been checked against similar work such as dredged material disposal areas as well as dam rehabilitations at Fort Gordon and Fort Bragg.

4.1 Earthwork

Suitable borrow material is not available on-site. Potential borrow areas have not been identified during the feasibility but will be identified during the implementation phase. For planning purposes, it is assumed that a suitable borrow site will be identified within close proximity to the site.

The earthen dam was observed to be heavily overgrown but fairly intact. However, based on discussion with the Project Delivery Team (PDT), it is assumed that about 80% of the existing earthen may need to be degraded and backfilled with suitable soils. The PDT assumed that half of the excavated material would be suitable for reuse. Cleared vegetation, any unsuitable soils, and any other debris will need to be removed from the site and disposed of in accordance with Federal, State and local regulations. Suitable spoil sites have not been identified but will be investigated during the implementation phase. For planning purposes, it is assumed that a suitable spoil site will be identified within close proximity to the site.

4.2 Dewatering/Diversion

It is assumed that a temporary coffer dams upstream and downstream of the existing breach in the earthen dam. Dewatering and temporary creek flow diversion can be completed utilizing

sump pumps to pump water downstream of the construction area. Use of the sump pump can be discontinued once the outlet works and earth fill have achieved a safe level above the new outlet discharge pipe.

4.3 Outlet Works

The outlet works will consist of a box culvert with concrete wing walls placed at up and downstream inlets, a concrete apron between the wing walls, and riprap at the downstream end. Additionally, a concrete lined broad crested spillway will be on the earthen dam in line with and above the box culvert. Geotextile fabric will be required beneath the concrete lined spillway and between the riprap and existing ground.

4.4 Acquisition

An acquisition strategy meeting has not taken place. Based on discussions with the PDT and contracting methods used on similar projects it is assumed that a small disadvantaged business (8a) set aside will be used for the project.

5.0 Project Feature Accounts

The baseline cost estimate was prepared and organized according to the Civil Works Breakdown Structure (CWBS). As such, the estimate includes the following feature accounts:

5.1 Account 01 – Lands and Damages

This feature account includes the cost for all real estate costs including administrative and land costs.

5.2 Account 04 – Dams

This feature includes clearing and grubbing, earthwork, construction of the outlet works and grassing required to rehabilitate the Rosedale Detention area.

5.3 Account 14 – Recreation Facilities

This feature includes the removal of existing structures and construction of a playground area in the Kissingbower neighborhood.

5.4 Account 30 – Planning, Engineering and Design

This feature includes project management, project planning, engineering analysis, surveying, final design, preparation of plans and specifications, engineering during construction (EDC), advertisement, opening of bids, and contract award. The cost for the 30 account was provided by the Project Manager.

5.5 Account 31 – Supervision and Administration

This feature includes onsite supervision for the work on this project and contract administration. The cost for the 31 account was provided by the Project Manager.

6.0 Cost Schedule Risk Analysis

Due to the size of the project, an Abbreviated Risk Analysis (ARA) was performed on this project to identify the 80% confidence level project cost and schedule duration.

The following is a brief discussion of the risk drivers by risk element.

Scope Growth – This project will require standard construction techniques and goals of the construction are relatively low-risk and technically simple. A critical element and the main risk driver for scope growth is the possibility of encountering contaminated soils or hazardous construction debris observed at the Rosedale Detention Area or in the demolition of the 1960s era homes in the Kissingbower neighborhood. There is a degree of uncertainty with regards to the number and complexity of features for the playground/park. Additionally, there is a chance that the sump pump will not be sufficient dewatering and that a small well-point system may be required.

Acquisition Strategy – There is no predefined strategy for acquisition for this project; however, projects of this magnitude are frequently sent to the 8A program. This typically results in 10-15% cost increases due to higher overhead rates for smaller firms.

Construction Elements – The design, construction, and other portions of this project are not considered to be complex or inherently risky. It is anticipated that there should be a sufficient pool of contractors experienced in similar work.

Design and Quantities – Variation and possible increase in quantities is identified as a major risk driver. Much of the site investigation will be completed during implementation phase prior to issuing a solicitation. The embankment quantities are likely to increase as are the unsuitable soil quantities, the pervious and impervious soil quantities, haul distances, staging area sizes etc.

Cost Estimate Assumptions – Various assumptions based on experience with similar projects and professional judgement were made during the development of the estimate that may be revised during implementation. These assumptions include fuel cost, proximity of spoil and borrow areas, the depth of excavation required for the box culvert, the presence of utilities, and competition in the bid environment.

External Project Risks – The main external project risk is timely funding.

Completion of the ARA determined that a contingency rate of 31% for construction features was required to achieve an 80% confidence level. The contingency rate for Real Estate is 25%. The PED phase has a contingency rate of 9% and 5% for construction management activities.

7.0 Construction Schedule

A construction schedule was prepared utilizing input from the PDT and reflects all project construction components. The schedule considers durations of individual components of construction to create an overall schedule that was used for the generation of the TPCS.

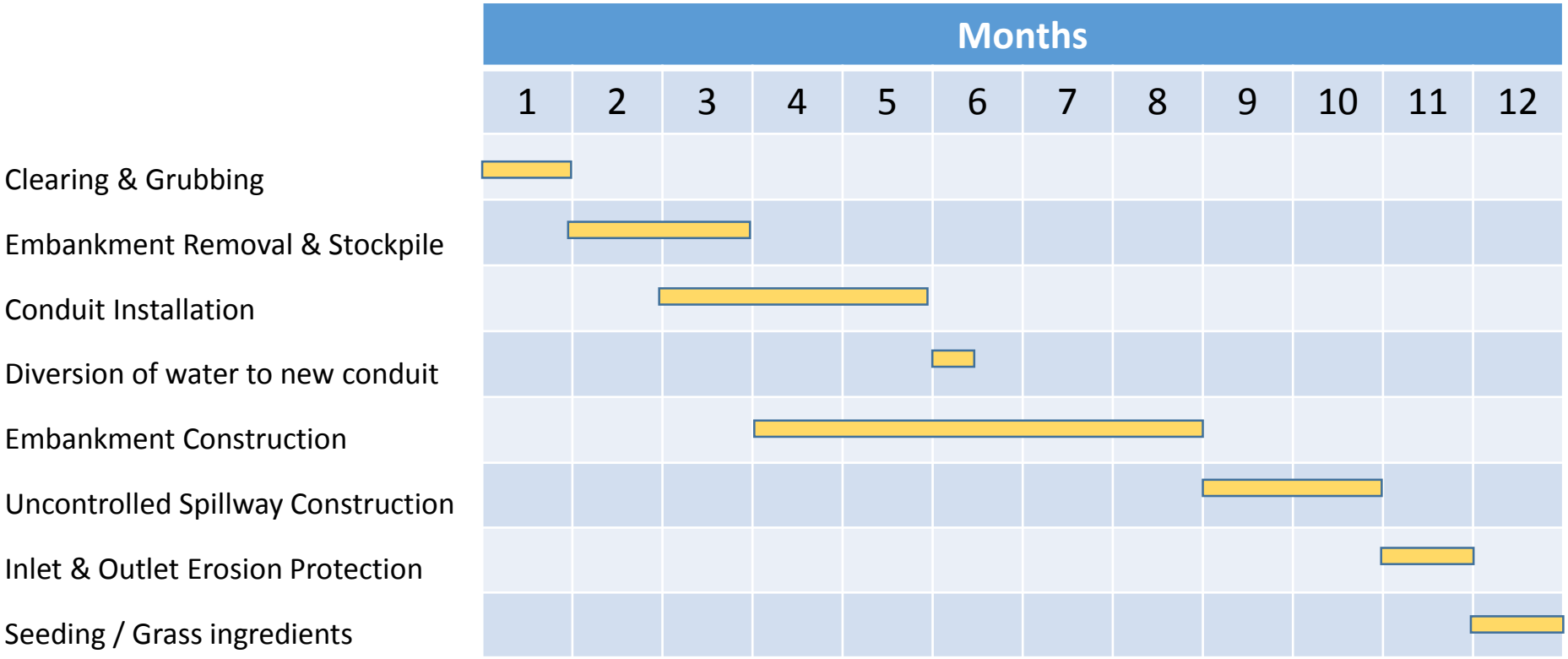
Construction is anticipated to start in August of 2019 and to be completed by end of the calendar year 2020. The schedule is attached at the end of this appendix.

8.0 Total Project Cost Summary

The cost estimate for the TSP is prepared with an identified price level date and inflation factors are used to adjust the pricing to the constant dollar value in the program year. This is known as the Project First Cost. The TPCS also shows the estimate escalated to the midpoint of construction for the various activities. This is known as the Fully Funded Cost. The TPCS includes all Federal and non-Federal costs: Lands, Easements, Rights of Way and Relocations; construction features; Planning Engineering and Design; Construction Management; Contingency; and Inflation. The TPCS, is attached at the end of this appendix.

Rocky Creek

Construction Schedule



WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

SAS - PN 321406
Rocky Creek
Augusta, Georgia
Section 205 Flood Risk Management (CAP)

The Rocky Creek Augusta, Georgia Section 205 Flood Risk Management Project, as presented by the Savanah District, has undergone a successful Cost Agency Technical Review (Cost ATR) of remaining costs, performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the cost products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of July 5, 2016, the Cost MCX certifies the estimated total project cost:

FY2018 First Costs:	$ 4,836,000
Total Project Costs:	$ 4,962,000

Note: Cost ATR was devoted to remaining work. It did not review spent costs, which requires an audit process. It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

CALLAN.KIM.C.1231558221

Digitally signed by CALLAN.KIM.C.1231558221
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CALLAN.KIM.C.1231558221
Date: 2016.07.05 15:00:12 -07'00'

Kim C. Callan, PE, CCE, PM
Chief, Cost Engineering MCX
Walla Walla District

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Rocky Creek Detention Study (Rosedale Kissingbower Combined w PL costs**
PROJECT NO: **P2 321406**
LOCATION: **Augusta, GA**

DISTRICT: **SAS Savannah District** PREPARED: **3/15/2017**

POC: **CHIEF, COST ENGINEERING, Paul Smith, P.E.**

This Estimate reflects the scope and schedule in report; CAP Feasibility STUDY - ROCKY CREEK

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC):				2018					
						Effective Price Level Date:				1-Oct- 17					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
04	DAMS	$2,001	$620	31%	$2,621	3.3%	$2,068	$641	$2,709		$2,709	3.0%	$2,129	$660	$2,789
14	RECREATION FACILITIES	$298	$92	31%	$390	3.3%	$308	$95	$403		$403	2.9%	$317	$98	$415
	CONSTRUCTION ESTIMATE TOTALS:	$2,299	$713		$3,012	3.3%	$2,376	$737	$3,112		$3,112	3.0%	$2,446	$758	$3,204
01	LANDS AND DAMAGES	$593	$148	25%	$741	3.3%	$613	$153	$766		$766		$613	$153	$766
30	PLANNING, ENGINEERING & DESIGN	$705	$63	9%	$768	6.4%	$750	$68	$818		$818	3.2%	$774	$70	$844
31	CONSTRUCTION MANAGEMENT	$125	$6	5%	$131	6.4%	$133	$7	$140		$140	5.9%	$141	$7	$148
	PROJECT COST TOTALS:	$3,722	$931	25%	$4,653		$3,872	$964	$4,836		**$4,836**	2.6%	$3,974	$988	$4,962

CHIEF, COST ENGINEERING, Paul Smith, P.E.

PROJECT MANAGER, Robert Sirard

CHIEF, REAL ESTATE, Ralph Werthmann

CHIEF, PLANNING, William Bailey

CHIEF, ENGINEERING, Gordy Simmons

CHIEF, ENGINEERING, Gordy Simmons

CHIEF, CONSTRUCTION, Ken Gray

CHIEF, CONTRACTING, Paige Brosch

CHIEF, PM-C, Margarett McIntosh

CHIEF, DPM, Erik Blechinger

ESTIMATED TOTAL PROJECT COST:		**$4,962**
ESTIMATED FEDERAL COST:	63%	$3,137
ESTIMATED NON-FEDERAL COST:	**37%**	$1,825
22 - FEASIBILITY STUDY (CAP studies):		**$101**
ESTIMATED FEDERAL COST:		$51
ESTIMATED NON-FEDERAL COST:		$50
ESTIMATED FEDERAL COST OF PROJECT		**$3,188**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Rocky Creek Detention Study (Rosedale Kissingbower Combined w PL costs
LOCATION: Augusta, GA
This Estimate reflects the scope and schedule in report; CAP Feasibility STUDY - ROCKY CREEK

DISTRICT: SAS Savannah District
POC: CHIEF, COST ENGINEERING, Paul Smith, P.E.

PREPARED: 3/15/2017

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 5/31/2016 Estimate Price Level: 1-Oct-2015				Program Year (Budget EC): 2018 Effective Price Level Date: 1-Oct-17								
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1													
04	DAMS	$2,001	$620	31.0%	$2,621	3.3%	$2,068	$641	$2,709	2019Q3	3.0%	$2,129	$660	$2,789
14	RECREATION FACILITIES	$298	$92	31.0%	$390	3.3%	$308	$95	$403	2019Q3	2.9%	$317	$98	$415
	CONSTRUCTION ESTIMATE TOTALS:	$2,299	$713	31.0%	**$3,012**		$2,376	$737	$3,112			$2,446	$758	$3,204
01	LANDS AND DAMAGES	$593	$148	25.0%	$741	3.3%	$613	$153	$766	2018Q1		$613	$153	$766
	RE Costs ($491) + Demo, Salvage ($12)													
30	PLANNING, ENGINEERING & DESIGN													
0.025	Project Management	$40	$4	9.0%	$44	6.4%	$43	$4	$46	2018Q4	2.9%	$44	$4	$48
0.02	Planning & Environmental Compliance	$15	$1	9.0%	$16	6.4%	$16	$1	$17	2018Q4	2.9%	$16	$1	$18
0.15	Engineering & Design	$385	$35	9.0%	$420	6.4%	$410	$37	$447	2018Q4	2.9%	$422	$38	$460
0.01	Engineering Tech Review ITR & VE	$125	$11	9.0%	$136	6.4%	$133	$12	$145	2018Q4	2.9%	$137	$12	$149
0.01	Contracting & Reprographics	$40	$4	9.0%	$44	6.4%	$43	$4	$46	2018Q4	2.9%	$44	$4	$48
0.03	Engineering During Construction	$25	$2	9.0%	$27	6.4%	$27	$2	$29	2019Q3	5.9%	$28	$3	$31
0.02	Planning During Construction	$50	$5	9.0%	$55	6.4%	$53	$5	$58	2019Q3	5.9%	$56	$5	$61
0.02	Project Operations	$25	$2	9.0%	$27	6.4%	$27	$2	$29	2018Q4	2.9%	$27	$2	$30
31	CONSTRUCTION MANAGEMENT													
0.1	Construction Management	$65	$3	5.0%	$68	6.4%	$69	$3	$73	2019Q3	5.9%	$73	$4	$77
0.02	Project Operation:	$30	$2	5.0%	$32	6.4%	$32	$2	$34	2019Q3	5.9%	$34	$2	$35
0.025	Project Management	$30	$2	5.0%	$32	6.4%	$32	$2	$34	2019Q3	5.9%	$34	$2	$35
	CONTRACT COST TOTALS:	$3,722	$931		**$4,653**		$3,872	$964	$4,836			$3,974	$988	**$4,962**

Estimated by SASEN-ET
Designed by SAS-EN
Prepared by E.K. Roughen
Preparation Date 5/26/2016
Effective Date of Pricing 5/26/2016
Estimated Construction Time 360 Days

Right click here and select "Update Field" to build the Table of Contents for this report.

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
Project Cost Summary Report			**3,682,977**	**0**	**0**	**0**	**3,682,977**
			592,500.00				*592,500.00*
01 Lands and Damages	**1.00**	**EA**	**592,500**	**0**	**0**	**0**	**592,500**
			592,500.00				*592,500.00*
0123 Constructn Contract(s) Documnts	**1.00**	**EA**	**592,500**	**0**	**0**	**0**	**592,500**
			592,500.00				*592,500.00*
012303 Real Estate Analysis Documents	**1.00**	**EA**	**592,500**	**0**	**0**	**0**	**592,500**
			1,962,100.49				*1,962,100.49*
04 Dams	**1.00**	**EA**	**1,962,100**	**0**	**0**	**0**	**1,962,100**
			1,581,091.77				*1,581,091.77*
0401 Main Dam	**1.00**	**EA**	**1,581,092**	**0**	**0**	**0**	**1,581,092**
			42,096.62				*42,096.62*
040101 Mob, Demob & Preparatory Work	**1.00**	**EA**	**42,097**	**0**	**0**	**0**	**42,097**
			25,875.65				*25,875.65*
040103 Care and Diversion of Water	**1.00**	**EA**	**25,876**	**0**	**0**	**0**	**25,876**
			4,312.61				*4,312.61*
04011002 05 Dewatering	**6.00**	**MO**	**25,876**	**0**	**0**	**0**	**25,876**
			378,225.76				*378,225.76*
040110 Earthwork for Structures	**1.00**	**EA**	**378,226**	**0**	**0**	**0**	**378,226**
			378,225.76				*378,225.76*
04011002 Site Work	**1.00**	**EA**	**378,226**	**0**	**0**	**0**	**378,226**
			98,341.72				*98,341.72*
04011002 01 Clearing and Grubbing	**1.00**	**EA**	**98,342**	**0**	**0**	**0**	**98,342**
			2.30				*2.30*
04011002 02 Stripping	**4,200.00**	**CY**	**9,652**	**0**	**0**	**0**	**9,652**
			270,232.38				*270,232.38*
04011002 03 Excavation, Common	**1.00**	**EA**	**270,232**	**0**	**0**	**0**	**270,232**
			1,104,733.17				*1,104,733.17*
040142 Earth and Rockfill Dam	**1.00**	**EA**	**1,104,733**	**0**	**0**	**0**	**1,104,733**
			1,104,733.17				*1,104,733.17*
04014202 Site Work	**1.00**	**EA**	**1,104,733**	**0**	**0**	**0**	**1,104,733**
			26.84				*26.84*
04014202 01 Borrow Excavation, Impervious	**5,000.00**	**ECY**	**134,188**	**0**	**0**	**0**	**134,188**
			23.71				*23.71*
04014202 02 Borrow Excavation, Pervious	**40,000.00**	**BCY**	**948,463**	**0**	**0**	**0**	**948,463**
			5.67				*5.67*
04014202 14 GeoTex	**1,100.00**	**SY**	**6,241**	**0**	**0**	**0**	**6,241**
			2.30				*2.30*

Currency in US dollars

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
04014202 17 Topsoil	**4,200.00**	**CY**	**9,659**	**0**	**0**	**0**	**9,659**
			1,545.59				*1,545.59*
04014202 18 Seeding	**4.00**	**ACR**	**6,182**	**0**	**0**	**0**	**6,182**
			30,160.58				*30,160.58*
040199 Demo Homes	**1.00**	**EA**	**30,161**	**0**	**0**	**0**	**30,161**
			4,447.13				*4,447.13*
Demo Small Home	**3.00**	**EA**	**13,341**	**0**	**0**	**0**	**13,341**
			5,606.39				*5,606.39*
Foundation Demolition	**3.00**	**EA**	**16,819**	**0**	**0**	**0**	**16,819**
			381,008.72				*381,008.72*
0402 Spillway	**1.00**	**EA**	**381,009**	**0**	**0**	**0**	**381,009**
			133.41				*133.41*
040232 Apron-Stilling Basin-Deflectors	**330.00**	**CY**	**44,026**	**0**	**0**	**0**	**44,026**
			187,002.76				*187,002.76*
040251 Concrete Outlet	**1.00**	**EA**	**187,003**	**0**	**0**	**0**	**187,003**
			1,026.59				*1,026.59*
04025103 5' x 6' Culvert	**150.00**	**LF**	**153,989**	**0**	**0**	**0**	**153,989**
			16,506.84				*16,506.84*
Wing Walls	**2.00**	**EA**	**33,014**	**0**	**0**	**0**	**33,014**
			149,980.24				*149,980.24*
040252 Concrete Overflow Section	**1.00**	**EA**	**149,980**	**0**	**0**	**0**	**149,980**
			21.43				*21.43*
04025213 Reinforced Conc Spillway	**7,000.00**	**SF**	**149,980**	**0**	**0**	**0**	**149,980**
			298,376.42				*298,376.42*
14 Recreation Facilities	**1.00**	**EA**	**298,376**	**0**	**0**	**0**	**298,376**
			298,376.42				*298,376.42*
1400 Recreation Facilities	**1.00**	**EA**	**298,376**	**0**	**0**	**0**	**298,376**
			15,643.14				*15,643.14*
140004 Permanent Access Roads & Parking	**1.00**	**EA**	**15,643**	**0**	**0**	**0**	**15,643**
			15,643.14				*15,643.14*
14000402 Site Work	**1.00**	**EA**	**15,643**	**0**	**0**	**0**	**15,643**
			15,643.14				*15,643.14*
14000402 11 Paving	**1.00**	**EA**	**15,643**	**0**	**0**	**0**	**15,643**
			251,829.89				*251,829.89*
140072 Day Use Areas	**1.00**	**EA**	**251,830**	**0**	**0**	**0**	**251,830**
			251,829.89				*251,829.89*
14007202 Site Work	**1.00**	**EA**	**251,830**	**0**	**0**	**0**	**251,830**
			2,736.79				*2,736.79*

Currency in US dollars

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
14007202 01 Picnic Tables	**10.00**	**EA**	**27,368**	**0**	**0**	**0**	**27,368**
			148,841.55				*148,841.55*
14007202 02 Playground Equipment	**1.00**	**EA**	**148,842**	**0**	**0**	**0**	**148,842**
			26,409.75				*26,409.75*
14007202 04 Walking Track	**1.00**	**EA**	**26,410**	**0**	**0**	**0**	**26,410**
			6,368.22				*6,368.22*
14007202 08 Benches	**1.00**	**EA**	**6,368**	**0**	**0**	**0**	**6,368**
			42,842.47				*42,842.47*
14007202 11 Walking Trail	**1.00**	**EA**	**42,842**	**0**	**0**	**0**	**42,842**
			11,195.42				*11,195.42*
140099 Associated General Items	**1.00**	**EA**	**11,195**	**0**	**0**	**0**	**11,195**
			11,195.42				*11,195.42*
14009902 Site Work	**1.00**	**EA**	**11,195**	**0**	**0**	**0**	**11,195**
			739.03				*739.03*
14009902 01 Trash Barrels	**1.00**	**EA**	**739**	**0**	**0**	**0**	**739**
			10,456.39				*10,456.39*
Fencing	**1.00**	**EA**	**10,456**	**0**	**0**	**0**	**10,456**
			19,707.97				*19,707.97*
140023 Site Grading and Landscaping	**1.00**	**EA**	**19,708**	**0**	**0**	**0**	**19,708**
			5,070.71				*5,070.71*
Grading	**2.50**	**ACR**	**12,677**	**0**	**0**	**0**	**12,677**
			7,031.19				*7,031.19*
Landscaping	**1.00**	**EA**	**7,031**	**0**	**0**	**0**	**7,031**
			705,000.00				*705,000.00*
30 Planning, Engineering and Design	**1.00**	**EA**	**705,000**	**0**	**0**	**0**	**705,000**
			705,000.00				*705,000.00*
3020 PED Costs - broken out on TPCS	**1.00**	**EA**	**705,000**	**0**	**0**	**0**	**705,000**
			705,000.00				*705,000.00*
302001 Engineering Analysis/Report	**1.00**	**EA**	**705,000**	**0**	**0**	**0**	**705,000**
			125,000.00				*125,000.00*
31 Construction Management	**1.00**	**EA**	**125,000**	**0**	**0**	**0**	**125,000**
			125,000.00				*125,000.00*
3123 Construction Contracts	**1.00**	**EA**	**125,000**	**0**	**0**	**0**	**125,000**
			125,000.00				*125,000.00*
312311 Supervision and Administration	**1.00**	**EA**	**125,000**	**0**	**0**	**0**	**125,000**

Currency in US dollars

Abbreviated Risk Analysis

Project (less than $40M): **Rocky Creek Detention Area** — **Alternative: Alt A**

Project Development Stage/Alternative: **Feasibility (Recommended Plan)**

Risk Category: **Low Risk: Typical Construction, Simple** — **Meeting Date: 6/2/2016**

Total Estimated Construction Contract Cost = **$ 1,799,914**

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ 592,500		25%	$ 148,125	$ 740,625
1	04 DAMS	**Mob/Demob**	$ 42,097		16%	$ 6,870	$ 48,967
2	04 DAMS	**Site Prep & Water Diversion**	$ 442,576		41%	$ 179,431	$ 622,007
3	04 DAMS	**Earth & Rock Fill Dam**	$ 1,104,733		24%	$ 270,057	$ 1,374,790
4	04 DAMS	**Spillway Deflectors**	$ 44,026		15%	$ 6,428	$ 50,454
5	04 DAMS	**Low-level Outlet**	$ 187,003		16%	$ 30,707	$ 217,710
6	04 DAMS	**Concrete Sillway**	$ 149,980		16%	$ 24,627	$ 174,607
7	04 DAMS	**Demo Small Homes**	$ 30,161		24%	$ 7,373	$ 37,534.00
8	14 RECREATION FACILITIES	**Small Park**	$ 298,376		61%	$ 180,772	$ 479,148.34
9			$ -		0%	$ -	$ -
10			$ -		0%	$ -	$ -
11			$ -		0%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 730,000		9%	$ 65,056	$ 795,056
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 125,000		5%	$ 6,250	$ 131,250
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ 592,500	25%	$ 148,125	$	740,625.00
Total Construction Estimate	$ 2,298,952	31%	$ 706,265	$	3,005,217
Total Planning, Engineering & Design	$ 730,000	9%	$ 65,056	$	795,056
Total Construction Management	$ 125,000	5%	$ 6,250	$	131,250
Total Excluding Real Estate	**$ 3,153,952**	**25%**	**$ 777,572**	**$**	**3,931,524**

Confidence Level Range Estimate ($000's)	**Base**	**50%**	**80%**
	$3,154k	$3,621k	$3,932k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Rocky Creek Detention Area Alt A

Feasibility (Recommended Plan)

Abbreviated Risk Analysis

Meeting Date: 2-Jun-16

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**40%**
PS-1	Mob/Demob	Scope of Mob/Demob should not change much.	Not an impact	Negligible	Possible	0
PS-2	Site Prep & Water Diversion	Is there a possibility of contaminated sols, asbestos shinges, fuel tanks, etc..	Area appears to have been usd as a dump for yard and house hold debris. Contaminated soils a concern. Possible cost and schedule impacts. Estimated impact 175K and 6 months	Significant	Likely	4
PS-3	Earth & Rock Fill Dam	If detention structure is classified as a dam will downstream structures causes reclassification of dam safety.	Buying 3 houses downstream as part of this project to eliminate concern.	Moderate	Unlikely	1
PS-4	Spillway Deflectors	Are deflectors to slow water leaving spillway adequately sized.	Deflectors are larger than required not a concern.	Negligible	Unlikely	0
PS-5	Low-level Outlet	Is low-level outlet adequately sized.	Sized according to flood study needs. Possible and not much more expensive.	Marginal	Unlikely	0
PS-6	Concrete Sillway	Is spillway adequately sized?	Sized according to flood study needs. Possible and not much more expensive.	Marginal	Unlikely	0
PS-7	Demo Small Homes	Will additional houses be needed to be purchased?	Not likely but Lands and damages could go up say 50K.	Marginal	Possible	1
PS-8	Small Park	The equipment and boundaries of the park are conceptual and are subject to change. Are there any contaminates which may cause the house debris to require special handeling?	Project scope could grow causing additional costs. If we encounter lead paint, asbestos shingles, or other contaminates this may need to be hauled to a special landfill.	Significant	Likely	4
PS-13	Planning, Engineering, & Design	Contaminated soils could cause PED costs to increase.	Contaminated soils could cause PED costs to increase say 35K	Marginal	Possible	1
PS-14	Construction Management	Contaminated soils could cause CM costs to increase.	Not likely but a possibility say 50K	Negligible	Unlikely	0
Acquisition Strategy				**Maximum Project Growth**		**30%**
AS-1	Mob/Demob	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3
AS-2	Site Prep & Water Diversion	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3
AS-3	Earth & Rock Fill Dam	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3
AS-4	Spillway Deflectors	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3

AS-5	Low-level Outlet	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3
AS-6	Concrete Sillway	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3
AS-7	Demo Small Homes	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Moderate	Likely	3
AS-8	Small Park	Acquisition strategy has not been selected; however, small projects like this are usually 8A or 8A set-aside. 8A projects are frequently over budget and this is a real concern.	The fact that this project will likely be a set-aside and it's effect upon cost is a real valid concern regarding cost,	Significant	Likely	4
AS-13	Planning, Engineering, & Design	The acquisition strategy should not effect the PED or the CM phase of this project.	The acquisition of this project should have little to no effect on the PED or CM phase.	Negligible	Unlikely	0
AS-14	Construction Management	The acquisition strategy should not effect the PED or the CM phase of this project.	The acquisition of this project should have little to no effect on the PED or CM phase.	Negligible	Unlikely	0
Construction Elements					**Maximum Project Growth**	15%
CON-1	Mob/Demob	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-2	Site Prep & Water Diversion	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-3	Earth & Rock Fill Dam	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-4	Spillway Deflectors	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-5	Low-level Outlet	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-6	Concrete Sillway	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-7	Demo Small Homes	construction techniques and contractors. Will special limited equipment be needed and will there be qualified contractors to do this work at a reasonable cost.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-8	Small Park	Of all the construction features this one does require a specialty contractor. Playground equipment, while not overly complex, does require a special contractor to install this equipment.	construction features, and require no specialty fabrication only requiring specialized installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Moderate	Possible	2
CE-13	Planning, Engineering, & Design	The design of this project is something SAS designers do with regularity and should not require special personnel.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
CE-14	Construction Management	The construction managemet of this project is something SAS personnel do with regularity and should not require special personnel.	construction features, and require no specialty fabrication or speciality installation. Additionaly the low complexity also loweres the potential for modifications and claims.	Negligible	Possible	0
Specialty Construction or Fabrication					**Maximum Project Growth**	50%
SC-1	Mob/Demob	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-2	Site Prep & Water Diversion	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-3	Earth & Rock Fill Dam	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0

SC-4	Spillway Deflectors	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-5	Low-level Outlet	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-6	Concrete Sillway	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-7	Demo Small Homes	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-8	Small Park	This feature does require special fabrification and installation of the playground equipment	Playground equipment is specialty fabricated and installed with a limited number of contractor who can do such tasks and as such there is some risk.	Moderate	Possible	2
SC-13	Planning, Engineering, & Design	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
SC-14	Construction Management	Nothing special or complex with regards to construction.	The estimator sees nothing in this project which would require speciality fabrication or construction.	Negligible	Unlikely	0
Technical Design & Quantities					**Maximum Project Growth**	**20%**
T-1	Mob/Demob	Equipment may be different than what the IGE uses. Larger or heavier equipment may be more expensive.	Larger equipment may be more expensive but productivity increases should help offset additional costs.	Negligible	Possible	0
T-2	Site Prep & Water Diversion	Site prep area could expand or trees might need to be cleared beyond staging area.	There is always a chance for project growth; however, land clearing is not unusually expensive. Even doubling of project area would result in a 10K increase.	Marginal	Possible	1
T-3	Earth & Rock Fill Dam	Unstable or unsuitable soils may cause 25-35% rise in quantities to be placed and hauling costs.	It's very likely that unsuitable soils may result increased quantities of excavation and fill. Haul distances could go up as well.	Moderate	Likely	3
T-4	Spillway Deflectors	Excessive velocities may deem size inadequate and cause redesign of deflectors.	Resizing of riprap will not cost much more per ton than anticipated.	Negligible	Possible	0
T-5	Low-level Outlet	Low level outlet may be under sized.	Increaseing the size and outlet capabilities would not be expensive or require more effort than whhat is now estimated.	Marginal	Possible	1
T-6	Concrete Sillway	Concrete spillway may need to enlarged.	Increasing the spillway capacity would not be much more expensive than what is now estimated.	Marginal	Possible	1
T-7	Demo Small Homes	There is a possibility that we may encounter lead paint or asbestos in structures to be demolished.	schedule. Possible 30-40K additional cost and 2-3 months additional tme. It appears this area was used as a dump for building debris so it is likely that we may find contaminated	Moderate	Likely	3
T-8	Small Park	This feature is the least defined feature and the estimator anticipates changes to the playground needs.	The paper gives a verbal indication of what is expected but since no laundry list of detailed equipment was provided changes are expected.	Moderate	Possible	2
T-13	Planning, Engineering, & Design	Design inadequacies may cause a partial redesign of any portion of this project.	Design has not been finalized so resizing of any portion should not negatively effect cost or schedule.	Negligible	Likely	1
T-14	Construction Management	Would a redesign effect the construction management cost or schedule.	Even a complete redesign should have no effect upon construction management.	Negligible	Unlikely	0
Cost Estimate Assumptions					**Maximum Project Growth**	**25%**
EST-1	Mob/Demob	Estimator used specialized equipment. Contractor may use differing or larger pieces of equipment.	If larger equipment is used productivity should go up to lessen equipment duration.	Marginal	Likely	2
EST-2	Site Prep & Water Diversion	Estimator used UPB item for clearing cost. Water diversion was performed by a sump pump and laborer.	Cost of clearing is consistent with what I regularly pay in the disposal areas after a long period of growth. It is possible a sump pump will not be adequate so a small well-point system	Moderate	Likely	3

EST-3	Earth & Rock Fill Dam	Estimate assumes borrow location within a 12 mile round-trip.	Borrow location may be farther away. Higher risk because of the cost. An assembly will be substituted for this UPB item as this study progresses.	Moderate	Possible	2
EST-4	Spillway Deflectors	Rip-rap used as spillway deflectors may be undersized and might need larger pieces.	If rip-rap needs replacing with larger pieces cost and schedule would not change much.	Marginal	Possible	1
EST-5	Low-level Outlet	Production rate for placing pipe may be too aggressive. The operation may be slower.	Rate of 1 - 8 foot section per 1.5 hours should be adequate; hoever estimator reset estimate rate to 8 feet every 3 hours to check for sensitivity. Cost for outlet increased by 10K or 7%.	Marginal	Possible	1
EST-6	Concrete Sillway	Cost for reinforced concrete placement and material cost taken from the UPB may be too low.	The cost from the UPB is 540 $/CY which is close to my ballpark cost of 600 $/CY. If it is higher it won't be much.	Marginal	Possible	1
EST-7	Demo Small Homes	Estimate assumes no lead paint or asbestos will be encountered.	Hazardous materials would negatively effect bith cost and schedule. Possible 30-40K additional cost and 2-3 months additional tme..	Moderate	Possible	2
EST-8	Small Park	A brief listing of what maybe required was provided but the stimator knows changes will be made by the designers when funding and time allows finnishing of the design.	The estimator anticipates changes which could the cost of this feature by 50%.	Moderate	Likely	3
EST-13	Planning, Engineering, & Design	PED, being a percentage of the construction costs, might not be sufficient for the amount of work involved.	Project management has selected the percentage based upon PDT input and should be sufficient.	Marginal	Unlikely	0
EST-14	Construction Management	CM, being a percentage of the construction costs, might not be sufficient for the amount of work involved.	Project management has selected the percentage based upon PDT input and should be sufficient.	Marginal	Unlikely	0
External Project Risks				**Maximum Project Growth**		20%
EX-1	Mob/Demob	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-2	Site Prep & Water Diversion	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-3	Earth & Rock Fill Dam	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-4	Spillway Deflectors	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-5	Low-level Outlet	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-6	Concrete Sillway	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-7	Demo Small Homes	The main external risks to this project's construction features is funding since weather delays are accounted for in the contracts front end. There is little concern for unanticipated inflation or market volatility or lack of competition.		Negligible	Unlikely	0
EX-8	Small Park	are fewer players than in the sitework market. The estimator's experience is that these projects come in 25-35% higher than previous IGEs. I have done 2 of these projects in DOD schools.		Marginal	Likely	2
EX-13	Planning, Engineering, & Design	N/A		Negligible	Unlikely	0
EX-14	Construction Management	N/A		Negligible	Unlikely	0