Selma, Alabama

Flood Risk Management Study

Integrated Feasibility Report and Environmental Assessment

APPENDIX C

US Army Corps of Engineers
Mobile District

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APPENDIX-C: Economics

Table of Contents

List of Figures

List of Tables

C.1. Introduction

This economic appendix documents the analysis of flood damage reduction for the national economic development (NED) and regional economic development (RED) undertaken for this study. Section I documents the flood damage reduction analysis, and Section II discusses the RED impact for the project alternatives.

C.2. Flood Damage Reduction

The Federal objective of water and related land resources project planning is to contribute to NED. Contributions to NED, expressed in monetary units, are the direct net benefits that accrue in the planning area and the rest of the Nation. Benefits from plans for reducing flood hazards accrue primarily through the reduction in actual or potential damages to affected land uses are NED. Inundation reduction benefits are the increases in net income generated by the affected land uses.

C.2.1. Study Authority

The study authority for conducting this study is contained in House Resolution No.66 adopted June 7, 1961 which states:

> *"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers arid Harbors be, and is hereby, requested to review the report on Alabama-Coosa Branch of Mobile River, Georgia and Alabama, published as House Document No. 66, Seventy-fourth Congress, first, session, with a view to determining the advisability of providing improvements for flood control on Alabama River in Dallas County, Alabama"*

The Bipartisan Budget Act of 2018 (Public Law 115-123), Division B, Subdivision 1, Title IV, appropriates funding for the study at full Federal expense. As identified under this "Supplemental Appropriation" bill, the study is subject to additional reporting requirements and is expected to be completed within three years and for $3 million dollars.

In accordance with the memorandum for the Commander dated February 25, 2020 from Headquarters (HQ) United States Army Corps of Engineers (USACE) to the South Atlantic Division (SAD), the investigation of streambank erosion measures is being conducted under the authority of Section 1203 of America's Water Infrastructure Act of 2018 as authorized:

> *"(a) Feasibility Reports.--The Secretary shall expedite the completion of a feasibility study for each of the following projects, and if the Secretary determines that the project is justified in a completed report, may proceed directly to preconstruction planning, engineering, and design of the project: (1) Project for riverbank stabilization, Selma, Alabama."*

C.2.2. Purpose

The purpose of this feasibility study is to identify and evaluate alternative plans that would address damages caused by flooding in the City of Selma. This study will assess solutions that are structurally sustainable, economically justified, and environmentally acceptable. There is a need for this feasibility study as the City of Selma has experienced historic flooding since its incorporation and many of the historic riverfront structures are at risk of condemnation and demolition due to flood-induced erosion and subsurface instability. There is a further social and regional economic need to maintain the historic, cultural, and community integrity of Selma as it played a pivotal role in the Civil Rights Movement, leading to landmark legislation that changed the nation. Without action, the historic context, viewshed of the Edmund Pettus Bridge, a National Historic Landmark, and crucial heritage tourism within the city could be significantly lessened or completely lost.

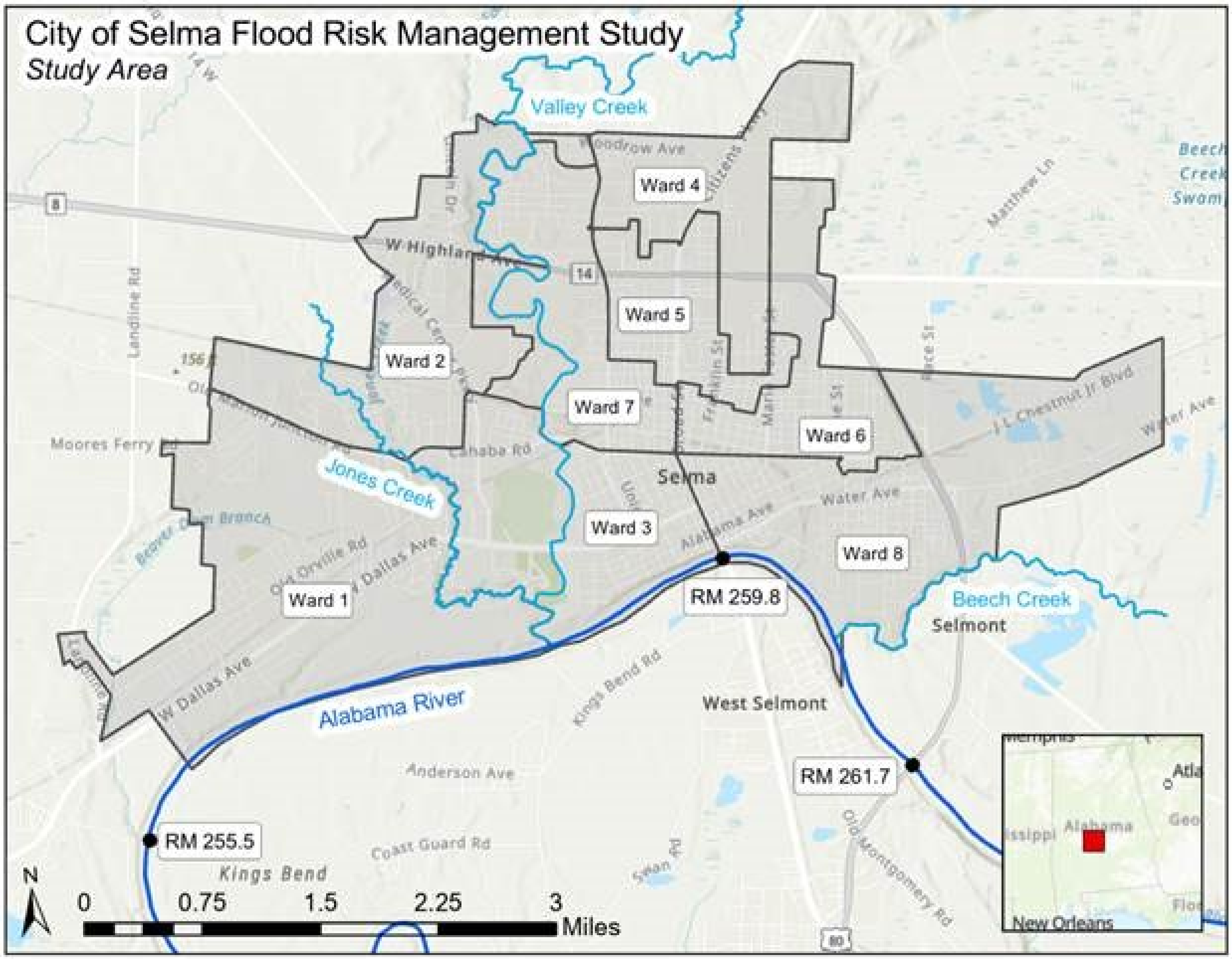
This document explains what is known about the study area, the floodplain characteristics, existing condition flood damages and expected future condition flood damages in the absence of flood damage reduction measures. The report then documents the procedures used to analyze various measures designed to reduce the risk of flood damages, incorporating National Economic Development (NED) guidelines, and recommends an alternative plan.

C.2.3. Study Area

The study area (**Figure C-1**) is located along the Alabama River in the City of Selma, approximately 50 miles west of Montgomery, Alabama via US Highway 80. The city itself is divided into wards with each ward having a representative in the city government. The wards receiving frequent flooding are identified in the Figure below and are the focused project area for this study. They include: Wards 1, 3, 6, and 8. The riverbank miles assessed for this study are from river mile 256-261 along the Alabama River.

Downtown Selma is architecturally unique as some of these structures date back to the 1830s, making the Selma riverfront one of the last intact historic riverfronts in the Southeast. This riverbank tells the story of America, from westward expansion, to the Civil War, to Civil Rights, and beyond. The historic structures along the Alabama River serve as the canvas backdrop to the famed Edmund Pettus Bridge and the history changing events that occurred there, much like the immediately recognizable New York City skyline. Selma's historic structures are indelibly linked to the bridge and the other historic structures that form the historic context and viewshed of this national/international landmark and are invaluable in their scope and breadth when it comes to their importance to the Nation. Fortifying Selma's riverbank foundation to protect its historic structures ensures that more than 200,000 annual world-wide visitors, can, as seven U.S. Presidents have done, walk across the famed Edmund Pettus Bridge to commemorate the brave actions taken and sacrifices made by activists to ensure the nation lives up to its guiding principles of equal rights and protections for all Americans by showcasing the republic's commitment to the Bill of Rights and the U.S. Constitution.

Figure C-1: Study Area. The City of Selma is divided into 8 administrative wards each represented by a City Councilor.



On March 7, 1965 Selma was the site of the first visual evidence of violent racial animus, which resulted in what is known as "Bloody Sunday", perpetrated on peaceful citizens who marched for their Constitutional civil rights. This widely viewed event galvanized the Nation to address fundamental human and civil rights for people of all colors and diverse backgrounds and led to the signing of the Civil Rights Voting Act of 1965. The events that occurred in Selma during the Spring of 1965 forever serve as an iconic depiction of the Nation's pursuit of equality for all men.

The flooding, and subsequent structural integrity issues in Selma have been well documented over the decades, evidenced by the 1967 USACE, Mobile District Flood Risk Management (FRM) Study, the USACE, Mobile District Selma, Alabama Continuing Authorities Program (CAP) Section 14 Study, and the 2016 FEMA armament of historic masonry stormwater outfall. The 1967 study highlights the overbank flooding towards the east of City, particularly in Ward 8. The FEMA armory and the current Section 14 study both highlight the continued flooding-induced erosion that significantly threaten the structural integrity of the historic Selma riverfront.

For the purposes of the economic appendix, the "Study Area" is defined as the City of Selma. The "Floodplain" is defined as the area in the City of Selma, extending to the boundaries of the 0.002 AEP (i.e. 500-year flood event). That floodplain will also include areas encompassing the .01 AEP (i.e. 100-year flood event) and other more frequent flood boundaries. Unless otherwise designated by its recurrence probability, the floodplain discussed in this report is the 0.002 AEP or 500-year floodplain.

C.2.3.1. Socioeconomic Data

Alabama's Black Belt originated as a reference to the rich fertile soil of the region, but in addition to this geologic reference the term also holds a demographic reference to the exploitation of African Americans' labor, both as enslaved populations and as sharecroppers and tenant farmers after the American Civil War. Selma, Alabama is located at the center of Dallas County, Alabama which rests in the heart of the Black Belt.

Alabama Population and Demographics: The U.S. Census Bureau estimates Alabama to have a total population of 4,878,747 as of July 1, 2017, from extrapolating the 2010 Census, which reports the State population at 4,779,736. The 2010 Census allows the U.S. Census Bureau to infer growth in the State's population by 2% with 51.6% identifying as female and 48.4% identifying as male. A strong majority of the State's population (98.3%) identify as one race alone, with 69.2% being White, 26.8% being Black or African American, 4.3% being Hispanic or Latino (of any race), 1.5% being Asian, 0.7% being American Indian and Alaska Native, and 0.1% being Native Hawaiian and Other Pacific Islander. Within Alabama there are 1,856,695 households and an average household size of 2.55.

Dallas County Population and Demographics: The U.S. Census Bureau estimates Dallas County to have a total population of 39,215 as of July 1, 2017, from extrapolating the 2010 Census, which reports the County population at 43,820. The 2010 Census allows the U.S. Census Bureau to infer a decline in the County's population by 10.5% with 53.9% identifying as female and 46.1% identifying as male. The median age within Dallas County is 39.3. A strong majority of the County's population (99.2%) identify as one race alone, with 70.5% being Black or African American, 27.9% being White, 1.1% being Hispanic or Latino (of any race), 0.5% being Asian, and 0.3% being American Indian and Alaska Native.

Selma City Population and Demographics: The U.S. Census Bureau estimates the City of Selma to have a total population of 18,310 as of July 1, 2017 from extrapolating the 2010 Census, which reports the City's population at 20,756. The 2010 Census allows the U.S. Census Bureau to infer a decline in the City's population by 11.5% with 55.7% identifying as female and 44.3% identifying as male. The median age within the City of Selma is 37.1. A strong majority of the City's population (99.1%) identify as one race alone, with 80.4% being Black or African American, 17.3% being White, 1.2% being Hispanic or Latino (of any race), 0.8% being Asian, and 0.1% being American Indian and Alaska Native.

Dallas County Industry: The U.S. Census Bureau's 2012 Economic Census reports the largest industry by number of employees to be "Manufacturing" and "Health care and social assistance" followed by "Retail trade" and "Accommodation and food services".

Dallas County Employment and Occupations: In October 2018 the Bureau of Labor Statistics reports Dallas County's unemployment rate at 6.4 percent, 2.6 percent higher than the unemployment rate for the state of Alabama. According to the U.S. Census Bureau's Quick Facts for Dallas County, Alabama, the percent of the population age 16 years and above in the civilian labor force from 2013-2017 is estimated to be 52.7%. According the U.S. Census Bureau's 2013-2017 American Community Survey 5-Year Estimates, the most common occupations within Dallas County, Alabama are "Management, business, science, and arts occupations" (27.0%), "Production, transportation, and material moving occupations" (25%), "Sales and office occupations" (21%), "Service occupations" (18%), and "Natural resources, construction, and maintenance occupations" (9%).

Dallas County Income and Poverty Status: Median household income in Dallas County is $30,065 with 27.9% of all people earning an income below the poverty level.

Social Statistics Important to City of Selma and Dallas County in Relation to Alabama and the Nation: While the subject area's population is contracting, there are thousands of citizens that continue to mark Dallas County, Alabama and observe the historic City of Selma as not only a part of their heritage but as an indelible part of our Nation's path to progress and the Voting Rights Act of 1965. Despite the difficult economic circumstances of the region, there is opportunity to strengthen the Selma Community and increase the citizen's resiliency with the mitigation of flood risk attributable to the Alabama River. The median household income is $24,223 and $30,065 for the City of Selma and Dallas County, respectively, in comparison to Alabama's median household income of $46,472 or the National median household income of $57,652 according to the U.S. Census's American Community Survey (ACS) 2013-2017 5-year estimates. The ACS estimates 38.3% and 31.9% of individuals live below the poverty level in Selma and Dallas County respectively. Additionally, 14.1% of Selma's population under the age of 65 have a disability, adding this group to the community's at risk population.

C.2.3.2. Floodplain Characteristics

The floodplain in the study area contains primarily residential development, with commercial structures dispersed along major thoroughfares and residential development in the surrounding area. Most of the commercial structures are slab-on-grade brick, metal, or prefabricated construction with first floor elevations of two feet or less above ground. Many of the residential structures are wood or brick construction with the first floor elevated one to two feet above ground. The residential development is typical of pre- and early post-WWII construction, having structures built on pier-type foundations. Some of the structures typifying post-WWII development have basements, and many more are slab-on-grade ranch and colonial style.

The floodplain within Selma is almost exclusively an urban area. No agricultural production is known to occur anywhere within the floodplain, with the exception of very small gardens of one acre or less. Development in the floodplain also includes the transportation, communication and utility infrastructure needed to serve the residents and businesses located in the area. This includes roads, bridges, storm-water collection and drainage structures, telephone networks and systems for water distribution, wastewater collection, natural gas, and electricity.

C.2.4. Methodology

In order to develop plans to address water resource problems within a study area, three conditions must be fully analyzed: the "existing" condition, the "future without project" condition, and the "future with project" condition.

In this analysis, the existing condition represents current floodplain conditions, which are in 2020 development and price levels. The future without project condition is the condition that would likely exist in the future without the implementation of a Federal project. This condition is evaluated for a 50-year period for urban flood control projects, and the results are expressed in terms of expected annual damages. For this study, the future without project condition is for the years 2025-2074. The future with project condition is the condition that would likely exist in the future with the implementation of a Federal project, using the same 50-year period as in the future without project condition.

The difference in expected annual flood damages to the floodplain properties between the future without and with project conditions represents the flood damage reduction benefits to the project. Economic and other significant outputs may accrue to the project as well, including recreation benefits, ecosystem restoration benefits, regional economic benefits, and other social effects. Other social effects, which often defy quantification in monetary terms, range from improvement in the quality of life within the study area to community impacts. This analysis attempts to recognize and, where possible, quantify all of the outputs of a Federal project in the study area.

C.2.4.1. Assumptions

This section of the analysis presents the assumptions used in computing average annual equivalent flood damages for the study area:

a. Floodplain residents will react to a floodplain management plan in a rational manner.
b. Real property will continue to be repaired to pre-flood conditions subsequent to each flood event.
c. The residential depth-percent damage relationships for structure and content contained in Economic Guidance Memorandum 01-03 and 04-01 are assumed to be representative of residential structures in the floodplain.
d. The residential depth-percent damage relationships for vehicles contained in Economic Guidance Memorandum 09-04 are assumed to be representative of vehicles in the floodplain.

e. Nonresidential depth-percent damage relationships for structure and content are from expert elicitation found in the revised 2013 draft report completed by the USACE Institute of Water Resources. Nonresidential flood depth-damage functions derived from expert elicitation are assumed to be representative of nonresidential structures in the floodplain.
f. The project's first costs and benefits will be annualized using the FY 2020 Federal discount rate of 2.75% assuming a period of analysis of 50 years.
g. All values are equivalent to 2020 dollars.
h. All project alternatives are evaluated for a 50-year period of analysis.
i. The project construction is scheduled to begin in 2025.

C.2.4.2. Risk and Uncertainty Factors

Risk and uncertainty are inherent in water resources planning and design. These factors arise due to errors in measurement and from the innate variability of complex physical, social, and economic situations. The measured or estimated values of key planning and design variables are rarely known with certainty and can take on a range of possible values.

C.2.4.2.1. Modeling Description

Risk analysis in flood damage reduction projects is a technical task of balancing risk of design exceedance with flood damage prevented; trading off uncertainty of flood levels with design accommodations; and providing for safe, reasonably predictable project performance. Risk-based analysis is therefore a methodology that enables issues of risk and uncertainty to be included in project formulation. A computerized risk-based model, Hydrologic Engineering Center-Flood Damage Reduction Analysis (HEC-FDA); version 1.4.2 (July 2017) was used in this analysis. This model is a product of the USACE and was created by the Corps' Hydrologic Engineering Center in Davis, California. HEC-FDA is a certified model used for flood damage analysis. It is a frequency-based model, relating expected flood damages to flood frequency and incorporating a multitude of variables.

C.2.4.2.2. Modeling Variables

Uncertainty was quantified for errors in the underlying components of the stage-damage relationship: structure values for residential and nonresidential structures, vehicle values for residential structures, depth-percent damage relationship for both residential and nonresidential structures, content to structure value ratios for residential and nonresidential structures, and first elevations for all structures.

a. Residential Structural Values - Structure values are crucial sources of uncertainty in the stage-damage relationship. Structure values play an important role in determining the dollar value of damage caused by a given depth of flooding in the structure itself, both to the structure itself and the contents of the structure. In this analysis, all of the existing condition structure values were obtained from S&W Minicomputers, Inc, which is a contractor of the Dallas County Tax Assessor's Office. S&W Minicomputers uses a computer software to derive total replacement value for a structure multiplied by a value based on "Observed Condition". This observed condition is equivalent to a depreciation factor. This derived value was exclusive of market and land values and meant to reflect an estimated replacement value estimate less depreciation for the residential structures. Furthermore, using the Marshall & Swift Residential Estimator Software Program, these values were compared to similar structures derived by the program and the results were comparable. Therefore, the residential structural values obtained from the tax assessor's contractor were verified as being reasonable estimates of replacement cost less depreciation. Moreover, in order to quantify the uncertainty surrounding the values calculated for the residential structure inventory, based on the 2019 RS Means Square Foot Costs Data catalog, the uncertainty surrounding the residential structure values was based on a triangular probability for each occupancy category. The triangular probability distributions based on the depreciation percentage associated with an observed age (determined using professional judgment) were entered into the HEC-FDA model to represent the uncertainty surrounding the structure values in each residential occupancy category.

b. Vehicle Inventory and Values - Based on 2013-2017 American Community Survey 5-year estimates for the study area, it was determined that the average household had 1 vehicle available. Economic Guidance Memorandum, 09-04, Generic Depth-Damage Relationships for Vehicles (2009) states that the average number of people who do not move vehicles to higher ground during flooding events is 26.93% (i.e. the average of the respondents who did not move vehicles given warning). That is to say, 26.93% of vehicles remain in the area of flooding and are susceptible to flood damages. According to the Edmunds 2018 Used Vehicle Market Report, the average price of a used vehicle was $19,657 at an average age of 4.5 years. Since only 26.93% of vehicles remain susceptible to damage during a flood event, a value of $5,293 (1*$19,657*0.2693) was assigned to each residential structure record in the HEC-FDA model. Vehicle damages were only calculated for residential properties, and not applied to nonresidential properties such as warehouses or offices. The Edmund's vehicle value adjusted for number of vehicles per household and for the evacuation of vehicles prior to the storm event was used as the most likely value. If an individual structure had more than one housing unit, then the adjusted vehicle value was assigned to each housing unit in a residential or multi-family structure category. Moreover, the uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function with a maximum of 168% and a minimum of 21%, the mean value in the triangular distribution is the value of the vehicle within the structure inventory. The average value of a new vehicle before taxes, license, and shipping charges was used as the maximum value. The average 10-year depreciation value of a used vehicle was used as the minimum value which is approximately 21%. These maximum and minimum percent values were entered in as the maximum and minimum values of the triangular distribution.

c. Nonresidential Structural Values – In this analysis, most of the existing condition structure values were obtained from S&W Minicomputers, Inc, which is a contractor of the Dallas County Tax Assessor's Office. S&W Minicomputers uses a computer software to derive total replacement value for a structure multiplied by a value based on “Observed Condition”. This observed condition is equivalent to a depreciation factor. This derived value was exclusive of market and land values and meant to reflect an estimated replacement value estimate less depreciation for the residential structures. Furthermore, using the Marshall & Swift Nonresidential Estimator Software Program, these values were compared to similar structures derived by the program and the results were comparable. Therefore, the nonresidential structural values obtained from the tax assessor’s contractor were verified as being reasonable estimates of replacement cost less depreciation. The uncertainty surrounding the nonresidential structure values was based on the 2019 RS Means Square Foot Costs Data catalog depreciation percentages. A triangular probability distribution based on the depreciation percentage associated with an observed age (determined using the professional judgment of personnel familiar with the study area) and the type of frame structure was used to represent the uncertainty surrounding the nonresidential structure values in each occupancy category.

d. Residential Depth-Damage Curves - The structure and content depth damage functions relate flood damage as a percent of the value of the structure or contents at various depths of flooding above the first floor elevation. These functions are contained in Economic Guidance Memorandum (EGM) 01-03 and EGM 04-01 and are based on surveys administered through the Corps of Engineers’ Institute for Water Resources. The functions show strong correlations between depth of flooding and percent of value in structure damage. The residential structures in the Selma floodplain are represented by these curves. Moreover, both EGM contained a normal distribution function with an associated standard deviation of damage to account for uncertainty surrounding the damage percentage associated with each depth of flooding.

e. Nonresidential Depth-Damage Curves - The structure and content depth damage functions relate flood damage as a percent of the value of the structure or contents at various depths of flooding above the first floor elevation. These functions are contained in the Draft Report, Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation. These values can be found in Appendix D, Tables D-22 through D-42 for structures and Tables D-42 through D-63 for content, of the report. In 2008, the Federal Emergency Management Agency (FEMA) contracted to have an expert elicitation panel derive nonresidential content-to-structure value ratios and flood depth-damage functions for 21 of the most commonly affected categories of nonresidential properties. USACE Institute for Water Resources (IWR) fully participated in the planning, process, implementation, and analysis of the results. The functions show strong correlations between depth of flooding and percent of value in structure damage. The vast majority of the nonresidential structures in the Selma are represented by these curves. Moreover, these functions contained a triangular distribution (i.e. minimum, maximum, most likely) to account for the uncertainty surrounding the damage percentage associated with each depth of flooding.

f. Residential Content to Structure Value Ratio - The content to structure value ratios included in this report are the content depth damage curves contained in the aforementioned EGM 01-03 and EGM 04-01. Moreover, both EGMs contained guidance to account for uncertainty associated with content/structure value ratio, which implies that the uncertainty in the content-to-structure value ratio should be inherent in the content depth-damage relationship as contained in both EGMs.

g. Nonresidential Content to Structure Value Ratio - The content to structure value ratios included in this report are contained in the aforementioned draft report, Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation, specifically Appendix E, Table E-1. Moreover, these functions contained a triangular distribution (i.e. minimum, maximum, most likely) to account for the uncertainty surrounding the ratio for each nonresidential occupancy type.

h. First Floor Elevations – Topographical data obtained from the Light Detection and Ranging (LIDAR) survey with a March 2018 published date for the study area was used to determine ground elevations, in NAVD88 datum, at the centroid of each parcel where the structure is most likely located. The height above ground were estimated from windshield survey of the structures in the study area which was conducted in 2018. The sum of the ground elevation plus the finished floor height above ground elevation is the first-floor elevation. Vehicles were assigned to the ground elevation of the adjacent residential structures. A first-floor standard deviation of 0.6 feet assuming normal distribution was used to quantify uncertainty based on guidance found in Engineering Manual (EM) 1110-2-1619, Table 6-5, aerial survey, 2-ft contour interval (i.e. 0.3ft for ground elevation plus 0.3ft for foundation height). The datum used to determine first floor elevations is the same datum Hydrology and Hydraulics Engineering used to determine water surface elevations.

C.2.5. Existing Condition

In December 2018, personnel from the U.S. Army Corps of Engineers surveyed the structure inventory within the City of Selma study area. Parcel data was obtained from the Dallas County tax assessor's office and used to build a GIS database identifying which parcels fell within the FEMA 0.002 AEP floodplain. The structure inventory survey identified 1,436 structures within 1,216 parcels, not including vacant lots. Moreover, there are no structures that fell within the FEMA floodway. The inventoried structures were categorized as Residential or Nonresidential.

Structure inventory depreciated replacement values were provided by S&W Minicomputers, Inc., which is a contractor of the Dallas County Tax Assessor's Office. The generic structure to content value ratios and depth-damage relationships were used from EGM 04-01, EGM 01-03 and the Revised 2013 Draft Report: Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation.

C.2.5.1. Reach Delineation

The term “reach” describes a section of the stream having similar hydraulic, hydrologic, political, geographic, or economic characteristics. Dividing the floodplain into reaches facilitates evaluation of flood damages by breaking the floodplain down into several areas having some common features and analyzing them separately. The Selma floodplain consists of one reach, which is defined by specific river stations on the Alabama River from the Hydrologic Engineering Center–River Analysis System (HEC-RAS) model outputs (Engineering Appendix for more details).

C.2.5.2. Structure Inventory Delineation

The setting of Selma is mostly urban and the floodplain itself is mostly developed. However, it is unlikely that the floodplain itself will experience significant development in the future. The structure inventory has not changed much in the last decade. Moreover, according to the U.S. Census Bureau, the City of Selma had a total population of 18,310 as of July 1, 2017 which represents decline of about 11.5% from the 2010 Census, which reported the City’s population at 20,756. Currently, the Selma structure inventory contains about 1,436 structures on 1,216 parcels (i.e. those structures located in Selma within the 0.002 AEP floodplain). Residential structures accounted for 1,175 structures, with the remaining 261 being nonresidential: Public, Commercial, and Industrial. Residential structures consisted of Single Family Dwelling, Mobile Homes, Multi Family Dwelling, and Temporary Lodging. Public structures consisted Religious and Educational Buildings. Commercial structures consisted of Convenience Stores, Restaurants, Office Buildings, and Service Stations. Industrial structures consisted of Warehouses. **Table C-1** and **Figure C-2** summarize the number of structures in the reach along with the depreciated replacement cost and vehicle depreciated replacement cost, and breakdown of the structures for the study area. **Table C-1** also shows the value of the inventory for residential and nonresidential properties stated in 2020 dollars.

Table C-1: Selma (Existing Condition Structure Inventory in $1,000, 2020 Prices)

Reach	Residential Structures	Non-Residential Structures	Total Structures	Structure Value	Content Value	Vehicle Value	Total Value
Alabama River	1,175	261	1,436	$177,480	$116,369	$11,918	$305,766

The abovementioned structure inventory was modeled in HEC-FDA using stage-damage relationship with uncertainty, along with stage-probability relationship with uncertainty. The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study reach in the existing and future conditions. The possible occurrences of each economic variable were derived through the use of Monte Carlo simulation and a total of 1,000 iterations were executed by the model for the Selma study. The sum of all sampled values was divided by the number of samples to yield the expected value for a specific simulation. A mean and standard deviation was automatically calculated for the damages at each stage. The HEC-FDA model used an equivalent record length of 30 years (verified with Hydrology and Hydraulic Engineer) for each study area reach to generate a stage-probability relationship with uncertainty for the existing and future without project conditions through the use of graphical method because discharge-probability was not used in the model. The model used the eight stage-probability events together with the equivalent record length to define the full range of the stage-probability or stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided. The eight AEPs that water surface profiles were provided for use in the damage calculations are as followed: 0.5 (2-year), 0.2 (5-year), 0.1 (10-year), 0.04 (25-year), 0.02 (50-year), 0.01 (100-year), 0.005 (200-year), and 0.002 (500-year).

Figure C-2: Location of Structures by Type

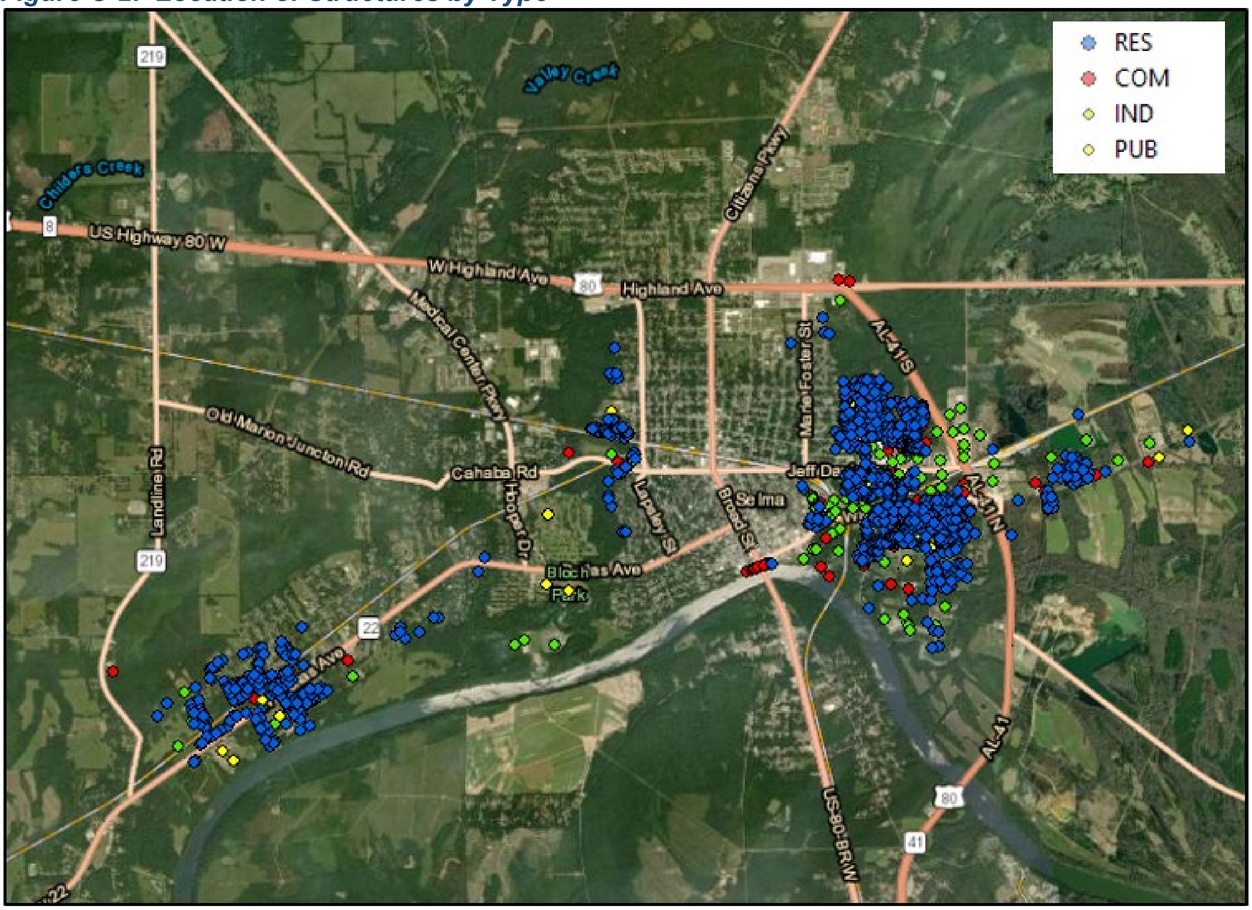


Table C-2 displays water surface profiles at the index location for each study area reach. The index location is a stream location (located upstream of Selma) within a damage reach and used to specify discharge-probability, stage-discharge, and stage-damage functions with uncertainty data for plan evaluations for that damage reach. Damages were reported at the index location for the study area reach. Following the conclusion of the Monte Carlo simulation, a mean was calculated from the observed expected annual damage calculation. **Table C-3** displays the existing condition mean expected annual damages according to reach and damage category.

Table C-2: Existing Condition Water Surface Profiles

Reach	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Selma	105.53	110.97	114.20	116.53	118.89	120.41	121.77	124.02

Table C-3: Existing Condition Mean Expected Annual Damages within the Selma Reach ($1,000, 2020 Prices)

Damages Category	Damages
Residential	$831
Nonresidential	$920
Total	$1,751

According to **Table C-3**, there are about $1.75 million in expected annual flood damages under the existing condition. The existing flood damages are the potential average annual dollar damages to structures, contents, and vehicles affected by flooding at the time of the study. No projection is involved, and the existing condition encompasses relevant factors that best characterize the planning perceptions of the affected area in the situation without a plan. As shown in the modeling results, the nonresidential damages make up the majority total damages even though majority of the structure inventory is residential. (reference **Figure C-2**). There are three main reasons to explain this. First, most of the flood damages are concentrated in Ward 8 of the study area (reference **Figure C-1**). Secondly, within Ward 8, most of the residential structures are 1-story single family structures that have a first floor elevation above 0.01 AEP. Thirdly, most of the nonresidential structures that are shown to receive damages consisted mainly of industrial warehouses, religious building, and commercial-convenience store with higher structure and content values. This existing condition provides the data from which to evaluate the condition that would likely exist in the future without the implementation of a Federal project. Under the future without project condition, which represents expected annual damages in the absence of a flood damage reduction project, damages are expected to increase, as development within the drainage area increases and contributes to higher runoff rates. Those higher runoff rates translate into higher stages in the future and correspondingly higher water surface profiles for any given flooding event.

C.2.6. Future Without Project Condition

The years 2025-2074 were selected to represent the future without project condition. No additional development within the 0.01 AEP floodplain of the study area is anticipated since the floodplain is essentially fully developed now and since the study area is a participant in the Federal Flood Insurance Program. The same 1,436 structures lying in the floodplain will continue to be affected by the risk of flooding and suffer increasing losses each year. Most of the structures in the study area are located outside the future without 0.01 AEP floodplain (reference Figure C-2).

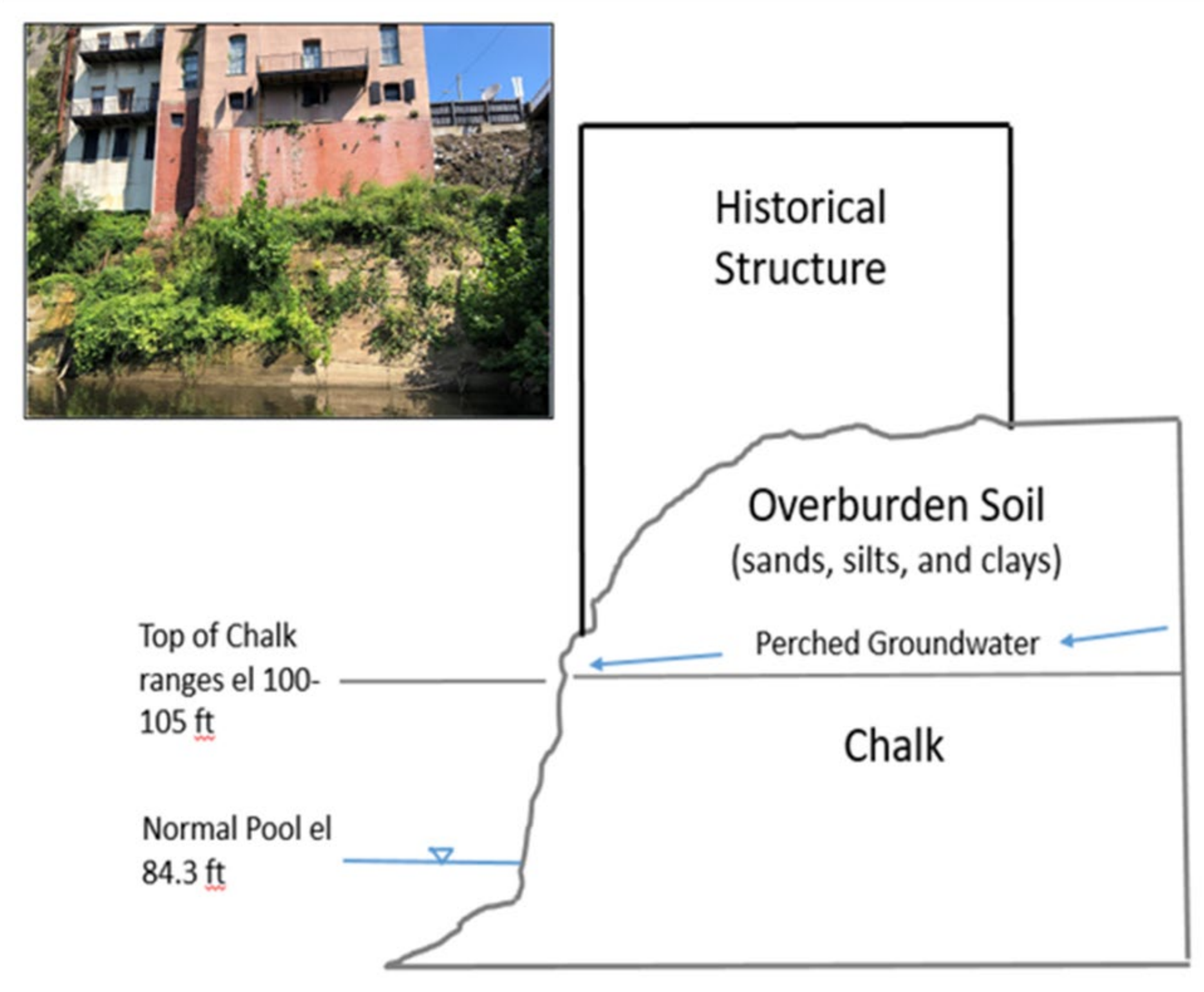
Furthermore, in the future without project condition, Water Avenue and the structures that sit along the bank of the Alabama River (see Figure below taken from Google Earth) would continue to experience structural/foundation damages that would lead to higher maintenance costs for the city and private owners and could present a life and safety risk to the public over time as the erosional conditions continue to compromise the structural integrity of the infrastructure.

Figure C-3: Water Avenue along the Alabama River in Selma, Alabama showing Historic structures along the riverbank

The foundations of these structures appear to be set in the overburden alluvial deposits, with little to no soil coverage on the riverside of the foundation. The chalk is somewhat impervious, causing concentrated groundwater to exit the bank slopes within the overburden material as this layer becomes saturated. This continual process could potentially result in material loss beneath the building foundations which, over time, would destabilize the buildings. **Figure C-4** below shows a generalized cross section of the geology of the river bank.

The interface of the overburden soils and underlying chalk fluctuates from approximate elevation 100 to 105 ft in the Study Area. When comparing this to river elevation, it puts the boundary of the two layers approximately 15 to 20 ft above the normal pool level of 84.3 ft. According to historical hydrologic data, this layer would see loading due to the river cresting at around the 0.5 AEP (2-year) flood event. This a fairly frequent loading and shows that minor flooding of the River could contribute to the building instability.

Figure C-4: Cross Section of the Downtown Selma Bluffs



Moreover, additional development within the drainage region, but at elevations beyond the 0.01 AEP, is possible. The development, consisting of a variety of commercial, industrial, and residential construction, will contribute to an increase in the land area impervious to storm water runoff. This in turn will lead to slightly higher stream inflows at any given event and somewhat higher stages at the various flood frequencies as shown in **Table C-4**. **Table C-4** and **Table C-5** display future without project condition water surface profiles at the index location for each study area reach and single event damages without uncertainty for the study area.

Table C-4: Future Without Project Condition Water Surface Profiles

Reach	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Selma	105.81	111.58	114.49	116.94	119.24	120.73	122.22	124.41

Table C-5: Future Without Project Condition Single Event Damages (1,000, 2020 Prices)

Event	0.5	0.2	0.1	0.04	0.02	0.01	0.005	0.002
Total	$0	$0.082	$0.519	$3,989	$20,686	$35,354	$54,621	$95,848

The result is an increase in the expected annual damages for the future, meaning that the losses suffered by the affected structures will increase between 2025 and 2074. As shown in **Table C-5**, the single event damages reflect the fact that it is not until the 0.04 AEP and greater event that structures begin to accrue damages. Like that of the existing condition, the HEC-FDA used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of exceedance (probability). From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the "without project" condition, the expected annual damages (EAD) were totaled for each study area reach to obtain the total without project EAD under future (2025 and 2074) conditions as shown in **Table C-6**.

Table C-6: Future Without Project Condition for the Selma Reach(1,000, 2020 Prices)

Selma Reach by Year	Residential	Nonresidential	Total
Base Year 2025	$831	$920	$1,751
Future Year 2074	$960	$1,054	$2,014

Moreover, damages for each of the years during the period of analysis were computed by linear interpolation between 2025 and 2074. The FY 2020 Federal discount rate of 2.75% was used to compound the stream of expected annual damages and benefits before the project base year and to discount the stream of expected annual damages and benefits occurring after the base year to calculate the total present value of the damages over the period of analysis. The present value of the expected annual damages was then amortized over the 50-year period of analysis using the Federal discount rate to calculate the equivalent annual damages. The results are shown in **Table C-7**.

Table C-7: Future Without Project Equivalent Annual Damages within the Selma Reach ($1,000, 2020 Prices)

Damages Category	Damages
Residential	$880
Nonresidential	$970
Total	$1,850

The forecasted higher stages in the future, without a project in place, resulted in higher damages. According to **Table C-7**, the total future "without project" equivalent annual damages are approximately $1.85 million. This figure represents the maximum possible annual benefits accruable to a flood damage reduction project at Selma (i.e. with project condition). The forecast of the future without project condition reflects the conditions expected during the period of analysis and provides the basis from which alternative plans are evaluated, compared, and selected since a portion of the flood damages would be prevented (i.e. flood damages reduced) with a Federal project in place.

C.2.7. Future With Project Condition

The future with project condition is the most likely condition expected to exist in the future if a specific project is undertaken. There are as many future with project conditions as there are project alternatives. A total of ten alternatives were considered for the Selma Flood Risk Management Study. Of these, three were structural, one was nonstructural, and the remaining seven were combinations of structural plans with the nonstructural plan. The nonstructural plan did not include a recreation plan. A description of the alternatives is listed in **Table C-8**.

Table C-8: Initial Array of Alternatives Description

Array of Alternatives	Plan Description
No Action Alternative (NAA)	No Federal undertaking would occur, and the results would be consistent with FWOP conditions.
Alt. 1: Non-Structural (A-Buyouts, B-Raise Structural Elevation, Structural move)	There are two (2) non-structural alternatives considered. Alternative 1.A includes buyouts which entails the acquisition of parcels, relocation of inhabitants, and demolition of structures. Alternative 1.B includes elevating structures or moving structures altogether out of the floodplain within Ward 8.
Alt. 2: 1967 Selma Levee	1967 Selma Levee with Selmont Levee alignment with floodgates/pumps where needed, buyout as necessary
Alt. 3: Optimized (Short) Selma Levee	Shortened/optimized levee alignment, U.S. Highway 80 tie in, floodgates/pump station where needed, buyout as necessary
Alt. 4: Bank Stabilization	Provide bank stabilization along all or part of RM 256-261
Alt. 5: Bank Stabilization + Buyouts	Combines Alternatives 4 & 1.A-Buyouts.
Alt. 6: Optimized Selma Levee + Buyouts + Bank Stabilization	Combines Alternatives 3 & 4 & Partial Non-Structural Alt.1 in areas not within the Optimized Levee alignment
Alt. 7: Optimized Selma Levee + Valley Creek Levee + Pump Station & Sluice Gate + Bank Stabilization	Combines Alternatives 3 & 4 & a smaller levee at Valley Creek & a pump station with a sluice gate at Beaver Dam Branch (maximum structural protection)
Alt. 8: Optimized Selma Levee + Valley Creek Levee + Buyouts + Bank Stabilization	Combines Alternative 6 plus Valley Creek levee (only purchase, relocation or raising elevation in the Ward 1 considered)
Alt. 9: Optimized Selma Levee + Valley Creek Levee + Buyouts	Combines Alternative 3, levee at Valley Creek (purchase, relocation or raising elevation in the Ward 1 considered)

Array of Alternatives	Plan Description
Alt. 10: Optimized Selma Levee + Valley Creek Levee + Pump Station with Sluice Gate	Alternative 7 with No bank stabilization (maximum structural protection without bank stabilization)

C.2.7.1. Evaluation of Alternative Plans

Table C-9 demonstrates a qualitative check to determine which of the initial alternatives met study objectives and avoided constraints. Alternatives that met a minimum of two (2) criteria were kept for further consideration. All screened alternatives are denoted in blue highlight and further discussed in the Plan Selection section of the Main Report. After further refinement and screening of the initial array, those carried became the Focused Array of Alternatives.

Table C-9: Screening of Initial Array into Focused Array of Alternatives

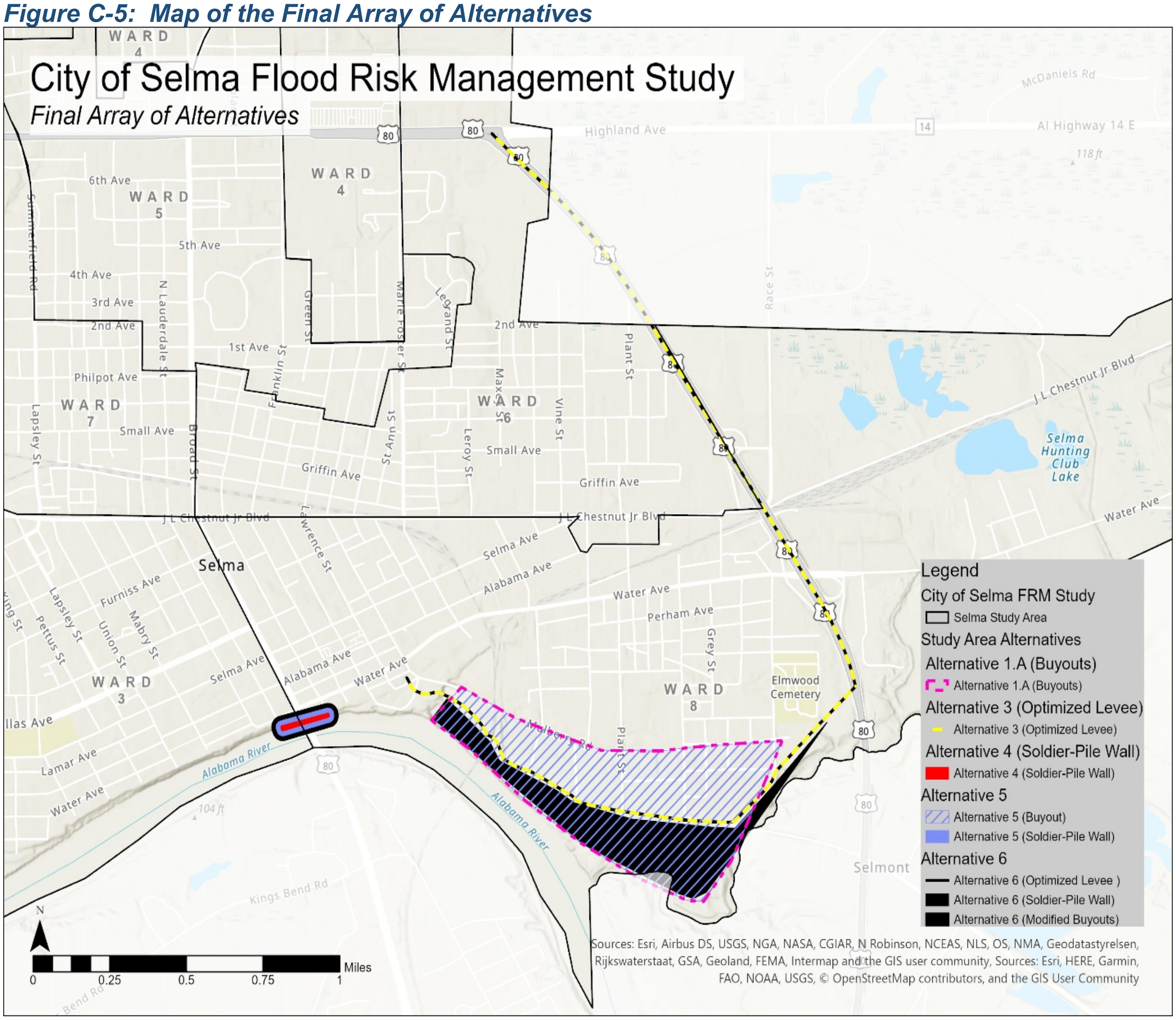
Alternative Description	Feasible	Meets Objectives	Avoids Constraints
Alt. 1.A – Buyout	Yes	Partially	Partially
Alt. 1.B – Elevation/Relocation of Structures (screened)	No	Yes	Partially
Alt. 2 – 1967 Levee	Partially	Yes	Partially
Alt. 3 – Optimized Levee	Yes	Yes	Partially
Alt. 4 – Bank Stabilization+ Rip Rap	Yes	Partially	Yes
Alt. 5 – Bank Stabilization + Buyout	Yes	Yes	Partially
Alt. 6 – Optimized Levee + Buyout + Bank Stabilization	Yes	Yes	Partially
Alt. 7 – Optimized Levee + Valley Levee + Pump Station/Gates + Bank Stabilization (screened)	No	Partially	No
Alt. 8 – Optimized Levee + Valley Levee + Buyout + Bank Stabilization (screened)	No	Yes	No
Alt. 9 – Optimized Levee + Valley Levee + Buyout (screened)	No	Partially	No
Alt. 10 – Optimized Levee + Valley Levee + Pump Station w/ Sluice Gate (screened)	No	No	No

The focused array of alternatives was screened based on their ability to meet objectives, avoid/minimize constraints, adherence to the four planning criteria, as well as their resiliency and sustainability. Bank stabilization construction methods, or “options”, were evaluated based on professional judgment and engineering feasibility to inform the selection for Alternative 4. Of the entire focused array, only Alternative 2 was screened from further analysis (reference Plan Selection section of Main Report for more details).

The alternatives that were carried forward were identified as the final array of alternative plans (**Figure C-5**):

- Alternative 1.A (Buyout);
- Alternative 3 (Optimized Levee);
- Alternative 4 (Bank Stabilization
- Alternative 5 (Bank Stabilization and Buyout); and
- Alternative 6 (Combination of Alternative 1.A and 5, but with a modified buyout footprint to capture parcels within Ward 8 and outside the levee alignment).

Figure C-5: Map of the Final Array of Alternatives



Relevant data for each of the alternatives described above were entered into the HEC-FDA and potential for flood damages reduced were calculated. The modeling results for each alternative are summarized as follows:

C.2.7.1.1. Alternative 1

Alternative 1.A. was a nonstructural solution that entailed a buyout of structures. This plan provides for permanent evacuation and demolition of floodplain structures. Grouping for those structures identified as candidates for buyouts considered vulnerability to flood risk, location within the 0.01 AEP floodplain extent, depths of flooding, and community cohesion (reference Plan Selection section of Main Report for more details). Approximately 25 parcels were identified within the buyout footprint encompassing approximately 170 acres. Implementation of this alternative would require acquisition of structures and relocation of inhabitants. Structures would then be demolished. Staging areas for demolition would be located within each parcel. Access would be obtained using existing roads. This alternative would take approximately 18 months to complete.

Alternative 1 did not produce any reductions in water surface elevations because structures that were identified as candidates for a buyout were removed from the structure inventory. Therefore, in the model, the only difference is in the structure inventory for future with and without project conditions. The water surface elevations used in the modeling of this alternative stayed the same. A summary of the residual flood damages and flood damage reductions are shown in **Table C-10** for Alternative 1.

Table C-10: Alternative 1, Buyouts Equivalent Annual Damages within the Selma Reach ($1,000, 2020 Prices)

Category	Damages	Reduced	Residual
Residential	$792	$88	90%
Nonresidential	$947	$23	98%
Total	$1,739	$111	94%[1]

In Selma, damages reduced were reflective of those structures removed from the floodplain. Since Alternative 1 is a nonstructural plan, the benefits can be evaluated using an alternative land use approach. In this approach, the candidate structures for buyouts are removed, and the land can no longer be used for urban development. An alternative land use can then be implemented such as recreation. However, the nonstructural plan did not include a recreation plan. Recreation was not considered for the buyout alternative because any propose recreational activities for the evacuated floodplain would be one of low quality passive recreation such as running, walking, and picnicking. In addition, there exist many parks in the Selma area such as Historic Riverfront Park, Phoenix Park, Lafayette Park, and Bloch Park that offer such passive recreation. Moreover, the city itself is and has experience a decline in population and has limited funds available to maintain recreational areas. Furthermore, there would be a lack of access to the areas proposed within the buyout area because of its location. The proposed buyouts area not located in the historic district nor would it offer any visitors the historical viewshed that is distinct to Selma.

C.2.7.1.2. Alternative 3

[1] Residual Damages for Ward 8 only was approximately 92%.

Alternative 3 is an optimized levee with two components: "new" levee construction and U.S. Highway 80 revetment and reinforcement. The full alignment would span approximately 1.6 mile of "new" levee construction across the southern portion of Ward 8 and approximately 2.0 mile of U.S. Highway 80 revetment and reinforcement for a total of 3.6 mi. The base of the "new" levee within Ward 8 would span approximately 94 ft wide, therefore the "new" levee construction would span approximately 18 acres. Two flood gates would be placed at intersections along U.S. Highway 80. Disposal areas would be required to place excavated material. Staging areas would also be required to contain all construction material necessary to build the levee and reinforce U.S. Highway 80; however potential locations for this alternative have not been identified. Access would be obtained using existing roads. This alternative would take approximately 36 months to complete.

This optimized levee alignment as modeled would reduce the majority of flooding risk in Ward 8. Therefore, the idea was that all other alignments would only accrue additional costs and not reduce any further flood damages. A summary of the residual flood damages and flood damage reductions are shown in **Table C-11**.

Table C-11: Alternative 3, Optimized Levee Equivalent Annual Damages within the Selma Reach ($1,000, 2020 Prices)

Category	Damages	Reduced	Residual
Residential	$694	$186	79%
Nonresidential	$795	$175	82%
Total	$1,489	$361	80%[2]

Alternative 3 reduced water surface elevation in the proposed levee area up to a level equivalent to the 0.01 AEP. However, it was shown, by modeling, to induce flooding to structures upstream, downstream, and in areas located directly opposite the levee across the Alabama River (reference Engineering Appendix for more details). These areas across from the levee included the town of Selmont, Alabama. Moreover, it was determined that in order to mitigate for this induced flooding another levee would be needed in Selmont.

C.2.7.1.3. Alternative 4

Alternative 4 provides bank stabilization of Selma's historic riverfront. This erosion control measure provides bank stabilization along all or part of River mile 256-261, Selma's historic riverfront, where historic structures adjacent to the Edmund Pettus Bridge are located. The majority of benefits for a FRM study using the HEC-FDA model largely accrue from inundation reduction benefits which are considered NED benefits. The HEC-FDA Model, using depth damage functions, does not capture physical damages attributable to inundation of foundations for structures sitting on a bluff, as is the case for Selma's historic riverfront. ER 1105 -2-100 defines physical damages as:

[2] Residual Damages for Ward 8 only was approximately 75%.

"Physical damages. Physical damages occur to residential, commercial, industrial, institutional, and public property. Damages occur to buildings, contents, automobiles, and outside property and landscaping. Physical damages include the costs to repair roads, bridges, sewers, power lines, and other infrastructure components. Physical damages also include the direct costs and the value of uncompensated hours for cleanup after the flood."(USACE, 2000, pg.3-15)"

Therefore, residual flood damages and flood damage reductions could not be derived for a bank stabilization alternative. In the case of Selma's historic riverfront, the river bank and foundation are being inundated up to elevation of about 120 feet during a moderate flood. The historic structures' foundations and soils are being inundated while their first floor elevations are not. As the flood water recedes, shear failures occur to the foundations (reference Engineer Appendix for more details). These shear failures threaten the structural integrity of these historic structures resulting in damages.

Benefits for the bank stabilization could consider the value of the loss of the historic structures, visitation, and business along the riverbank (reference RED section of this Appendix). These historical site's structures have an estimate depreciated replacement cost of about $3.8 million or an estimated market value of $5.4 million and could be loss over time. Several structures at this location of river bank have been demolished due to the resulting instability of its foundation.

As stated in Study Authority Section, this study was granted the permission to continue evaluating bank stabilization as stated in the memorandum for the Commander dated February 25, 2020 from HQ USACE to SAD, and in accordance with Section 1203 of America's Water Infrastructure Act of 2018 as authorized. Moreover, a NED Exception was granted for the Selma Alabama FRM Study (MFR from the ASA(CW) to HQ USACE dated June 10, 2020). In support of the approval that was granted by ASA (CW) for the NED Exception, HQ, USACE, in an endorsement MFR, dated 16 July 2020, allowed for an analysis of the erosion control measure using Section 14 methodology of the Flood Control Act of 1946 (Public Law 79-526), as amended, for emergency streambank and shoreline protection for public facilities and services. This methodology calls for formulation and evaluation of an alternative using the least cost approach. The plan is justified if the total cost of the alternative is less than the costs to relocate the threatened structures as stated below:

"The proposed TSP includes river embankment stabilization via a retaining wall to protect historic buildings in the downtown area adjacent to the Edmund Pettus Bridge. Stream bank stabilization can be considered in the formulation of a project for Selma in accordance with Section 1203 of WRDA 2018. It needs to be demonstrated that the recommended plan is the least cost plan to mitigate the erosion. That analysis has not been completed and it was not discussed in the exception request. The approach to formulating a project under Section 14 of the Flood Control Act of 1946, as amended, could be applicable to the Selma study. For Section 14 investigations, the formulation and evaluation of alternatives focus on the least cost alternative solution. The least cost plan is justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility. The monetary cost of relocation of the structures, and the potential impacts to historic resources including the view shed should be analyzed at an appropriate level of detail to determine the costs of relocation."

Therefore, Alternative 4 was further refined to focus on bank stabilization along Water Avenue in Selma based on areas most vulnerable to erosion and sloughing. Construction methods, presented as "options", included a range of river shoreline stabilization techniques that were based on similar USACE projects.

C.2.7.1.3.1. Bank Stabilization Option 1, Sheet Pile Wall

Placement (driving) of the sheet-pile wall could affect existing structures and foundations and lead to failure of the structures. Contractors may be reluctant to assume the liability for this construction method. Because this variant of the alternative could negatively impact the stability of the historic structures along the bank stabilization this option was screened from further evaluation and comparison.

C.2.7.1.3.2. Bank Stabilization Options 2a/b, Riprap and/or Extension

This construction method presents both constructability and aesthetic concerns. This method would require a severe setback and the toe would extend far into the Alabama River, which would cause navigation impediments. As such, this configuration was screened out from further analysis.

C.2.7.1.3.3. Bank Stabilization Option 3, Cast in Place:

This construction method is aesthetically pleasing; however, it requires coffer dams and dewatering which adds a significant amount to the cost of construction. Environmental impacts resulting from the dewatering would be substantial. Therefore, this configuration was screened out from further analysis.

C.2.7.1.3.4. Bank Stabilization Option 4, Soldier-Pile Wall and Riprap

Construction is not likely to affect existing structures and foundations. It also presents the least environmentally damaging impacts to natural resources, cultural artifacts, and Unexploded Ordnances (UXO(s)). Therefore, this configuration was selected as the Bank Stabilization structural design for Alternative 4.

C.2.7.1.3.4.1. Soldier-Pile Wall Least Cost Analysis

The structures along this bank include are nationally registered properties and part of the Water Avenue and Historic Districts. These structures compose the viewshed of the National Historic Landmark, the Edmund Pettus Bridge. Although the market value of these structures is approximately $5.4 million or about $3.8 million in depreciated replacement cost, the historic and regional economic value of these structures and what they represent for not only the city of Selma but for the nation and the local economy cannot be overstated. The structures are the viewshed of the Edmund Pettus Bridge, one of the most recognizable Civil Rights sites in the United States and comprise the tourism hub of Selma, Alabama. Loss of these structures would be detrimental to Selma's economy and the negative economic impacts would reverberate significantly in Civil Rights tourism throughout the region of central Alabama (this is investigated more in the RED analysis).

Many of the threatened structures were constructed during the late 1800s or early 1900s making relocation exorbitantly expensive. Taking these factors into account brings potential relocation costs to approximately $132 million[3]. **Table C-12** outlines the least cost alternative method using the Section 14 methodology of the Flood Control Act of 1946 (Public Law 79-526), as amended, for emergency streambank and shoreline protection for public facilities and services in which the cost analysis utilized the relocation cost as a base comparison.

Table C-12: Bank Stabilization Least Cost Analysis

Alternative	Construction Costs	O&M Costs
Relocation (base cost)	$132,000,000	$0
Soldier-Pile Wall	$27,537,000	$4,000

C.2.7.1.3.4.2. Soldier-Pile Wall NED Benefits

As mentioned in the previous section, the structures located on Selma's Historic Riverfront compose the viewshed of Edmund Pettus Bridge; therefore, the values of these structures are not solely based on of their physical characteristics but also their cultural and historical value to the Nation. As the viewshed of the Edmund Pettus Bridge, these structures merit Federal participation to reduce flood risk to these structures. As evidence for this, a NED Exception was granted for the Selma Alabama FRM Study (MFR from the ASA(CW) to HQ USACE dated June 10, 2020). Moreover, in endorsement MFR, dated July 16, 2020 (as reference in Section 1.7.1.3), HQ USACE required that the monetary cost of relocation of the structures, and the potential impacts to historic resources including the viewshed should be analyzed at appropriate level of detail to determine the cost of relocation.

Given this guidance, for the soldier-pile wall NED analysis, it was assumed that increased flood-induced erosion and subsequent sheer bank failures are threatening the viewshed; therefore, would destabilize these structures along the historical riverfront within the 50 year the period of analysis. And that the alternative to the soldier-pile wall would be the relocation of these structures. Therefore, the cost of relocation of these structures would be counted as the benefit of the soldier-pile wall (i.e. cost avoided) because the opportunity cost of constructing the soldier-pile wall to protect the viewshed would be the cost of relocating these structures.

Estimated relocation costs is approximately $132 million. Depending on the year of relocation (which is assume to occur within the 50 year period of analysis), the present worth of this relocation cost ranges from about $128 million in year 1, 2025, (i.e. high

[3] Approximated costs are based on best professional engineering judgment.

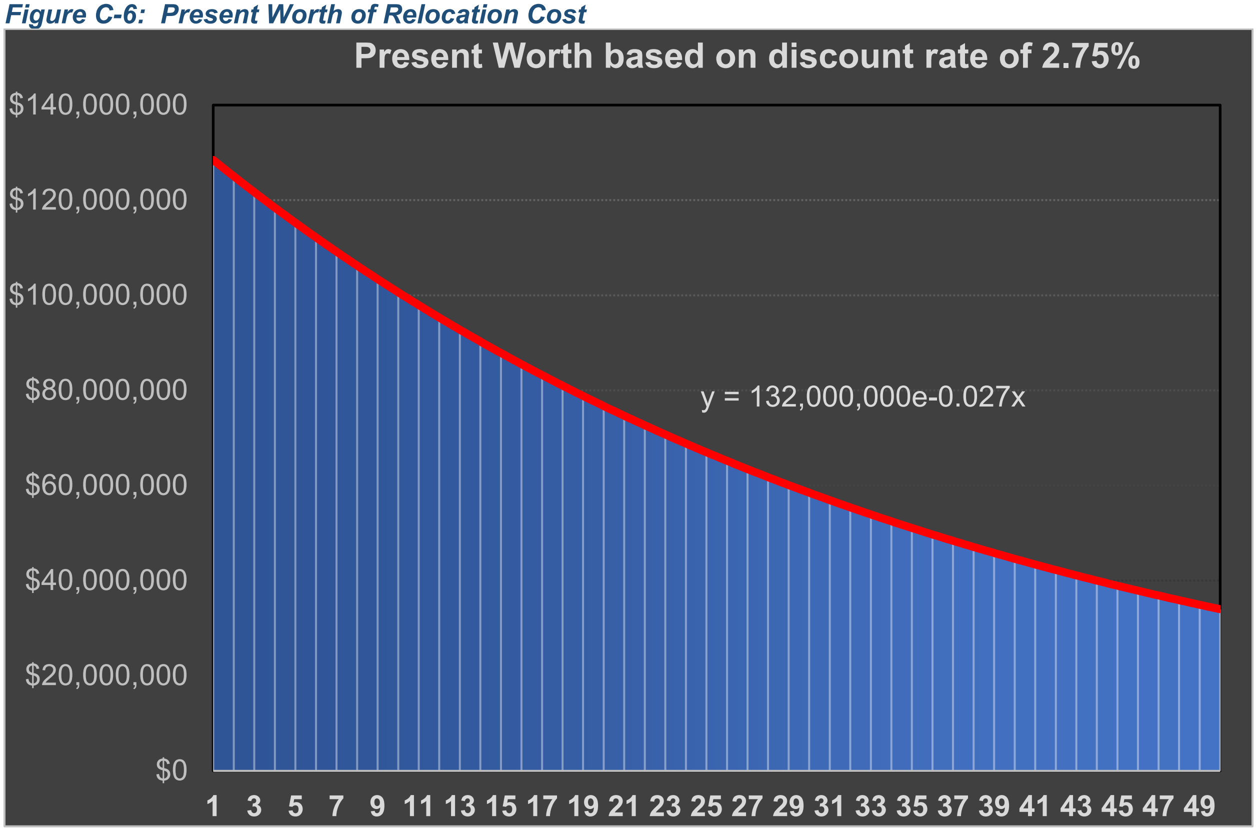
value) to $34 million (i.e. low value) in year 50, 2074, with an average of about $71 million based on the FY20 discount rate of 2.75% as shown in **Table C-13**. Moreover, **Figure C-6** is a graphical representation of **Table C-13** and the average was derived by taking the average of the area under the curve as shown in the figure.

Table C-13: Present Worth of Relocation Cost

Number	Year	Present Worth Factor	Relocation Cost	Present Worth
0	2024	1.0000000	$132,000,000	$132,000,000
1	2025	0.9732360	$132,000,000	$128,467,153
2	2026	0.9471883	$132,000,000	$125,028,860
3	2027	0.9218378	$132,000,000	$121,682,588
4	2028	0.8971657	$132,000,000	$118,425,877
5	2029	0.8731540	$132,000,000	$115,256,328
6	2030	0.8497849	$132,000,000	$112,171,609
7	2031	0.8270413	$132,000,000	$109,169,449
8	2032	0.8049064	$132,000,000	$106,247,639
9	2033	0.7833638	$132,000,000	$103,404,028
10	2034	0.7623979	$132,000,000	$100,636,524
11	2035	0.7419931	$132,000,000	$97,943,089
12	2036	0.7221344	$132,000,000	$95,321,741
13	2037	0.7028072	$132,000,000	$92,770,551
14	2038	0.6839973	$132,000,000	$90,287,640
15	2039	0.6656908	$132,000,000	$87,871,183
16	2040	0.6478742	$132,000,000	$85,519,399
17	2041	0.6305345	$132,000,000	$83,230,559
18	2042	0.6136589	$132,000,000	$81,002,977
19	2043	0.5972350	$132,000,000	$78,835,014
20	2044	0.5812506	$132,000,000	$76,725,075
21	2045	0.5656940	$132,000,000	$74,671,606
22	2046	0.5505538	$132,000,000	$72,673,095
23	2047	0.5358187	$132,000,000	$70,728,073
24	2048	0.5214781	$132,000,000	$68,835,108
25	2049	0.5075213	$132,000,000	$66,992,806
26	2050	0.4939380	$132,000,000	$65,199,811
27	2051	0.4807182	$132,000,000	$63,454,804
28	2052	0.4678523	$132,000,000	$61,756,500
29	2053	0.4553307	$132,000,000	$60,103,650
30	2054	0.4431442	$132,000,000	$58,495,036
31	2055	0.4312839	$132,000,000	$56,929,476
32	2056	0.4197410	$132,000,000	$55,405,816
33	2057	0.4085071	$132,000,000	$53,922,935
34	2058	0.3975738	$132,000,000	$52,479,742

Number	Year	Present Worth Factor	Relocation Cost	Present Worth
35	2059	0.3869331	$132,000,000	$51,075,175
36	2060	0.3765773	$132,000,000	$49,708,199
37	2061	0.3664986	$132,000,000	$48,377,810
38	2062	0.3566896	$132,000,000	$47,083,026
39	2063	0.3471432	$132,000,000	$45,822,897
40	2064	0.3378522	$132,000,000	$44,596,493
41	2065	0.3288099	$132,000,000	$43,402,913
42	2066	0.3200097	$132,000,000	$42,241,278
43	2067	0.3114449	$132,000,000	$41,110,733
44	2068	0.3031094	$132,000,000	$40,010,445
45	2069	0.2949970	$132,000,000	$38,939,606
46	2070	0.2871017	$132,000,000	$37,897,427
47	2071	0.2794177	$132,000,000	$36,883,141
48	2072	0.2719394	$132,000,000	$35,896,001
49	2073	0.2646612	$132,000,000	$34,935,280
50	2074	0.2575778	$132,000,000	$34,000,273

Figure C-6: Present Worth of Relocation Cost



Referencing **Table C-12** of the least cost analysis, the average annual cost of relocation was not evaluated; however, having derived the present worth of this relocation cost, an average annual cost can now be derived. Based on the assume year relocated and the

FY20 discount rate, a range of average annual costs were derived. As mentioned earlier, the cost of relocation of these structures would be counted as the benefit of the soldier-pile wall; therefore, the average annual costs of relocation would be the average annual benefits of the soldier-pile wall as shown in **Table C-14** and **Table C-15**.

Table C-14: Average Annual Cost of Relocation Cost

	High	Average	Low
Present Worth	$128,467,153	$71,069,239	$34,000,273
Average Annual Costs	$4,758,541	$2,632,470	$1,259,401

Table C-15: Average Annual Benefits of Soldier-Pile Wall

Average Annual Benefits
$4,758,541
$2,632,470
$1,259,401

For the purpose of evaluating the benefits, because the bank stabilization alternative would be completed by 2025 (which begins the period of analysis), it is assumed that relocation would happen by 2025 too. Reason for this assumption includes there is an increased interest to protect this historical viewshed sooner rather than later because of its historical significance and what it represents regarding the Civil Rights movement. Also, hydrologic data shows minor flooding (frequent loading) of the Alabama River could contribute to the building instability; therefore, this instability could happen around a 0.5 AEP (2-year) flood event (reference Future Without Project Condition section). Providing further evidence for this reason is in the recent past, there was a historical structure located on Water Avenue that eventually collapsed due to instability as shown in the following pictures taken from Google Earth.

Figure C-7: Selma Riverfront in the 1990s

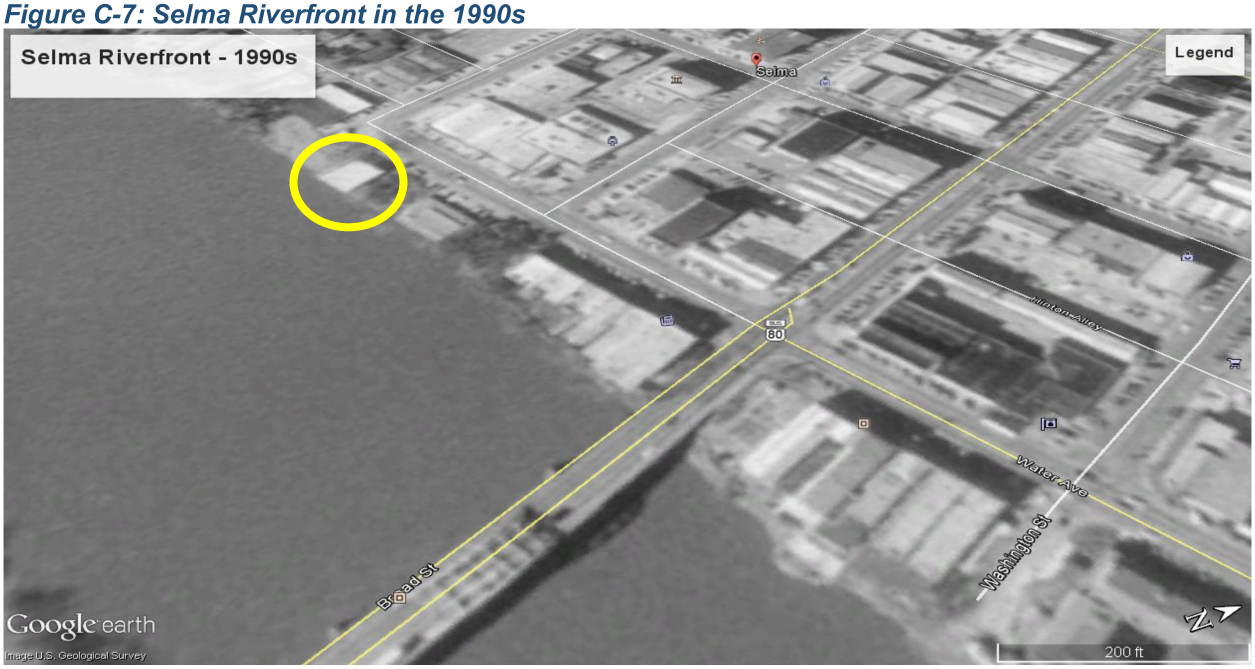


Figure C-8: Selma Riverfront in 2006

Figure C-9: Selma Riverfront in 2014

Figure C-10: Selma Riverfront in 2019 (structure collapsed)

Figure C-11: Structure on Water Avenue that collapsed due to instability

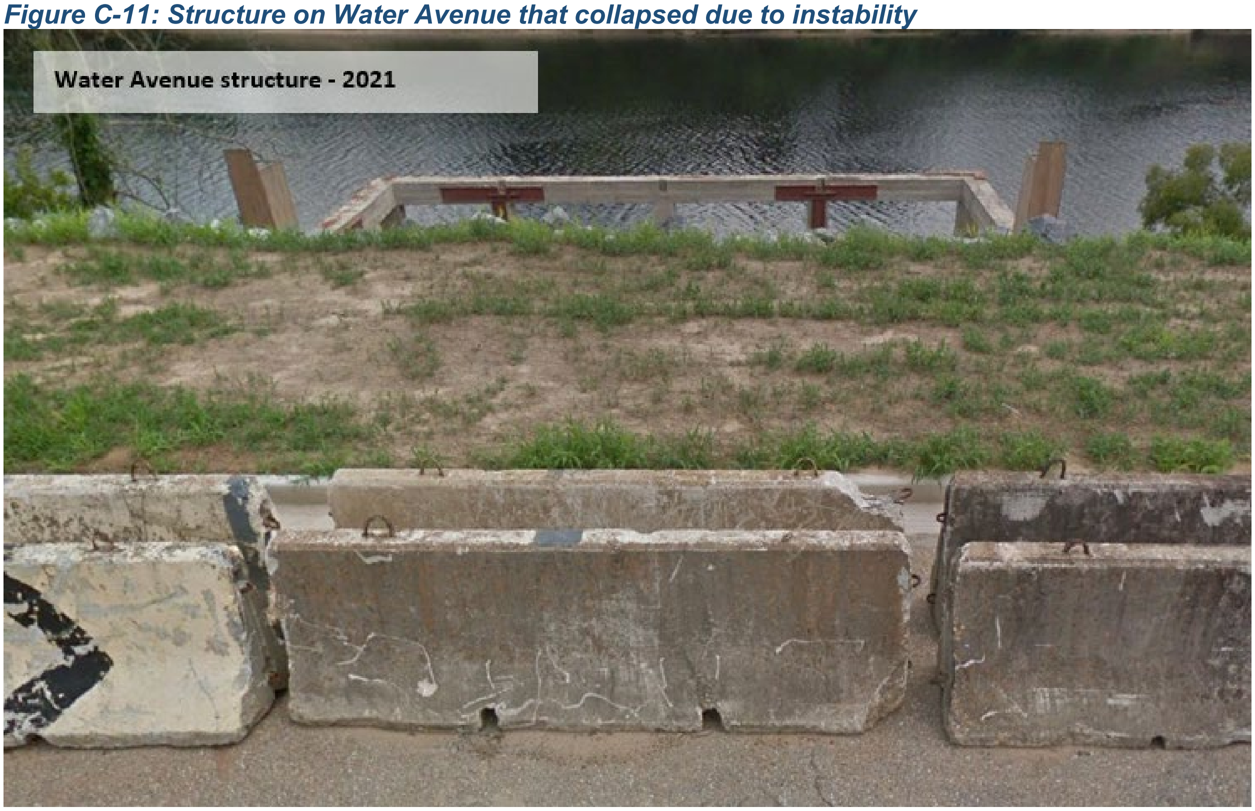


Figure C-7 shows a structure (circled) located on Water Avenue that was located along the historical riverfront in the 1990s. This same structure shown in **Figure C-8** stood intact in the year 2006. However, the erosional conditions, present along the historical riverfront, begin to compromise the structural integrity of this building as shown in **Figure C-9**. This structure continued to experience structural/foundation damages which caused the structure to collapse, due to instability, sometime after the year 2014; therefore, as shown in **Figure C-10**, the structure had to be removed sometime before the year 2019. And present day, in the year 2021, there are only remnants of the structure along with barricades for public safety as shown in **Figure C-11**. Additionally, the historical riverbank could be viewed in these subsequent year images as receding due to the loss of soil coverage and indicative of risk to the remaining structures within the viewshed (i.e. material loss beneath the building foundations which, over time, would destabilize the buildings).

C.2.7.1.4. Alternative 5

Alternative 5 is a combination of Alternatives 1.A and 4. This alternative would take approximately 30 months to complete. Since inundation reduction benefits could not be derived for the soldier pile wall, the summary of the residual flood damages and flood damage reductions for Alternative 5 would be the same as what is shown for Alternative 1.A. However, the benefits would be sum of Alternative 1.A and Alternative 4.

C.2.7.1.5. Alternative 6

Alternative 6 is a combination of Alternatives 3 and 5 with the exception of buyout footprint. A total of nine (9) parcels in Ward 8 identified within the 68-acre buyout footprint for this alternative would be located outside the levee alignment. This alternative would take approximately 42 months to complete.

Alternative 6 combines an optimized levee with buyouts of structures immediately outside of the optimized leveed area, and a soldier pile wall. As mentioned in Alternative 3, the optimized levee was model to reduce the majority of flooding risk in Ward 8; therefore, the modeling of alternative 3 was inclusive of these structures, outside the immediate leveed area, being removed from the floodplain. Moreover, since inundation reduction benefits could not be derived for the soldier pile wall, the summary of the residual flood damages and flood damage reductions for Alternative 6 would be the same as what is shown for Alternative 3. However, the benefits would be sum of Alternative 3 and Alternative 4.

C.2.8. Alternative Comparison

Comparison of costs with regards to benefits was performed for each alternative. These comparisons provide the framework for completing the evaluation of alternative plans.

C.2.8.1. Rough Order of Magnitude (ROM) Costs

Continuing the evaluation process, first cost estimates were developed for each of the alternatives that were evaluated. The ROM costs were provided by Mobile District's Cost Engineering Section Division in 2020 price levels. For comparison to the benefits, which were average annualized, the first costs were stated in average annual terms using the FY20 discount rate of 2.75% and a 50-year period of analysis. Interest during construction (IDC) was added to the ROM first costs assuming 18 months for Alternative 1, 48 months for Alternative 2, 36 months for Alternative 3, 30 months for Alternative 5, and 42 months for Alternative 6. In addition, annual operation and maintenance (O&M) costs were also added to the alternatives. **Table C-16** displays the results of the costs calculation.

Table C-16: Project Alternative Costs

Alternative	First Cost	IDC	O&M	Average Annual Cost
1.A	$4,950,000	$102,000	-	$187,000
3	$74,040,000	$4,167,000	$ 27,000	$2,924,000
4	$27,537,000	$955,000	$4,000	$1,059,000
5	$32,400,000	$1,124,000	$4,000	$1,246,000
6	$104,860,000	$5,140,000	$29,500	$4,104,000

C.2.8.2. Comparison of Benefits to Costs

The equivalent annual benefits were then compared to the average annual cost to develop net benefits and a benefit-to-cost ratio (BCR) for each alternative. The net benefits for each alternative were calculated by subtracting the average annual costs from the equivalent average annual benefits, and a BCR was derived by dividing average benefits by average annual costs. Net benefits were used for identification of the NED plan in accordance with the Federal objective. For comparative purposes, **Table C-17** summarizes the equivalent annual damages (benefits), average annual costs, first cost, net benefits, and BCR for each alternative.

Table C-17: Comparison of Benefits and Costs

Alternative	Average Annual Benefits	Average Annual Costs	First Cost	Net Benefits	Benefit-to-Cost Ratio
1.A	$111,000	$187,000	$4,950,000	($76,000)	0.59
3	$361,000	$2,924,000	$74,040,000	($2,563,000)	0.12
4	$4,759,000-$36,000	$1,059,000	$27,537,000	$3,700,000-($1,023,000)	4.50-0.03[4]
5	$4,870,000-$147,000	$1,246,000	$32,400,000	$3,624,000-($1,099,000)	3.91-0.12
6	$5,120,000-$397,000	$4,104,000	$104,860,000	$1,016,000 ($3,707,000)	1.25-0.1

As a result of the comparison of the alternatives, no alternatives were identified as the NED Plan in accordance with the Federal objective; therefore, there is no NED plan. Based on the results of this analysis, USACE, Mobile District requested an exception to the standard identified in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, specifically that the selected

[4] Includes uncertainty. Reference Economic Risk Section.

plan should have "…the greatest net economic benefit (the NED Plan) consistent with protecting the Nation's environment, unless the Secretary… grants an exception to this rule." This exception was granted in the Memorandum for Record from the Assistant Secretary of the Army (Civil Works) (ASA(CW)) to HQ USACE dated June 10, 2020.

In support of the approval that was granted by ASA (CW) for the NED Exception, HQ, USACE, in an endorsement MFR, dated 16 July 2020, allowed for an analysis of the erosion control measure using Section 14 methodology of the Flood Control Act of 1946 (Public Law 79-526), as amended, for emergency streambank and shoreline protection for public facilities and services. This methodology calls for formulation and evaluation of an alternative using the least cost approach. The plan is justified if the total cost of the alternative is less than the costs to relocate the threatened structures as stated below:

"The proposed TSP includes river embankment stabilization via a retaining wall to protect historic buildings in the downtown area adjacent to the Edmund Pettus Bridge. Stream bank stabilization can be considered in the formulation of a project for Selma in accordance with Section 1203 of WRDA 2018. It needs to be demonstrated that the recommended plan is the least cost plan to mitigate the erosion. That analysis has not been completed and it was not discussed in the exception request. The approach to formulating a project under Section 14 of the Flood Control Act of 1946, as amended, could be applicable to the Selma study. For Section 14 investigations, the formulation and evaluation of alternatives focus on the least cost alternative solution. The least cost plan is justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility. The monetary cost of relocation of the structures, and the potential impacts to historic resources including the view shed should be analyzed at an appropriate level of detail to determine the costs of relocation."

Therefore, as shown in **Table C-17**, the benefits for the soldier-pile wall were not based on traditional FRM benefits (i.e. inundation reduction compared to the future without project condition) but instead benefits derived using the methodology found in a Section 14 study (i.e. as costs avoidance of relocation). However, the benefits for the buyouts and levee were derived based on inundation reduction benefits.

C.2.8.3. Economic Risk

Risk-informed planning should incorporate transparency in the estimation of benefits. The primary role in dealing with risk and uncertainty is to characterize to the extent possible the different degrees of risk and uncertainty and to describe them clearly so that decisions can be based on the best available information. For Alternative 4, which is the soldier-pile wall, a case could be made that the most likely alternative with the least cost is not to stabilize the bank which would lead to the eventual failure of the structures along the historical riverfront. These structures have a market value of approximately $5.4 million or about $3.8 million in depreciated replacement cost and the same methodology that was done for the relocation cost could be applied to the depreciated replacement cost.

Therefore, depending on the year of failure (which is assume to occur within the 50 year period of analysis), the present worth of this depreciated replacement cost ranges from about $3.7 million in year 1, 2025, (i.e. high value) to $0.979 million (i.e. low value) in year 50, 2074, with an average of about $2 million based on the FY20 discount rate of 2.75% as shown in **Table C-18**. Moreover, **Table C-18**, **Table C-19**, and **Table C-20** display the subsequent average annual cost for the structures which would then translate to the average annual benefits for the soldier-pile wall.

Table C-18: Present Worth of Relocation Cost

Number	Year	Present Worth Factor	Depreciated Cost	Present Worth
1	2025	0.97323601	$3,800,000	$3,698,297
2	2026	0.947188331	$3,800,000	$3,599,316
3	2027	0.921837791	$3,800,000	$3,502,984
4	2028	0.897165734	$3,800,000	$3,409,230
5	2029	0.873153999	$3,800,000	$3,317,985
6	2030	0.849784914	$3,800,000	$3,229,183
7	2031	0.827041278	$3,800,000	$3,142,757
8	2032	0.804906354	$3,800,000	$3,058,644
9	2033	0.783363848	$3,800,000	$2,976,783
10	2034	0.762397906	$3,800,000	$2,897,112
11	2035	0.741993095	$3,800,000	$2,819,574
12	2036	0.722134399	$3,800,000	$2,744,111
13	2037	0.702807201	$3,800,000	$2,670,667
14	2038	0.683997276	$3,800,000	$2,599,190
15	2039	0.66569078	$3,800,000	$2,529,625
16	2040	0.647874238	$3,800,000	$2,461,922
17	2041	0.630534538	$3,800,000	$2,396,031
18	2042	0.613658918	$3,800,000	$2,331,904
19	2043	0.597234957	$3,800,000	$2,269,493
20	2044	0.581250566	$3,800,000	$2,208,752
21	2045	0.565693982	$3,800,000	$2,149,637
22	2046	0.550553754	$3,800,000	$2,092,104
23	2047	0.535818738	$3,800,000	$2,036,111
24	2048	0.521478091	$3,800,000	$1,981,617
25	2049	0.507521256	$3,800,000	$1,928,581
26	2050	0.493937962	$3,800,000	$1,876,964
27	2051	0.480718211	$3,800,000	$1,826,729
28	2052	0.467852274	$3,800,000	$1,777,839
29	2053	0.45533068	$3,800,000	$1,730,257
30	2054	0.443144214	$3,800,000	$1,683,948
31	2055	0.431283907	$3,800,000	$1,638,879
32	2056	0.419741029	$3,800,000	$1,595,016
33	2057	0.408507084	$3,800,000	$1,552,327

Number	Year	Present Worth Factor	Depreciated Cost	Present Worth
34	2058	0.397573804	$3,800,000	$1,510,780
35	2059	0.386933143	$3,800,000	$1,470,346
36	2060	0.376577268	$3,800,000	$1,430,994
37	2061	0.366498558	$3,800,000	$1,392,695
38	2062	0.356689594	$3,800,000	$1,355,420
39	2063	0.347143157	$3,800,000	$1,319,144
40	2064	0.337852221	$3,800,000	$1,283,838
41	2065	0.328809947	$3,800,000	$1,249,478
42	2066	0.320009681	$3,800,000	$1,216,037
43	2067	0.311444945	$3,800,000	$1,183,491
44	2068	0.303109436	$3,800,000	$1,151,816
45	2069	0.294997018	$3,800,000	$1,120,989
46	2070	0.28710172	$3,800,000	$1,090,987
47	2071	0.279417733	$3,800,000	$1,061,787
48	2072	0.271939399	$3,800,000	$1,033,370
49	2073	0.264661216	$3,800,000	$1,005,713
50	2074	0.257577826	$3,800,000	$978,796

Table C-19: Average Annual Cost of Depreciate Replacement Cost

	High	Average	Low
Present Worth	$3,698,297	$2,045,933	$978,796
Average Annual Costs	$136,988	$75,783	$36,255

Table C-20: Average Annual Benefits of Soldier-Pile Wall

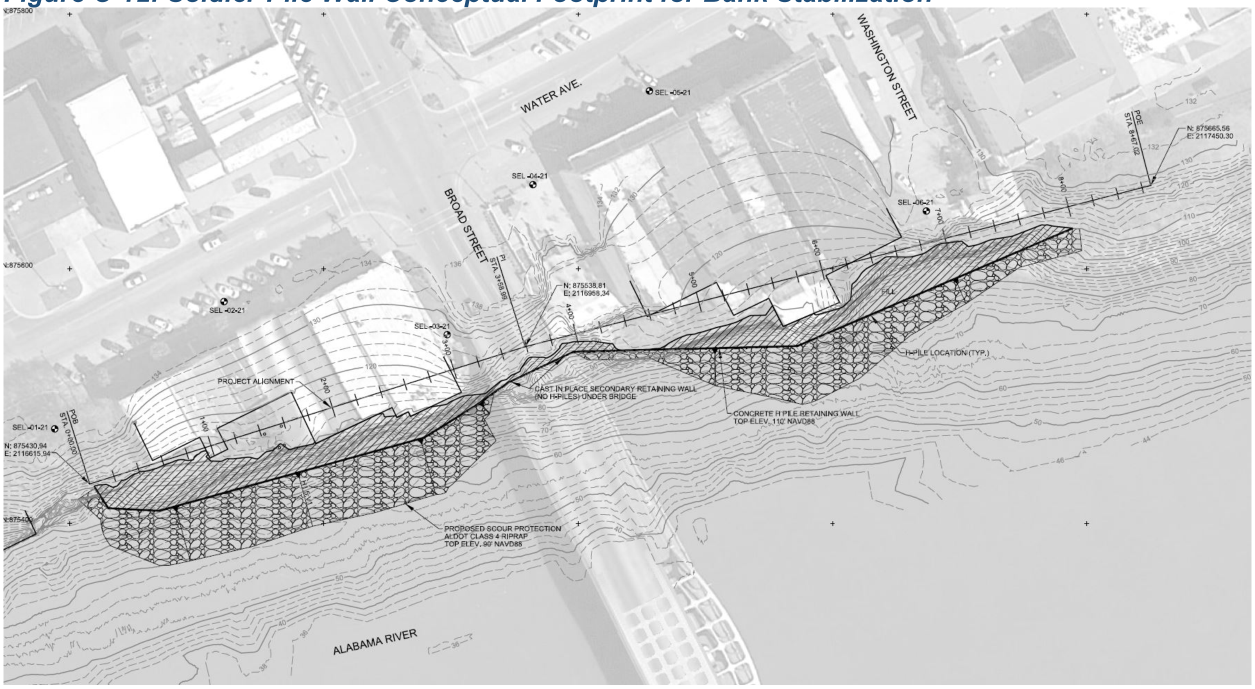
Average Annual Benefits
$136,988
$75,783
$36,255

However, as described in section **C.2.7.1.3.4.2**, these structures located on Selma's Historic Riverfront compose the viewshed of Edmund Pettus Bridge; therefore, the values of these structures should not be solely based on of their physical characteristics but also their cultural and historical value to the Nation (i.e. the viewshed). Therefore, it was assumed that value of the viewshed is at least the cost of relocating these structures if not more.

C.2.8.4. Identification of the Recommended Plan

The recommended plan for this study was identified as Alternative 4 in conjunction with a flood response plan (FRP) measure that was identified during the Alternative Mile Meeting (AMM). **Figure C-12** depicts the conceptual design and footprint for the Soldier-Pile Wall overlaid on a Google Earth imagery. The FRP will identify hazards within the city limits, discuss effects of flooding and provide recommendation for addressing flood risk through responsible future development of the floodplain. The FRP would also provide a detailed plan for the City to implement the use of emergency notification and evacuation of flood prone areas in the event of an approaching flood event. Additionally, because a FRP could be combined with any alternative, it was not incorporated into each alternative description.

Figure C-12: Soldier-Pile Wall Conceptual Footprint for Bank Stabilization



C.2.9. Recommended Plan

The recommended plan identified for this study was Alternative 4 which includes a soldier pile wall that provides bank stabilization. Bank stabilization would be achieved through a Soldier-Pile Wall with riprap caps on the upstream and downstream ends (reference **Figure C-13**[5]). Moreover, the recommended plan would eliminate the significant sources of risk to the viewshed in that the solider-pile wall would reduce the risk of erosion to the river bank; therefore, preventing instability and providing stability for the structures located on the river bank which would then, in turn, preserve the viewshed. For more information regarding this plan selection, reference Plan Selection section of the Main Report.

After the release of the Draft Integrated Feasibility Report and Environmental Assessment for Selma, Alabama for public and agency review, comments were received. Comments did not alter the plan selection; however, refinements were made.

[5] The drawing is conceptual only, and are based upon preliminary development plans, which are subject to withdrawal, revisions, and changes without notice. It should not be relied upon as representation of the final detail of the proposed wall.

Figure C-13: Soldier-Pile Wall Conceptual Rendering

C.2.9.1. Refined Benefits

One such refinement was the cost of relocation for those structures that made up the viewshed. As previously stated in **C.2.7.1.3.4.2**, the cost of relocation of these structures would be counted as the benefit of the soldier-pile wall (i.e. cost avoided) because the opportunity cost of constructing the soldier-pile wall to protect the viewshed would be the cost of relocating these structures. Therefore, the cost of relocation was further refined to include estimated component costs of relocation considering historic data and concurrent USACE projects cost (e.g., the Selma Section 14) as shown in **Table C-21**.

Table C-21: Components of Relocation Cost (October 2021 Price Level)

Estimate	Description	Unit of Measure	Unit Price	Estimated Amount
Construction	Site Work	Lump Sum	$208,000	$208,000
Construction	Structure Relocation	Lump Sum	$42,000,000	$42,000,000
Construction	Utility Relocation	Lump Sum	$2,500,000	$2,500,000
Construction	New Foundation Construction	Lump Sum	$910,000	$910,000
Construction			**Total Construction Cost**	**$45,618,000**
Construction	Contingency	40%		$18,247,200
Construction	E&D	20%		$9,123,600

Estimate	Description	Unit of Measure	Unit Price	Estimated Amount
Construction	S&A	6%		$2,737,080
Construction			**Grand Total**	**$75,725,880**
Real Estate Acquisition and Relocation	Lands and Damages	Lump Sum	$2,500,000	$2,500,000
Real Estate Acquisition and Relocation	Relocation Assistance	Lump Sum	$780,000	$780,000
Real Estate Acquisition and Relocation	Administration Cost	Lump Sum	$200,000	$200,000
Real Estate Acquisition and Relocation			**Total RE Cost**	**$3,480,000**
Real Estate Acquisition and Relocation	Contingency	25%		$870,000
Real Estate Acquisition and Relocation	E&D	20%		$696,000
Real Estate Acquisition and Relocation	S&A	6%		$208,800
Real Estate Acquisition and Relocation			**Grand Total**	**$5,254,800**
	Total Cost of Project	**Lump Sum**		**$80,980,680**

Estimated relocation costs was refined to be approximately $81 million. Using the same methodology prescribed to derive the benefits for the soldier-pile wall referenced in **C.2.7.1.3.4.2**, based on the assume year relocated and the FY21 discount rate, a range of average annual costs were derived as shown in **Table C-22** and **Table C-23**.

Table C-22: Refined Average Annual Cost of Relocation Cost

	High	Average	Low
Present Worth	$79,024,000	$45,838,000	$23,566,000
Average Annual Costs	$2,786,000	$1,616,000	$831,000

Table C-23: Refined Average Annual Benefits of Soldier-Pile Wall

Average Annual Benefits
$2,786,000
$1,616,000
$831,000

Also using the same rationale which assumed that relocation would happen by 2025 (referenced in Section **C.2.7.1.3.4.2**), the present worth of this relocation cost is about $79 million in year 1, 2025, based on the FY21 discount rate of 2.5% as shown in **Table C-24**. Likewise, based on the assume year relocated and the FY21 discount rate, the average annual costs were derived. As referenced earlier, the cost of relocation of these structures would be counted as the benefit of the soldier-pile wall; therefore, the average annual costs of relocation would be the average annual benefits of the soldier-pile wall also shown in **Table C-24**.

Table C-24: Present Worth and Average Annual Benefits of Relocation Cost

Category	Amount
Present Worth	$79,024,000
Average Annual Benefits	$ 2,786,000

C.2.9.2. Refined Costs

Continuing the refinement process, first cost estimates for the Soldier-Pile Wall was further refined from the original ROM cost (i.e. estimated to identify the recommended plan). This cost was provided by Mobile District's Cost Engineering Section Division in October 2021 price levels. For comparison to the benefits, the first costs were stated in average annual terms using the FY21 discount rate of 2.5% and a 50-year period of analysis. Moreover, interest during construction (i.e. based on 18 months) and annual operation and maintenance (O&M) costs were also included. **Table C-25** summarizes the refined first cost and average annual costs.

Table C-25: Summary of Costs

Cost	Amount
Project First Cost	$23,897,000
Interest During Construction	$ 448,000
Average Annual First Cost	$ 858,360
Annual O&M Cost	$ 30,499
Average Annual Annualized Costs	$ 888,859

C.2.9.3. Plan Benefits and Costs

Table C-26 outlines the least cost alternative method using the Section 14 methodology of the Flood Control Act of 1946 (Public Law 79-526), as amended, for emergency streambank and shoreline protection for public facilities based on the refined relocation cost.

Table C-26: Bank Stabilization Least Cost Analysis based on the Refined Relocation Cost

Alternative	Construction Costs	O&M Costs
Relocation (base cost)	$81,000,000	$0
Soldier-Pile Wall	$23,897,000	$30,499

The benefits of implementing the soldier-pile wall were not based on traditional FRM benefits (i.e. inundation reduction compared to the future without project condition) but instead benefits derived using the methodology found in a Section 14 study (i.e. as costs avoidance of relocation). Benefits were calculated based on cost of constructing the soldier-pile wall compared to the relocation costs of the viewshed. **Table C-27** provides a summary of the annual costs and benefits of the plan discounted at 2.5% over a 50-year period in October 2021 price level.

Table C-27: Benefits and Costs for Recommend Plan

Average Annualized Benefits	$2,786,000
Average Annual Annualized Costs	$ 889,000
Net Benefits	$1,897,000
BCR	3.13

C.3. Regional Economic Development (RED)

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

C.3.1. Background

Despite Selma, Alabama's turbulent and pivotal history to the Republic, the progress achieved through Civil Rights demonstrators, activists and organizers in the 1960s, it was not until March 11, 2013 that the site secured its status as a National Historic Landmark, 48 years after becoming indelibly linked to the Nation's history. It was not until 2014 that Paramount Pictures released *Selma,* the film, yet Selma's story transcends the struggles and triumphs achieved in passing the Voting Rights Act in 1965. Selma's place in Civil Rights History serves as a turning point in the continuing quest for democracy and justice around the globe.

The USACE South Atlantic Division endorses Mobile District's proposal, Alternative 4, the Soldier-Pile Wall along the historic downtown riverfront in the area adjacent to the Edmund Pettus Bridge in an effort to maintain heritage tourism to the region.

C.3.2. Impacts of Recommended Plan

HERITAGE TOURISM: COMPARISON TO MONTGOMERY, AL AND WILLIAMSBURG, VA

Dallas County's 2018 Gross Domestic Product (GDP) was $1,174,931,000 according to the Bureau of Economic Analysis (BEA). The Alabama Department of Tourism reported Dallas County generated $75,781,018 in tourism revenue in 2018, a 7.1 percent increase over 2017 and supported 1,028 jobs.

In 2018, tourism increased by a healthy 8.5 percent in Alabama. Dallas County's tourism increased 7.1 percent with Selma as its hub, meanwhile Montgomery County's tourism growth increased by 12.6 percent. Some of Montgomery's increase in tourism can be traced to a 2004 revitalization initiative including the construction of a riverfront park along the Alabama River and a new minor league baseball stadium.

If the Soldier-Pile Wall is not supported, the structures along Selma's Historic Riverfront could be condemned, since it is estimated that within the 50 year period of analysis these structures would be designated structurally unsound if there was no action. This scenario would not only reduce property tax revenues but also weaken Selma's appeal for heritage tourism and puts $75 million in annual tourism at risk.

For a comparison to another heritage tourism destination look to Colonial Williamsburg, found in the Williamsburg City, Virginia, which supported 6,019 jobs through tourism during 2018 according to the Virginia Tourism Corporation. Another reference point: travelers spent more than $612 million in Williamsburg City, VA in 2018. To be clear, tourism in Williamsburg City supports nearly 5,000 more jobs and generates $536 million more in tourism than did Selma, AL in 2018. However, while heritage tourism contributes to both of these localities' economies, Williamsburg benefits from 50 additional years of national recognition. To reiterate, Williamsburg, VA was listed in 1966 in the National Register of Historic Places, whereas the City of Selma was listed in 2016. Both localities serve as integral pieces to the Nation's history.

Civil Rights heritage tourism draws visitors to Selma and its sister cities of Montgomery and Birmingham, a notion supported from the identification of a $12.6 million grant to the preservation and rehabilitation of Civil Rights sites in 24 states, of which, over $2 million was allocated to Alabama sites in 2018 by the Department of Interior's Historic Preservation Fund.

C.3.3. Additional RED Benefit Category: Real-Estate Values

Indirect benefits may also accrue from Alternative 4's Soldier-Pile Wall on Selma's Historic Riverfront. According to data from U.S. Federal Housing Finance Agency as obtained through the St. Louis Federal Reserve Economic Data (FRED); the House Price Index for Dallas County, AL declined 9.2% from 2013 to 2018. Meanwhile home prices maintained their value over the same period in Montgomery County, AL and home prices appreciated by 9.4 percent in Williamsburg, VA as indicated by their respective House Price Indices over the same period. Stabilization of home prices in Montgomery might be attributable to recent revitalization projects and a causal link can be drawn from the prospect of losing Selma's Historic District, which could lead to the dissolution of the city, heightened by the prospect of condemnation on Selma's anchor properties to residential real-estate value declines in Dallas County, Alabama. Fortifying the Historic Riverfront will not only support heritage tourism but also may subsequently lead to property values stabilizing or increasing in the City of Selma and Dallas County, AL.

C.3.4. RECONS Methodology

When the economic activity lost in the study area can be transferred to another area or region in the national economy, these losses cannot be included in the NED account. However, the impacts of the employment, income, and output of the regional economy are considered part of the RED account. The input-output macroeconomic model RECONS was used to address the impacts of the construction spending associated with Alternative 2, Alternative 3, Alternative 4 and Alternative 6 (results displayed in section 2.7 below).

The RECONS Core-based Statistical Area (CBSA) of Selma, AL was selected using an expenditure year of 2022.

This RED analysis, using RECONS, employs input-output economic analysis, which measures the interdependence among industries and workers in an economy. This analysis uses a matrix representation of a region's economy to predict the effect of changes, the implementation of a project of a specific USACE Business Line, to the various industries that would be impacted. The greater the interdependence among industry sectors, the larger the multiplier effect on the economy. Changes to government spending drive the input-output model to project new levels of sales (output), value added (Gross Regional Product or GRP), employment, and income for each industry.

The specific input-output model used in this analysis was RECONS (Regional Economic System). This model was developed by the Institute for Water Resources (IWR), Michigan State University, and the Louis Burger Group. RECONS uses industry multipliers derived from the commercial input-output model IMPLAN to estimate the effects that spending on USACE projects have on a regional economy. The model is linear and static, showing relationships and impacts at a certain fixed point in time. Spending impacts are composed of three different effects: direct, indirect, and induced.

Direct effects represent the impacts the new federal expenditures have on industries which directly support the new project. Labor and construction materials can be considered direct components to the project. Indirect effects represent changes to secondary industries that support the direct industries. Induced effects are changes in consumer spending patterns caused by the change in employment and income within the industries affected by the direct and induced effects. The additional income workers receive via a project and spent on clothing, groceries, dining out, and other items in the regional area are secondary or induced effects.

The inputs for the RECONS model are expenditures that are entered by work activity or industry sector, each with its own unique production function. The Flood Risk Management production function of "Flood Risk Management Construction" was selected to gauge the impacts of the construction of the Soldier-Pile Wall. The baseline data used by RECONS to represent the regional economy of Selma, AL are annual averages from the Bureau of the Census, the Bureau of Labor Statistics, and the Bureau of Economic Analysis for the year 2020. The model results are expressed in 2021 dollars.

C.3.5. Assumptions

Input-output analysis rests on the following assumptions. The production functions of industries have constant returns to scale, so if inputs are to increase, output will increase in the same proportion. Industries face no supply constraints; they have access to all the materials they can use. Industries have a fixed commodity input structure; they will not substitute any commodities or services used in the production of output in response to price changes. Industries produce their commodities in fixed proportions, so an industry will not increase production of a commodity without increasing production in every other commodity it produces. Furthermore, it is assumed that industries use the same technology to produce all of its commodities. Finally, since the model is static, it is assumed that the economic conditions of 2019, the year of the socio-economic data in the RECONS model database, will prevail during the years of construction.

C.3.6. Description of Metrics

"Output" is the sum total of transactions that take place as a result of the construction project, including both value added, and intermediate goods purchased in the economy. "Labor Income" includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income. "Gross Regional Product (GRP)" is the value-added output of the study region. This metric captures all final goods and services produced in the study areas because of the project's existence. It is different from output in the sense that one dollar of a final good or service may have multiple transactions associated with it. "Jobs" is the estimated worker-years of labor required in full time equivalent units to build the project.

C.3.7. RECONS Results for Array of Alternatives

Since the RECONS model has constant returns to scale, it is expected that Alternative 2, with the highest first cost of any alternative, would generate the highest simulative impact on the region, as displayed in **Table C-28**. Again, however, this alternative was screened out due to its exorbitant operations and maintenance costs and the deleterious responsibilities it would pose to the local sponsor.

Table C-28: Regional Economic System Model for Alternative 2

Factors ($000)	Alt. 2 - 1967 Levee
First Costs	$297,070
Local Capture	$176,172
Output	$216,799
Jobs	1,249*
Labor Income	$64,527
Value Added	$91,070
Results Discussion	*Jobs generated are short-term resulting from construction spending.

A summary of the RECONS results for Alternative 4, the recommended plan, is juxtaposed to Alternative 3 and Alternative 6 within **Table C-29**. Alternative 5 is not displayed within the table since it is a combination of Alternative 1.A and Alternative 4 and using the first cost of Alternative 1.A (a buyout or acquisition measure) is not a suitable input to the RECONS model. That is, only demolition costs are suitable inputs to RECONS for this alternative which are negligible. Thus, by way of the transitive property, so too would it be inappropriate to use the sum of the first costs for Alternative 1.A and Alternative 4 as an input for the first cost of Alternative 5.

Table C-29: Regional Economic System Model for Array of Alternatives

Factors ($000)	Alt. 1.A. Buyouts	Alt. 3 Optimized Leve	Alt. 4 Soldier Pile Wall	Alt. 6. Opt. Levee/Wall/Buyouts
First Costs	$4,950	$74,040	$27,537[6]	$104,860
Local Capture	N/A	$43,908	$15,352	$62,185
Output	N/A	$54,034	$24,095	$76,526
Local Area Jobs	N/A	311*	251*	440*
Local Value Added	N/A	$22,698	$13,487	$32,146
Results Discussion	Buyout costs may not be appropriate inputs to RECONS.	*Jobs generated are short-term resulting from construction spending.	*Jobs generated are short-term resulting from construction spending.	*Jobs generated are short-term resulting from construction spending.

C.3.8. RECONS Results for Recommended Plan

For the Selma, Alabama Core Based Statistical Area, the construction first cost estimate of $23.897 million would generate 218.4 full-time equivalent jobs, $12.061 million in labor income, and $20.91 million in output. For the state of Alabama, as a whole, the construction would generate 235.3 full-time equivalent jobs, $13.980 million in labor income, and $30.6 million in output. For the Country, as a whole, the construction would generate 456.1 full-time equivalent jobs, $28.7 million in labor income, and $64.925 million in output (see **Table C-30**).

Table C-30: RECONS Overall Summary for Recommended Plan

Area	Local Capture ($000)	Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
Local					
Direct Impact		$13,323	168.7	$9,812	$7,518
Secondary Impact		$7,587	49.7	$2,249	$4,187
Total Impact	*$13,323*	*$20,910*	*218.4*	*$12,061*	*$11,705*
State					
Direct Impact		$16,036	149.7	$9,560	$8,320
Secondary Impact		$14,565	85.7	$4,420	$7,737
Total Impact	*$19,083*	*$30,600*	*235.3*	*$13,980*	*$16,058*
US					
Direct Impact		$22,804	254.7	$15,282	$14,669
Secondary Impact		$42,121	201.5	$13,417	$22,966

[6] ROM cost during alternative comparison (reference **Section C.2.8.1**)

Area	Local Capture ($000)	Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
Total Impact	*$22,804*	*$64,925*	*456.1*	*$28,700*	*$37,635*

Jobs are presented in full-time equivalence (FTE)

The local impact area captures about 56% of the direct spending on the project. About 24% of the spending leaks out into other parts of the state of Alabama. The rest of the nation captures about 16%.