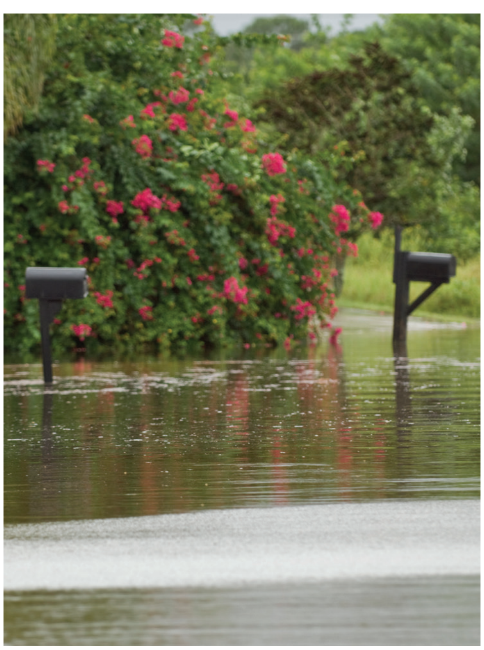
# Central and Southern Florida (C&SF) Flood Resiliency (Section 203) Study

## BROWARD BASINS

*Draft Integrated Feasibility Report and Environmental Evaluation*



# EXECUTIVE SUMMARY

Authorized in 1948, the Central and Southern Florida (C&SF) Project established a comprehensive infrastructure network of canals, levees, water control structures, pump stations, and water conservation areas that have collectively provided flood risk reduction and water supply, in addition to other authorized purposes, to eastern Broward and southeastern Palm Beach counties. Over seven decades, this engineered system has been maintained by the South Florida Water Management District (SFWMD) and has provided flood risk management to the communities within this region, but the system was designed for a markedly different landscape and climate. Land use changes, sea level rise, extreme precipitation and storm events, tidal cycles, and groundwater levels are anticipated to reduce the design capacity and operational effectiveness of the existing system. Enhancements to the existing system that provide a greater level of resilience are required to ensure that the C&SF Project continues to serve communities under future climate scenarios.

The purpose and need of this Draft Integrated Feasibility Report and Environmental Evaluation for the C&SF Flood Resiliency (Section 203) Study - Broward Basins, herein referred to as the Section 203 Study, is to develop and evaluate continued and improved flood risk management and resilience solutions that meet the needs driven by significant hydrologic and climatological changes, demographic and economic changes, and associated flood risk to sustain socioeconomic prosperity and community resilience for years to come. A National Environmental Policy Act analysis is integrated into the Study to evaluate effects to the natural and human environment from alternatives that have been developed as potential solutions.

The Section 203 Study evaluates a 50-year period of analysis from 2035 to 2085 in a Study Area consisting of approximately 420 square miles, within the eastern portion of Broward County and a small portion of southern Palm Beach County. The study area extends from the eastern side of the East Coast Protective Levee and the Intracoastal Waterway and encompasses nine upstream watersheds and six downstream watersheds exposed or vulnerable to flooding. The area of emphasis where changes are proposed is the Section 203 Study Action Area, which consists of 302 square miles of managed upstream watersheds with nine water control structures owned and operated by the SFWMD. The Section 203 Study is being conducted under the authority of Section 216 of the Flood Control Act of 1970.

The objective of the Section 203 Study is to enhance the C&SF Project water control and salinity structures' functionality and capacity to reduce flood damages and improve resiliency within the Action Area caused by inundation and changed conditions within the Study Area over the 50-year period of analysis of 2035 to 2085. Measures and alternatives for the Section 203 Study were developed following the U.S. Army Corps of Engineers' established six-step SMART planning process. Initial plan formulation resulted in unique alternatives that were evaluated against the problems, opportunities, objectives, and constraints of the Section 203 Study. Screening and recombination of the initial array of alternatives resulted in a final array of three discrete alternatives that varied in scale from lower to higher complexity to best meet the Study objective. The final array of alternatives were evaluated through MIKE SHE and MIKE Hydro for the base year and out year of the period analysis for eight compound flood frequency events (combinations of rainfall and coastal water level return frequency events) ranging from a joint probability of 12.5 percent to 0.2 percent across low, intermediate, and high sea level rise scenarios.

HEC-FDA 2.0 was used to quantify Total Avoided Equivalent Annual Damages to structures, contents, vehicles, roadways, and other costs, including emergency clean-up. Flood depths from MIKE SHE output and Total

Avoided Equivalent Annual Damages from HEC-FDA were used to evaluate multiple comprehensive benefits across the four accounts. Total benefits—comprising avoided equivalent annual damages plus travel-time and operational savings derived from reduced flood depths—were combined with estimated project costs to compute net benefits and benefit-to-cost ratios for the final array of alternatives. Business interruption and direct output loss and associated changes in direct and secondary regional economic impacts were quantified from changes in flood depths for commercial structures. Total days and costs saved from temporary displacement, including changes in direct and secondary regional economic impacts, were quantified from changes in flood depths for residential structures. Direct and secondary regional economic benefits from construction and operations were quantified as well as changes in flood depths that may inform credits to the National Flood Insurance Program. Environmental quality effects included considerations for threatened and endangered species, wellfield protection, change in risk to septic systems, and change in risk to sanitary sewer overflows. Other social effects evaluated changes in risk to critical infrastructure and cultural resource sites and buildings. The comprehensive benefits analysis provided a robust, multi-account evaluation of the performance of the final array of alternatives.

The comprehensive benefits analysis of the final array revealed an important resilience vulnerability: the alternatives with the highest net benefits scored lowest across other comprehensive benefit categories. The analysis also highlighted that increased engineering complexity can introduce management tradeoffs that require careful operational consideration. Based on these results, an optimization exercise was completed to identify a fourth alternative that could maximize net benefits, maintain higher comprehensive benefits, and minimize tradeoffs. An effectiveness exercise was performed at the watershed basin level across three sea level rise scenarios to identify measures for this alternative. The final array was recombined and compared across all benefit categories. In addition, a resilience assessment of the final array was conducted to evaluate each alternative's ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions over the period of analysis in the intermediate and high sea level rise scenarios. A full evaluation of the final array of alternatives, including comprehensive benefits and resilience performance, identified Alternative Resiliency Optimized (Alternative RO) as the alternative that balances cost effectiveness with resilience. Alternative RO has been selected as the Tentatively Selected Plan (TSP).

The estimated cost of the TSP is $1.8 billion. This includes the cost of acquiring lands, construction costs, Preconstruction Engineering Design, construction management, and contingencies. Cost assumptions are further detailed in **Appendix E, Cost Engineering and Risk Analysis**. Net annualized operations and maintenance is estimated at $2 million throughout the period of analysis (2035 to 2085) with an additional one-time $42 million estimated for repair, replacement, and rehabilitation. The project cost reflects a FY26 price level and the FY26 federal discount rate of 3.25 percent.

The TSP offers national and regional benefits that make it a valuable investment. Nationally, it delivers net benefits of $512 million with a Benefit-Cost Ratio (BCR) of 1.15 under the intermediate sea level rise scenario, and greater benefits of $568 million with a BCR of 1.17 under the high sea level rise scenario. This demonstrates economic efficiency and resilience against future climate uncertainties. Regionally, the TSP significantly reduces business interruptions and direct output losses—cutting these losses by 15 percent in the intermediate sea level rise scenario and 33 percent in the high sea level rise scenario. This means more stable economic activity and less disruption for local businesses and communities. Temporary displacement of residents is also expected to drop by 12 to 28 percent, enhancing community stability and quality of life. Flood depths in key National Flood Insurance Program (zones AO, AE, and AH) are improved, which not only reduces flood risk but also provides opportunities for communities to gain benefits through the Community Rating System, potentially lowering flood insurance premiums for residents. The TSP protects critical infrastructure and cultural resources by improving flood conditions above first-floor elevations, safeguarding vital community assets from damage and loss. The plan incorporates operational measures to manage flooding both upstream and downstream, ensuring balanced and effective flood risk management throughout the watershed.

The effects of the TSP on natural, physical, and economic environmental resources were evaluated along with the final array of alternatives. The TSP, Alternative RO, is a hybrid of effective and resilient measures of Alternatives A, B, and C, the environmental effects of the which would not result in any impacts beyond what was analyzed for Alternatives A through C. The TSP complies with key environmental laws and with ongoing environmental compliance activities described in this Draft Integrated Feasibility Report and Environmental Evaluation. Construction of the TSP would not begin until all necessary consultation and coordination with agencies, Tribes, and the public are fully completed and all environmental commitments are satisfactorily addressed. This ensures adherence to applicable regulatory requirements and the protection of natural and cultural resources throughout the period of analysis. To ensure responsible project implementation, specific environmental, engineering, design, permitting, and operational commitments will be integrated into the TSP. These measures are designed to avoid, minimize, and where necessary, mitigate any potential adverse effects on the environment, community, and cultural resources, thereby promoting sustainable and compliant project outcomes. The TSP will ensure the C&SF system's water management infrastructure can effectively adapt to changing conditions from urbanization, sea level rise, extreme rainfall events, and flooding risks, while increasing community, economic, and ecosystem resiliency in eastern Broward County and southern Palm Beach County.

There are no known project concerns or controversies at this time. Risk and uncertainty associated with planning, design, and implementation of the TSP are summarized below:

- **Cost estimating:** Current cost estimates are rough-order-magnitude and incorporate nominal dollar assumptions to account for inflation. These assumptions and cost estimates may require refinement following Cost and Schedule Risk Analysis review.
- **Net benefits:** Net benefits have been calculated and reported in nominal dollars; real-dollar sensitivity analyses have also been considered during plan formulation and selection.
- **Downstream effects:** Downstream impacts were evaluated using sensitivity modeling. While those analyses were robust, model results could over- or under-estimate actual effects, which in turn could influence plan selection and required mitigation.
- **Hydrology and precipitation:** Recent rainfall patterns show departures from historical norms. If further rainfall analysis is required, refinements could affect both study cost and schedule.

The SFWMD has prepared this Section 203 Study for submission to the Assistant Secretary of the Army (Civil Works). The Assistant Secretary of the Army (Civil Works) will review the Study and determine recommendations for Congress regarding authorization of the TSP under the authority of Section 216 of the Flood Control Act of 1970.

# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF APPENDICES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ac | acre(s) |
| Action Area | Approximately 302 square miles of managed upstream watersheds with 9 water control structures owned and operated by the SFWMD |
| AEP | annual exceedance probability |
| ASA(CW) | Assistant Secretary of the Army (Civil Works) |
| BCR | benefit-to-cost ratio |
| BMP | best management practice |
| C&SF Project | Central and Southern Florida Project |
| C&SF | Central and Southern Florida |
| CEPP | Central Everglades Planning Project |
| CFR | Code of Federal Regulations |
| cfs | cubic foot (feet) per second |
| dBA | A-weighted decibel |
| EFH | Essential Fish Habitat |
| EO | Executive Order |
| EPA | U.S. Environmental Protection Agency |
| EQ | Environmental Quality |
| ER | Engineering Regulation |
| Esri | Environmental Systems Research Institute |
| F | Fahrenheit |
| FAS | Floridan Aquifer System |
| FDEP | Florida Department of Environmental Protection |
| FEC | Florida East Coast |
| FEMA | Federal Emergency Management Agency |
| FFE | first floor elevation |
| FLL | Fort Lauderdale-Hollywood International Airport |
| FPLOS | flood protection level of service |
| FR | Federal Register |
| FRM | flood risk management |
| FRM-PCX | Flood Risk Management Planning Center of Expertise |

| | |
|---|---|
| ft | foot, feet |
| FWOP | Future Without Project |
| FWP | Future With Project |
| GDP | gross domestic product |
| H&H | hydrologic and hydraulic |
| HP | horsepower |
| HTRW | hazardous, toxic, and radioactive waste |
| IBA | Important Bird Area |
| INT | intermediate |
| LERRD | Lands, Easements, Rights-of-Way, Relocations, and Disposal |
| NAAQS | National Ambient Air Quality Standards |
| NAVD88 | North Atlantic Vertical Datum of 1988 |
| NED | National Economic Development |
| NFIP | National Flood Insurance Program |
| NGVD29 | National Geodetic Vertical Datum of 1929 |
| NMFS | National Marine Fisheries Service |
| NRHP | National Register of Historic Places |
| NSR | noise sensitive receptor |
| OMRR&R | operation, maintenance, repair, replacement, and rehabilitation |
| OSE | Other Social Effects |
| P&G | Principles and Guidelines |
| PED | Preconstruction Engineering and Design |
| RED | Regional Economic Development |
| ROW | right-of-way |
| SAS | Surficial Aquifer System |
| Section 203 Study | Central and Southern Florida Flood Resiliency (Section 203) Study - Broward Basins |
| SERPM | Southeast Florida Regional Planning Model |
| SFWMD | South Florida Water Management District |
| SMART | Specific, Measurable, Attainable, Risk-Informed, and Timely |

| | |
|---|---|
| Study Area | Approximately 420 square miles in eastern Broward County and southern Palm Beach County, encompassing 15 watershed basins, 7 primary canals, and 9 water control structures |
| Study | Central and Southern Florida Flood Resiliency (Section 203) Study - Broward Basins |
| TMDL | Total Maximum Daily Load |
| TSP | Tentatively Selected Plan |
| U.S.C. | United States Code |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| WCS | water control structure(s) |
| WRDA | Water Resources Development Act |

# 1.0 INTRODUCTION

The Draft Integrated Feasibility Report and Environmental Evaluation for the Central and Southern Florida (C&SF) Flood Resiliency (Section 203) Study - Broward Basins, herein referred to as the Section 203 Study, is prepared by the South Florida Water Management District (SFWMD) pursuant to Section 203 of the Water Resources Development Act of 1986, as amended (WRDA of 1986). The Section 203 Study evaluates continued and improved flood risk management (FRM) and resiliency solutions for the existing federally authorized and constructed C&SF Project throughout the period of analysis from 2035 to 2085. The federally authorized and constructed C&SF Project is a large multipurpose water resource project authorized under the Flood Control Act of 1948 that is operated and maintained by the SFWMD. This Section 203 Study is critical to identifying potential FRM and resiliency solutions that could be incorporated into the C&SF Project to further enhance FRM performance in the interest of public safety, the community's quality of life, and the environment. The SFWMD completed this Section 203 Study with support from the Florida Department of Environmental Protection (FDEP), Broward County, and technical and federal activities assistance from the U.S. Army Corps of Engineers (USACE) Jacksonville District.

This Section 203 Study determines if federal participation in improving FRM and resiliency within Broward Basins is feasible, acceptable, and economically justified. This Section 203 Study complies with the plan formulation framework for a Specific, Measurable, Attainable, Risk-Informed, and Timely (SMART) feasibility study that emphasizes comprehensive environmental evaluation as part of the planning process. All planning efforts within this Section 203 Study comply with the SMART Planning Guidance and Planning Bulletins, including PB 2018-01(S) on Feasibility Study Milestones, as well as any subsequent guidance issued during the Study. The Section 203 Study also adheres to Engineer Regulation 1105-2-103, Policy for Conducting Civil Works Planning Studies and, where appropriate, Engineer Regulation 1105-2-100, USACE Planning Guidance Notebook.

Several Executive Orders (EOs), Engineering Regulations (ERs), and guidance emphasizing the importance of considering changing environmental conditions and extreme weather events, sustainability, and resilience in planning and decision-making for federal projects are also evaluated in this Section 203 Study. These include:

- **EO 11988: Floodplain Management** requires agencies to avoid long-term risks in floodplains and emphasizes using natural floodplains to enhance flood resilience (May 1977).
- **EO 11990: Protection of Wetlands** mandates the preservation of wetlands, which play an important role in flood mitigation (May 1977).
- **ER 1105-2-103: Policy for Conducting Civil Works Planning Studies** provides planning guidance on assessing expected environmental conditions for the with and without project condition, including climate change, climate variability, and sea level rise.
- **ER 1110-2-8162: Incorporating Sea Level Change in Civil Works Programs** provides guidance for incorporating direct and indirect physical effects of project future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects (USACE 2019).

- **MEMORANDUM FOR U.S. Army Corps of Engineers, South Atlantic Division Planning and Engineering Communities of Practice; SUBJECT: Future Without Project In-Progress Review**, reiterates future without project conditions as the baseline for effects assessment (April 19, 2024).
- **Planning Primer, IWR Report 97-R-15**, describes the USACE plan formulation basics, including defining future without project conditions as what is expected to happen without action to solve the problem, and future with project conditions as what is expected to happen if an alternative plan is implemented (November 1997).

These EOs and guidance provide a comprehensive framework for ensuring resiliency solutions are designed to address changing environmental and climate conditions and extreme weather events while integrating environmental, social, and economic considerations for sustainable and equitable outcomes.

The findings of this Section 203 Study will guide the SFWMD in determining the most appropriate FRM and resiliency measures while minimizing adverse socioeconomic and environmental effects, resulting in a Tentatively Selected Plan (TSP). This process includes extensive collaboration with federal, state, and local agencies as well as consultation with stakeholders and the public to ensure the decision-making process is informed by a wide range of perspectives.

## 1.1 Study Authority

The SFWMD prepared this Section 203 Study for submission to the Assistant Secretary of the Army (Civil Works) (ASA[CW]). The ASA(CW) will review and determine recommendations to Congress for authorization of the TSP under the authority of Section 216 of the Flood Control Act of 1970.

The Section 203 Study builds on the C&SF Section 216 Study described in **Section 1.4.1**, which authorizes the Secretary of the Army, through the Chief of Engineers, to review completed USACE projects when significant physical or economic changes occur. The Secretary may then recommend modifications to project structures or operations to Congress, aiming to improve navigation, flood control, water supply, and environmental quality in the public interest.

The C&SF Section 216 Study states:

*"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by USACE in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."*

## 1.2 Study Scope

In 2021, the SFWMD and the USACE Jacksonville District launched the C&SF Section 216 Study to modernize the region's aging flood control system, originally built under the 1948 C&SF Project. Its primary objective is enhancing FRM and flood resilience in Palm Beach, Broward, and Miami-Dade Counties. The original USACE C&SF Section 216 Study Area was later geographically divided into Reaches A through D, allowing flood resiliency and risks to be collaboratively addressed and integrated, and parallel strategies to be advanced.

The SFWMD initiated the Section 203 effort, federally authorized under the C&SF Section 216 Study, to address the critical need for FRM solutions within Broward Basins' communities. Reach A, the northernmost reach of the C&SF Section 216 Study and the subject of this effort, is referred to herein as the Section 203 Study Area (or Study Area). This Section 203 Study focuses on enhancing the resiliency of the water control structures and adjacent primary canals in Broward Basins Reach A.

## 1.3 Study Area and Action Area

The Section 203 Study Area, also known as the Planning Area, consists of approximately 420 square miles within the eastern portion of Broward County and a small portion of southern Palm Beach County. The Section 203 Study Area comprises the nine upstream watersheds and six downstream watersheds that are exposed or vulnerable to flooding, located between the eastern side of the East Coast Protective Levee and the Intercoastal Waterway (**Table 1-1**). The Study Area delineation is based on existing watersheds, contiguous urban areas, and previous studies (SFWMD's Flood Protection Level of Service [SFWMD 2021] and USACE's South Atlantic Coastal Study [USACE 2021]).

The Section 203 Action Area consists of 302 square miles of managed upstream watersheds with 9 WCS owned and operated by the SFWMD. The Section 203 Action Area is the area of emphasis for evaluating improvements to the water control structures' functionality and capacity to reduce flood damages. **Figure 1-1** shows the Section 203 Study Area and Action Area.

**Table 1-1. Section 203 Study Area—Managed Watershed Basins, Primary Canals, and Water Control Structures.**

| Managed Upstream Watershed Basin | Primary Canal | Primary Water Control Structure | Downstream Watershed Basin |
|---|---|---|---|
| Hillsboro Canal Basin | G-08 (Hillsboro) Canal | G-56 Gated Spillway | Coral Reef Basin |
| Pompano Canal Basin | G-16 (Pompano) Canal | G-57 Gated Spillway | Coral Reef Basin |
| C-14 West Basin | C-14 (Cypress Creek) Canal | S-37B Gated Spillway[a/] | C-14 East Basin |
| C-14 East Basin | C-14 (Cypress Creek) Canal | S-37A Gated Spillway | Coral Reef Basin |
| C-13 West Basin | C-13 (Middle River) Canal | S-36 Gated Spillway | C-13 East, North Fork Middle River, and Coral Reef Basins |
| C-12 West Basin | C-12 (Plantation) Canal | S-33 Gated Spillway | C-12 East and Coral Reef Basins |
| North New River Canal West Basin | G-15 (North New River) Canal | G-54 Gated Spillway | North New River Canal East and Coral Reef Basins |
| C-11 West Basin | C-11 (South New River) Canal | S-13AW Gated Culvert[a/] | C-11 East Basin |
| C-11 East Basin | C-11 (South New River) Canal | S-13 Pump Station and Gated Spillway | Coral Reef and C-10 Basins |

Note: C = canal, G = gate, S = structure
a/ The S-37B Gated Spillway and S-13AW Gated Culvert are non-coastal structures; all others are coastal structures.

Urbanized Broward County is one of six counties within the Atlantic Coastal Ridge, also referred to as the Lower East Coast. The Lower East Coast is the most densely populated area in Florida and includes the West Palm Beach, Fort Lauderdale, and Miami population centers. Water levels in this area are tightly controlled near the shoreline to prevent over-drainage and manage saltwater intrusion. The area depends on the operation of the C&SF Project for flood control, water supply, and other purposes.

Broward County covers approximately 1,323 square miles, with a heavily developed landscape that includes urban, suburban, and few rural areas. It is home to more than 1.9 million residents, making it the second most populous county in the state (second to Miami-Dade County). Broward County is characterized by its extensive coastline along the Atlantic Ocean and a complex system of canals, lakes, and wetlands, which play a crucial role in water management and flood mitigation (Broward County 2024a). Similarly, southern Palm Beach County is characterized by densely populated urban development with a mix of land uses including residential, commercial, and industrial. This is interspersed with water control structures (e.g., canals, pumps) that provide flood control and water supply.

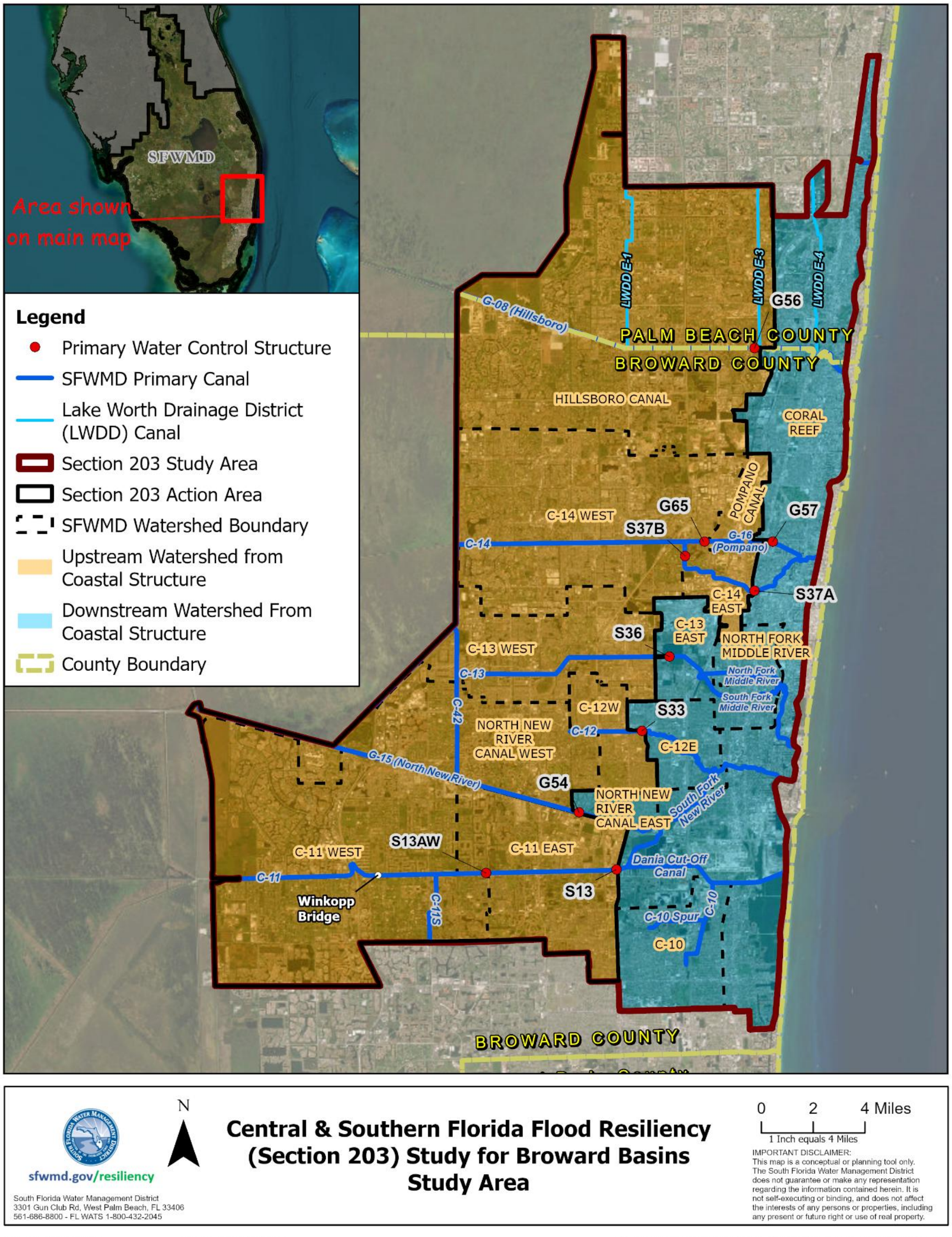



**Figure 1-1. Section 203 Study Area and Action Area.**

## 1.4 Background and Related Actions

As summarized in the C&SF Project Initial Appraisal Report (March 2020), in 1948, the Department of the Army submitted to Congress the Comprehensive Report on C&SF for Flood Control and Other Purposes (House Document 80-643; C&SF Comprehensive Plan). The C&SF Project's authorization was a result of devastating extreme rainfall and inland and coastal flood events that occurred in the 1920s and again in the 1940s. The 1948 C&SF Comprehensive Plan described how water stored in Water Conservation Areas would be used to irrigate agricultural lands along Florida's east coast, raise the groundwater table, improve municipal and industrial water supply, control salinity within primary canals, and help alleviate saltwater intrusion into coastal water supply wellfields. Spillways and culverts were to be constructed in the Water Conservation Area levees to provide water to agricultural areas for use during the dry season. Lake Okeechobee would serve as a multiple-use reservoir with flood control, navigation, and water conservation functions. Construction of initial phases of the C&SF Project was authorized in 1948, and construction began in 1949.

The Flood Control Act of 1954 authorized the remainder of the C&SF Project proposed in House Document 80-643 and established the Office of the Chief of Engineers' discretionary authority to modify the C&SF Comprehensive Plan. The USACE concluded that the C&SF Project's municipal, industrial, and agricultural water supply benefits increased overall project benefits. To optimize project benefits, a system of secondary works was required; these secondary works were provided by SFWMD as the local project sponsor. USACE also concluded that continued federal participation in the C&SF Project was justified by reduced flood risk benefits.

In the WRDA of 2000, the Comprehensive Everglades Restoration Plan was approved as a framework for the continued modifications and operational changes to the C&SF Project that were needed to restore, preserve, and protect the South Florida ecosystem while addressing other water-related needs of the region, including water supply and flood protection (USACE 2024).

### 1.4.1 Section 216 of the Flood Control Act of 1970

In 2021, the SFWMD and the USACE Jacksonville District launched the C&SF Section 216 Study to modernize the region's aging flood control system, originally built under the 1948 C&SF Project.

Key infrastructure of the C&SF Project, as of 2025, includes more than 2,175 miles of canals, more than 2,130 miles of levees/berms, 936 water control structures, 620 project culverts, 98 pump stations, and approximately 3,537 hydrological monitoring stations at more than 687 flow sites, including 201 rain gauges and 22 weather stations. This regional system serves a population of approximately 9.5 million residents across South Florida but faces growing threats from population growth, urban development, extreme weather, and sea level rise. Its primary objective is enhancing FRM and flood resilience in Palm Beach, Broward, and Miami-Dade Counties.

The size of the original USACE C&SF Section 216 Study Area was later geographically divided into Reaches A through D, allowing flood resiliency and risks to be collaboratively addressed and integrated, and parallel strategies to be advanced. Therefore, the SFWMD initiated this Section 203 Study to address the critical need for FRM solutions within Broward Basins' communities, as supported by the county, respective to Reach A. The Section 216 study has been redirected to focus on Reach C (Miami-

Dade County) and other implementation strategies are being advanced for the remaining Reach B and Reach D.

### 1.4.2 Flood Protection Level of Service

The SFWMD has been implementing the flood protection level of service (FPLOS) program for the past decade to ensure the C&SF flood control system can meet current and future needs. The FPLOS program addresses the challenges posed by South Florida's growing population, urban expansion, and the increasing threats associated with evolving climate conditions, including sea level rise and extreme weather events, to water management infrastructure. Established to protect communities and critical infrastructure from flood risk, the FPLOS program assesses the performance of flood protection systems and identifies improvements needed to maintain an acceptable level of service. It evaluates primary and secondary flood control systems across the region, focusing on areas managed by the SFWMD including major canals, levees, and water control structures. Through robust hydrological modeling, the FPLOS program analyzes the system's capacity to handle various storm scenarios and offers guidance on infrastructure investments needed to increase, or regain, the flood protection level of service within communities. The FPLOS program's modeling tools, developed thorough partnerships such as with Broward County, now support critical studies, including this Section 203 Study.

## 1.5 USACE Planning Process

The SFWMD prepared this Section 203 Study to meet USACE regulations and guidance for feasibility studies under the authority of Section 216 of the Flood Control Act of 1970. The USACE planning framework characterizes water resource needs within a study area while evaluating potential alternatives to meet those needs. According to the WRDA of 1986, USACE planning decision documents must clearly communicate the uncertainties associated with the benefits, costs, and impacts of various alternatives and investment recommendations. This requirement emphasizes the importance of transparency in reporting, ensuring stakeholders understand the uncertainties inherent in planning evaluations, expected performance of alternatives, and expected effects of the recommended actions.

The USACE planning process follows six steps defined in the agency's Principles and Guidelines. This structured approach to problem solving provides a rational framework for sound decision-making and is used for all planning studies conducted by USACE. The six steps are:

- **Step 1:** Identifying problems and opportunities
- **Step 2:** Inventorying and forecasting conditions
- **Step 3:** Formulating alternative plans
- **Step 4:** Evaluating alternative plans
- **Step 5:** Comparing alternative plans
- **Step 6:** Recommendation of a plan

USACE planning study decision-making is based on the completion and documentation of these steps. It is important to stress the iterative nature of this process. As more information is acquired and developed, revisiting some of the steps may be necessary. Though the steps are presented and discussed sequentially for ease of understanding, they usually occur iteratively and sometimes concurrently. Iterations of steps are conducted as necessary to formulate efficient, effective, complete, and acceptable plans.

The Section 203 Study planning process performed by the SFWMD adopts and builds upon the C&SF Section 216 Study planning process performed by the USACE. The C&SF Section 216 Study conducted extensive outreach and stakeholder engagement as recently as 2023. The C&SF Section 216 Study plan formulation explores FRM issues within the Section 203 Study Area. The Section 203 Study project delivery team builds alternatives addressing FRM by qualitatively assessing FRM and resiliency measures within the Section 203 Action Area. Feasible measures are combined into alternatives that are quantitatively and qualitatively evaluated to gauge an alternative’s performance and iteratively refined to optimize effective, acceptable, complete, and efficient FRM.

### 1.5.1 Purpose and Need

The purpose of this Section 203 Study is to develop and evaluate continued and improved FRM and resilience solutions that align with the Federal Objective, as defined in Section 2031 of the Water Resources Development Act of 2007 and to evaluate potential effects to support the plan decision. The Federal Objective specifies that water resources planning shall reflect national priorities, encourage economic development, and protect the environment by seeking to maximize sustainable economic development, avoiding the unwise use of floodplains, and protecting and restoring natural ecosystems. The planning process informs an implementable suite of measures to address flood risk damages and involves parallel efforts across managed watershed basins, primary canals, and water control structures.

The need for this Section 203 Study is driven by several factors: significant physical, hydrological, climatological, demographic, and economic changes; increasing flood risks; and maintaining quality of life, socioeconomic prosperity, and community resiliency in the Study Area. As stated above, there is a critical need to improve upon the existing USACE federally authorized and constructed C&SF Project.

The Section 203 Study includes a TSP designed to maximize flood resiliency and FRM benefits for the population, property, economy, and critical infrastructure within the Action Area consistent with the study’s purpose and need. Specifically, this Section 203 Study advances the feasibility assessment and initial engineering designs for adapting water/flood control structures in areas of Broward County and a small portion of southern Palm Beach County most vulnerable to flood risk.

### 1.5.2 Problems and Opportunities

The C&SF Project features are experiencing challenges in adapting to changing conditions like sea level rise, extreme rainfall, compound flooding, and urbanization, resulting in significant flooding across South Florida’s natural, agricultural, and urban areas, with worsening conditions expected in the future. The population of the Study Area has grown from 2 million in 1950, when construction was authorized, to approximately 9.5 million today, leading to increased urbanization. While the SFMWD maintains the C&SF Project system to USACE standards, it is not designed for existing or anticipated changing conditions. High sea levels have been observed, limiting overall system performance and gravity discharge capacity that depends on the head differential between headwater and tailwater levels, even exceeding the top of existing gate structures during extreme high tide events. The number of hours these gates remain closed has increased due to average tidal elevations being higher than inland water levels for longer periods of time, forcing earlier drawdown ahead of storms. Flooding is causing extensive damage to residences, businesses, and critical infrastructure, threatening public safety. Additionally, operational limitations of coastal structures may heighten the risk of saltwater intrusion into freshwater habitats and the Biscayne Aquifer, the region's primary water supply. Resiliency improvements to the existing infrastructure of the C&SF Project are essential for public safety, as they will enhance flood risk management capacity and support water supply for approximately 9.5 million people.

#### *1.5.2.1 Problems*

The problems anticipated in the Study Area that are expected to occur within the period of analysis, from 2035 to 2085, were informed by the Section 216 Study process, and are as follows:

- **Compound Flooding:** Combination of inland and coastal flood drivers exacerbate flooding.
- **Limitations of Existing Infrastructure:** The existing flood control infrastructure was designed for conditions that have changed profoundly since construction.
- **Changing Conditions:** Conditions are expected to worsen over the 50-year period of analysis:
  - Urbanization (land development and projected population increase in the Study Area);
  - Sea level rise (low, intermediate, and high scenarios);
  - Increased total flood water depths and surface area inundation due to extreme rainfall intensification (frequency and intensity) compounded with storm surge and sea level rise and its effects on flooding;
  - Increased total flood water depths and surface area inundation due to the highest tidal cycles compounded with sea level rise; and
  - Increased total flood water depths and surface area inundation due to higher groundwater tables compounded with sea level rise.
- **Flood Damages to Communities:** Flood damage – including property, critical infrastructure, environmental, social, and economic impacts – attributable to ongoing C&SF Project reduction in capacity, diminished water conveyance, and changed conditions at the water control structures exacerbated by sea level rise and extreme rainfall events compounded with storm surge and/or high tides.
- **Public Safety Risks:** Public safety risks attributable to diminished water conveyance near C&SF Project water control structures caused by flooding during extreme rainfall events compounded with storm surge, sea level rise, and/or high tides.

#### *1.5.2.2 Opportunities*

Opportunities offered by the Section 203 Study include:

- Managing risk to historical and cultural resources,
- Managing public and life safety caused by inundation, and
- Unifying coordination and building trust with stakeholders and the public.

### 1.5.3 Objectives and Constraints

In this Section 203 Study, *objectives* describe the desired result of addressing problems through solutions developed during the planning process, and *constraints* define planning process limitations and bound the Section 203 Study effort. These may include legal, or policy constraints as defined by law, regulations, or guidance; and resources constraints associated with environmental, social, financial, time, or data limitations.

#### *1.5.3.1 Objectives*

The Section 203 Study identifies the following objective:

- Enhance C&SF Project water control and salinity structures' functionality and capacity to reduce flood damages and improve resiliency within the Action Area caused by inundation and changed conditions within the Study Area over the 50-year period of analysis of 2035 to 2085.

#### *1.5.3.2 Constraints*

The Section 203 Study is bound by the following constraints:

- Avoid, minimize, and/or mitigate the transfer of flood risk to other locations within the Study Area during the period of analysis.
- Avoid, minimize, and/or mitigate impacts to the stated objectives and authorized benefits of other federal studies and projects within the Study Area.

## 2.0 EXISTING CONDITIONS AND FUTURE WITHOUT PROJECT CONDITIONS

This section outlines current conditions and the projected FWOP scenario for the Study Area, categorized by natural, physical, and economic environments. Existing conditions are those at initiation of analysis. The existing conditions are used to formulate the FWOP scenario, representing reasonably foreseeable circumstances should a project not be constructed. The FWOP is the point of comparison for Future With Project conditions. Future With Project conditions are those that can be expected to occur if an alternative plan is implemented.

A description of the Section 203 Study purpose and need, problems and opportunities, and objectives and constraints is in Section 1 of this document. Detailed analyses are provided in **Appendix B, Environmental Resources**.

## 2.1 General Setting

Eastern Broward County and southeastern Palm Beach County face significant FRM challenges due to urban development and changing climate conditions. This densely populated urban area, with its mix of residential, commercial, and industrial land uses, relies on C&SF Project water control and salinity structures' functionality and capacity to reduce flood damages and improve resilience against flood inundation and changed conditions. Conditions within the Study Area such as urbanization, sea level rise, extreme rainfall events, high tide cycles, and high groundwater tables have increased significantly since design and construction of the C&SF Project and are expected to continue to increase over the Section 203 Study's 50-year period of analysis from 2035 to 2085.

## 2.2 Natural Environment

The natural environment refers to biotic and abiotic elements that occur in the absence of, but may be influenced, by human activities. The Study Area's natural environment consists of several interconnected systems, each facing unique challenges. Air quality remains within U.S. Environmental Protection Agency (EPA) National Ambient Air Quality Standards (NAAQS). Industrial emissions and transportation are the main sources of air pollution, but strict adherence to NAAQS helps keep air quality in check. However, rising greenhouse gas emissions are driving warmer temperatures, higher sea levels, and more extreme weather, which strain flood control infrastructure and complicate long-term water management.

The area's hydrology relies on a complex network of primary, secondary, and tertiary canals for flood control and aquifer recharge. Urbanization, sea level rise, and extreme weather events have reduced the efficiency of this system. Water quality has suffered from urban development, leading to nutrient enrichment. Broward County addresses these issues through Total Maximum Daily Load (TMDL) programs that aim to reduce pollutants in local water bodies.

Land use changes have dramatically altered regional vegetation, replacing many native plant communities with invasive species such as Brazilian pepper, Australian pine, and melaleuca. These invasives disrupt natural ecosystems. Wildlife, including threatened species like the eastern indigo snake, wood stork, and Everglade snail kite, face severe habitat fragmentation, saltwater intrusion, and other climate-related threats.

The Biscayne Aquifer is the main source of drinking water for the Study Area. This unconfined aquifer, made up of porous soils and the Miami Limestone formation, is highly transmissive and productive. However, its karst geology makes it especially vulnerable to saltwater intrusion as sea levels rise.

Although the region's geology and soils are relatively stable, rising water levels and stronger storm surges will accelerate erosion and sediment displacement. WCS will struggle to manage floodwaters and prevent saltwater intrusion as sea levels rise and extreme weather events regularly exceed the structure's design capacity. These failures could lead to widespread inland flooding.

## 2.3 Physical Environment

The physical environment generally refers to the non-living components of the natural and constructed world. South Florida has undergone rapid urbanization in recent decades. The Study Area's visual environment is dominated by human-made structures and landscapes. Current land use patterns and planning efforts reflect the highly developed nature of the Study Area, which includes major transportation byways and water management infrastructure.

Rising water levels and storm surge are increasing pressure on the area's physical environment. Infrastructure such as roads, utilities, and buildings will face repeated flooding and saltwater exposure, resulting in costly repairs and reduced functionality. Urban landscapes will deteriorate, and parks and other visual resources will lose their appeal due to ongoing flooding and erosion.

## 2.4 Economic Environment

The economic environment is a combination of factors influencing consumer behavior and business performance. Study Area communities are particularly economically vulnerable to flooding that exacerbates existing economic challenges with repeated disasters hindering adaptation and recovery.

Flooding can cause extensive damage to homes, properties, businesses, infrastructure, and utilities, and it can disrupt essential services. The costs associated with repair, maintenance, evacuation, and displacement place a burden on residents, local governments, state agencies in Florida (including the SFWMD), and businesses. Flooding interferes with the operation and management of critical infrastructure, which encompasses infrastructure and utilities as well as essential services such as healthcare, public safety, and social services. Additional impacts include business interruptions, income losses for individuals and businesses, and disruptions to the workforce.

Saltwater intrusion threatens the potable water source for millions of people. Increased costs for potable water treatment may strain local economies. In the long term, environmental degradation and infrastructure failure undermine regional economic stability and growth.

The Study Area's flood management systems are critical to its economic environment. Robust flood control infrastructure and mitigation strategies are essential to address these interconnected economic and environmental challenges.

**Table 2-1** provides a summary of existing and FWOP conditions of natural, physical, and economic environment resources. Detailed information is provided in **Appendix B.**

**Table 2-1. Summary of Existing Conditions and Future Without Project Conditions.**

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| Air Quality | Air quality in the Study Area currently meets the National Ambient Air Quality Standards (NAAQS) set by the U.S. Environmental Protection Agency, with pollutant levels below regulatory thresholds and a designation of attainment for all criteria pollutants. While the region remains in compliance under typical conditions, flooding events can cause temporary emission spikes. Emissions result from waste accumulation, debris handling, and heavy equipment use during cleanup and reconstruction. These episodic impacts have not affected the area's attainment status but may locally degrade air quality. | Air quality in the Study Area is expected to improve over time as cleaner energy generation and increased electric vehicle use reduce emissions. These trends should enhance long-term air quality. However, more frequent and intense flooding from climate-related events could indirectly affect air quality by releasing terrestrial carbon, accumulating waste, and requiring emissions-intensive cleanup and repairs. In residential areas, reconstruction efforts may temporarily increase localized emissions. Without mitigation, these episodic impacts could partially offset long-term air quality improvements. |
| Greenhouse Gases | In 2023, Broward County's per capita emissions were 10 metric tons of carbon dioxide equivalent, which was a 10% decrease from 2018 levels. However, total countywide emissions still reached about 20 million metric tons of carbon dioxide equivalent in 2021. Broward County is engaged in ongoing efforts to cut emissions through local regulations and sustainability initiatives (Broward County 2023a). Periodic impacts in the region, such as flooding, may contribute to regional greenhouse gas emissions from decomposition of vegetation under anaerobic conditions, which releases greenhouse gases such as carbon dioxide ($CO_2$) and methane ($CH_4$). | Greenhouse gas emissions would be expected to continue to be uncertain. Uncertainty in efforts to sequester carbon and/or reduce future emissions would be expected to influence the future climate conditions. Flooding may increase greenhouse gas emissions through terrestrial carbon release, waste accumulation, debris handling, and the use of heavy equipment for cleanup and repairs. In residential areas, flood damage may require reconstruction, leading to temporary increases in localized greenhouse gas emissions from construction activity, material transport, and energy use. If not mitigated, these episodic effects could partially offset long-term reductions in emissions. |
| Climate | The Study Area has a tropical climate with distinct wet and dry seasons, characterized by mild winters and hot, humid summers. Average temperatures range from the mid-70s °F in winter to the high 80s °F in summer. Annual rainfall averages approximately 63 inches, with the majority occurring during the summer wet season, often intensified by tropical storms and hurricanes. | Climatological conditions in South Florida are expected to continue along a trajectory of intensifying weather patterns, including stronger storms and increased flood events. These climate trends will persist regardless of construction of the project. Uncertainty surrounding climate patterns, particularly regarding the frequency and duration of extreme precipitation, is expected within the Study Area in the future. |
| Noise | No known ambient noise monitoring has been conducted in the Study Area; consequently, no quantitative data on noise levels within the Study Area are available for analysis. Roadway traffic near residential zones is the primary noise source, as no major noise-generating facilities operate in the Study Area. Schools, churches, and other noise-sensitive buildings do not directly border WCS. Operational sound generated by existing gated spillways is expected to be low level and likely at or below ambient sound levels during normal operation. During infrequent atypical operation, a standby generator may produce a sound pressure level of approximately 85 A-weighted decibels (dBA) at a distance of 23 feet from the generator. In the event of a power loss, standby generator operation at the S-37A Gated Spillway would result in a received sound | Noise in the Study Area would not be expected to change over time. The affected area would continue to be predominantly high density residential with noise from traffic and other urban infrastructure. The baseline level of noise generated by existing WCS would not change in the future. |

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| | level of 46 dBA at the nearest school. Similarly, for the G-54 and G-57 Gated Spillways, the resultant received sound levels from generator operation would be 45 dBA at the closest school and 57 dBA from the closest church, respectively. | |
| Hydrology | Southeast Florida's flat, low-lying terrain, permeable Biscayne Aquifer, and strong surface-groundwater interactions—combined with canals and levees—define its hydrology. The urbanized eastern regions of Broward County rely on primary canals and WCS for flood control, water supply, and aquifer recharge. Water control operations prevent flooding and saltwater intrusion while recharging the aquifer. However, hydrologic modeling of nine watershed basins reveals uneven flood protection levels of service. Infrastructure gaps and low finished floor elevations of older homes contribute to urban flooding, especially in vulnerable basins during extreme rainfall. | Major hydrology drivers in the region, including rainfall, evapotranspiration, groundwater levels, and sea levels, would be expected to change in the future. These changing climatic conditions will significantly impact stormwater runoff (intensity, duration, frequency), resulting in a reduction of the system efficiency and future flood protection level of service. Flooding events result in property damage to residences, businesses, and critical infrastructure, present health and life safety risks, and threaten economic activities that are of significance. |
| Groundwater | The Study Area's aquifer system has three layers: the Floridan Aquifer (deepest), intermediate confining layer (impermeable), and Biscayne Aquifer (shallow, highly permeable), which supplies most drinking water. Rainfall, especially during wet seasons, primarily recharges the Biscayne Aquifer. Municipal, industrial, and agricultural pumping accounts for most groundwater withdrawals. The groundwater is calcium-bicarbonate type, requiring treatment to reduce hardness for public use. Saltwater intrusion has pushed the freshwater/saltwater boundary landward over the past century. Both the SFWMD's Water Resource Protection Programs and county-enforced wellfield protection zones provide some protection measures against groundwater contamination for the region's groundwater resources. | Rising sea levels and increased groundwater demand due to population growth will likely degrade groundwater quality, composition, and overall supply in the Study Area. As saltwater intrusion progresses, wells tapping the Biscayne Aquifer near the coast may need to be relocated or replaced with the brackish Floridan Aquifer, requiring new water treatment systems. A study by the Water Utility Climate Alliance (WUCA 2019) estimates that by 2060, 16% of Broward County's public supply wells will be at risk of saltwater intrusion. Several wellfields have already been decommissioned due to rising salinity levels. |
| Surface Water Quality | Urban development degrades water quality by disrupting natural drainage with canals and levees, increasing pollution from nutrients (total nitrogen, total phosphorus), fecal coliform, oil, grease, toxic chemicals and heavy metals. The Biscayne Aquifer—a critical freshwater source—faces contamination and saltwater intrusion risks. Programs like Broward County's Ambient Water Quality initiative track pollutants and enforce TMDL in key canals to meet state/federal standards, targeting nutrient and bacterial reductions. The Broward County Environmental Monitoring Laboratory monitors quarterly water quality data collected at 46 sites from canals and intracoastal waterways to determine the overall water quality of the county's water resources. The most recently published water quality data shows that *E. coli* exceedances of the FDEP statistical threshold value of 410 cfu/100 mL | Water quality in the Study Area will likely degrade over time as sea levels rise and saltwater intrusion becomes a primary factor. Broward County, currently the second most populous in Florida, is projected to grow by 12% by 2050 (BEBR 2024). This population increase will contribute to conditions that negatively affect water quality. While Broward County has numerous ordinances to manage impervious surface, rising percentages of impervious surfaces can be expected to boost runoff, worsening water quality and heightening contamination risks. An increase in rainfall duration and intensity, along with a projected rise in sea level, leads to an increase in the inflow and infiltration of the wastewater system, resulting in overloads (FTL 2024). Exceedances of *E. coli* thresholds will likely increase due to anthropogenic and climatic changes. |

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| | were found at 1 of the 46 sites monitored (Broward County 2024). *Enterococci* exceedances were found at 14 monitoring stations during the same period. | |
| Vegetation | Over the past century, agricultural expansion and urban development have drastically altered the region's vegetation. Once part of the Everglades ecosystem with diverse mangroves, prairies, hammocks, and marshes, the area now contains less than 5% natural lands. Urbanization and controlled drainage systems have replaced over 95% of the original landscape, leaving only fragmented remnants of wetland and upland vegetation. Invasive plants are partly controlled by government programs. | The 5% cover by natural lands is significantly constrained by urban development. Without improvements to the WCS, water levels would exceed WCS design capacity more frequently, resulting in increased flooding and soil erosion, and impacting or displacing remnants of wetland and upland vegetation. FWOP conditions are likely to cause remnant natural vegetation to convert into other types of vegetation cover, but in general, no net loss is expected. |
| Wetlands | Historically, the majority of the Study Area was part of the vast Everglades wetlands ecosystem. Systematic drainage has reduced the volume of wetlands in the Study Area. Freshwater non-forested wetlands constitute approximately 2.0 percent of the Study Area and are, due to urban landscape constraints, fragmented, low quality and providing minimal ecological services. Estuarine wetlands occupy 0.3 percent of the Study Area and are located in the Coral Reef Basin. | FWOP conditions are unlikely to result in net freshwater or estuarine wetlands losses. Hydric conditions that facilitate wetlands emergence will remain. However, hydric condition specifics (duration of inundation, salinity, etc.) are likely to alter in response to climatic events, such as storms, sea level rise, and flooding. Study Area wetlands are particularly vulnerable to these events. These changes may shift the dominant wetlands vegetation and type and affect the community's resilience. |
| Invasive Species | EO 13112 classifies invasive species as non-native organisms that harm ecosystems, economies, or human health by displacing native biodiversity. Florida's subtropical climate, busy ports, and dense population make it a hotspot for invasions, with over 32,000 exotic species dwarfing its 4,000 to 5,000 native plants and animals. These invaders degrade ecosystems, endanger public health, and damage agriculture and infrastructure. Broward County exemplifies the crisis, hosting 121 invasive plant species—67 of which (Category I) aggressively displace native flora. Both Broward and Palm Beach counties have ongoing programs to minimize the impacts of invasive plants and animals. Because of uncontrollable inputs from the Everglades, homes, and unmanaged private lands, both counties report prevention-of-spread much more often and reporting reduction or eradication. | It is expected that increased summer and winter minimum temperatures, increased extreme tropical systems, sea level rise, and changing weather patterns (e.g., droughts, floods) will enhance invasive species colonization, from introduction through establishment and expansion. Both Broward and Palm Beach counties have ongoing programs to minimize the impacts of invasive plants and animals. FWOP conditions are unlikely to change the uncontrollable inputs of invasive species from the Everglades, homes, and unmanaged private lands. Therefore, the change in environmental conditions within the Study Area is expected to compound the negative effects from invasive species to a minor/moderate degree in the FWOP conditions. |
| Essential Fish Habitat (EFH) | EFH in the inland canals of the Study Area include snapper and grouper complex; spiny lobster; penaeid shrimp; and coastal migratory pelagics, plus a fragment of Atlantic Highly Migratory Species EFH and Coral and Hardbottom EFH. Habitat loss has already impacted many managed fisheries and their habitats through overfishing, land conversion, altered hydroperiods, invasive species, and water quality decline. | In the future, it is predicted that the Study Area's high density urban landscape will remain largely intact, and the amount of EFH will be relatively unchanged. The quality of EFH is expected to degrade due to disruptions from flood control and lack of regulated freshwater flows between the present and 2085. Important EFH habitat constituents like mangroves would also be negatively impacted from storm surges, |

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| | | drought, and lack of space for inland migration. Predicted changes will degrade these habitats and may affect their viability as EFH. |
| Federally Threatened and Endangered Species | Twenty-nine federally listed species either currently inhabit or may inhabit the Study Area. In Florida, habitat loss has already impacted many listed species through land conversion, wetland drainage, altered hydroperiods, invasive species, and water quality decline. | Federally threatened and endangered species are either known to exist or potentially exist within the Study Area. In the future, it is predicted that the Study Area's high density urban landscape will remain largely intact, limiting the amount of habitat available for these species. As sea level rises, the remaining habitats face encroachment from saltwater intrusion and erosion, shrinking the already scarce natural areas where these species can survive. Strong storms and hurricanes will become more frequent and intense, reshaping coastlines and threatening ecosystems. Low-lying areas and coastal habitats will face persistent flooding and erosion, potentially leading to the disappearance of many habitats that support federally threatened and endangered species. |
| Fish and Wildlife | Florida hosts approximately 16,000 native species across all phyla, with the Study Area historically part of the Everglades' tropical rainforest zone. Today, urbanization has transformed over 95% of this region, leaving just 4.9% as natural lands—primarily Everglades wetlands, estuaries, and mangroves, which are all threatened by shifts in climate. The Florida Fish and Wildlife Conservation Commission prioritizes protecting Species of Greatest Conservation Need, including rare species like Florida burrowing owl, Miami chafer beetle, statira, and gopher tortoise, found near WCS in the Study Area. | Fish and wildlife are expected to be heavily impacted by the year 2085 due to shifting climate patterns in the highly urbanized Study Area. Saltwater intrusion and changes to salinity and temperature levels would change freshwater/saltwater fish species distributions and associated angler opportunities. Habitat loss for coastal-dependent species like wading birds and marine fish is expected as sea level rises, and storm surges erode shorelines. Important habitat like mangroves would also be negatively impacted from storm surges, drought, and lack of space for inland migration. Species on watch lists for the potential to become endangered or threatened, such as endemic species and those that time breeding according to hydrological cycles, may be negatively impacted. Shifts in migration, ranges, and breeding time are expected (and are already being documented for some species) for birds, amphibians, reptiles, mammals, and insects. |
| Geology and Soils | The Study Area's geology features two key formations, the young Everglades Geomorphic District and the Atlantic Coastal Ridge Province, both underlain by porous Miami Limestone (Pleistocene-era) that forms the Biscayne Aquifer. The region experiences stable geologic conditions with minimal seismic activity and gradual sinkhole formation. There are no active mining or oil operations in the Study Area. The predominantly sandy, poorly drained soils that are unsuitable for prime farmland, combined with urban development, create unique water management challenges. These conditions both support critical water infrastructure and complicate drainage and flood mitigation efforts. | Geologic conditions in the Study Area are not expected to change over time. The general topography, structural geology, and stratigraphy would remain the same. There are no active mines or oil/gas production within the Study Area. Seismic risk would remain low. Soil erosion would increase from increased frequency of extreme precipitation events and flooding. |
| Hazardous, Toxic, and Radioactive Waste | Phase I Environmental Site Assessment surveys were completed at nine WCS. No recognized environmental conditions were identified but one | It is expected that any accumulation of hazardous, toxic, or radioactive materials in the Study Area would continue to accumulate by 2085 and |

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| | compliance issue was noted at the S-33 Gated Spillway. Phase II Environmental Site Assessment surveys were conducted at six WCS sites. Results showed contaminants at levels both above and below leachability criteria; all levels were below Soil Cleanup Target Level. | may have migrated or expanded beyond the current extent. This could result in higher maintenance and cleanup costs as the water level rises and requirements regarding hazardous and toxic materials evolve over time. |
| Visual Resources | The Study Area's visual environment earns a Bureau of Land Management Class IV rating, the highest urbanization classification, due to pervasive development and infrastructure, minimal visible natural features, and high visual contrast from built elements (e.g., roads, canals, and WCS). This classification reflects the complete dominance of human-made landscapes over natural scenery. While limited views of natural landscapes exist at the periphery of the Study Area, such as the beaches and Atlantic Ocean to the east and the Everglades to the west, these do not mitigate the overwhelming visual impact of urban development. The degree of landscape modification within the Study Area is so significant that natural features are virtually absent, making the built environment the prevailing visual element. | Visual resources in the Study Area may be significantly degraded because of rising sea levels, increased flooding, and saltwater intrusion. As water levels rise and more frequent extreme weather events occur, the natural landscapes, scenic views, and coastal features could be altered or eroded, diminishing the area's aesthetic appeal. The built environment, including infrastructure and development, could become more costly to upkeep and ultimately fall into various states of disrepair, further detracting from the visual integrity of the built environment. |
| Land Use and Real Estate | Developed and human-modified land uses (urban, transportation, and infrastructure categories) comprise approximately 81% of the Study Area. Natural lands and waters account for approximately 6%. The remaining 13% consists of engineered or modified lands and waters, such as canals, detention areas, or other human-altered features. This distribution reflects a Study Area that is largely characterized by intensive development and infrastructure, with limited remaining natural cover types. Broward County's land use plan emphasizes high-density development near transit hubs and flood-resilient design. Palm Beach County additionally emphasizes mixed-use zoning and environmental conservation. SFWMD Rights-of-Way guidelines maintain clear zones along canals and structures to support C&SF Project operations—ensuring flood control, water supply, navigation, and environmental protection while accommodating urban growth. | Land use patterns in the Study Area may be significantly impacted by future land development, increased flooding, saltwater intrusion, and shifting water levels. As sea levels rise and extreme weather events become more frequent, the flood control system may no longer be able to effectively manage water volumes, resulting in more frequent and severe flooding of surrounding lands. This could lead to widespread infrastructure damage, including the deterioration of roads, utilities, and buildings due to increased flooding and saltwater intrusion. The built environment would face more frequent and severe damage, potentially resulting in higher repair and maintenance costs. Development in low-lying areas may become less feasible, leading to reduced density or abandonment of vulnerable parcels. Some lands could transition to open space or stormwater management areas to enhance flood storage capacity, while zoning and land use regulations may shift to favor flood-resilient design, stricter building codes, and expanded conservation zones. Additionally, the severance of essential services, such as water supply, drainage systems, and transportation routes, could further impede existing and planned developments. |
| Transportation and Traffic | The core infrastructure in the Study Area consists of major roadways (I-95 and Florida Turnpike, which are high congestion), rail (including Tri-Rail [commuter] and Brightline [intercity]), airports (Fort Lauderdale-Hollywood International [FLL] and municipal airports), and major waterways (primarily the Intracoastal Waterway and Port Everglades). | The transportation network in the Study Area may experience significant strain in the future. Roads and transportation routes could become more prone to disruption from rising water levels, which would impede vehicle access and increase travel times. The existing road network may not be able to accommodate the growing demands of |

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| | Annual Average Daily Traffic data reveal traffic congestion hotspots, particularly near critical flood-control structures. Though these flood control structures lack navigational functions, they prioritize water management and flood resilience. | both local and commuter traffic, leading to congestion and diminished mobility. Additionally, essential transportation infrastructure, such as bridges and drainage systems, including drainage associated with airports and the port, may be vulnerable to increasing flood damage, further compromising the efficiency and reliability of the transportation network. As a result, traffic flow and accessibility could be severely impacted. |
| Infrastructure and Utilities | The Study Area's flood control system features include nine primary gated WCS and canals that are part of the C&SF Project. These structures actively regulate water flow and levels; prevent flooding, conserve water, and block saltwater intrusion; and operate via remote and manual controls. Routine structure inspections detect deficiencies, while scheduled maintenance and overhauls maintain safety compliance and system reliability. The system's operations follow USACE guidelines in ER 1110-2-1156 and state regulations under Chapter 373, Florida Statutes, which govern water management and flood control operations.<br><br>Broward County manages approximately 30 utilities for potable (drinking) water and wastewater treatment, along with an estimated 30 stormwater management utilities. Wellfields that supply drinking water and are situated near the coast are at risk of saltwater intrusion. Both potable and wastewater systems are susceptible to infiltration and inflow issues caused by flooding, which disrupts treatment and distribution processes. Additionally, sanitary sewer overflows occurring during flooding events and drainage capacities of the stormwater utilities are minimized. | Sea level rise, saltwater intrusion, extreme rainfall, and drought will intensify and place increasing stress on the Study Area's WCS. These structures currently manage flooding, block saltwater from moving upstream, conserve freshwater, and regulate water levels both upstream and downstream. As sea levels and rainfall volumes rise, water levels in primary canals will exceed the WCS design capacity. When that occurs, the structures will no longer control flows effectively, and flood events will become more frequent and severe. The system's reduced performance will compromise water management across the region.<br><br>Flooding events will further affect the potable water, wastewater, and stormwater utilities managed by Broward County. There is an expectation of increased infiltration and inflow events, which will disrupt treatment and distribution processes. Wellfields are likely to become more vulnerable to saltwater intrusion, potentially necessitating their relocation or abandonment in favor of new water supply sources. Additionally, the frequency of sanitary sewer overflows is expected to rise, along with greater challenges in stormwater management drainage. |
| Federally Recognized Tribes | The Study Area is home to the federally recognized Miccosukee Tribe of Indians and Seminole Tribe of Florida. Reservation lands are largely within the boundary of the SFWMD. | The status of federally recognized Tribes is not expected to change in the FWOP condition. |
| Cultural Resources | There are 7,944 cultural resources, including historic buildings, bridges, structures, cemeteries, and archaeological sites, located within the Study Area. One hundred and eighty-three of the recorded cultural resources are eligible for the National Register of Historic Places (NRHP) and an additional 20 resources are potentially eligible.<br><br>Twenty cultural resources intersect with the WCS and canals that are the focus of the Section 203 Study. Fourteen of these cultural resources (one listed, seven eligible, and six not evaluated) are historic properties. These include Lock 1 of the G-54 Gated Spillway, which is listed on the NRHP. Three canal systems are eligible for NRHP inclusion including the | There are 7,944 recorded cultural resources present within the Study Area and it is probable that additional resources will be identified in the future. Preservation studies have shown that there is an increasing threat of disturbance, damage, and/or destruction to cultural resources, especially in coastal areas, due to sea level rise, flooding, storm surges, and associated erosional activities. These environmental situations are likely to impact cultural resources through, at a minimum, ground disturbance, weathering over time, water damage, and structural damage. These impacts have the potential of diminishing the integrity of these cultural resources. The future of natural hazard risks is |

| Resource | Existing Conditions | Future Without Project Conditions |
|---|---|---|
| | G-08 (Hillsboro) Canal, G-15 (North New River) Canal, and C-11 (South New River) Canal. Four additional NRHP-eligible cultural resources include the Florida East Coast (FEC) Railway Bridge, portions of the FEC Railway, portions of Dixie Highway, and portions of the Seaboard Air Line Railroad. Six cultural resources have not been evaluated for NRHP inclusion: Hillsboro Canal Bridge, E-2 Canal, Deerfield Lock, S-13 Pump Station and Gated Spillway, Site 8D182, and Site 8BD183. The remaining six cultural resources are ineligible for the NRHP: E-3 Canal, Military Trail, Bridge #860184, C-14 Canal, C-13 Canal, and C-12 Canal. | uncertain, but it is likely that the risks will worsen in the future, resulting in further threat to cultural resources within the Study Area. If left unaddressed, impacts from the environmental stressors, including sea level rise and flooding, will increase the threat to cultural resources. |
| Socioeconomics | Broward County has a higher population density, a younger median age, and greater labor force participation than Palm Beach County. However, Palm Beach County leads in per capita income, housing values, and homeownership rates. Both counties have experienced population growth, with minority populations growing the fastest. Distribution of industry sector employment in Broward and Palm Beach counties is on par with state and national levels. When all industries are totaled, both counties demonstrate positive percent changes in gross domestic product (GDP). Job growth spans across all industries, but Palm Beach County shows stronger economic momentum, with higher income and GDP growth rates compared to Broward County.<br><br>The Study Area communities, including personal property, businesses, and critical infrastructure, are economically vulnerable to flooding, with repeated events hindering recovery. | As part of a national trend, populations in the Study Area are expected to continue growing through 2075. This growth will drive demand for both the filling of vacant housing units and the construction of additional units. At the same time, sea level rise is likely to inundate more neighborhoods and homes, leading to property sales or abandonment and creating associated economic challenges. In Broward and Palm Beach counties, overall positive job growth (totaled across all industries) is expected through 2032. Despite net positive growth, Broward County projects a decrease in certain industry sectors by 2032, including construction and government. Palm Beach County projects a decrease in agriculture, forestry, fishing, hunting, and mining within the same time frame. These decreases are likely to be exasperated further in the future by natural hazards that make it difficult to produce product output due to potential lack of habitable construction areas and fishable water. The future trajectory of natural hazard risks is uncertain, but it is likely that these risks will worsen in the future, resulting in further socioeconomic impacts on Study Area communities. If left unaddressed, impacts from environmental stressors such as flooding and saltwater intrusion will exacerbate economic challenges. |

## 2.5 Period of Analysis

A key component of the Section 203 Study is hydrology and hydraulics modeling based on future conditions, sea level rise and extreme storm/flood events. This comprehensive analysis provides a foundation for assessing long-term flood risk management strategies in the Study Area.

The Section 203 Study's 50-year period of analysis is 2035 to 2085. 2035 was chosen as the initiation of the period of analysis because that is when authorized infrastructure is expected to be constructed and operational and is determined as the study's existing condition baseline. In the 2085 FWOP, it is assumed that selected local resilience efforts will be established and functional. It is also reasonable to assume new and updated infrastructure as part of the FWOP conditions scenario.

## 2.6 Infrastructure Features

Operations and infrastructure that are or will be part of existing and FWOP conditions include features to manage water conveyance, diversion, and redirection for the purposes of retention, managing flood risk, water quality, minimizing saltwater intrusion, mitigating sea level rise, and ecosystem protection (**Table 2-2**). These features also include impoundment management to retain water and minimize seepage. They are included in existing and FWOP conditions because these mechanisms are essential for managing flood risk and there is a high level of certainty that these features will be constructed and fully operational before the base year of the period of analysis. WCS and canals that are part of existing and FWOP conditions are described in **Table 2-3**. Existing and FWOP features, and model assumptions, are described in greater detail in **Appendix A, Engineering Appendix**.

Features inside and outside the Study Area that are excluded from existing and FWOP study modeling assumptions are described in **Table 2-4**.

**Table 2-2. Infrastructure Identified and Included in Existing or Future Without Project Modeling.**

| Project (Lead Agency) | Description | Existing Condition Baseline 2035 | Future Without Project Condition 2085 |
|---|---|---|---|
| Central Everglades Planning Project (CEPP) (USACE/SFWMD) | Major conveyance, seepage, and storage improvements to manage water flow across all reaches | Operational | Operational |
| Fran Reich Preserve (Site 1 Impoundment Phase 1) (USACE/SFWMD) | Reduces seepage loss from the Loxahatchee National Wildlife Refuge (Water Conservation Area 1) to retain more water in the natural system during dry periods | Phase I, features operational | Phase I, features operational |
| C-9/C-11 Impoundment: Broward County Water Preserve Areas (USACE/SFWMD) | Independent operation for water diversion between canals under flood conditions to protect urban areas | Operational features for C-9 and C-11 Impoundments | Operational features for C-9 and C-11 Impoundments |
| C-1/C-2 Sample Road Recharge Line (Broward County) | Interconnects canals for flood control and saline water prevention; gated culvert installed for flow management | Completed and operational | Completed and operational |

| Project (Lead Agency) | Description | Existing Condition Baseline 2035 | Future Without Project Condition 2085 |
|---|---|---|---|
| Broward and Hillsboro Basins: North Springs Improvement District Pump Station 3 (Broward County) | Operates to discharge excess water to Hillsboro Canal during high and low peak periods to maintain target water levels | Completed and operational | Completed and operational |
| FLL Ravenwood System Interconnection (Broward County) | Connects Northern and Ravenswood systems; phases include equalizer pipe, pump station, and stormwater management improvements for flood attenuation and sea level rise adaptation | Completed and operational | Completed and operational |
| Sample Road Improvement Project and Recharge Line (Broward County) | Adds gated culvert for water release from Crystal Lake to C-1 Canal; maintains consistent coastal water levels for saline intrusion prevention | Completed and operational | Completed and operational |
| FLL Edgewood Park Stormwater Project (Broward County) | Upgrades drainage culverts and restores drainage system to manage discharge to Osceola Creek; addresses sea level rise risk | Completed and operational | Completed and operational |
| FLL System 1 Basin A and B Interconnection Projects (Broward County) | Enhancements to interconnect primary drainage basins for optimized flood protection and capacity management | Completed and operational | Completed and operational |
| Seawall Master Plan (Fort Lauderdale) | Planned elevation of city-owned seawalls along New River Canal to manage out-of-bank flooding and enhance flood resilience in the area | Planning in progress | Completed and operational |
| Progresso and Dorsey-Riverbend Neighborhood Stormwater Improvements (Fort Lauderdale) | Upgrades to stormwater management to reduce flooding and enhance water quality | Ongoing | Completed and operational |
| Dorsey Riverbend Stormwater Flooding Improvements (Fort Lauderdale) | Upgrades to stormwater management to reduce flooding and enhance water quality | Completed and operational | Completed and operational |
| Bulkhead Replacement Project (Port Everglades) | Replacement of the north bulkhead to the entrance channel | Bulkhead Replacement Project, Group 1, Project complete | Bulkhead Replacement Project, Group 1, Project complete |

**Table 2-3. Description of Water Control Structures and Associated Primary Canals.**

| Water Control Structure | G-56 Gated Spillway | G-57 Gated Spillway | S-37B Gated Spillway | S-37A Gated Spillway | S-36 Gated Spillway | S-33 Gated Spillway | G-54 Gated Spillway | S-13AW Gated Culvert | S-13 Pump Station and Gated Spillway |
|---|---|---|---|---|---|---|---|---|---|
| **Design Specifications** | | | | | | | | | |
| Year Built | 1991 | 1987 | 1959 | 1959 | 1954 | 1954 | 1992 | 2007 | 1954, Pump station refurbished in 2017 |
| Design Discharge (cubic feet per second) | 3,760 | 375 | 3,390 | 3,890 | 1,090 | 920 | 1,600 | 500 | 1,080 (540 via 3 pumps and 540 via 1 gate) |
| Optimum Headwater Elevation (ft NAVD88) | 5.9 | 2.9 | 5.4 | 2.4 | 2.9 | 1.9 | 2.4 | 1.4 to 2.0 | 0.0 |
| Design Discharge Flow Type | Uncontrolled submerged | Controlled submerged | Uncontrolled submerged | Controlled submerged | Uncontrolled submerged | Uncontrolled submerged | Uncontrolled submerged | Submerged | Uncontrolled submerged (for gate) and pumped |
| Generator Room/Building Finished Floor Elevation (ft NAVD88) | 12.9 | 8.3 | 9.9 | 7.4 | 13.1 | 11.9 | 8.9 | 7.7 | 7.0 |
| Water Level which will Bypass Structure (ft NAVD88) | 12.4 | 7.4 | 9.9 | 6.4 | 9.9 | 8.4 | 6.4 | 6.6 | 6.4 |
| Number of Spillway/Culvert Gates | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 1 |
| Gate Type | Vertical slide | Vertical lift | Vertical lift | Vertical lift | Vertical lift | Vertical lift | Vertical slide | Vertical-lift sluice | Vertical lift |
| Gate Lift Mechanism Type | Hydraulic cable lift hoist | Cable drum | Electric driven cable drum | Hydraulic cable lift hoist | Direct drive electric motor gear, connected to cables | Cable drum | Hydraulic cable lift hoist | Stem-driven | Cable lift |

| Water Control Structure | G-56 Gated Spillway | G-57 Gated Spillway | S-37B Gated Spillway | S-37A Gated Spillway | S-36 Gated Spillway | S-33 Gated Spillway | G-54 Gated Spillway | S-13AW Gated Culvert | S-13 Pump Station and Gated Spillway |
|---|---|---|---|---|---|---|---|---|---|
| Manatee Protection Pressure Sensors[a/] | No | No | No | No | No | Yes | No | No | No[b/] |
| Gate Lift Normal Power Source | Commercial electricity | Commercial electricity | Commercial electricity | Commercial electricity | Commercial electricity | Commercial electricity | Commercial electricity | Commercial electricity | Commercial electricity |
| Gate Lift Backup Power Source | LPG engine-driven generator | LPG engine-driven generator | LPG engine-driven generator | LPG engine-driven generator | LPG engine-driven generator | LPG engine-driven generator | LPG engine-driven generator | LPG engine-driven generator | 2 diesel engine-driven generators (1 primary, 1 backup) |
| **Canal Description** | | | | | | | | | |
| Primary Canal | G-08 (Hillsboro) Canal | G-16 (Pompano) Canal | C-14 (Cypress Creek) Canal | C-14 (Cypress Creek) Canal | C-13 (Middle River) Canal | C-12 (Plantation) Canal | G-15 (North New River) Canal | C-11 (South New River) Canal | C-11 (South New River) Canal |
| Bottom Width (upstream, downstream) (ft) | 80.0 | 20.0 | 20.0, 30.0 | 45.0, 80.0 | 20.0 | 10.0 | 100, 72.5 | 40.0 | 40.0 |
| Bottom Elevation (upstream, downstream) (ft NAVD88) | -12.6, -18.6 | -8.6 | -16.1, -16.6 | -16.6 | -9.6, -10.6 | -4.6, -6.6 | -7.6, -9.6 | -5.6 | -10.6 |

a/ Where manatee protection pressure sensors do not exist, WCS can be operated in such a manner as to exclude manatees (e.g., 2.5-foot minimum gate openings).
b/ Although the S-13 Pump Station and Gated Spillway gate does not include manatee protection sensors, it does include a metal grating within its spillway discharge bay that functions as a physical barrier to prevent manatees from contacting the S-13 spillway gate.
Note: LPG = liquified petroleum gas
Source: As-built drawings of structures and SFWMD 2022 a-h

**Table 2-4. Resilience Infrastructure Identified but Not Included in Existing or Future Without Project Modeling.**

| Project[a/] (Lead Agency) | Description |
|---|---|
| Resilient Florida Projects (Florida Department of Environmental Protection) | Various small-scale stormwater improvements like interconnections, canal bank elevation, and living shorelines |
| Broward County Local Mitigation Strategy | Projects that are identified from the study of Broward County's vulnerabilities to natural and human-caused hazards |
| De-watering Pumps at SR-A1A for Hollywood North Beach Park (Broward County) | Manages localized flooding on the barrier island, unrelated to C&SF system |
| C-4 Canal Conveyance Improvements (Broward County) | Canal dredging and bank stabilization of local C-4 Canal with geotextile tubes to improve water flow towards Hillsboro Canal |
| Hardening Seawalls at Hollywood North Beach (Broward County) | Shoreline construction with seawall structures and living shorelines to mitigate tidal flooding and protect resources |
| Canal Pump Station S-45 Resilience Improvements (Broward County) | Pump captures fresh water during dry periods to recharge secondary canals, protecting water sources from saltwater intrusion |
| Boulevard Gardens Neighborhood Stormwater Improvements (Broward County) | Green infrastructure for flood reduction and water quality improvements, providing year-round benefits in North Fork New River Basin |

a/ Additional projects were identified in Hollywood, Dania Beach, Sunrise, Weston, and Deerfield Beach that were not carried forward.

# 3.0 FORMULATION OF ALTERNATIVE PLANS

This section outlines the foundation for plan formulation and details the process by which alternatives were developed and evaluated to support the selection of a preferred alternative (i.e., TSP). The formulation of alternative plans for the Section 203 Study follows the Policy for Conducting Civil Works Planning Studies (ER 1105-2-103) and adheres to USACE Agency Specific Procedures as prescribed in 33 CFR 234.

## 3.1 USACE Planning Framework

USACE follows a six-step iterative planning process for all planning studies as defined in the Principles and Guidelines (P&G) for Water and Related Land Resources Implementation Studies and in ER 1105-2-103, Planning Policy for Conducting Civil Works Planning Studies. This structured process enables the planning team to create and assess various alternatives, ultimately leading to the selection of a TSP. Steps are reiterated, as necessary, as data collection and analyses progress throughout the study. Each of the six steps is described in detail below.

### 3.1.1 Step 1: Identifying Problems and Opportunities

Plan formulation begins by clearly defining the scope and direction of planning studies. This is achieved by identifying problems, opportunities, objectives, and constraints. Study scoping is accomplished through collaboration and engagement with federal and state agencies, Tribes, stakeholders, community members, and non-governmental organizations. Once the problems, opportunities, objectives, and constraints are identified, iterations of the planning framework are completed to inform decision making and to identify data and analysis needs.

As noted in **Section 1.5**, the problems, opportunities, objectives, and constraints for the Section 203 Study were adopted from the ongoing C&SF Section 216 Study. The scope for the C&SF Section 216 Study was designed to address a broad range of problems and opportunities across a large Study Area. The Section 203 Study refines the problems, opportunities, objectives, and constraints to the specific needs of Section 203 Study Area. As part of Study scoping, planning meetings were held in October and December 2024 to gather input for the problems, opportunities, objectives, and constraints; to refine the overall understanding of existing and future conditions; to gather input for the development of measures and alternatives; and to fulfill public scoping requirements.

In summary, the problems identified for the Section 203 Study include:

- Effects of compound flooding;
- Limitations of existing infrastructure to address changing conditions;
- Various changing conditions affecting flooding, such as urbanization, sea level rise, intensified extreme rainfall, increased high tide events, and higher groundwater tables;
- Community, environment, and economic impacts associated with flood damages; and
- Public safety risks related to flood events.

The opportunities of the Study include:

- Managing risk to historical and cultural resources,
- Managing public and life safety concerns caused by inundation, and
- Unifying coordination and building trust with stakeholders and the public.

The Section 203 Study objective is to enhance the functionality and capacity of C&SF Project water control and salinity structures to reduce flood damages and improve resiliency caused by inundation and changing conditions within the Study Area over the 50-year period of analysis from 2035 to 2085.

Constraints include:

- Avoiding, minimizing, and/or mitigating the transfer of flood risk to other locations within the Study Area during the analysis period; and
- Avoiding, minimizing, and/or mitigating impacts to the stated objectives and authorized benefits of other federal studies and projects within the Study Area.

### 3.1.2 Step 2: Inventorying and Forecasting Conditions

To build the FWOP condition, a baseline condition is developed that accurately reflects existing environmental, economic, and social conditions, including their interconnections. The baseline condition is expanded to consider conditions in the forecast year of the period of analysis, constituting the FWOP scenario. Forecasted conditions must reasonably account for anticipated changing conditions, incorporate inputs from Study scoping, and identify uncertainties associated with the projections of future conditions. The FWOP condition for the Section 203 Study consists of a period of analysis from 2035 to 2085, with qualitative analyses extending an additional 50 years to account for longer-term changes. The FWOP accounts for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the existing and authorized C&SF Project. FWOP is the same as the No Action Alternative and is compared to Future With Project (FWP) conditions. Existing conditions and FWOP conditions are included in **Section 2** of this Report. Assumptions for the period of analysis are described in **Section 3.2** below.

### 3.1.3 Step 3: Formulating Alternative Plans

To develop an initial array of alternatives, the objectives and constraints as well as contributions from federal and state agencies, Tribes, stakeholders, community members, and non-governmental organizations, are applied to formulate management measures. Management measures form the foundation for the initial array of alternatives and include structural, nonstructural, and nature-based measures.

Measures and alternatives must be formulated to achieve the Federal Objective and Guiding Principles. The Federal Objective, established by the Water Resources Development Act of 2007, mandates that federal investments in water resources align with national priorities, promote economic development, and safeguard the environment by maximizing sustainable economic development; avoid the imprudent use of floodplains and flood-prone areas, and minimize adverse impacts and vulnerabilities when their use is unavoidable; and protect and restore the functions of natural systems while mitigating any unavoidable harm to these systems.

The Guiding Principles of the Principles, Requirements, and Guidelines for Federal Investments in Water Resources inform a more balanced consideration of economic, social, and environmental objectives in decision making.

The formulation and evaluation criteria must also be used to develop measures and alternatives, taking into account the FWOP scenario that incorporates changing conditions, and the resilience of the proposed measure or alternative. The formulation criteria are detailed as follows:

- Completeness: This refers to how well the measures or alternatives include all necessary investments and actions—by both federal and nonfederal entities—to achieve the planning objectives. It also involves considering the sustainability and long-term aspects of the plans, ensuring all resource needs are accounted for. Completeness does not imply that all objectives are fully met, but that the essential resources and actions are incorporated to realize the estimated benefits.
- Effectiveness: This measures how well a measure or alternative addresses the specified problems and takes advantage of the opportunities identified. It does not require that all planning objectives be fully addressed or achieved.
- Efficiency: This criterion evaluates whether a measure or alternative offers a cost-effective solution to the problem and meets the objectives. Efficiency is assessed by comparing the costs and benefits of each alternative.

- Acceptability: This concerns the feasibility and practicality of the measure or alternative in terms of acceptance by state and local entities, the public, and its alignment with existing laws, regulations, and public policies. Acceptability has two aspects—implementability and satisfaction. Implementability refers to the technical, financial, and legal feasibility of the alternative. Satisfaction reflects the degree to which the plan is politically or preferentially supported.

Management measures carried forward to the initial array of alternatives were refined by qualitative or quantitative analysis and are described in detail in **Section 3.3** below. For structural measures, hydraulic modeling was completed to develop and test the performance of measures, where appropriate. Development of the Section 203 Study's initial array of alternatives was carried out in accordance with the guidelines and requirements established by ER 1105-2-103 and 33 CFR 234 to ensure sustained and enhanced FRM and resiliency solutions for the Study Area over the period of analysis from 2035 to 2085 and are described in detail in **Section 3.4**. The initial array of alternatives includes the following required plans listed in ER 1105-2-103 and 33 CFR Part 234:

- FWOP
- Max Net Public Benefits
- Total Benefits, including Regional Economic Development
- Nature-Based Solution Alternative
- Environmentally Preferred
- Non-Structural Plan
- Locally Preferred Plan

### 3.1.4 Step 4: Evaluating Alternative Plans

The evaluation of alternatives aims to provide a comprehensive assessment of each alternative's outcomes, including benefits, costs, impacts, risks, and uncertainties. Alternatives are systematically compared based on their effectiveness in achieving the Section 203 Study objectives, the Federal Objective, Guiding Principles, and the four formulation and evaluation criteria. Comprehensive benefits are established and classified into four accounts: National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The NED account captures benefits or effects to the nation. The RED account captures benefits or effects specific to the region. The EQ account capture benefits or effects to the environment. The OSE account captures benefits or effects to communities, cultural resources, public safety, etc. Comprehensive benefits, monetary or non-monetary, are displayed to transparently inform the realized benefits, including trade-offs that occur among the alternatives being evaluated. The potential effects of alternatives are also identified and include direct, indirect, and cumulative effects. Costs reflect the life cycle of the project. Comprehensive benefits opportunities were scoped from the USACE Comprehensive Benefit Evaluation Scooping Tool. The comprehensive benefits selected for the Section 203 Study are included in **Table 3-1** below.

**Table 3-1. Section 203 Study Comprehensive Benefits.**

| National Economic Development (NED) | Regional Economic Development (RED) | Environmental Quality (EQ) | Other Social Effects (OSE) |
|---|---|---|---|
| Total Benefits from Avoided Equivalent Annual Damages | Business Interruption Direct Output Loss | Threatened and Endangered Species Impacts | Change in Risk to Critical Infrastructure |
| Transportation Benefits (Travel Time and Operations Savings) | Temporary Displacement, Days and Cost Savings | Wellfield Effects (salinity intrusion risks) | Change in Risk to Cultural Resources Sites and Buildings |
| Net Benefits and Benefit to Cost Ratio | Temporary Displacement Regional Economic Impacts (Direct and Secondary) | Change in Risk to Septic Tanks | |
| | Construction Benefits, Short-term (Direct and Secondary) | Change in Risk to Sanitary Sewer Overflow Incidents | |
| | Operations Benefits, Long-Term (Direct and Secondary) | | |
| | National Flood Insurance Program Discounts | | |

### 3.1.5 Step 5: Comparing Alternative Plans

The comparison of alternatives begins with evaluating each alternative against the FWOP scenario, followed by a comparative analysis of all alternatives to identify differences in performance across the comprehensive benefits selected for the Study. This comparison considers the entire project lifecycle and the ability to sustain the project throughout the period of analysis. It also evaluates risks and uncertainties related to achieving the Study objectives. The performance of each alternative relative to the FWOP scenario, Study objectives, formulation and evaluation criteria, Federal Objective, and Guiding Principles are then summarized in a table of effects. This table supports the comparison of alternatives and facilitates the identification and discussion of trade-offs. Trade-offs reveal the distribution of benefits and impacts both within and beyond the Study Area and help inform which alternative best addresses the Federal Objective and Guiding Principles. Through this comparative process, the following plans must be identified: the NED Plan, which reasonably maximizes NED benefits consistent with protecting the Nation’s environment; the Total Net Benefits Plan, which reasonably maximizes net benefits across the four P&G accounts; and the Least Environmentally Damaging Practicable Alternative, as required by Section 404 of the Clean Water Act (40 CFR Part 230).

The comprehensive benefits selected for evaluating and comparing the performance of alternatives are presented in **Table 3-2** below. **Table 3-2** details the comprehensive benefit, the corresponding P&G account, input required to develop the benefit metric, and the output generated for comparison across alternatives.

### 3.1.6 Step 6: Recommendation of a Plan

The selection of a TSP is a collaborative process between the planning team, governments, stakeholders, and the public. Planning iterations are repeated, if necessary. The identified TSP must be shown as preferable to no action or any other alternative considered in the Study and must clearly demonstrate meeting the Study objectives, addressing problems, and realizing opportunities. A complete trade-off analysis is required for the TSP, including the risks and uncertainties of the plan over the lifecycle of the project. Compliance with applicable laws, regulations, and policies must be demonstrated. The TSP is further described in **Section 6** of this report.

**Table 3-2. Section 203 Study Comprehensive Benefits Metrics.**

| Comprehensive Benefit | P&G Account[a/] | Model/Tool for Analysis[b/] | Data Input(s)[c/] | Data Output(s) |
|---|---|---|---|---|
| Total Benefits | NED | NED Spreadsheet Tool | • HEC-FDA 2.0 Avoided Equivalent Annual Damages (Structures, Roads, Vehicles)<br>• Transportation Benefits | Total Benefits (nominal results, values escalated to account for inflation) |
| Transportation Benefits | NED | Transportation Benefits | • Southeast Florida Regional Planning Model Output Vehicle Hours Traveled and Vehicle Miles Traveled | • Transportation Benefits<br>• Travel Time and Operations Savings |
| Benefit to Cost Ratio | NED | NED Spreadsheet Tool | • Total Benefits (nominal results, values escalated to account for inflation)<br>• Construction ROM Project Costs<br>• Operations ROM Project Costs | • Net Benefits<br>• Benefit to Cost Ratio |
| Business Interruption Direct Output Loss | RED | Quickbase Tool | • HEC-FDA 2.0 Depth above First Floor Elevation for Residential Structures – 2-Year Coastal, 25-Year Rainfall; 2-Year Coastal, 100-Year Rainfall; 100-Year Coastal, 100-Year Rainfall<br>• Hazus Building Occupancy Definitions and National Standard Values | • Direct Output Loss<br>• Annualized Cost |
| Temporary Displacement | RED | Temporary Displacement Tool | • HEC-FDA 2.0 Depth above First Floor Elevation for Residential Structures – 2-Year Coastal, 25-Year Rainfall; 2-Year Coastal, 100-Year Rainfall; 100-Year Coastal, 100-Year Rainfall<br>• U.S. Census Data (Esri)<br>• Hazus Flood Technical Manual | • Temporary Displacement<br>• Days and Cost Savings |
| Temporary Displacement Regional Economic Impacts (Direct and Secondary) | RED | IMPLAN | • Temporary Displacement<br>• Days and Cost Savings | • Total Jobs (Full-Time Equivalent)<br>• Total Labor Income<br>• Total Value Added<br>• Total Output |
| Construction Benefits, Short-Term (Direct and Secondary) | RED | IMPLAN | Construction ROM Project Costs | • Total Jobs (Full-Time Equivalent)<br>• Total Labor Income<br>• Total Value Added<br>• Total Output |
| Operations Benefits, Long-Term (Direct and Secondary) | RED | IMPLAN | Operations ROM Project Costs | • Total Jobs (Full-Time Equivalent)<br>• Total Labor Income<br>• Total Value Added<br>• Total Output |

| Comprehensive Benefit | P&G Account[a/] | Model/Tool for Analysis[b/] | Data Input(s)[c/] | Data Output(s) |
|---|---|---|---|---|
| National Flood Insurance Program Discounts | RED | GIS | • HEC-FDA 2.0 Depth above First Floor Elevation for All Structures – 2 Year Coastal, 25 Year Rainfall; 2 Year Coastal, 100 Year Rainfall; 100 Year Coastal, 100 Year Rainfall<br>• National Flood Insurance Program Flood Zones | Number of Flood Claims |
| Threatened and Endangered Species Effects | EQ | GIS | MIKE SHE Output Flood Depths above Ground Surface Elevation, 100 Year Surge, 100 Year Rainfall | Threatened and Endangered Species Impacts |
| Wellfields Effects | EQ | GIS | MIKE SHE Output Flood Depths above Ground Surface Elevation, All Scenarios | Wellfield Effects and Potential Benefits (qualitative) |
| Change In Risk To Septic Tanks | EQ | Septic Tanks with Flood Values Tool | • MIKE SHE Output Flood Depths above Ground Surface Elevation – 2 Year Surge, 25 Year Rainfall; 2 Year Surge, 100 Year Rainfall; 100 Year Surge, 100 Year Rainfall<br>• Florida Water Management Inventory | Septic Tanks with Flood Values per Frequency Event |
| Change in Risk to Sanitary Sewer Overflow Incidents | EQ | Spreadsheet Analysis | • HEC-FDA 2.0 Depth above First Floor Elevation For all Structures – 2 Year Coastal, 25 Year Rainfall; 2 Year Coastal, 100 Year Rainfall; 100 Year Coastal, 100 Year Rainfall<br>• Florida Department of Environmental Protection Water Quality Data | Percent Change in Flood Depths in Comparison to FWOP per Frequency Event |
| Change in Risk to Critical Infrastructure | OSE | Spreadsheet Analysis | • HEC-FDA 2.0 Depth above First Floor Elevation For all Structures – 2 Year Coastal, 25 Year Rainfall; 2 Year Coastal, 100 Year Rainfall; 100 Year Coastal, 100 Year Rainfall | Critical Infrastructure with Flood Values per Frequency Event |
| Change in Risk to Cultural Resources Sites and Buildings | OSE | Cultural Resources Sites and Buildings with Flood Values Tool | • MIKE SHE Output Flood Depths above Ground Surface Elevation – 2 Year Surge, 25 Year Rainfall; 2 Year Surge, 100 Year Rainfall; 100 Year Surge, 100 Year Rainfall<br>• State Historic Preservation Office Resource Groups – Florida Master Site File<br>• Cemeteries and Cultural Centers – Florida Geographic Data Library<br>• National Register of Historic Places and State Historic Preservation Office Eligible Bridges – National Park Service and Florida Master Site File<br>• American Indian and Tribal Lands | Cultural Resources Sites and Buildings with Flood Values per Frequency Event |

a/ P&G = Principles and Guidelines
b/ IMPLAN = economic impact modeling software. GIS = geographic information system.
c/ HEC-FDA = flood damage reduction analysis software developed by USACE Hydrologic Engineering Center. ROM = rough order of magnitude. MIKE SHE = integrated hydrological modeling software.

## 3.2 Assumptions

In accordance with the risk-informed planning process, the Study team has identified assumptions while scoping the Section 2-3 Study and formulating alternative plans. Assumptions are used to inform FWOP and FWP scenarios. Assumptions have been communicated to decision makers. Assumptions for the Section 203 Study are as follows:

- The Section 203 Study assesses the Study Area's problems, opportunities, and FWOP conditions for the 50-year period of analysis from 2035 to 2085. This assumption includes time for the completion of the feasibility study, construction authorization occurring in 2026, a Preconstruction, Engineering, and Design (PED) period of approximately 4 years with an overlapping construction period of approximately 7 years. It is assumed that the beginning of the construction period will overlap with the later part of the PED period, because the PED period will involve the preparation of project design documents for multiple construction contracts, some of which will be commence while the design documents for other construction contracts are still being finalized. The Section 203 Study assumes that benefits will accrue following project implementation in 2035.
- Features recommended in the TSP will be developed to a 30 to 35 percent design maturity level and Level 3 Cost Estimate for the final feasibility study report by using existing data and collecting new geotechnical, hydrology and hydraulics modeling, and survey data as needed. During the PED phase, detailed data and final design calculations would achieve a 100 percent design maturity.
- Sea level change scenarios in the Section 203 Study are consistent with ER 1100-2-8162 (USACE 2019). The Section 203 Study modeling quantitively factors sea level change projections for the 50-year period of analysis of 2035 to 2085. 2035 intermediate sea level is 0.7 foot above the 1992 reference. According to the USACE Sea-Level Change Calculator (Vaca Key Gauge) and referenced to the baseline 2035 (USACE intermediate), projected water surface elevation will rise by 0.5 foot, 1.3 feet, and 3.7 feet for the 2085 low, intermediate, and high curve conditions, respectively. Sea level change for low, intermediate, and high curve conditions were incorporated into the hydraulic modeling boundary condition. **Figure 3-1** displays the estimated sea level change projection for low, intermediate, and high sea level change conditions.

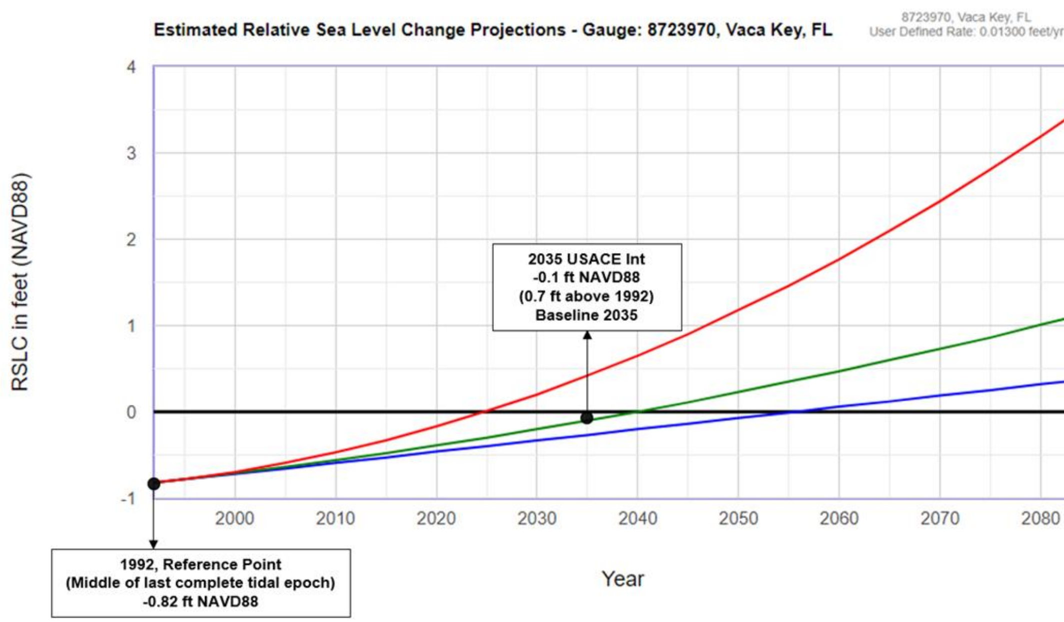



**Figure 3-1. Estimated Relative Sea Level Change Projections.**

- The structure inventory, or exposure database representing all properties within the Study Area, is a refined version of the initial structure inventory created by the USACE Jacksonville District for the C&SF Section 216 Study. The Digital Elevation Model was used to determine bare surface elevations for each structure. Based on the random point sampling approach, the average first-floor elevations were set 0.75 foot above the ground elevation for two types of residential buildings without elevation certificates, RES1-1SNB and RES2-SNB structures, as most structures are slab on-grade.

- MIKE SHE and Mike Hydro modeling incorporate eight compound flood frequency events for the base year (2035) and the outyear (2085) for the period of analysis. A combination of eight simulations were conducted for various combinations of rainfall-based (pluvial) flooding and coastal hazards such as storm surge, herein referred to as compound flood frequency events. Future sea level rise and tidal conditions that are applied as downstream boundary conditions were derived from the South Atlantic Coastal Study Coastal Hazard System. This system provides numerical and probabilistic modeling results for coastal forcings, including storm surge. **Table 3-3** provides a description of these compound flood frequency events and their probability.

**Table 3-3. Section 203 Study Compound Flood Frequency Events.**

| Coastal Water Level Return Period (Surge) (years) | Rainfall Return Period (years) | Joint Recurrent Frequency (years) | Joint Probability |
|---|---|---|---|
| 2 | 5 | 8 | 12.50% |
| 2 | 10 | 14 | 7.14% |
| 2 | 25 | 30 | 3.33% |
| 10 | 10 | 32 | 3.13% |
| 20 | 25 | 75 | 1.33% |

| Coastal Water Level Return Period (Surge) (years) | Rainfall Return Period (years) | Joint Recurrent Frequency (years) | Joint Probability |
|---|---|---|---|
| 2 | 100 | 110 | 0.91% |
| 2 | 500 | 538 | 0.19% |
| 100 | 100 | 430 | 0.23% |

Source: USACE 2021 and NOAA's National Weather Service, NOAA Atlas 14, Precipitation Frequency Estimates

- Depth-damage functions for residential and several non-residential structures were based on the North Atlantic Coast Comprehensive Study: Physical Depth Damage Function Summary Report (USACE 2015). Depth-damage functions in the USACE Institute for Water Resources Nonresidential Flood Depth-Damage Functions Report (USACE 2009) were referenced for the remaining non-residential structures.
- The adoption and enforcement of land use regulations meet the requirements of federal floodplain management and flood insurance programs (33 U.S.C. § 701b-12 and 42 U.S.C. Chapter 50).
- Communities in the floodplain participate in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA) or have private flood insurance.
- Structures are compliant with Section 308 of the WRDA of 1990, P.L. 101-640. Section 308 states that buildings built in the 100-year floodplain with a first-floor elevation of less than the 100-year flood elevation after July 1, 1991, must not be included in the benefit base for justifying federal coastal storm risk management and FRM projects.
- Given the unique geology, surface water levels, and subsurface water conditions in the region, the modeling tools used in this study must incorporate the effects of groundwater-induced flooding. Additionally, the C&SF system within the Study Area is heavily managed, with system operations and water management decisions playing a significant role in flood dynamics. Therefore, the tools must accurately simulate the effects of system operations. Furthermore, the tools need to capture coastal-induced flooding impacts—including storm surge, high tides, and sea level rise—and their influence on the C&SF system operations and overall flood risks. Due to the Study Area's proximity to the coast and the impact of storm surge on C&SF flood control structures, coastal processes must be represented in the analysis. This integrated approach, referred to as total water levels (or compound flooding), considers multiple flood sources—rainfall runoff, groundwater, and coastal forcings—to comprehensively characterize flood risk and uncertainty for effective planning and design in the C&SF Flood Resiliency Study.
- This study focuses exclusively on the primary infrastructure of the C&SF system. Secondary and tertiary systems, as well as additional distributed storage facilities, are not included as part of the management measures considered. These local infrastructure components are outside the proposed scope and are not federally relevant for this study.

## 3.3 Management Measures

A management measure is a feature or activity that can be implemented at a specific geographic site to address the objectives of the Section 203 Study. A feature is a physical element that generally requires site construction. An activity is an action that may be a one-time occurrence or ongoing. Management measures are created through planning iterations with stakeholders and through public involvement processes. Management measures become more specific and better defined as planning progresses. This Section 203 Study consists of structural, nonstructural, and nature-based management measures.

### 3.3.1 Structural Measures

Structural measures are human-made, constructed engineering solutions to manage flood risk and reduce damages. Structural measures were considered for the nine existing primary WCS to manage compound flood events in changing conditions. Structural measures initially considered for the Section 203 Study were adopted from the ongoing C&SF Section 216 Study. Structural measures from the Section 216 Study carried forward for the Section 203 Study include the following:

- Expanding canal cross sections
- Raising canal banks
- Adding gates
- Moving existing gates
- Constructing flood barriers
- Adding pump stations
- Upgrading existing pump stations
- Hardening structures
- Removing coastal water control structures
- Relocating coastal water control structures
- Creating storage and inter-basin transfers

These structural measures were reviewed and refined based on their suitability for addressing problems within the Study Area, addressing the Study opportunities, meeting the Study objective, and avoiding constraints. Applicable measures were carried forward for consideration. Site-specific management measures were created at the watershed level, where appropriate.

**Table 3-4** below displays the structural measures from the C&SF Section 216 Study that are considered for the Section 203 Study. Specific operational activities at structural features may be applied in appropriate locations if this further improves FRM conditions. For example, water levels in a canal may be drawn down prior to a forecasted storm to allow capacity for retention of excess rainwater.

**Table 3-4. Section 203 Study Structural Measures.**

| C&SF Section 216 Study Measures | Section 203 Study Measures | |
|---|---|---|
| Expanding canal cross sections; raising canal banks; adding or moving gates; constructing flood barriers | C-14 East Basin | Increase the size of the S-37A Gated Spillway so that it includes four, 25-foot wide gates and improve canal conveyance to increase gravity flow capacity; raise existing gates/platform and add floodwalls |

| C&SF Section 216 Study Measures | Section 203 Study Measures | |
|---|---|---|
| | Pompano Canal Basin | Increase the size of the G-57 Gated Spillway so that it includes three, 14-foot wide gates and modify the culvert upstream of G-57 Gated Spillway to a triple barrel culvert to increase gravity flow capacity; raise existing gates/platform and add floodwalls |
| | C-13 West Basin | Increase the size of the S-36 Gated Spillway so that it includes two, 25-foot wide gates and improve canal conveyance to increase gravity flow capacity; raise existing gates/platform and add floodwalls |
| | C-12 West Basin | Increase the size of the S-33 Gated Spillway so that it includes two, 20-foot wide gates and improve canal conveyance to increase gravity flow capacity; raise existing gates/platform and add floodwalls for extreme weather event |
| | C-11 West Basin | Improve canal conveyance within Winkopp Bridge area |
| | North New River Canal West Basin | Increase the size of the G-54 Gated Spillway so that it includes five, 16-foot wide gates and improve canal conveyance to increase gravity flow capacity; raise existing gates/platform and add floodwalls |
| | Hillsboro Canal Basin | Increase the size of the G-56 Gated Spillway so that it includes five, 20-foot wide gates to increase gravity flow capacity; to include dredging, storage, raised banks if necessary |
| | C-14 West Basin | Increase the size of the S-37B Gated Spillway so that it includes two, 35-foot wide gates and improve canal conveyance to increase gravity flow capacity; include tie-back floodwalls/barriers |
| | C-11 East Basin | Increase the size of the S-13 Gated Spillway so that it includes five, 16-foot wide gates to increase gravity flow capacity; raise existing gates/platform and add floodwalls |
| Adding pump stations; upgrading existing pump stations; hardening structures | C-14 East Basin | Add pump station capacity of 4,000 cubic feet per second (cfs); structure hardening; pre-storm drawdown |
| | Pompano Canal Basin | Add pump station capacity of 375 cfs; structure hardening; pre-storm drawdown |
| | C-13 West Basin | Add pump station capacity of 1,100 cfs; structure hardening; pre-storm drawdown |
| | C-12 West Basin | Add pump station capacity of 1,000 cfs; structure hardening; pre-storm drawdown |
| | C-11 West Basin | Management measure not applied |
| | North New River Canal West Basin | Add pump station capacity of 1,500 cfs; structure hardening; pre-storm drawdown |
| | Hillsboro Canal Basin | Add pump station capacity of 3,600 cfs; structure hardening; pre-storm drawdown |
| | C-14 West Basin | Structure hardening, unspecified; evaluate pre-storm drawdown operations |
| | C-11 East Basin | Increase pump station capacity to 1,080 cfs; structure hardening; pre-storm drawdown |
| Removing coastal water control structures | C-14 East Basin | Remove S-37A Gated Spillway and allow for natural flow |
| | Pompano Canal Basin | Remove G-57 Gated Spillway and allow for natural flow |
| | C-13 West Basin | Remove S-36 Gated Spillway and allow for natural flow |

| C&SF Section 216 Study Measures | Section 203 Study Measures | |
|---|---|---|
| | C-12 West Basin | Remove S-33 Gated Spillway and allow for natural flow |
| | C-11 West Basin | Management measure not applied |
| | North New River Canal West Basin | Remove G-54 Gated Spillway and allow for natural flow |
| | Hillsboro Canal Basin | Remove G-56 Gated Spillway and allow for natural flow |
| | C-14 West Basin | Remove S-37B Gated Spillway and allow for natural flow |
| | C-11 East Basin | Remove S-13 Pump Station and Gated Spillway and allow for natural flow |
| Relocating coastal water control structures | C-14 East Basin | Relocate S-37A Gated Spillway downstream of confluence with G-16 (Pompano) Canal and increase capacity to accommodate discharge from G-16 (Pompano) Canal and C-14 (Cypress Creek) Canal; structure hardening; pre-storm drawdown |
| | Pompano Canal Basin | Tie-in to S-37A Gated Spillway relocation downstream of confluence with G-16 (Pompano) Canal and increase capacity to accommodate discharge from G-16 (Pompano) Canal and G-15 (North New River) Canal; structure hardening; pre-storm drawdown |
| | C-13 West Basin | Relocate S-36 Gated Spillway downstream (control elevation 1.5-3 ft) to Middle River and increase capacity (3,500 cfs) to accommodate additional runoff at proposed location; structure hardening; pre-storm drawdown |
| | C-12 West Basin | Remove connection between C-11 (South New River) Canal and South Fork New River Canal and add auxiliary structure downstream of G-15 (North New River) Canal and C-12 (Plantation) Canal confluence with the same control elevation as S-33 Gated Spillway; structure hardening; pre-storm drawdown |
| | C-11 West Basin | Modify operation of S-13AW Gated Culvert to increase operational capacity |
| | North New River Canal West Basin | Add auxiliary structure for G-54 Gated Spillway downstream of the G-15 (North New River) Canal and C-12 (Plantation) Canal confluence with same control elevation as S-33 Gated Spillway and increase capacity (4,500 cfs) to accommodate additional runoff at proposed location |
| | Hillsboro Canal Basin | Relocate G-56 Gated Spillway to the east side of I-95 and increase its capacity to handle additional discharge from Lake Worth Drainage District E-3 Canal and I-95 stormwater management system outfall; include dredging/storage/raised banks if necessary; structure hardening; pre-storm drawdown |
| | C-14 West Basin | Management measure not applied |
| | C-11 East Basin | Relocate S-13 Pump Station and Gated Spillway downstream on Dania Cut-off Canal and increase capacity to 5,000 cfs; remove connection between C-11 (South New River) Canal and South Fork New River Canal; add auxiliary structure downstream of G-15 (North New River) Canal and C-12 (Plantation) Canal confluence; structure hardening; pre-storm drawdown |

| C&SF Section 216 Study Measures | Section 203 Study Measures | |
|---|---|---|
| Creating inter-basin transfers | C-14 East Basin | Divert water from C-14 (Cypress Creek) Canal; operation of G-65 Gated Culvert for flood control |
| | Pompano Canal Basin | Divert water from C-14 (Cypress Creek) Canal; operation of G-65 Gated Culvert for flood control |
| | C-13 West Basin | Fully open S-125 Gated Culvert for inter-basin flow, connecting C-13 (Middle River) Canal to G-15 (North New River) Canal |
| | C-12 West Basin | Modify operation of Old Plantation pump station to discharge into upstream C-12 (Plantation) Canal when elevation is 8.5 ft NGVD29 |
| | C-11 West Basin | Maximize operation of C-11 (South New River) Canal impoundment to pump at lower elevations and earlier in a storm event (3.5 ft NGVD29) |
| | North New River Canal West Basin | Fully open S-125 Gated Culvert for inter-basin flow, connecting C-13 (Middle River) Canal to G-15 (North New River) Canal |
| | Hillsboro Canal Basin | Conceptualize storage and re-route to Site 1 impoundment |
| | C-14 West Basin | Conceptualize storage and divert water from C-14 (Cypress Creek) Canal; operation of G-65 Gated Culvert for flood control |
| | C-11 East Basin | Management measure not applied |

### 3.3.2 Nonstructural Measures

Nonstructural measures are permanent or contingent actions applied to a building and/or its contents to prevent or resist flood damage. Unlike structural measures that aim to reduce the probability of flooding, nonstructural measures focus on managing the risk, including both the likelihood and consequences of flooding. These measures include physical features such as elevation, acquisition, relocation, wet floodproofing, and dry floodproofing. They also encompass nonphysical strategies like education and communication, flood emergency preparedness and warning, evacuation procedures, floodplain management, and building codes. 33 CFR Part 234 requires that a nonstructural alternative be included within the array of alternatives to determine if nonstructural measures can address flood risk through the feasible use of nonstructural approaches.

Nonstructural measures were evaluated for their suitability in addressing the Section 203 Study problems, achieving the Section 203 Study objectives, and meeting plan formulation criteria such as effectiveness, acceptability, completeness, and efficiency. Measures were screened based on their evaluation performance or if they were already an element of existing conditions. **Table 3-5** presents the nonstructural measures considered for the Section 203 Study.

**Table 3-5. Section 203 Study Nonstructural Measures.**

| Measure Type | Nonstructural Measures (Nonstructural FRM Matrix) | Measure Considered for Section 203 Study | Screening Details |
|---|---|---|---|
| Physical | Structure Elevation | Yes | N/A – measure considered in Study |
| Physical | Dry Floodproofing (Commercial Structures Only) for flood depths < 3 feet | Yes | N/A – measure considered in Study |
| Physical | Wet Floodproofing | No | Allows water to come into properties and only appropriate for uninhabited portions of a structure |

| Measure Type | Nonstructural Measures (Nonstructural FRM Matrix) | Measure Considered for Section 203 Study | Screening Details |
|---|---|---|---|
| Physical | Relocation | No | Would require relocation outside of the Study Area, impacting community cohesion |
| Physical | Acquisition | No | Mandatory participation not in alignment with study opportunities; landowner willingness unlikely |
| Nonphysical | Evacuation Plans | No | Currently implemented and in-place |
| Nonphysical | Flood Emergency Preparation | No | Currently implemented and in-place |
| Nonphysical | Floodplain Mapping | No | Currently implemented and in-place |
| Nonphysical | Land Use Regulations | No | Currently implemented and in-place |
| Nonphysical | Risk Communication | No | Currently implemented and in-place |
| Nonphysical | Zoning | No | Currently implemented and in-place |
| Nonphysical | Flood Insurance | No | Currently implemented and in-place |
| Nonphysical | Buyout/Acquisition | No | Mandatory participation not in alignment with study opportunities; landowner willingness unlikely |
| Nonphysical | Flood Warning System | Yes | N/A – measure considered in Study |

The following refined management measures were formulated following evaluation and screening of the nonstructural measures disclosed in the Nonstructural FRM Matrix:

- Elevate existing structures within the Study Area to address changing conditions.
- Dry floodproof existing commercial structures where flood depths are less than 3 feet within the Study Area to address changing conditions.
- Elevate existing structures within the Study Area that are vulnerable to residual risk.
- Dry floodproof existing commercial structures within the Study Area to address residual risk.
- Implement a flood warning system with real-time flood forecasting.

### 3.3.3 Nature-based Measures

Nature-based measures are human-designed, engineered, and constructed to mimic natural characteristics that have evolved through physical, biological, geologic, and chemical processes. The sustainability of these nature-based measures is typically ensured through maintenance operations. They can be developed through sustainable planning, environmental design, environmental management, and engineering practices that promote adaptation and resilience in floodplains. Nature-based measures can be implemented as standalone FRM solutions or combined with structural measures to provide economic, environmental, and social benefits. Examples include vegetative environments such as maritime forests, freshwater wetlands, fluvial floodplains, and barrier islands.

In the Section 203 Study, nature-based measures were considered both as standalone FRM measures and in combination with structural measures. Measures carried forward for consideration in the Section 203 Study are reflected in **Table 3-6** below.

**Table 3-6. Section 203 Study Nature-based Measures.**

| Measure Type | Nature-based Measure | Measure Considered for Section 203 Study | Screening Details |
|---|---|---|---|
| Standalone | Created or restored wetlands | Yes | N/A – measure considered in Study |
| Standalone | Stormwater parks | Yes | N/A – measure considered in Study |
| Standalone | Converted developed land into lakes/ponds | Yes | N/A – measure considered in Study |
| Standalone | Floodway enlargement/restoration | Yes | N/A – measure considered in Study |
| Standalone | Increased/Enhanced Infiltration/Groundwater Recharge | No | A location within the Study Area that meets the screening criteria (see criteria below) was not found |
| Standalone | Canal widening/naturalization/layback slopes | No | A location within the Study Area that meets the screening criteria was not found |
| In Combination | Living shorelines (erosion control) | No | Outside of the study scope or objective and therefore not fully evaluated |
| In Combination | Riparian buffers for erosion control | No | Outside of the study scope or objective and therefore not fully evaluated |
| In Combination | Distributed storage via green infrastructure features across basin | No | A location within the Study Area that meets the screening criteria was not found |
| In Combination | Increased distributed detention/retention | Yes | N/A – measure considered in Study |
| In Combination | Mangroves, marsh, reef, and dune restoration | No | Outside of the study scope or objective and therefore not fully evaluated |
| In Combination | Reforestation | No | Outside of the study scope or objective and therefore not fully evaluated |
| In Combination | Land use conversion | No | Outside of the study scope or objective and therefore not fully evaluated |
| In Combination | Beneficial reuse of dredged material | No | Not consistent with the Study objective |

For the nature-based measures considered in the Section 203 Study, land availability was assessed to identify suitable locations for constructing nature-based measures and associated storage features that would have result in flood reduction benefits directly tied to the primary system. An initial list of parcels with potential for nature-based measures was compiled using publicly available sources. Approximately 110 parcels were identified for consideration based on the following criteria:

- Parcel greater than 10 acres
- Located within the action area
- Within 2 miles of primary canal centerline
- Land use classification
- Proximity to nearest primary and secondary canals

    - Ownership type
    - Parcel area exceeding 0.15 percent of the total watershed area
    - No known hazardous, toxic, and radioactive waste or cultural resource sites within or adjacent to the parcel boundary
- Parcels identified for consideration were further refined based on the following criteria:
    - For existing recreational parcels, storage features may negatively impact vitality of recreational usage.
    - Storage sites impact to future site development or redevelopment.
    - Existing land use classification impedes conversion to storage area.
    - Parcel contains existing stormwater retention or detention features and additional water storage features may impede the functionality of existing features.
    - Inclusion of water storage features at parcel would not improve the performance of a primary or secondary system.
    - Water storage features at a parcel, or also at adjacent parcel in combination, would not provide storage for less than 1 percent of the area.

Of the 110 parcels evaluated, 11 parcels were identified as meeting the criteria identified above. Of the 11 parcels identified, 9 were classified as private lands and 2 were public lands. Water storage measures were created for these parcels and carried forward to the initial array of alternatives.

The following refined nature-based management measures were formulated following evaluation and screening of available parcels for the development of nature-based features:

- Increase or enhance surface storage in basin through created or restored wetlands.
- Increase or enhance surface storage in the basin through stormwater parks.
- Increase or enhance surface storage in the Study Area through the conversion of developed land into lakes/ponds.
- Increase or enhance surface storage in the Study Area through floodway enlargement/restoration.

## 3.4 Initial Array of Alternatives

The initial array of alternatives includes all site-specific structural management measures, refined nonstructural management measures, and refined nature-based management measures carried forward for consideration. The initial array of alternatives are as follows:

- Alternative 1: Gravity Conveyance Improvements (Canals and Structures)
- Alternative 2: Pumps at Structures and Hardening
- Alternative 3: Removal of Coastal Structures
- Alternative 4: Relocation of Coastal Structures (to the East)
- Alternative 5: Alternative to Discharging East on Peak

- Alternative 6: Nature-based Only
- Alternative 7a: Nonstructural Only
- Alternative 7b: Nonstructural to support residual risk
- Alternative 8: FWOP (No Action)

### 3.4.1 Initial Array of Alternatives Evaluation

The initial array of alternatives was qualitatively evaluated based on the alternative's ability to meet the Section 203 Study objectives and the planning framework decision criteria (acceptability, efficiency, effectiveness, and completeness). Hydrologic and hydraulic modeling was completed to evaluate the effectiveness of the structural alternatives for each watershed. Evaluation of the initial array of alternatives is included as **Appendix C, Plan Formulation** of this report. Based on this evaluation, Alternatives 1 and 2 have been carried forward to the final array of alternatives. Alternatives 5, 6, and 7b have also been carried forward for consideration in the final array in combination with Alternatives 1 and 2.

## 3.5 Final Array of Alternatives

### 3.5.1 General Description

The Section 203 Study team reformulated the alternatives carried forward from the initial array into four alternatives (A, B, C, and subsequently, Resiliency Optimized (RO)) to provide continued and improved FRM and resiliency solutions for the C&SF Project throughout the period of analysis from 2035 to 2085. They also evaluated a Future Without Project (or No Action) Alternative. Alternatives A through C increase in complexity or level of intervention, and therefore, associated cost.

Alternatives include various structural measures and/or nature-based measures, either solely or in combination, to achieve improved FRM in the Section 203 Study Area.

#### *3.5.1.1 Structural Measures*

Structural measures consist of constructing improvements and upgrades to eight primary WCS and six primary canals, and implementing operational activities. Each of these is explained below.

Construction at WCS includes hardening and resiliency improvements, building new pump stations to increase capacity, and constructing new gates. Existing WCS would be demolished and rebuilt to support improvements. Rebuilding WCS may require real estate acquisition. Any real estate acquisition is noted in the specific alternatives descriptions below.

- Hardening and resiliency improvements: This involves raising the elevation of WCS components by several methods, which are intended, where feasible, to prevent water from backflowing through and around structures during high tide and/or high surge events exacerbated by sea level rise. These include replacing existing spillway gates with taller gates and raising the elevation of the operating platform above the gates, adding a new concrete cap on top of the existing concrete cap on the top of wingwalls, raising the elevation of the spillway service bridge deck, and constructing additional riprap or similar revetment to prevent erosion during high surge events.

- New pump stations: This includes adding pumps where none currently exist, deploying additional pumps, and/or upgrading pumps to higher capacity at a WCS.
- New gates: This entails constructing additional gates or expanding the width of existing gates at a WCS to allow for increased flowrates through these structures when needed, especially during major storm events. These modifications would typically involve demolishing the existing WCS and rebuilding a new one with upgraded gates.

Construction at canals includes modifying cross sections and constructing culverts as explained below.

- Cross sections: This involves excavating segments of canals (i.e., increasing depth and/or width via dredging or similar means) where flow is currently restricted to increase flow capacity. Excavation would occur within the right-of-way (ROW) of each canal, and excavated material would be placed on uplands in the ROW to raise the height of canal banks, access roads, and parking areas. If necessary, excess excavated material may be disposed of at approved sites within Broward County and/or Palm Beach County.
- Culverts: This includes constructing two additional 10-foot-diameter culverts (or one box culvert) parallel to an existing 10-foot-diameter culvert upstream of the G-57 Gated Spillway.

Operational activities include more aggressively drawing down water in the SFWMD-managed primary canals upstream of the WCS prior to a storm by pumping water in these canals from the upstream side of the WCS to the downstream side of the WCS, resulting in water from the canals being moved at a faster rate downstream to the Intracoastal Waterway prior to the storm, and significant storage capacity built up in the system to accommodate excess stormwater runoff from rainfall events. This operation would take advantage of improved infrastructure and would supersede the current/no-action operation of simply operating in the canal low range as defined in the currently authorized water control plan. Additionally, local water management entities would likely drawdown water in secondary managed canals and move it into SFWMD-managed primary canals prior to storm events. This additional volume of water would be moved downstream to the Intracoastal Waterway through operation of the WCS in advance of the storm rather than solely attempting to react as stages rise.

#### *3.5.1.2 Nature-based Measures*

The only nature-based measure that was carried forward in the final array of alternatives for this Section 203 Study is increasing water storage with associated nature-based functions. Water storage would be increased by either expanding the capacity of an existing storage feature and/or adding a new storage feature. Real estate acquisition may be required to implement nature-based measures. Any real estate acquisition is noted in the specific alternatives descriptions below.

- Expanding capacity of an existing storage feature to enhance absorption of the primary system and reduce flooding in upstream watersheds: This involves constructing new water control features at the existing Markham Park lake system in the North New River Canal West watershed. An expanded system would support the temporary storage of stormwater from the G-15 (North New River) Canal during storm events to reduce peak stages in that canal. Discharges would be directed to the location when canal stages rise above the operating range (and subject to a maximum depth of ~ 2 to 3 ft in low-lying areas of the site) and would be released back from the feature when canal stages recover back to the operating range. This feature is noted as a small blue polygon in the western part of the Study Area in **Figure 3-3** and **Figure 3-4**.

- Adding a new storage feature to enhance absorption of the primary system and reduce flooding in upstream watersheds: This includes constructing a new, aboveground stormwater retention pond in the Hillsboro Canal Basin watershed. The new storage feature would support the temporary storage of stormwater from the G-08 (Hillsboro) Canal during storm events to reduce peak stages in that canal. Discharges would be directed to the location when canal stages rise above the operating range (and subject to a maximum depth of approximately 2 to 3 feet in low-lying areas of the site) and would be released back from the feature when canal stages recover back to the operating range. This feature is illustrated by a blue polygon in the northern part of the Study Area in **Figure 3-4**.
- Both features would have water depths that would support a mosaic of open water (lake), enhanced detention/retention/absorption features, and wetland landscapes within the footprint. It is expected that use of these locations would provide ancillary ecosystem restoration and water quality benefits.

**Figure 3-2** through **Figure 3-4** illustrate the alternatives with respect to their location in the Study Area.

### 3.5.2 Future Without Project (No Action) Alternative

Under the Future Without Project Alternative, which is the same as the No Action Alternative, structural measures (including operational activities) and nature-based measures would not be constructed or undertaken. Operation of the system would follow the criteria described in the currently authorized water control plans, including utilizing low range canals operations (without additional pre-storm drawdown of water) in advance of and during storm conditions. The existing WCS and primary canals that are the focus of this Section 203 Study would not be improved in any way.

### 3.5.3 Activities Common to All Alternatives

When implementing structural measures under the alternatives, certain construction activities would occur regardless of the specific alternative. These include:

- Erecting temporary cofferdams in canals during construction of in-water structures (e.g., new spillways and pump stations);
- Excavating existing WCS abutments and retaining walls within the SFWMD ROW to provide room for construction of new spillways and pump stations;
- Excavating and grading the canal bottom upstream and downstream of new spillways and/or pumps to match existing canal depths;

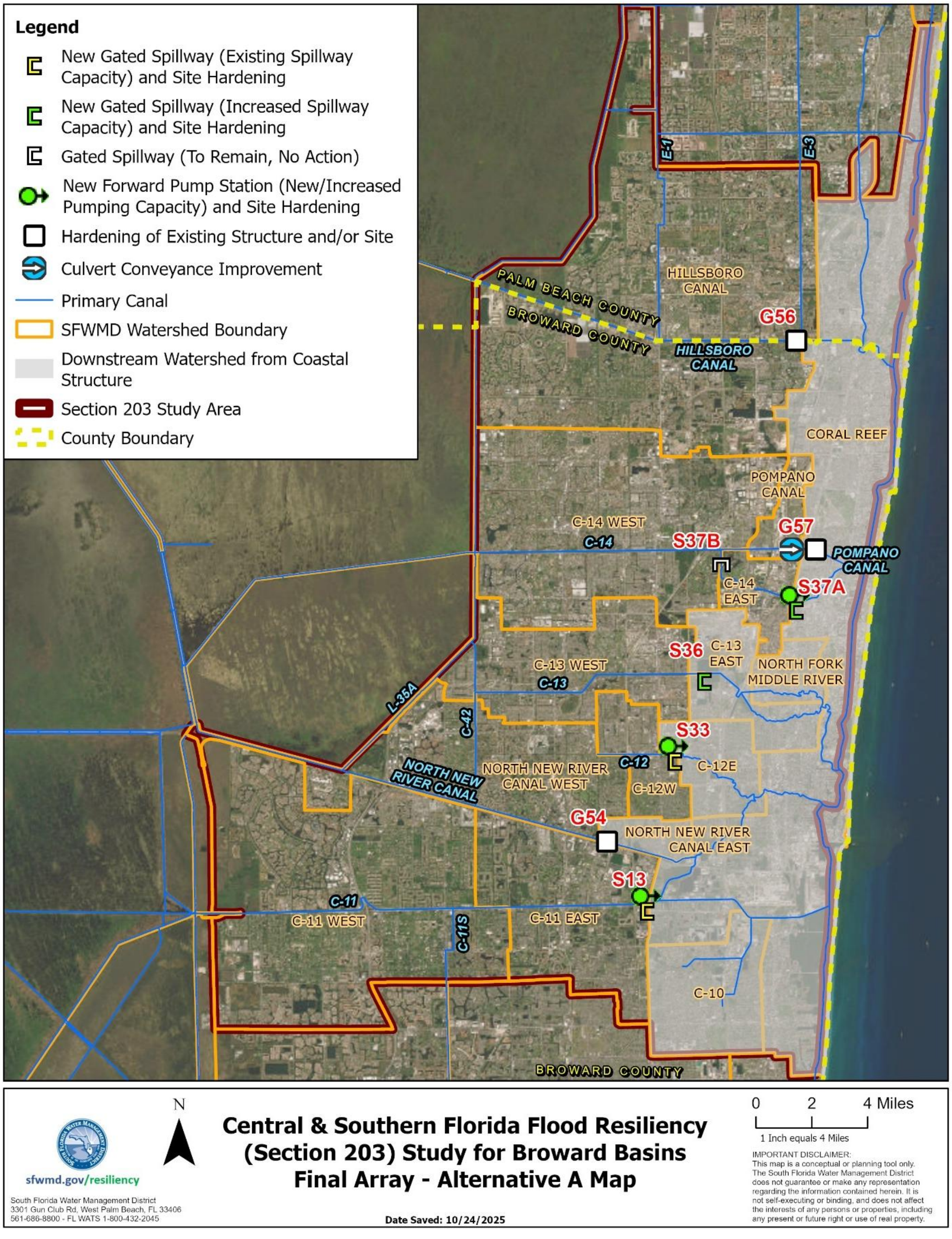



**Figure 3-2. Draft Final Array Model for Alternative A for the Section 203 Study.**

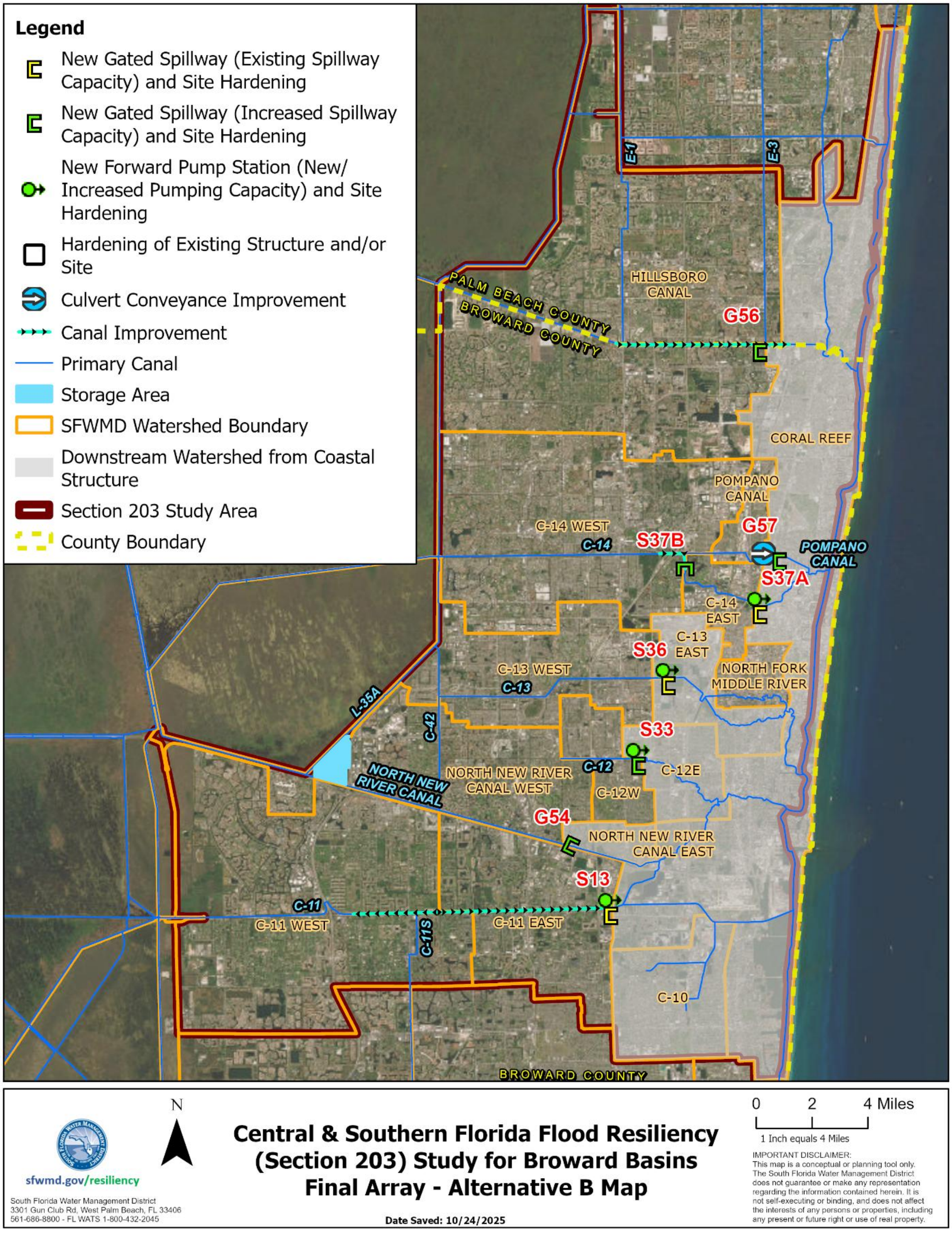



**Figure 3-3. Draft Final Array Model for Alternative B for the Section 203 Study.**

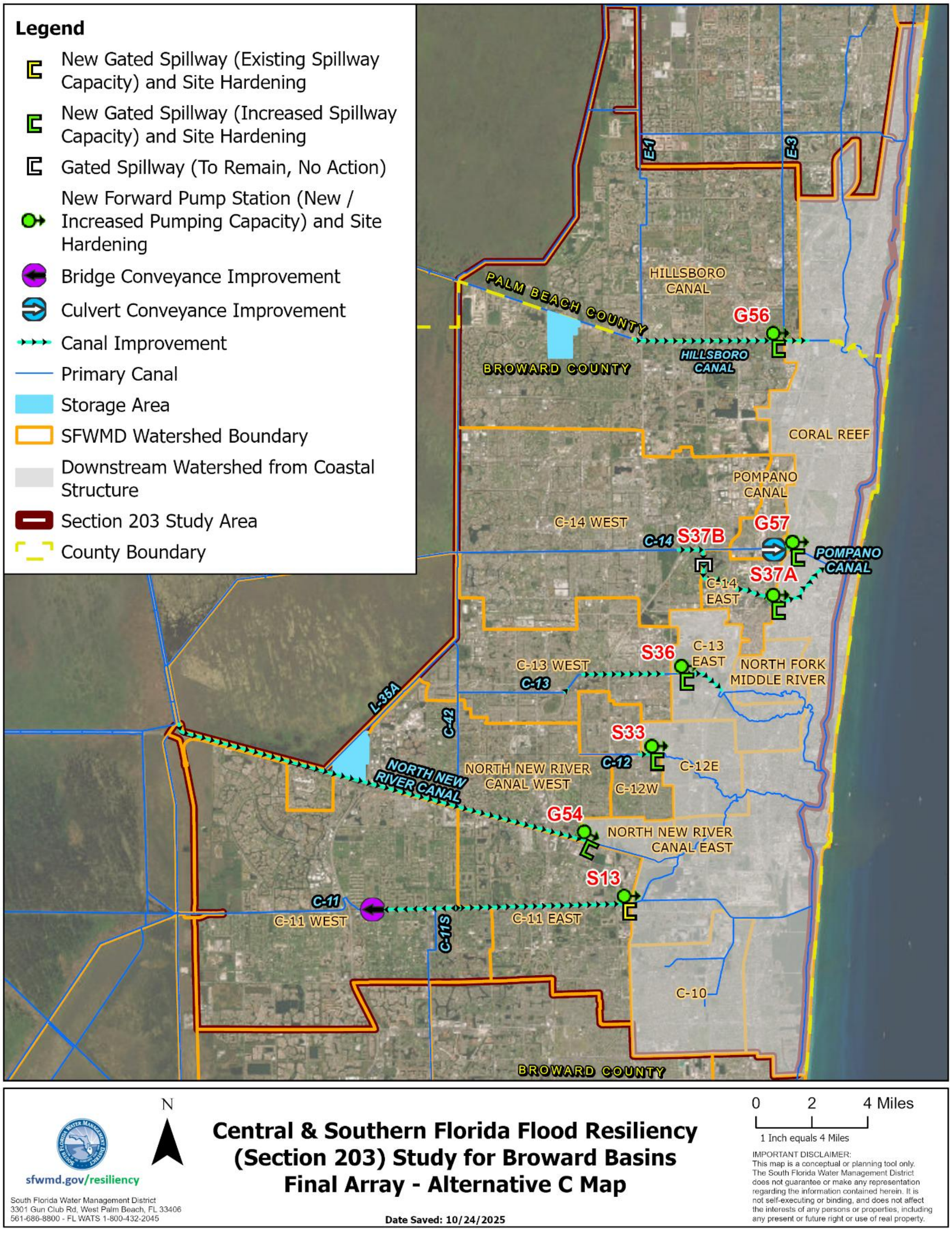



**Figure 3-4. Draft Final Array Model for Alternative C for the Section 203 Study.**

- Placing, compacting, grading, and sodding excavated material (i.e., dredged material) on uplands within existing SFWMD canal ROWs to raise the height of structures, canal banks, access roads, and parking areas;
- Disposing of excess excavated material at approved, upland disposal sites within Broward County, Palm Beach County, and/or at another location determined by SFWMD (potentially for future use in another SFWMD project);
- Constructing new or modifying existing retaining walls within the SFWMD ROW to connect new structures to existing retaining walls and/or nearby higher ground elevations;
- Building new ancillary structures (e.g., control/generator building, electrical transformer, fuel tank storage, antenna) on uplands in existing SFWMD ROW;
- Creating a backup power system for new pump stations and/or spillways that is designed to provide a minimum 7 days of operation at 100 percent load;
- Demolishing existing WCS and ancillary structures when new spillways and/or pump structures are constructed;
- Constructing one headwater (upstream) and one tailwater (downstream) monitoring station to track canal stage (i.e., water height) at each WCS to replace existing headwater and tailwater monitoring stations. Each new station would include at least two stilling wells connected to a backup controller system. Stations would be tied to flood warning monitoring strategy (as described in **Appendix I**) and placed at least 150 feet upstream or downstream of each structure, and would be mounted on a retaining wall (where such walls exist) or on a platform constructed for this purpose; and
- Implementing operational activities that draw down water in SFWMD-managed primary canals upstream of WCS prior to a storm (i.e., opening gates and pumping water from the upstream to the downstream side of the WCS), resulting in water from the canals being moved downstream to the Intracoastal Waterway prior to the storm. These activities would take advantage of improved infrastructure and would create additional storage for excess stormwater and improve conveyance.

Inclusion of nonstructural measures under the alternatives are for the purposes of additional risk management and to enhance overall benefits to provide a comprehensive flood risk management approach.

### 3.5.4 Alternative A

Alternative A represents the least complex alternative in that the fewest measures are proposed, and therefore, costs are the lowest of all four alternatives. There are no nature-based measures proposed in any watershed basin under Alternative A.

#### *3.5.4.1 Hillsboro Canal Basin*

The Hillsboro Canal Basin watershed is primarily controlled by the G-56 Gated Spillway (26.327972°N, 80.131583°W) on the G-08 (Hillsboro) Canal. The G-56 Gated Spillway consists of three 20-foot-wide gates.

Under Alternative A, structural measures would include hardening and resiliency improvements, where feasible, to prevent backflow through the WCS. Existing spillway gates would be replaced with taller gates and the operating platform elevation would be raised above the gates. A new concrete cap would be added on top of the existing concrete cap on top of the existing wingwalls. The spillway service bridge deck would also be raised. Additional riprap (or similar revetment) would be placed along the canal adjacent to the spillway.

#### *3.5.4.2 Pompano Canal Basin*

The Pompano Canal Basin watershed is primarily controlled by the G-57 Gated Spillway (26.230850°N, 80.121525°W) on the G-16 (Pompano) Canal. The G-57 Gated Spillway consists of two 14-foot-wide gates. A 1,400-foot-long, 10-foot-diameter culvert is located approximately 350 feet northwest (upstream) of the existing structure, parallel to Atlantic Boulevard (State Road 814), between South Dixie Highway (State Road 811) and Cypress Road.

Under Alternative A, structural measures would include hardening and resiliency improvements, where feasible, to prevent backflow through the WCS. Existing spillway gates would be replaced with taller gates and the operating platform elevation would be raised above the gates. A new concrete cap would be added on top of the existing concrete cap on top of the existing wingwalls. The spillway service bridge deck would also be raised. Additional riprap (or similar revetment) would be placed along the canal adjacent to the spillway.

In addition, two new 10-foot-diameter culverts (or a double 10-foot-span by 9-foot-rise concrete box culvert) would be constructed parallel to and on the south side of the existing 10-foot-diameter culvert. The existing culvert would remain and water flow through it would be maintained during construction of the new culverts. New concrete end walls would be built at both ends to accommodate the new parallel culverts. Construction would most likely occur by jack-and-bore method or similar trenchless installation methods under South Dixie Highway (SR 811),the Florida East Coast Railroad, and SW 1st Avenue and Cypress Road, and via trenching in the remaining areas.

A Perpetual Easement along the length of the culverts would be necessary to support future access to and maintenance of the culverts. These include multiple parcels owned by the City of Pompano Beach totaling 67,470 square feet, plus a 9,871-square-foot parcel owned by Florida East Coast Railway LLC and two parcels with unknown ownership totaling 12,514 square feet.

Temporary Easements would also be necessary to support construction of the new culverts. These temporary easements would encompass multiple parcels owned by the City of Pompano Beach totaling 6,213 square feet, plus a 2,558-square-foot parcel owned by Florida East Coast Railway LLC and a 2,786-square-foot parcel with unknown ownership.

#### *3.5.4.3 C-14 West Basin*

The C-14 West Basin watershed is primarily controlled by the S-37B Gated Spillway (26.223689°N, 80.170163°W) located on the C-14 (Cypress Creek) Canal. The S-37B Gated Spillway consists of two 25-foot-wide gates. Under Alternative A, there are no structural measures proposed in the C-14 West Basin.

### *3.5.4.4 C-14 East Basin*

The C-14 East Basin watershed is primarily controlled by the S-37A Gated Spillway (26.206246°N, 80.131641°W) located on the C-14 (Cypress Creek) Canal. The S-37A Gated Spillway consists of two 25-foot-wide gates.

Under Alternative A, structural measures would include building a new gated spillway with four 25-foot-wide roller gates to replace the current S-37A Gated Spillway. A new pump station would also be constructed adjacent to the new gated spillway, which would house three 400-cubic-foot-per-second (cfs) pumps and one 400-cfs auxiliary pump, for a total design discharge capacity of 1,200 cfs. Although the new WCS would be in the same location as the existing one, it would be longer and wider to accommodate the new pump station (approximately 265 feet long by 239 feet wide). Approximately 96,059 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. A 3-D rendering of a gated spillway and pump station structure with a similar design is provided in **Figure 3-5** (obtained from HDR's 60 percent design drawings for the S-28N Coastal Structure and Forward Pump Station project, dated March 2025, prepared for SFWMD).

**Figure 3-5. Representative Gated Spillway and Pump Station.**

In order to construct the new WCS, real estate acquisition would be required. A 12,315-square-foot parcel adjacent to the SFWMD ROW on the south bank of the C-14 (Cypress Creek) Canal and west of an unnamed canal would be purchased by the SFWMD. The parcel is currently owned by the Pine Crest Preparatory School. The acquisition would support vehicle access to the WCS during construction and for regular maintenance of the facility after construction. A Temporary Easement would also be needed in a 14,767-square-foot parcel on the north side of the canal for project management office trailers and equipment/materials laydown during construction.

#### *3.5.4.5 C-13 West Basin*

The C-13 West Basin watershed is primarily controlled by the S-36 Gated Spillway (26.173183°N, 80.179122°W) located on the C-13 (Middle River) Canal. The S-36 Gated Spillway consists of one 25-foot-wide gate.

Under Alternative A, structural measures would include building a new gated spillway with two 25-foot-wide roller gates to replace the current S-36 Gated Spillway. Although the new WCS would be in the same location as the existing one, it would be longer and wider to accommodate the new spillways and meet current SFWMD design standards (approximately 52 feet long by 62 feet wide). Approximately 21,003 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal.

In order to construct the new WCS, a Temporary Easement would be needed in a 9,734-square-foot parcel on the south side of NW 39th Street, which is owned by the City of Oakland Park, for construction trailer parking and to allow room for an existing shared use path to be moved away from the new WCS.

#### *3.5.4.6 C-12 West Basin*

The C-12 West Basin watershed is primarily controlled by the S-33 Gated Spillway (26.135942°N, 80.194494°W) located on the C-12 (Plantation) Canal. The S-33 Gated Spillway consists of one 20-foot-wide gate.

Under Alternative A, structural measures would include building a new, replacement gated spillway with one 20-foot-wide roller gate approximately 200 feet west (upstream) of the current S-33 Gated Spillway. A new pump station would also be constructed, which would house three 170-cfs pumps and one 170-cfs auxiliary pump, for a total design discharge capacity of 510 cfs. Approximately 47,940 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.

Approximately 80 feet downstream of the existing WCS, the existing box culvert that drains stormwater from the neighborhood to the south of the canal would be replaced, and a new stormwater outfall and headwall would be constructed at the canal interface.

#### *3.5.4.7 North New River Canal West Basin*

The North New River Canal West Basin watershed is primarily controlled by the G-54 Gated Spillway (26.095082°N, 80.229682°W) located on the G-15 (North New River) Canal. The G-54 Gated Spillway consists of three 16-foot-wide gates.

Under Alternative A, structural measures would include hardening and resiliency improvements, where feasible, to prevent backflow through the WCS. Existing spillway gates would be replaced with taller gates and the operating platform elevation would be raised above the gates. A new concrete cap would be added on top of the existing concrete cap on top of the existing wingwalls. The spillway service bridge deck would also be raised. Additional riprap (or similar revetment) would be placed along the canal adjacent to the spillway.

#### *3.5.4.8 C-11 West Basin*

The C-11 West Basin watershed is primarily controlled by the S-13AW Gated Culvert (26.064633°N, 80.281512°W) located on the C-11 (South New River) Canal. The S-13AW Gated Culvert consists of two 10-foot-wide gates. Under Alternative A, there are no structural measures proposed in the C-11 West Basin.

#### *3.5.4.9 C-11 East Basin*

The C-11 East Basin watershed is primarily controlled by the S-13 Pump Station and Gated Spillway (26.066360°N, 80.208858°W) located on the C-11 (South New River) Canal. The S-13 Pump Station and Gated Spillway consists of a single 16-foot-wide spillway gate with a pump station with three 180-cfs pumps for a total design discharge capacity of 540 cfs.

Under Alternative A, structural measures would include building a new replacement structure approximately 200 feet west (upstream) of the current S-13 Pump Station and Gated Spillway. A gated box culvert with one 25-foot-wide roller gate would be constructed. A new pump station with four main pumps (including two 115-cfs pumps and two 235-cfs pumps) and one 235-cfs auxiliary pump would be constructed, which would increase the total design discharge capacity via pumping for the WCS from 540 cfs to 700 cfs. Approximately 53,876 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. As noted in **Section 3.5.3**, all ancillary structures would be demolished; this includes the large trash rake structure just upstream of the existing WCS.

An approximately 13,000-square-foot portion of the remnant bypass channel located southeast of the existing WCS would be partially backfilled with soil, and a smaller channel would be left in place to maintain existing drainage from State Road 7 (US 441) and the stormwater system for the residential community south of the S-13 site. Upland soil material from the new S-13 Pump Station and Gated Spillway excavation would be used as backfill for the remnant channel; excavated material would be tested for compliance prior to use as backfill. The material would be properly graded and stabilized and would incorporate a small pilot channel to carry existing drainage.

A small, 425-square-foot parcel of land along the southern canal bank, just east of the terminus of SW 47th Terrace, would need to be acquired from Swaying Palms, LLC for maintenance of a new concrete end wall and stormwater pipes that would discharge upstream of the new pump station.

### 3.5.5 Alternative B

Alternative B represents an intermediate scenario where the number of proposed measures are greater than in Alternative A but fewer than in Alternative C. Correspondingly, Alternative B costs are higher than Alternative A and lower than Alternative C.

#### *3.5.5.1 Hillsboro Canal Basin*

Under Alternative B, structural measures would include building a new replacement gated spillway with four 25-foot-wide roller gates approximately 75 feet west (upstream) of the current G-56 Gated Spillway. Approximately 17,278 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal. A Temporary Easement in a 3,923-square-foot parcel owned by the City of Deerfield Beach would be required for project management office trailers.

Additionally, an approximately 5.5-linear-mile section of the G-08 (Hillsboro) Canal would be excavated (i.e., dredged) to enlarge the canal cross section, improving water conveyance. Approximately 4.6 miles of canal upstream (west) of the G-56 Gated Spillway would be excavated to a maximum depth of 5 feet below the existing canal bottom, removing an estimated 718,307 neat cubic yards of sediment. Additionally, about 0.9 miles downstream (east) of the spillway would be similarly dredged to a depth not exceeding 5 feet below the existing canal bottom, with 25,976 neat cubic yards of sediment excavated. Dredged material from both areas would be placed, compacted, graded and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Under Alternative B, there are no nature-based measures proposed in the Hillsboro Canal Basin.

#### *3.5.5.2 Pompano Canal Basin*

Under Alternative B, structural measures would include building a new replacement gated spillway with two 21-foot-wide roller gates approximately 250 feet northwest (upstream) of the current G-57 Gated Spillway. The new gated spillway would be constructed in the center of the canal. Approximately 6,511 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal.

Alternative B would also include the same culvert improvements as in Alternative A, with two new 10-foot-diameter culverts (or a double 10-foot-span by 9-foot-rise concrete box culvert) constructed parallel to the existing culvert and new concrete end walls. Perpetual Easements would be the same as Alternative A, except the 512-square-foot Perpetual Easement proposed under Alternative A at the southeast quadrant of the intersection of Cypress Road and the G-16 (Pompano) Canal would instead be a 512-square-foot property acquisition from the Cypress Park condominium complex, purchased by SFWMD. An additional 1,684-square-foot parcel within Bill Keith Park (owned by the City of Pompano Beach) would also be needed as a Perpetual Easement for vehicle access, for a total of 91,027 square feet. Temporary Easements would be the same as Alternative A (11,557 square feet total) except an additional 2,670-square-foot parcel within Bill Keith Park would also be needed to relocate the existing park pathway for a total of 14,227 square feet of Temporary Easements.

Under Alternative B, there are no nature-based measures proposed in the Pompano Canal Basin.

#### *3.5.5.3 C-14 West Basin*

Under Alternative B, structural measures would include building a new, replacement gated spillway with three 25-foot-wide roller gates approximately 215 feet north (upstream) of the current S-37B Gated Spillway. Approximately 6,467 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal.

Additionally, an approximately 1.2-linear-mile section of the C-14 (Cypress Creek) Canal, extending upstream north and then west of the S-37B Gated Spillway, would be excavated to enlarge the canal cross section, improving water conveyance. Approximately 1.2 miles of canal upstream (north) of the S-

37B Gated Spillway would be excavated to a maximum depth of 5 feet below the existing canal bottom, removing an estimated 26,631 neat cubic yards of sediment. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Under Alternative B, there are no nature-based measures proposed in the C-14 West Basin.

#### *3.5.5.4 C-14 East Basin*

Alternative B for the C-14 East Basin watershed is the same as Alternative A, with the following exceptions:

- The new gated spillway to replace the current S-37A Gated Spillway would consist of two 25-foot-wide roller gates, rather than the four 25-foot-wide roller gates in Alternative A. As a result of this smaller footprint, approximately 74,852 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- The new pump station would house a greater pump capacity than the new pump station in Alternative A, consisting of three 500-cfs pumps and one 500-cfs auxiliary pump, for a total design discharge capacity of 1,500 cfs.
- The real estate acquisition from the Pine Crest Preparatory School would be a smaller parcel than what is proposed in Alternative A (4,751 square feet under Alternative B versus 12,315 square feet under Alternative A) because the gated spillway would be narrower.

Under Alternative B, there are no nature-based measures proposed in the C-14 East Basin.

#### *3.5.5.5 C-13 West Basin*

Alternative B for the C-13 West Basin watershed is the same as Alternative A, with the following exceptions:

- The new gated spillway to replace the current S-36 Gated Spillway would only have one 25-foot-wide roller gate, rather than the two 25-foot-wide roller gates in Alternative A.
- A new pump station would be constructed adjacent to the new gated spillway with three 170-cfs pumps and one 170-cfs auxiliary pump, for a total design discharge capacity of 510 cfs. Approximately 39,695 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- The Temporary Easement along the south side of NW 39th Street would be larger than the one in Alternative A, with an area of 13,226 square feet (versus 9,734 square feet as proposed in Alternative A).
- Property acquisition would be required for vehicle access and to construct a retaining wall along the south side of the project site. This would entail acquisition of two parcels of land on the south side of the C-13 (Middle River) Canal and north side of Blue Heron Lake: one 1,364-

square-foot parcel owned by Cypress Lakes Owner, LLC, and one 15,030-square-foot parcel owned by the City of Oakland Park.

Under Alternative B, there are no nature-based measures proposed in the C-13 West Basin.

#### *3.5.5.6 C-12 West Basin*

Alternative B for the C-12 West Basin is the same as Alternative A, with the following exceptions:

- The new gated spillway to replace the current S-33 Gated Spillway would have two 20-foot-wide roller gates instead of a single 20-foot-wide gate proposed under Alternative A.
- The width of the new WCS would be larger than under Alternative A, necessitating excavation of the south canal bank and the existing box culvert downstream of the current WCS. Approximately 53,706 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. A new headwall would be constructed to tie the new WCS into the canal sidewalls.

Under Alternative B, there are no nature-based measures proposed in the C-12 West Basin.

#### *3.5.5.7 North New River Canal West Basin*

Under Alternative B, structural measures would include building a new replacement gated spillway with four 20-foot-wide roller gates approximately 30 feet west northwest (upstream) of the current G-54 Gated Spillway. Approximately 11,500 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal.

One nature-based measure is proposed in the North New River Canal West Basin under Alternative B– the Markham Park Stormwater Storage Capacity Improvement Project. The existing Markham Park lake network would be upgraded so the system can temporarily store stormwater from the G-15 (North New River) Canal beyond what it is currently designed and permitted to store. This would facilitate reducing peak stages in the G-15 (North New River) Canal during certain storm events.

The Markham Park Stormwater Storage Capacity Improvement Project would include the following components:

1. A new 105-cfs inflow pump station (with three 35-cfs pumps and one 35-cfs auxiliary pump) on the southern edge of the Markham Park lake system (approximately 26.125373°N, 80.352476°W), which would pump stormwater from the G-15 (North New River) Canal to the Markham Park lakes;
2. Two 84-inch-diameter culverts, each with a fixed upstream weir, to serve as overflow structures;
3. A modified stormwater outfall control structure (located at 26.124824°N, 80.352830°W) that includes an automated 2.5-foot-wide by 2.5-foot-tall gate that would close when the 105-cfs pump is operating (to prevent gravity outflow from Markham Park to the G-15 Canal when the pump is operating), and would open when the pump is not operating (to allow water to move from Markham Park to the G-15 Canal when the pump is not operating); and

4. Two culvert crossings under roads upstream of the existing Markham Park stormwater outfall control structure (at approximately 26.126275°N, 80.352030°W and 26.128980°N, 80.350111°W), each consisting of double 84-inch, 150-foot long culverts with concrete end walls.

Real estate acquisition would be required for the Markham Park Stormwater Storage Capacity Improvement Project. Specifically, an approximately 4.5-acre parcel located at approximately 26.125492°N, 80.352919°W and currently owned by Broward County would be acquired for the purposes of constructing and operating the pump station. Additionally, two Temporary Easements (0.5 acre and 1.5 acres) would need to be obtained from Broward County for the construction of the two culvert crossings.

#### *3.5.5.8 C-11 West Basin*

Under Alternative B, structural measures would include excavating an approximately 8.4-linear-mile section of the C-11 (South New River) Canal in both the C-11 West Basin and C-11 East Basin, between the Winkopp Bridge and the S-13 Pump Station and Gated Spillway. The Winkopp Bridge, which spans the C-11 (South New River) Canal within the C-11 West Watershed, is located approximately 0.75 miles east of the intersection of I-75 and SR 818 (Griffin Road). The purpose of excavating this segment of canal would be to improve conveyance. Approximately 8.4 miles of canal upstream (west) of the S-13 Pump Station Gated Spillway would be excavated to a maximum depth of 5 feet below the existing canal bottom, removing an estimated 277,407 neat cubic yards of sediment. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Under Alternative B, there are no nature-based measures proposed in the C-11 West Basin.

#### *3.5.5.9 C-11 East Basin*

Alternative B for the C-11 East Basin is the same as Alternative A, with the following exceptions:

- The new pump station would house a greater pump capacity consisting of two 180-cfs pumps, two 360-cfs pumps, and one 360-cfs auxiliary pump for a total design discharge capacity of 1,080 cfs. Approximately 64,687 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- An 8.4-linear-mile section of the C-11 (South New River) Canal would be excavated, as described in **Section 3.5.5.8**.

Under Alternative B, there are no nature-based measures proposed in the C-11 East Basin.

### 3.5.6 Alternative C

Alternative C is more complex than Alternatives A and B because it proposes additional structural and nature-based measures.

#### *3.5.6.1 Hillsboro Canal Basin*

Alternative C for the Hillsboro Canal Basin is the same as Alternative B, with the following exceptions:

- A new pump station would be constructed adjacent to the new gated spillway. The pump station would have three 335-cfs pumps and one 335-cfs auxiliary pump, for a total design pumping capacity of 1,005 cfs. Alternative C is the only alternative that includes a pump station for the G-56 Gated Spillway site. Approximately 62,778 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- A nature-based measure would be constructed—the Hillsboro Watershed Stormwater Storage Capacity Improvement Project. This project would convert an existing 721-acre agricultural property located on the south side of the G-08 (Hillsboro) Canal at the southeast quadrant of the intersection of North University Drive and Loxahatchee Road into a shallow, aboveground stormwater storage area. This would reduce peak stages in the G-08 (Hillsboro) Canal during certain storm events.

The Hillsboro Watershed Stormwater Storage Capacity Improvement Project would include the following components:

1. Construction of a perimeter levee and seepage canal to create a new aboveground stormwater storage area, where water would be stored to no more than 4 feet above the average ground surface;
2. Construction of a new 600-cfs inflow pump station (with three 200-cfs pumps and one 200-cfs auxiliary pump) that would pump stormwater from the G-08 (Hillsboro) Canal to the new stormwater storage area;
3. Construction of a 60-cfs seepage pump station to pump seepage water from the seepage canal to the new stormwater storage area;
4. Construction of an overflow weir structure for excess discharges of water from the storage area to the G-08 (Hillsboro) Canal; and
5. Construction of a gated outflow structure to convey stormwater from the storage area to the G-08 (Hillsboro) Canal.

Real estate acquisition would be required for the Hillsboro Watershed Stormwater Storage Capacity Improvement Project. Specifically, a 721-acre parcel located at approximately 26.329464°N, 80.243476°W would be acquired by SFWMD from a private landowner to construct the aboveground stormwater storage area.

#### *3.5.6.2 Pompano Canal Basin*

Alternative C for the Pompano Canal Basin is the same as Alternative B, with the following exceptions:

- A new pump station would be constructed in the center of the canal and adjacent to the new gated spillway. The pump station would have three 100-cfs pumps and one 100-cfs auxiliary pump, for a total design pumping capacity of 300 cfs. Approximately 30,480 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. Alternative C is the only alternative that includes a pump station for the new G-57 Gated Spillway site.

- Instead of the 1,684-square-foot Perpetual Easement within Bill Keith Park (owned by the City of Pompano Beach) proposed under Alternative A, a Perpetual Easement in a different location within Bill Keith Park with an area of 1,357 square feet would be required.
- Instead of the Temporary Easement within Bill Keith Park, the SFWMD would acquire a 10,749-square-foot parcel within Bill Keith Park from the City of Pompano Beach. SFWMD would also acquire a 1,911-square-foot parcel within the ROW of SE 3rd Avenue from the City of Pompano Beach.

Under Alternative C, there are no nature-based measures proposed in the Pompano Canal Basin.

#### *3.5.6.3 C-14 West Basin*

Alternative C for the C-14 West Basin is the same as Alternative A in that no changes are proposed to the S-37B Gated Spillway.

Alternative C proposes additional canal cross section modifications than what is proposed in Alternative B. Under Alternative C, an approximately 6.8-linear-mile section of the C-14 (Cypress Creek) Canal would be excavated; this includes the 1.2-linear-mile section proposed under Alternative B. Approximately 3.1 miles of additional excavation would occur between S-37B and S-37A (extending into the C-14 East Basin), with 595,400 neat cubic yards of sediment removed. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. An additional 2.5 miles of excavation would occur downstream of S-37A (in the Coral Reef Basin), with 258,977 neat cubic yards of sediment removed Dredged material generated from this segment of canal excavation would be disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Alternative C also includes the operational change of using the G-65 Gated Culvert as a flood control structure to divert a portion of stormwater that would otherwise flow south through the S-37B Gated Spillway to flow to the G-57 Gated Spillway by fully opening its gate during storm events. The G-65 Gated Culvert is a single barrel 54-inch-diameter gated culvert. Under current operations, the G-65 gate normally remains only partially open (0.5 feet open) to maintain a minimum flow for environmental purposes and to maintain the optimum water surface elevation in the G-16 (Pompano) Canal (between the G-65 Gated Culvert and G-57 Gated Spillway) of 4.5 feet National Geodetic Vertical Datum of 1929 (NGVD29).

Under Alternative C, there are no nature-based measures proposed in the C-14 West Basin.

#### *3.5.6.4 C-14 East Basin*

Alternative C for the C-14 East Basin is the same as Alternative A, with the following exception:

- Canal cross section modifications would occur as described in **Section 3.5.6.3** along an approximately 6.8-linear-mile section of the C-14 (Cypress Creek) Canal in the C-14 West Basin, C-14 East Basin, and Coral Reef Basin.

Under Alternative C, there are no nature-based measures proposed in the C-14 East Basin.

### *3.5.6.5 C-13 West Basin*

Alternative C for the C-13 West Basin is the same as Alternative B, with the following exceptions:

- The new gated spillway to replace the current S-36 Gated Spillway would have two 25-foot-wide roller gates instead of a single 25-foot-wide gate proposed under Alternative B.
- The pump station would have greater capacity, with three 200-cfs pumps and one 200-cfs auxiliary pump, for a total design discharge capacity of 600 cfs. Approximately 52,535 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- The C-13 (Middle River) Canal would be excavated along approximately 4.1 linear miles upstream (west) of the S-36 Gated Spillway to improve water conveyance. Deepening and/or widening would occur to a maximum depth of 7 feet, removing an estimated 219,745 neat cubic yards of sediment. An additional 1.3 miles of canal deepening and/or widening to a maximum depth of 5 feet would occur downstream of the S-36 Gated Spillway, in the C-13 East Basin, resulting in 118,152 neat cubic yards of excavated sediment. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Under Alternative C, there are no nature-based measures proposed in the C-13 West Basin.

### *3.5.6.6 C-12 West Basin*

Alternative C for the C-12 West Basin is the same as Alternative B, with the following exceptions:

- The pump station would have greater capacity, with three 235-cfs pumps and one 235-cfs auxiliary pump, for a total pumping design capacity of 705 cfs. As a result of the increased pump capacity, the pump station would be 4 feet wider than the pump station under Alternative B. Approximately 55,815 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- The C-12 (Plantation) Canal would be excavated along a 0.5-linear-mile section upstream of the proposed new WCS to improve water conveyance. Deepening and/or widening would occur to a maximum depth of 5 feet, removing an estimated 15,335 neat cubic yards of sediment. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Under Alternative C, there are no nature-based measures proposed in the C-12 West Basin.

### *3.5.6.7 North New River Canal West Basin*

Alternative C for the North New River Canal West Basin is the same as Alternative B, with the following exceptions:

- A new pump station would be constructed adjacent to the new gated spillway. The pump station would have three 270-cfs pumps and one 270-cfs auxiliary pump, for a total design pumping capacity of 810 cfs. Approximately 52,251 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.
- The retired boat lock downstream of the existing WCS would be demolished.
- The G-15 (North New River) Canal would be excavated along a 13.9-linear-mile section upstream of the proposed new WCS by to improve water conveyance. Deepening and/or widening would occur to a maximum depth of 5 feet, removing an estimated 626,627 neat cubic yards of sediment. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

Nature-based measures under Alternative C would be the same as Alternative B with the construction of the Markham Park Stormwater Storage Capacity Improvement Project.

#### *3.5.6.8 C-11 West Basin*

Alternative C is the same as Alternative B because it would include the excavation of an 8.4-linear-mile section of the C-11 (South New River) Canal (between the Winkopp Bridge and the S-13 Pump Station and Gated Spillway) to improve conveyance.

Under Alternative C, there are no nature-based measures proposed in the C-11 West Basin.

#### *3.5.6.9 C-11 East Basin*

Alternative C for the C-11 East Basin is the same as Alternative B, with the following exception:

- The new pump station would have greater pump capacity, consisting of two 250-cfs pumps, two 500-cfs pumps, and one 500-cfs auxiliary pump, for a total design discharge capacity of 1,500 cfs. Approximately 67,281 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal.

Alternative C includes the same structural measure as Alternative B to excavate a 8.4-linear-mile section of the C-11 (South New River) Canal, described in **Section 3.5.5.8**.

Under Alternative C, there are no nature-based measures proposed in the C-11 East Basin.

## 4.0 PLAN COMPARISON AND SELECTION

The purpose of plan comparison is to provide a comprehensive assessment of each alternative's outcomes, including benefits, costs, impacts, risks, and uncertainties. From this, the performance of each alternative can be evaluated relative to the no action alternative as well as in comparison to one another. This comprehensive evaluation enables decision-makers to carefully weigh the benefits and trade-offs of each alternative, ultimately supporting the selection of the most suitable alternative.

As detailed in **Section 3, Formulation of Alternative Plans**, the Section 203 Study's final array includes four alternatives:

- Future Without Project Conditions (i.e., No Action Alternative)
- Alternative A – represents the least complex alternative in that the fewest measures are proposed, and therefore, costs are the lowest of all four alternatives
- Alternative B – represents an intermediate scenario where the number of proposed measures are greater than in Alternative A but fewer than in Alternative C
- Alternative C – more complex than Alternatives A and B because it proposes additional structural and nature-based measures

The final array of alternatives is fully described in **Section 3.5** of this report. The process to evaluate these alternatives is further described below.

## 4.1 Plan Comparison Process

As explained in **Section 3.1.4**, alternatives are evaluated based on their ability to meet Section 203 Study objectives, considering benefits, costs, risks, and uncertainties. Comprehensive benefits—monetary and non-monetary—are classified into four P&G accounts: NED, RED, EQ, and OSE. The Comprehensive Benefits Evaluation Scoping Tool provides metrics by USACE mission area and P&G account to facilitate comparison and evaluation of proposed plans. These metrics are systematically organized into a table of effects, which facilitates a detailed assessment of each alternative's performance relative to the FWOP scenario, study objectives, formulation and evaluation criteria, the Federal Objective, and the Guiding Principles. Trade-offs are carefully considered to understand potential impacts that might offset benefits anticipated under the future conditions with project implementation. The metrics selected for the Section 203 Study are presented in **Figure 4-1**. The selected metrics are thoroughly analyzed and discussed in detail within the context of their respective NED, RED, EQ, and OSE accounts below. The table of effects is illustrated in **Appendix D, Benefits Analysis,** of this report.

Per requirements in ER 1105-2-103, the comparative process must also identify the NED Plan, which reasonably maximizes NED benefits consistent with protecting the Nation's environment; the Total Net Benefits Plan, which reasonably maximizes net benefits across the four P&G accounts; and the Least Environmentally Damaging Practicable Alternative, as required by Section 404 of the Clean Water Act (40 CFR Part 230). These plans are identified in **Section 4.2** below.

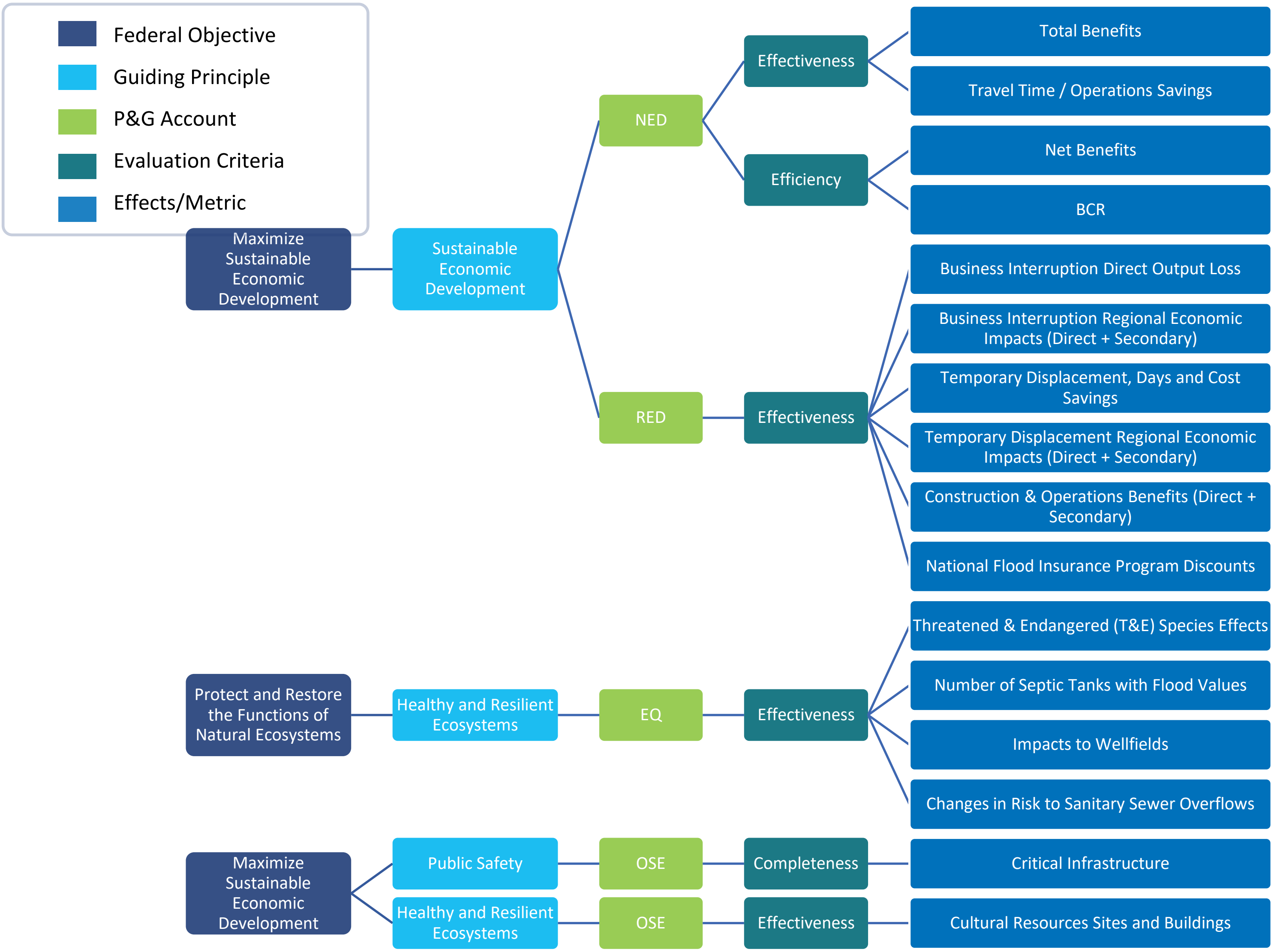



**Figure 4-1. Section 203 Study Table of Effects, with Metrics Selected for Evaluation of Alternatives.**

### 4.1.1 National Economic Development Account

NED benefits represent the increase in the net value of the national output of goods and services attributable to the project. These benefits are central to plan selection, guiding the comparison of how each alternative impacts economic outcomes at the national level. This Section 203 Study assesses the effects of flood damage to structures, roads, and vehicles, combined with traffic reallocation, across the final array of alternatives, and quantifies the associated benefits from managing these effects. **Figure 4-2** provides an illustration of the modeling analyses that contributed to the NED results.

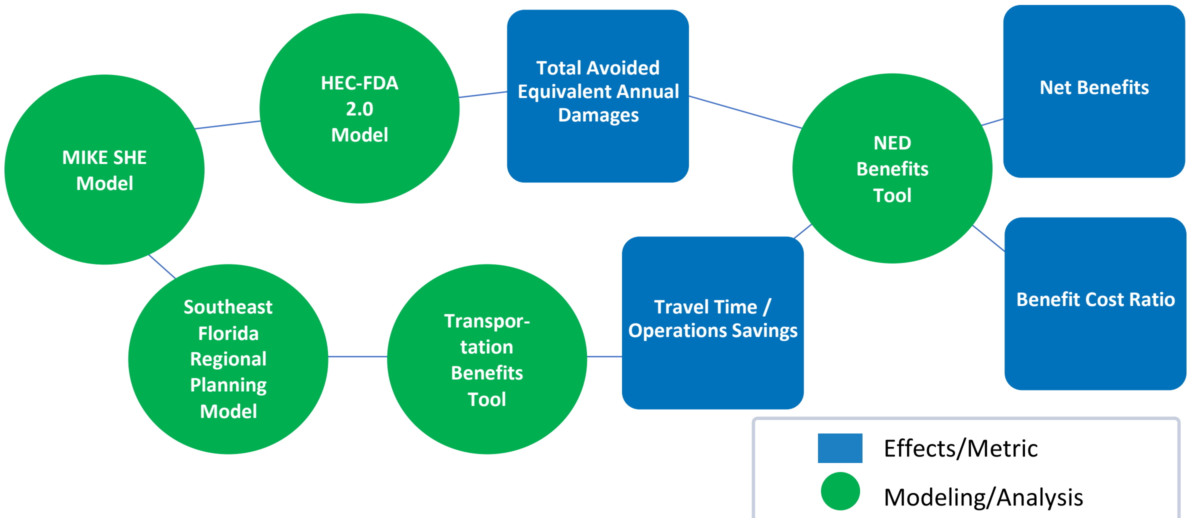



**Figure 4-2. National Economic Development Benefits Modeling Analyses.**

Depth duration (hours) and peak flood depth (feet) are derived from MIKE SHE and MIKE Hydro modeling of existing and future conditions. These serve as critical hydrologic and hydraulic inputs for both the Hydrologic Engineering Center's Flood Damage Assessment Model version 2.0 (HEC-FDA 2.0) and the Southeast Florida Regional Planning Model (SERPM). MIKE SHE and Mike Hydro modeling incorporate eight compound flood frequency events for the base year (2035) and the outyear (2085) for the period of analysis. Compound flooding events include various combinations of rainfall and coastal water level return frequency events (i.e., surge conditions). Sea level change is incorporated into the coastal water level data/boundary condition for the 2085 future condition, with scenarios run in parallel for low, intermediate, and high sea level change projections.

The HEC-FDA 2.0 model quantifies the Total Avoided Equivalent Annual Damages to structures, contents, vehicles, roadways, and other costs, including emergency clean-up requirements, across eight compound flood frequency events and three sea level rise scenarios within the Action Area. Life safety risk benefits are excluded from the final array of alternatives because model conditions indicate relatively low flood depths without wave action or additional hazards. A HEC-FDA 2.0 Technical Memorandum for the final array of alternatives is available in **Appendix D**.

Transportation benefits are also incorporated into the NED analysis to evaluate effectiveness. Depth duration (hours) and peak flood depth (feet), derived from MIKE SHE and MIKE Hydro modeling of existing and future conditions, serve as inputs to the SERPM. SERPM estimates the impacts of flooding on vehicle miles traveled and vehicle hours traveled for the 3.33 percent compound probability event in the base year (2035) and the outyear (2085) under the intermediate sea level rise scenario. These results are then used to quantify transportation benefits, representing the net present value of travel time and operations savings across the final array of alternatives. The travel time and operations savings are quantified using the transportation benefits analysis tool and approved for use by the USACE Flood Risk Management Planning Center of Expertise (FRM-PCX). The SERPM Technical Memorandum and respective Transportation Benefits Technical Memorandum are included in **Appendix D**.

Total benefits, net benefits, and the benefit-to-cost ratio (BCR) are quantified using the NED economic analysis tool, which is approved for use by the USACE FRM-PCX. Total benefits are derived from total avoided equivalent annual damages to evaluate effectiveness. Total benefits for the low, intermediate, and high sea level rise scenario and travel time and operations savings for the intermediate sea level rise scenario are calculated over a 50-year period of analysis using a 3 percent discount rate. Estimated project costs for the final array of alternatives include initial construction costs, real estate costs, and OMRR&R expenses over the same 50-year period.

Net benefits and the BCR evaluate efficiency of the alternatives. Net benefits represent the overall economic gain or loss, where positive net benefits indicate that alternative's benefits exceed its costs, and negative net benefits indicate that costs exceed benefits. The BCR compares total benefits to total costs; a BCR greater than 1.0 indicates an alternative is cost-effective, while a BCR less than 1.0 indicates the alternative is not cost-effective. All costs and benefits are expressed in 2025 dollars and evaluated as net present value with a base year of 2035. The NED analysis results for the final array of alternatives are presented in **Table 4-1**. Net benefits and the BCR are illustrated in **Figure 4-3**. A NED Benefits Technical Memorandum for the final array of alternatives is available in **Appendix D**.

**Table 4-1. Summary of National Economic Development Analysis Net Present Value Results.**

| Alternative | Benefit-Cost Calculation | Sea Level Rise Scenario[a/] | | | |
|---|---|---|---|---|---|
| | | Low Sea Level Rise | Intermediate Sea Level Rise | Intermediate Sea Level Rise (including transportation benefits) | High Sea Level Rise |
| Alternative A | Total Benefits | $1,815 | $1,847 | $2,195 | $2,611 |
| | Total Costs | $1,333 | $1,333 | $1,333 | $1,333 |
| | BCR | 1.36 | 1.39 | 1.65 | 1.96 |
| | Net Benefits | $482 | $514 | $863 | $1,278 |
| Alternative B | Total Benefits | $1,855 | $1,912 | $2,221 | $2,815 |
| | Total Costs | $2,218 | $2,218 | $2,218 | $2,218 |
| | BCR | 0.84 | 0.86 | 1.00 | 1.27 |
| | Net Benefits | -$363 | -$307 | $3 | $597 |
| Alternative C | Total Benefits | $1,965 | $2,014 | $2,314 | $2,973 |
| | Total Costs | $3,910 | $3,910 | $3,910 | $3,910 |
| | BCR | 0.50 | 0.52 | 0.59 | 0.76 |
| | Net Benefits | -$1,945 | -$1,896 | -$1,596 | -$937 |

a/ Dollar amounts in millions, 2025 dollars.
Note: BCR = Benefit-to-Cost Ratio

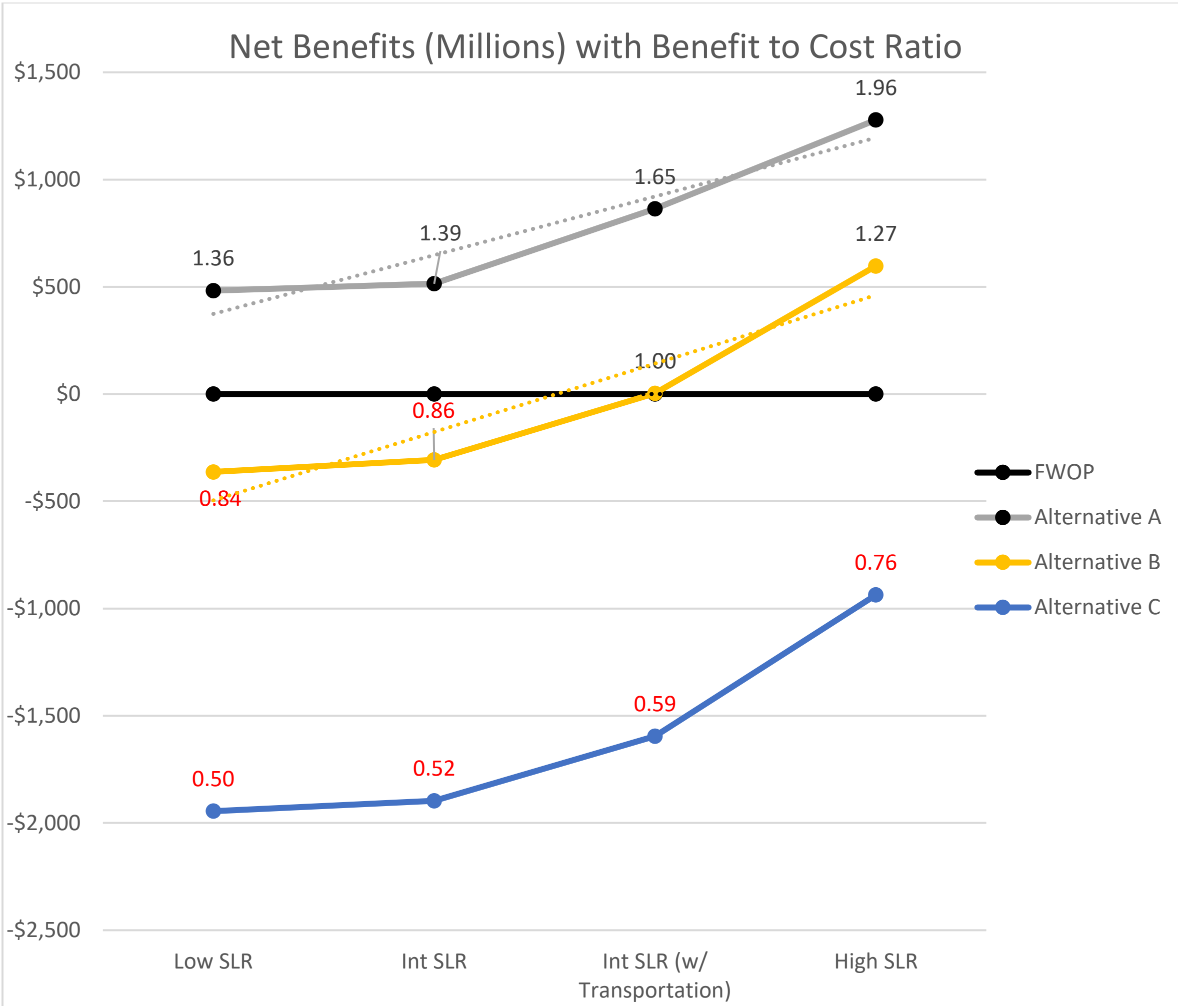



**Figure 4-3. National Economic Development Analysis Net Benefits and Benefit-to-Cost Ratio.**

### 4.1.2 Regional Economic Development

The RED account plays a pivotal role in highlighting regional and local economic impacts associated with each alternative. The RED account provides planners and stakeholders with a comprehensive understanding of how regional economic activity is distributed and influenced by alternatives through indicators such as income, employment, output, and population. By integrating RED benefits into the planning process, the evaluation ensures that regional economic implications are systematically considered alongside other accounts to inform decision-making.

The RED benefits for the Section 203 Study evaluate effectiveness of the alternatives through the following metrics: business interruption due to flood events, total temporary displacement and its impact on the regional economy, construction and operational benefits and their effects on the regional economy, and discounts to National Flood Insurance Program rates. RED benefits are quantified for compound probability events of 3.33 percent, 0.91 percent, and 0.23 percent under both intermediate and high sea level rise scenarios.

**Figure** 4-4 provides an illustration of the modeling analyses that contributed to the RED results.

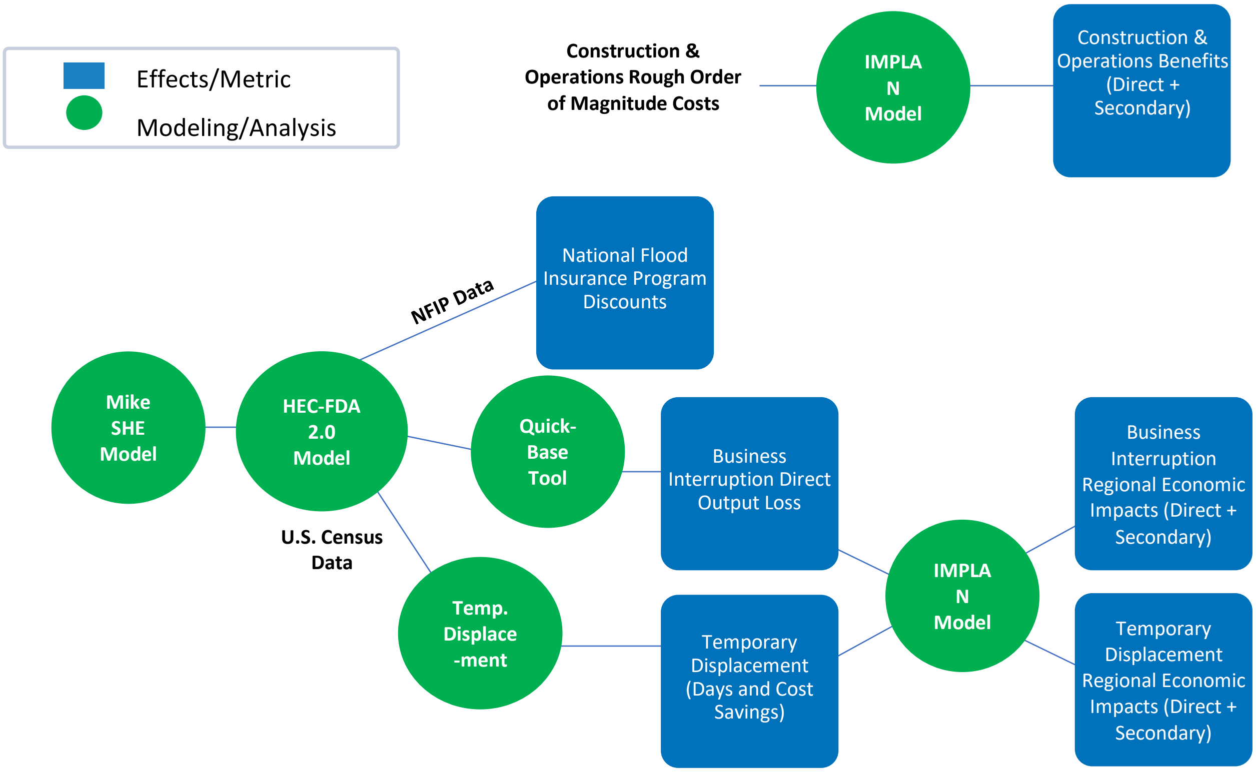



**Figure 4-4. Regional Economic Development Benefits Analyses.**

*4.1.2.1 Business Interruption Analysis*

Business Interruption, Direct Output Loss is analyzed within the QuickBase data platform approved for use by the USACE FRM-PCX by integrating the HEC-FDA structure-specific damage output with Hazus Loss Estimation Methodology. Hazus is a standardized risk assessment tool developed by FEMA under the Natural Hazards Risk Assessment Program. The analysis employed Hazus' Building Inventory Technical Manual and Flood Technical Manual to estimate direct output losses for non-residential structures within the Action Area through non-recoverable and non-transferable loss of sales and revenues resulting from business closures. The results of the Business Interruption Analysis are presented in **Table 4-2** and **Figure 4-5**. A Business Interruption, Direct Output Loss Technical Memorandum for the final array of alternatives is available in **Appendix D.**

**Table 4-2. Business Interruption Analysis, Direct Output Loss Results.**

| Alternative | Annualized Direct Output Loss, Intermediate Sea Level Rise, >0 feet Depth[a/] | Percent Change from FWOP | Annualized Direct Output Loss, High Sea Level Rise, >0 feet Depth[a/] | Percent Change from FWOP |
|---|---|---|---|---|
| No Action | $2,618,693 | -- | $5,878,050 | -- |
| Alternative A | $2,321,148 | 11% | $3,506,747 | 40% |
| Alternative B | $2,112,570 | 19% | $2,921,546 | 50% |
| Alternative C | $2,025,591 | 23% | $2,959,318 | 50% |

a/ Dollar amounts are in 2025 dollars.

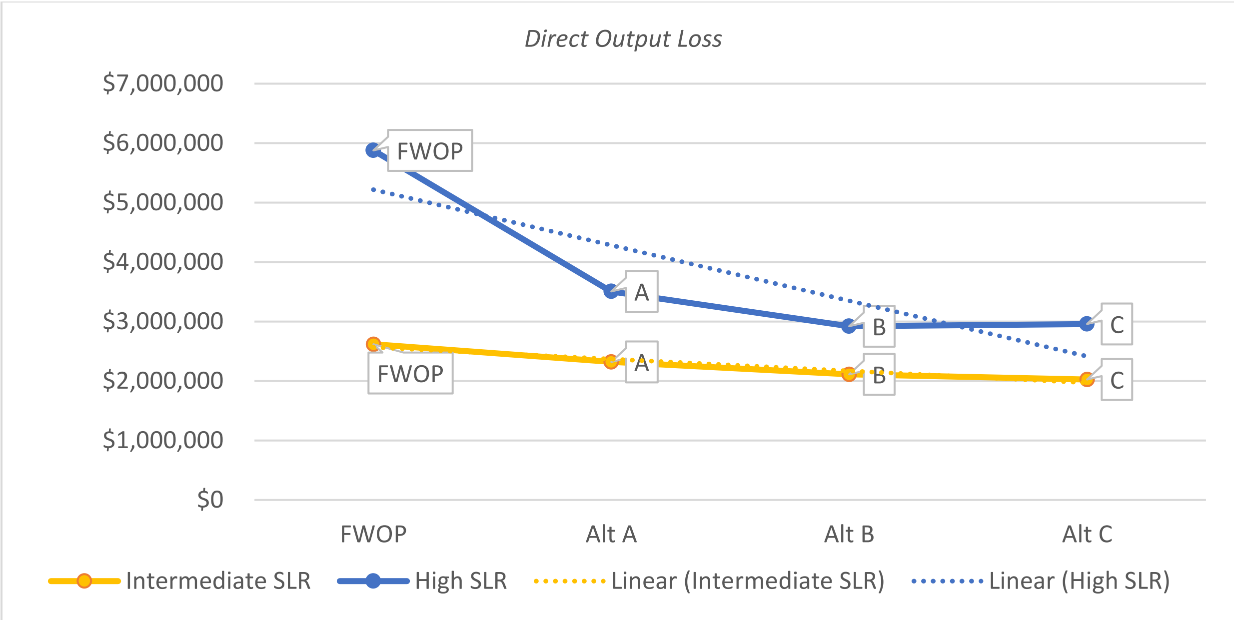



**Figure 4-5. Business Interruption, Direct Output Loss Results.**

### *4.1.2.2 Business Interruption Regional Economic Impacts*

Regional economic impacts are estimated from the savings associated with business interruption, direct output losses discussed in Section 4.1.2.1 under each of the final array of alternatives. **Table 4-5** presents the estimated direct and secondary (indirect and induced) regional economic impacts resulting from the change in direct output loss. These impacts reflect the decreased losses in employment, labor income, value added, and output within the Miami-Fort Lauderdale-West Palm Beach Metropolitan Statistical Area. **Figure 4-13-6** through **Figure 4-9** illustrate the range of savings in the high sea level rise scenario provided by each alternative in the FWP condition. A Regional Economic Impact Technical Memorandum for the final array of alternatives is available in **Appendix D**.

**Table 4-3. Business Interruption, Regional Economic Impacts Savings.**

| | Employment (Full Time Equivalent) High Sea Level Rise | | | Labor Income High Sea Level Rise | | | Value Added High Sea Level Rise | | | Output High Sea Level Rise | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alternative** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** |
| Alternative A | 30 | 10 | 40 | $1.9 | $0.6 | $2.5 | $1.8 | $1.2 | $3.0 | $2.3 | $2.0 | $4.3 |
| Alternative B | 39 | 12 | 51 | $2.4 | $0.8 | $3.2 | $2.3 | $1.5 | $3.8 | $2.9 | $2.6 | $5.4 |
| Alternative C | 38 | 12 | 51 | $2.4 | $0.8 | $3.2 | $2.3 | $1.5 | $3.8 | $2.8 | $2.5 | $5.4 |

Notes: Dollar amounts in millions, 2025 dollars. The output from the IMPLAN model provides a change in loss. These results are enumerated as decreases in the Technical Memo. For ease of understanding, the table above provides results as positive values to demonstrate savings

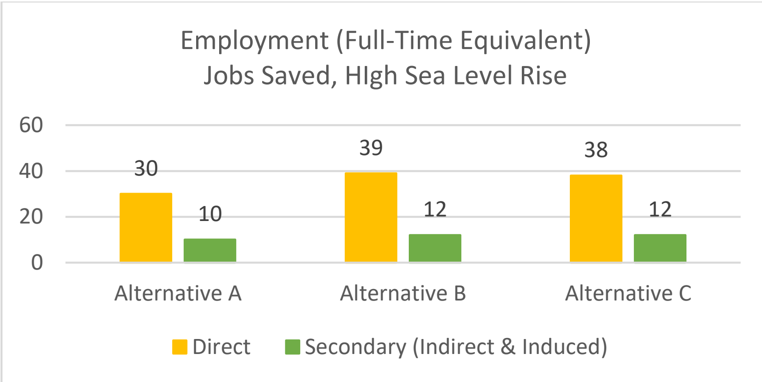



**Figure 4-6. Business Interruption, Regional Economic Impacts, Annual Employment (Full Time Equivalent) Jobs Savings.**

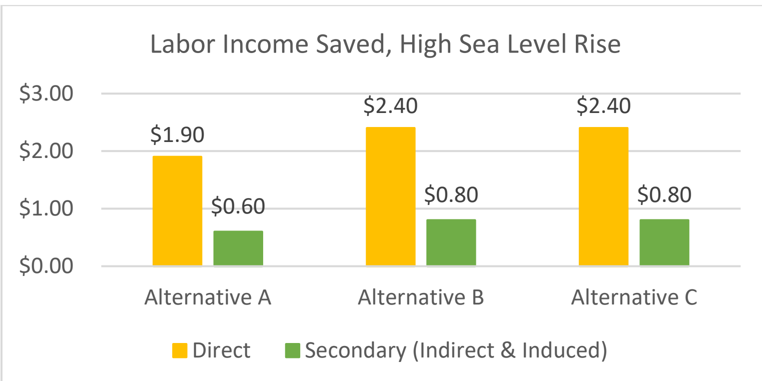



**Figure 4-7. Business Interruption, Regional Economic Impacts, Annual Labor Income Saved.**

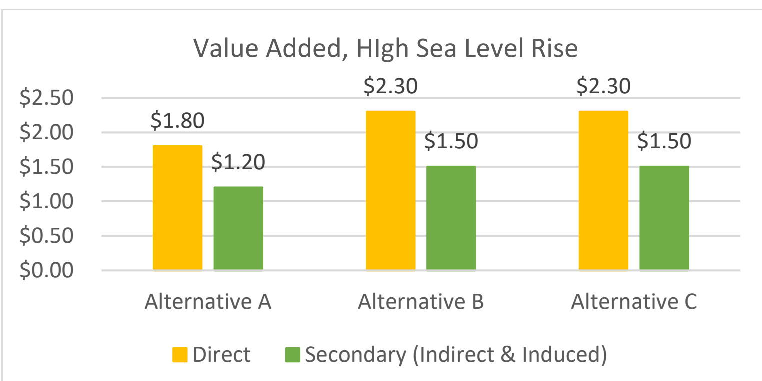



**Figure 4-8. Business Interruption, Regional Economic Impacts, Annual Value Added.**

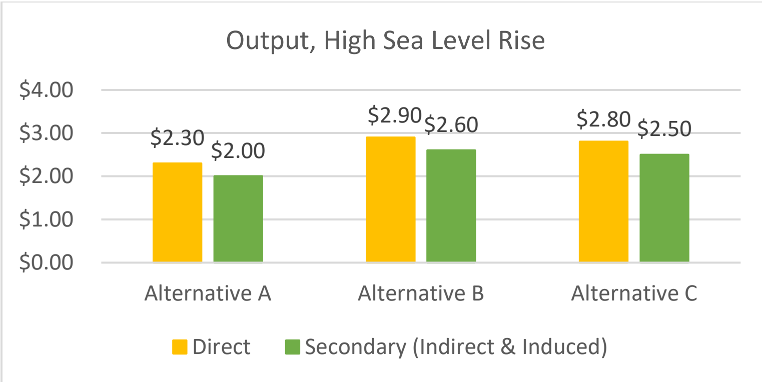



**Figure 4-9. Business Interruption, Regional Economic Impacts, Annual Output Saved.**

#### *4.1.2.3 Temporary Displacement*

Temporary displacement is calculated using the Temporary Displacement Analysis Tool approved for use by the USACE FRM-PCX. Inputs for the Tool include the HEC-FDA structure damage details inventory, combined with U.S. Census data to estimate the population displaced if residential structures experienced flood depths greater than 0.25 foot. The 2022 U.S. Census survey estimates an average household size of 2.57 persons for Broward County (USCB 2022). Displacement duration is quantified based on the Hazus Flood Technical Manual, which provides estimates of maximum restoration days by flood depth in 4-foot increments above the first-floor elevation. This Section 203 Study assumes 75 percent of the maximum restoration days. Additionally, it is assumed that re-occupancy would occur when 90 percent restoration is achieved and that permanent displacement does not occur. Total temporary displacement-related costs are quantified using per diem rates from the U.S. General Services Administration for fiscal year 2025, specific to Fort Lauderdale. The analysis also assumes that displacement would increase food and incidental expenses by 25 percent. The results of the temporary displacement analysis presented in **Table 4-4** represent the annualized value of total displacement days. **Figure 4-10**, **Figure 4-11**, and **Figure 4-12** illustrate the change in total temporary displacement days compared to the FWOP. A Temporary Displacement Technical Memorandum for the final array of alternatives is available in **Appendix D**.

**Table 4-4. Temporary Displacement, Value of Total Displacement Days.**

| Alternative | Compound Flood Frequency Scenarios | | | | | |
|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | |
| | Annualized Value of Total Displacement Days Intermediate SLR | Annualized Value of Total Displacement Days High SLR | Annualized Value of Total Displacement Days Intermediate SLR | Annualized Value of Total Displacement Days High SLR | Annualized Value of Total Displacement Days Intermediate SLR | Annualized Value of Total Displacement Days High SLR |
| **FWOP** | $6,052,338 | $8,423,768 | $4,851,237 | $6,604,833 | $1,324,374 | $2,422,392 |
| **Alternative A** | $5,264,734 | $6,170,444 | $4,244,342 | $5,141,134 | $1,154,529 | $1,788,782 |
| **Alternative B** | $5,190,532 | $5,854,890 | $4,172,374 | $4,840,037 | $1,089,096 | $1,655,017 |
| **Alternative C** | $5,126,508 | $5,638,136 | $4,036,111 | $4,626,461 | $1,056,199 | $1,560,719 |

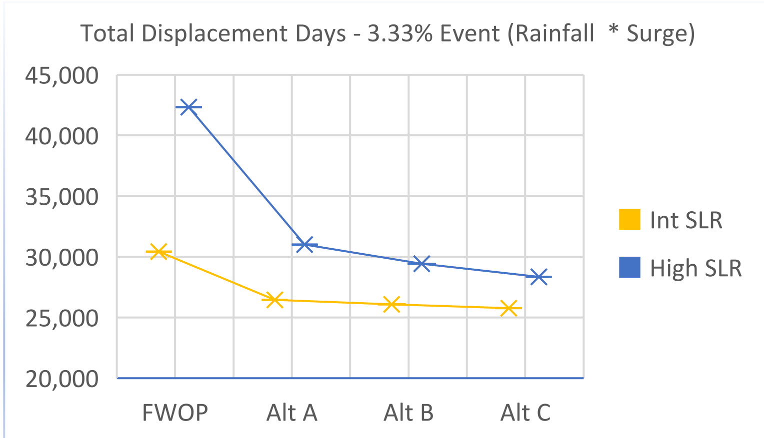



**Figure 4-10. Change in Total Temporary Displacement Days Compared to the Future Without Project Alternative, 3.33% Probability Event (2 Year Surge, 25 Year Rainfall).**

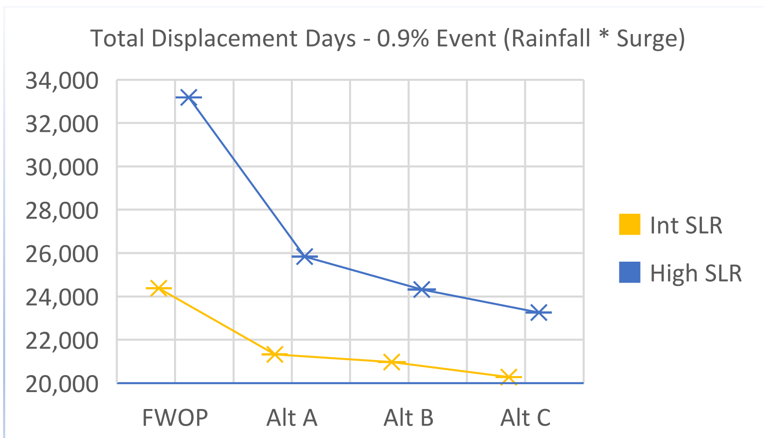



**Figure 4-11. Change in Total Temporary Displacement Days Compared to the Future Without Project Alternative, 0.91% Probability Event (2 Year Surge, 100 Year Rainfall).**

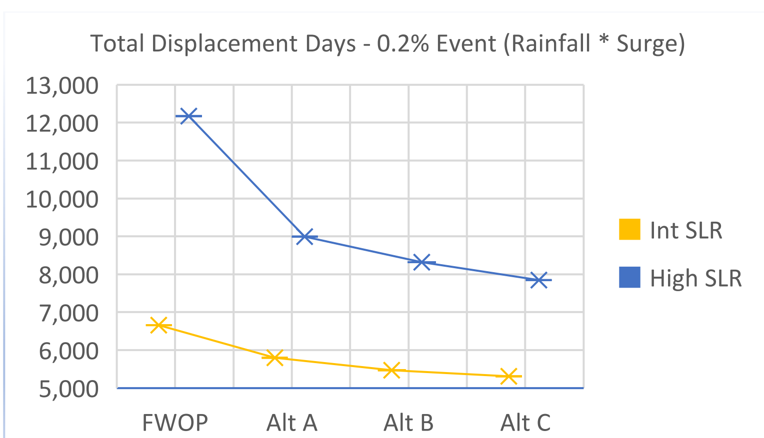



**Figure 4-12. Change in Total Temporary Displacement Days Compared to the Future Without Project Alternative, 0.23% Probability Event (100 Year Surge, 100 Year Rainfall).**

#### *4.1.2.4 Temporary Displacement Regional Economic Impacts*

Regional economic impacts are estimated from the cost savings associated with total temporary displacement impacts and analyzed in the IMPLAN Model, a model approved for use by the USACE FRM-PCX. Temporary displacement cost savings serve as inputs to IMPLAN sectors 489 (Hotels and motels), 389 (Retail – food and beverage stores) and 492 (Limited-service restaurants) under each of the alternatives to generate savings for employment, labor income, value added, and output. Estimated temporary displacement costs are assumed to be split between lodging and food with the food expenditure further split between grocery purchases (85 percent) and restaurants (15 percent). The savings are annualized for the compound probability events of 3.33 percent, 0.91 percent, and 0.23 percent under both intermediate and high sea level rise conditions. **Table 4-5** presents the estimated direct and secondary (indirect and induced) regional economic impacts resulting from the change in temporary displacement. These impacts reflect the decreased losses in employment, labor income, value added, and output within the Miami-Fort Lauderdale-West Palm Beach Metropolitan Statistical Area. **Figure 4-13** through **Figure 4-16** illustrate the range of savings between intermediate and high sea level rise scenarios provided by each alternative in the FWP condition. A Regional Economic Impact Technical Memorandum for the final array of alternatives is available in **Appendix D**.

**Table 4-5. Temporary Displacement, Regional Economic Impacts.**

| | Employment (Full Time Equivalent) Intermediate/High Sea Level Rise | | | Labor Income Intermediate/High Sea Level Rise | | | Value Added Intermediate/High Sea Level Rise | | | Output Intermediate/High Sea Level Rise | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alternative** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** |
| Alternative A | 8/21 | 4/11 | 12/32 | $0.5/$1.4 | $0.3/$0.8 | $0.7/$2.2 | $1.0/$3.1 | $0.5/$1.4 | $1.5/$4.5 | $1.3/$4.1 | $0.8/$2.4 | $2.1/$6.4 |
| Alternative B | 9/25 | 5/13 | 13/38 | $0.6/$1.6 | $0.3/$0.9 | $0.9/$2.5 | $1.3/$3.6 | $0.6/$1.6 | $1.8/$5.2 | $1.7/$4.8 | $1.0/2.8 | $2./$7.6 |
| Alternative C | 10/27 | 5/14 | 15/41 | $0.6/$1.8 | $0.4/$1.0 | $1.0/$2.8 | $1.4/$4.0 | $0.6/$1.8 | $2.0/$5.8 | $1.9/$5.2 | $1.1/$3.1 | $3.0/$8.3 |

Notes: Dollar amounts in millions, 2025 dollars. The output from the IMPLAN model provides a change in loss. These results are enumerated as decreases in the Technical Memo. For ease of understanding, the table above provides results as positive values to demonstrate savings.

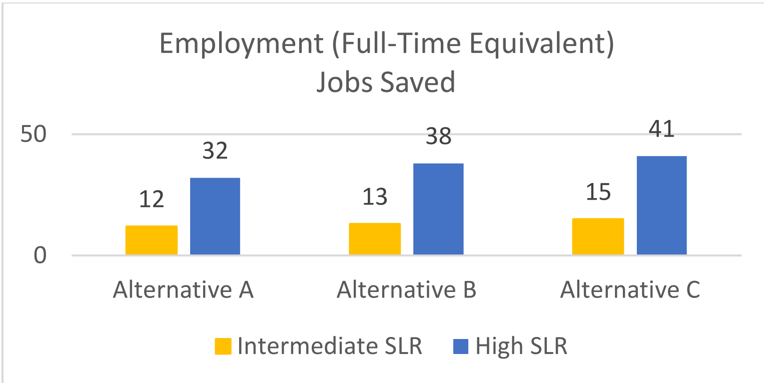



**Figure 4-13. Temporary Displacement, Regional Economic Impacts, Annual Employment (Full Time Equivalent) Jobs Savings.**

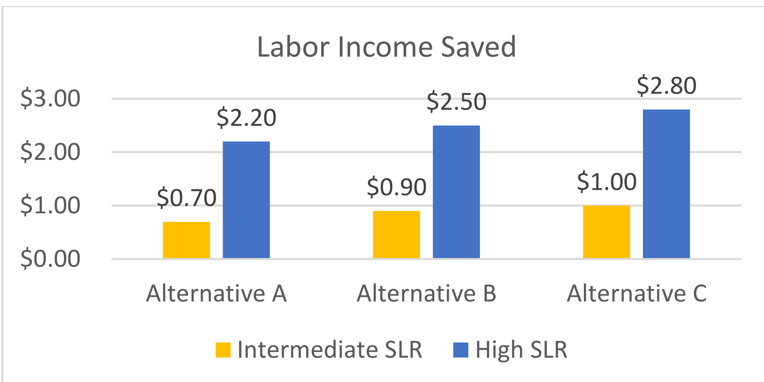



**Figure 4-14. Temporary Displacement, Regional Economic Impacts, Annual Labor Income Saved.**

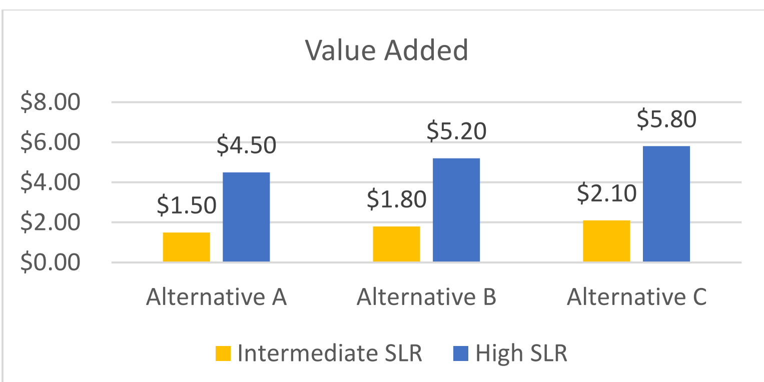



**Figure 4-15. Temporary Displacement, Regional Economic Impacts, Annual Value Added.**

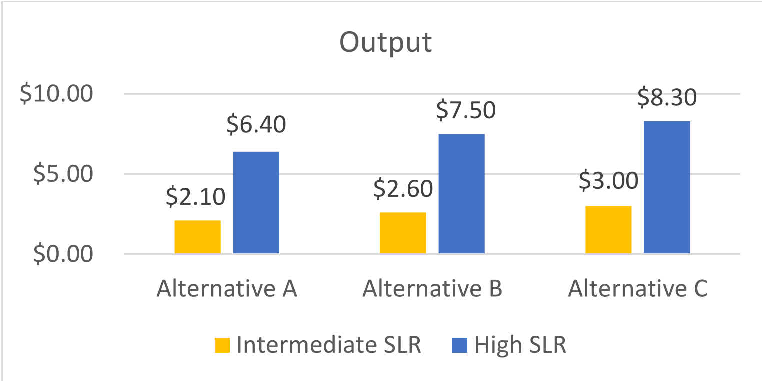



**Figure 4-16. Temporary Displacement, Regional Economic Impacts, Annual Output Saved.**

#### *4.1.2.5 Construction Short-Term Regional Economic Impacts*

Short-term regional impacts are assessed based on the construction activities required to build the project. These benefits include positive impacts on the Miami-Fort Lauderdale-West Palm Beach Metropolitan Statistical Area. Construction is expected to take place over a 7-year period from 2028 to 2034. A Regional Economic Impact Technical Memorandum for the final array of alternatives is available in **Appendix D.**

**Table 4-6** below presents the construction short-term regional economic impacts results from the IMPLAN analysis for employment, labor income, value added, and output for the final array of alternatives. These results are illustrated in **Figure 4-17**. A Regional Economic Impact Technical Memorandum for the final array of alternatives is available in **Appendix D.**

**Table 4-6. Annual Construction Short-term Regional Economic Impacts.**

| | Employment (Full Time Equivalents) | | | Labor Income a/ | | | Value Added a/ | | | Output a/ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alternative** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** | **Direct** | **Secondary** | **Total** |
| Alternative A | 481 | 259 | 739 | $31.9 | $18.8 | $50.7 | $50.3 | $34.3 | $84.6 | $84.0 | $59.3 | $143.3 |
| Alternative B | 802 | 431 | 1,234 | $53.2 | $31.5 | $84.7 | $84.0 | $57.2 | $141.2 | $140.1 | $98.9 | $239.0 |
| Alternative C | 1,334 | 718 | 2,051 | $88.4 | $52.3 | $140.7 | $139.6 | $95.2 | $234.8 | $233.0 | $164.5 | $397.5 |

a/ Dollar amounts in millions, 2025 dollars.

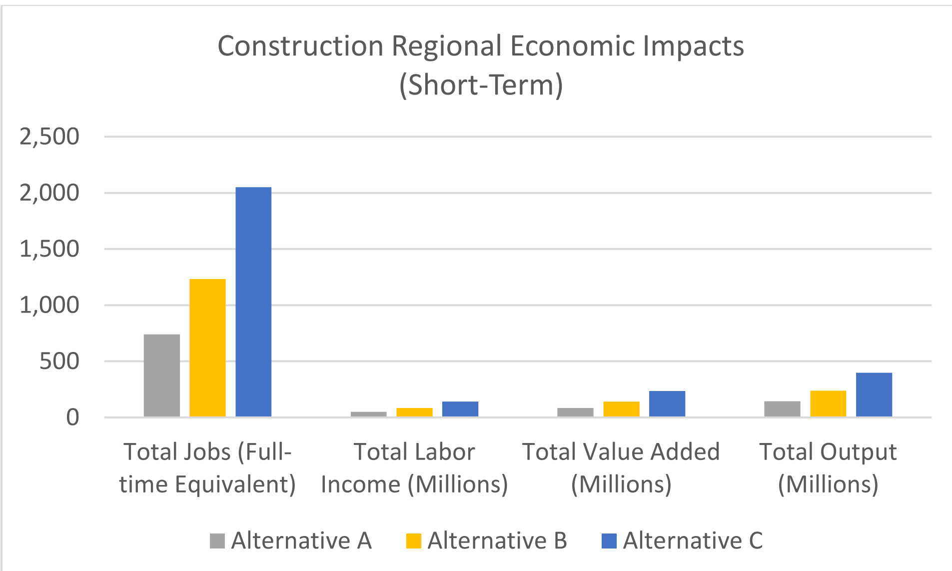



**Figure 4-17. Annual Construction Short-term Regional Economic Impacts.**

#### *4.1.2.6 Operations Long-Term Regional Economic Impacts*

Long-term regional economic impacts are assessed based on the operational activities required to maintain the project during the analysis period from 2035 to 2085. These benefits include positive effects on the Miami-Fort Lauderdale-West Palm Beach Metropolitan Statistical Area. **Table 4-7** presents the results of the IMPLAN analysis for employment, labor income, value added, and output associated with the final array of alternatives during operations. These results are illustrated in **Figure 4-18**. A Regional Economic Impact Technical Memorandum for the final array of alternatives is available in **Appendix D.**

**Table 4-7. Annual Operations Long-term Regional Economic Impacts.**

| | Employment (Full Time Equivalents) | | | Labor Income [a/] | | | Value Added [a/] | | | Output [a/] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alternative | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total |
| Alternative A | 8 | 6 | 14 | $0.5 | $0.4 | $0.9 | $0.9 | $0.8 | $1.7 | $1.8 | $1.3 | $3.1 |
| Alternative B | 15 | 11 | 26 | $1.0 | $0.8 | $1.8 | $1.7 | $1.4 | $3.1 | $3.4 | $2.4 | $5.8 |
| Alternative C | 32 | 22 | 54 | $2.1 | $1.6 | $3.7 | $3.6 | $3.0 | $6.5 | $7.1 | $5.1 | $12.2 |

a/ Dollar amounts in millions, 2025 dollars.

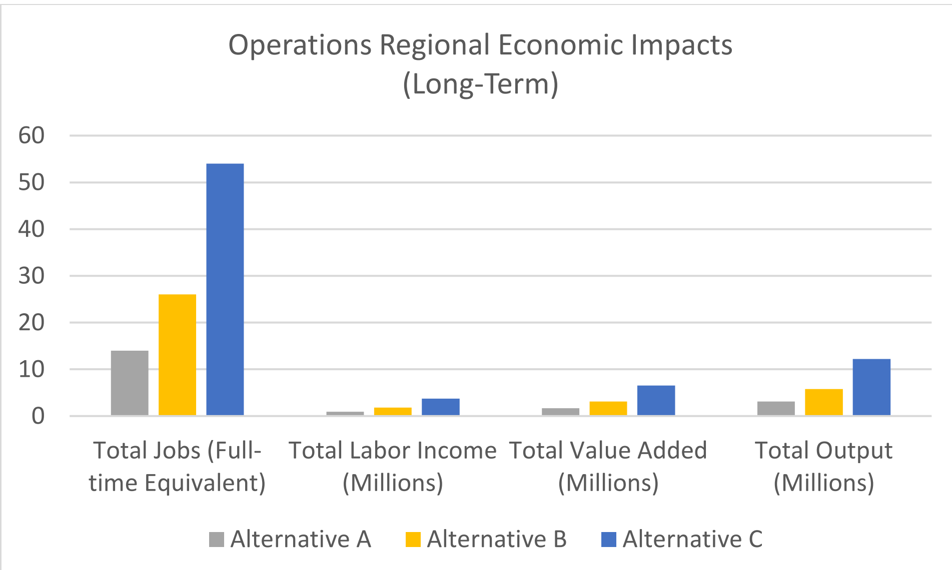



**Figure 4-18. Annual Operations Long-term Regional Economic Impacts.**

#### *4.1.2.7 National Flood Insurance Program Discounts*

Flood depth evaluations were conducted at specific high-risk National Flood Insurance Program (NFIP) zones—namely AE, AO, and AH—to determine whether flood depths above the first floor elevation (FFE) at structures improved in comparison to the FWOP scenario. Zone AE includes areas subject to inundation by the 1 percent annual exceedance probability (AEP) flood event, commonly referred to as the 100-year flood. Zone AO comprises areas prone to shallow flooding, typically characterized by sheet flow or overland flooding, with average depths ranging from 1 to 3 feet during the 1 percent AEP event. Zone AH encompasses areas subject to ponding with similar average flood depths of 1 to 3 feet during the 1 percent AEP event. The 1 percent AEP flood event closely corresponds to the 0.91 percent frequency event evaluated in this Section 203 Study. The evaluation results, summarized in **Table 4-8**, detail the improvements in flood depths above FFE for structures within zones AE, AO, and AH across the final array of alternatives, which are further illustrated in **Figure 4-19** through **Figure 4-21**.

**Table 4-8. NFIP Perspective, Number of Structures with Flood Values Above First Floor Elevation.**

| | Compound Flood Frequency Scenarios | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | | | |
| | Zone AE | | Zone AO | | Zone AH | | Zone AE | | Zone AO | | Zone AH | | Zone AE | | Zone AO | | Zone AH | |
| **Alternative** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** | **INT SLR** | **HIGH SLR** |
| FWOP | 1 | 1 | 129 | 482 | 484 | 552 | 11 | 11 | 519 | 1267 | 1,197 | 1,435 | 11 | 11 | 709 | 2,733 | 1,250 | 1,718 |
| Alternative A | 1 | 1 | 112 | 217 | 422 | 463 | 11 | 11 | 409 | 728 | 1,074 | 1,232 | 11 | 11 | 663 | 1,768 | 1,110 | 1,436 |
| Alternative B | 1 | 1 | 106 | 187 | 419 | 460 | 11 | 11 | 383 | 638 | 1,054 | 1,178 | 11 | 11 | 453 | 1,603 | 1,082 | 1,346 |
| Alternative C | 1 | 1 | 115 | 188 | 397 | 445 | 11 | 11 | 370 | 604 | 1,006 | 1,122 | 11 | 11 | 438 | 1,593 | 1,026 | 1,214 |
| *Alternative with Greatest Change in Flood Values* | -- | -- | B | B | C | C | -- | -- | C | C | B | C | -- | -- | C | C | C | C |

Notes: NFIP = National Flood Insurance Program; INT = Intermediate; SLR = sea level rise; FWOP = Future Without Project

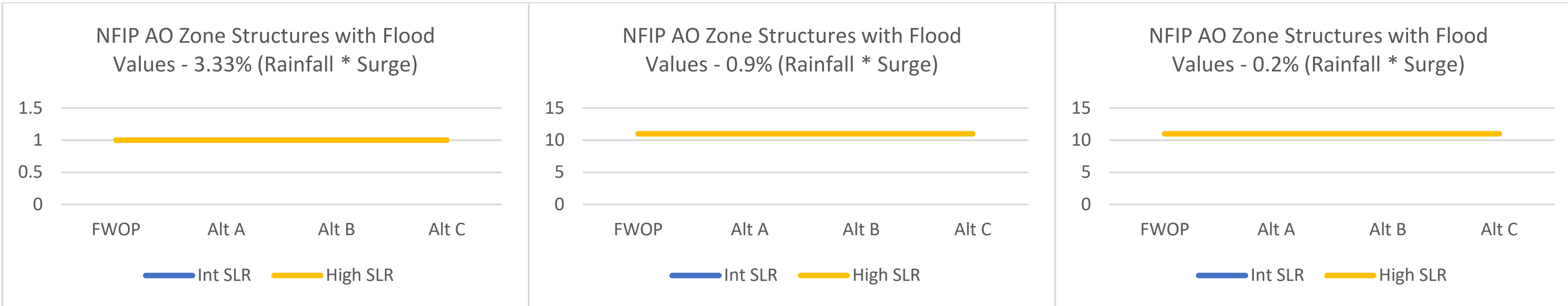



**Figure 4-19. NFIP AO Zones with Flood Values, Multiple Probability Events, Intermediate and High Sea Level Rise.**

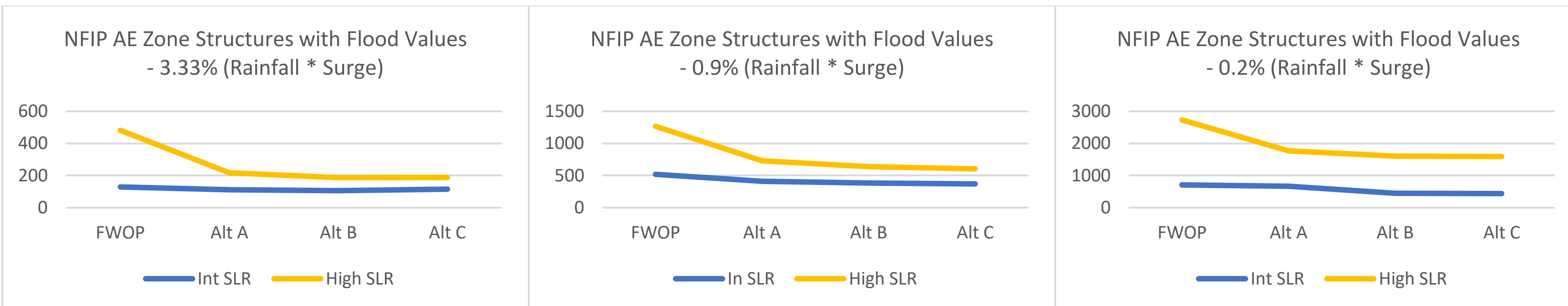



**Figure 4-20. NFIP AE Zones with Flood Values, Multiple Probability Events, Intermediate and High Sea Level Rise.**

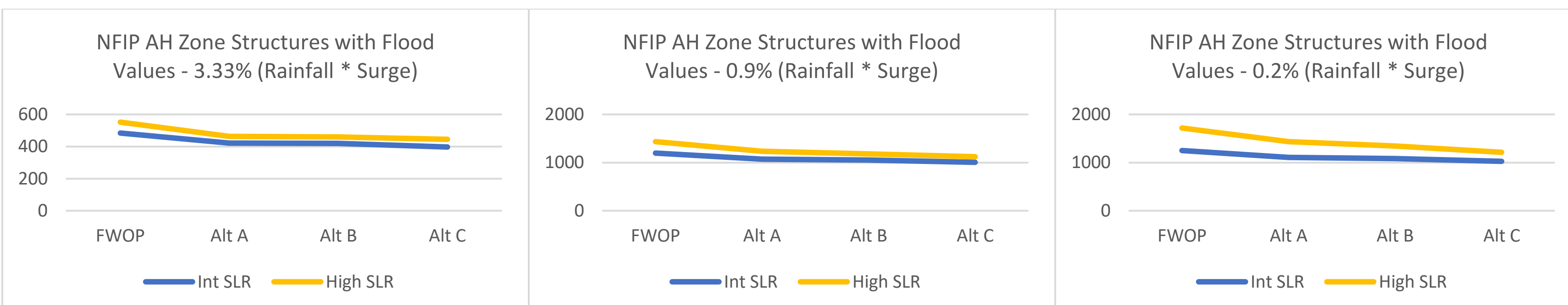



**Figure 4-21. NFIP AE Zones with Flood Values, Multiple Probability Events, Intermediate and High Sea Level Rise.**

### 4.1.3 Environmental Quality Account

The EQ account is essential for capturing non-monetary effects on ecological, cultural, and aesthetic resources. EQ benefits play a pivotal role in maintaining community quality of life, supporting biodiversity, and preserving cultural heritage. By evaluating EQ benefits and impacts, environmental considerations are recognized and integrated into the decision-making process. This Section 203 Study examined both positive and adverse environmental quality effects of the final array of alternatives to threatened and endangered species, impacts to septic tanks, impacts to wellfields that supply potable water, and sanitary sewer overflow occurrences to evaluate effectiveness of the alternatives. EQ benefits are quantified for compound probability events of 3.33 percent, 0.91 percent, and 0.23 percent under both intermediate and high sea level rise scenarios. **Figure 4-22** provides an illustration of the modeling analyses that contributed to the EQ results.

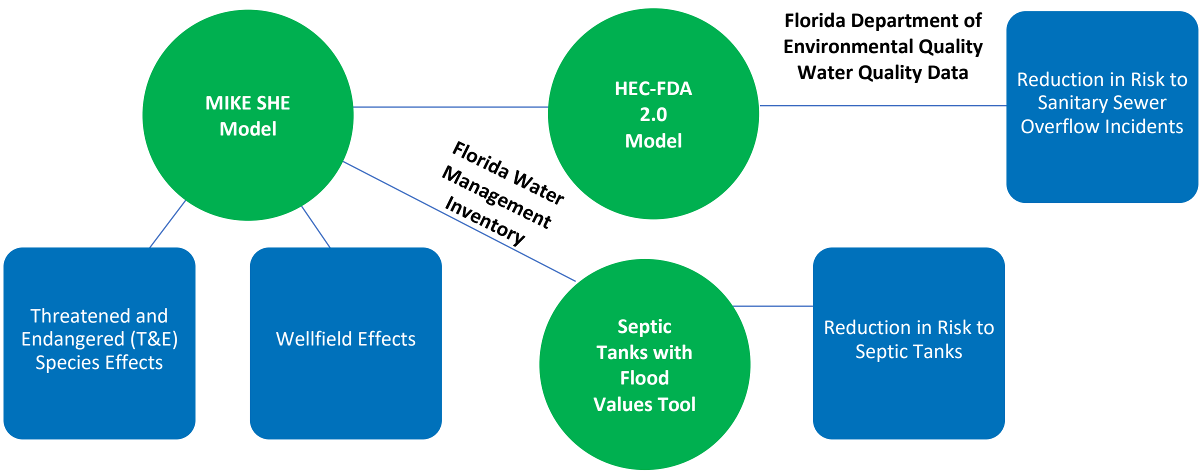



**Figure 4-22. Environmental Quality Benefits Analyses.**

#### *4.1.3.1 Effects to Threatened and Endangered Species*

Effects to threatened and endangered species are evaluated as part of environmental consequences (**Section 5, Environmental Effects**, and **Appendix B**). Overall, construction may result in both direct and indirect effects, often involving temporary disturbances such as noise, turbidity, and habitat disruption. Construction impacts are expected to be insignificant across all species and alternatives. OMRR&R may result in indirect effects that are neutral or beneficial, notably due to improved water conveyance during operations that reduces permanent habitat loss from sea level rise and increased efficiency of storm/pre-storm drawdown events, which would help maintain habitat stability. Based on the results of this analysis, no risks to threatened and endangered species have been identified for the final array of alternatives.

#### *4.1.3.2 Number of Septic Tanks with Flood Values*

Impacts to septic tanks can create long-term environmental issues. Septic tanks may be affected during flood events if they become buoyant; if soil saturation prevents infiltration; or if the tanks are damaged, allowing inflow into the system. For the purposes of the Section 203 Study, the number of septic tanks at risk of flooding within the Action Area is quantified through the Septic Tanks with Flood Values Tool, approved for use by the USACE FRM-PCX, to assess whether improvements in flood risk management reduced their flood exposure. **Table 4-9** presents the results of improvements to septic tanks at risk of flooding with the final array of alternatives. These results are illustrated in **Figure 4-23** through **Figure 4-25**. A Septic Tanks with Flood Values Technical Memorandum for the final array of alternatives is available in **Appendix D.**

**Table 4-9. Number of Septic Tanks with Flood Values and Percent Change.**

| Alternative | Compound Flood Frequency Scenarios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | |
| | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change |
| No Action | 7,854 | -- | 8,071 | -- | 9,312 | -- | 9,550 | -- | 9,368 | -- | 9,713 | -- |
| Alternative A | 7,769 | -1% | 7,860 | -3% | 9,153 | -2% | 9,323 | -2% | 9,200 | -2% | 9,442 | -3% |
| Alternative B | 7,762 | -1% | 7,835 | -3% | 9,143 | -2% | 9,289 | -3% | 9,160 | -2% | 9,421 | -3% |
| Alternative C | 7,732 | -2% | 7,798 | -3% | 9,096 | -2% | 9,234 | -3% | 9,112 | -3% | 9,350 | -4% |

Note: SLR = sea level rise

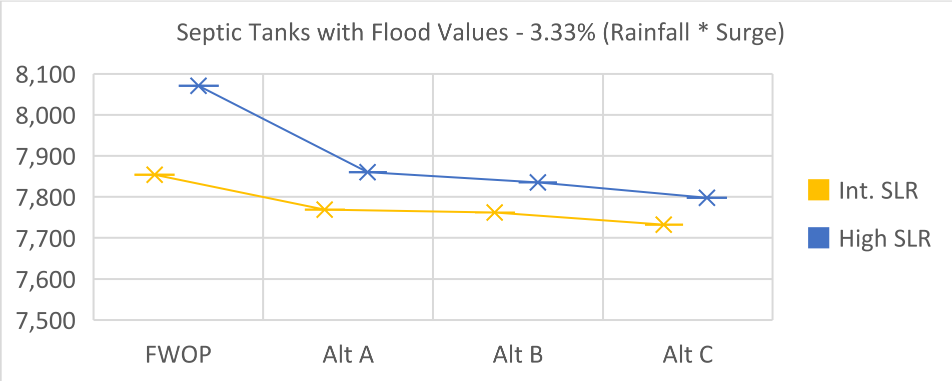



**Figure 4-23. Change in Number of Septic Tanks with Flood Values Compared to the Future Without Project Alternative , 3.33% Probability Event (2 Year Surge, 25 Year Rainfall).**

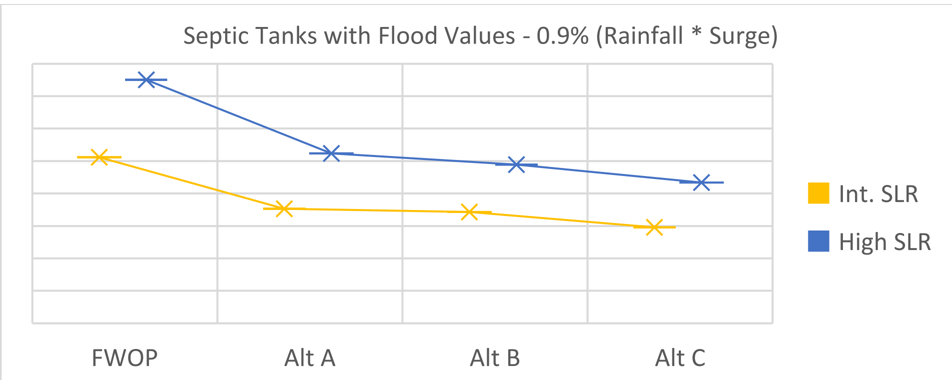



**Figure 4-24. Change in Number of Septic Tanks with Flood Values Compared to the Future Without Project Alternative, 0.91% Probability Event (2 Year Surge, 100 Year Rainfall).**

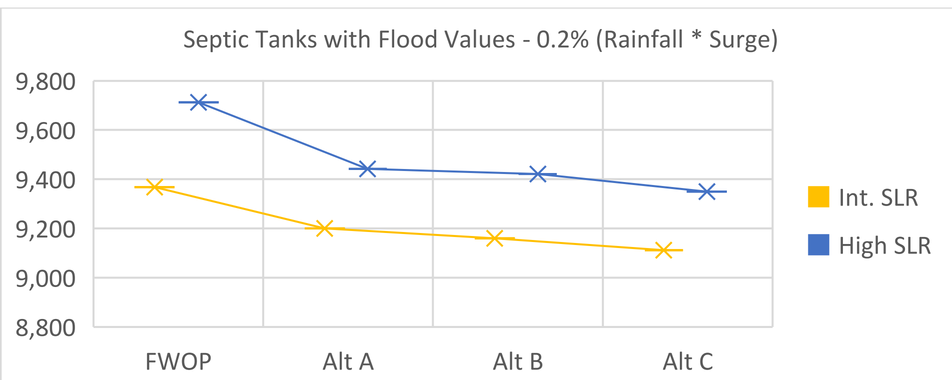



**Figure 4-25. Change in Number of Septic Tanks with Flood Values Compared to the Future Without Project Alternative, 0.23% Probability Event (100 Year Surge, 100 Year Rainfall).**

### *4.1.3.3 Impacts to Wellfields*

Maintaining groundwater levels is crucial to minimizing the risk of saltwater intrusion, which can adversely affect water supply operations. It is estimated that the proposed features of the final array, along with associated operational activities, will neither lower nor deplete groundwater levels. Although sea level rise may influence saltwater intrusion, this factor is independent of the project. Structural improvements and associated operations across the final alternatives provide indirect benefits to water supply operations by enhancing the capacity and flexibility of pre-storm drawdown events. Increased capacity and flexibility allow for the initiation of pre-storm drawdown closer to storm landfall as the likelihood of the event becomes clearer. This results in less water being discharged and greater groundwater retention within the system for water supply purposes. Headwater stages play a critical role in limiting the inland movement of the saltwater front, providing greater adaptability for water supply operations associated with sea level rise impacts. It is anticipated that as engineering complexity increases from Alternative A to Alternative C, there is greater capacity and flexibility to manage pre-storm drawdown events and protect water supply operations.

#### *4.1.3.4 Changes in Risk to Sanitary Sewer Overflow Occurrences*

Sanitary sewer overflows occur when flooding exceeds the capacity of a sewer system, resulting in the discharge of untreated sewage into the environment. During heavy rainfall or flood events, excess stormwater can infiltrate the sewer system, reducing its effective design capacity. This can lead to the release of untreated or partially treated wastewater into streets, waterways, or properties, posing significant public health and environmental risks. Sanitary sewer overflow incidents within the Action Area over the past 5 years have been provided by the Florida Department of Environmental Protection. The locations of these incidents are matched to existing parcel data within the HEC-FDA outputs. Improvements in flood depths above FFE are summarized in **Table 4-10** below, presented as the weighted average change for the final array of alternatives. These results are illustrated in **Figure 4-26** and **Figure 4-27**.

**Table 4-10. Percent Change in Flood Depths Adjacent to Sanitary Sewer Overflow Incidents.**

| Flood Depth Improvement (Percent Average) | Compound Flood Frequency Scenarios | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | |
| | Alternative A | Alternative B | Alternative C | Alternative A | Alternative B | Alternative C | Alternative A | Alternative B | Alternative C |
| Intermediate Sea Level Rise | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| High Sea Level Rise | 2% | 2% | 2% | 3% | 3% | 4% | 5% | 5% | 6% |

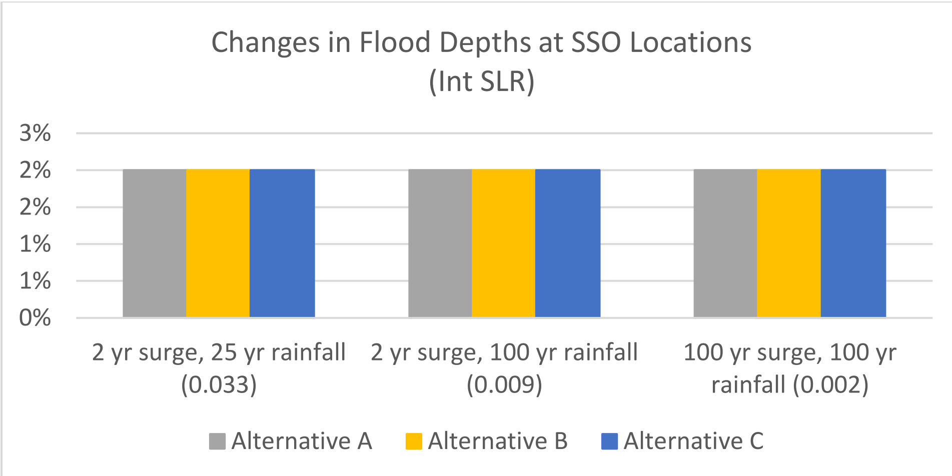



**Figure 4-26. Changes in Flood Depths at Sanitary Sewer Overflow Incident Locations, Intermediate Sea Level Rise Scenario.**

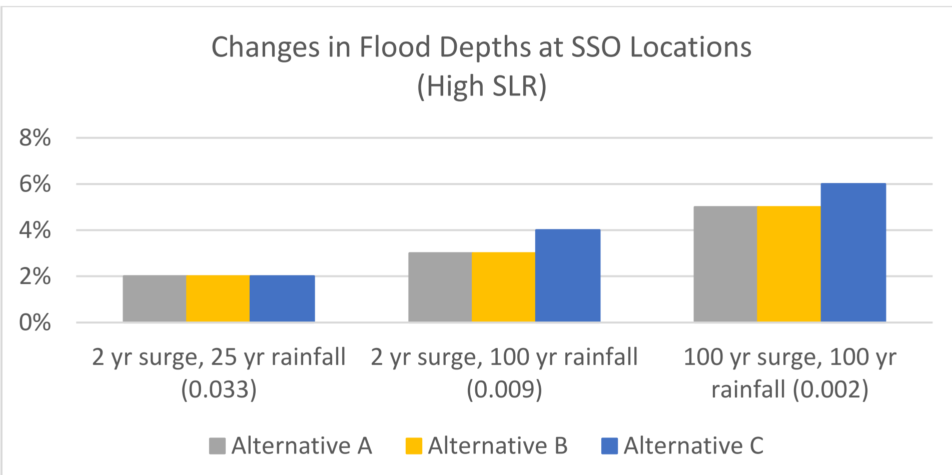



**Figure 4-27. Changes in Flood Depths at Sanitary Sewer Overflow Incident Locations, High Sea Level Rise Scenario.**

### 4.1.4 Other Social Effects

The OSE account is essential to realize non-monetary effects to the social fabric of a community. OSE effects include, but are not limited to, life safety conditions, public health conditions, community identity, social connectedness, community productivity, energy conservation, aesthetics, and leisure and recreation. The OSE benefit metrics for the Section 203 Study include effects to critical infrastructure within the Action Area and effects to cultural resources sites and buildings. OSE benefits are quantified for compound probability events of 3.33 percent, 0.91 percent, and 0.23 percent under both intermediate and high sea level rise scenarios. **Figure 4-28** provides an illustration of the modeling analyses that contributed to the OSE results.

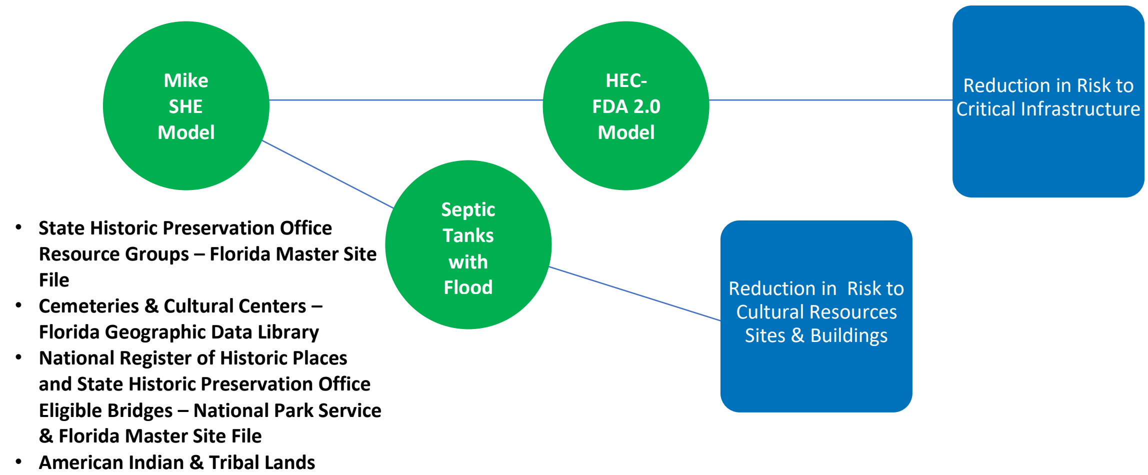



**Figure 4-28. Other Social Effects Benefits Analyses.**

### *4.1.4.1 Critical Infrastructure*

Impacts to critical infrastructure can significantly affect the operation of essential facilities and systems vital to public safety, health, and economic stability. Critical infrastructure includes, but is not limited to, emergency response facilities, transportation networks, and utilities. For the purposes of the Section 203 Study, the evaluation of alternatives' completeness includes quantifying changes in flood depths above FFE at critical infrastructure sites based on HEC-FDA outputs. The results are summarized in **Table 4-11** and illustrated in **Figure 4-29** through **Figure 4-31** below.

**Table 4-11. Percent Change in Flood Depths at Critical Infrastructure.**

| Alternative | Compound Flood Frequency Scenarios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | |
| | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change |
| No Action Alternative | 4 | -- | 5 | -- | 10 | -- | 15 | -- | 12 | -- | 26 | -- |
| Alternative A | 4 | 0% | 4 | -20% | 8 | -20% | 13 | -13% | 11 | -8% | 19 | -27% |
| Alternative B | 4 | 0% | 4 | -20% | 8 | -20% | 13 | -13% | 10 | -17% | 18 | -31% |
| Alternative C | 4 | 0% | 4 | -20% | 8 | -20% | 13 | -13% | 9 | -25% | 16 | -38% |

Note: SLR = sea level rise

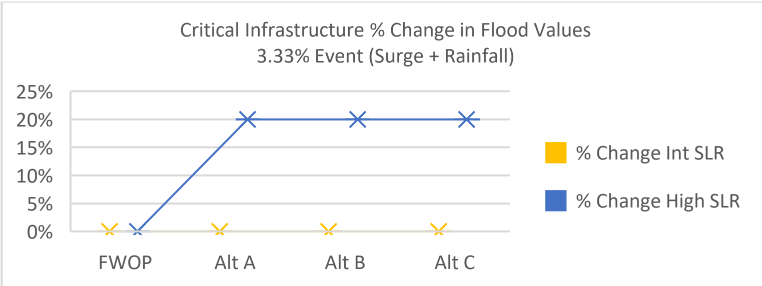



**Figure 4-29. Percent Change in Flood Depths at Critical Infrastructure, 3.33% Probability Event (2 Year Surge, 25 Year Rainfall).**

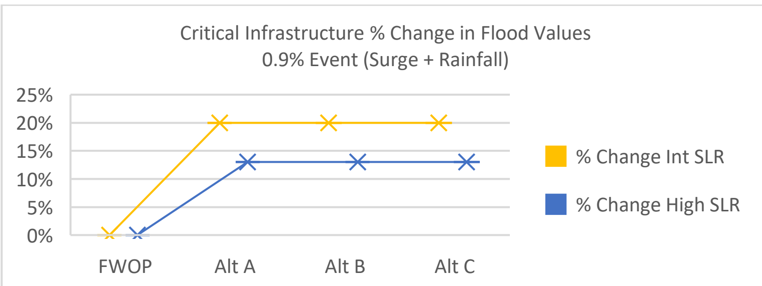



**Figure 4-30. Percent Change in Flood Depths at Critical Infrastructure, 0.91% Probability Event (2 Year Surge, 100 Year Rainfall).**

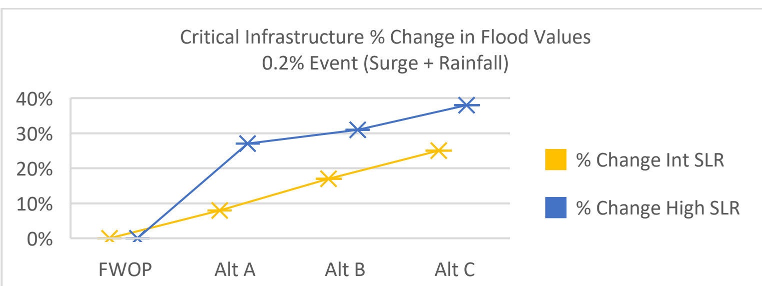



**Figure 4-31. Percent Change in Flood Depths at Critical Infrastructure, 0.23% Probability Event (100 Year Surge, 100 Year).**

#### *4.1.4.2 Cultural Resources Sites and Buildings*

Impacts to cultural resources sites and buildings can significantly affect community identity, values, quality of life, property values, and community equity. For the purposes of the Section 203 Study, the number of cultural resources sites and buildings at risk of flooding is quantified using the Cultural Resources with Flood Values Tool, which is approved for use by the USACE FRM-PCX. This tool is used to assess whether alternatives reduce flood exposure, thereby evaluating the effectiveness of the alternatives. **Table 4-12** presents the change in flood values at cultural resources sites and buildings in comparison to the FWOP alternative. These results are illustrated in **Figure 4-32** through **Figure 4-34**. A Cultural Resources Site and Buildings with Flood Values Technical Memorandum for the final array of alternatives is available in **Appendix D.**

**Table 4-12. Change in Flood Values and Percent Change at Cultural Resources Sites and Buildings.**

| Alternative | Compound Flood Frequency Scenarios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | |
| | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change |
| FWOP | 104 | -- | 106 | -- | 116 | -- | 119 | -- | 116 | -- | 121 | -- |
| Alternative A | 105 | -1% | 106 | 0% | 116 | 0% | 118 | 1% | 116 | 0% | 118 | 3% |
| Alternative B | 104 | 0% | 106 | 0% | 116 | 0% | 117 | 2% | 117 | 1% | 119 | 2% |
| Alternative C | 102 | 2% | 103 | 3% | 113 | 3% | 115 | 3% | 113 | 3% | 117 | 3% |

Note: SLR = sea level rise

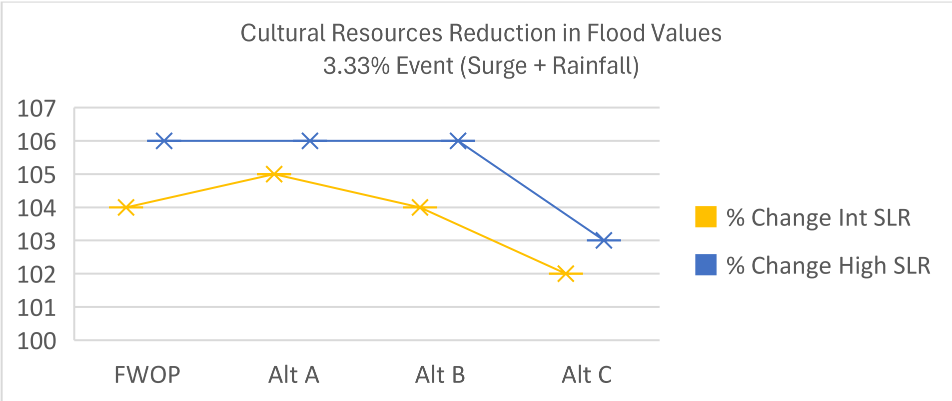



**Figure 4-32. Number of Cultural Resources Sites and Buildings with Flood Values, 3.33% Probability Event (2 Year Surge, 25 Year Rainfall).**

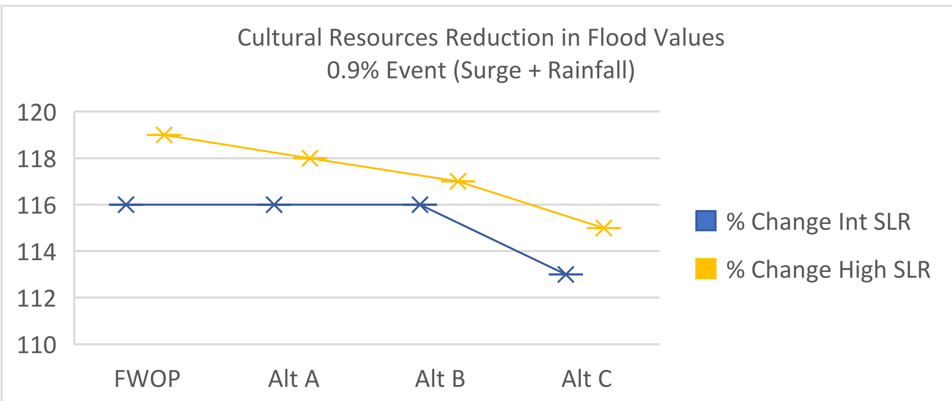



**Figure 4-33. Number of Cultural Resources Sites and Buildings with Flood Values, 0.91% Probability Event (2 Year Surge, 100 Year Rainfall).**

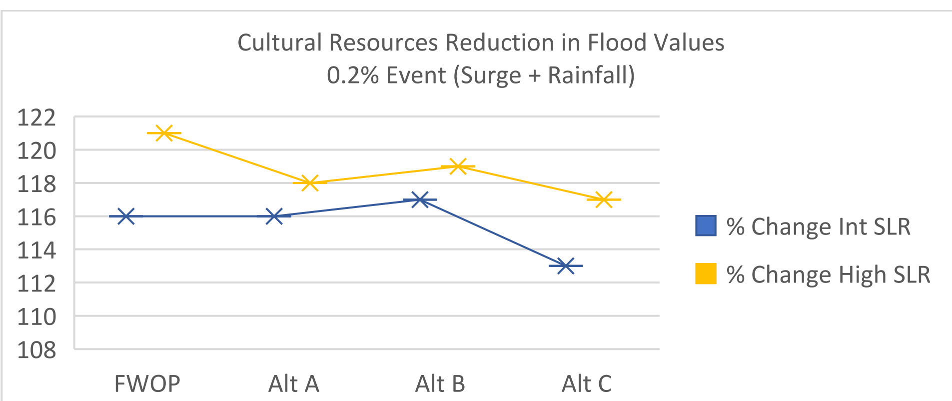



**Figure 4-34. Number of Cultural Resources Sites and Buildings with Flood Values, 0.23% Probability Event (100 Year Surge, 100 Year Rainfall).**

## 4.2 Results of Comprehensive Benefits Analyses

For each metric or effect discussed in the preceding sections, the alternative that provides the greatest comprehensive benefit is identified. This comparative evaluation allows for a clear understanding of which alternative most effectively addresses each specific flood risk management objective and any related impacts. The comprehensive benefits results for the entire final array of alternatives are compiled and presented in **Table 4-13** below, providing a detailed summary of performance for each metric or effect. Alternative A resulted in the highest net benefits and BCR, while Alternative C ranked highest for most comprehensive benefits.

**Table 4-13. Comprehensive Benefits Analyses Results for the Final Array of Alternatives.**

| Benefit Metric | Alternative with Greatest Benefit | Explanation |
|---|---|---|
| Total Benefits | Alternative C | Greatest avoided equivalent annual damages across three sea level rise scenarios |
| Travel Time / Operations Savings | Alternative A | Greatest travel time and operations savings |
| Net Benefits | Alternative A | Greatest net benefits across three sea level rise scenarios |
| Benefit-to-cost Ratio (BCR) | Alternative A | Greatest benefit to cost ratio across three sea level rise scenarios |
| Business Interruption, Direct Output Loss | Alternative C | Lowest observable direct output loss across three frequency events, intermediate and high sea level rise |
| Business Interruption Regional Economic Impacts (Direct and Secondary) | Alternative B | Greatest regional benefits across three frequency events, high sea level rise |
| Temporary Displacement, Days and Cost Savings | Alternative C | Greatest number of days saved and valued saved across three frequency events, intermediate and high sea level rise |
| Temporary Displacement Regional Economic Impacts (Direct and Secondary) | Alternative C | Greatest regional benefits across three frequency events, intermediate and high sea level rise |
| Construction and Operations Benefits (Direct and Secondary) | Alternative C | Greatest regional benefits across three frequency events, intermediate and high sea level rise |
| National Flood Insurance Program Discounts | Alternative C | Greatest likelihood of insurance discounts across three frequency events, intermediate and high sea level rise |
| Threatened and Endangered Species | Alternative A | Lowest insignificant impacts to the environment |
| Wellfield Effects | Alternative C | Greatest operational enhancements that are protective to wellfield resources |
| Change in Risk to Septic Tanks | Alternative C | Lowest number of septic tanks with flood values across three frequency events, intermediate and high sea level rise |
| Change in Risk to Sanitary Sewer Overflow Incidents | Alternative C | Greatest percent change in flood depths in areas of recurring sanitary sewer overflow incidents across three frequency events, intermediate and high sea level rise |
| Change in Risk to Critical Infrastructure | Alternative C | Lowest number of critical infrastructure with flood values across three frequency events, intermediate and high sea level rise |
| Change in Risk to Cultural Resources Sites and Buildings | Alternative C | Lowest number of cultural resources sites and buildings with flood values across three frequency events, intermediate and high sea level rise |

## 4.3 Alternative C Effectiveness Enhancement

Based on the comprehensive benefits results, an effective enhancement exercise was completed for Alternative C to evaluate if the addition of nonstructural features could enhance overall benefits to the Action Area and enhance effectiveness. Areas of residual risk were identified where flood depths exceeded the FFE. Design flood elevations were based on the highest base flood elevation within the NFIP map or Broward County ordinance, with American Society of Civil Engineers' freeboard requirements applied according to structure type. Regionally specific unit costs for nonstructural measures were incorporated, including elevation and dry floodproofing (the latter applied to non-residential structures with flood depths under 3 feet). The analysis assumed 100 percent voluntary participation from owners of eligible structures. Cost estimates for nonstructural measures were compiled for elevating and dry floodproofing both residential and non-residential buildings. Structures built after 1991 with an FFE below the base flood elevation were excluded from the inventory. Total benefits, net benefits, and the BCR were recalculated to evaluate if a comprehensive flood risk management approach that includes these nonstructural measures would generate greater benefits. While benefits increased, the inclusion of nonstructural measures resulted in an overall effective solution in the high sea level rise scenario only. The results of this evaluation are presented in **Table 4-14** and illustrated in **Figure 4-35**.

**Table 4-14. Results of Alternative C Effectiveness Enhancement Exercise.**

| Alternative | Benefit-Cost Calculation | Sea Level Rise Scenario[a/] | | | |
|---|---|---|---|---|---|
| | | Low Sea Level Rise | Intermediate Sea Level Rise | Intermediate Sea Level Rise (including transportation benefits) | High Sea Level Rise |
| Alternative A | Total Benefits | $1,815 | $1,847 | $2,195 | $2,611 |
| | Total Costs | $1,333 | $1,333 | $1,333 | $1,333 |
| | BCR | 1.36 | 1.39 | 1.65 | 1.96 |
| | Net Benefits | $482 | $514 | $863 | $1,278 |
| Alternative B | Total Benefits | $1,855 | $1,912 | $2,221 | $2,815 |
| | Total Costs | $2,218 | $2,218 | $2,218 | $2,218 |
| | BCR | 0.84 | 0.86 | 1.00 | 1.27 |
| | Net Benefits | -$363 | -$307 | $3 | $597 |
| Alternative C | Total Benefits | $1,965 | $2,014 | $2,314 | $2,973 |
| | Total Costs | $3,910 | $3,910 | $3,910 | $3,910 |
| | BCR | 0.50 | 0.52 | 0.59 | 0.76 |
| | Net Benefits | -$1,945 | -$1,896 | -$1,596 | -$937 |
| Alternative C, Enhanced with Nonstructural Plan | Total Benefits | $2,770 | $2,827 | $3,127 | $3,928 |
| | Total Costs | $3,910 | $3,910 | $3,910 | $3,910 |
| | BCR | 0.71 | 0.72 | 0.80 | 1.00 |
| | Net Benefits | -$1,140 | -$1,083 | -$783 | $18 |

a/ Dollar amounts in millions, 2025 dollars.
Note: BCR = Benefit-to-Cost Ratio

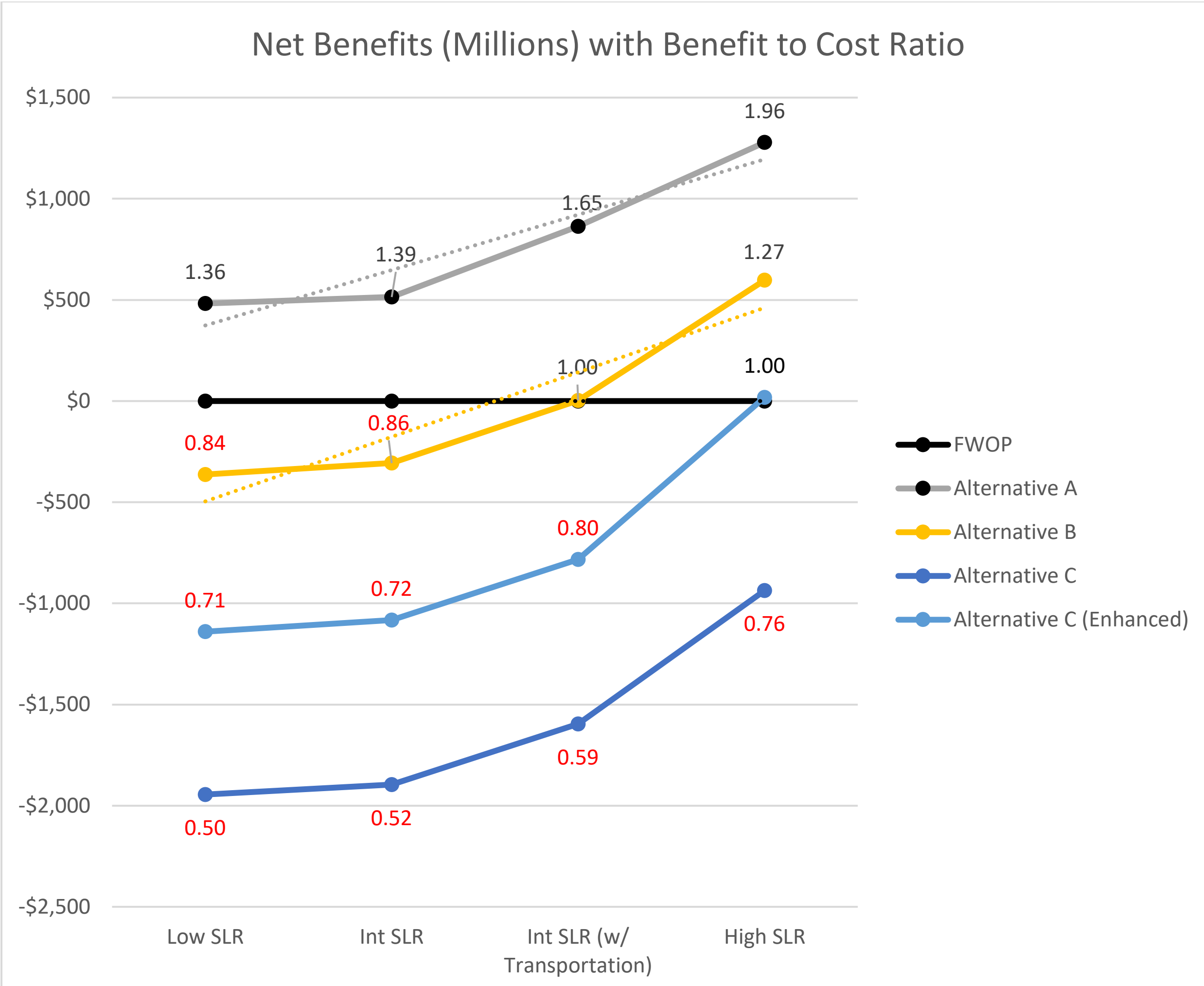



**Figure 4-35. Results of Comprehensive Plan Optimization.**

## 4.4 The Watershed Approach

The Watershed Approach, as defined in the Principles, Requirements, and Guidelines, requires consideration of cumulative effects in both upstream and downstream environments. In the context of this Section 203 Study, alternatives have been evaluated to identify tradeoffs, whereby flood risk is transferred either within the Action Area (upstream environment) or within the Study Area (upstream and downstream environment). It is understood that potential tradeoffs may occur as engineering complexity increases. Alternative A involves the least engineering complexity and has the lowest likelihood for tradeoffs in the upstream and downstream environments. Alternative C involves the greatest engineering complexity and has the highest likelihood for tradeoffs in the upstream and downstream environments. Operations planning presents the greatest opportunity to minimize or effectively rule out potential upstream and downstream effects to the extent practicable. Potential effects will be thoroughly evaluated and potential mitigation costs for both upstream and downstream environments will be incorporated into the total cost of the project.

## 4.5 Alternatives Comparison and Optimization

Alternative A is the NED Plan, the Least Environmentally Damaging Practicable Alternative, and the most cost-effective solution among the final array of alternatives. Alternative A is also the Total Net Benefits Plan and provides the greatest net public benefits by improving the performance of the primary infrastructure by providing greater control of headwater conditions and volume conveyance across low, intermediate, and high sea level rise scenarios. Alternative B provides a greater benefit in flood risk management than Alternative A and is cost-effective under the intermediate and high sea level rise scenarios. Alternative C produces the greatest benefit in flood risk management and achieves the highest comprehensive benefits but is not cost-effective in any sea level rise scenario.

Because Alternatives A and B include cost-effective measures while Alternative C yields the greatest comprehensive benefits, an optimization exercise was completed to identify if another optimized alternative could be developed to deliver a higher level of flood risk management for the Action Area while managing potential downstream effects. This optimization was informed by an assessment of individual features across Alternatives A through C and three sea level rise scenarios to identify cost-effective measures. This assessment is fully described in Section 4.5.1 below.

### 4.5.1 Effectiveness Optimization

In alignment with the Study objective to improve the C&SF System's WCS—enhancing their functionality and capacity to reduce flood damages and increase resiliency under inundation and changing conditions—the features of Alternatives A through C were assesses based on their ability to 1) maintain structure discharge rates relative to current system performance, and 2) maintain peak 12-hour average headwater levels relative to existing conditions.

Within this framework, achieving these key infrastructure-specific performance goals was assigned a normalized nominal score of 1.0. Simulated reductions in discharge capacity or increases in canal stages resulted in proportionally lower scores. Using this scoring approach, measures that retained C&SF infrastructure capacity (indicated by scores closer to 1.0) were selected within each sub-watershed. The results of this qualitative analysis are illustrated in **Figure 4-36**. The features selected for inclusion in a resiliency-optimized alternative, Alternative RO, based on effective features realized through this assessment, are provided in **Table 4-15** below.

| Basin | Structure | ECB | 2085L | | | | 2085i | | | | 2085h | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | FWOPL | AltA | AltB | AltC | FWOPi | AltA | AltB | AltC | FWOPH | AltA | AltB | AltC |
| Hillsboro Canal | G-56 | 1.00 | 0.98 | 0.95 | 0.96 | 0.95 | 0.93 | 0.91 | 0.92 | 0.92 | 0.71 | 0.77 | 0.77 | 0.78 |
| Pompano Canal | G-57 | 1.00 | 0.96 | 0.95 | 0.95 | 0.96 | 0.88 | 0.89 | 0.89 | 0.90 | 0.60 | 0.57 | 0.55 | 0.75 |
| C-14 West Basin | S-37B | 1.00 | 0.98 | 0.99 | 1.00 | 1.00 | 0.93 | 0.94 | 1.00 | 0.98 | 0.73 | 0.83 | 0.87 | 0.85 |
| C-14 East Basin | S-37A | 1.00 | 0.95 | 0.99 | 0.99 | 0.99 | 0.86 | 0.90 | 0.92 | 0.94 | 0.45 | 0.68 | 0.72 | 0.67 |
| C-13 West Basin | S-36 | 1.00 | 0.94 | 0.98 | 1.00 | 1.00 | 0.80 | 0.91 | 0.93 | 0.98 | 0.35 | 0.40 | 0.70 | 0.83 |
| C-12 Basin | S-33 | 1.00 | 0.97 | 0.97 | 0.97 | 0.99 | 0.90 | 0.93 | 0.94 | 0.97 | 0.65 | 0.83 | 0.83 | 0.92 |
| North New River Canal West Basin | G-54 | 1.00 | 0.91 | 0.96 | 0.98 | 1.00 | 0.77 | 0.87 | 0.82 | 0.97 | 0.26 | 0.37 | 0.25 | 0.79 |
| C-11 East and West Basins | S-13 | 1.00 | 0.95 | 0.94 | 0.93 | 0.92 | 0.87 | 0.88 | 0.87 | 0.86 | 0.49 | 0.68 | 0.66 | 0.65 |

**Figure 4-36. Effectiveness Optimization of the Final Array of Alternatives.**

### Table 4-15. Final Array of Alternatives, Including Alternative RO

| Site | Canal | Alternative A | | | Alternative B | | | Alternative C | | | Alternative RO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pump Station | New Gated Structure | Canal/Storage Improvements | Pump Station | New Gated Structure | Canal/Storage Improvements | Pump Station | New Gated Structure | Canal/Storage Improvements | Pump Station | New Gated Structure | Canal/Storage Improvements | Downstream Monitoring Stations |
| G-56 | G-08 (Hillsboro) | | | | | Demo G-56 and ancillary structures, new gated spillway with 4-25 ft wide roller gate | 5.5 miles canal improvement | 3-335 cfs pumps and 1-335 aux pump | Demo G-56 and ancillary structures, new gated spillway with 4-25 ft wide roller gate | Hillsboro Watershed Stormwater Storage Capacity Improvement Project - 1-600 cfs pump station with overflow weir structure and gated outflow structure | | Demo G-56 and ancillary structures, new gated spillway with 4-25 ft wide roller gate | 1.1 miles canal improvement | Yes |
| G-57 | G-16 (Pompano) | | | 2-10 ft diameter culverts | | Demo G-57 and ancillary structures, new gated spillway with 2-21 ft wide roller gate | 2-10 ft diameter culverts | 3-100 cfs pumps and 1-100 cfs aux | Demo G-57 and ancillary structures, new gated spillway with 2-21 ft wide roller gate | | | Demo G-57 and ancillary structures, new gated spillway with 2-21 ft wide roller gate | 2-10 ft diameter culverts | Yes |
| S-37B | C-14W (Cypress Creek) | | | | | Demo S-37B and ancillary structures, new gated spillway with 3-25 ft wide roller gate | 1.2 miles canal improvement | | | 6.8 miles canal improvement | | Reduced footprint of Alt B: Demo S-37B and ancillary structures, new gated spillway with 2-25 ft wide roller gate | 1.2 miles canal improvement | Yes |
| S-37A | C-14E (Cypress Creek) | 3-400 cfs pumps and 1-400 cfs aux | Demo S-37A and ancillary structures, new gated spillway with 4-25 ft wide roller gate | | 3-500 cfs pumps and 1-500 cfs aux | Demo S-37A and ancillary structures, new gated spillway with 2-25 ft wide roller gate | | 3-400 cfs pumps and 1-400 cfs aux | Demo S-37A and ancillary structures, new gated spillway with 4-25 ft wide roller gate | 6.8 miles canal improvement | 3-400 cfs pumps and 1-400 cfs aux | Reduced footprint of Alt A: Demo S-37A and ancillary structures, new gated spillway with 3-25 ft wide roller gate | | Yes |
| S-36 | C-13 (Middle River) | | Demo S-36 and ancillary structures, new gated spillway with 2-25 ft wide roller gate | | 3-170 cfs pumps and 1-170 cfs aux | Demo S-36 and ancillary structures, new gated spillway with 1-25 ft wide roller gate | | 3-200 cfs pumps and 1-200 cfs aux | Demo S-36 and ancillary structures, new gated spillway with 2-25 ft wide roller gate | 5.4 miles canal improvement | 3-170 cfs pumps | Reduced footprint of Alternative A: Demo S-36 and ancillary structures, new gated spillway with 2-16 ft wide roller gate | | Yes |
| S-33 | C-12 (Plantation) | 3-170 cfs pumps and 1-170 cfs aux | Demo S-33 and ancillary structures, new gated spillway with 1-20 ft wide roller gate | Replace existing box culvert downstream | | Demo S-33 and ancillary structures, new gated spillway with 2-20 ft wide roller gate | Replace existing box culvert downstream | 3-235 cfs pumps and 1-235 cfs aux | Demo S-33 and ancillary structures, new gated spillway with 2-20 ft wide roller gate | 0.5 miles canal improvement | 3-170 cfs pumps and 1-170 cfs aux | Demo S-33 and ancillary structures, new gated spillway with 2-20 ft wide roller gate | | Yes |
| G-54 | G-15 (North New River) | | | | 3-35 cfs pumps and 1-35 cfs aux | Demo G-54 and ancillary structures, new gated spillway with 4-20 ft wide roller gate | Markham Park Stormwater Storage Capacity Improvement; 2 84-inch culverts with fixed upstream weir; modified stormwater outfall control structure; 2 culverts upstream of outfall | 3-270 cfs pumps and 1-270 cfs aux | Demo G-54 and ancillary structures, new gated spillway with 4-20 ft wide roller gate | Markham Park Stormwater Storage Capacity Improvement and 13.9 miles canal improvement | 3-270 cfs pumps | Demo G-54 and ancillary structures, new gated spillway with 4-20 ft wide roller gate | | Yes |
| S-13 | C-11 (South New River) | 2-115 cfs pumps and 2-235 cfs pumps and 1-235 cfs aux | Demo S-13 and ancillary structures, new gated box culvert with 1-25 ft wide roller gate | | 2-180 cfs pumps and 2-360 cfs pumps and 1-360 cfs aux | Demo S-13 and ancillary structures, new gated box culvert with 1-25 ft wide roller gate | 8.4 miles canal improvement | 2-250 cfs pumps and 2-500 cfs pumps and 1-360 cfs aux | Demo S-13 and ancillary structures, new gated box culvert with 1-25 ft wide roller gate | 8.4 miles canal improvement | 2-180 cfs pumps and 2-360 cfs pumps and 1-360 cfs aux | Demo S-13 and ancillary structures, new gated spillway with two 14-foot-wide roller gates | 2.0 miles canal improvement | Yes |

Notes: cfs = cubic feet per second

### 4.5.2 Comprehensive Benefits of Alternative RO

The comprehensive benefits analyses were repeated for Alternative RO following the effectiveness assessment of the final array of alternatives. Results for Alternative RO are shown **Table 4-16** through **Table 4-28** and are presented in the same format as the comprehensive benefits for the final array of alternatives in **Section 4.1**. A comparison of the final array alternatives, including the optimized Alternative RO, is provided in **Appendix D**.

**Table 4-16. Summary of National Economic Development Analysis, Net Present Value Results of Alternative RO.**

| | Sea Level Rise Scenario | | | |
|---|---|---|---|---|
| Benefit-Cost Calculation | Low Sea Level Rise | Intermediate Sea Level Rise | Intermediate Sea Level Rise (including transportation benefits) | High Sea Level Rise |
| Total Benefits | $1,922 | $1,840 | $2,630 | $2,675 |
| Total Costs | $2,280 | $2,280 | $2,280 | $2,280 |
| BCR | 0.84 | 0.81 | 1.15 | 1.17 |
| Net Benefits | -$359 | -$440 | $350 | $394 |

Notes for Tables 4-16 to 4-28: When provided, dollar amounts are in millions, 2025 dollars. BCR = Benefit-to-Cost Ratio. FWOP = Future Without Project. NFIP = National Flood Insurance Program. INT = intermediate. SLR = sea level rise. Alt = Alternative.

**Table 4-17. Business Interruption Analysis, Direct Output Loss Results of Alternative RO.**

| Alternative | Annualized Direct Output Loss, Intermediate Sea Level Rise, >0 feet Depth | Percent Change from FWOP | Annualized Direct Output Loss, High Sea Level Rise, >0 feet Depth | Percent Change from FWOP |
|---|---|---|---|---|
| FWOP | $2.6 | -- | $5.9 | -- |
| Alternative RO | $2.2 | 15% | $3.9 | 33% |

**Table 4-18. Business Interruption, Regional Economic Impacts, Indirect and Induced Savings (Direct and Secondary Benefits) of Alternative RO.**

| | Employment (Full Time Equivalent) High Sea Level Rise | | | Labor Income High Sea Level Rise | | | Value Added High Sea Level Rise | | | Output High Sea Level Rise | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alternative | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total |
| Alternative RO | 25 | 8 | 32 | $1.6 | $0.5 | $2.1 | $1.4 | $0.9 | $2.4 | $1.7 | $1.6 | $3.3 |

**Table 4-19. Temporary Displacement, Annualized Value of Total Displacement Days of Alternative RO.**

| Alt | Compound Flood Frequency Scenarios | | | | | |
|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | |
| | Annualized Value of Total Displacement Days Intermediate Sea Level Rise | Annualized Value of Total Displacement Days High Sea Level Rise | Annualized Value of Total Displacement Days Intermediate Sea Level Rise | Annualized Value of Total Displacement Days High Sea Level Rise | Annualized Value of Total Displacement Days Intermediate Sea Level Rise | Annualized Value of Total Displacement Days High Sea Level Rise |
| FWOP | $6.1 | $8.4 | $4.9 | $6.6 | $1.3 | $2.4 |
| Alt RO | $5.3 | $6.1 | $4.2 | $5.1 | $1.2 | $1.9 |

**Table 4-20. Temporary Displacement Regional Economic Impacts, Indirect and Induced Savings (Direct and Secondary Benefits) of Alternative RO.**

| | Employment (Full Time Equivalent) Intermediate/High Sea Level Rise | | | Labor Income Intermediate/High Sea Level Rise | | | Value Added Intermediate/High Sea Level Rise | | | Output Intermediate/High Sea Level Rise | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alternative | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total |
| Alternative RO | 21/26 | 11/14 | 32/40 | $0.5/$1.4 | $0.3/$0.8 | $0.8/$2.2 | $1.1/$3.1 | $0.5/$1.4 | $1.6/$4.5 | $1.5/$4.1 | $0.9/$2.4 | $2.3/$6.5 |

**Table 4-21. Annual Construction Short-term Regional Economic Impacts of Alternative RO.**

| | Employment (Full Time Equivalents) | | | Labor Income a | | | Value Added | | | Output | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alternative | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total |
| Alternative RO | 828 | 446 | 1,274 | $54.9 | $32.5 | $87.4 | $86.7 | $59.1 | $145.8 | $144.7 | $102.1 | $246.8 |

**Table 4-22. Annual Operations Long-term Regional Economic Impacts of Alternative RO.**

| | Employment (Full Time Equivalents) | | | Labor Income | | | Value Added | | | Output | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alternative | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total | Direct | Secondary | Total |
| Alternative RO | 15 | 10 | 25 | $1.0 | $0.7 | $1.7 | $1.6 | $1.4 | $3.0 | $3.2 | $2.4 | $5.6 |

**Table 4-23. NFIP Perspective, Number of Structures with Flood Values Above First Floor Elevation of Alternative RO.**

| | Compound Flood Frequency Scenarios | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | | | |
| | Zone AE | | Zone AO | | Zone AH | | Zone AE | | Zone AO | | Zone AH | | Zone AE | | Zone AO | | Zone AH | |
| Alternative | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR | INT SLR | HIGH SLR |
| FWOP | 1 | 1 | 129 | 482 | 484 | 582 | 11 | 11 | 519 | 1,267 | 1,197 | 1,435 | 11 | 11 | 709 | 2,733 | 1,250 | 1,718 |
| Alternative RO | 1 | 1 | 114 | 234 | 427 | 463 | 11 | 11 | 429 | 823 | 1,060 | 1,177 | 11 | 11 | 621 | 2,134 | 1,132 | 1,360 |

### Table 4-24. Number of Septic Tanks with Flood Values and Percent Change of Alternative RO.

| Alternative | Compound Flood Frequency Scenarios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | |
| | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change |
| FWOP | 7,854 | -- | 8,071 | -- | 9,312 | -- | 9,550 | -- | 9,368 | -- | 9,713 | -- |
| Alternative RO | 7,761 | -1% | 7,856 | -3% | 9,152 | -2% | 9,282 | -3% | 9,232 | -1% | 9,449 | -3% |

### Table 4-25. Percent Change in Flood Depths Adjacent to Sanitary Sewer Overflow Incidents of Alternative RO.

| Alt | Compound Flood Frequency Scenarios | | | | | |
|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | |
| | Intermediate SLR | High SLR | Intermediate SLR | High SLR | Intermediate SLR | High SLR |
| Alt RO | -2% | -2% | -2% | -3% | -2% | -5% |

### Table 4-26. Percent Change in Flood Depths at Critical Infrastructure of Alternative RO.

| Alternative | Compound Flood Frequency Scenarios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | |
| | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change |
| FWOP | 4 | -- | 5 | -- | 10 | -- | 15 | -- | 12 | -- | 26 | -- |
| Alternative RO | 4 | 0% | 4 | -20% | 9 | -10% | 14 | -7% | 11 | -8% | 21 | -19% |

### Table 4-27. Reduction in Flood Values and Percent Change at Cultural Resources Sites and Buildings of Alternative RO.

| Alternative | Compound Flood Frequency Scenarios | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 Year Surge, 25 Year Rainfall Event (3.33% Probability) | | | | 2 Year Surge, 100 Year Rainfall Event (0.91% Probability) | | | | 100 Year Surge, 100 Year Rainfall Event (0.23% Probability) | | | |
| | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change | Intermediate SLR | Percent Change | High SLR | Percent Change |
| FWOP | 104 | -- | 106 | -- | 116 | -- | 119 | -- | 116 | -- | 121 | -- |
| Alternative RO | 105 | +1% | 105 | -1% | 115 | -1% | 116 | -3% | 116 | 0% | 117 | -3% |

### Table 4-28. Other Benefits of Alternative RO.

| Alternative | Threatened &Endangered Species Risk | Headwater Stage Management with Indirect Benefits to Wellfields | Watershed Approach (Maintains Integrity Across Sub Basins) |
|---|---|---|---|
| FWOP | No direct effects | Least capacity to manage headwater stages (1) | Diminished conditions in upstream watersheds. |

| Alternative | Threatened &Endangered Species Risk | Headwater Stage Management with Indirect Benefits to Wellfields | Watershed Approach (Maintains Integrity Across Sub Basins) |
|---|---|---|---|
| Alternative RO | No direct effects | Moderate capacity to manage headwater stages (3) | Moderate engineering complexity to reduce flooding in upstream watersheds; moderate tradeoffs in upstream and downstream watersheds. |

### 4.5.3 Resilience Assessment of Final Array of Alternatives and Alternative RO

A resilience assessment was completed to evaluate each alternative's ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions over the period of analysis in the intermediate and high sea level rise scenarios. The four principles of resilience were used to score and rank alternative performance: prepare, absorb, recover, and adapt. Each resilience principle was evaluated at the project, system, and community scale. The project scale consists of resilience performance at the watershed basin level (upstream), the system scale considers resilience across the action area (upstream watershed basins), and the study scale considers resilience across the study area (upstream and downstream watershed basins). Qualitative scores informed by a review of hydrologic and project benefit information are provided in parentheses for each metric discussed below.

- Project Scale (Upstream Watershed Basins)
  - Preparedness evaluates and qualitatively scores improvements to pre-storm drawdown efficiency achieved by the alternative. Scoring considers diversified measures including hardening to prevent high-tide backflow (+1); improvements to gravity flow at the WCS (+1); additional pump capacity (+1); and primary canal conveyance improvements (+1). An example illustrating effective pre-storm drawdown prior to storm peak is shown in **Figure 4-37**.
  - Absorption evaluates upstream stage management to avoid peak flood impacts. Scoring includes hardening (+1) and the ability to maintain discharge magnitude and control-structure headwater (HW) stages (maximum +3). The effectiveness assessment was used to evaluate how the alternative maintains discharge and HW stages relative to current conditions: ≥85 percent (+1); ≥90 percent (+2); ≥95 percent (+3).
  - Recovery evaluates operational enhancements that modernize drawdown and recovery to restore normal operating stages as quickly as possible (maximum +2). An example measure illustrating post-storm recover to the operating range after the storm peak is shown in **Figure 4-37**. Redundancy is also factored into the score: if two or more different feature types are incorporated (for example, multiple pump units) add +1; if two or more different feature types are incorporated (for example, gravity improvements plus additional pump capacity) add +2.
  - Adaptability evaluates reductions in operations and maintenance demands and improvements in operational flexibility. The effectiveness assessment was used as a surrogate for the 100-year intermediate sea level rise planning horizon to evaluate flexibility. Scoring is based on how the alternative maintains discharge and HW stages relative to the current condition: ≥40 percent (+1); ≥60 percent (+2); ≥80 percent (+3).

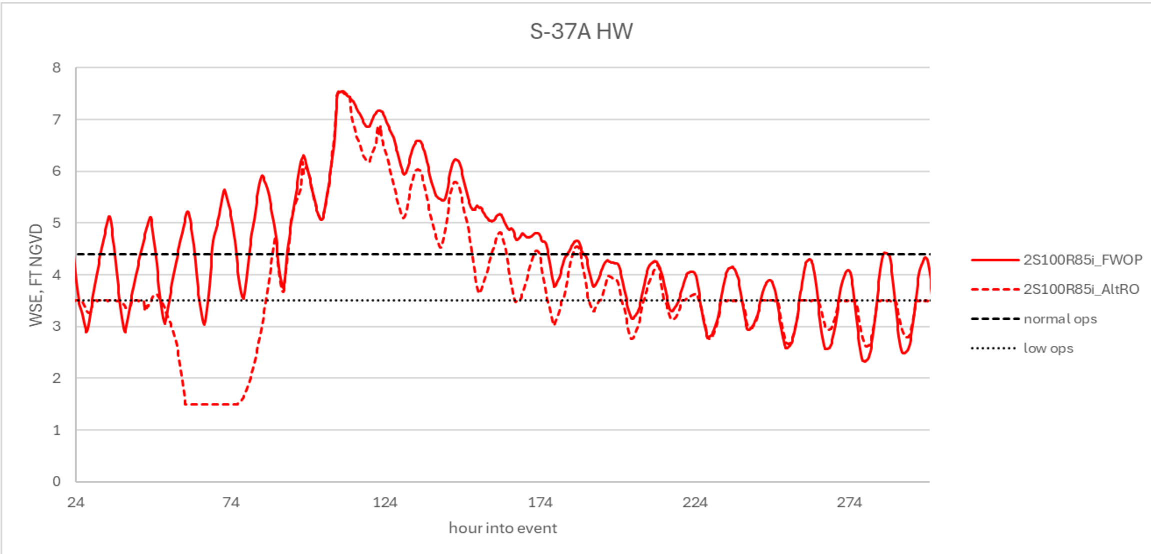



**Figure 4-37. Pre-storm Drawdown Prior to Storm Peak.**

- System Scale (Action Area)
  - Preparedness evaluates the alternative's contribution to community preparedness through the ability to promote pre-storm water level lowering to avoid impacts. A qualitative score of +10 is assigned for conditions where hydrology improves but with limited robustness or diversification. A qualitative score of =30 is assigned where hydrology significantly improves but with enhanced robustness and diversification.
  - Absorption evaluates how the alternative increases capacity to control peak water levels in the primary canals and upstream watersheds. This assessment is informed by peak canal stages profiles, an example of which is shown in **Figure 4-38**, where lower stages than the FWOP upstream of the coastal structure indicate improvement. A qualitative score of +10 is assigned for conditions where hydrology improves but with limited robustness or diversification. A qualitative score of +30 is assigned where hydrology significantly improves with enhanced robustness and diversification.
  - Recovery evaluates how the alternative reduces recovery time in the action area by providing a means for communities to efficiently drain into the primary system. A qualitative score of +10 is assigned for conditions where hydrology improves but with limited robustness or diversification. A qualitative score of +30 is assigned where hydrology significantly improves with enhanced robustness and diversification.
  - Adaptability evaluates if the alternative enhances performance in the action area to adapt to changing conditions. A qualitative score of +10 is assigned for conditions where hydrology improves but with limited robustness or diversification. A qualitative score of +30 is assigned where hydrology significantly improves with enhanced robustness and diversification.

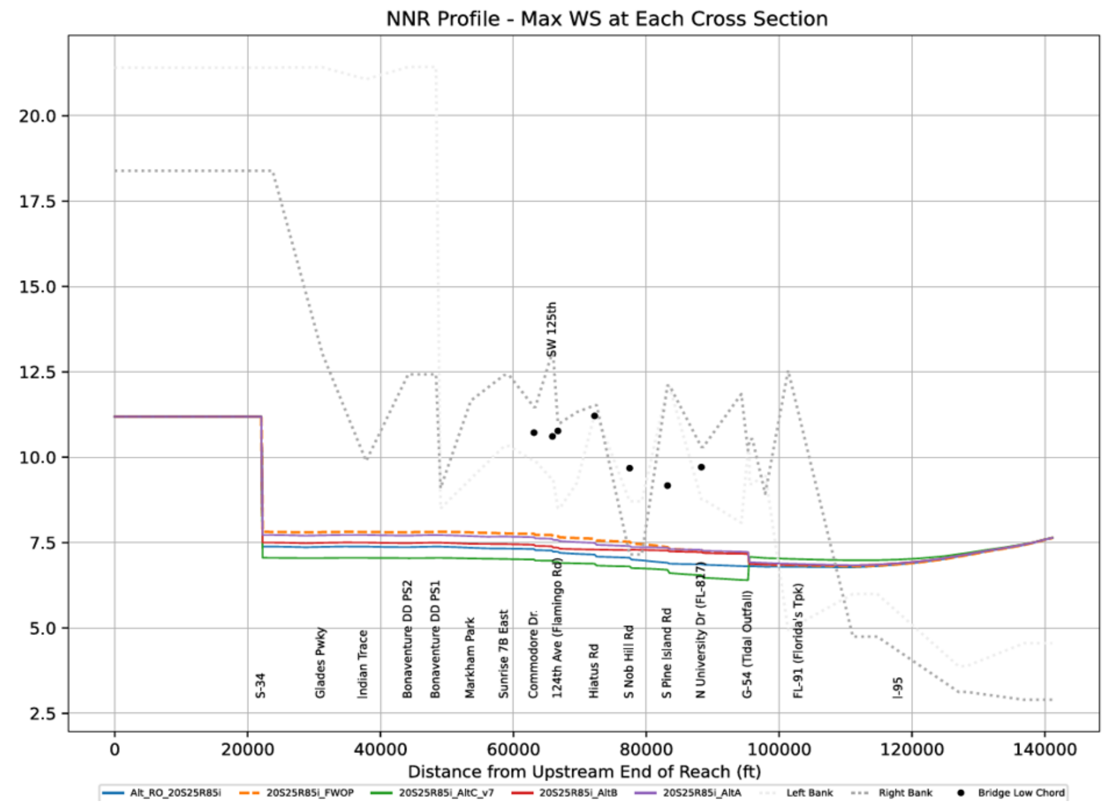



**Figure 4-38. Peak Canal Stage Profiles.**

- Community Scale (Study Area)
  - Preparedness evaluates the alternative's contribution to community preparedness through enhanced monitoring within the study area. Scoring is based on monitoring scope: limited community or watershed-condition system monitoring (+15); enhanced upstream-watershed monitoring (+30), which facilitates dynamic and flexible operation (+30).
  - Absorption evaluates how the alternative increases capacity to control peak water levels in upstream watersheds. This assessment is informed by damage analyses and peak-stage difference maps with consideration of downstream effects: improvements in upstream watershed conditions (+20); significant improvements (+30); and significant adverse downstream effects (-20).
  - Recovery evaluates how the alternative enhances flexibility to recover and reduce flood impacts as illustrated by the comprehensive benefits travel time and operations savings which accounts for travel impacts in both the upstream and downstream watershed basins. A qualitative score of +10 is assigned if capacity and flexibility is improved; +20 if capacity and flexibility is significantly improved; +30 if capacity and flexibility is maximized.
  - Adaptability evaluates if the alternative reduces risk to downstream watersheds in changing conditions. A qualitative score of +10 is assigned for enhanced infrastructure monitoring for

dynamic operational refinements; +20 for reduced risk of tradeoff due to flexibility in infrastructure; 0 if there is an increased risk for potential trade-offs.

Scores across the resilience scales and principles were tallied to compare the final array of alternatives, including Alternative RO. Alternative A exhibits the lowest resilience across the project, system, and community scales; Alternative B is second; Alternative C ranks third due to tradeoffs affecting overall performance; and Alternative RO provides the highest overall resilience. The metrics of the resilience assessment and scoring results are presented in **Table 4-29** below.

## Table 4-29. Resilience Assessment of Final Array of Alternatives, including Alternative RO.

| PARA Principle | Prepare | | | | Absorb | | | | Recover | | | | Adapt | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Enhance pre-storm drawdown efficiency through diversified means<br><br>+1, hardening prevents high tide backflow<br>+1, Improves gravity flow at WCS<br>+1, adds pump capacity with hardening<br>+1, primary canal conveyance improvements | | | | Optimize upstream stage management to avoid peak flood impacts through hardening and the ability to maintain discharge magnitude and control structure headwater<br><br>+1, hardening prevents tidal backflow or overtopping<br><br>Using Intermediate SLR for formation:<br>+1, Provides "effectiveness" calculation to maintain discharges & HW stages to >=85% of current, or<br>+2, Provides "effectiveness" calculation to maintain discharges & HW stages to >=90% of current, or<br>+3, Provides "effectiveness" calculation to maintain discharges & HW stages to >=95% of current | | | | Automates or modernizes operations to enhance draw down and recover quickly<br><br>+1, Enhances timing of recovery to normal operating stages, or<br>+2, Significantly enhances timing of recovery to normal operating stages<br><br>+1, Redundancy of two or more features within a measure (e.g., multiple pump units) to ensure reliability of recovery, or<br>+2, Redundancy of two or more features (e.g., gravity and pump) to ensure reliability of recovery | | | | Reduces operations and maintenance demands and enhances operational flexibility in changing conditions<br><br>+1, hardening to protect WCS, protect canal banks, and prevent saltwater intrusion upstream of WCS, and maintain capacity benefits<br><br>Flexibility to adapt in changing conditions - High SLR (surrogate for 100 yr Int SLR) and extreme rainfall<br>+1, Provides "effectiveness" calculation to maintain discharges & HW stages to >=40% of current, or<br>+2, Provides "effectiveness" calculation to maintain discharges & HW stages to >=60% of current, or<br>+3, Provides "effectiveness" calculation to maintain discharges & HW stages to >=80% of current | | | |
| *Project (Watershed Basin),<br>MAX Score 32 in each category* | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO |
| Hillsboro | 1 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| Pompano | 2 | 3 | 4 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 |
| C-14W | 1 | 3 | 2 | 2 | 3 | 4 | 4 | 4 | 2 | 3 | 2 | 2 | 4 | 4 | 4 | 4 |
| C-14E | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| C-13 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 2 | 3 | 4 | 3 |
| C-12 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 3 |
| G-15 | 1 | 2 | 4 | 3 | 3 | 2 | 4 | 3 | 2 | 3 | 4 | 4 | 2 | 1 | 4 | 3 |
| C-11 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Combined Score | 17 | 24 | 30 | 25 | 24 | 24 | 29 | 26 | 20 | 24 | 28 | 26 | 24 | 24 | 29 | 25 |

| **PARA Principle** | **Prepare** | | | | **Absorb** | | | | **Recover** | | | | **Adapt** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Enhances performance of primary system through robust, reliable and diversified features; lowering pre-storm primary canal stages provides opportunity for secondary and tertiary systems to discharge and lower antecedent water levels in advance of events.<br><br>+10, Hydrology improved, but with limited Robustness and Diversification, or<br>+30, Hydrology significantly improved with enhanced Robustness and Diversification | | | | Increases capacity to control peak water levels in primary canals within the action area; effects extend beyond the locality of the WCS and primary canal network and demonstrate improvements throughout the secondary & tertiary systems and the communities that the water management infrastructure collectively serves.<br><br>+10, Hydrology improved, but with limited Robustness and Diversification, or<br>+30, Hydrology significantly improved with enhanced Robustness and Diversification | | | | Reduces recovery time in action area by providing a means for communities to efficiently drain into the primary system<br><br>+10, Hydrology improved, but with limited Robustness and Diversification, or<br>+30, Hydrology significantly improved with enhanced Robustness and Diversification | | | | Enhances performance in action area to adapt to changing conditions<br><br>+10, Hydrology improved, but with limited Robustness and Diversification, or<br>+30, Hydrology significantly improved with enhanced Robustness and Diversification | | | |
| *System (Action Area - Upstream Environment)* | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO |
| Action Area | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 |
| | Improves community preparedness through enhanced monitoring<br><br>+15, Limited or WCS Monitoring<br>+30, Enhanced Monitoring in Watershed facilitates dynamic and flexible operation | | | | Increases capacity to control peak water levels in upstream watershed as informed by damage analysis and peak stage difference maps, with consideration of downstream impacts<br><br>+20, Improved conditions across the upstream watershed, or<br>+30, Significantly Improved conditions across the upstream watershed<br><br>-20, Significant downstream stage impacts observed | | | | Enhances flexibility to recover and reduce flood impacts as illustrated by comprehensive benefits including travel interruption, etc...<br><br>+10, improved capacity/flexibility & performance, or<br>+20, significantly improved capacity/flexibility & performance, or<br>+30, maximum capacity/flexibility & performance | | | | Reduces adaptability risk to downstream watersheds in changing conditions<br><br>+10, Enhanced infrastructure monitoring allows for dynamic operational refinements<br><br>+20, Reduced risk of tradeoff due to flexible infrastructure, or<br>0, Potential Risk for trade-offs | | | |
| *Community (Study Area - Upstream & Downstream Environment)* | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO | ALT A | ALT B | ALT C | ALT RO |
| Study Area | 15 | 15 | 15 | 30 | 0 | 10 | 10 | 30 | 10 | 10 | 20 | 30 | 10 | 10 | 10 | 30 |
| Overall Score (out of 92 in each category) | 42 | 69 | 75 | 85 | 34 | 64 | 69 | 86 | 40 | 64 | 78 | 86 | 44 | 64 | 69 | 85 |

Notes: WCS = water control structure; HW = headwater; SLR = sea level rise; Int = intermediate; Alt = Alternative.

## 5.0 ENVIRONMENTAL EFFECTS

The various structural and nature-based measures proposed under the final array of alternatives for the Section 203 Study (see **Section 4, Evaluation and Comparison of Alternative Plans**) were analyzed for their potential effects on natural, physical, and economic environmental resources. Alternatives A, B, C, and RO were evaluated against the Future Without Project Conditions (No Action Alternative) to describe changes to existing conditions with the implementation of each alternative. The anticipated environmental effects are summarized below by resource type. Where applicable, effects are separated into those from construction and those from OMRR&R. **Appendix B** contains a detailed discussion for each resource.

Effects or impacts are changes to the human environment from the alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the alternatives, including those effects that occur at the same time and place as the alternatives. The potential effects of the alternatives are described in this Draft Integrated Feasibility Report and Environmental Evaluation using the following terms:

- Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
- Direct: Caused by the agency action and occurring at the same time and place as the action.
- Indirect: Caused by the agency action but occurring at either a later time or at a place that is farther removed (i.e., outside of the place where the action occurred).

- Intensity, or severity of the potential impact, is rated as follows:
    - Negligible Effect: Change to the resource or discipline is barely perceptible, not measurable, and confined to a small area.
    - Minor Effect: Change to the resource or discipline is perceptible, measurable, and localized, but may not have an appreciable effect on the resource.
    - Moderate Effect: Change to the resource or discipline is clearly detectable and could have appreciable effect on the resource or discipline, or the effect is perceptible and measurable throughout the Study Area.
    - Major Effect: Change to the resource or discipline is substantial, highly noticeable, and would occur on a regional scale.

Duration of the potential effects are rated as follows:

- No Duration: No effect.
- Temporary: Effects generally occur during construction by the end of which the resources recover to their pre-construction conditions.

- Short-term: Effects generally occur during construction and/or operations for a limited time thereafter, generally less than 2 years, by the end of which the resources recover to their pre-construction/pre-operation conditions.
- Long-term: Effects last beyond the construction and/or operations period, and the resources may not regain their pre-construction/pre-operation conditions for a longer period.

Best management practices (BMPs) and mitigation measures, where applicable, are noted in the subsections below. Mitigation measures are used to reduce the adverse effects of project implementation to below significant. BMPs and design measures, such as those used to control erosion and stormwater runoff, would be implemented in accordance with permit requirements and regulations to minimize adverse effects.

## 5.1 Air Quality

### 5.1.1 Construction

The No Action Alternative would have no effect on air quality since no construction would occur.

Emission models were simulated for WCS improvements proposed under Alternative A, including hardening and resiliency improvements and construction of new spillways. Various construction and site preparation activities would occur under this alternative, including soil removal, demolition, land disturbance, tree removal, new building construction, dewatering, riprap installation, structural backfill, asphalt pavement removal, and topsoil stripping. Simulations conducted through the Air Conformity Applicability Model indicate that total emissions, while greater than under the No Action Alternative, would remain below de minimis levels and under the EPA’s General Conformity regulations insignificance thresholds for criteria pollutants. Therefore, Alternative A’s effects on air quality during construction would be adverse, direct, minor, and temporary.

Alternatives B and C propose the construction of additional features across the WCS. These alternatives also include canal conveyance improvements (i.e., dredging, which may include hauling dredged material off-site in certain circumstances) and nature-based stormwater storage. As such, the resulting estimated air pollutant emissions from construction of Alternatives B and C is greater than under Alternative A and the No Action Alternative. However, as with Alternative A, total emissions would remain below de minimis levels and under the insignificance thresholds for each of the criteria pollutants. The effects on air quality from the construction of Alternatives B and C would be adverse, direct, minor, and temporary.

Alternative RO proposes many of the same structural measures as Alternative B, including canal conveyance improvements, without the addition of nature-based stormwater storage. The air pollutant emissions under Alternative RO during construction are similar in nature and magnitude to those under Alternatives B and C, and while greater than the No Action Alternative, they remain below de minimis levels and under the insignificance thresholds for each of the criteria pollutants. The effects of the construction of Alternative RO on air quality would be adverse, direct, minor, and temporary.

Under all alternatives, reasonable precautions and BMPs would be used to prevent airborne dust, including the use of water to control dust from building construction, demolition, land clearing, and road grading. Cleared or graded areas would be seeded or vegetated promptly to minimize fugitive dust.

Given the sustained potential for emissions over an averaged 12-month construction period, SFWMD would coordinate with construction teams to ensure that these BMPs are effectively implemented.

Quantitative air emissions calculations for construction are presented in **Appendix B** and **Appendix Q**.

### 5.1.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, existing flood control infrastructure would not be upgraded, and legacy systems including diesel- and gasoline-powered pumps, generators, and control equipment would remain in operation. Continued reliance on outdated engine technology would result in the sustained emission of criteria pollutants such as nitrogen oxides ($NO_x$), carbon monoxide (CO), particulate matter ($PM_{2.5}$ and $PM_{10}$), and volatile organic compounds (VOCs), which contribute to the formation of ground-level ozone and degrade regional air quality. As a result, the No Action Alternative would result in adverse, direct, minor, long-term impacts to air quality.

During OMRR&R, Alternatives A through C and RO would not exceed EPA's General Conformity regulations insignificance thresholds or violate any federal, state, or local air regulations. There would be a substantial reduction in emissions from upgraded engines as the main source of power for pumping water at the S-13 Pump Station and Gated Spillway. As a result, Alternatives A through C and RO would result in beneficial, direct, long-term effects on air quality as compared to the No Action Alternative, though such effects are expected to be minor. Quantitative air emissions calculations for OMRR&R are presented in **Appendix B** and **Appendix Q.**

## 5.2 Greenhouse Gases

### 5.2.1 Construction

There would be no effect on greenhouse gases under the No Action Alternative, since no construction would occur.

Under all alternatives, greenhouse gas emissions are estimated to occur from 2027 to 2031, with 2031 representing the beginning of the steady state where the same emissions would be repeated for the life of the WCS pump stations. Greenhouse gas emissions during construction, while greater than under the No Action Alternative, would be negligible when compared to both state and national emission totals. Individually, $CO_2$, $CH_4$, and $N_2O$ emissions from the alternatives would also be well below 0.00001 percent of corresponding state and U.S. totals, indicating that the construction of Alternatives A through C and RO would have no effect on greenhouse gas emissions and would not be considered significant under regulatory thresholds. Quantitative greenhouse gas emissions calculations for construction are presented in **Appendix B** and **Appendix Q**.

### 5.2.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, there would not be beneficial air quality outcomes associated with reduced fuel consumption and improved combustion efficiency of the upgraded WCS. Lower greenhouse gas emissions (e.g., $CO_2$ and $CH_4$) would not be realized. In addition, the lack of modernization of aging WCS may hinder opportunities for electrification or integration of renewable energy sources into flood control operations. Therefore, the No Action Alternative would result in adverse, direct, minor, long-term greenhouse gas emissions that would negatively affect regional air quality and public health.

Under all alternatives, starting in 2031 and throughout the OMRR&R phase, annual emissions from the WCS pump stations would remain steady—referred to as steady state emissions. All alternatives would provide a reduction in GHG emissions as compared to the No Action Alternative due to replacing four large diesel generators (currently at the S-13 Pump Station and Gated Spillway) with grid electricity. This change lowers emissions significantly because of reduced run time and cleaner energy sources, resulting in de minimis impacts on total greenhouse gas output. The conversion improves the carbon profile and maintains compliance with air quality and climate standards. As a result, the effects of OMRR&R of all alternatives on greenhouse gas emissions would be beneficial, direct, minor, and long-term. Quantitative greenhouse gas emissions calculations for OMRR&R are presented in **Appendix B** and **Appendix Q**.

## 5.3 Climate

### 5.3.1 Construction

Climatological conditions in South Florida are expected to continue along a trajectory of intensifying weather patterns, including stronger storms and increased flood events. These climate trends would persist regardless of construction of the project. The proposed construction of flood control infrastructure under Alternatives A, B, C, and RO would have no effect on the climate of the region and would be no different than under the No Action Alternative.

### 5.3.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

OMRR&R of the project under Alternatives A, B, C, and RO, would have no effect on the climate of the region and would be no different than under the No Action Alternative.

## 5.4 Noise

### 5.4.1 Construction

No impacts to noise are expected for the No Action Alternative, since construction would not occur.

For all action alternatives, a construction equipment inventory was prepared and sound levels were predicted at the closest noise sensitive receptors (NSRs; e.g., residences, schools, etc.). Predicted received sound level at NSRs during construction are provided in **Appendix B**. Consistent with comparable developments, construction may generate noise levels that exceed ambient levels and has the potential to cause a minor, short-term disturbance as compared to the No Action Alternative. The SFWMD would make reasonable efforts to minimize impacts through BMPs and/or noise mitigation measures when necessary, such as positioning noisy equipment as far as possible from receptors, and only operating necessary equipment on-site. Contractors would be required to maintain equipment properly, install quality mufflers, and, where feasible, apply additional noise controls such as silencers or engine wraps. BMPs would also include minimizing backup alarm noise, restricting the use of compression brakes on public roads, outfitting transport containers with rubberized liners, adjusting traffic schedules or routes to lessen noise, and coordinating with stakeholders about exceptional noise-generating activities. Construction of all alternatives would result in adverse, direct, minor, temporary impacts to noise.

### 5.4.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, noise generated by existing WCS would not change, resulting in no impact beyond the baseline level of current noise.

Under each of the alternatives, noise from OMRR&R was modeled using the CadnaA acoustic software program, which conforms to the ISO 9613-2 standard and incorporates site-specific details. For Alternative A, several watersheds would have no new facilities or changes would be limited to installing new or modifying existing spillways, which would not produce appreciable noise as compared to the No Action Alternative. New pump stations would be installed at the C-14 East Basin, C-12 West Basin, and C-11 East Basin where predicted sound levels at NSRs were 44 A-weighted decibels (dBA), 39 dBA, and 38 dBA, respectively. Auxiliary pumps were not included in the analysis since they are not expected to operate under normal conditions. For Alternative B, the C-14 East Basin and C-11 East Basin would have a greater pump capacity than what was proposed for Alternative A and the resultant sound levels at NSRs were 46 dBA and 41 dBA, respectively. The new pump station in the C-13 West Basin would result in 41 dBA at the closest NSR. Changes to operations at C-12 West Basin would be the same as described for Alternative A. Under Alternative C, new pump stations are proposed for the Hillsboro Canal, Pompano Canal, and North New River Canal West Basins and the predicted sound levels were 50 dBA, 46 dBA, and 48 dBA at the nearest NSRs, respectively. C-14 East Basin would have the same pump configuration as proposed for Alternative A. The C-12 West Basin and C-11 East Basin would each have a pump station but with a greater capacity than what was proposed in Alternatives A and B. Resultant sound levels at the closest NSRs were 42 dBA for the C-12 West Basin and 43 dBA for the C-11 East Basin. Under Alternative RO, predicted sound levels at NSRs would be 48 dBA at the pump station in the North New River Canal West Basin, 41 dBA at the C-11 East Basin pump station, 33 dBA at the C-12 West Basin pump station, 41 dBA at the C-13 West pump station, and 44 dBA at the C-14 East Basin pump station. Under all alternatives, OMRR&R noise impacts would be greater than under the No Action Alternative and would be adverse, direct, minor, and long-term.

## 5.5 Hydrology

### 5.5.1 Construction

Under the No Action Alternative, there would be no construction. Therefore, no effects to hydrology would occur.

Alternatives A through C and RO include various WCS and canal improvements. During construction, adverse, indirect, negligible, and temporary effects to hydrology are possible as compared to the No Action Alternative due to reduced flow from the placement of temporary cofferdams around new WCS; however, such effects are expected to be negligible since construction would be phased with bypass channels to maintain level of service. Adverse, indirect, negligible, and temporary impacts to hydrology may also occur in the Markham Park lakes area during construction of a nature-based stormwater storage feature under Alternative B. The stormwater storage feature in the Hillsboro Watershed, under Alternative C, would have no effect on hydrology.

### 5.5.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, there would be no improvements to the existing WCS. Without structural improvements, there would be adverse, indirect, moderate, and long-term impacts on hydrology within the Study Area. Increased rainfall intensity, duration, and frequency, and increases in sea level, would affect the region in the future. These changing conditions would result in a reduction of the C&SF system efficiency and a resulting reduction in future flood protection levels of service.

Under all alternatives, hardening and resiliency improvements at WCS would increase water storage capacity, reducing flooding within the Study Area as compared to the No Action Alternative. The addition of culverts in the G-16 (Pompano) Canal would reduce the likelihood of water levels exceeding the WCS design capacity and increase water holding capacity and water conveyance. Adding gates and pump stations at WCS and increasing pump station capacity would enable the more rapid and efficient removal of excess water during heavy rainfall events, thereby reducing the risk of flooding in the surrounding area. Where proposed, new floodgates would improve WCS's responsiveness to rapidly changing conditions and facilitate better water management. Canal excavation in selected locations would enlarge the cross-sectional flow area, also resulting in improved water conveyance. Overall, all alternatives would have beneficial, indirect, moderate, and long-term effects on hydrology as compared to the No Action Alternative.

A hydrologic and hydraulic (H&H) model consisting of an integrated/coupled surface-groundwater MIKE SHE/MIKE Hydro (Version 2022) model was created by the SFWMD and was used to generate flood hazard information for use in the flood damage assessment. This 2D H&H model covers the entire Study Area and extends past the tidal boundary condition to the east. The focus in this Section 203 Study is the primary canal system; however, the model includes a high level of detail within the secondary and tertiary canal systems. The current and FWOP conditions baseline model scenarios as well as the proposed alternatives were simulated with the MIKE SHE/MIKE Hydro software. **Appendix A** provides a complete Model Documentation Report.

H&H modeling results for a worst case scenario (100-year surge event, 100-year rainfall event, and high sea level rise in 2085) and an intermediate case scenario (2-year surge, 25-year rainfall, and intermediate sea level rise in 2085) were examined to determine the total area over which a decrease in inundation depth was predicted and the total area over which an increase in inundation depth was predicted for each of the upstream basins across all alternatives. Quantitative modeling results are provided in **Appendix A** and **Appendix B**. Under the worst case scenario, Alternative RO provides the greatest areal extent of reduction in inundation depths in the range of 0.1 to 0.3 foot. However, Alternative RO provides the lowest areal extent of reduction in inundation depths that are greater than 0.3 foot. In addition, under the worst case scenario, Alternative RO provides the lowest areal extent of increased inundation depths. For the intermediate case scenario, Alternatives B and RO provide similar predicted increases and reductions of inundation across all depths.

The nature-based measures proposed under Alternative B (Markham Park Stormwater Storage Capacity Improvement Project) and Alternative C (Hillsboro Watershed Stormwater Storage Capacity Improvement Project) would greatly improve the hydrological dynamics of the North New River Canal West Basin and Hillsboro Canal Basin, respectively. Increased stormwater storage capacity within the Markham Park lakes and a new pump station, culverts, and stormwater outfall structure would allow for efficient transfer of stormwater during periods of high rainfall intensity, thereby reducing the risk of flooding. In the Hillsboro Canal Basin, the construction of a levee and seepage canal would facilitate storage of stormwater above the ground surface, effectively reducing peak water levels in the G-08 (Hillsboro) Canal during storm events. The nature-based measures proposed under Alternatives B and C would result in additional beneficial, long-term effects on hydrology as compared to the No Action Alternative.

## 5.6 Groundwater

### 5.6.1 Construction

The No Action Alternative is expected to have no effect on groundwater, since no construction would occur.

The construction of Alternatives A through C and RO would result in adverse, indirect, negligible, and temporary impacts to groundwater from temporarily reduced flow in canals and a slight increase in water demand as compared to the No Action Alternative. For cases where significant in channel work is to be completed (i.e., replacement or construction of new WCS), a bypass channel will be implemented as part of the construction phase to maintain level of service. Therefore, any temporary negative effects during the construction phase due to reduced flow, while greater than under the No Action Alternative, are expected to be negligible.

In addition, adverse, indirect, negligible, and temporary impacts to groundwater from construction dewatering are expected. Construction dewater may induce high gradients potentially altering local groundwater flow paths. This may be of concern where there is groundwater contamination in the vicinity. Phase I Environmental Site Assessments identified concerns associated with only two of the sites. At the G-57 Gated Spillway, one site upstream of the spillway but adjacent to the west section of the facility has recent known contamination in groundwater samples. At the S-33 Gated Spillway, compliance issues related to missing underground storage tank closure documents was noted. These as well as any additional vicinity groundwater issues would be revisited and analyzed prior to construction and considered when planning dewatering. The use of a coffer dam bottom (tremie) seal, as recommended for construction under the alternatives, would significantly reduce the amount of dewatering needed and likely mitigate any impacts to groundwater.

### 5.6.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, there would be no improvements or modifications made to any of the WCS. The WCS currently impede saltwater from moving upstream and allows fresh water in the canals to recharge the Biscayne Aquifer. Without improvements to the WCS, water levels during high tide or storm events could exceed WCS design capacity, increasing infiltration from storm and inflow events that contribute to increased saltwater intrusion. Wellfields tapping the Biscayne Aquifer are likely to become more vulnerable to saltwater intrusion, potentially necessitating their relocation or abandonment in favor of new and costlier freshwater supply sources and treatment systems such as reverse osmosis water treatment plants. Overall, the No Action Alternative would result in adverse, indirect, moderate, and long-term impacts to groundwater.

Structural measures under all the alternatives—such as hardening and resiliency improvements and adding gates and pumps at WCS—would generally increase holding capacity and reduce the likelihood of water levels exceeding WCS design capacity, thereby reducing the potential for surface saltwater intrusion. Dredging to enlarge the cross-sectional area of canals would also allow for increased flow capacity, therefore reducing flooding conditions during high-energy events. Deepening canals could increase the surface area for conductance. The increased conductance can potentially result in greater groundwater recharge. The two nature-based stormwater storage features proposed under Alternatives B and C would increase stormwater retention, which would correspondingly enhance groundwater recharge. Alternatives A through C and RO would result in beneficial, indirect, long-term effects to groundwater as compared to the No Action Alternative, though any such effects are expected to be negligible.

## 5.7 Surface Water Quality

### 5.7.1 Construction

There would be no effect to surface water quality under the No Action Alternative, since no construction would occur.

Construction and demolition activities that disturb soil could lead to increased erosion and may cause localized sediment loads, increasing turbidity. New temporary and permanent access roads could impact surface water quality by increasing impervious surfaces and increasing runoff during high rainfall events. Construction of new culverts in the G-08 (Pompano) Canal could affect water quality, but any such effects would be highly localized and temporary. Canal conveyance improvements (i.e., dredging) would result in dredged material being placed in the SFWMD canal ROWs; any such dredged material will be compacted, graded, and sodded for stability and to reduce the potential for soil to enter the waterway. Overall, the impacts of constructing the various structural and nature-based features under all alternatives, while greater than under the No Action Alternative, are expected to be adverse, indirect, negligible and temporary. BMPs would be implemented to minimize any potential impacts to surface water quality during construction. BMPs may include silt fencing, erosion blankets, socks, soil trackers, stabilized construction entrances, and temporary stabilization with sod and seed. In-water controls may include erosion curtains and tuff booms to minimize movement of sediment and debris.

### 5.7.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, adverse, indirect, minor, long-term impacts to surface water quality are anticipated. Increasing sea level and increasing rainfall intensity, duration, and frequency in the future would result in a reduction in efficiency of the C&SF system and decreased future flood protection levels of service. WCS would be inept at handling an increase in runoff, resulting in worsening water quality and heightened contamination risks. Additionally, the frequency of sanitary sewer overflows is expected to rise, along with greater challenges in stormwater management and drainage.

Under Alternative A, hardening and resiliency improvements at three WCS could benefit surface water quality as compared to the No Action Alternative by reducing erosion during high surge events; however, any such indirect benefits are expected to be negligible and short term.

Under all alternatives, the operation of new pumps (where none previously existed) and increased-capacity pumps could alter water quality by managing sediment transport, thereby reducing the buildup of sediment at the gated spillway. However, pumps may also create localized currents, resulting in sediment resuspension and locally increased turbidity. These indirect effects to surface water quality during the OMRR&R phase, both beneficial and adverse, are expected to be negligible and temporary.

The nature-based features proposed under Alternatives B and C may have positive effects on water quality. By increasing stormwater storage capacity, these features would help mitigate peak water stages during high-energy storm events. This would lead to better control over runoff and reduce the risk of flooding, which would maintain consistent water quality. Effects from the nature-based stormwater storage features under Alternatives B and C would be beneficial, indirect, and long term as compared to the No Action Alternative, though such benefits are expected to be negligible.

Future operational protocols could be implemented to better prevent saltwater intrusion due to sea level rise and/or intensifying weather patterns. Should a future operational protocol be developed to address this concern, it could result in the need to maintain higher headwater stages than those currently simulated in this Section 203 Study. This infrastructure could facilitate maintaining higher headwater stages than was simulated in this Study—especially during the dry season—when the risk of saltwater intrusion is greater and when flood control risk is reduced compared to the wet season.

## 5.8 Vegetation

### 5.8.1 Construction

Under the No Action Alternative, there would be no land disturbance from construction, and therefore, no impacts to vegetation would occur.

Land disturbance—and the associated potential impacts to vegetation—from construction of the alternatives would occur within existing SFWMD ROWs, in areas where vegetative communities have already been significantly modified due to long-term landscape changes and the presence of a highly developed environment. During WCS construction, approximately 13.6 acres, 23.9 acres, 21.5 acres, and 24.5 acres would be disturbed under Alternatives A, B, C, and RO, respectively. Culvert expansion in the G-16 (Pompano) Canal (under all alternatives) would result in approximately 1 acre of land disturbance. Canal conveyance improvements may affect additional vegetation in SFWMD ROWs through the placement of dredged material (approximately 155 acres under Alternative B, 240 acres under Alternative C, and 43 acres under Alternative RO). Dredged material will only be placed in the SFWMD canal ROWs and will be compacted, graded, and sodded for stability. Vegetation that is displaced in the highly-disturbed canal ROWs due to dredged material placement would be expected to regrow in the same area.

The stormwater storage capacity projects proposed under Alternatives B and C would result in disturbance to approximately 1 acre (Markham Park Stormwater Storage Capacity Improvement Project [Alternatives B and C]) and 706 acres (Hillsboro Watershed Stormwater Storage Capacity Improvement Project [Alternative C]). All land-disturbing activities are assumed to be temporary; however, the nature of the disturbance may permanently alter vegetation communities (e.g., by changing slopes or drainage). All disturbed areas would be re-vegetated to reduce erosion. These land disturbance estimates provide a worst-case scenario; actual construction footprints would be further delimited during the PED phase. None of the land disturbance activities proposed under any alternative would impact seagrasses, which are only present in highly discontinuous, sparse patches in the most eastern portion of the Coral Reef Basin (in and near the Intracoastal Waterway).

Under all alternatives, construction would result in adverse, direct, negligible, and short-term impacts to vegetation as compared to the No Action Alternative.

### 5.8.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, OMRR&R activities at the existing WCS would continue, which would minimally disturb vegetation (e.g., mowing). Without improvements to the WCS, water levels would exceed WCS design capacity more frequently, resulting in increased flooding and soil erosion, and impacting or displacing remnants of wetland and upland vegetation. The dominant remnant natural communities (Glades Marsh, Rockland Hammock, and Scrub/Sand Pine Scrub) would likely be among the first to convert into less complex communities that are more vulnerable to invasive species. Uncontrolled salt water that inundates terrestrial habitats upstream of the WCS Could cause the vegetative community to change to more salt-tolerant species, with vegetation in low-lying areas being the first to convert into salt-tolerant communities. The No Action Alternative is expected to result in adverse, direct, minor, and long-term impacts to vegetation.

During OMRR&R, enhanced operational water conveyance would reduce terrestrial inundation from sea level rise by 545 acres under Alternative A across all upstream watersheds relative to the No Action Alternative under the intermediate modeling scenario. Alternatives B and C would provide a 643-acre and 148-acre reduction in terrestrial inundation in the upstream watersheds relative to the No Action Alternative, respectively (also under an intermediate scenario). The Hillsboro Watershed Stormwater Storage Improvement Project, which is only proposed under Alternative C, would provide an additional 706 acres that could support wetland vegetation, resulting in potentially beneficial effects to vegetative communities, though any such effects are expected to be negligible given the small size of this feature compared to the entire Study Area (approximately 0.26 percent of the 420-square-mile Study Area). Under Alternative RO, enhanced operational water conveyance would reduce terrestrial inundation from sea level rise across 582 acres of upstream watersheds relative to the No Action Alternative (under an intermediate scenario). Across all alternatives, benefits from any reduced inundation are expected to be negligible since approximately 95 percent of the Study Area consists of disturbed lands with only minimal vegetative communities. Also, under all alternatives, OMRR&R activities (such as mowing) would minimally disturb vegetation. Overall, the effects to vegetation during OMRR&R under all alternatives are expected to be adverse, direct, negligible, and long-term as compared to the No Action Alternative.

## 5.9 Wetlands

### 5.9.1 Construction

Under the No Action Alternative, there would be no estuarine wetlands, freshwater wetlands, or water bottom disturbance from construction. Therefore, no effects to estuarine wetlands, freshwater wetlands, or water bottoms would occur.

Effects from construction of Alternatives A, B, C, and RO would occur on canal banks, in water bottoms, or at WCS locations and would be greater than the No Action Alternative. Alternative A would result in the excavation of up to 218,878 neat cubic yards of soil to support proposed WCS improvements. Not all excavation would affect wetlands and water bottoms; the quantity is provided as a worst-case scenario of potential wetland effects, which are expected to be minimal because disturbance would be confined within previously-disturbed construction footprints. Alternative B would result in 1,323,017 neat cubic yards excavation to support WCS and canal improvements, resulting in additional potential direct wetlands and water bottoms effects. Alternative C, which proposes the greatest extent of structural measures, would result in 2,432,783 neat cubic yards of excavation for WCS and canal improvements, which is the greatest of all alternatives. A percentage of potential wetland losses associated with Alternatives B and C could be offset by the Markham Park Stormwater Storage Capacity Improvement Project, wherein approximately 1 acre could convert to wetlands associated with stormwater storage. Alternative C also includes conversion of 706 acres of agricultural property into the Hillsboro Watershed Stormwater Storage Capacity Improvement Project. Wetlands would not be impacted from the construction of this above ground stormwater storage area and ultimately, the Hillsboro Watershed Stormwater Storage Capacity Improvement Project could increase wetlands acreage within the Study Area.

Under Alternative RO, approximately 507,520 neat cubic yards would be excavated during proposed WCS and canal improvements. Additionally, 1.5 miles of the C-11 (South New River) Canal would be stabilized with filter fabric and the placement of 16,762 neat cubic yards of riprap bedding stone and 66,124 neat cubic yards of riprap. Another 482 neat cubic yards of upland excavated materials would be used to backfill a portion of a remnant channel in the C-11 (South New River) Canal.

Canal and water bottom excavations may remove vegetation or benthic organisms unable to leave the construction area. The areas affected are low quality, volunteer wetlands communities and disturbed water bottoms. Effects from excavation under all action alternatives, while greater than the No Action Alternative, are adverse, direct, short-term, and negligible because they will reverse over time as organisms recolonize the area. Riprap placement would represent a permanent conversion from partially- and fully-inundated soil subsurface to hardscape with no potential for wetland colonization and minimal benthic habitat value. Channel remnant backfill (i.e., soil) would be expected to convert to uplands.

Disposal of excavated material would occur in highly disturbed uplands or at landfills. No effects from excavated materials disposal are expected. Construction activities will not affect estuarine wetlands. Wetlands would be delineated after the PED phase. CWA Section 404 permits would be obtained before construction begins and any mitigation or best management practices in the permit adopted.

### 5.9.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

The No Action Alternative would not have direct effects on wetlands during OMRR&R. Wetland communities in the Study Area could be indirectly affected by storm events, sea level rise, flooding, and further fragmentation. Without improvements to the WCS, water levels would likely exceed WCS design capacity more frequently due to rising sea levels. Increased storm intensity could also increase inundation, saltwater intrusion, and sedimentation. The existing fragmented wetlands remnants could shift dominant wetlands vegetation type, affecting the community's resilience and making it more vulnerable to other threats, such as invasive species.

OMRR&R activities under the action alternatives would not result in any greater effects than would occur under the No Action Alternative. Enhanced water management under all the action alternatives would minimize terrestrial inundation from sea level rise and storms as compared to the No Action Alternative. Water management activities would focus on minimizing temporal and spatial inundation, precluding conditions that would support wetlands expansion. OMRR&R activities include vegetation removal, including wetlands vegetation, to allow rapid water evacuation, which may result in direct wetland impacts. Reduced inundation from sea level rise and flooding could prevent changes in dominant wetlands vegetation and classification over time, but such benefits are expected to be minimal. Overall, the effects to wetlands during OMRR&R under all alternatives are expected to be both adverse and beneficial, direct and indirect, negligible, and long-term as compared to the No Action Alternative.

## 5.10 Invasive Species

### 5.10.1 Construction

Under the No Action Alternative, there would be no land disturbance from construction, and therefore, no impacts to invasive species would occur.

Approximately 13.6 acres, 23.9 acres, 21.5 acres, and 24.5 acres of vegetation and land would be temporarily disturbed within the combined WCS construction footprints under Alternatives A, B, C, and RO, respectively. Under all alternatives, construction would include vegetation and land management measures (e.g., replanting with native species). As a result, construction of the alternatives is expected to result in no effects on invasive species as compared to the No Action Alternative.

### 5.10.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

It is expected that increased summer and winter minimum temperatures, increased extreme tropical systems, sea level rise, and changing weather patterns (e.g., droughts, floods) would enhance invasive species colonization in the Study Area, from introduction through establishment and expansion. Under the No Action Alternative, the lack of improvements to FRM are unlikely to change the uncontrollable inputs of invasive species from the Everglades, homes, and private lands, even with ongoing invasive species management programs. As such, the effects of the No Action Alternative on invasive species are expected to be adverse, indirect, and long-term, though such effects are likely to be negligible.

Under all alternatives, OMRR&R would include vegetation and land management measures (e.g., mowing and structure maintenance). As a result, OMRR&R for any of the alternatives is expected to result in no effects to invasive species as compared to the No Action Alternative.

## 5.11 Essential Fish Habitat

THIS SECTION OF THE REPORT WILL BE COMPLETED AT A LATER DATE.

## 5.12 Threatened and Endangered Species

THIS SECTION OF THE REPORT WILL BE COMPLETED AT A LATER DATE

.

## 5.13 Fish and Wildlife

### 5.13.1 Construction

The No Action Alternative would not impact aquatic or terrestrial fish and wildlife species. since no construction would occur.

Ground and water disturbance, visual disturbance, and noise from construction at WCS and canals and the stormwater storage capacity projects under the action alternatives could impact fish and wildlife. Aquatic Species, such as American alligator, river otter, largemouth bass, bluegill/sunfish, peacock bass, oscar, and cichlid may be impacted in their daily movement patterns through the canals. Terrestrial species, such as white ibis, herons, snowy egret, glossy ibis, American bittern, limpkin, black rail, king rail, wood stork, snapping turtle, crayfish, and raccoon using the green spaces and trees areas adjacent to canals, could be disturbed by noise and land/soil disturbance from construction vehicles and staging. Tree removal may indirectly impact some terrestrial species such as migratory birds (passerines, birds of prey, etc.) and bats. Impacts to rarer invertebrates previously found to occur near some WCS, such as the Miami chafer beetle and statira sulphur butterfly, may also occur with construction, though given the limited occurrence of these species, such impacts are expected to be minor to negligible. WCS construction proposed under Alternatives A, B, C, and RO, would be highly localized, resulting in adverse, direct and indirect, minor, temporary impacts aquatic and terrestrial species as compared to the No Action Alternative.

Canal conveyance improvements under Alternatives B, C, and RO would entail dredging segments of canals, which would potentially cause turbidity, sedimentation, noise, and visual disturbances to fish, amphibians, mammals, and macroinvertebrate communities. However, studies on aquatic environments within canals and Florida Landscape Assessment Model rankings have documented limited habitat with non-sensitive species of fish, poor stream condition index, and low landscape quality. BMPs would be employed during in-water work to ensure that impacts are avoided and minimized to the greatest extent possible. As such, dredging impacts, while adverse, are expected to be indirect, minor, and temporary.

Under Alternatives B and C, there are two areas proposed for stormwater storage capacity improvements. The Markham Park Stormwater Storage Capacity Improvement Project is expected to result in adverse, indirect, minor, and temporary impacts as compared to the No Action Alternative due to the limited footprint of construction. The Hillsboro Watershed Stormwater Storage Capacity Improvement Project may result in adverse, indirect, moderate, impacts to terrestrial species (such as white-tailed deer, Virginia opossum, and southeastern fox squirrel, and birds of prey that rely on agricultural lands such as red-shouldered hawk and American kestrel) though such effects are expected to be temporary. Select rare and/or protected species (e.g., state-listed Florida burrowing owl, gopher tortoise, migratory birds) may occur near any of the proposed construction areas; surveys for State and Federally listed Threatened and Endangered Species presence would occur prior to construction so avoidance measures may be implemented, as applicable.

### 5.13.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

The No Action Alternative would threaten freshwater habitats and species reliant on them. Without improved FRM, saltwater intrusion, erosion, and flooding will change the make-up, or result in a complete loss, of existing habitat and ecosystems for some aquatic and terrestrial species. Mammals, reptiles, amphibians, fish, and wading birds that prefer freshwater or less saline conditions (e.g. river otters, Florida softshell turtle, southern leopard frog, golden topminnow, and little blue herons), would need to find new habitats or may otherwise become extirpated from their currently occupied habitats in the Study Area. Native aquatic and terrestrial species will have a reduced ability to survive ecosystem changes while more resilient, non-native species take over. The No Action Alternative would result in adverse, indirect, moderate, long-term impacts on aquatic and terrestrial species.

Under all alternatives, effects to aquatic and terrestrial species from OMRR&R are expected to be beneficial, indirect, negligible, and long-term as compared to the No Action Alternative. Increased flow conveyance resulting from upgraded WCS and/or canal improvements would reduce future expected impacts of extreme storm events and sea level rise. This would reduce the threat of permanent habitat loss, particularly wetlands and upland habitats, for aquatic and terrestrial species. Under Alternative C, the Hillsboro Watershed Stormwater Storage Capacity Improvement Project would provide additional, high quality wetland habitat in for species such as wading birds, river otter, and American alligator, resulting in additional long-term, beneficial effects.

## 5.14 Geology and Soils

### 5.14.1 Construction

Under the No Action Alternative, no improvements to the existing WCS would be made. There would be no soil disturbance from WCS construction, and therefore, no impacts to geology and soils would occur.

Under Alternatives A through C and RO, construction activities would cause adverse, direct, minor, temporary impacts to the existing geologic and soil conditions at the WCS, canals, and stormwater storage sites as compared to the No Action Alternative. The near-surface geologic conditions and existing soil column would be disturbed by construction and demolition, especially within the WCS's operational footprint. Tree-clearing, grading, excavation, and other site development activities would cause soil disturbance. Canal conveyance improvements (i.e., dredging) would result in dredged material being removed from the canal bottom and placed alongside the canal in terrestrial ROWs. Dredged material would rapidly integrated into the local geology and soil condition. WCS construction would result in approximately 13.6 acres, 23.9 acres, 21.5 acres, and 24.5 acres of soil disturbance for

Alternatives A, B, C, and RO, respectively. No viable geologic or soil resources would be lost from construction activities.

Canal conveyance improvements would disturb soils through the placement of dredged material in existing SFWMD rights-of-way under Alternative B (155 acres), Alternative C (240 acres), and Alternative RO (43 acres). The dredged material would be windrowed and contoured to form a berm adjacent to the top of the canal bank, effectively raising the elevation of the banks.

The stormwater storage features would result in additional soil disturbance at Markham Park (1 acre; Alternatives B and C) and Hillsboro Watershed (706 acres; Alternative C). While the Hillsboro Watershed parcel would no longer be suitable for agricultural use once converted to stormwater storage, this parcel is not currently identified as prime farmland.

All alternatives would require a National Pollutant Discharge Elimination System Construction General Permit due to the disturbance of 5 or more acres. The Construction General Permit would mandate BMPs such as stormwater management, erosion and sediment control, waste containment, and a site-specific Stormwater Pollution Prevention Plan. The Stormwater Pollution Prevention Plan would include erosion control and revegetation plans, ensuring disturbed areas are restored post-construction. With these measures, impacts to geology and soils would be minimized, though impacts would be greater than under the No Action Alternative.

### 5.14.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, OMRR&R at the existing WCS would continue. Without improvements to the WCS, water levels would exceed WCS design capacity more frequently due to rising sea level and increased storm intensity, with an ensuing increase in flooding and soil erosion at the WCS and across the Study Area, resulting in adverse, indirect, moderate, and long-term impacts.

Under all alternatives, erosion from stormwater runoff and wind action may occur occasionally during OMRR&R, but any such adverse, indirect effects would likely be negligible and temporary, would be less than under the No Action Alternative due to improved water conveyance provided by the upgraded WCS.

## 5.15 Hazardous, Toxic, and Radioactive Waste

### 5.15.1 Construction

Under the No Action Alternative, there would be no effect on hazardous, toxic, and radioactive waste. There would be no disturbance to upland soils near the WCS nor sediment removal from canals. In the short term, there would be no need for additional testing or cautionary measures due to hazardous constituents in the sediment and soil.

Sediment or soil testing was not conducted at the S-13AW Gated Culvert. Contaminants, including Arsenic and Chromium, were found in the sediment and soil at the G-54 Gated Spillway, G-56, Gated Spillway, G-57 Gated Spillway, S-37A Gated Spillway, S-37B Gated Spillway, S-36 Gated Spillway, S-33 Gated Spillway, and S-13 Pump Station and Gated Spillway. Structural measures proposed under all action alternatives would have adverse, direct, negligible, and temporary impacts on hazardous, toxic, and radioactive waste as compared to the No Action Alternative by disturbing the sediment and soils, potentially releasing hazardous constituents to surface water or exposing them to workers. BMPs would be employed during all construction activities to minimize such effects.

Additionally, under Alternative C, the Hillsboro Watershed Stormwater Storage Improvement Project is proposed. Sediment and soil testing were not conducted for this site, but if this alternative is selected, such surveys would take place prior to construction, and applicable measures would be implemented to reduce effects from hazardous, toxic, and radioactive waste.

All structural measures regardless of location or alternative would be implemented with appropriate sediment and erosion control plans, spill control plans, and BMPs specific to handling potentially contaminated materials to achieve a net zero effect.

During the subsequent PED phase of the project, the design of Alternative RO's feature would be refined and optimized as the design of these features is advanced to the 100 percent design level of completion.

### 5.15.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

The No Action Alternative is expected to result in adverse, indirect, minor, long-term impacts through the continued accumulation of hazardous constituents in the sediment and soil, resulting in higher costs for maintenance and the continued leaching of some constituents into surface water.

There is no effect to hazardous, toxic, and radioactive waste expected under any of the alternatives during OMRR&R as compared to the No Action Alternative**.**

## 5.16 Land Use and Real Estate

### 5.16.1 Construction

Under the No Action Alternative, no construction or operational activities associated with the proposed action alternatives would occur. As a result, there would be no impacts to land use or real estate related to temporary or permanent land acquisitions, construction staging, or site access. Existing land use patterns and zoning designations would remain unchanged in the near term, and there would be no disruption to ongoing development or land management activities.

Under Alternatives A through C and RO, construction and dredging activities would result in adverse, direct, minor, and temporary impacts to land use and real estate as compared to the No Action Alternative. Temporary land use disruptions, including increased noise, dust, and access limitations may alter physical characteristics but are not anticipated to substantially modify the functional land use character of the existing WCS and canal system. Where necessary, Temporary Easements would be obtained to support vehicle movement and equipment laydown. Temporary Easements would be needed at five, seven, and six parcels for Alternatives A, B, and C, respectively. Under Alternative RO, six Temporary Easements would be required. All easements would expire after construction is complete and the land would be restored in accordance with project requirements.

### 5.16.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, land use and real estate may experience adverse, direct, moderate to major, long-term impacts. Without modernization, WCS would be less able to manage water volumes during more intense and frequent weather events. Increased flooding would result in infrastructure damage, making some areas less viable for development and prompting shifts in land use patterns, including reduced density, abandonment of vulnerable parcels, or conversion to open space or stormwater retention areas. In response, local governments may adopt more stringent building codes, revise zoning regulations to encourage flood-resilient development, and expand conservation or managed retreat zones. H&H modeling was used to predict the number of acres that would experience an increase in inundation peak depths in FWOP conditions (No Action Alternative). Terrestrial habitat inundation, where depths would exceed 1 foot in the upstream watershed basins, in the FWOP condition is predicted to be 24,615 acres and 12,641 acres under the worst case and intermediate modeling scenarios, respectively.

Under all alternatives, adverse, direct, minor, long-term impacts may occur as compared to the No Action Alternative through the conversion of land from passive or natural use to operational or maintenance-related purposes. However, such disturbances would be confined to SFWMD ROWs or parcels proposed for acquisition. The agricultural land conversion in the Hillsboro watershed basin would constitute a permanent change in land use designation, from agricultural to stormwater management. Real estate acquisition requirements would be greater under Alternative C than Alternatives A, B, and RO to accommodate additional improvements. Perpetual Easements would be needed at three parcels under Alternative A, four parcels each under Alternatives B and C, and three parcels under Alternative RO. Fee Estate Acquisition (i.e., permanent property acquisition) would be needed at two, six, eight, and four parcels under Alternatives A, B, C, and RO, respectively.

Terrestrial habitat inundation modeling for the upstream watershed basins predicts that under Alternative A, 22,302 and 12,096 acres would experience depths exceeding 1 foot under the worst case and intermediate modeling scenarios, respectively. Alternative B predicts 21,815 acres (worst case scenario) and 11,998 acres (intermediate scenario) of inundation. Alternative C predicts 21,690 acres (worst case scenario) and 12,493 acres (intermediate scenario) of inundation. Predicted inundation under Alternative RO is 22,350 acres and 12,059 acres for the worst case and intermediate modeling scenarios, respectively. All alternatives represent an improvement over FWOP (i.e., No Action Alternative). **Appendix A** provides full model results.

To further examine the effects of potential flooding on land use and real estate, an analysis was conducted to determine the impact of flooding on residents and the costs they would incur to temporarily relocate while the flooding recedes and their homes are restored to habitable condition ("temporary displacement days"). Alternatives A, B, and C improve temporary displacement days as compared to the FWOP, with Alternative C providing the greatest reduction in temporary displacement days. Under Alternative RO, temporary displacement days are closest in comparison to Alternative A and represent an improvement over FWOP conditions. Additional discussion is provided in **Appendix B** and **Appendix D**.

## 5.17 Visual Resources

### 5.17.1 Construction

The Study Area is characterized as fully developed, with the canals and WCS being assigned the highest Visual Resource Management classification (Class IV), indicating the lowest level of visual sensitivity. Under the No Action Alternative, there would be no effect to visual resources as they would remain unchanged from their current state. Additionally, no construction-related visual disruptions, such as from equipment, cleared vegetation, and staging areas, would occur.

Under all alternatives, construction would result in adverse, direct, minor, and temporary visual impacts as compared to the No Action Alternative due to the presence of equipment, active demolition and construction zones, exposed structural elements, and possible dust generation. The establishment of temporary laydown and staging areas would further contribute to visual disruption. Although these activities may be observable by nearby property owners, recreational users, and site visitors, they are expected to be largely consistent with prior construction activities in the area and would not be visually prominent from long distances due to surrounding development and vegetation acting as screening. Construction of nature-based measures proposed under Alternatives B and C, notably the Hillsboro Watershed Stormwater Storage Capacity Improvement Project, would be more perceptible since this site is visible from surrounding roadways and nearby properties. However, direct, adverse visual impacts from the construction of nature-based features are still expected to be minor and temporary.

### 5.17.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, adverse, direct, moderate, long-term impacts from visual degradation could occur from increased flooding, erosion, standing water, and damage to surrounding infrastructure and vegetation. As aging WCS lose functionality, more frequent flood events could alter the visual landscape, resulting in debris accumulation, deteriorated infrastructure, and unmanaged areas. These effects could reduce the aesthetic quality and scenic value of the area over time.

All action alternatives would have adverse, direct, long-term visual impacts as compared to the No Action Alternative, primarily resulting from new built elements (i.e., new WCSs and Pump Stations) and bank reinforcement activities, such as berm construction, riprap placement, and retaining wall installation. In locations where new pump stations are being constructed, the superstructure of each pump station will be substantially taller – approximately twice the height of the existing spillways structures – and would introduce distinctly new vertical and massing elements into the viewshed. These pump stations would therefore appear more visually prominent within the surrounding landscape and could alter the perceived scale and form of the built environment, particularly in areas with nearby residential or recreational uses.

Impacts under Alternative A would be the least as only two new and one replacement pump station are proposed. Visual impacts from Alternative B would be somewhat greater, with three new and one replacement pump station, but less than under Alternative C, which includes six new and one replacement pump station. Visual effects under Alternative RO would be less than Alternative C but greater than Alternative B, with four new and one replacement pump station proposed. Despite the increased prominence of these structures, the pump stations would be located within an already highly modified flood-control landscape characterized by levees, canals, and existing utility infrastructure; as such, overall visual impacts are expected to be minor as compared to the No Action Alternative. In addition, canal conveyance improvements proposed under Alternatives B, C, and RO, would involve placement, compaction, and grading of dredged material within SFWMD canal rights-of-way, which may provide minor beneficial effects by visually screening portions of new WCS infrastructure. However, any such screening effects would be negligible in the overall visual context. Under Alternative C only, converting agricultural land into a stormwater storage area would permanently alter the landscape, introducing engineered features like levees into a flat, open setting. While this change would be visually noticeable, the use of vegetated embankments, managed water levels, and green infrastructure would help maintain compatibility with surrounding open spaces and create a more naturalized appearance over time. The visual impact would reflect functional transformation rather than intensive development, reducing industrial or urbanized visual intrusion.

## 5.18 Transportation and Traffic

### 5.18.1 Construction

The No Action Alternative would have no effect on transportation and traffic, since no construction would occur.

Under Alternatives A through C and RO, adverse, indirect, minor, and temporary traffic impacts are anticipated during construction as compared to the No Action Alternative due to increased construction-related vehicle traffic, as well as potential lane closures or detours on adjacent roadways. Traffic impacts are expected to occur only in the vicinity of each WCS. Any intermittent delays for residents, businesses, or service providers would not degrade overall traffic flow or level of service on collector or arterial roadways. None of the alternatives introduce new public roadways, alter traffic signalization or intersection configurations, or change regional freight or transit patterns. A full transportation model analysis that examines potential construction impacts from all alternatives was completed and is provided in **Appendix D**.

### 5.18.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, the transportation network in the Study Area may experience increasing strain. Without improvements to WCS, roads and key transportation corridors could become more prone to disruption from rising water levels and flood events, reducing vehicle access and increasing travel times. In addition, critical infrastructure–such as bridges, drainage systems, and transportation assets tied to airports and port facilities–may be vulnerable to damage or failure, further compromising the reliability and efficiency of the region's transportation network. These adverse, indirect, moderate, long-term impacts could result in reductions in traffic flow, accessibility, and emergency response capabilities.

Under all alternatives, no adverse impacts to traffic or transportation networks are anticipated from OMRR&R. In contrast, beneficial, indirect, minor, and long-term effects to regional and local transportation systems are anticipated as compared to the No Action Alternative from enhanced flood protection and stormwater management. Improved FRM would safeguard roadway accessibility, reduce emergency response delays, and mitigate travel-time variability. These benefits would scale with the scope of the alternative. A full transportation model analysis that examines both impacts and potential benefits from the Section 203 Study alternatives is provided in **Appendix D**. The transportation benefit model quantified the impacts of roadway flooding on travel performance and associated road-user costs. Impacts were measured as changes in Vehicle-Hours Traveled (representing additional delay), and Vehicle-Miles Traveled (representing additional travel distance) due to flood-related roadway closures. Under the FWOP condition in 2085 for a 25-year storm under intermediate sea level rise projections, 54,661,000 Vehicle-Miles Traveled and 30,941,000 Vehicle-Hours Traveled are anticipated. In all alternatives, Vehicle-Hours Traveled and Vehicle-Miles Traveled for both trucks and automobiles are reduced as compared to the FWOP (No Action Alternative) condition, with Alternative RO providing the greatest benefits in reduction of additional travel delays and travel distances.

## 5.19 Infrastructure and Utilities

### 5.19.1 Construction

Under the No Action Alternative, no improvements to the existing WCS would be made; therefore, there would be no construction-related impacts to infrastructure and utilities.

Alternatives A through C and RO consist of a range of improvements including WCS hardening and resiliency improvements, spillway replacement, construction of new pump stations, canal conveyance improvements (i.e., dredging), and creating stormwater storage sites. During WCS construction, electricity would be provided by portable generators. Water would be used for mixing concrete and periodic dust suppression. Diesel fuel would be required to power construction equipment. Portable toilets would be used for sanitary waste. The demand on utilities would be low and mainly associated with a slight increase in water usage. Under Alternatives B, C, and RO, petroleum fuel would be required for construction equipment during canal dredging; however, fuel can be transported to the site(s) as needed. Infrastructure and utility requirements for the construction of stormwater storage sites under Alternatives B and C would be similar to WCS requirements but in lesser amounts due to the smaller scope of those features. Alternative A would pose the least demand with increased demand expected under Alternatives B, C, and RO in accordance with increasing construction scopes. Overall, construction activities under all alternatives are expected to result in adverse, indirect, minor, and temporary impacts on infrastructure and utilities as compared to the No Action Alternative.

### 5.19.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, OMRR&R on the existing WCS would continue, and utilities usage would generally remain the same. However, without improvements to WCS, water levels will exceed WCS design capacity, exacerbated by sea level rise and extreme rainfall. Flood events will become more frequent and severe, impacting the Study Area’s utility infrastructure, resulting in adverse, indirect, minor, long-term impacts. Critical infrastructure, including essential facilities, within the FWOP scenario is expected to experience structural damage above first-floor elevations during flood events in the upstream watershed basins. Under the worst case scenario, 26 structures would be flooded. A full, quantitative analysis of the anticipated impacted critical infrastructure with flood depths exceeding first-floor elevation is provided in **Appendix D**. Sanitary sewer overflows release raw sewage containing pathogens, nutrients, organic matter, and potentially toxic substances into the urban environment, degrading water quality. Such events are anticipated to increase in frequency in the FWOP scenario.

Similarly, underground septic tanks and onsite sewage treatment and disposal systems may become more frequently inundated, increasing the risk of failures and environmental impacts. An assessment of impacts from sanitary sewer overflows and septic tank impacts is provided in **Appendix B** and **Appendix D**.

Under all alternatives, new spillways and pump stations would be constructed near existing infrastructure and connected to public utilities, including electric power, potable water, sanitary sewer, and telecommunications. Electricity would power control buildings, spillway gates, and pumps, with backup systems in place for outages. Potable water service would support restroom facilities at pump stations, though not at spillway-only sites. Telecommunications would provide phone and internet access to all facilities. Under Alternatives B, C, and RO, the facilities for the stormwater storage capacity improvements would require electricity for operation of the pumps and gated spillways, similar to the WCS, but at lesser amounts due to their smaller scale. Overall, utility providers in urbanized Broward County have sufficient capacity to support these needs. Some adverse, indirect, minor, long-term impacts may result from increases in water and electricity use at the improved WCS as compared to the No Action Alternative, but no service limitations are anticipated.

Under Alternative A, seven fewer critical infrastructure assets would be damaged above first-floor elevations in the upstream watershed basins under the worst case scenario in comparison to FWOP. Under Alternative B, eight fewer critical infrastructure assets would be damaged in the worst case scenario as compared to FWOP, and under Alternative C, 10 fewer critical infrastructure assets would be damaged as compared to FWOP. Alternative RO results in five fewer damaged critical infrastructure assets as compared to FWOP, demonstrating that all alternatives result in reduced damages. Modeling data results also demonstrate that sanitary sewer overflows and septic tank impacts are less likely to occur under all alternatives as compared to FWOP.

## 5.20 Socioeconomics

### 5.20.1 Construction

The No Action Alternative would not result in any impacts to socioeconomic resources since construction would not occur.

Under all alternatives, employment may benefit indirectly as compared to the No Action Alternative from a temporary increase due to additional employment opportunities during the period of construction; however, such effects are expected to be minor. Socioeconomic factors such as population, demographics, housing, income, and labor force are not expected to be affected by the construction of any alternatives.

### 5.20.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Under the No Action Alternative, impacts to housing, income, and employment are expected to occur. Flooding of taxable property would result in property damage and associated financial losses, could displace residents and businesses, and could affect access to employment, resulting in minor, long-term impacts. The National Risk Index for Natural Hazards calculates the expected annual loss from natural hazards in Broward County to be very high compared to the rest of the United States. Under current conditions county-wide, coastal flooding is calculated to result in expected annual losses of $473,690;

riverine flooding is expected to result in annual losses of $5,439,354; and hurricanes are expected to incur annual losses of $894,835,315. This annual loss is expected to compound over time under the No Action Alternative due to increased flooding, storm surge, and hurricanes. As the frequency of these disasters increases, the expected annual economic losses would increase as well. Overall, the No Action Alternative would result in adverse, indirect, minor, long-term impacts to socioeconomic conditions.

All alternatives would benefit socioeconomic conditions as compared to the No Action Alternative through improved flood management, which would result in less property damage and less income spent on repairs or replacement. Housing costs due to displacement would also be reduced. Employment may benefit from a demand for construction. Where necessary to construct specific features, land acquisition and easements may benefit the local economy by generating revenue for property owners, including municipalities. Overall, the effects to socioeconomic resources from all alternatives are expected to be beneficial, indirect, minor, and short-term.

## 5.21 Cultural Resources

THIS SECTION OF THE REPORT WILL BE COMPLETED AT A LATER DATE

## 5.22 Past, Present, and Reasonably Foreseeable Actions

### 5.22.1 Construction

The proposed project footprint is currently, and has been in the past, dedicated to water control in a densely urbanized landscape. The proposed project area and its current and past use would remain essentially unchanged for the foreseeable future because it is a right of way dedicated to water management with no expectations that it would change.

### 5.22.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation

It is reasonable to assume water management would become more efficient with improved WCS and canals and would more effectively address sea level rise, extreme weather events, and flooding. No land use and resources changes in the area of potential effects are expected to result from project implementation. The project would not directly change current resources conditions or create conditions that would indirectly facilitate changes. Foreseeable effects to land use and resources may occur due to changing climatological conditions and more severe weather events that will occur irrelevant of Alternative RO implementation.

However, this is unlikely to result in significant effects because the proposed action’s purpose is addressing those conditions and events.

## 5.23 Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of resources is one in which the ability to use and/or enjoy a resource is lost forever. An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time.

The proposed action consists of improvements to existing water control infrastructure, including construction of new WCS and operational changes to current water management practices. It does not include construction of permanent structures or structural modifications outside of the footprint of the existing WCS.

Non-motile or low motility benthic organisms may be unable to leave the areas where dredging or excavation occurs. These animals would be lost but it is reasonable to expect the vicinity would be recolonized after construction is completed. Similarly, aquatic and upland vegetation, including wetlands species removed during construction would be lost but expected to recolonize. These adverse effects are unavoidable.

The proposed action would not cause the permanent removal or consumption of any natural resource.

### 5.24 Unavoidable Adverse Impacts

The loss of non-motile or low motility benthic organisms and aquatic vegetation, including wetlands species during construction, are unavoidable adverse effects.

## 6.0 THE TENTATIVELY SELECTED PLAN

Based on plan comparison (**Section 4**) and environmental effects (**Section 5**), Alternative RO has been selected as the TSP for the Section 203 Study. The TSP represents an optimized plan designed to deliver the greatest level of flood risk management and resilience features within the Section 203 Action Area while not causing or mitigating adverse downstream impacts. Alternative RO is appropriate as the TSP because it is a hybrid alternative comprised of features included in Alternatives A, B, and C designed to mitigate compound flood risks intensified by sea level rise, elevated groundwater tables, and extreme rainfall.

The resilience justification for the TSP is grounded in the best available regional science and federal guidance, drawing from the SFWMD’s Water and Climate Resilience Metrics series, which document observed long-term trends in rainfall, sea level, and groundwater behavior, and from USACE climate and resilience regulations and directives. These include Engineering Construction Bulletin (ECB) 2018-14, Engineering Regulation (ER) 1100-2-8162, the USACE Climate Action and Adaptation Plans, and federal policy directives such as Executive Orders 13990 (2021) and March 18, 2025 – Achieving Efficiency Through State and Local Preparedness.

Together, these sources form the technical and policy foundation for selecting a robust, adaptive, and resilient TSP that, while potentially higher in cost and lower in conventional benefit-cost ratio (BCR), provides superior long-term system reliability, cost efficiency, and risk reduction. This approach aligns with federal, state, and regional resiliency mandates, ensuring that the C&SF Project remains functional, sustainable, and protective of South Florida’s communities and ecosystems in the decades ahead.

Enhanced pumping capacity and system redundancy substantially improve reliability, operational flexibility, and adaptive performance of the TSP. While inclusion of higher-capacity pumps and enhanced automation increases initial project cost and lowers the overall BCR, these features deliver major long-term resilience dividends by reducing life-cycle risk, maintenance exposure, and operational downtime. The resulting system provides consistent performance under a wider range of hydrologic and climatic futures and aligns directly with regional, state, and federal resilience frameworks. The hybrid design thus strengthens system-wide reliability, supports adaptive management under future uncertainties, and integrates both engineering efficiency and climate robustness within the overall FRM strategy.

The TSP's hybrid scenario configuration enhances operational resilience and reliability under compound rainfall–surge conditions. Redundant pump units and improved automation allow continuous operation during high-tide or partial-outage scenarios, reducing downtime and minimizing flood-risk exposure when rainfall coincides with coastal surge events. This redundancy provides operators with critical flexibility to redistribute pumping capacity between basins as hydrologic conditions shift, maintaining conveyance efficiency and system balance across interconnected canals and structures.

## 6.1 Plan Accomplishments

The TSP represents a carefully evaluated structural alternative that effectively meets the study objective of enhancing the functionality and capacity of the C&SF Project. It directly addresses the challenges posed by existing infrastructure, which currently shows limited adaptability to changing hydrologic conditions and the compounded effects of flooding. By doing so, the TSP significantly mitigates flood damages within the Action Area. Additionally, it addresses opportunities to manage public safety risks associated with inundation, protect historical and cultural resources from flood-related threats, and foster improved coordination and trust among stakeholders and the public.

Designed to reduce flood damages and improve resilience to inundation and changing conditions within the Study Area over the 50-year analysis period from 2035 to 2085, the TSP is estimated to prevent $31.8 million dollars of equivalent annual damages in the intermediate sea level rise scenario and $66.5 million in the high sea level rise scenario. This equates to $2.6 billion in total benefits in the intermediate and high sea level rise scenarios. The specific features of the TSP, including how they were selected from Alternatives A through C, are provided in

**Table** 6-1, and the TSP is illustrated in **Figure 6-1.**

**Table 6-1. Tentatively Selected Plan Features by Watershed and Alternative.**

| Watershed Basin | Water Control Structure | Existing Condition | Final Array Alternative for Each Watershed | Tentatively Selected Plan |
|---|---|---|---|---|
| Hillsboro Canal Basin | G-56 Gated Spillway | (3) 20-ft-wide spillway gates | Alternative B Modified | NEW gated spillway w/ (4) 25-ft-wide roller gates / demolition of existing structure<br>~1.1 miles of Hillsboro Canal improvement |
| Pompano Canal Basin | G-57 Gated Spillway | (2) 14-ft-wide spillway gates<br>(1) 1,400-linear-ft 10-ft-diam. culvert (upstream of G-57) | Alternative B | NEW gated spillway w/ (2) 21-ft-wide roller gates / demolition of existing structure<br>2 NEW 1,400-linear-ft 10-ft-diam. culverts (upstream of G-57) |
| C-14 West Basin | S-37B Gated Spillway | (2) 25-ft-wide spillway gates | Alternative B Modified | NEW gated spillway w/ (2) 25-ft-wide roller gates / demolition of existing structure<br>~1.2 miles of C-14 Canal improvement |
| C-14 East Basin | S-37A Gated Spillway | (2) 25-ft-wide spillway gates | Alternative A Modified | NEW gated spillway w/ (3) 25-ft-wide roller gates / demolition of existing structure<br>NEW 1,200-cfs pump station w/ 400-cfs auxiliary pump |
| C-13 West Basin | S-36 Gated Spillway | (1) 25-ft-wide spillway gate | Alternative B Modified | NEW gated spillway w/ (2) 16-ft-wide roller gates / demolition of existing structure<br>NEW 510-cfs pump station |
| C-12 West Basin | S-33 Gated Spillway | (1) 20-ft-wide spillway gate | Alternative B | NEW gated spillway w/ (2) 20-ft-wide roller gates / demolition of existing structure<br>NEW 510-cfs pump station w/ 170-cfs auxiliary pump |
| North New River Canal West Basin | G-54 Gated Spillway | (3) 16-ft-wide spillway gates | Alternatives B + C Modified | NEW gated spillway w/ (4) 20-ft-wide roller gates / demolition of existing structure<br>NEW 810-cfs pump station |
| C-11 West Basin and C-11 East Basin | S-13 Pump Station and Gated Spillway | 540-cfs pump station with<br>(1) 16-ft-wide spillway gate | Alternative B Modified | NEW gated spillway w/ (2) 14-ft-wide roller gates / demolition of existing structure<br>NEW 1080-cfs pump station w/360-cfs auxiliary pump<br>~2.0 miles of C-11 Canal improvement |

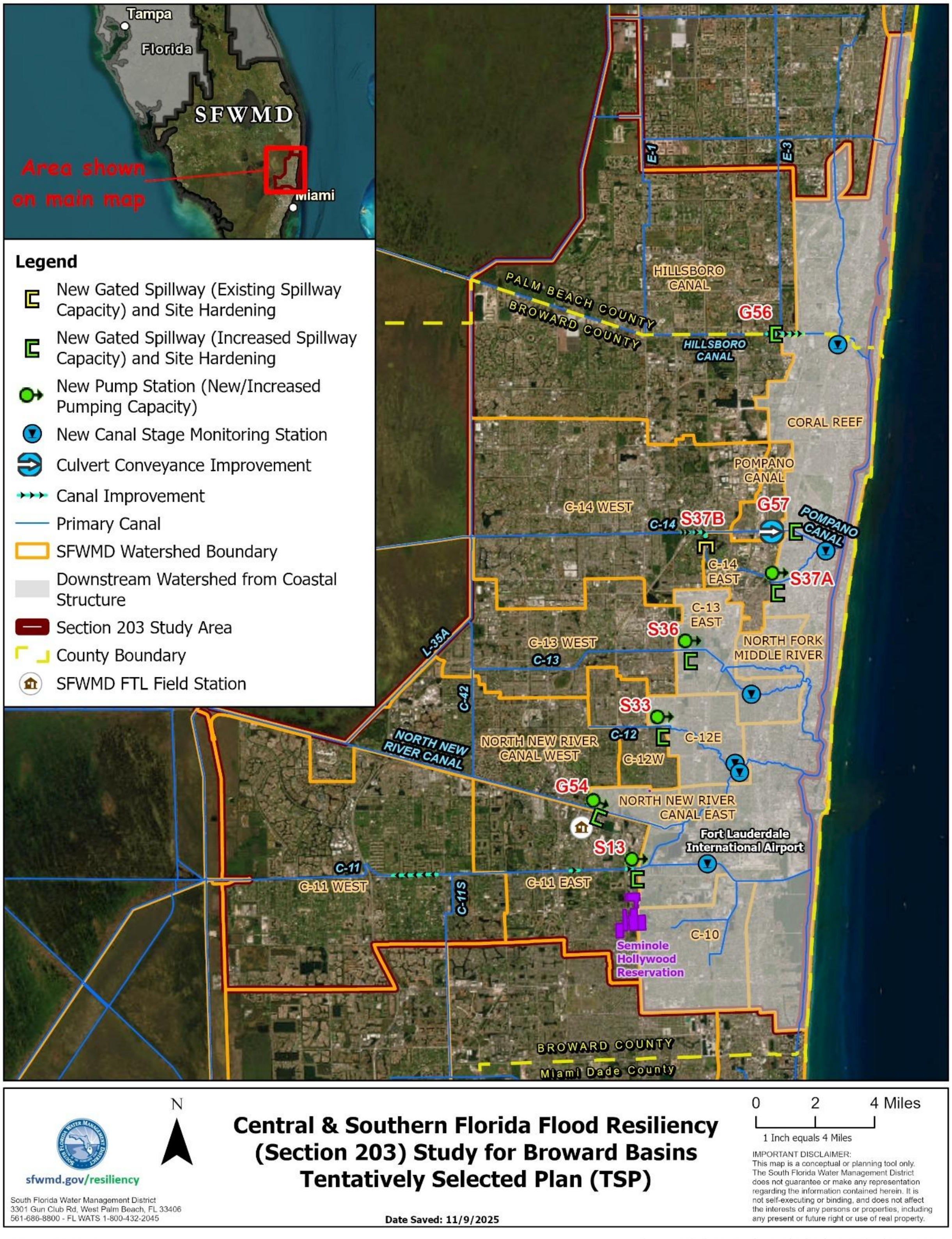



**Figure 6-1. Section 203 Study Tentatively Selected Plan.**

## 6.2 Plan Components

The TSP is comprised of structural measures complemented by operational activities designed to effectively manage flood risk within the Section 203 Action Area. Detailed descriptions of the specific features and components of the TSP are organized by watershed and provided in the sections below, offering a comprehensive overview of the plan's tailored solutions for each part of the Action Area. Additional details for the TSP improvements are provided in **Section A.1** of **Appendix A**.

### 6.2.1 Hillsboro Canal Basin

The Hillsboro Canal Basin watershed is primarily controlled by the G-56 Gated Spillway (26.327972°N, 80.131583°W) on the G-08 (Hillsboro) Canal. The existing G-56 Gated Spillway consists of three 20-foot-wide gates. The TSP features include the construction of a new, replacement gated spillway with four 25-foot-wide roller gates approximately 75 feet west (upstream) of the current G-56 Gated Spillway and demolition of the old spillway. Approximately 17,278 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal.

Additionally, an approximately 1.1-linear-mile section of the G-08 (Hillsboro) Canal would be excavated (i.e., dredged) to enlarge the canal cross section, improving water conveyance. Approximately 0.2 mile of canal, beginning approximately 500 feet west of the existing G-56 Gated Spillway and proceeding west, would be excavated to a maximum depth of 5 feet below the existing canal bottom, removing an estimated 23,868 neat cubic yards of soil. Additionally, approximately 0.9 mile of canal beginning on the east side of the spillway would be similarly dredged to a depth not exceeding 5 feet below the existing canal bottom, with 25,485 neat cubic yards of soil excavated. Dredged material from all areas would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW and proposed perpetual easement.

### 6.2.2 Pompano Canal Basin

The Pompano Canal Basin watershed is primarily controlled by the G-57 Gated Spillway (26.230850°N, 80.121525°W) on the G-16 (Pompano) Canal. The existing G-57 Gated Spillway consists of two 14-foot-wide gates. An existing 1,400-foot long, 10-foot diameter culvert is located approximately 350 feet northwest (upstream) of the existing structure, parallel to Atlantic Boulevard (State Road 814), between South Dixie Highway (State Road 811) and Cypress Road, for the purpose of stormwater conveyance. The TSP features include the construction of a new replacement gated spillway with two 21-foot-wide roller gates approximately 250 feet northwest (upstream) of the current G-57 Gated Spillway and demolition of the old spillway. Approximately 6,511 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW, proposed fee estate acquisition, perpetual easements, and temporary easements.

In addition, two new 10-foot diameter culverts (or a double 10-foot-span by 9-foot-rise concrete box culvert) would be constructed parallel to and on the south side of the existing 10-foot diameter culvert. The existing culvert would remain. New concrete support walls would be built at both ends of the site to support installation of the new parallel culverts. Construction of the new culverts would occur by jack and bore or similar trenchless installation methods under South Dixie Highway (SR 811), the Florida East Coast Railroad, and SW 1st Avenue and Cypress Road, and via trenching in the remaining areas.

### 6.2.3 C-14 West Basin

The C-14 West Basin watershed is primarily controlled by the S-37B Gated Spillway (26.223689°N, 80.170163°W) located on the C-14 (Cypress Creek) Canal. The existing S-37B Gated Spillway consists of two 25-foot-wide gates. The TSP features include the construction of a new replacement gated spillway with two 25-foot-wide roller gates approximately 215 feet north (upstream) of the current S-37B Gated Spillway and demolition of the existing spillway. Approximately 4,311 neat cubic yards of soil excavation would be required to construct the new WCS and connect the WCS intake and discharge bays to the existing canal. The TSP also includes conveyance improvements by excavating and enlarging the canal cross section of 1.2-linear miles of the C-14 (Cypress Creek) Canal, extending north and then west of the S-37B Gated Spillway. Approximately 1.2 miles of canal north of the S-37B Gated Spillway would be excavated to a maximum depth of 5 feet below the existing canal bottom, removing an estimated 26,631 neat cubic yards of sediment. All dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

### 6.2.4 C-14 East Basin

The C-14 East Basin watershed is primarily controlled by the S-37A Gated Spillway (26.206246°N, 80.131641°W) located on the C-14 (Cypress Creek) Canal. The existing S-37A Gated Spillway consists of two 25-foot-wide gates. The TSP features include the construction of a new gated spillway with three 25-foot-wide roller gates and demolition of the old spillway. A new pump station would be constructed adjacent to the new gated spillway, which would house three 400-cfs pumps and one 400-cfs auxiliary pump, for a total design discharge capacity of 1,200 cfs. Although the new WCS would be in the same location as the existing one, it would encompass a larger footprint to accommodate the new pump station. Approximately 85,456 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW, proposed fee estate acquisition, and temporary easement.

### 6.2.5 C-13 West Basin

The C-13 West Basin watershed is primarily controlled by the S-36 Gated Spillway (26.173183°N, 80.179122°W) located on the C-13 (Middle River) Canal. The existing S-36 Gated Spillway consists of one 25-foot-wide gate. The TSP features include the construction of a new gated spillway with two 16-foot-wide roller gates to replace the current S-36 Gated Spillway and demolition of the existing spillway. Although the new WCS would be in the same location as the existing spillway, it would encompass a larger footprint to accommodate the new gates and would meet current SFWMD design standards. A new pump station would be constructed adjacent to the new gated spillway, which would house three 170-cfs pumps for a total design discharge capacity of 510 cfs. Approximately 43,305 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW, proposed fee estate acquisitions, and temporary easement.

### 6.2.6 C-12 West Basin

The C-12 West Basin watershed is primarily controlled by the S-33 Gated Spillway (26.135942°N, 80.194494°W) located on the C-12 (Plantation) Canal. The existing S-33 Gated Spillway consists of one 20-foot-wide gate. The TSP features include the construction of a new gated spillway with two 20-foot-wide roller gates and demolition of the existing spillway. A new pump station would also be constructed, which would house three 170-cfs pumps and one 170-cfs auxiliary pump, for a total design discharge capacity of 510 cfs. The width of the new WCS would necessitate excavation of the south canal bank and partial removal of an existing concrete box culvert that discharges to the C-12 (Plantation) Canal downstream of the current WCS. Approximately 53,706 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. All work would occur within the existing canal ROW.

### 6.2.7 North New River Canal West Basin

The North New River Canal West Basin watershed is primarily controlled by the G-54 Gated Spillway (26.095082°N, 80.229682°W) located on the G-15 (North New River) Canal. The existing G-54 Gated Spillway consists of three 16-foot-wide gates. The TSP features include the construction of a new gated spillway with four 20-foot-wide roller gates approximately 30 feet west northwest (upstream) of the current G-54 Gated Spillway and demolition of the old spillway. A new pump station would be constructed adjacent to the new gated spillway. The pump station would house three 270-cfs pumps for a total design pumping capacity of 810 cfs. Approximately 42,064 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. The abandoned boat lock downstream of the existing WCS would be demolished. All work would occur within the existing canal ROW.

### 6.2.8 C-11 West Basin

The C-11 West Basin watershed is primarily controlled by the S-13AW Gated Culvert (26.064633°N, 80.281512°W) located on the C-11 (South New River) Canal. The existing S-13AW Gated Culvert consists of two 10-foot-wide gates. The TSP features include the excavation of a 1.5 miles of the C-11 (South New River) Canal in the C-11 West Basin watershed to improve conveyance. Excavation would begin approximately 50 feet east of the east side of the Winkopp Bridge and proceed east along the canal. Excavation would occur to a maximum depth of 5 feet below the existing canal bottom, removing an estimated 85,039 neat cubic yards of soil. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites. The excavated north and south side slopes of this 1.5-mile canal section would be stabilized with riprap (approximately 66,124 neat cubic yards) underlaid by bedding stone (approximately 16,762 neat cubic yards) and filter fabric. All work would occur within the existing canal ROW.

### 6.2.9 C-11 East Basin

The C-11 East Basin watershed is primarily controlled by the S-13 Pump Station and Gated Spillway (26.066360°N, 80.208858°W) located on the C-11 (South New River) Canal. The existing S-13 Pump Station and Gated Spillway consists of a single 16-foot-wide spillway gate with a pump station with three 180-cfs pumps for a total design discharge capacity of 540 cfs. The TSP features include the construction of a new gated spillway approximately 200 feet west (upstream) of the current S-13 Pump Station and Gated Spillway and demolition of the existing spillway. A new gated spillway with two 14-foot-wide roller gates would be constructed. A new pump station with four main pumps (including two 180-cfs pumps and two 360-cfs pumps) and one 360-cfs auxiliary pump would be constructed, which would increase the total design discharge capacity via pumping for the WCS from 540 cfs to 1,080 cfs. Approximately 64,687 neat cubic yards of soil excavation would be required to construct the new gated spillway and pump station and connect the WCS intake and discharge bays to the existing canal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites.

In addition, an approximately 13,000-square-foot portion of the remnant bypass channel located southeast of the existing WCS would be partially backfilled with soil, and a smaller channel would be left in place to maintain existing drainage flows from State Road 7 (US 441) and the stormwater system for the residential community south of the S-13 site. Upland soil material from the new S-13 Pump Station and Gated Spillway excavation would be used as backfill for the remnant channel; excavated material would be tested for compliance prior to use as backfill. The material would be properly graded and stabilized and would incorporate a small pilot channel to carry existing drainage. In addition, 0.5 mile of the C-11 (South New River) Canal in the C-11 East Basin watershed would be excavated in two places to improve conveyance. First, approximately 0.3 mile of canal excavation, beginning at the centerline of SW 74th Avenue and proceeding east along the canal, would occur to depths not exceeding 5 feet below the existing canal bottom and would result in approximately 17,752 neat cubic yards of soil removal. Then, approximately 0.2 mile of canal excavation, beginning 50 feet east of the east side of the Florida Turnpike northbound offramp bridge and proceeding east along the canal, would occur to depths not exceeding 5 feet below the existing canal bottom and would result in approximately 11,427 neat cubic yards of soil removal. Dredged material would be placed, compacted, graded, and sodded within the existing access corridors along the canal ROW, with any excess soil disposed of at permitted landfills or other SFWMD-approved sites.

### 6.2.10 Downstream Monitoring Stations

The TSP includes the installation of six canal stage monitoring stations (each consisting of a pile-supported steel platform, steel stilling well pipe, solar powered remote data logger, and staff gauge) within the downstream watersheds in the Study Area. The downstream monitoring stations would be in addition to monitoring stations that would be installed approximately 150 to 200 feet downstream of each new WCS. The downstream monitoring stations are further described in **Section A.1.12** of **Appendix A.**

## 6.3 Cost Estimate

The estimated cost of the TSP is $1.8 billion. This includes the cost of acquiring lands, construction costs, PED, construction management, and contingencies. Cost assumptions are further detailed in **Appendix E, Cost Engineering and Risk Analysis**. Annual operations and maintenance costs are estimated at $2 million throughout the period of analysis (2035 to 2085). This estimate accounts for any additional operations and maintenance costs beyond those presently implemented by SFWMD that are incorporated into the FWOP scenario. Repair, replacement, and rehabilitation costs of $42 million are estimated to occur within the midpoint of the period of analysis. The project cost summary is included in **Table 6-2** and reflects a FY26 price level and the FY26 federal discount rate of 3.25 percent.

**Table 6-2. Tentatively Selected Plan Cost Estimate.**

| Tentatively Selected Plan | Estimated Cost[a/] |
|---|---|
| Real Estate / LERRD | $28 |
| Construction, including mobilization and demobilization | $1,266 |
| Subtotal | $1,294 |
| Preconstruction Engineering and Design | $152 |
| Construction Management | $95 |
| Estimated Cost | $1,541 |
| Net Annualized Operations and Maintenance | $2 |
| Estimated Repair, Replacement, and Rehabilitation | $42 |

a/ Dollar amounts in millions, 2025 dollars.
Notes: LERRD = Lands, Easements, Rights-of-Way, Relocations, and Disposal.

## 6.4 Lands, Easements, Rights-of-Way, Relocations, and Disposal

A Real Estate Plan describing the real estate requirements and costs for the TSP can be found in **Appendix F**. As the non-federal sponsor, the SFWMD is responsible for acquiring the necessary Lands, Easements, Rights-of-Way, Relocations, and Disposal (LERRDs) in accordance with federal requirements, including securing ownership interests, easements, or other rights. Real estate requirements identified for the TSP are necessary to ensure the proper siting of TSP features, long-term operability of flood control works, and continued access for inspection and maintenance activities. The types of real estate actions proposed include Temporary Easements, Perpetual Easements, and Fee Estate Acquisitions. Real estate acquisition costs for the TSP are estimated at $28 million, comprising $6 million in Perpetual Easements, $20 million in Fee Estate Acquisitions, and $2 million in Temporary Easements. No residential structures would be acquired as part of the TSP. The majority of costs are associated with actions to provide access and work areas to support construction and long-term OMRR&R needs. Real estate estimates include contingencies to address uncertainties with preliminary estimates.

## 6.5 Operations, Maintenance, Repair, Replacement and Rehabilitation

The purpose of OMRR&R is to sustain the constructed project and to maintain the stated level of benefits at the completion of construction and throughout the life of the project. OMRR&R would commence following completion of construction activities and occur annually throughout the period of analysis. Preliminary OMRR&R costs were estimated based on standardized SFWMD Operations and Maintenance protocols established for existing conditions.

## 6.6 Project Risks

Certain risks and uncertainties have been managed throughout the feasibility phase of the Section 203 Study that may impact implementation of the TSP. Project risks and uncertainties are detailed in **Table 6-33**. Risks are presented in alphabetical order and not listed in order of priority or magnitude.

**Table 6-33. Section 203 Study Risks and Uncertainties.**

| Issue or Event to be Managed | Risk Identification | Study/ Implementation Risk | Consequence | Likelihood | Uncertainty | Action to Reduce Risk |
|---|---|---|---|---|---|---|
| Accuracy of costs for final array | Cost assumptions pre-TSP may need to be refined | May impact plan selection if cost assumptions should change | Low | Low | Low | Submit CSRA early for evaluation |
| BCR Calculation | BCR is presented in nominal dollars to account for inflation | May impact plan selection if converting to real dollars | Low | Medium | Low | Consider both nominal and real BCR in plan selection |
| Canal Bottom Substrate Assumptions | Work may identify canal bottom substrate is different than assumption | May impact implementation schedule if assumption is incorrect | Low | Medium | Low | Using existing data to inform soil assumptions |
| Downstream Effects Analysis | The downstream effects analysis needs to incorporate existing conditions that are planned by state and local governments | May impact plan selection if overestimation downstream effects | High | Low | Low | Perform additional modeling to evaluate downstream effects |
| Population displacement assumptions | Study assumes no permanent displacement associated with compound flood events | May impact comprehensive benefit analysis if assumption should change | Low | Low | Low | Tolerate risk |
| Rainfall Events Analysis | Rainfall events establish new trendline beyond what is published in Atlas 14 | May impact cost and schedule if rainfall analysis requires further refinement | High | Low | Low | Tolerate risk |

| Issue or Event to be Managed | Risk Identification | Study/ Implementation Risk | Consequence | Likelihood | Uncertainty | Action to Reduce Risk |
|---|---|---|---|---|---|---|
| Structures built after 1991 | Structure inventory refinements to remove structures located in 1% zone with first floor elevations below the base flood elevation in high-risk flood zones | May impact plan selection if greater than 25% of structures must be removed from inventory | Low | Medium | Low | Refine structure inventory and repeat HEC-FDA analysis |

Notes: TSP = Tentatively Selected Plan; CSRA = Cost and Schedule Risk Analysis; BCR = benefit-to-cost ratio

## 6.7 Cost Sharing

Section 203 of the WRDA allows for feasibility studies to be fully funded by non-federal state or local entities. In this context, the SFWMD has covered 100 percent of the feasibility study costs with an apportionment of the study funds provided to USACE for technical assistance and federal activities development. Authorization of the PED and construction phases will be confirmed by Congress with specifications for cost-share implementation of the TSP. Section 103 of the WRDA of 1986, as amended (33 U.S.C. 2213), specifies the cost-sharing requirements applicable to the design and implementation phases of the project.

It is anticipated that the cost share agreement for design and implementation in accordance with ER 1105-2-100, Appendix E, will apply to both PED and construction phases. SFWMD will contribute 35 percent of design and construction costs and shall apply LERRD costs toward its share of the costs.

SFWMD shall waive reimbursement for the value of real property interests and relocations that exceed 35 percent of construction costs. Section 221 of the Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), provides that future signed Partnership Agreement(s) shall be enforceable in the appropriate district court of the United States. SFWMD may request to provide in-kind contributions as part of its 35 percent cost share and shall obtain all applicable licenses and permits necessary for such work. It is understood that OMRR&R is the responsibility of SFWMD.

In addition to providing its share of the costs of the PED and construction phases, acquiring LERRD, and OMRR&R, it is understood that SFWMD is responsible for remediating any HTRW that is discovered in the project areas prior to construction. The WRDA of 1986 (Public Law 99-662) and various administrative policies provide the basis for this division of responsibilities. The final division of specific responsibilities will be formalized in the agreements for the PED and construction phases. **Table 6-44** provides a breakout of estimated cost-sharing based on requirements in ER 1105-2-100, Appendix E.

**Table 6-44. Cost Sharing for the Section 203 Study Tentatively Selected Plan.**

| Tentatively Selected Plan | Non-Federal Estimated Cost[a/] | Federal Estimated Cost[a/] |
|---|---|---|
| Real Estate / LERRD | $28 | $0 |
| Construction, including mobilization and demobilization | $443 | $860 |
| Subtotal | $471 | $860 |

| Tentatively Selected Plan | Non-Federal Estimated Cost[a/] | Federal Estimated Cost[a/] |
|---|---|---|
| Preconstruction Engineering and Design | $55 | $101 |
| Construction Management | $34 | $64 |
| Estimated Cost | $560 | $1,025 |
| Annualized OMRR&R | $3 | $0 |

a/ Costs in millions, 2025 dollars.
Notes: SFWMD = South Florida Water Management District; LERRD = Lands, Easements, Rights-of-Way, Relocations, and Disposal; OMRR&R = Operations, Maintenance, Repair, Replacement and Rehabilitation.

## 6.8 Design and Construction

Construction is currently estimated to begin in 2029 depending on project authorization, appropriation and availability of funding, full environmental compliance, and execution of a binding agreement with USACE. A continuous funding stream is needed to complete this project within the anticipated timeline, which requires continuing appropriations from Congress to fund the detailed design phase PED and fully fund construction contracts. Once construction funds are appropriated, the non-federal sponsor and the Department of the Army enter into a Project Partnership Agreement. Following implementation of this Agreement, SFWMD will acquire the necessary LERRD to construct the project. Because project measures cannot be advertised for construction until the appropriate real estate interests have been acquired, obtaining the necessary real estate in a timely fashion is critical to meeting the project schedule. At the completion of construction, or functional portions thereof, SFWMD would be fully responsible for OMRR&R.

## 6.9 Environmental Consequences

The TSP is a hybrid alternative comprised of effective features included in Alternatives A, B, and C. The effects of the TSP on natural, physical, and economic environmental resources were evaluated through the final array of alternatives and are summarized in **Section 5** and further described in **Appendix B**. The TSP is a hybrid of Alternatives A, B, and C designed to optimize performance. The TSP contains either the same footprint or a reduced footprint of what was considered in Alternatives A through C. As such, the environmental effects of the TSP will not result in any impacts beyond what was analyzed for Alternatives A through C.

## 6.10 Environmental Compliance and Commitments

The TSP complies with several key environmental laws, with ongoing environmental compliance activities described in **Section 7** and **Appendix B** to be completed by the USACE as an inherently federal action. Construction of the TSP will not begin until all necessary consultations are fully completed and all environmental commitments are satisfactorily addressed. This ensures adherence to regulatory requirements and the protection of natural and cultural resources throughout the period of analysis. To ensure responsible project implementation, specific environmental, engineering, design, permitting, and operational commitments will be integrated into the TSP. These measures are designed to avoid, minimize, and where necessary, mitigate any potential adverse effects on the environment, community, and cultural resources, thereby promoting sustainable and compliant project outcomes.

### 6.10.1 Environmental Commitments

The following commitments would be included in contract specifications to avoid, minimize, or mitigate adverse effects during construction activities:

1. The contractor would be required to keep construction activities under surveillance, management, and control to avoid pollution of surface waters, groundwaters, and wetlands. The contract specifications would require the contractor to employ BMPs with regard to erosion and turbidity control.
2. The contractor would be required to prevent oil, fuel, or other hazardous substances from entering the air, ground, drainage, local bodies of water, or wetlands. The contract specifications would require that the contractor adopt safe and sanitary measures for the disposal of solid wastes and would require a spill prevention plan. The contractor would also be required to transport and dispose of any construction and demolition debris in accordance with applicable requirements.
3. The contractor would be required to keep construction activities under surveillance and control to minimize damage to the environment by noise and air pollution.
4. The contractor would be required to keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage to fish and wildlife. The contractor would be required to inform the construction team of the potential presence of threatened and endangered species in the work area, the need for construction conservation measures, and any requirements resulting from Endangered Species Act Section 7 consultation.
5. The contractor would be required to take appropriate measures to protect historic, archeological, and cultural resources within the work area.
6. The contractor would be required to keep construction activities under surveillance, management, and control to prevent the transfer and spread of invasive species due to construction activities. The contract specifications would require the contractor to employ BMPs and measures designed to prevent the transfer and spread of invasive species.

In addition, as required under WRDA 2000, CERP Programmatic Regulations, and current USACE policy, the SFWMD Section 203 Study Project Team has taken the following actions:

1. The TSP has been evaluated in light of its potential effects on existing legal sources of water and the level of service for flood protection. Additional information can be found in **Appendix A** and **Appendix D**.

## 6.11 Views from the SFWMD

The TSP was developed by a multidisciplinary study team led by SFWMD, in coordination with ASA(CW) and USACE Headquarters. Throughout the development process, the TSP was further refined through proactive and ongoing collaboration with Broward County to ensure alignment with local priorities and stakeholder interests. This critical Section 203 Study delivers a comprehensive and technically robust TSP aimed at reducing flood risk resulting from compound flood events—such as the combined effects of storm surge, heavy rainfall, and high tides—within the designated Action Area. Emphasis is placed on protecting the health, safety, and property of surrounding communities while carefully avoiding flood risk trade-offs that could shift vulnerabilities to other areas. Additionally, the TSP seeks to sustain and promote the long-term economic vitality and resilience of the entire Study Area, preserving its environmental and community assets for future generations. Through a balanced integration of engineering solutions, environmental stewardship, and community engagement, the TSP supports a resilient approach to flood risk management in South Florida. Broward County has expressed strong support for the robust and resilient TSP, emphasizing the importance of active floodwater management, enhanced pumping capacity, and regional investment coordination. The County's recommendations include implementing Scenario B and Scenario C improvements at selected locations. These refinements are grounded in empirical local experience managing groundwater–sea-level interactions and reflect the County's technical understanding of the system's response to compound flooding and elevated groundwater conditions.

Broward County's support reinforces both the technical and policy alignment of the TSP with regional, state, and federal resiliency objectives. The County's position underscores that active management and adaptive infrastructure are essential to sustaining flood protection and operational reliability across vulnerable coastal sub-basins. Their involvement represents a collaborative refinement of the TSP that strengthens its justification for final recommendation and future Congressional authorization.

The County also emphasized that the project's success is critical to broader regional resilience initiatives, supporting billions of dollars in ongoing and planned local infrastructure investments. Ensuring that the final plan fully incorporates adaptive pumping, automation, and operational flexibility is viewed as vital to protecting these interconnected systems and maintaining long-term flood resilience for the region.

Following the Draft Integrated Feasibility Report and Environmental Evaluation public-review process, the TSP will undergo NEPA Environmental Assessment Review, Agency Technical Review and Independent External Peer Review. These review phases—along with public and interagency input—may inform refinements to the TSP prior to final recommendation.

These iterative review and coordination steps are fundamental to ensuring that the Recommended Plan achieves the highest standards of technical robustness, economic soundness, environmental compliance, and stakeholder alignment. The collaborative engagement among USACE, SFWMD, FDEP, and Broward County exemplifies the multi-jurisdictional approach required to deliver adaptive, resilient infrastructure that safeguards South Florida's communities and ecosystems for decades to come.

# 7.0 ENVIRONMENTAL COMPLIANCE

THIS SECTION OF THE REPORT WILL BE COMPLETED AT A LATER DATE

# 8.0 SOUTH FLORIDA WATER MANAGEMENT DISTRICT RECOMMENDATIONS

[Preparers Note: The SFWMD will provide recommendations in this section following Agency Technical Review.]

## 8.1 SFWMD Recommendation of the Tentatively Selected Plan

The TSP is recommended and described in detail in **Section 6**. The TSP is a hybrid alternative consisting of effective flood risk management features originally incorporated in Alternatives A, B, and C. The TSP represents a carefully evaluated structural plan that effectively meets the Study objective of enhancing the functionality and capacity of the C&SF system in the Section 203 Action Area and prepares for potential mitigation efforts within the Section 203 Study Area. Additionally, it addresses opportunities to manage public safety risks associated with inundation, protect historical and cultural resources from flood-related threats, and foster improved coordination and trust among stakeholders and the public.

## 8.2 Project Cost and Implementation

Should the TSP be approved by the ASA (CW) and enter into a binding Project Partnership Agreement defining the terms and conditions of cooperation for implementation, shared implementation costs for designing and constructing the TSP are 35 percent (non-federal and 65 percent (federal).

The SFWMD will provide all LERRDs for the TSP. The SFWMD is also responsible for 100 percent of the cost of OMRR&R.

## 8.3 Local Cooperation and Interest

[Preparers Note: The SFWMD will provide recommendations and plan agreement from Broward County in this section following Agency Technical Review.]

## 8.4 Future Opportunities

[Preparers Note: The SFWMD will provide recommendations regarding Secondary Systems and further enhancement of flood protection in this section following Agency Technical Review.]

## 8.5 Request for Congressional Authorization

The recommendations contained herein reflect the information available at this time and current departmental policies governing development of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the state, interested federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

## 9.0 LIST OF PREPARERS

**Table 9-1** provides a list of persons involved in the preparation of this document.

**Table 9-1. List of Report Preparers**

| Name | Role |
|---|---|
| **South Florida Water Management District** | |
| Andreotta, Holly | Biological Resources |
| Ballard, Carol | H&H Modeling |
| Duecaster, Aaron | Geospatial/GIS Analysis |
| Griffin, David | Project Management |
| Maran, Ana Carolina | Flood Control Planning and Resiliency |
| Morrison, Matthew | Project Management |
| Mrykalo, Robert | Biological Resources |
| Pena Guerra, Francisco | H&H Modeling |
| Ramirez, Armando | Cultural Resources |
| Tadesse, Michael | H&H Modeling |
| Warraich, Natasha | Biological Resources |
| Wilcox, Walter | Senior H&H Modeling, Economics Modeling |
| Wu, Vincent | Economics Modeling |
| Zhao, Hongying | Economics Modeling |
| **J-Tech** | |
| Blair, Steve | Engineer |
| Canty, Lisa | Vegetation Communities, Invasive Species |
| Childers, Jamie | Project Management |
| Cooper, Dewey | Air Quality, Greenhouse Gases, Climate |
| Darrow, Heather | Biological Resources |
| Delaney, Joanne | Senior NEPA Specialist |
| Elias, Ana | Transportation Modeling |
| Foster, Emily | Hydrology, Groundwater, Surface Water Quality |
| Grbic, Jelena | Biological Resources |
| Green, David | Comprehensive Benefits Analysis |
| Hayes, Beverly | Project Management |
| Klug, Katelyn | GIS Specialist |
| Lybolt, Tracy | Biological Resources, Vegetation Communities, Invasives |
| Macke, Chris | Hydrology, Groundwater, Surface Water Quality |
| Magoun, Katie | Plan Formulation |
| Maxwell, Marijke | Biological Resources |
| McCarta, Erin | Hazardous, Toxic, and Radioactive Waste |
| McGahee, Stuart | Cost Engineering |
| Metcalf, Kari | GIS Specialist |

| Name | Role |
|---|---|
| Pellerin, Tricia | Noise |
| Pett, Sam | NEPA Specialist |
| Pierce, Alexis | Socioeconomics |
| Playstead, Kurt | Transportation Benefits |
| Rahmig, Troy | Biological Resources |
| Rose, Sean | Real Estate, Visual Impacts |
| Sciortino, Raymond | Lead Engineer |
| Southerland, Lindsay | Socioeconomics |
| Stryjewski, Liz | NED Benefits |
| Vince, Georgia | Senior Project Management |
| Vose, Scott | Economics Modeling |
| Waldeck, Shawn | Senior Project Management |
| Webster, Rebecca | Cultural Resources |
| Wertz, David | Geology, Infrastructure |
| White, Leigh Ann | Transportation Modeling |
| Yusuf, Fatuma | Comprehensive Benefits Analysis |
| **HDR** | |
| Miller, Alexander | Comprehensive Benefits Analysis |
| **ICF** | |
| Ng, Corey | Comprehensive Benefits Analysis |

Note: H&H = hydrologic and hydraulic. NEPA = National Environmental Policy Act. NED = National Economic Development.

## 10.0 REFERENCES

BEBR (Bureau of Economic and Business Research). 2024. Population Projections by Age, Sex, Race, and Hispanic Origin for Florida and Its Counties, 2025–2050, With Estimates for 2023. University of Florida. Retrieved from https://bebr.ufl.edu/wp-content/uploads/2024/11/projections_2024_asrh.pdf. Accessed December 2024.

Broward County. 2023. Broward County 2021 Greenhouse Gas Emissions Inventory. Retrieved from https://experience.arcgis.com/experience/97beefc5b5134750b42e26de5daf17a8/page/GHG-Emissions-Inventory. Accessed March 2025.

Broward County. 2024a. Urban Planning Division Quick Facts. Retrieved from https://www.broward.org/Planning/Demographics/Pages/QuickFacts.aspx. Accessed December 2024.

Broward County. 2024b. Ambient Water Quality Monitoring. Retrieved from https://www.broward.org/NaturalResources/Lab/Pages/canalwaterquality.aspx. Accessed August 2025.

FTL (City of Fort Lauderdale). 2024. Inflow and Infiltration. Retrieved from https://www.fortlauderdale.gov/government/departments-i-z/public-works/engineering-division/inflow-infiltration. Accessed August 2025.

SFWMD (South Florida Water Management District). 2021. Flood Protection Level of Service Provided by Existing Infrastructure for Current and Future Sea Level Conditions in Nine Broward County Watersheds Final Comprehensive Report. October 5, 2021.

SFWMD. 2022a. G-56 Structure Book. March 11, 2022.

SFWMD. 2022b. G-57 Structure Book. March 4, 2022.

SFWMD. 2022c. S-37b Structure Book. March 18, 2022.

SFWMD. 2022d. G-37a Structure Book. March 11, 2022.

SFWMD. 2022e. G-36 Structure Book. March 11, 2022.

SFWMD. 2022f. G-33 Structure Book. March 4, 2022.

SFWMD. 2022g. G-56 Structure Book. March 4, 2022.

SFWMD. 2022h. G-56 Structure Book. February 21, 2022.

USACE (U.S. Army Corps of Engineers). 2009. Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation. Institute for Water Resources.

USACE. 2015. North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk. Physical Depth Damage Function Summary Report. U.S. Army Corps of Engineers. January 2015. Retrieved from https://www.nad.usace.army.mil/Portals/40/docs/NACCS/10A_PhysicalDepthDmgFxSummary_26Jan2015.pdf. Accessed on August 14, 2025.

USACE. 2019. Incorporating Sea Level Change in Civil Works Programs. Retrieved from https://www.publications.usace.army.mil/Portals/76/Users/182/86/2486/ER_1100-2-8162.pdf?ver=2019-07-02-124841-933. Accessed August 2025.

USACE. 2021. South Atlantic Coastal Study. Retrieved from https://www.sad.usace.army.mil/SACS/. Accessed March 2025.

USACE. 2024. May 2024 Fact Sheet Central & Southern Florida (C&SF) Project Construction (C) Congressional Districts: 9, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28. Retrieved from https://www.saj.usace.army.mil/About/Congressional-Fact-Sheets-2024/C-SF-Project-C/. Accessed March 2025.

USCB (U.S. Census Bureau). 2022. American Community Survey 1-year estimates, 2022. U.S. Department of Commerce. Retrieved from: https://data.census.gov/. Accessed August 2025.

WUCA (Water Utility Climate Alliance). 2019. Water Resources Resilience in Broward County. Retrieved from https://toolkit.climate.gov/course-lessons/water-resources-resilience-broward-county. Accessed August 2025.




## Get the latest information from SFWMD

Learn more by signing up for the District's emails.
Visit SFWMD.gov and click on ***"Subscribe for Email Updates."***

Connect with us on Facebook, X, Instagram,
LinkedIn and YouTube.

3301 Gun Club Road
West Palm Beach, FL 33406
SFWMD.gov

November 2025