APPENDIX J

SYSTEM OPERATING MANUAL
Volume 4

CENTRAL AND SOUTHERN FLORIDA PROJECT FOR FLOOD CONTROL AND OTHER PURPOSES

SYSTEM OPERATING MANUAL - VOLUME 4

WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK, AND ENP-SOUTH DADE CONVEYANCE SYSTEM

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT
January 2020

HISTORY OF REVISIONS

The table below is intended to include a listing of all revisions incorporated into this Volume of the System Operating Manual. In addition, when revisions are incorporated to this Volume, each page containing a revision will be identified at the bottom of the page with the date the revision was incorporated. Revisions may include water management operating criteria newly approved by the South Atlantic Division after completion of this Volume. This includes, but is not limited to, a Project Operating Manual for a Comprehensive Everglades Restoration Project.

REVISION	DATE	ADDITIONAL INFORMATION
Draft Master Water Control Manual	June 1996	
WCAs, ENP, ENP-SDCS Water Control Plan	October 2012	
Draft System Operating Manual, WCAs, ENP, ENP-SDCS Water Control Plan, SBC Project Basins 1, 2, and 4 Water Control Plans	January 2020	ONGOING

NOTICE TO USERS

It is recommended that hardcopies of this Volume of the Master Water Control Manual/System Operating Manual be preserved in good condition so that inserts can be made to keep the manual complete and current. As revisions are incorporated into this Volume, each page containing a revision, identified by the revision date at the bottom of the page, will be inserted at the appropriate location in the document. Documents containing newly approved water management operating criteria such as a Project Operating Manual for a Comprehensive Everglades Restoration Project will be inserted into Appendix A of this Volume, as appropriate. Note that for ease of use when viewing electronically, Internet webpages are provided as hyperlinks.

EMERGENCY REGULATION ASSISTANCE

In the event that unusual conditions arise, emergency regulation assistance can be achieved by contacting the following:

Jacksonville District (SAJ) Water Management Section Chief: XXX XXX-XXXX

Jacksonville District (SAJ) Water Management Section Staff: XXX XXX-XXXX

LIST OF ABBREVIATIONS/ACRONYMS

C&SF	Central and Southern Florida
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CMP	Corrugated Metal Pipe
CPC	National Oceanic and Atmospheric Administration Climate Prediction Center
DM	Design Memorandum, Design Memoranda
DOI	United States Department of the Interior
DEP	Florida Department of Environmental Protection
EM	United States Army Corps of Engineers Engineer Manual
ENSO	El Niño/Southern Oscillation
ER	United States Army Corps of Engineers Engineer Regulation
ET	Evapotranspiration
FWCC	Florida Fish and Wildlife Conservation Commission
FWS	United States Fish and Wildlife Service
HRD	Climate Prediction Center Hurricane Research Division
HW	Headwater
MPF	Maximum Probable Flood
MTIF	Miccosukee Tribe of Indians of Florida
MWCM	Master Water Control Manual
mph	Miles per hour
NAVD	North American Vertical Datum
N/A	Not Applicable
NHC	National Oceanic and Atmospheric Administration National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
NGVD	National Geodetic Vertical Datum
O&M	Operation and Maintenance
SAD	United States Army Corps of Engineers South Atlantic Division
SAJ	United States Army Corps of Engineers Jacksonville District
SAJP	United States Army Corps of Engineers Jacksonville District Pamphlet
RC	Reinforced Concrete Pipe
SCADA	Supervisory Control And Data Acquisition
SCL	Seaboard Coast Line Railroad
SERFC	National Weather Service Southeast River Forecast Center
SFWMD	South Florida Water Management District
SM	Square Mile(s)
SPF	Standard Project Flood
STOF	Seminole Tribe of Indians of Florida
TW	Tailwater
U.S.	United States
USGS	United States Geological Survey
WCP	Water Control Plan

Elevations (grades): All references to elevation (+0.6 feet or –3.3 feet, for example) are above or below the National Geodetic Vertical Datum (NGVD) of 1929.

Side Slopes: References to side slopes (such as 1V:6H) indicate the proportion between vertical and horizontal.

FRB PROJECT AND RELATED COMPONENTS

"B-"	indicates Bridge
"C-"	indicates Canal
"L-"	indicates Levee
"S-"	indicates water management Structure (spillway, culvert)

CENTRAL AND SOUTHERN FLORIDA PROJECT

SYSTEM OPERATING MANUAL - VOLUME 4
WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK,
AND ENP-SOUTH DADE CONVEYANCE SYSTEM

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, JACKSONVILLE DISTRICT
JACKSONVILLE, FLORIDA

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1 INTRODUCTION

1.1 Authorization for Manual

This volume of the System Operating Manual (SOM) for the Central and Southern Florida (C&SF) Project is prepared pursuant to and in compliance with the following applicable authorities:

- Section 7 of the Flood Control Act of 1944 (33 U.S.C. § 709)
- U.S. Army Corps of Engineers (USACE), South Atlantic Division (SAD) Memorandum of Approval Subject: Water Conservation Areas (WCAs), Everglades National Park (ENP), and ENP– South Dade Conveyance System (ENP-SDCS) Water Control Plan (WCP), dated 14 November 1994
- Section 601(h)(3) of the Water Resources Development Act of 2000 (WRDA), Public Law (P.L.) 106-541, 114 Stat. 2688, enacted December 11, 2000
- 33 Code of Federal Regulations (CFR) Section (§) 222.5, Water control management (ER 1110-2-240)
- 33 CFR § 208.11, Regulations for use of storage allocated for flood control or navigation and/or project operation at reservoirs subject to prescription of rules and regulations by the Secretary of the Army in the interest of flood control and navigation
- 33 CFR § 385.5(a), Guidance Memoranda (GM) of the Programmatic Regulations for the Comprehensive Everglades Restoration Plan (CERP)
- 33 CFR §385.28(b), Operating Manuals of the Programmatic Regulations for the CERP
- Engineer Regulation (ER) 1110-2-240, Engineering and Design, Water Control Management, dated May 30, 2016
- Engineering Manual (EM) 1110-2-3600, Engineering and Design, Management of Water Control Systems, dated October 10, 2017
- ER 1110-2-8156, Engineering and Design, Preparation of Water Control Manuals, dated December 11, 2018

1.2 Purpose and Scope

Operating Manuals are the set of documents that describe how to operate the components of the C&SF Project and the CERP Projects to ensure that the goals and purposes of the projects are achieved. Operating Manuals include the SOM and Project Operating Manuals (POM). Operating Manuals contain WCPs, regulation schedules, and operating criteria for project and/or system regulations as well as additional information necessary to operate projects to ensure that the goals and purposes are achieved. A SOM provides an integrated system-wide plan for the operation of components of the C&SF Project and the CERP Project features to ensure that projects function in a coordinated, systematic way. The SOM shall be based on the existing completed C&SF Project features and shall be developed by the USACE as provided in 33 CFR § 222.5(g) (ER 1110-2-240) and by the local sponsor (non-Federal) as required by these laws and regulations. A POM provides guidance on operational concerns relevant to individual components of CERP projects. As CERP progresses POMs will serve as supplements to the SOM and provide greater detail on the incremental features necessary for integrating the operation of the individual CERP project with the system operation described in the SOM. Chapter 7 of the SOM is titled

"Water Control Plan (WCP)" and it prescribes the water management operations to achieve the congressionally authorized project purposes to the greatest extent possible while seeking to minimize the risk to public safety. WCPs are approved by USACE. Existing WCPs, regulation schedules, and Master Water Control Plans for the C&SF Project shall remain in effect until approval of the respective SOM.

This document is Volume 4 in a series of seven volumes that together comprise the SOM for the entire C&SF Project (refer to Section 1.3). Volume 4 of the SOM covers the WCAs, ENP, ENP-SDCS, and Seminole Big Cypress (SBC) basins. Volume 4 of the SOM is an update to the 1996 Master Water Control Manual (MWCM) and the 2012 WCP for the Everglades Restoration Transition Plan (ERTP). The Central and Southern Florida Ecosystem Restoration Critical Project, Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project (SBC Project) is located within the SBC Basin. The SBC Project WCPs for Basin 1, 2 and 4 are provided in Appendix G and will be updated to POMs in the future.

The purpose of Volume 4 of the SOM is to assist the USACE Jacksonville District Water Management Section and the non-Federal sponsors, South Florida Water Management District (SFWMD), and the Seminole Tribe of Florida (STOF) personnel in the day-to-day operation of the water management system (see Section 1.5). Additionally, this SOM serves to assemble and preserve, as a convenient reference source, information pertinent to the C&SF Project components. Chapter 2 of this volume describes the project location, authorizations, and purpose detail on project areas, components, and features (canals, levees, structures) which comprise the project. Chapters 3 and 4 provide historical information and watershed characteristics for the project area. Chapters 5 and 6 provide information on data collection and communication networks, and hydrologic forecasts for the project area. Chapters 7, 8 and 9 describe the WCP, its effects, and water control management for the project.

1.3 Related Manuals and Reports

The development of the SOM for the C&SF Project is ongoing and will consist of the following volumes. The WCPs, WCMs, and POMs continue to govern operations until the SOM Volumes are completed (except Volume 7, which will be a new SOM Volume for Southwest Florida):

- Volume 1, System-wide
- Volume 2, Kissimmee River-Lake Istokpoga Basin
- Volume 3, Lake Okeechobee and Everglades Agricultural Area
- Volume 4, Water Conservation Areas, Everglades National Park, and ENP-South-Dade Conveyance System
- Volume 5, East Coast Canals
- Volume 6, Upper St. Johns River Basin
- Volume 7, Southwest Florida (will be a new SOM Volume)

Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) manuals for Modified Water Deliveries (MWD) and C-111 South Dade (SD) Projects were provided to the local sponsor, the SFWMD. The complete information on the physical features of the completed project and required operation, maintenance, and coordination as defined in the engineering regulation ER 1100-2-401 Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors are presented in the OMRR&R manuals. SFWMD is required to comply with this manual per the Code of Federal Regulations 33 CFR § 208.10, Local Flood Protection

Works; Maintenance and Operations of Structures and Facilities. The OMRR&R manuals for the MWD and C-111SD projects are listed below.

- S-356 Pump Station OMRR&R Manual, August 2017
- S-357N Control Structure and C-358 Seepage Canal OMRR&R Manual, May 2018
- C-111 South Dade Project OMRR&R for Contracts 1 – 8A, December 2018

1.3.1 Prior Operation and Maintenance Manuals

The Operation and Maintenance (O&M) Manual for the C&SF Project (USACE, Jacksonville District Pamphlet 1130-2-13, 1954-55) consists of three volumes for facilities operated and maintained by the USACE and SFWMD. A fourth volume describes facilities operated and maintained by the USACE. The O&M Manual has had multiple revisions (Latest Change is dated December 2018). Periodically, as facilities are completed and transferred to SFWMD, the O&M Manual is revised and updated. The O&M Manual contains O&M regulations and procedures for operation during both normal and high water periods. The water control criteria found in this volume of the SOM supersede the water control criteria in the O&M Manual. All O&M manuals may be found in Appendix G.

1.3.2 Design Memoranda

The USACE has prepared a series of general design memoranda (GDM), detail design memoranda (DDM), and Detailed Design Reports (DDRs) for the C&SF Project, its canals and water control structures from 1951 through the present (Section 3-2). See **Table 1-4** at the end of this chapter for a list of Design Memoranda (DM) prepared for the entire C&SF Project.

1.3.3 C&SF Project, Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement

Section 601 of WRDA 2000 approved the Comprehensive Everglades Restoration Plan (Plan) contained in the Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, dated April 1, 1999. As stated in Section 601(h) of WRDA 2000 “the overarching objective of the Plan is the restoration, preservation, and protection of the South Florida ecosystem while providing for other water-related needs of the region, including flood protection and water supply.” The Plan approved by Congress contained 68 major components that anticipated the creation of approximately 217,000 acres of reservoirs and wetland-based water treatment areas, wastewater reuse plants, seepage management, and the removal of levees and canals in natural areas. These components are expected to increase storage and water supply for the natural system, as well as for urban and agricultural needs, while continuing to fulfill the original objectives of the existing C&SF Project. CERP Project Implementation Reports (PIRs) bridge the gap between the conceptual level of detail contained in the Plan and the detailed design necessary to prepare plans and specifications required to proceed to construction, providing CERP project delivery teams the opportunity to optimize the features described in the Plan. The CERP PIRs that have influence within the C&SF Project area are listed below:

- C&SF, CERP, C-111 Spreader Canal Western Project Final Integrated PIR and EIS, January 2011
- CERP, Central Everglades Planning Project (CEPP), Final Integrated PIR and EIS, July 2014 and Revised December 2014

1.4 Project Owner

The USACE operates the main outlets of WCA-1, WCA-2, and WCA-3 as authorized in House Document (H.D.) 643. The SFWMD is the local sponsor for the C&SF Project as well as the CERP project components covered by this volume and operates the project in accordance with regulations prescribed by the USACE. The SFWMD was created in 1949 by the Legislature of the State of Florida as the C&SF Flood Control District, and renamed in 1976 to its current name. The local sponsor for the SBC Project is the STOF. The SBC Project is operated by the STOF and is located on the Big Cypress Seminole Indian Reservation.

1.5 Operating Agency

1.5.1 U.S. Army Corps of Engineers

The USACE operates and maintains the main outlets to WCA-1 (S-10A, S-10C, and S-10D), WCA-2A (S-11A, S-11B, and S-11C), WCA-3A (S-12A, S-12B, S-12C, and S-12D), and WCA-3B (S-355A and S-355B). Of these structures S-11A, S-11B, S-11C, S-12A, and S-12B are operated manually and S-10A, S-10C, S-10D, S-12C, and S-12D can be operated remotely. Table 1-1 lists key USACE water control management personnel.

Table 1-1. U.S. Army Corps of Engineers Key Water Control Management Personnel

Name	Phone Number
XXXXXXXX, Chief Water Management Section, EN-WW	XXX XXX-XXXX
XXXXXXXX, Chief Water Resources Engineering Branch, EN-W	XXX XXX-XXXX
XXXXXXXX, Chief Engineering Division, EN	XXX XXX-XXXX

1.5.2 South Florida Water Management District (SFWMD)

SFWMD is responsible for O&M of the C&SF project works covered in this volume except for the SBC Project. **Table 1-2** lists the SFWMD Headquarters Water Managers Operations Control Center contact number and SFWMD Field Stations where key water control management personnel are for coordination with the USACE Jacksonville District Water Management Section. Please reference the following link: https://www.sfwmd.gov/locations. Additionally, SFWMD operates and maintains canals and structures which are not part of the Federal C&SF Project.

Table 1-2. South Florida Water Management District Key Water Control Management Personnel (*indicates field stations)

Area of Operations	Phone Number	Location
SFWMD: Water Managers Operations Control Center	XXX XXX-XXXX	3301 Gun Club Road, West Palm Beach, FL 33406
Clewiston *	XXX XXX-XXXX	2425 Hookers Point Road, Clewiston, FL 33440
Fort Lauderdale *	XXX XXX-XXXX	2535 Davie Road, Davie, FL 33317
Homestead *	XXX XXX-XXXX	2195 NE 8th Street, Homestead, FL 33033
Miami *	XXX XXX-XXXX	9001 NW 58th Street, Miami, FL 33178
West Palm Beach *	XXX XXX-XXXX	801 Sansburys Way Royal, Palm Beach, FL 33411

1.5.3 Seminole Tribe of Florida (STOF)

STOF is responsible for O&M of the SBC Project. The STOF operates and maintains the C&SF Project features within SBC Basin 1, SBC Basin 2, and SBC Basin 4 either manually and/or remotely. See **Table 1-3** for the contact number.

Table 1-3. Seminole Tribe Key Water Control Management Personnel

Position	Area of Responsibility	Phone Number
Director, Environmental Resource Management Department	Water Management	XXX XXX-XXXX

1.6 Regulating Agencies

The USACE is responsible for prescribing regulations and key operating criteria for all project works to meet the congressionally authorized project purposes. The Florida Fish and Wildlife Conservation Commission (FWC) is responsible for the management of fish and wildlife resources consistent with project purposes. The U.S. Fish and Wildlife Service (USFWS), U.S. Department of the Interior (DOI) is responsible for administering the Endangered Species Act (ESA) and also managing the fish and wildlife resources in WCA-1, also known as the Arthur R. Marshall Loxahatchee National Wildlife Refuge (LNWR). The National Park Service (NPS), DOI is responsible for preserving the resources of ENP. Florida Department of Environmental Protection (FDEP) is responsible for regulating the quality of water and for coastal zone management, including enforcement of the State of Florida Coastal Zone Management Plan.

1.7 Vertical Datum

All elevations referenced in this SOM are in feet, and reference the National Geodetic Vertical Datum of 1929 (feet, NGVD). This section will be updated as the North American Vertical Datum of 1988 (NAVD) is incorporated into WCAs, ENP, ENP-SDCS component of the C&SF Project. At that time, a table will be included that correlates the NGVD datum to the NAVD datum to facilitate the datum transition.

Table 1-4. Design Memoranda for the C&SF Project

Part I Agricultural and Conservation Areas
Part II Kissimmee River Basin and Related Areas
Part III Upper St. Johns River Basin and Related Areas
Part IV Lake Okeechobee and Outlets
Part V Coastal Areas South of St. Lucie Canal
Part VI General Studies and Reports

Part	Supplement*	Title	Date
I	Basic Report	Agricultural and conservation areas (with preliminary information on Lake Okeechobee and principal outlets)	10 Jul 51
I	1	Geology and soils	6 Dec 51
I (1)	1	Agricultural area levees	29 Dec 51

Part	Supplement*	Title	Date
I	3	DM, Pump Station 5A	28 Nov 52
V	2	DM, Canal 4	22 Feb 52
V	3	DM, Canal 9 and Structure 29	22 Feb 52
V (2)	4	Hydrology and hydraulic design, Greater Miami area (preliminary draft)	23 Feb 52
V (3)	1	DM, Canal 11	27 Feb 52
I	6	DM, Gates and operating machinery of control structures 5A-E, 5A-W, and 5A-S	5 Mar 52
I	Addendum to 3	DM, Pump Station 5A	24 Mar 52
VI (1)	Section 1	Modified first phase plan	26 Mar 52
I	5	Test levee investigations	28 Mar 52
VI (1)	Section 3 (advance copy)	Schedules, outlines, and costs for preparation of definite project report	8 May 52
VI (1)	Section 2 (advance copy	Construction schedule and cost estimates, authorized first phase	9 May 52
I	4	Structural design (works planned for construction through fiscal year [FY] 1953)	18 Jul 52
V	7	DM (revised), Canal 11, Pump Station 3, Control Structure 13A	8 Aug 52
V	8	DM, Canals 12 and 13, Control Structures 33 and 36	31 Oct 52
V	9	DM (revised), Canal 11, Pump Station 13	17 Nov 52
V(4)	6	DM, Pump Station 9	28 Nov 52
V	10	DM, Vehicle-operated gate hoists	4 Dec 52
I	8	DM, Development of plan of protection for agricultural area	6 Feb 53
I	7	DM, Permeability investigations by well-pumping tests	16 Feb 53
VI	Section 4	Modified first phase plan, 1953	20 Feb 53
IV	1	DM, Effectiveness of Lake Okeechobee Outlets	12 Mar 53
V	5	DM Geology and soils	30 Apr 53
V	Section 5	DM, Channel roughness	1 May 53
I	10	DM, Pump Station 6	27 May 53
I	9	DM, Hydrology and hydraulic design of West Palm Beach Canal and related works (L-10 and L-12)	8 Jun 53
I	11	DM, Hydrology and hydraulic design of 17 Jun 53 West Palm Beach Canal and related works (L-18, L-19, L-20, and S-7)	17 Jun 53
I	13	DM, Hydrology and hydraulic design of 6 Jul 53 North New River Canal and related works (L-18, L-19, L-20, and S-7)	6 Jul 53
I	12	DM, Hillsboro Canal (Levees 14 and 15)	15 Jul 53
I	15	DM, Pump Station 2	29 Jul 53
V	II	DM, Hydrology and hydraulic design 31 Jul 53	31 Jul 53

Part	Supplement*	Title	Date
		of design of Hollywood Canal (C-10)	
I	14	DM, Hydrology and hydraulic design 17 Aug 53 of Miami Canal and related works (L-23, L-24, L-25, S-3, and S-8)	17 Aug 53
VI	Section 6	DM, Rainfall-frequency estimates	4 Sep 53
IV	Supplement 2 (Section 1)	Hydrology and hydraulic design DM, 13 Oct 53 Section Storage level in Lake Okeechobee at the beginning of critical hurricanes	13 Oct 53
I	16	DM, West Palm Beach Canal (Levees 10 & 12)	15 Oct 53
I	17	DM, Pump Station 13	30 Oct 53
I	18	DM, Revision of hydrology and hydraulic design of West Palm Beach, Hillsboro North New River, and Miami Canals	16 Nov 53
I	19	DM, North New River Canal (Levees 20, 19, and 18)	1 Dec 53
IV	Supplement 2 (Section 2)	Hydrology and hydraulic design DM, Hurricane winds over Lake Okeechobee	31 Dec 53
IV	Supplement 2 (Section 5)	Hydrology and hydraulic design DM Lake-regulating facilities	12 Jan 54
IV	Supplement 2 (1) (Section 3)	Hydrology and hydraulic design DM, Wind tides produced by hurricanes	21 Jan 54
IV	3	DM, Prototype tests of Lake Okeechobee type sector gates at Ortona lock	28 Jan 54
I	30	DM, Miami Canal (Levees 25, 24, and 23)	5 Feb 54
V	12 (Revised)	DM, Hydrology and hydraulic design, canals in Greater Miami area (C-2 through C-9)	23 Mar 54
VI	Section 7	DM, Interim report on evaluation of Manning's n in vegetated areas	2 Apr 54
IV	Supplement 2 (1) (Section 4)	Hydrology and hydraulic design DM, Wave action coincident with wind tides	27 Apr 54
V	13	DM, Water- and salinity-control structures in Greater Miami area	2 Jul 54
IV	Supplement 2 (Section 6)	Hydrology and hydraulic design DM, Resistance of levees to wave erosion	13 Aug 54
V	14	DM, Snapper Creek Canal (C-2) and Control Structure 22	1 Oct 54
IV	4	DM, Effects of fresh-water discharges through St. Lucie Canal	27 Oct 54
I	21	DM, Agricultural area levees, Levees 4 (east), 5, and 6	1 Nov 54
I	22	DM, Agricultural area levees, Levees 2, 3, and 4 (west)	19 Nov 54
V	15	DM, Snake Creek Canal extension (C-9, Section 4)	15 Dec 54
VI	Section 8	DM, Rainfall-excess evaluation	5 Jan 55
VI (1)	Section 10	Project authorizations	10 Mar 55
VI	Section 9	DM, Regimen of runoff	16 Mar 55
IV	Supplement 2 (Section 5A)	Hydrology and hydraulic design DM, additional lake-regulating facilities	28 Mar 55

Part	Supplement*	Title	Date
V	16	DM, Canal 17 and Control Structures 43 & 44	5 Apr 55
V	17	DM, Snapper Creek Canal (C-2) navigation requirements	13 May 55
I (1)	23	DM, Levee 39 and Spillway 10	20 Jun 55
II	1	DM, Moore Haven-Newhall area (C-19, L-41, L-42, L-51, S-47B, S-47D, and S-8I)	21 Jul 55
II	2	DM, Hydrology and hydraulic design, Lake Istokpoga-Indian Prairie area (Canals 39A, 40, 41, and 41A, and Structures 66, 68, 70, 71, 72, 75, 82, 83, and 84)	28 Nov 55
I	24	DM, Pump Station 7	13 Dec 55
V	19	DM, Canal 9, Section 1	6 Dec 56
V	18	DM, Little River Canal (C-7)	17 Jan 56
II	4	General DM, Hydrology and hydraulic design, Fisheating Creek area (C-22 and S-69)	24 Apr 56
II	3	DM, Lake Istokpoga-Indian Prairie area (Canals 39A, 40, and 41, and Structures 70, 71, 72, 75, and 82)	31 May 56
VI	Section II	DM, Meteorologic and water-level networks, parts I and V	19 Jun 56
IV	5	Special report on mullet migrations through St. Lucie lock and Dam, 1955-56	20 Jun 56
IV	Supplement 2, Section 3 (Revised)	Hydrology and hydraulic design DM, Wind tides produced by hurricanes	26 Jul 56
IV	Supplement 2, Section 4 (Revised)	Hydrology and hydraulic design DM, Wave action coincident with wind tides	27 Jul 56
V	20	General and Detail DM, Canal 18 and Control Structure 46	20 Aug 56
V	21	Detail DM, Biscayne Canal (C-8) and Control Structure 28	24 Sep 56
II	5	General DM, Kissimmee River Basin	8 Oct 56
VI	Section 12	Summary report, 1954 authorized works on which general DM studies will not be completed by end of 1956	11 Oct 56
II	6	DM, Plan of regulation for Lake Istokpoga	12 Oct 56
III	1	General DM, St. Lucie County canals and control structures (Canals 23, 23A, 24, & 25, & Control Structures 48, 49, 50, 97, 98, & 99)	23 Jan 57
III	2	General DM, upper St. Johns River Basin	20 Mar 57
IV	6	General DM, Caloosahatchee River and control structures (Canal 43 and lock and Spillway Structures 77, 78, and 79)	24 Apr 57
I	26	Detail DM, Pump Station 8	27 May 57
V (1)	22	Detail DM, Canal 10 (Hollywood and Spur Canals)	26 Sep 57
I	25	General DM, Plan of regulation for Conservation Area 1	29 Nov 57
II	7	Detail DM, Canal 41A (Slough and Stub Canals) and Structures 66, 68, 83, & 84	22 Jan 58

Part	Supplement*	Title	Date
I	27	General DM, Plan of regulation for Conservation Area 2	28 Feb 58
IV	Supplement 2 (1) (Section 7)	Hydrology and hydraulic design, Preliminary draft of General DM, Combinations of hydrologic and hydraulic factors affecting height of levees	14 Apr 58
V	23	General and Detail DM, Canal 14 and Control Structures 37A, 37B, and 38A	5 May 58
IV	8	DM, General development plan, recreation, public use, and operation	6 May 58
V	23 (Revised)	DM, Levee 39, Spillway 10, and interim modifications to Levees 7 and 40	Ju1 58
III	3	Detail DM, Canals 23A and 24 (North Fork St. Lucie River and Diversion Canal) and Control Structure 49	19 Sep 58
II	8	Detail DM, Automatic electric control system for Structures 66, 68, 70, 71,72, systems for structures 66,68, 70, 71, 72, 75, 82, 83, and 84, Lake Istokpoga-Indian Prairie area	30 Oct 58
II	5 (Section 1)	Kissimmee River Basin, General DM, Modification of Kissimmee River (C-38) for fish and wildlife	31 Oct 58
I	28	Detail DM, Levee 38 (east), Section 1	23 Dec 58
V	24	General DM, Canals 15 and 16 and Control Structures 40, 41, and 42	31 Dec 58
IV	Supplement 2 (Section 7)	Hydrology and hydraulic design General DM, Combinations of hydrologic and hydraulic factors affecting height of levees	25 Feb 59
V	25	General DM, Canal 1 and Control Structure 21	27 Feb 59
V	26	Detail DM, Cathodic Protection for Control Structures 22 & 29	10 Mar 59
V	27 (Section 5)	General and Detail DM, Canal 9 and Control Structure 30	20 Apr 59
IV (5)	9	Detail DM, Detail development plan, recreation facilities on Canals 43 & 44	14 May 59
IV	7	General and Detail DM, Lake Okeechobee northwest shore levees (Levees 48, 49, and 50, Interceptor Dikes 59, 60, and 61, and Pump Stations 127, 128, 129, 130, 131, and 132)	29 May 59
I	29	Detail DM, Levee 38, Section 2 (raising U.S. Highway 27 between Structures 11A and 11C)	28 Ju1 59
I	30	General DM, Levee 28 (Section 2) and related works	15 Sep 59
IV	11	General DM, Prevention of levee erosion by tree planting	24 Sep 59
I	31	Detail DM, Levees 35B and 38 (Section3), spoil islands--Levees 35B and 38 (Section 2), and Control Structure 38	13 Oct 59
IV (6)	10	General DM, Biological investigations of St. Lucie Estuary in connection with Lake Okeechobee discharges through St. Lucie Canal	15 Oct 59
V	29	General and Detail DM, Modification of Control Structure 13A in Canal 11	22 Oct 59

Part	Supplement*	Title	Date
V	28	Detail DM, Canal 1 (Black Creek) and Control Structure 21	30 Oct 59
V	30	General DM, Levee 31 and related works	6 Nov 59
III	4	Detail DM, Canal 25 (Belcher Canal) and Control Structures 50, 98, and 99	10 Dec 59
V	22 (Revised)	Detail DM, Canal 10 (Hollywood and Spur Canals)	20 May 60
I	33	General DM, Conservation Area 3	22 Jun 60
VI	Section 13	Detail DM, Hydraulic design of inlet structures	24 Jun 60
III	5	Detail DM, Canal 23 and Control Structures 48 and 97	18 Jul 60
IV	13	Detail DM, Pump Stations 127, 129 and 131	7 Sep 60
IV	12	Detail DM, Canal 43, Section 1 (Caloosahatchee River)	22 Sep 60
I	31	General and Detail DM, Canal 1 and Control Structures 21, 148, and 149	29 Sep 60
I	34	Detail DM, Levees 67A and 29, Section 3, and Control Structure 151	30 Sep 60
I	35	Detail DM, Levee 29, Sections 1 and 2, and Control Structures 12A, B, C, D, E, and 14	7 Nov 60
IV	14	Detail DM, Herbert Hoover Dike, Levees D-1, D-2 (part), and D-3 (part)	26 May 61
I	36	General DM, Hydrologic and meteorologic gaging programs, Conservation Area 3	31 May 61
II	9	Detail DM, Canal 38, Section 1 Kissimmee River, and Control Structure 65E	21 Jun 61
II	10	Detail DM, Canals 31 and 35 (St. Cloud and South Port Canals) and Control Structures 59 and 61	23 Jun 61
IV	16	Detail DM, Structure 79, lock and spillway on Canal 43	7 Jul 61
IV	15	Detail DM, Canal 43, Section 2 (Caloosahatchee River)	4 Aug 61
V	32	Detail DM, Levee 31 East, Section 1 (Old Cutler Road to Goulds Canal), and Control Structure 21B	5 Jan 62
V	33	Detail DM, Canal 1, Section 3, and Control Structure 149	26 Jan 62
I	32	Detail DM, Levee 28, Sections 2, 3, and 5	2 Mar 62
II	11	Detail DM, Structure 65D	14 Mar 62
I	38	Detail DM, Levee 68A	22 Mar 62
I	37	Detail DM, Structures 24B, 31, and 150 (Conservation Area 3)	27 Apr 62
V	34	Detail DM, Canals 15 and 16 and Control Structures 40 and 41	28 Jun 62
II	13	Detail DM, Spillways and locks on Canal 38, Structures 65, 65A, 65B, and 65C	20 Jul 62
II	12	Detail DM, Canal 38, Sections 2 and 3 (Kissimmee River)	17 Aug 62

Part	Supplement*	Title	Date
IV	17	Detail DM, Canal 43, Section 3 (Caloosahatchee River)	22 Aug 62
IV	18	Detail DM, Herbert Hoover Dike, Levees D2 (Part), D9 and D4	18 Sep 62
II	14	Detail DM, Canals 36 and 37 (Cypress-Hatchineha Canal and Hatchineha-Kissimmee Canal)	19 Sep 62
IV	20	Detail DM, Structures 77 & 78 on Canal 43	15 Nov 62
II	15	Detail DM, Canal 38, Sections 4, 5 and 6 (Kissimmee River)	11 Feb 63
IV	21	Detail DM, Lake Okeechobee Northeast Shore Area (L-47, L-62, L-63, L-64, L-65, S-133, S-134, S-135, S-152, S-153, S-154, tieback levees, inlet structures, etc.)	12 Mar 63
V	35	Detail DM, Levee 31E, Section 2 (Goulds Canal to Florida City Canal), and Structures 20G and 21A	29 Mar 63
I	39	General DM, Nine-Mile Canal Area (C-20, C-21, L-D1 borrow canal, S-4, S-47, S-169, S-170, railroad bridges, etc.)	29 Mar 63
VI	Section 14	Project authorizations to date	30 Apr 63
IV	19	Preliminary Master Plan, Caloosahatchee River	31 May 63
V	36	General and Detail DM, Cutler Drain Area (C-100, C-100A, C-100B, C-100C, S-118, S-119, S-120, S-121, S-122, and S-123)	23 Jul 63
I	40	Detail DM, Levee 28 interceptor and feeder canals	23 Aug 63
IV	22	Detail DM, Herbert Hoover Dike, Levee D3 (remainder)	5 Sep 63
V	37	General DM, South Dade County	12 Sep 63
III	6	Detail DM, Canals 54 and 56 (Sebastian and Poinsett Outlet Canals), Levee 73, Sec. 1 (Taylor Ck. portion of Jane Green Levee), and Structures 55, 96, 157, and 164	18 Dec 63
V	38	Detail DM, Canal 111, Section 1, and Control Structure 18C	31 Dec 63
I	41	Detail DM, Pump Station 140	19 Jun 64
IV	23	Detail DM, Canal 43, Sections 4 and 5 (Caloosahatchee River)	9 Sep 64
II	16	Detail DM, Canals 33 and 34 (Alligator- Gentry Canal and Canoe Creek Canal	28 Sep 64
V	39	Detail DM, Canals 102 (Princeton Canal, 102(N), and Control Structures 165, 194, and 195	19 Nov 64
V	41	General and Detail DM, Structures 124 and 125 (C-42 and related areas)	15 Dec 64
V	40	Detail DM, Canals 103 (Mowry Canal), 22 Jan 65 103(N), and 103(S), and Control Structures 20F, 166, 167, 179, and 196	22 Jan 65
I	42	Detail DM, Levee 38 (West), Section 1	11 Feb 65
IV	24	Detail DM, Herbert Hoover Dike, Levee 47, and Control Structure 191	8 Mar 65
IV	25	Detail DM, Pump Stations 133 and 135	30 Apr 65
IV	19B (C-1)	Construction DM, Olga Lock and Dam (S-79), Public-use facilities	8 Jun 65

Part	Supplement*	Title	Date
V	42	Detail DM, Levee 31 East, Section 3 30 Ju1 65 (Florida City Canal to Card Sound Road) and Control Structures 20 and 20A	30 Jul 65
V	43	Detail DM, Canal 111, Sections 2 and 3, Canal 111(E), and Control Structures 176, 177, and 178	31 Aug 65
II	17	Detail DM, Canals 30 and 32 and Control Structures 57 and 58	30 Nov 65
V	44	Detail DM, Levee 31(N) and Control Structure 173	31 Jan 66
II	18	Detail DM, Canals 29, 29A, 29B, and Control Structure 62	29 Ju1 66
IV	26	Detail DM, Levees 64, 65, St. Lucie Canal north tieback levee, and Control Structure 153	28 Oct 66
V	45	Detail DM, Canals 109 and 110, and Control Structure 18	15 Dec 66
V	46	General DM, Canals 4, 5, and 6, and Control Structures 25, 25A, 25B, and 26	18 Apr 67
IV	28	Detail DM, lock Structure 193	5 Jun 67
IV	27	Detail DM, Levees 62, 63(N), 63(S), Canal 59 and Control Structure 192	14 Sep 67
I	43	Detail DM, Levee 13 (Cross Canal)	31 Oct 67
V	47	Detail DM, Levee 31(W), Canal 113, and Control Structures 174 and 175	17 Nov 67
III	7	Detail DM, Levee 73, Section 2, Canals 57 and 58, and Control Structures 161, 162, 163, and 221	28 Feb 68
I	44	Detail DM, Pump Station 4	22 Apr 68
V	48	Detail DM, Canals 106, 107, and 108 and Control Structures 19 and 198	23 Aug 68
II	Supplement 5 Section 2	General DM, Modification of Plan for Canals 46 and 46A and Structures 87, 87A, 87B, and 87C	11 Apr 69
I	45	Detail DM, Canal 21 and Control Structure 169	6 Jun 69
V	45 (Revised)	Detail DM, Canals 109 and 110, and Control Structures 18 and 199	14 Oct 69
IV	27 (Revised)	Detail DM, Levees 62, 63(N), 63(S), Canal 59, and Control Structure 192	20 Oct 69
IV	29	Detail DM, Seaboard Coast Line Railroad Bridge B-142 Over Levee 63(N) Borrow Canal	10 Aug 70
III		Detail DM, Levee 72, Control Structure 160, Culverts 1 through 6	18 Aug 70
I	47	Detail DM, Canal 20, Levees D1 and D3 Connecting Canal and Control Structures 47, 233, 234, and 235	30 Dec 70
V	50	Detail DM, Coastal Areas South of St. Lucie Canal-Control Structure 25 in Miami Canal (C-6)	26 Nov 71
IV	30	Detail DM, Lake Okeechobee and Outlets St. Lucie Canal Tieback Levees	13 Jan 72

Part	Supplement*	Title	Date
I	46	General and Detail DM, Pump Station 236	28 Feb 72
V	49	General and Detail DM, Canals 12N and 13, Control Structures 224 and 237	4 Apr 72
V	51	General and Detail DM, West Palm Beach Canal and Related Areas with Detail Design Appendix on Pump Station 319	Jun 72
I	47	Detail DM, Canal 20 (Revised)	12 Jun 72
I	49	General and Detail DM, Modification of Levees 7, 35B, and 38, Section 2 (U.S. Highway 27—Between Structures 11A and 11C), and Deletion of Canal 302	31 Aug 72
V	54	Detail DM, Canal 51 and Control Structures 155 and 155A	Nov 72
V	53	Detail DM, Control Structures 25 and 25A in Comfort Canal (C-5) and 25B in Tamiami Canal (C-4)	Nov 72
IV	31	General and Detail DM, Port Mayaca lock (S-308B) and Spillway (S-308C)	Nov 72
V	52	General DM Conveyance Canals to ENP and South Dade County with Detail Design Appendix on Pump Station 331 and Enlargement of Reaches of Levee 31(N) Borrow Canal, C-1, and C-103	Jun 73
V	55	Detail DM, Levee 29, Section 3, Borrow Canal Enlargement, Pump Station 332, and Control Structures 194(Mod), 333, 334, 335, 336, and 338	Aug 74
V	56	Detail DM, Levee 30, Borrow Canal Enlargement and Control Structures 32A and 337	Mar 76
IV	52	General and Detail DM, Lock Structure 310 (S-310)	May 76
I	48	General DM, Hendry County Area with Detail Design Appendix on Structure 239 and Canals 139 and 139 South	Feb 77
I	53	General and Detail DM on Structures 339 and 340	Sep 77
I	51	General and Detail DM on L-18 and L-19 (North New River Canal), and L-24 and L-25 (Miami Canal) Bump Removal	Mar 78
V	52 (Addendum 1)	General and Detail DM, Enlargement of Canal 304 and Culvert Structure 151	Jun 78
V	57	Buttonwood Canal Improvements and Related Works, ENP, Structure 341	Ju1 79
V	41 (Addendum 1)	Detail DM, Canal 51-East End and Control Structure 155	Dec 81
II	19	General DM, Nicodemus Slough Area	Jan 82
IV	33 (HGS-4)	General DM, Spillway Structures 351	Jun 84
III	11	General DM, St. Lucie County Water Supply Element, C-131, Enlargement C-28 Portion, PS-2l4, S-115, S-116, S-117, S-118, PS-307, PS-313, S-112, and S-348	Jun 84
III	2 (Addendum 3)	General DM Upper St. Johns River Basin with Draft Environmental Impact Statement (EIS)	Ju1 84

Part	Supplement*	Title	Date
V	54	Detail DM Canal 51-West End, Control Structure 155A and Pump Station 319	Ju1 85
IV	34	DM, Spillway Structure 351 (HGS-4)	Jun 85
IV	35	General DM, Spillway Structure 352 (HGS-4)	Aug 85
IV	37	Detail DM Spillway Structure 352 (HGS-5)	May 86
III	12	Detail DM Structure 96B and Tieback Levee	Ju1 86
IV	36	General DM, Spillway Structure 354 (HGS-3)	Dec 86
III	13	Detail DM, Structure l61A and Tieback Levee Structure 255, Levee 74N (Part) and Levee 74E	Mar 87
IV	38	Detail DM, Spillway Structure 354 (HGS-3)	Apr 87
III	14	Detail DM, S-252A, S-252B and S-252C Levee 78 and Levee 79	Aug 87
III	15	Detail DM, Structure 96C and 96D	Oct 88
III	15	Detail DM, Structure 96C and 96D (Revised)	Feb 89
III	16	Detail DM, S-250A, S-250B, S-250C, S-251 and S-254, Levee 74W, L-77 and L-74N (Part)	Mar 87
II	20	General DM, Shingle Creek, C-120A, C-120B, S-353 and Environmental Structures ES-1, ES-2, and ES-3	Sep 89
III	17	Detail DM, Levee 75 (Section 1)	Oct 89
III	18	Detail DM, Levee 74 N. Part, Levee 75 Remainder, and Structure 256	Mar 91
(1)		C&SF Project, Modified Water Deliveries (MWD) to Everglades National Park General DM	Jun 92
I	55	Feature DM, Agricultural And Conservation Areas	Sep 93
		C&SF Project, Final Integrated General Reevaluation Report (GRR) and Environmental Impact Statement (EIS), C-111 South Dade County, Florida	May 1994
V	54 (Addendum2) (Revised)	Detail DM, Canal 51-West End, Control Structures 155A and 360, Pump Station 319 and Levee 85	Sep 97
n/a	n/a	C&SF Project, Modified Water Deliveries (MWD) to Everglades National Park, Florida 8.5 Square Mile Area (SMA), General Reevaluation Report (8.5 SMA GRR)	July 00
n/a	n/a	DDR Pump Station S-357	Mar 03
n/a	n/a	C&SF Project, GRR/Supplemental EIS (GRR/EIS) for the Tamiami Trail Modifications, MWD to ENP,	Dec 03
n/a	n/a	C&SF Project, Final Revised GRR/Second Supplemental EIS (GRR/EIS) for the Tamiami Trail Modifications, MWD to ENP,	Nov 05
n/a	n/a	MWD to Everglades National Park, Tamiami Trail Modifications Final Limited Reevaluation Report (LRR) and EA	Jun 08
n/a	n/a	Everglades National Park, Tamiami Trail Modifications: Next Steps Final EIS,	Nov 10
n/a	n/a	DDR Pump Station S-357	Mar 03

Part	Supplement*	Title	Date
n/a	n/a	DDR C-111, Detention Area and Other Features (Contract 8)	Apr 12
n/a	n/a	DDR for the Big Cypress Seminole Indian Reservation Western Water Conservation Restoration Project – Everglades Restoration Critical Project #6	Sep 04
n/a	n/a	DDR 8.5 Square Mile Area S-357N Control Structure and C-358 Seepage Canal	Jan 15
n/a	n/a	DDR C-111, Detention Area and Other Features (Contract 8)	Sep 15
n/a	n/a	DDR C-111, L-31W Borrow Canal and Miscellaneous Features	Apr 16
n/a	n/a	Canal 111 (C-111), South Dade County, Florida Final Limited Reevaluation Report (LRR),	Nov 16

* NOTES:

1) Superseded by later studies
2) Superseded by Part V, Supplement 12, dated 23 March 1954
3) Superseded by Part V, Supplements 7 and 9, dated 8 August 1952 and 17 November 1952, respectively
4) Superseded previous DM (Part V, Supplement 6, dated 8 September 1952)
5) Superseded by DDM No. 1, Okeechobee Waterway, Florida, dated 17 December 1959
6) Superseded by consultant's report, dated 15 October 1959

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2 REGIONAL DESCRIPTION

This chapter (2) describes the Federal components of the C&SF Project within WCAs, ENP, ENP-SDCS Basin. Features which are integrated or pertinent to the Federal project but are non-Federally built are listed in Chapter 3 of this SOM. Pertinent sections in Chapter 3 (Section 3.4) need to be reviewed to have a complete understanding of the configuration and operation of the water control system.

2.1 Location

The Water Conservation Areas, Everglades National Park, and ENP-South Dade Conveyance Basin (WCAs, ENP, and ENP-SDCS) are located in a region of south Florida known as the Everglades (Plate 2-1-Infrastructure map dated May 2019). The WCAs include WCA-1, WCA-2, and WCA-3 which are adjacent to and south of the Everglades Agricultural Area (EAA) (Plate 2-2 through Plate 2-5 WCAs and SDCS maps). WCA-1 is approximately 15 miles west of West Palm Beach. WCA-2 is approximately 15 miles west of Fort Lauderdale, Florida. WCA-3 and ENP-SDCS are approximately 20 miles west and southwest of Miami, Florida, respectively. ENP extends from Tamiami Trail (U.S. Highway 41 located immediately south of WCA-3) to Florida Bay and the Gulf of Mexico. ENP-SDCS is east of ENP and extends from Tamiami Trail (U.S. Highway 41 located immediately south of WCA-3) to Biscayne Bay and Florida Bay. The WCAs, ENP, ENP-SDCS expands across parts of 6 counties in Florida: Palm Beach County, Hendry County, Broward County, Miami-Dade County, Collier County, and Monroe County.

2.2 Purpose

The Congressionally authorized project purposes for the WCAs, ENP, and ENP-SDCS component of the C&SF Project are: flood control (flood risk management); navigation; water supply for agricultural irrigation, municipalities and industry, the Everglades National Park (ENP), regional groundwater control, and salinity control; enhancement of fish and wildlife; and recreation. Refer to Table 2-11, Volume 1 Master Water Control Manual for public laws authorizing these purposes.

2.3 Physical Components

The WCA-1, 2, and 3 are completely contained by levees, except for approximately a 7 mile gap in the levee on the Big Cypress National Preserve (BCNP)/WCA-3A boundary. The Seminole Big Cypress Basin is northwest of WCA-3A and consists of three Seminole Big Cypress Reservation Water Conservation Plan Critical Project (SBC Project) sub-basins (Basins 1, 2, and 4) that may release water to the BCNP and structure 190 (S-190) located on the L-28 Interceptor Canal. There is a levee system on the east side of the East Everglades (eastern boundary of the WCAs), also called the East Coast Protective Levee (ECPL), which protects the urban, agricultural and industrial areas from flooding due to high water levels in the WCAs. The ENP-SDCS is a water conveyance system bounded on the north by L-29 and C-4, on the east by developed areas of south Miami-Dade and the East Coast Canal (ECC) system, on the west by ENP, and on the south by ENP Panhandle and Biscayne Bay. WCAs, ENP, ENP-SDCS are managed by a system of canals, pump stations, and water management structures. Detailed descriptions of the pump stations and water control structures are listed in Appendix A. The main canals include The West Palm Beach Canal, Miami Canal, North New River Canal, South New River Canal, Hillsboro Canal, Tamiami Canal (L-29 Borrow Canal), L-31N Borrow Canal, and Canal111 (C-111). Reference Plate 2-1 through Plate 2-6 for maps of structure locations.

2.3.1 Seminole Big Cypress Basin 1

The Seminole Big Cypress Basin 1 is located in the northwest corner of the Seminole Big Cypress Reservation. It is bound by the West Feeder Canal to the south, the Reservations Western boundary to the west, and the existing field ditch system to the east and north. The SBC Project features in this area provide water quality improvements, ecosystem restoration, water storage capacity, and flood risk management for the 25-year 72-hour storm event. Features include Water Resource Areas (WRAs), Irrigation Storage Cells (ISCs), levees, water management structures, and pump stations. For operational criteria see the Interim Water Control Plan for Seminole Big Cypress Reservation Water Conservation Plan Critical Project – Basin 1 (located in Appendix G of this document). Basin 1 contains four canals (I1ANE, I1AS, I1FS and I1ES) used for the conveyance of basin water. Project features can be seen in Figure 2 of the Interim Water Control Plan for Seminole Big Cypress Reservation Water Conservation Plan Critical Project Basin 1 in Appendix G.

2.3.1.1 Levees

A system of levees encompasses each of the WRAs (WRA-1W and WRA-1E) and each of the ISCs (I1A, I1B, I1C, I1D, I1E, and I1F). Total leveed embankment length is approximately 12 miles including SBC 1, SBC WRA-1W, and SBC WRA-1E. These include eight different levee segments (SBC 1-1E, SBC 1-1F, SBC 1-1B, SBC 1-1A, SBC WRA-1W, SBC 1-1D, SBC WRA-1E, and SBC 1-1C).

2.3.1.2 Structures

2.3.1.2.1 EP1

EP1 is an equalization structure which hydrologically connects WRA-1W and WRA-1E (the WRAs are shallow wetland areas). EP1 is a five barreled uncontrolled (free flowing) corrugated aluminum pipe culvert approximately 250 feet long and with each barrel measuring 60 inches in diameter.

2.3.1.2.2 OUT1A/1B

OUT1A and 1B are outfall structures for WRA1 into the West Feeder Canal. They both are two barreled corrugated aluminum pipe culverts 70 feet long and with each barrel measuring 48 inches in diameter. To prevent over drainage of the WRA the culverts are equipped with a stop log riser with a fix crest overflow.

2.3.1.2.3 Siphon 1

Siphon 1 provides additional flood control for WRA1 by siphoning water from that area under the West Feeder Canal into a spreader swale which releases water to the Native area south of the West Feeder Canal. Siphon 1 consists of a high-density polyethylene (HDPE), two-barreled culvert 450 feet long and with each barrel 60 inches in diameter. The riser/weir box consists of a 42 feet long box length with a fixed crest elevation of 19.2 feet, NGVD29. Siphon 1 discharges into a 2,400 feet long spreader swale designed to spread the released water into the Native Area south of the Feeder Canal.

2.3.1.2.4 Irrigation Storage Cell Structures

Overflow structures are located within the ISCs and consist of a fixed weir which will release water above the maximum depth in the cells. The intent of the ISCs is to store water for flood damage reduction and then use that stored water for water supply as needed. However, due to excessive seepage from these

areas limited water supply can be provided. The cells contain three types of culvert structures: overflow structures (OF1A, OF1C2, OF1C3, OF1D2 and OF1D3), irrigation return structures (IR1A, IR1C, IR1D and IR1E), and irrigation return/overflow structures (OF1B, OF1C1, OF1D1, OF1E, and OF1F). For full structure details see water control plan (Appendix G).

2.3.1.3 Pumps

Basin 1 contains 10 pump stations (P1, P2-1, P2-2, P3-1, P3-2, P3-3, P4, P5, P6-1, P6-2, P7-1, P7-2, P8, P9, and P10) which operate for both flood risk management and water supply. Pumps P4, P5, P8, P9 and P10 transfer excess water away from the citrus groves and other agricultural fields located inside the basin to the ISCs. P6 and P7 transfer water from agricultural fields and pastures to ISCs located adjacent to a WRA. P1 provides irrigation water from the West Feeder Canal into citrus groves. P2 and P3 transfer water from the agricultural fields and Billie Swamp Safari Wildlife Area into WRA1-W. For pump station data please refer to the water control plan (Appendix G).

2.3.2 Seminole Big Cypress Basin 2

The Seminole Big Cypress Basin 2 is located in the northwest corner of the Seminole Big Cypress Reservation. It is bound by the West Feeder Canal to the south, the existing field ditch system to the west that serves as a common boundary between Basin 1 and Basin 2, the existing field ditch system approximately two miles east of the western boundary which would have served as the common boundary with Basin 3, and by the Reservation's boundary to the north. The project features in this area provide water quality improvements, ecosystem restoration, water storage capacity, and flood risk management. For operational criteria see the Big Cypress Seminole Indian reservation Water Conservation Plan Critical Restoration Project Water Control Plan for Basin 2 (Appendix G). Basin 2 contains one WRA, which is split into two parts, WRA2E (193 acres) and WRA2W (278 acres), by Cowbone Island Road and the adjacent Cowbone Island Canal. There are two borrow canals along the boundaries of WRA2E and WRA2W used for the conveyance of basin water and one additional canal (Canal 1) for agricultural drainage along the northeast side of WRA2W. Project features can be seen in Figure 7-2 of the Interim Water Control Plan for Seminole Big Cypress Reservation Water Conservation Plan Critical Project Basin 2 in Appendix G.

2.3.2.1 Levees

Levees surround the two water resource area cells (WRA2E and WRA-2W). Total leveed embankment length is 6.38 miles with two segments (WRA-2E and WRA-2W).

2.3.2.2 Structures

2.3.2.2.1 EP2

EP2 is an equalization structure which connects WRA2E and WRA2W to allow unrestricted water movement between the two cells. The structure is a 42-inch diameter uncontrolled single barreled corrugated aluminum pipe culvert 269 feet long.

2.3.2.2.2 Siphon 2

Siphon 2 releases water from WRA-2 by siphoning water from that area under the West Feeder Canal into a 2,400-foot long spreader swale which releases water to the Native area south of the West Feeder Canal.

Siphon 2 design discharge is 244 cubic feet per second (cfs). Siphon 2 consists of a high-density polyethylene, two-barrel culvert 450 feet long and with each barrel 60 inches in diameter. The riser/weir box consists of a 42 feet long box length.

2.3.2.2.3 OUT2A/2B

OUT2A and 2B are outfall structures for WRA-2E and WRA2W, respectively, into the West Feeder Canal. OUT2A is a one-barreled culvert and OUT2B is two-barreled culvert, which are both corrugated aluminum pipe 73 feet long.

2.3.2.3 Pump Stations

Basin 2 has four pump stations (P11, P14, P15, and P27) which operate for flood risk management and water supply. P11 and P27 serve as irrigation pumps for water supply throughout the year and are intended to run only during dry weather conditions when supplemental water is needed for irrigation. P11 and P27 are designed to pump water from the West Feeder Canal to irrigation canals and are controlled by the water level of the irrigation canal to which they are pumping. P11 discharges into WRA-2 West Canal and P27 discharges into Cowbone Island Canal. P14 and P15 serve as flood risk management pumps and are intended to run only during wet weather conditions. P14 is designed to pump water from the Cowbone Island Canal into WRA-2W and is controlled by the water level in that canal. P15 is designed to pump water from the WRA2E irrigation canal (which receives water from the citrus groves and agricultural fields) into WRA-2E.

2.3.3 Seminole Big Cypress Basin 4

The Seminole Big Cypress Basin 4 is located north of the Seminole Big Cypress Reservation. The northern boundary is an unimproved road along the north boundary of Township 48 South which is also the divide line of Township 47 South (T47S) and 48 South (T48S) of Hendry County (USGS Quad Sheets Goddens Strand, FLA and Cow Bone Island, FLA) and the southern boundary is approximately one mile south of the northern boundary. The eastern boundary runs along the North Feeder Canal and the westward extent is near vicinity of County Road No. 833 (BIA Road No.1281). SBC Project features in this area provide water quality improvements, ecosystem restoration, water storage capacity, and flood risk management and are the WRA-4, a stormwater cell (S4A), levees, water management structures, and pump stations. For operational criteria see the Big Cypress Seminole Indian reservation Water Conservation Plan Critical Restoration Project Water Control Plan for Basin 4 (Appendix G). Basin 4 contains six Borrow Canals (WRA-4E, S4A, WRA-4A, WRA-4B, WRA-4C, and WRA-4D) used for the conveyance and drainage of basin water. Project features can be seen in Figure 2 of the Interim Water Control Plan for Seminole Big Cypress Reservation Water Conservation Plan Critical Project Basin 4 in Appendix G.

2.3.3.1 Levees

Basin 4 levees encompass WRA-4 and one stormwater cell (S4A). Total leveed embankment is approximately 3 miles consisting of SBC S4A and SBC WRA-4.

2.3.3.2 Structures

2.3.3.2.1 OUT4

OUT4 is an outfall structure which allows flow from WRA-4 into the North Feeder Canal via WRA-4E canal. The design releases from OUT4 is approximately 15 cfs.

2.3.3.2.2 OF4A

OF4A is an uncontrolled single barreled corrugated aluminum pipe culvert structure 56 feet long and 36 inches in diameter, which releases water from S4A into the WRA-4.

2.3.3.3 Pump Stations

Basin 4 contains two pump stations (P25 and P26) which provide flood risk management by transferring water from S4A canal into S4A stormwater cell.

2.3.3.4 Structure 190 (S-190)

S-190 is located on the L-28 Interceptor Canal about 32 miles south of Clewiston. This structure is a reinforced concrete, gated spillway with release controlled by two cable operated, vertical lift gates. Operation of the gates is automatically controlled in accordance with the established operational criteria. This structure maintains optimum upstream water control stages in the North and West Feeder Canals, and prevents over drainage of these canals. Detailed S-190 structure description and its operating criteria are listed in Appendix A of the SOM.

2.3.4 Stormwater Treatment Area 1 East (STA-1E)

STA-1E is located approximately 20 miles west of West Palm Beach, Florida, south of State Road (S.R.) 80 and C-51, adjacent to the northeast boundary of WCA-1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge). STA-1E features include levees, water management structures, and pump stations. STA-1E consists of three parallel treatment paths, or flow-ways, with eight treatment cells flowing from north to south. This created wetland marsh system will provide an effective treatment area of 4approximately 5,000 acres within the eight treatment cells, and an additional 1,046 acres in the distribution cells upstream of the eight treatment cells. For additional information, refer to the “SFWMD Interim Operation Plan for Stormwater Treatment Area 1 East” of the SOM, Volume 3.

2.3.4.1 Levees

2.3.4.1.1 Levee 85 (L-85)

L-85 encompasses the north, east, and southern portions of STA-1E and is approximately 9 miles long. L-85 is a part of the ECPL, acting as a barrier between STA-1E and the urban areas to the east and north as well as holding water in STA-1E for treatment. L-85 has a construction grade of 26.0 feet, NGVD, a design elevation of 24.0 feet, NGVD, and an estimated overtopping elevation of 22.6 feet, NGVD.

2.3.4.1.2 Levee 40 (L-40)

L-40 forms the western boundary of STA-E as well as the eastern boundary of WCA-1. The total length is approximately 29 miles from West Palm Beach Canal to Hillsboro Canal at the junction with L-36 (WCA-2A). L-40 is considered part of the ECPL and provides for the management of floodwater. L-40 has a construction grade ranging of 24.5 feet, NGVD, a design elevation of 24.0 feet, NGVD, and an estimated overtopping elevation of 22.8 feet, NGVD. L-40 contains a gated spillway, S-39, and three SFWMD structures, G-94A, G-94C, and G-94D. The L-40 Borrow Canal is on the west side of the levee.

2.3.4.2 Structures

2.3.4.2.1 Structure G-311

G-311 (non-Federal) is a three-bay gated spillway with a symmetrical ogee weir located at the northwestern edge of STA-1E south of S-5AS. The primary purpose of G-311 is to move water from the STA-1 Inflow & Distribution works into STA-1E, with a secondary purpose of moving water between STA-1E (Federal) and 1W (non-Federal). G-311 can be operated remotely or manually.

2.3.4.3 Pump Stations

2.3.4.3.1 Pump Station 319 (S-319)

S-319 is located on the C-51 at the northern rim of STA-1E, east of S-5AE and west of S-155A. S-319 pumps water from the C-51 canal into STA-1E with five diesel engine-driven pumps (three 960- cfs pumps and two 550-cfs pumps) which have a total capacity of 3,980 cfs. S-319 releases water into the East Distribution Cell and can then be routed to the eastern and central flow-ways, where it acts as the primary inflow structure. Water is delivered to the west distribution cell from S-319 through S-375, where water can either be sent into the western flow-way or diverted to the STA-1 Inflow & Distribution works through G-311. S-319 can be operated remotely or manually. S-319 was designed to pump all permitted inflows to STA-1E (generally at a rate of one inch per day) plus seepage inflow from C-51.

2.3.4.3.2 Pump Station 362 (S-362)

S-362 is located at the southern tip of STA-1E on the L-40 Borrow Canal which is inside WCA-1. S-362 is the outflow pumping station moving treated water from STA-1E into WCA-1. S-362 consists of seven pumps: five diesel-driven pumps (three 960- cfs pumps and two 550-cfs pumps) and two electric motor driven pumps (each with a capacity of 110-cfs) with a combined nominal capacity of 4,200 cfs. S-362 can be operated remotely or manually. The design pumping capacity is equivalent to the inflow pump stations S-319 and S-361 and direct rainfall over STA-1E.

2.3.4.3.3 Pump Station 361 (S-361)

S-361 is located immediately east of STA-1E and provides flood risk management to the lands to its south and east. These areas were previously managed by C-51, but with the addition of STA-1E, S-361 was needed to provide management of those areas similar to before construction. S-361 also acts as seepage control for STA-1E. The design capacity of S-361 is 75 cfs provided by three vertical electric pumps (diesel power generators are available as backup). S-361 can be operated remotely or manually.

2.3.5 Water Conservation Area 1 (WCA-1)

WCA-1, with an area of 221 square miles, is completely contained by Levee 7 (L-7), L-40, and L-39. Inflows to WCA-1 can occur from STA-1E S-362 , from S-5A pump station thought the STA-1 Inflow and Distribution Works through non-Federal structures (G-300, G-301) and non-Federal pump stations from STA-1W (G-251 and G-310). Additional inflows to WCA-1 include flows from Federal pump station S-6 (through non-Federal structure G-338). Releases from WCA-1 are made through the three major federally controlled outlet structures, S-10A, S-10C, and S-10D, and two smaller spillways S-39 and S-5A(S). Non-Federal WCA-1 outflow structures G-94A, G-94C, and G-94D located on L-40 are mainly used for water supply deliveries to the agricultural and urban areas to the east of WCA-1. Outflows can also be made out of G-338.

2.3.5.1 Levees

Information such as location, general condition, and risks associated with levees in south Florida can be found at the National Levee Database (https://levees.sec.usace.army.mil/#/). Construction grade, design elevation, and estimated overtopping elevation of WCA-1 levees are listed in **Table 2-1**.

Table 2-1. WCA-1 Levee Construction Grades, Design Elevations, and Overtopping Elevations

Levee	Construction Grade (feet, NGVD)	Design Elevation (feet, NGVD)	Estimated Overtopping Elevation (feet, NGVD)
L-85	26.0	24.0	22.6
L-7	22.0	21.0	18.9
L-40	24.5	24.0	22.8
L-39	20.8	21.0	19.0
L-40S	24.5	24.0	22.7

2.3.5.1.1 Levee 7 (L-7)

L-7 begins at the Hillsboro Canal, Pump Station 6 (S-6) and extends north 17.0 miles to the West Palm Beach Canal defining the western boundary of WCA-1. L-7 provides for the conservation of floodwater runoff.

2.3.5.1.2 Levee 40 (L-40)

L-40 forms the eastern boundary of WCA-1 and extends southward 29 miles from West Palm Beach Canal to Hillsboro Canal at the junction with L-36 (WCA-2A). L-40 is the northern most levee of the ECPLL-40 contains a small, gated spillway, S-39, and three SFWMD structures, G-94A, G-94C, and G-94D, which were replaced between 2014 and 2016. The L-40 Borrow Canal is on the west side of the levee.

2.3.5.1.3 Levee 39 (L-39)

L-39 creates the southern boundary separating WCA-1 and WCA-2. L-39 runs for approximately 13.0 miles along the south side of Hillsboro Canal from Pump Station S-6 to L-40 and contains S-10A, S-10C, and S-10D for water releases from WCA-1 into WCA-2.

2.3.5.2 Structures

2.3.5.2.1 Structure 5A East (S-5AE)

S-5AE is a double-barreled reinforced concrete box culvert connecting the L-8 Borrow Canal with C-51 (West Palm Beach Canal) at the L-40 intersection. S-5AE has a design discharge of 700 cfs. S-5AE functions primarily with S-319 but also with S-5AW, S-5AS, and S-5AE to manage runoff and provide water supply releases to C-51 east of L-40. L-8 Basin runoff can be moved through S-5AE via C-51 to tide.

2.3.5.2.2 Structure 5A South (S-5AS)

S-5AS is a gravity flow spillway located in the L-8 Borrow Canal south of C-51 where L-7 intersects the L-40 Borrow Canal. S-5AS has a design discharge of 2,000 cfs controlled by two cable operated, vertical lift gates. S-5AS functions with S-5AE, S-5AW, and S-5A to manage flood runoff from the L-8 basin via STA-1E and/or STA-1W as well as to make water supply releases from WCA-1. . S-5AS can work in conjunction with pump stations S-319 and/or S-5A and the STA-1 Inflow and Distribution work to send water north through the L-8 Borrow Canal to the L-8 FEB. If desired to send water to the eastern or central flow paths of STA-1E then water could be diverted through S-5AE to S-319.

2.3.5.2.3 Structure 5AW (S-5AW)

S-5AW is a double-barreled reinforced concrete box culvert connecting the L-12 borrow canal to the L-8 borrow canal. S-5AW has a design discharge of 700 cfs controlled by motor operated sluice gates. S-5AW functions with S-5AE, S-5AS, and S-5A to control irrigation releases in the L-10 and L-12 basins as well as to pass flood runoff from L-8 Borrow Canal and C-51 into WCA-1 via the S-5A and the STA-1 Inflow and Distribution Works.

2.3.5.2.4 Structures 10A, 10C, and 10D (S-10A, S-10C and S-10D)

S-10A, S-10C, and S-10D (S-10s) are located in L-39 on the southwest boundary of WCA-1 approximately 15 miles west of Boca Raton. The S-10s are gated, four-bay, spillways with a combined design discharge of 14,400 cubic cfs. The S-10s are the primary outlet structures for releases from WCA-1 to WCA-2. The S-10s can be operated manually or remotely by the Jacksonville District Water Management Section.

2.3.5.2.5 Structure 39 (S-39)

S-39 is a gated reinforced concrete spillway located where L-40 crosses the Hillsboro Canal. S-39 has a design discharge of 800 cfs controlled by one remotely or manually operated tainter gate. The primary purpose of S-39 is to release water from WCA-1 to the Hillsboro Canal for water supply during dry periods. S-39 has also been used to send water east to tide from WCA-1 when downstream capacity is available.

2.3.5.3 Pump Stations

2.3.5.3.1 Pump Station 5A (S-5A)

S-5A is located west of S-5AW near the intersection of L-40, L-8 Borrow Canal, C-51, and L-12 Borrow Canal. S-5A has six diesel pumps with a total capacity of 4,600 cfs. S-5A pumps water from the L-12 Borrow Canal, L-8 Borrow Canal, and C-51 into WCA-1 via STA-1 Inflow and Distribution Works primarily for flood risk management. The primary purpose of the pumping station is to pump surplus water from the L-10, L-

12 basin, the S-5A agricultural area northwesterly of the pumping station into Conservation Area No. 1, at the rate of 3/4 inch per day, from the 230 sq. mile tributary drainage area.

2.3.5.3.2 Pump Station 6 (S-6)

S-6 is located in northern end of the Hillsboro Canal at the junction of L-7 and L-6. S-6 has three diesel pumps for a total capacity of 2,925 cfs and pumps water from the Hillsboro Canal into WCA-2 via STA-2. The purpose of the pumping station is to pump surplus water via the Hillsboro Canal from Lake Okeechobee and the agricultural area northwesterly of the pumping station into STA-2, at the rate of 3/4 inch per day from the 146 sq. mile tributary drainage area. S-6 may also operate in conjunction with non-Federal structure G-338 to send untreated water to WCA-1 in the event of extreme high water upstream of WCA-1, or to pass water supply releases from upstream sources into WCA-1. Also, when conditions warrant, S-6 may also be used to move Lake Okeechobee releases south for treatment in STA 2.

2.3.5.3.3 Pump Station 362 (S-362)

S-362 is located at the northern end of the L-40 Borrow Canal and is the outflow pumping station for STA-1E. S-362 has seven pumps: five diesel engine-driven pumps (three 960 cfs pumps and two 550 cfs pumps) and two additional 110 cfs electric motor driven pumps, for a combined nominal capacity of 4,200 cfs. S-362 is used to pump treated water from STA-1E project into WCA-1.

2.3.6 Water Conservation Area 2 (WCA-2)

WCA-2 is located south of WCA-1, north of WCA-3 and is 210 square miles, subdivided by L-35B into WCA-2A and 2B. The Hillsboro Canal separates WCA-2 from WCA-1 and the North New River Canal separates WCA-2 from WCA-3. A levee system encompasses WCA-2, including L-35B (the WCA-2A/WCA-2B divider levee), L-39 (border with WCA-1), L-6, L-35, L-35A, L-36, L-38E, and L-38W. Inflows into WCA-2 occur through the Federal structures S-10s from WCA-1 and S-7from the North New River Canal and from STA-2 via non-Federal structures G-336G and G-336A-F. Releases from WCA-2A are made through the three major Federal outlet structures, S-11A, S-11B, and S-11C (S-11s) into WCA-3A. Releases are also made from WCA-2A into WCA-2B through Federal structures S-144, S-145, and S-146. Additionally, releases can be made out of WCA-2A east to tide via Federal structure S-143 into the North New River Canal and east to tide via Federal structure S-38. Releases out of WCA-2B can be made through Federal structure S-141 to the North New River Canal.

2.3.6.1 Levees

Construction grade, design elevation, and estimated overtopping elevation of WCA-2 levees are listed in **Table 2-2**.

Table 2-2. WCA-2 Levee Construction Grades, Design Elevations, and Overtopping Elevations

Levee	Construction Grade (feet, NGVD)	Design Elevation (feet, NGVD)	Estimated Overtopping Elevation (feet, NGVD)
L-6 Exterior	17.5	21.0	12.9*
L-35B Section 1	20.0	13.0	20.4
L-35B Section 2	19.0	18.0	17.9
L-36	20.0	22.0	19.9

Levee	Construction Grade (feet, NGVD)	Design Elevation (feet, NGVD)	Estimated Overtopping Elevation (feet, NGVD)
L-38 East Section 1	20.0	19.5	15.7
L-38 East Section 2	19.5	18.0	17.5
L-35	22.0	20.0	20.3
L-35A	22.0	20.0	21.0
L-35B Section 2	19.0	18.0	17.9
L-36	22.0	20.0	19.7
L-38 East Section 3	14.0	13.0	13.0

2.3.6.1.1 Levee 6 (L-6)

L-6 forms the northwestern boundary of WCA-2A. L-6 historically extended from the junction of the Hillsboro Canal with L-7 (S-6 Pump Station) to the junction of the North New River Canal with L-5 (S-7 Pump Station). The lower 3 miles of L-6 were degraded to allow discharges from STA-2 to distribute into the WCA-2A marsh. L-6 consists of a low interior levee on the northwest side and a high exterior levee on the southeast side with a Borrow Canal in between. As part of the outer-encirclement perimeter levees, L-6 protects the agricultural land to the northwest from water in WCA-2 and hurricane driven wind tides and waves. L-6 contains the non-Federal structures G-336A-F and G-336G which move releases from STA-2 from the L-6 borrow canal into the northeast and southwest segments of the L-6 Borrow Canal, respectively. Treated releases from STA-2 are either released to WCA-2A via G-336G (non-Federal) through a 3-mile gap in the L-6 levee, which is located just northeast of S-7 Pump Station or through G-336A-F. The L-6 gap, constructed in 1999, was one of eight hydropattern restoration projects proposed in the 1996 Everglades Construction Project Programmatic Environmental Impact Statement. The remainder of the L-6 on the exterior is approximately 8 miles long and approximately 11 miles for the interior portion.

2.3.6.1.2 Levee 35 (L-35)

L-35 forms the southern boundary of WCA-2B. L-35 begins at S-34E and extends southeast along the north bank of North New River Canal from the junction of L-37 with North New River Canal to the south end of L-35A. L-35 is approximately 5 miles long and protects lands to the south and east of the levee from water within WCA-2B.

2.3.6.1.3 Levee 35A (L-35A)

L-35A forms the southeastern boundary of WCA-2B. It extends approximately 6 miles northeastward from the southeast end of L-35, on the north bank of North New River Canal, and connects to the south end of L-36. Along with the other perimeter levees, L-35A protects the urban areas to the east from water within WCA-2 and hurricane driven wind tides and waves. L-35A is considered part of the ECPL. L-35A Borrow Canal is located to the east of the levee and contains S-124.

2.3.6.1.4 Levee 35B (L-35B)

L-35B originates where U. S. Highway 27 crosses S-11A and ends at L-36 at the western end of the Pompano Canal (C-14). L-35B is an interior levee that separates WCA-2A and WCA-2B which is subject to

overtopping during hurricane wind tides and wave run-up. L-35B contains three culvert structures, S-144, S-145, and S-146 that pass water from WCA-2A to WCA-2B. L-35B has the dual function of controlling wind tides and waves in WCA-2B and providing a more adequate means of regulating seepage losses to the east from WCA-2.

2.3.6.1.5 Levee 36 (L-36)

L-36 forms the eastern boundary of WCA-2. L-36 extends north from the north end of L-35A to S-39 at the junction of L-40 with the Hillsboro Canal. L-36 contains Structures 38 and 38A. Along with the other perimeter levees, L-36 protects the eastern urban area from water within WCA-2 and hurricane driven wind tides and waves. L-36 is approximately 11 miles long and is considered part of the ECPL.

2.3.6.1.6 Levee 38 (L-38E and L-38W)

L-38, consisting of L-38 East (L-38E) and L-38 West (L-38W), forms the southwest boundary of WCA-2A, separating WCA-2 and WCA-3. L-38 is parallel to and on both sides of U.S. Highway 27, extending southeast from S-7 to S-11C and then south to S-34E. L-38 is approximately 15 miles long and provides flood risk management for U.S. Highway 27. L-38 contains spillway structures S-11A, 11B, and 11C, S-143 and a weir structure S-141.

2.3.6.2 Structures

2.3.6.2.1 Structures 11A, 11B and 11C (S-11A, S-11B and S-11C)

S-11A, 11B, and 11C (S-11s) are located in L-38. S-11C is approximately 2 miles north of where U.S. Highway 27 and S.R. 84 intersect, and the remaining two are spaced approximately two miles apart going north from S-11C. The S-11s are gated, four-bay spillways which are the main outlets for WCA-2 and have a total design discharge of 17,200 cfs. Water flows west from WCA-2A into WCA-3A. The S-11s are operated manually by USACE South Florida Operations Office at the direction of the Jacksonville District Water Management Section.

2.3.6.2.2 Structure 34E (S-34E) (formerly S-34)

S-34E, formerly named S-34, was completely rebuilt by the SFWMD in 2019 and re-named S-34E. S-34E is located in North New River Canal where the L38E canal meets the L35 canal, northeast of the I-75 and US-27 intersection in west Broward County. S-34E is a double-barreled corrugated aluminum pipe (CAP) gated culvert which releases water from WCA-2 to provide water supply along the North New River Canal during dry periods and has a total design discharge of 600 cfs. If conditions warrant, S-34E may also release flood water from WCA-2A and/or WCA-2B into North New River Canal if there is downstream capacity.

2.3.6.2.3 Structure 38 (S-38)

S-38 is a double-barreled corrugated metal pipe culvert (CMP) located in L-36 in the southeast corner of WCA-2A where L-36intersects C-14. S-38 has a design discharge of 500 cfs with sluice gates which can be controlled remotely or manually. S-38 releases water from WCA-2A for management of water in the area as well as provides water supply in the area served by C-13 (via S-38C) and C-14 (Pompano Canal).

2.3.6.2.4 Structure 38A (S-38A)

S-38A is a double-barreled CMP culvert, located in the L-36 Borrow Canal on the east perimeter of WCA 2, just north of C-14. S-38A has a total design discharge of 190 cfs controlled by two dual variable crests, manually operated, multi-leaf slide gates. S-38A, together with S-38B, controls the seepage from WCA-2A and release from the North Springs Improvement District (NSID) Pump Station Number 1at S-38B by regulating water in the southern part of L-36 Borrow Canal. S-38A has a design flow of 190 cfs.

2.3.6.2.5 Structure 38B (S-38B)

S-38B is a single barreled CMP culvert located in the L-36 Borrow Canal approximately mid-way between S-38 and S-39. Flow at S-38B is controlled by a slide gate mounted on the upstream (north) side of the structure. This culvert helps control the seepage from WCA-2A by regulating the water level in the northern half of the L-36 Borrow Canal.

2.3.6.2.6 Structure 38C (S-38C)

S-38C is a double-barreled CMP culvert located in the L-36 Borrow Canal south of C-14 and S-38. Flow at S-38C is controlled by flashboards on the upstream (north) side of the structure. S-38C releases water to the south in L-36 Borrow Canal to supply water into the areas served by C-13.

2.3.6.2.7 Structure 39A (S-39A)

The structure is a rectangular double-barreled, reinforced concrete gated culvert, located in southern Palm Beach County at the northern end of the L-36 Borrow Canal near its junction with the Hillsboro Canal and is adjacent to WCA-1 and 2A. S-39A has a design discharge capacity of 700 cfs. S-39A gates can either be remotely or manually operated. This structure, together with S-38B, controls the seepage rate from Conservation Area 2A by regulating the water level in the north half of the L-36 borrow canal.

2.3.6.2.8 Structure 124 (S-124)

S-124 is gated, three-barrel reinforced concrete box culvert, located in the L-35A Borrow Canal immediately north of North New River Canal. S-124 is a divide structure between the C-13 and North New River Basins and has a design discharge of approximately 550 cfs, controlled by sluice gates. This structure functions together with S-125, S-38C and S-36 to maintain an optimum water surface elevation in the C-13 Basin, east of Conservation Area No. 2 and to maintain a stage in L35A borrow to limit seepage through L-35A from Conservation Area 2B. It also is used to discharge excess water from the C-13 Basin for pumping to Conservation Area 3 or for discharge to tidewater when capacity is available in the North New River Canal.

2.3.6.2.9 Structure 141 (S-141)

S-141 is a three-bay, variable height weir structure located at the southwest corner of WCA-2B, in L-38E approximately 175 feet east of U.S. Highway 27. S-141 has a design discharge of approximately 435 cfs controlled by manually operated, twin stem, stainless steel downward-opening slide gates on the upstream (east) side of the structure. This structure affords the sole means of releasing water from Conservation Area 2B. It discharges into the North New River Canal between S-143 and S-34. It can be used to discharge excess water from Conservation Area 2B when capacity is available in the North New River Canal.

2.3.6.2.10 Structure 143 (S-143)

S-143 is a double-barreled CMP culvert located in the L-35B and North New River Canal, south of S-11A. Flow at S-143 is controlled by two manually operated sluice gates which releases water from WCA-2A to the North New River Canal via S-34E. The design flow of S-143 is approximately 500 cfs. This structure permits release of water from Conservation Area 2A to supply water needs along the North New River Canal during the dry season. It also can be used to discharge excess water from Conservation Area 2A when capacity is available in the North New River Canal and when the water is not needed in Conservation Area 3A and stage at downstream S-34E is not above 6.0 feet.

2.3.6.2.11 Structures 144, 145 and 146 (S-144, 145, and 146)

S-144, S-145, and S-146 are single barreled culverts located in L-35B which separates WCA-2A from WCA-2B located five, seven, and nine miles east of U.S. Hwy. 27, respectively. S-144, S-145, and S-146 have a design discharge of 210 cfs each controlled by one manually operated sluice gate at each structure. S-144, S-145, and S-146 move water from WCA-2A into WCA-2B.

2.3.6.3 Pump Stations

2.3.6.3.1 Pump Station 7 (S-7)

S-7 is located in the North New River Canal at the junction of L-18, L-5, L-6, and L-38. S-7 has a gravity flow spillway, and three pumps which have a total design discharge of 2,490 cfs. S-7 moves water from STA 3/4 via the North New River Canal into WCA-2A. Water from STA 3/4 must first pass through non-Federal structure G-371 in the North New River Canal before reaching S-7 and WCA-2.

2.3.7 Water Conservation Area 3 (WCA-3)

WCA-3 is the largest of the three conservation areas, encompassing 925 square miles. WCA-3 is subdivided into WCA-3A and WCA-3B by parallel levees, L-67A and L-67C. The Miami Canal crosses WCA-3 from northwest to southeast to facilitate the flow of water through WCA-3. An interior levee system (L-67A and L-67C) in the southeastern corner of WCA-3 reduces seepage into the Floridian Aquifer (an extremely pervious aquifer). WCA-3 outer perimeter levees consist of L-4, L-5, L-38 (which separates WCA-3 from WCA-2A and 2B), L-37, L-33, L-30, L-29, and L-28 which contains a gap to allow for natural drainage from Collier County. Interior levees within WCA-3 include L-67A and L-67C, and L-68A. L-67 Extension (L-67 Ext.) extends from the approximate mid-point of L-29 south into ENP for about 5.5 miles. In 2002, the lower 4 miles of the L-67 Extension were removed and the adjacent borrow canal was backfilled. The L-67 Ext was designed to permits water deliveries from WCA-3A to Shark River Slough (SRS) via the S-12s while reducing the depth and duration of flooding in the area formerly known as Southwest Dade County, which was incorporated into Everglades National Park with the 1989 Everglades National Park Protection and Expansion Act. This portion of ENP is now known as Northeast Shark River Slough.

Water can enter WCA-3A from WCA-2A via Federal structures S-11A, S-11B, and S-11C. Water can also enter WCA-3 from the STAs via Federal structures S-150 and S-8 as well as non-Federal structures G-404. Water can also enter WCA-3 from the east urban areas via S-9 and S-9A, from the west at S-140 and from the SBC Basin at S-190. Water leaves WCA-3 southward into ENP via the main Federal outlet structures S-12A, S-12B, S-12C, and S-12D. Water can move out of WCA-3A west into BCNP through Federal structures S-343A, S-343B, and S-344. Water can move out of WCA-3A to the east into L-29 Borrow Canal via Federal structure S-333 and S-333N. Water can move out of WCA-3A into WCA-3B via federal

structures S-151 and S-152. Water can move out of WCA-3B east via Federal structures S-31 and S-337 as well as south into the L-29 Borrow Canal and ENP via S-355A and S-355B. WCA-3 also contains two internal structures, S-339 and S-340, which are located in C-123 (Miami Canal).

2.3.7.1 Levees

Construction grade, design elevation, and estimated overtopping elevation of WCA-3 levees are listed in **Table 2-3**.

Table 2-3. WCA-3 Levee Construction Grades, Design Elevations, and Overtopping Elevations

Levee	Construction Grade (feet, NGVD)	Design Elevation (feet, NGVD)	Estimated Overtopping Elevation (feet, NGVD)
L-4 Exterior	23.6	26 to 27.0	*
L-5 Exterior	17.5	26.0 to 27.0	15.5
L-28 Section 5	17.5	17.5	9.59
L-29 Section 1	17.5	17.5	14.4
L-29 Section 2	14.8	14.8	14.3
L-67A	19.0	18.0	12.7
L-29 Section 3	14.0	14.0	12.4
L-30	20.0	18.0	18.0
L-33	20.0	18.0	17.5

* A 215-foot section of L-4 Exterior Levee was degraded to allow water to flow from L-4 Borrow Canal into WCA-3A.

2.3.7.1.1 Levee 4 (L-4)

L-4, along with L-5 forms the northern boundary of WCA-3A. L-4 begins west of the northwest corner of WCA-3A at the junction of L-28/L-3 and follows the Palm Beach-Broward County line eastward for approximately 6.5 miles to the Miami Canal. L-4 consists of a low interior levee on the north side (near Rotenberger Wildlife Management Area) and a high exterior levee on the south side with a Borrow Canal in between. L-4 consists of approximately 3.5 miles of the northern WCA-3A boundary and has a 215 foot gap approximately 3.5 miles west of G-404. The L-4 Levee gap allows water in L-4 Borrow Canal to flow into the northwest corner of WCA-3A. The L-4 Borrow Canal receives discharges from G-404, G-357, and G-88.

2.3.7.1.2 Levee 5 (L-5)

L-5 extends from the Miami Canal to the North New River Canal along the Palm Beach-Broward County line. L-5 along with L-4 forms the northern boundary of WCA-3A. L-5 consists of a low interior levee on the north side (near Holey Land Wildlife Management Area - STA 3/4) and a high exterior levee on the south side with a borrow canal in between. The gated spillway for S-8 is located in the L-5. L-5 is approximately 14.5 miles long.

2.3.7.1.3 Levee 28 (L-28)

L-28 forms the west boundary of WCA-3A in two main segments with a seven-mile wide gap in between. The north segment of L-28 is approximately 19.52 miles long and consists of three sections, which are Section 1, Section 2, and Section 3. L-28 starts at the northwest corner of WCA-3A at a junction with L-3 Tieback Levee, extends eastward for about 3 miles and then south for about 16.5 miles. Pump Station S-140 is located in the L-28 Section 2 and its primary function is to discharge excess drainage water from L-28 borrow canal into WCA-3A. L-28 Section 4 was never constructed and hence there is a seven-mile gap between L-28 north segment and L-28 south segment. The purpose of this gap in L-28 Levee is to allow natural drainage to enter WCA-3A from Collier County. The south segment of L-28 is about 16.27 miles long and has a designation of L-28 Section 5. It starts at a junction with L-29 Levee at the southwest corner of WCA-3A and extends north to end at high ground. Approximately 4.5 miles of the northernmost reach of L-28 Section 5 is designated as the L-28 Tieback Levee. There are three 150 foot long gaps in the L-28 Tieback Levee and these gaps were constructed to allow overland flow into the Big Cypress from WCA 3A. The bottom elevations of these gaps are approximately 10.0 feet, NGVD. Culvert structure S-344 is located in L-28 Section 5 where the borrow canal crosses from the east to the west side of the levee.

2.3.7.1.4 Levee 29 (L-29)

L-29 forms the southern boundary of WCA-3A and extends easterly to join L-30 at the southeast corner of WCA-3B. L-29 contains structures S-12A, S-12B, S-12C, S-12D, S-14, S-333, S-334, S-343A, S-343B, S-355A, and S-355B. When L-29 was originally constructed west of S-333 the old Tamiami Trail was relocated to the crest of the L-29 between S-12A and S-333. East of S-333, L-29 Levee and the Tamiami Trail are separated with L-29 Borrow Canal, with L-29 positioned north of the L-29 borrow canal, and the Tamiami Trail is located to the south of the L-29 borrow canal.

As a result of anticipated increased water levels from the implementation of the Modified Water Deliveries to ENP Project, two Miccosukee Indian villages, Tigertail Camp and Osceola Camp, located south of L-29 were raised up to elevation 10.0 feet, NGVD. The Tigertail Camp is situated on the berm strip between L-29 and L-29 borrow canal and is located approximately 5 miles west of S-334. The Tigertail Camp was raised about three feet from the original existing grade of about elevation 7.5 feet, NGVD. The Osceola Camp is located just south of U.S. 41 and east of S-333. The original grade of the Osceola Camp was estimated to be around 8.0 feet, NGVD.

2.3.7.1.5 Levee 30 (L-30)

L-30 forms the southeast side of WCA-3B. L-30 begins at the eastern end of L-29. L-30 runs north and crosses over the Miami Canal at S-337/S-31 tying into L-33. L-30 contains S-335, S-337, and S-31. S-32A is at the north end of L-30 in the Dade-Broward Dike. L-30 is considered part of the ECPL and is approximately 14 miles long.

2.3.7.1.6 Levee 33 (L-33)

L-33 is located west of U.S. Highway 27 and extends between the Miami Canal at S-31 and the S-9 pump station at C-11. L-33 delineates the eastern perimeter of WCA-3B north of the Miami Canal. The L-33 Borrow Canal is connected to the Miami Canal by S-32 and to C-11 by S-9XS. L-33 is considered part of the ECPL and is approximately 8 miles long.

2.3.7.1.7 Levee 38 (L-38E and L-38W)

See **Section 2.3.6.1.6**.

2.3.7.1.8 Levee 67A (L-67A)

L-67A begins at spillway structure S-333 in the L-29, and extends northeast for approximately 26 miles to L-33 south of Pump Station 9 in the North New River Canal. L-67A contains S-151in the Miami Canal and S-152 that releases water into the lower part of WCA-3B. L-67A reduces seepage under east side L-30 and 33 of WCA-3A. The L-67A Borrow Canal is located approximately 100 feet west of L-67A.

2.3.7.1.9 Levee 67C (L-67C)

L-67C begins at the L-67A approximately 0.4 miles north of the S-333 structure and runs in the northeast direction approximately 1 mile east paralleling L-67A. In the north L-67C connects again to the L-67A approximately 1.3 miles southwest of pump station S-9. L-67C reduces seepage under the east side (L-30 and 33) of WCA-3A. L-67C contains a 3,000-foot gap with three 1,000-foot backfill treatments of the borrow canal (no backfill, partial backfill, and complete backfill using adjacent levee material). The current 3000-foot gap is approximately 6.1 miles northeast of S-333 and is one of the major components of the Decompartmentalization Project and Sheetflow Enhancement Physical Model (DPM) field test. In addition, there is a 1,000-foot gap in the northern reach of L-67C levee located about 11.7 miles northeast of S-333. It was constructed in 1994 as part of the L-67 Gap Pilot Field Test to allow uncontrolled sheet flow to pass from the area between L-67A and L-67C to WCA-3B.

2.3.7.1.10 Levee 67 Extension (L-67 Ext)

L-67 Extension begins at L-67A near S-333 and extends south into ENP for approximately eight miles (southern 4.0 miles were degraded in 2002).

2.3.7.1.11 Levee 68A (L-68A)

L-68A originates at the junction of L-37 and C-11 Extension (South New River Canal) at the S-9 pump station and extends 6.25 miles northward parallel to and approximately one mile west of L-37, ending where L-37 and North New River Canal intersect. L-68A reduces seepage under the ECPL.

2.3.7.1.12 Levee 37 (L-37)

L-37 originates at the junction of L-68A and C-11 Extension (South New River Canal) at the S-9 Pump Station and extends approximately 6 miles northward parallel to and approximately one mile east of L-68A, ending where L-68A and North New River Canal intersect. L-37 reduces seepage under the ECPL and is approximately 6 miles long.

2.3.7.2 Structures

2.3.7.2.1 Structure 12 (12A, B, C, and D)

S-12A, S-12B, S-12C, and S-12d (the S-12s) are all four gated spillways. The S-12 structures are gated spillways located in L-29 (U.S. Highway 41) on the southern perimeter of WCA-3A and are considered the main outflow from WCA-3A. Flow at each S-12 structure is controlled by six cable operated vertical lift

gates. The S-12s have a design discharge capacity is 32,000 cfs at a stated headwater elevation of 12.4 feet, NGVD, and a tailwater elevation of 11.9 feet, NGVD. However, based on review of actual stage-flow measurements by the U.S. Geological Survey (USGS) at the structures, the S-12s may not be able to achieve this design discharge capacity due to several limiting factors including, but not limited to, tailwater constraints and limited headwater/tailwater differential. The S-12s provide an important source of flow into ENP.

2.3.7.2.2 Structure 14 (S-14)

S-14 is a double-barreled reinforced concrete box culvert, located in the L-29 immediately west of S-12A. S-14 has a design discharge of 500 cfs with two manually operated sluice gates. The purpose of S-14 is to provide gravity drainage from the lower reaches of the L-28 borrow pit to ENP, via the L-29, Section 2, borrow pit, through the U.S. Highway 41/Tamiami Trail into ENP. However, S-14 has not functioned as intended due to tailwater conditions which were higher than design assumptions and therefore, it is currently not operational.

2.3.7.2.3 Structure 31 (S-31)

S-31 is a three-barreled culvert that is located where L-30 crosses the Miami Canal. S-31 releases water from WCA-3B into the Miami Canal and has a design discharge of 700 cfs controlled by remotely operated sluice gates. S-31 helps regulate water levels in WCA-3B. If conditions necessitate, S-31can be used in conjunction with S-151 to help release water from WCA-3A to the tide if canal capacity is available downstream.

2.3.7.2.4 Structure 32 (S-32)

S-32 connects the Miami Canal and the L-33 borrow canal. S-32 is located in a county road adjacent to the Miami Canal. Flow at S-32 is controlled by manually operated sluice gates and controls drainage of the area north of the structure between L-33 and U.S. Highway 27. S-32 allows water to be stored in the L-33 borrow canal just north of the Miami Canal. Together with S-9XS and S-30 the structure maintains the borrow canal stages to help control seepage from the northern part of WCA-3B under L-33.

2.3.7.2.5 Structure 32A (S-32A)

S-32A is a gated culvert structure at the north end of L-30 borrow canal immediately south of the Miami Canal. Flow at S-32A is controlled by a manually operated sluice gate. S-32A operates in conjunction with S-335, to reduce seepage under L-30 from WCA-3B, and facilitates the southward releases of water at S-335.

2.3.7.2.6 Structure 142 (S-142)

S-142 is a doubled-barreled culvert located east of U. S. Highway 27 in L-38W and is located between S-34E and S-143. S-142 has a design discharge of 500 cfs and is controlled by remotely operated sluice gates. S-142 releases water from WCA-3A to supply water along the North New River Canal and can be used to discharge excess water from Conservation Area 3A when capacity is available in the North New River Canal.

2.3.7.2.7 Structure 150 (S-150)

S-150 is a three-barrel cast-in-place reinforced concrete box culvert with automatically operated single leaf slide gates. It is located on the northern perimeter of WCA-3A in L-5 near the intersection of L-38W. S-150 has a design discharge of 1,000 cfs and can be controlled by either the on-site control or remotely from the SFWMD Operation Control Center. . S-150, together withS-8 releases water from STA 3/4 into WCA-3A. The original S-150 was replaced with an in-kind structure by SFWMD in April 2015.

2.3.7.2.8 Structure 151 (S-151)

S-151 is a six-barreled CMP culvert located in L-67A in the Miami Canal approximately 6.5 miles northwest of S-31. S-151 has a design discharge of 1,105 cfs and is controlled by remotely operated sluice gates. S-151 releases water from WCA-3A to South Miami-Dade County and along the Miami Canal for WCA-3A regulation and water supply needs and to maintain water levels in WCA-3B. S-151 also provides capacity for water releases through structure S-31 to the east coast. An in-kind replacement of S-151 was initiated by SFWMD in 2017 and S-151 is projected to return to service in September 2020. The new structure is a four eight by eight foot cast-in-place concrete box culvert and discharge is controlled with single leaf slide gates.

2.3.7.2.9 Structure 152 (S-152)

S-152 is a ten barreled, 60-inch diameter, high-density polypropylene culvert located in the L-67A canal approximately 12.3 miles southwest of S-151. S-152 flow is controlled by manually operated vertical slide gates. S-152 operates to move water from WCA-3A into WCA-3B and has a design discharge of 750 cfs. S-152 is meant to be a temporary structure constructed as part of the DPM field test.

2.3.7.2.10 Structure 190 (S-190)

S-190 is a reinforced concrete, gated spillway with release controlled by two cable operated vertical lift gates. S-190 is located on the L-28 Interceptor Canal (northwest WCA-3A) and it maintains optimum upstream water control stages in the east and west feeder canals; and prevents over drainage of these canals. S-190 has a design discharge of 2,960 cfs and serves as the connection between SBC Basin and WCA-3A.

2.3.7.2.11 Structure 339 (S-339)

S-339 is a sheet pile barrier dam located in the C-123 (the Miami Canal). S-339 is approximately six miles north of Everglades Parkway (I-75, Alligator Alley). S-339 has a release rate of 1,100 cfs and consists of a vertical wall across C-123 with three manually operated slide gates. S-339 prevents over drainage of the northern portion of WCA-3A and helps to transfer water to ENP, Metropolitan Miami, and areas of south Miami-Dade County.

2.3.7.2.12 Structure 340 (S-340)

S-340 is a sheet pile barrier dam located in the Miami Canal approximately 2.4 miles south of Everglades Parkway. S-340 has a release rate of 1,100 cfs and consists of a vertical wall across C-123 with three manually operated slide gates on the face of the wall. S-340 prevents over drainage of the northern portion of WCA-3A and helps to transfer water to ENP, Metropolitan Miami, and areas of south Miami-Dade County.

2.3.7.2.13 Structure 343A (S-343A)

S-343A is a three-barrel CMP culvert located in the western portion of L-29 with flow controlled by slide gates. S-343A along with 343B, can divert up to 390 cfs from WCA-3A into BCNP to supplement outflows of WCA-3A into ENP.

2.3.7.2.14 Structure 343B (S-343B)

S-343B is identical to S-343A and is also in the western portion of L-29. S-343B is a gated culvert, and along with 343A, can divert up to 390 cfs from WCA-3A into BCNP to supplement outflows of WCA-3A into ENP.

2.3.7.2.15 Structure 344 (S-344)

S-344 is a two-barreled, CMP culvert located where the Borrow Canal crosses from the east to the west side of L-28 approximately 9 miles north of U.S. 41 (Tamiami Trail). S-344 has a release rate of 135 cfs and is controlled by a slide gate. S-344 may pass flow to eastern BCNP during dry conditions as well as release water from WCA-3A during wet conditions. An in-kind replacement of S-344 was constructed by SFWMD in March 2018.

2.3.7.2.16 Structure 355A (S-355A)

S-355A is a single bay, reinforced concrete ogee weir spillway with vertical lift slide gate controls. S-355A is located in levee 29 (L-29), north of both the L-29 Borrow Canal and US Highway 41 (Tamiami Trail). S 355A has a design discharge of 1,000 cfs; however, flows of this magnitude have not been experienced through this structure due to the upstream resistance of marsh restricting the flow of water to the structure. The primary function of S-355A is to make release out of WCA-3B into ENP.

2.3.7.2.17 Structure 355B (S-355B)

S-355B is a single bay, reinforced concrete ogee weir spillway with vertical lift slide gate controls. S-355B is located in L-29, north of both the L-29 Borrow Canal and Tamiami Trail. S-355B has a design discharge of 1,000 cfs, however, flows of this magnitude have not been experienced through this structure due to the upstream resistance of marsh restricting the flow of water to the structure. The primary function of S-355B is to make release out of WCA-3B into ENP.

2.3.7.3 Pump Stations

2.3.7.3.1 Pump Station 8 (S-8)

S-8 is in the Miami Canal at the junction of L-23, L-4, and L-5. S-8 has four axial-flow horizontal pumps as well as a gravity spillway. The spillway bay on S-8 is parallel to the pump bays. S-8 pumps and the spillway have a total design capacity of 4,160 cfs and 500 cfs, respectively. The purpose of the structure is to discharge excess drainage water via the Miami Canal, from the agricultural area north of the pumping station, into Conservation Area No. 3 at the rate of 3/4 inch per day from the 208 sq. mile tributary drainage area. In normal conditions, S-8 pumps water from STA 3/4 and STA 5 via the Miami Canal into WCA-3A. Also, when conditions warrant, S-8 may also be used to move Lake Okeechobee releases south for treatment in STA 3/4 and 5.

2.3.7.3.2 Pump Station 9 (S-9)

S-9 is located at the junction of L-37 and C-11 (South New River Canal), approximately one-half mile west of U.S. Highway 27. S-9 has three pumps, with a combined design capacity of 2,880 cfs, to pump runoff generated in the east coast urban area into WCA-3. The purpose of the structure is to pump surplus water into Conservation Area 3 via the South New River Canal from the Davie agricultural area west of control structure 13A and to pump seepage under Levees 33 and 37 back into Conservation Area 3, at the rate of 3/4 inch per day from the tributary drainage area plus approximately the same quantity of seepage.

2.3.7.3.3 Structure 9A (S-9A)

S-9A is located at the junction of L-37 and C-11 (South New River Canal), adjacent to S-9. S-9A has four pumps, with a combined design capacity of 500 cfs (2 diesel units at 175 cfs each and 2 electric units at 75 cfs each), to pump runoff generated in the east coast urban area into WCA-3. The use of S-9A reduces the operational dependency placed on the larger S-9 Pumping Station.

2.3.7.3.4 Structure 140 (S-140)

S-140 is in L-28 approximately 0.4 miles north of I-75 (alligator Alley) within the Miccosukee Indian Reservation. S-140 has a gated gravity spillway and three pumps with a design discharge of 1,300 cfs and the spillway has gravity design discharge rate of 300 cfs. The purpose of S-140 is to release excess drainage water from the Levee 28 Borrow Canal into WCA-3, at the rate of 7/16 inch per day from the tributary drainage area. The S-140 drainage area is 110 square miles north and east of the interceptor canal and west of L-28.

2.3.8 Everglades National Park-South Dade Conveyance System (ENP-SDCS)

The levees with in ENP-SDCS are L-29, L-30, L-31N, L-31W, L-315, L-316, L-332 Tieback, and L-357W. The structures within ENP-SDCS include S-18C, S-24A, S-173, S-176, S-177, S-178, S-194, S-196, S-197, S-199, S-316A, S-316B, S-316C, S-318, S-322F, S-322H, S-323A, S-323B, S-327, S-328, S-331, S-332B, S-332C, S-332D, S-332DX1, S-333, S-334, S-335, S-336, S-337, S-355A, S-355B, S-356 S-357, S-357N, S-360E and S-360W. L-29 and L-30 were included in the previous sections describing WCA-3. The canals with ENP-SDCS include L-29 Borrow Canal east of S-333, L-31N Borrow Canal, C-1, C-4, C-6, C-102, C-103, and C-111. The levees and structures to be described here are all south of WCA-3 and west of Homestead, Florida. Sub-areas within the ENP-SDCS include 8.5 Square Mile Area (8.5 SMA or Las Palmas Community), the Northern Detention Area (NDA), the Southern Detention Area (SDA), and the S-332D Detention Area (DA).

2.3.8.1 Levees

2.3.8.1.1 Levee 31 North (L-31N)

L-31N is located in southeast Miami-Dade County and prevents overland flows from the Everglades area into the agricultural and urban development in south Dade area. The L-31N Borrow Canal conveys runoff from the area between the levee drainage divide and the south Miami-Dade area southward into C-111 and L-31W Canal and allows ENP seepage water to be moved north to S-356 and when there is downstream capacity moves water east through C-1W, C-102, and C-103. Structures S-173 and pump station S-331 are contained in the L-31N Borrow Canal along with G-211. Under certain conditions, the L-31N Borrow Canal can be used to convey releases from WCA-3A.

2.3.8.2 Structures

2.3.8.2.1 Structure 18C (S-18C)

S-18C is a reinforced gated spillway located within the C-111 canal approximately 6 miles south of S-177. S-18C has a design discharge of 2,100 cfs and is controlled by two cable operated, vertical lift gates. S-18C is used to maintain a desirable freshwater head against northerly saltwater intrusion into C-111 and passes minimum required deliveries to the C-111 and flood release to the eastern panhandle of ENP or to S-197 which is released to tide.

2.3.8.2.2 Structure 24A (S-24A)

S-24A was a double-barreled, corrugate metal pipe culvert located in L-31N about 2.86 miles south of Tamiami Trail, in southwestern Miami-Dade County, Florida. The gates, located on the western side of L-31N levee, were originally installed for the control of water in the western lands originally targeted for farming, which never materialized as the lands subsequently became part of today's Everglades National Park. S-24A was designed to allow discharges from the western lands into L-31N canal. However, S-24A structure was removed by SFWMD in 2015 as part of the Phase 2 cutoff wall installation of the L-31N Seepage Control Project.

2.3.8.2.3 Structure 173 (S-173)

S-173 is a single barreled concrete pipe culvert located at the drainage divide on the L-31N Borrow Canal adjacent to S-331. S-173 has a design discharge of 100 cfs and is controlled by a remotely operated sluice gate. S-173 may be used in conjunction with S-331 to pass water south to protect areas to the west including the 8.5 SMA of L-31N. This structure maintains a desirable water control stage upstream in L-31N. It passes the design flood (40% of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and discharge velocities to non-damaging levels.

2.3.8.2.4 Structure 176 (S-176)

S-176 is a gated spillway located in C-111 approximately five miles west of Homestead, Florida. S-176 has a design discharge of 630 cfs. S-176 together with S-332B, S-332C and S-332D, maintains a desirable water control stage upstream in L-31N Borrow Canal. S-176 also passes the design flood (40% of the SPF) without exceeding upstream flood design stage and restricts downstream flood stages and velocities to non-damaging levels. S-176 can also be used for water supply and salinity control at S-18C.

2.3.8.2.5 Structure 177 (S-177)

S-177 is a gated spillway located in C-111 south of S.R. 27. S-177 has a design discharge of 1,400 cfs. S-177 helps to maintain stages upstream in C-111, passes the design flood (40% of the SPF), and during floods helps to restrict downstream stages and velocities to non-damaging levels. S-177 can also be used for water supply and salinity control at S-18C.

2.3.8.2.6 Structure 178 (S-178)

S-178 is a single barreled gated culvert and is located at the north end of C-111E, approximately 110 feet upstream of S.R. 27. S-178 has a design discharge of 500 cfs. S-178 maintains optimum water control

stages in C-111E, passes the design flood (40% of the SPF) and restricts downstream flood stages and velocities to non-damaging levels. S-178 flow is controlled by 2 manually operated gates.

2.3.8.2.7 Structure 194 (S-194)

S-194 is a double box concrete culvert structure located on C-102 (Princeton Canal) west of Krome Avenue (SR997), about six miles upstream from S-165 and seven miles north of Homestead, Florida. S-194 has a design discharge of 190 cfs. Its control is effected by remotely controlled dual-leaf slide gates. S-194 functions as a drainage divide structure and a control for stages in C-102 to the west and may also convey either water supply or excess water from the L-31N Canal to the east when capacity is available. The original S-194 structure was replaced in-kind by SFWMD in 2019 and returned to service on April 3, 2020.

2.3.8.2.8 Structure 196 (S-196)

S-196 is a single-barreled, reinforced concrete pipe culvert located on C-103 approximately 350 feet upstream from Richards Road. S-196 has a design discharge of 200 cfs and is controlled by a manually operated sluice gate. S-196 is a drainage divide structure and a control for stages in C-103. S-196 allows limited runoff to the east when capacity is available and provides supplemental water supply during dry periods.

2.3.8.2.9 Structure 197 (S-197)

S-197 is a 4 barreled cast-in-place concrete box culvert located upstream of the mouth of the C-111 Canal approximately 3 miles from the shore of Manatee Bay and 750 feet east of U.S. Highway 1 in Southern Miami-Dade County. S-197 has a design discharge of 2,400 cfs and was controlled by manually operated vertical slide gates. S-197 was retrofitted with automated gate structure in February 2020 to allow remote and local automatic controls. S-197 is used to maintain optimum upstream water control stages in C-111 as well as prevents saltwater intrusion during high tides and blocks reverse flow during storm surges. S-197 may be opened for flood risk management. S-197 normally remains closed to divert flows over the southern bank of C-111 to the panhandle of ENP.

2.3.8.2.10 Structure 327 (S-327)

S-327 is a concrete weir in the southern side of the C-111 SD high head cell (HHC). This weir is 1,600 feet long with crest elevation 8.1 feet NGVD, approximately 2.5-3.0 feet above grade. S-327 was previously 1,850 feet long, however, 250 feet of the weir was degraded to the existing lime rock surface in August 2016 as part of the design changes to the C-111 South Dade authorized project, which were documented in the 2016 C-111 South Dade Modifications to North and South Detention Areas and Associated Features Engineering Documentation Report. The purpose of the 250-foot gap in S-327 weir is to allow for greater flow volume into the S-332D Detention Area.

2.3.8.2.11 Structure 333 (S-333)

S-333 is a gated spillway located on L-67 at the southeast corner of WCA-3A approximately 30 miles west of Miami. S-333 has a design discharge of 1,350 cfs and is controlled by a cable operated vertical lift gate. S-333 functions principally as a component of the South Dade conveyance system which supplies water from WCA-3A to south and east Miami-Dade County, to North East Shark River Slough and Taylor Slough areas of ENP.

2.3.8.2.12 Structure 333N (S-333N)

S-333N is a gated spillway located at the intersection of L-67A and L-29 Borrow Canals adjacent to S-333. S-333N has a design discharge of 1,150 cfs and is controlled by vertical lift roller gates. S-333N is a component of the South Dade conveyance system which supplies water from WCA-3A to south and east Miami-Dade County to North East Shark River Slough and Taylor Slough areas of ENP.

2.3.8.2.13 Structure 334 (S-334)

S-334 is a gated spillway located on the east end of L-29 Borrow Canal approximately 20 miles west of Miami and near L-30. S-334 has a design discharge of 1,230 cfs. As an element of the south Dade conveyance system, S-334 functions primarily to make supplemental water deliveries to south and east Miami-Dade County and Taylor Slough area of ENP. S-334 can also be used to pass all or a portion of releases from WCA-3A made through S-333.

2.3.8.2.14 Structure 335 (S-335)

S-335 is a single bay spillway located at the south end of L-30 Borrow Canal, upstream of U.S. Highway 41, and west of State Highway 27. S-335 has a design discharge of 525 cfs and is controlled by a vertical operated vertical lift gate. S-335 functions mainly to make water deliveries to south and east Miami-Dade County, to Taylor Slough or to maintain the C-111 hydraulic ridge. S-335 may also be used to maintain optimum stages in the L-30 as well as make releases from WCA-3.

2.3.8.2.15 Structure 336 (S-336)

S-336 is a gated culvert located on C-4 (Tamiami Canal) east of the junction of L-30 and L-31N Borrow Canals. S-336 has a design discharge of 145 cfs. S-336 can be used to divert flows via the L-30, L-31N, or L-29 Borrow Canals to supply water in east Miami-Dade County. S-336 can also divert floodwater from WCA-3A to the Tamiami Canal when capacity is available and when necessary can also help prevent saltwater intrusion in the eastern structures.

2.3.8.2.16 Structure 337 (S-337)

S-337 is a gated culvert located in L-30 where L-30 crosses the Miami Canal. S-337 has a design discharge of 605 cfs and operates together with S-31 and S-151 to release water from WCA-3 to supply water needs in south and east Miami-Dade County. In addition, S-337 may be used in conjunction with S-151 and S-335 to provide WCA-3A water for Taylor Slough and maintenance of the C-111 hydraulic ridge.

2.3.8.2.17 Structure 338 (S-338)

S-338 is a double-barreled CMP culvert located at the point where C-1 crosses Krome Avenue approximately 12 miles north of Homestead. S-338 has a design discharge of 170 cfs and is controlled by electric gear driven sluice gates. S-338 provides water supply releases during dry periods and also provides flood risk management releases from the area between Krome Avenue and L-31N and north of S-331.

2.3.8.3 Pump Stations

2.3.8.3.1 Pump Station 331 (S-331)

S-331 is a three-unit pumping plant located on the L-31N Borrow Canal approximately nine miles north of Homestead. S-331 has a design discharge of 1,160 cfs. S-173 is co-located with S-331 and may be used in conjunction with S-331 to pass water to the south. The original purpose of this structure was to function as a component of the South Dade Conveyance System to deliver supplementary water supply to South Dade County and to provide a continuous supply to the Everglades National Park at Taylor Slough and to the Panhandle Area. Over time operations at S-331 have evolved and may now be used for water supply, water deliveries to Taylor Slough and maintenance of hydraulic ridge in the C-111 detention areas, environmental water deliveries to Biscayne Bay, and flood mitigation for the 8.5 SMA. Whenever stages allow, siphon operations at S-331 are used to deliver water south.

2.3.8.3.2 Pump Station 332B (S-332B)

S-332B is a five-unit pump station located approximately 5.5 miles south of S-331, along the L-31N canal. Constructed in 2000 as a temporary structure for the protection of the endangered Cape Sable seaside sparrow. S-332B has four (4) 125 cfs diesel engine-driven pumps, and one (1) 75 cfs electric motor driven pump with flap gates on downstream side and has a design capacity of 575 cfs. S-332B pumps water from the L-31N canal and releases through five (5), 60-inch diameter pipes. Three of the S-332B pump outlets release 0.40 miles to the west into the Southern Detention Area (SDA) while the two remaining pipe outlets release 0.13 miles to the northwest into the Northern Detention Area (NDA). S-332B operates with S-332C, S-332D and S-176 to manage desired water levels in the L-31N Canal reach between S-331 and S-176.

2.3.8.3.3 Pump Station S-332C (S-332C)

S-332C is a five-unit pump station located approximately 7.80 miles south of S-331, along the L-31N canal on the west bank, in Miami-Dade County. Constructed in 2002 as a temporary structure for the protection of the endangered Cape Sable seaside sparrow. S-332C has four (4) 125 cfs diesel engine-driven pumps, and one (1) 75 cfs electric motor driven pump with flap gates on downstream side and has a design capacity of 575 cfs. The hydraulic design parameters for the S-332C pump station are the same as the S-332B pump station. S-332C releases into the middle section of the SDA and operates with S-332B, S-332D and S-176 to manage desired water levels in the L-31N Canal reach between S-331 and S-176.

2.3.8.3.4 Pump Station 332D (S-332D)

S-332D is a five-unit pump station located approximately 10.25 miles south of S-331, along the L-31N canal. S-332D has four (4) 125 cfs diesel engine-driven pumps, and one (1) 75 cfs electric motor driven pump with flap gates on downstream side and has a design capacity of 575 cfs. S-332D releases water directly into the Frog Pond high head cell which allows water to either flow north through S-332DX1 into the SDA or south into the Frogpond Detention Cell towards Taylor Slough. S-332D is used to pump water from the L-31N canal, upstream of S-176, into an S-332D Detention Area to facilitate flows to Florida Bay via Taylor Slough. S-332D is used with S-332B, S-332C, and S-176 to manage desired water levels in the L-31N Canal reach between S-331 and S-176.

2.3.8.3.5 Pump Station 356 (S-356).

S-356 is a four-unit pump station located along Tamiami Canal adjacent to the S-334 gated spillway. S-356 has four (4) 125 cfs diesel engine-driven pumps with duck bills on downstream side for a total design discharge of 500 cfs. S-356 is intended to manage water stages in the L-31N and L-30 Canals between G-211 and S-335 by pumping water from the L-31 North canal west of S-334 structure into the L-29 Borrow Canal (Tamiami Trail Canal).

2.3.8.4 8.5 Square Mile Area (8.5 SMA)

The 8.5 SMA known as the Las Palmas Community lies within a region commonly referred to as the Rocky Glades, occupying the western slope of the Atlantic Coastal Ridge. It is bounded on the west and north by a protective levee (L-357W) approximately seven miles in length, on the north by SW 104th Street, on the south by SW 168th Street (Richmond Drive), and separated from more intensively developed urban lands to the east by the L-31N flood protection levee and Borrow Canal. The 8.5 SMA is located in the East Everglades, approximately 20 miles southwest of Miami, approximately ten miles north of Homestead, and 6.6 miles south of U.S. Highway 41 (Tamiami Trail). The East Everglades Area is bounded on the north and west by North East Shark River Slough (NESRS), on the south by the Taylor Slough headwaters and on the east by the urban and agricultural areas east of L-31N. The outer perimeter levees are L-357W (which separates 8.5 SMA from NESRS) and L-31N. S-357 pumps into the 8.5 SMA detention cell which is comprised of the L-359 (perimeter levees) and interior levees L-360E and L-360W. Levees L-360E and L-360W direct water from S-357 into the Northern Detention Area (NDA). A major interior seepage collection canal, C-357, located in the Las Palmas Community and its southern end is connected to S-357 Pump Station. In addition, a seepage collection canal, C-358, is situated between the southern border of the 8.5 SMA and northern border of the 8.5 SMA detention cell along the south side of Richmond Drive which diverts seepage through S-357N to the headwater of S-357. The L-357W perimeter levee, C-357 and C-358 seepage collection canals, S-357N structure, and S-357 pump station are designed to collectively provide flood mitigation to the Las Palmas Community in order to prevent impacts from higher water levels in NESRS resulting from the implementation the Modified Water Deliveries to Everglades National Park Project.

2.3.8.4.1 Levees

The levees in 8.5 SMA consist of the Levee 357 (L-357), Levee 357 West (L-357W), Levee 359 (L-359), Levee 360 East (L-360E), and Levee 360 West (L-360W).

2.3.8.4.1.1 Levee 357 (L-357)

L-357 is an interior levee embankment which runs parallel to the main seepage collection canal C-357. It is approximately 3.3 miles long and has a crest elevation of 9.5 feet, NGVD. The purpose of this levee embankment is to prevent surface water runoff from directly flowing into the C-357 canal.

2.3.8.4.1.2 Levee 357W (L-357W)

L-357W is a perimeter levee to provide flood mitigation for the 8.5 SMA from increased stage within Everglades National Park, specifically NESRS. L-357W is approximately 7.1 miles long and includes a roadway crossing at Richmond Drive about 0.8 mile west of C-357 seepage canal, and ties into both the existing L-31N Levee about 2 miles north of Howard Drive and the L-359 Levee about 0.4 miles south of Richmond Drive. L-357W perimeter levee crest elevation is 10.2 feet, NGVD. The L-357W Levee was

extended by 0.40 miles between Richmond Drive and L-359 at the northwest corner of the 8.5 SMA Detention Area in 2017.

2.3.8.4.1.3 Levee 359 (L-359)

L-359 is a perimeter levee embankment which encircles the flow-way downstream of S-357 pump station and the 8.5 SMA detention cell. The total length of the L-359 perimeter levee is about 3 miles and has a 900-foot gap at the southern segment that delineates the boundary between the 8.5 SMA Detention Area and the C-111 North Detention Area (NDA) and an overflow weir, S-360E. The 900-foot gap provides a hydrologic connection between the 8.5 SMA Detention Area and the NDA.

2.3.8.4.1.4 Levee 360 East (L-360E)

L-360E is the east interior flow-way berm inside of 8.5 SMA Detention Cell and is approximately 3,800 feet long with a crest elevation of 10.3 feet, NGVD. The L-360E and L-360W interior flow-way berms were designed to permit S-357 discharges to flow directly through the 8.5 SMA Detention Cell and into the main flow-way of the NDA.

2.3.8.4.1.5 Levee 360 West (L-360W)

L-360W is the west interior flow-way berm inside 8.5 SMA Detention Cell and is approximately 4,000 feet long with a top of berm elevation of 10.3 feet, NGVD. L-360W and L-360E serve as an internal flow-way with the 8.5 SMA Detention Cell to direct flows south into the NDA.

2.3.8.4.2 Canals

The canals in 8.5 SMA consist of Canal 357 (C-357) and Canal 358 (C-358).

2.3.8.4.2.1 C-357

C-357 is a seepage collection canal located in the middle of 8.5 SMA. It begins in the northern quadrant of 8.5 SMA near SW 136th Street and G-596 gauge, tracks westward for about 1.3 miles to the intersection of SW 136th Street and SW 205th Avenue, and then heads directly south for about 2.1 miles to the terminus at S-357 pump station. C-357 is managed with the S-357 pump station and designed to maintain water levels within 8.5 SMA to the same levels as existed prior to the implementation of the MWD Project. The embankments on both side of C-357 are L-357 Levees.

2.3.8.4.2.2 C-358

C-358 is a seepage collection canal located at the southern boundary of 8.5 SMA and just south of SW 168th Street (Richmond Drive). It begins at the intersection of L-357W and SW 168th Street and travels eastward for about 0.75 miles to the terminus at S-357N structure/C-357. C-358 was added to the 8.5 SMA flood mitigation system as a result of the Environmental Assessment and Proposed Finding of No Significant Impact on the Design Refinement for 8.5 SMA, dated March 2012. C-358 serves to provide flood mitigation for the southwest corner of the 8.5 SMA reducing seepage north from the 8.5 SMA detention system and from ENP.

2.3.8.4.3 Structures

The structures contained within the 8.5 SMA consist of the Structure 357N (S-357N), Structure 360 East (S-360E) and Structure 360 West (S-360W). S-360E and S-360W are weirs on the southern end of the 8.5 SMA Detention Cell.

2.3.8.4.3.1 Structure 357 North (S-357N)

S-357N is a three-barreled High-Density Polyethylene (HDPE), gated culvert located on the C-358 seepage collection canal, which is just south and runs parallel to Richmond Drive along the southern boundary of the 8.5 SMA. S-357N has a design discharge of 326 cfs and is controlled by three manually operated double leaf slide gate systems which were designed to accommodate variable flow regimes: (1) weir flows by lowering the top gate; (2) orifice flows by raising the lower gate; or (3) submerged or un-submerged, uncontrolled flows by raising both the top and bottom gates above the top (crown) of the culvert. S-357N hydraulically connects the C-358 Seepage Canal to the C-357 Canal in order to provide flood mitigation for 8.5 SMA by maintaining optimum upstream water levels to influence the groundwater levels north of Richmond Drive. Releases from S-357N are pumped by S-357 into the 8.5 SMA detention system.

2.3.8.4.3.2 Structure 360 East (S-360E)

S-360E is one of two broad-crested 350 foot long overflow weirs located in the south segment of the L-359 perimeter levee of the 8.5 SMA Detention Area. It has a top elevation of 9.5 feet, NGVD and is located about 1,100 feet east of the L-359 gap and 1 mile southwest of S-357 pump station. S-360E weir allows water to overflow from the east storage compartment of the 8.5 SMA Detention Area to the eastern storage area of the NDA.

2.3.8.4.3.3 Structure 360 West (S-360W)

S-360W was the second of two broad-crested overflow weirs located in the south segment of the L-359 perimeter levee. It was completely removed in 2018 as part of the C-111 South Dade Contract 8A construction to create a 900-foot gap in L-359 levee to connect the 8.5 SMA Detention Area flow-way with the NDA.

2.3.8.4.3.4 L-359 Gap

The newly constructed 900-foot gap in L-359 levee was completed in 2018 as part of the C-111 South Dade Contract 8A construction. It is located 1,100 feet west of S-360E structure. The gap section of L-359 levee was degraded down to elevation 6.8 feet, NGVD. It serves as a hydraulic connection between the 8.5 SMA Detention Area and the C-111 NDA allowing S-357 releases to flow unimpeded into the C-111 NDA western flow-way.

2.3.8.4.4 Pump Stations

2.3.8.4.4.1 Pump Station 357 (S-357)

S-357 is a four-unit pump station located on the south end of the C-357 canal, approximately 3 miles west of Krome Avenue, and approximately 300 feet south of SW 168th Street (Richmond Drive) between SW 205th and SW 206th Avenues. S-357 has four (4) 125 cfs diesel engine-driven pumps and one (1) 75

cfs electric-driven pump. Structure maintains optimum upstream canal levels to provide flood mitigation for the Las Palmas Community from the implementation of the MWD Project.

2.3.8.5 C-111 South Dade Northern Detention Area (NDA)

The NDA is located in the northern part of the Rocky Glades and is bounded on the west by the L-315 levee and on the east by the L-316 levee. The NDA receives inflows from the 8.5 SMA S-357 pump station via the 8.5 Detention Cell Flow-way (established by L-360E and L-360W) and S-332BN. The L-318 is an interior berm located between the western levee (L-315) and the eastern levee (L-316) of the NDA. The L-318 berm divides the NDA into two areas, a western flow-way area, and an eastern detention area, which are connected by a 3,000-foot weir, S-318. The western flow-way contains 640 acres and the eastern detention area contains 800 acres. The total acreage within the NDA area is approximately 1,440 acres. The berm is approximately 17,675 feet long (including the S-318 weir length of 3,000 feet). The area extends northward from the S-332B pump station to the 8.5 SMA Detention Cell. The purpose of the NDA is to serve as a detention area for S-357 and S-332BN discharges and as a hydraulic ridge to reduce seepage losses from ENP between the 8.5 SMA Detention Cell and the S-332B pump station. Up to 250 cfs pump capacity from 2 diesel units at S-332B, designated as S-332BN, may be discharged into the NDA with the inflow location near the southeast corner of the detention area. The L-316 levee contains four emergency overflow weirs, S-316A, S-316B, S-316C, and S-316D, with potential to release water from the NDA to the eastern buffer area if depths exceed approximately 3.5 feet in the NDA. The NDA and its project features are shown in **Figure 2-1**.

2.3.8.5.1 Levees

The levees contained within the NDA consist of the Levee 315 (L-315), Levee 316 (L-316), and Levee 318 (L-318).

2.3.8.5.1.1 Levee 315 (L-315)

L-315 is the western perimeter levee of the NDA. It is approximately 5.1 miles long with an average crest elevation of 12.9 feet, NGVD. L-315 levee starts from the north at L-359 and ends at L-316 near S-332B to the south.

2.3.8.5.1.2 Levee 316 (L-316)

L-316 is the eastern perimeter levee of the NDA. It is approximately 3.8 miles long with a crest elevation of 12.9 feet, NGVD. L-316 levee starts at L-359 from the north and ends at L-315 near S-332B to the south. The L-316 levee contains four emergency overflow weirs, S-316A, S-316B, S-316C, and S-316D to allow overflows from NDA to the eastern buffer area if depths exceed approximately 3.5 feet.

2.3.8.5.1.3 Levee 318 (L-318)

L-318 is an internal berm that delineates a western flow-way and an eastern storage area within the NDA. It is approximately 3.3 miles long with a crest elevation of 8.8 feet, NGVD. L-315 levee starts at L-359 from the north and ends at L-316 near S-332B to the south. It has a 3,000-foot overflow weir (S-318) to convey water from the western flow-way to the eastern storage area.

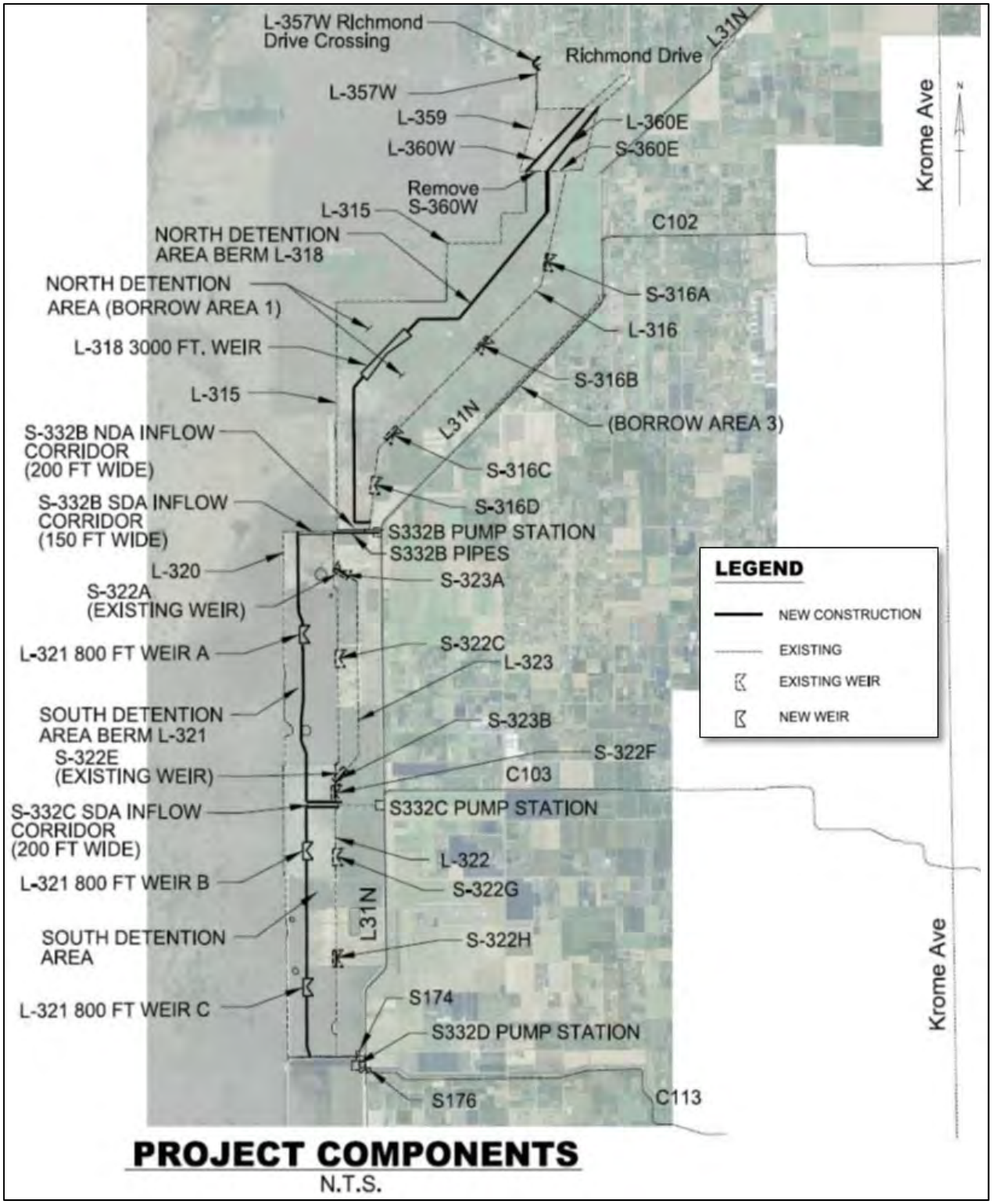

Figure 2-1. C-111 South Dade NDA and SDA Project Area Features

2.3.8.5.2 Structures

The structures contained within the NDA consist of four emergency overflow, weirs (S-316A, S-316B S-316C, S-316D), and an interior weir S-318.

2.3.8.5.2.1 Structure 316A (S-316A)

S-316A is a 500-foot emergency overflow weir along the northern reach of L-316 levee that permits water to overflow into the eastern buffer area if depths exceed approximately 3.5 feet in the eastern storage area of the NDA. The S-316A weir height elevation is approximately 10.0 feet, NGVD

2.3.8.5.2.2 Structure 316B (S-316B)

S-316B is a 500-foot emergency overflow weir along the mid-section of L-316 levee that permits water to overflow into the eastern buffer area if depths exceed approximately 3.5 feet in the eastern storage area of the NDA. The S-316B weir height elevation is approximately 10.0 feet, NGVD

2.3.8.5.2.3 Structure 316C (S-316C)

S-316C is a 500-foot emergency overflow weir along the mid-section L-316 levee that permits water to overflow to the eastern buffer area if depths exceed approximately 3.5 feet in the eastern storage area of the NDA. The S-316B weir height elevation is approximately 10.0 feet, NGVD

2.3.8.5.2.4 Structure 316D (S-316D)

S-316D is a 400-foot emergency overflow weir along southern reach of L-316 levee that permits water to overflow into the eastern buffer area if depths exceed approximately 3.5 feet in the eastern storage area of the NDA. The S-316B weir height elevation is approximately 10.1 feet, NGVD. S-316D weir is located approximately 2,150 feet north-northwest of S-332B pump station.

2.3.8.5.2.5 Structure 318 (S-318)

S-318 is a 3,000-foot overflow weir along the southern reach of L-318 levee that allows overflow discharges from the NDA western flow-way to the eastern storage area of the NDA. The weir height elevation is approximately 8.0 feet, NGVD. S-318 is located about 2.0 miles southwest of L-359 Gap.

2.3.8.6 C-111 South Dade Southern Detention Area (SDA)

The SDA is located immediately south of the NDA, east of ENP, and west of L-31N and South Dade Agricultural Area. The SDA is not connected to NDA. . The SDA is bounded on the west by the L-320 exterior levee and on the east by the L-322 levee. The detention area extends from the S-332B pump station in the north to the S-332DX1 gated culvert in the south. The purpose of the SDA is to serve as a detention area for discharges from S-332BW, S-332C, and S-332DX1 for flood control and also as a hydraulic ridge to reduce seepage losses from ENP between the S-332B and S-332D pump stations. L-321 is an interior berm located between the western levee (L-320) and the eastern levee (L-322) of the SDA. The L-321 berm divides the SDA into two areas, a western flow-way and an eastern detention area, which are connected by three 800 foot weirs, S-321A, S-321B, and S-321C. These weirs allow overflow of water from the western flow-way to the eastern detention area. L-321 berm has two segments, L-321N and L-321S. The L-321N interior berm and L-320 levee form the north reach of the western flow-way and L-321S interior

berm and L-320 levee form the south reach of the western flow-way in the SDA. The western flow-way contains 325 acres and the eastern detention area contains 985 acres. The total acreage within the SDA area is approximately 1,310 acres. L-322 levee contains six emergency overflow weirs, S-322A, S-322C, S-322E, S-322F, S-322G, and S-322H. S-322A, S-322C, S-322E provide three evenly spaced controlled outflow locations from the northern portion of the SDA storage area into the remnant Partial Connector Detention Area between L-322 and L-323 levees. The L-323 levee located on the east side of the northern portion of SDA storage area. It has two emergency overflow weirs, S-323A and S-323B, to release water from the remnant Partial Connector Detention Area to the State-owned buffer lands east of the SDA. The remaining overflow weirs, S-322G and S-322H, in the southern reach of L-322 levee also allow water releases from the SDA to the State-owned buffer lands. These overflow weirs were designed to allow water release from the SDA to the buffer lands when the average water depth exceeds 3.5 feet in the SDA. The SDA and its project features are shown in **Figure 2-1**.

2.3.8.6.1 Levees

The levees contained within the SDA consist of the Levee 320 (L-320), Levee 321 (L-321), Levee 322 (L-322), and Levee 323 (L-323).

2.3.8.6.1.1 Levee 320 (L-320)

L-320 is the western perimeter levee of the SDA. It is approximately 5.2 miles long with an average crest elevation of 12.9 feet, NGVD. L-320 perimeter levee starts from its northern end at S-322B outflow structure and ends at its southern terminus at L-31W levee near S-332DX1 structure. The northern east-west segment of L-320 and L-321N form a 150-foot flow-way for S-332BW outflows.

2.3.8.6.1.2 Levee 321 (L-321)

L-321 is an internal berm that delineates a western flow-way and an eastern storage area within the SDA. L-321 has two segments, L-321N and L-321S. The L-321N berm is approximately 3 miles long with a crest elevation of 8.8 feet, NGVD. It starts from the north at L-322 and ends at L-322 near S-332C pump station. L-321N berm has one 800-foot overflow weir, S-321A, to allow releases of water from the western flow-way to the eastern storage area of the SDA. L-321S berm is approximately 2.5 miles long with a crest elevation of 8.8 feet, NGVD. It starts from the north end at L-322 levee near S-3232C pump station and ends at the south terminus at L-31W levee near S-332DX1 structure. L-321S has two 800-foot weirs, S-321B and S-321C, to allow overflows of water from the western flow-way to the eastern storage area of the SDA. Both east-west segments of L-321N and L-321S located downstream of S-332C outflow structure form a 250-foot corridor to the eastern flow-way for S-332C releases.

2.3.8.6.1.3 Levee 322 (L-322)

L-322 is the eastern perimeter levee of the SDA. It is approximately 4.6 miles long with an average crest elevation of 12.9 feet, NGVD. L-322 levee starts at the northern end at S-332BW outflow structure and ends at the south terminus at L-31W levee between S-332DX1 structure and S-332D pump station. L-322 levee has six emergency overflow weirs, S-322A, S-322C, S-322E, S-322F, S-322G, and S-322H. These overflow weirs allow releases of water from SDA to the State-owned buffer lands when average depths exceeds 3.5 feet, NGVD.

2.3.8.6.1.4 Levee 323 (L-323)

L-323 is the second of two eastern perimeter levee of the SDA and is also known as a connector levee. It is approximately 2.1 miles long with an average crest elevation of 12.9 feet, NGVD. L-323 is located on the east side of L-322 levee and in between S-332BW outflow structure and S-332C outflow structure. It has two emergency overflow weirs, S-323A and S-323B, to allow releases from the remnant Partial Connector Detention Area to the State-owned buffer lands east of the SDA.

2.3.8.6.2 Structures

The structures contained within the SDA consist of the eleven overflow weirs (S-321A, S-321B, S-321C, S-322A, S-322C, S-322E, S-322F, S-322G, S-322H, S-323A, S-323B).

2.3.8.6.2.1 Structure 321A (S-321A)

S-321A is an 800-foot weir located in L-321N levee that permits water to overflow from the western flow-way to the eastern storage area of the SDA. It has a weir crest elevation of 8.0 feet, NGVD.

2.3.8.6.2.2 Structure 321B (S-321B)

S-321B is the first of two 800-foot weirs located in L-321S levee that permits water to overflow from the western flow-way to the eastern storage area of the SDA. It has a weir crest elevation of 8.0 feet, NGVD.

2.3.8.6.2.3 Structure 321C (S-321C)

S-321C is the second of two 800-foot weirs located in L-321S levee that permits water to overflow from the western flow-way to the eastern storage area of the SDA. It has a weir crest elevation of 8.0 feet, NGVD.

2.3.8.6.2.4 Structure 322A (S-322A)

S-322A is a 400-foot overflow weir located in L-322 and located approximately 0.4 miles south of S-332B outflow structure. It permits overflow of water from the SDA to the remnant Partial Connector Detention Area between L-322 and L-323 levees when average water depths exceed 3.5 feet in the SDA. S-322A has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.5 Structure 322C (S-322C)

S-322C is a 500-foot overflow weir located in L-322 levee and is approximately one miles south of S-332B outflow structure. It permits overflow of water from the SDA to the remnant Partial Connector Detention Area between L-322 and L-323 levees when average water depths exceed 3.5 feet in the SDA. S-322C has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.6 Structure 322E (S-322E)

S-322E is a 500-foot overflow weir located in L-322 and is approximately 0.3 miles north of S-332C outflow structure. It permits overflow of water from the SDA to the remnant Partial Connector Detention Area between L-322 and L-323 levees when average water depths exceed 3.5 feet in the SDA. S-322E has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.7 Structure 322F (S-322F)

S-322F is a 500-foot overflow weir located in L-322 and is approximately 660 feet north of S-332C outflow structure. It permits overflow of water from the SDA to the State-owned buffer lands east of the SDA when average water depths exceed 3.5 feet in the SDA. S-322F has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.8 Structure 322G (S-322G)

S-322G is a 1,500-foot overflow weir located in L-322 and is approximately 0.4 mile south of S-332C outflow structure. It permits overflow of water from the SDA to the State-owned buffer lands east of the SDA when average water depths exceed 3.5 feet in the SDA. S-322G has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.9 Structure 322H (S-322H)

S-322H is a 500-foot overflow weir located in L-322 and is approximately 1.3 miles south of S-332C outflow structure. It permits overflow of water from the SDA to the State-owned buffer lands east of the SDA when average water depths exceed 3.5 feet in the SDA. S-322H has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.10 Structure 323A (S-323A)

S-323A is a 500-foot overflow weir located in L-323 and is approximately 0.4 miles south of S-332B outflow structure. It permits overflow of water from the remnant Partial Connector Detention Area to the State-owned buffer lands east of the SDA when average water depths exceed 3.5 feet in the remnant Connector area. S-323A has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.11 Structure 323B (S-323B)

S-323B is a 500-foot overflow weir located in L-323 and is approximately 0.3 miles north of S-332C outflow structure. It permits overflow of water from the remnant Partial Connector Detention Area to the State-owned buffer lands east of the SDA when average water depths exceed 3.5 feet in the remnant Connector area. S-323B has a weir crest elevation of 9.52 feet, NGVD.

2.3.8.6.2.12 Structure 332DX1 (S-332DX1)

S-332DX1 is a four-barrel corrugated aluminum pipe (CAP) structure located approximately 0.5 miles west of S-332D. S-332DX1 has a design discharge rate of 250 cfs and is controlled by vertical lift gates and may pass water either north or south. Forward flow, is defined as the flow passing south to north, from the S-332D High Head Cell (HHC) to the Southern Detention Area (SDA). Reverse flow would be considered from the SDA to the HHC.

2.3.8.7 S-332D Detention Area (DA)

The S-332D DA is located in the eastern area of the historic Taylor Slough headwaters and downstream of S-332D pump station. The detention area was constructed for use as a flow through detention system to provide flows to Taylor Slough. The S-332D DA has approximate 2,300 acres, four levees, four overflow weirs, four internal cells, and one gated culvert. The northern, western, and southern perimeter levees of

the S-332D DA are the north segment of L-31W levee. The eastern levee of the S-332 DA consists of L-329, L-328, and L-327 (formerly named the S-332D Tieback Levee). . The overflow weirs are S-327, Cell 1 earthen berm, S-329, and S-205. Four internal cells are DA S-332D High Head Cell (HHC), Cell 1, Cell 2, and Flow-way Cell. The purpose of the HHC is to convey water from the S-332D pump station westward and then south through a gap in S-327 weir and over the S-327 weir into the S-332D DA. In addition, releases from S-332D can be directed through S-332DX1 to the SDA, especially during the calendar based CSSS Sparrow restrictions from 01 January through 14 July. Water flows south from the S-332D HHC over S-327 weir to Cell 1, from Cell 1 over Cell 1 earthen berm to Cell 2 then continues south over the S-329 weir into the S-332D flow-way, the southernmost cell of the S-332D DA. Water then exits the S-332D flow-way through the S-205 weir in the L-31W levee into Taylor Slough. The S-328 gated culvert, located in the southwest corner of Cell 1, provides the ability to release surface water from Cell 1 into the L-31W canal to go around the southern portion of the S-332D Detention Area if necessary to ensure water deliveries reach Taylor Slough. S-332D Detention Area and its project features are shown in **Figure 2-2**.

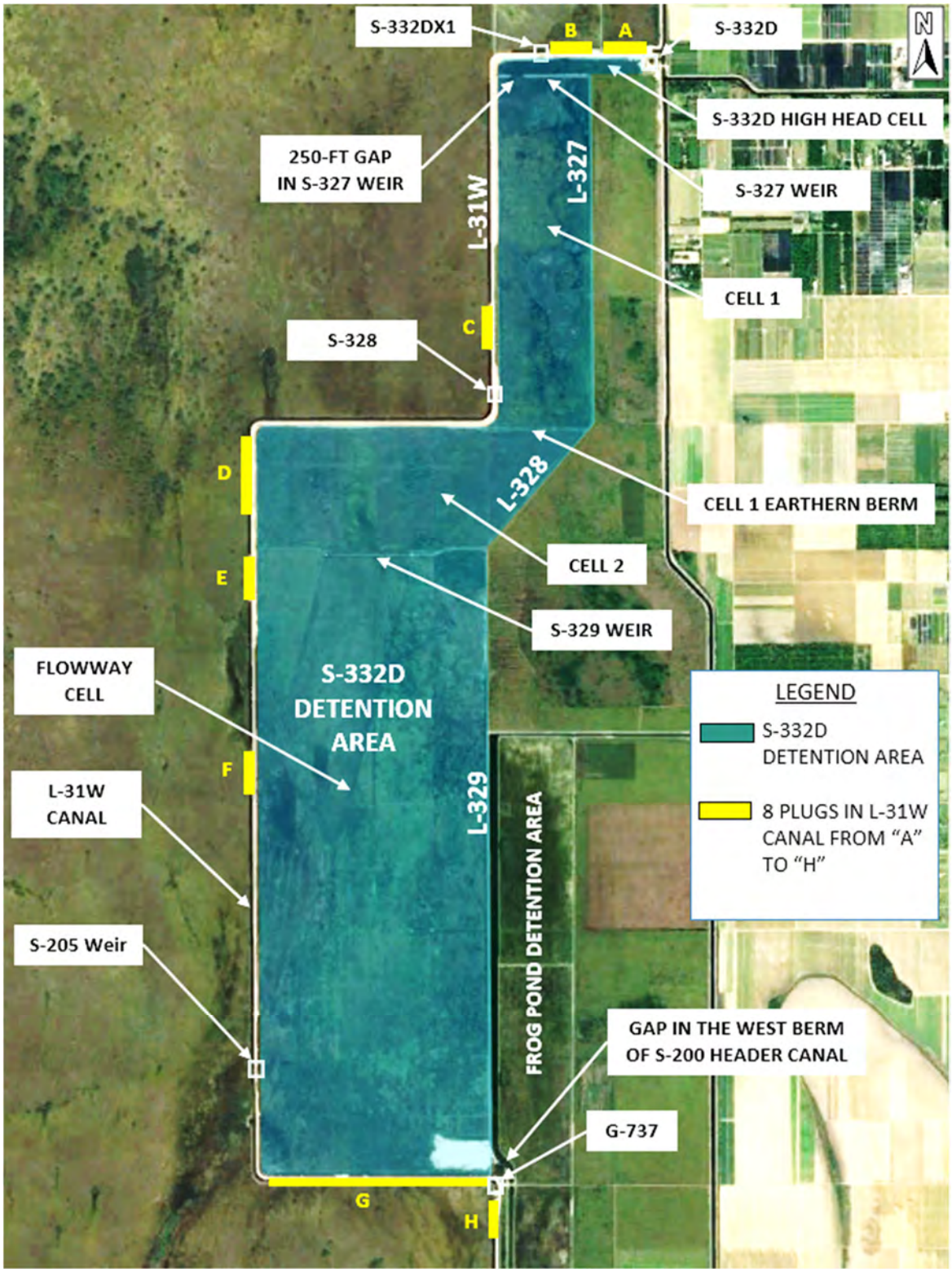

Figure 2-2. S-332D Detention Area and Project Features

2.3.8.7.1 Levees

The levees contained within the S-332 DA consist of the Levee 31 West (L-31W), Levee 327 (L-327), Levee 328 (L-328) Levee 329 (L-329), and Cell 1 earthen berm.

2.3.8.7.1.1 Levee 31 West (L-31W)

L-31W extends westward 0.6 miles from its junction with L-31N at the location of the S-332D pump station to the ENP boundary and then follows southward for approximately eight miles. It has an average crest elevation of 15.0 feet, NGVD. The L-31W Levee prevents flooding from the ENP into agricultural and industrial areas to the east. L-31W levee contains Federal culvert S-328, federal weir S-205, non-Federal culvert G-737. L-31W Borrow Canal maintains hydroperiods and replenishes the fresh water supply in Taylor Slough. Eight earthen plugs (A through H) were installed in the L-31W Borrow Canal, located immediately west of the L-31W Levee, as part of C-111 South Dade Contract 9 in 2018, see Figure 2-2 for locations of plugs.

2.3.8.7.1.2 Levee 327 (L-327)

L-327 is one of three levee segments that make up the eastern perimeter levee of the S-332D DA. It is approximately 1.6 miles long and has an average crest elevation of 9.7 feet, NGVD. There are two reaches within the L-327 levee. An east-west that goes from S-332D pump station to L-31W containing the S-327 forming the southern boundary of the S-332D DA HHC. The remaining north-south reach of L-327 from S-327 weir to the Cell 1 berm forms the eastern boundary of Cell 1 of the S-332D DA.

2.3.8.7.1.3 Levee 328 (L-328)

L-328 is the second of three levee segments that make up the eastern perimeter levee of the S-332D DA. It is approximately 0.6 miles long and has average crest elevation of 9.7 feet, NGVD. L-328 levee forms the eastern levee of S-332D Cell 2.

2.3.8.7.1.4 Levee 329 (L-329)

L-329 is the third of three levee segments that made up the eastern perimeter levee of the S-332D DA. It is approximately 2.5 miles long and has average crest elevation of 9.2 feet, NGVD. L-329 levee forms the eastern levee of S-332D Flow-way Cell.

2.3.8.7.1.5 Cell 1 Earthen Berm

Cell 1 earthen berm is an interior berm dividing Cell 1 from Cell 2 of the S-332D DA and has an average crest elevation of 6.5 feet, NGVD. It is approximately 2,500 feet long and 1.5 feet high.

2.3.8.7.2 Structures

The structures contained within the S-332D DA consist of S-327, S-328, S-329, and S-205. .

2.3.8.7.2.1 Structure 327 (S-327)

S-327 is a 1,900-foot weir located just to the west of L-327 and about 1,500 feet downstream of S-332D pump station. It allows water in the S-332D HHC to overflow into Cell 1 of the S-332D DA when the depth

exceeds 2.5 feet. However, a 250-foot section of the S-327 overflow weir was degraded to match the adjacent ground surface elevation in 2016 to reduce return seepage to the adjacent L-31N Canal and increase surface water flows toward Taylor Slough.

2.3.8.7.2.2 Structure 328 (S-328)

S-328 is an eight-barreled CMP culvert located in the southwest corner of Cell 1 of the S-332D Detention Area. S-328 flow is controlled by manually operated gates and has a design discharge of 500 cfs. S-328 may be used to make deliveries (up to 250 cfs) to Taylor Slough when S-332D flows are greater than 250 cfs. S-328 has a design discharge of 500 cfs.

2.3.8.7.2.3 Structure 329 (S-329)

S-329 is a 1,800-foot overflow weir located between Cell 2 and the Flow-way Cell of the S-332D DA and has an average crest elevation of 6.0 feet, NGVD

2.3.8.7.2.4 Structure 205 (S-205)

S-205 is a 500-foot overflow weir located near the southwest corner of L-31W levee. It has a crest elevation of 6 feet, NGVD and an integrated weir with a 96-foot adjustable flashboard riser section (adjusts between 4.25 feet NGVD and 6 feet NGVD). The flashboards will remain in place year-round unless extreme conditions occur and require removing the flashboards to increase flows west toward L-31W canal. S-205 weir was constructed in 2018 along with partial levee reconstruction to replace the previous 2,100-foot L-31W levee gap. The S-205 weir is higher than the previous L-31W gap and much narrower; therefore, it would prevent surface water losses from Taylor Slough into the S-332D DA when water levels in ENP are higher than inside the S-322D Flow-way Cell.

2.3.8.8 C-111 Spoil Mound Removal

Spoil mound on the western bank of C-111 Canal was removed in 1996 under Contract 2 (DACW17-96-C-0048). The purpose of the spoil mound removal is to improve overland flow of water into the eastern panhandle of the ENP. Refer to **Figure 2-3** for locations of the spoil mounds.

2.3.8.9 Taylor Slough Bridge

The pre-existing bridge crossing the flood plain of Taylor Slough was replaced by a longer bridge over Taylor Slough in 1999 under Contract 3 (DACW17-99-C-0028) in order to achieve a more historic spatial distribution of the flow. Refer to Figure 2-3 for the location of the new bridge.

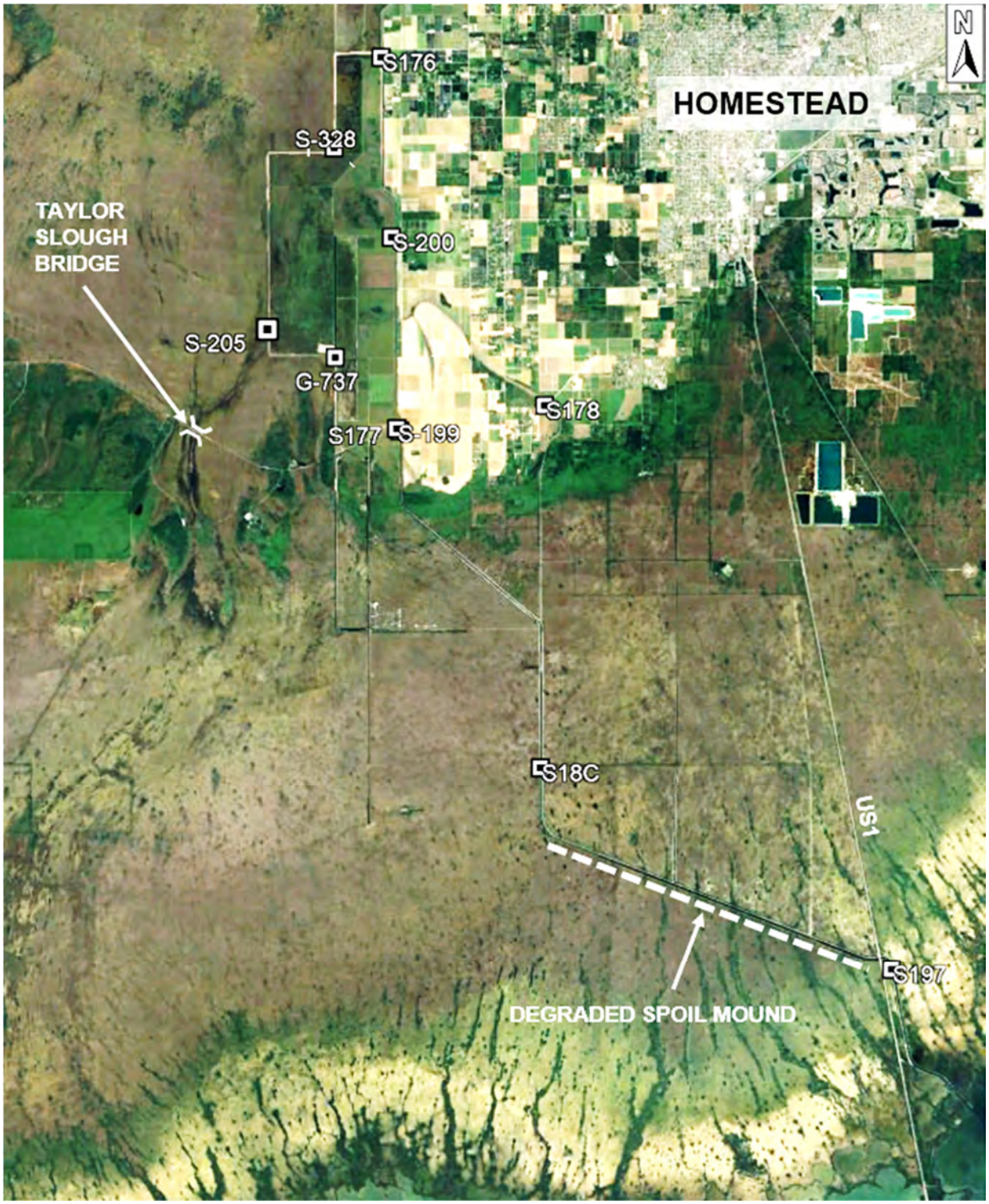

Figure 2-3. C-111 Spoil Mound Removal and Taylor Slough Bridge Map

2.4 Related Control Facilities

The WCAs, ENP, ENP-SDCS component of the C&SF Project is surrounded by other C&SF components which are described in Volumes 3 and 5 of this SOM. Volume 3 describes Lake Okeechobee and the Everglades Agricultural Area and describes upstream structures and regulation responsible parties. Volume 5 East Coast Canals describes the C&SF Project features operated by SFWMD and the various local drainage district network of canals, levees, pump stations, and/or water management infrastructure downstream of the WCAs, ENP, and ENP-SDCS.

2.4.1 Other Related Structures

The C-111 Spreader Canal project is divided into two Project Implementation Reports (PIRs). The first PIR (Western PIR) focuses on restoring the Florida Bay via increased flows through Taylor Slough. A second PIR (Eastern PIR) will focus on restoring the Model Lands and Southern Glades. The C-111 Spreader Canal Western Project features are constructed, owned, and operated by SFWMD.

The C-111 Spreader Canal Western Project is located in southern Miami-Dade County, in an area bounded by ENP, the Florida City-Homestead area, and Manatee Bay. Components of the project include construction of a six-mile hydraulic ridge between Taylor Slough and the C-111 Canal to reduce seepage loss from Taylor Slough and its headwaters. Implementation of the project will improve the quantity, timing and distribution of water delivered to Florida Bay via Taylor Slough; improve hydroperiods and hydropatterns in the Southern Glades and Model Lands; and return coastal salinities to historical recorded conditions by redistributing water that is currently discharged to the Atlantic Ocean and Gulf of Mexico. The hydraulic ridge will be created by constructing a 590 acre above ground detention area in the Frog Pond area (south of pump station S-332D), by installing two 225 cfs pump stations (S-199 and S-200), and integrating other C-111 Spreader Canal Western Project features. Construction of a plug at existing structure S-20A, operational changes at the existing S-20 structure, and construction of earthen plugs at the C-110 Canal. The C-111 Spreader Canal Western Project features are shown in **Figure 2-4**.

The SFWMD implemented features of the C-111 Spreader Canal Western Project as part of its program to expedite design and construction of a number of critical restoration projects consistent with the CERP. Authorization for construction and requirements for SFWMD monitoring of project performance were provided with USACE permit number SAJ-2005-09856. The Frog Pond Detention Area, partial C-111SD LRR 13 November 2016.

Aerojet Canal features, plugs in the C-110 Canal, and a plug at S-20A were completed in 2012. Construction of the remaining two southern weirs along the Aerojet Canal was completed in early 2015. A new water control structure in the lower C-111 Canal (i.e. S-198, which would be located south of S-18C) and incremental increases in the open/close stage triggers at S-18C and S-20 have not yet been implemented. Steps will be taken in the future to incorporate the project into the federally authorized C&SF Project once the project's consistency with the Water Resources Reform and Development Act of 2014 authorized project has been documented and approved by the USACE, and a Project Partnership Agreement (PPA) between the USACE and SFWMD has been executed. Concurrent with the MWD Increment 1 field test, the SFWMD will continue to operate their expedited C-111 Spreader Canal Western Project, and the SFWMD will continue to monitor the impacts of the project and ensure protection of privately owned lands in the vicinity of the C-111 Spreader Canal Western Project. It is presently anticipated that additional information generated from the ongoing SFWMD monitoring within the C-111 Spreader Canal Western Project area will be considered during development of the COP.

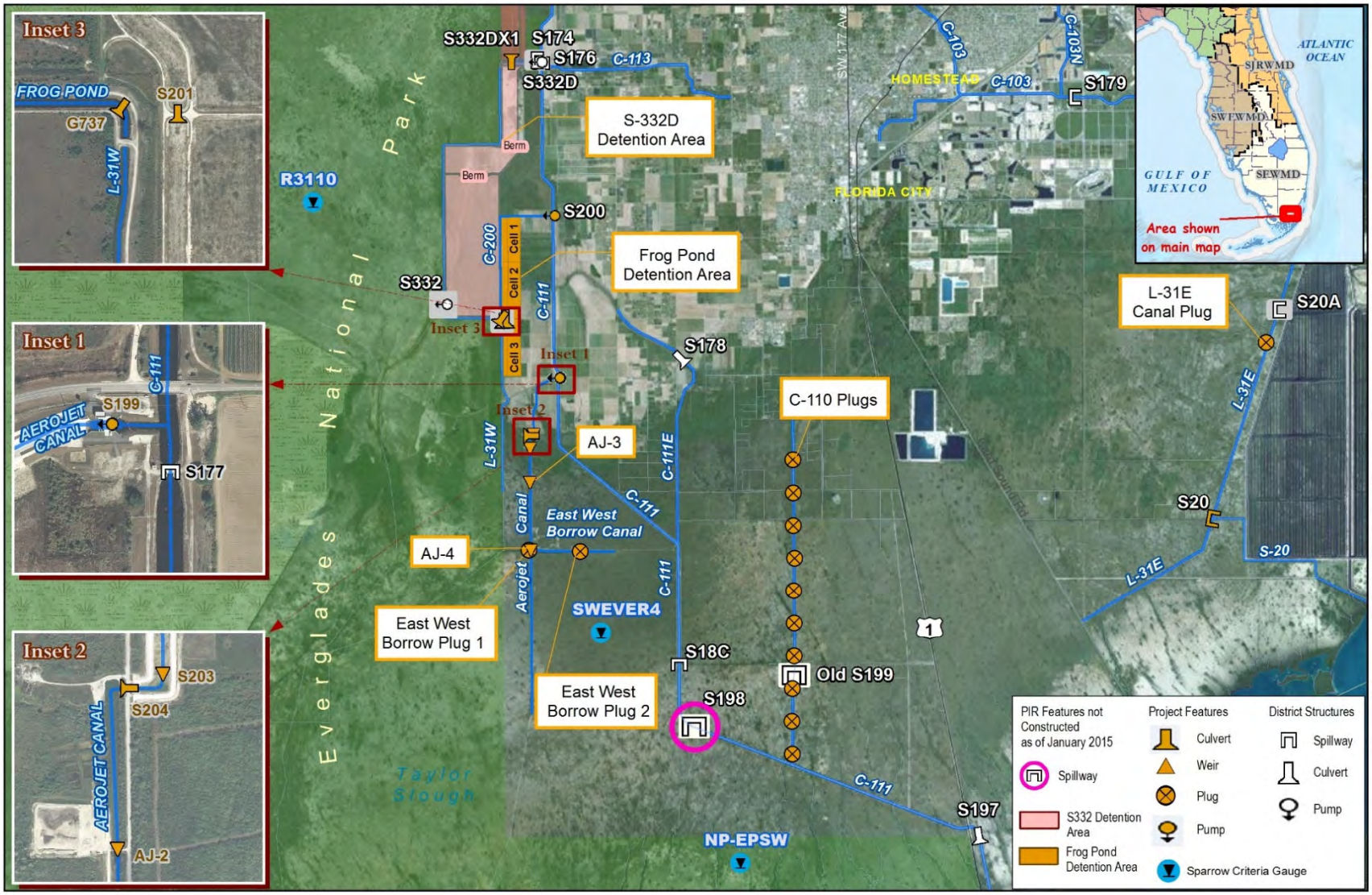

Figure 2-4. C-111 Spreader Canal Western Project Features

2.4.1.1 Structure 199 (S-199)

S-199 is a four-unit pump station located immediately north of S-177 and approximately 200 feet west of the C-111 Canal. The pump station currently consists of four (4) vertical axial flow submersible pumps which collectively provide a total design capacity of 300 cfs (75 cfs each). S-199 is operated along with S-200 pump station to improve the quantity, timing, and distribution of the water delivered to the Florida Bay via Taylor Slough. The pump can be remotely controlled by either the on-site control or from the SFWMD operations control center.

The structure was built in 2012 by SFWMD. The structure initially included three pumps with a total design capacity of 225 cfs. However, in early 2018, SFWMD increased the pump capacity at S-199 (and S-200) by installing an additional 75 cfs electric pump (1 per pump station).

2.4.1.2 Structure 200 (S-200)

S-200 is a four-unit pump station located immediately west of C-111 Canal between the existing control structures S-176 and S-177. More specifically, the approach channel to Pump Station S-200 connects directly to the C111 Canal approximately 2.9 miles north of the control structure S-177. The pump station currently consists of four (4) vertical axial flow submersible pumps which collectively provide a total design capacity of 300 cfs (75 cfs each). S-200 is operated along with S-199 pump station to improve the quantity, timing, and distribution of the water delivered to the Florida Bay via Taylor Slough. The pump can be remotely controlled by either the on-site control or from the SFWMD operations control center.

The structure was built in 2012 by the SFWMD. The structure initially included three pumps with a total design capacity of 225 cfs. However, in early 2018, SFWMD increased the pump capacity at S-200 (and S-199) by installing an additional 75 cfs electric pump (1 per pump station).

2.5 Real Estate Acquisition

Real estate acquisitions within WCA-ENP-SDCS have been completed in accordance with prior project authorizations including MWD, C-111 SD, and CERP C-111 SC projects.

2.6 Public Facilities

The fish and wildlife resources within the WCAs have been separated into two areas, the Arthur R. Marshall Loxahatchee National Wildlife Refuge and the Everglades Wildlife Management Area. The canals offer plenty of fishing and boating opportunities throughout the area and there have been numerous access sites and concession businesses developed for public use by federal, state, and local agencies within these areas. The NPS manages the ENP consistent with its recognition as a national wilderness area.

2.6.1 Arthur R. Marshall Loxahatchee National Wildlife Refuge (LNWR)

WCA-1 includes LNWR, the natural resources within the LNWR are managed by the U.S. Fish & Wildlife Service under an agreement with the SFWMD. The SFWMD also contracts concessions to commercial businesses and monitors them for compliance with these contracts. The Hillsboro Concession Facility (Loxahatchee Recreation Area), a daily fee full-service concession, exemplifies public use facilities as it consists of an interpretive center, nature boardwalk, wildlife observation area and a seven-mile canoe

trail. Primary activities offered are fishing, boating, airboat rides, and waterfowl hunting during the hunting season. Nearly 300,000 people visit LNWR each year.

2.6.2 The Everglades Wildlife Management Area (EWMA)

The EWMA is located within WCA-2 and WCA-3. The Francis Taylor Wildlife Management Area, a portion of EWMA, is located within WCA-3B. These areas are managed by the Florida Fish and Wildlife Conservation Commission (FWC) under an agreement with SFWMD. Sawgrass Recreation Area, a concession corner of the area off U.S. Highway 27. A full service concession, the Everglades Holiday Park, is within WCA-3 and near pump station 9 (S-9). There are also private fish camps within the area. The primary activities are fishing, airboating, hunting, and frogging. The MTIF has use rights for the area in WCA-3 south of Alligator Alley.

2.6.3 Big Cypress National Preserve (BCNP)

The Big Cypress Swamp spans approximately 1,205 square miles (771,000 acres) from southwest of Lake Okeechobee to the Ten Thousand Islands in the Gulf of Mexico. The 570,000-acre BCNP was established by Big Cypress Enabling Legislation, Public Law 93-440, in 1974 to protect natural and recreational values of the Big Cypress watershed and to allow for continued traditional uses such as hunting, fishing, and oil and gas production. It was also established to provide an ecological buffer zone and protect the ENP's water supply. In 1988, Congress passed the Big Cypress National Preserve Addition Act, Public Law 100-301, which added 146,000 acres to the BCNP.

2.6.4 Everglades National Park (ENP)

ENP spans the southern tip of the Florida Peninsula and most of Florida Bay, and is the only subtropical preserve in North America. ENP has been designated a World Heritage Site, and International Biosphere Reserve, and a Wetland of International Importance. Millions of people from all over the world visit ENP each year. In 2017, ENP received 1,018,557 visitors. Less than 0.1% (1,200 of the total 1.4 million acres) of ENP is developed. Visitors to the ENP can choose from activities such as nature study, sightseeing, fishing (both saltwater and freshwater), boating, canoeing, bird watching, hiking, and camping. Although charter fishing, group tours, and guided excursions are available, the park mainly offers primitive recreation experiences. The recreational facilities for public use include five visitor information center nature observation sites, 48 designated backcountry (water-based) campsites, 3 campgrounds totaling 423 sites, 156 miles of trails (including canoe trails), 2 environmental education camps, 4 marinas and 5 boat ramps. The commercial concessions licensed by the National Park Service, to serve the area, consist of three air taxis to Fort Jefferson National Monument, 24 charter boats, six canoe outfitters, three nature photographers, and one bus company. ENP is home to more than 400 bird species, 25 mammal species, 60 amphibian and reptile species, 125 fish species, 55 threatened and endangered flora species and 13 endangered wildlife species.

3 REGIONAL HISTORY

The purpose of this chapter is to provide information on non-Federal infrastructure relationship to the WCA, ENP, ENP-SDCS component of the C&SF Project. The historical progression of water management operations and documentation related to the WCA, ENP, ENP-SDCS component of the C&SF Project is also included. Chapter 2 describes the Federal components of the C&SF Project within WCAs, ENP, ENP SDCS Basin.

3.1 Authorization of Project

The C&SF Project, which includes the WCAs, ENP, ENP-SDCS components, began with the Flood Control Act of 1948 (P.L. 858, 80th Congress, 2nd Session), which authorized Phase 1 of the Comprehensive Plan for Flood Control and Other Purposes (Comprehensive Plan). However, the Federal participation began much earlier with the Rivers and Harbors Act of July 3, 1930, which established the first Federal effort of flood control in the C&SF Project area.

3.1.1 Flood Control Act of 1948

The Flood Control Act of 1948 (P.L. 858, 80th Congress, 2nd Session) authorized Phase 1 of the C&SF Project. Phase 1 consisted of levees, channels and control works of Lake Okeechobee; protection and major drainage of the EAA; conservation of water for control of regional groundwater levels; the protection of east coast urban areas from overflow from the Everglades; flood control and water control for salinity control in the existing urban areas along the east coast; and the main outlets for the WCAs.

3.1.2 Flood Control Act of 1950

Further authorization was contained in section 204 of the Flood Control Act approved May 17, 1950 (P.L. 516, 81st Congress, 2nd Session). This Act authorized most of the works necessary to afford flood protection to the rich agricultural development south of Lake Okeechobee and to the highly developed urban area along the lower east coast of the State.

3.1.3 Flood Control Act of 1954

The remainder of the Comprehensive Plan was authorized by the Flood Control Act of 1954 (P.L. 780, 83rd Congress, 2nd Session). The works authorized by the 1954 Act are presented in House Document 643. This included flood control, water conservation, and navigation in the upper St. Johns and Kissimmee River Basins; an increase in the outlet capacity of the Caloosahatchee River from Lake Okeechobee; the remainder of the protective levees for the EAA and the WCAs; and the remaining salinity barrier in South Dade County.

3.1.4 Flood Control Act of 1958

The Flood Control Act of 1958 (P.L. 85-500) authorized cost sharing for the project works authorized by the 1954 Act. It also authorized the deletion of several project works from the Comprehensive Plan. The 1958 Act also authorized flood protection for 64 square miles in Hendry County.

3.1.5 Flood Control Act of 1962

The Flood Control Act of 1962 (P.L. 87-874) authorized modification and extension of the C&SF Project for flood control and major drainage in the following areas: West Palm Beach Canal, Boggy and Shingle Creeks in the Kissimmee River Basin, South Dade County, and Cutler Drain area of Dade County.

3.1.6 Flood Control Act of 1965

The Flood Control Act of 1965 (P.L. 89-298) authorized flood protection projects in Hendry County and southwest Dade County. The 1965 Act also provided for a seasonal plan in southwest Dade County which would provide levees, canals, water control structures, and pump stations.

3.1.7 Flood Control Act of 1968

The ENP-SDCS was authorized under the Flood Control Act of 1968 (P.L. 90-483). It authorized modification to the existing project in accordance with Senate Document 101 and House Document 369, in the interest of improved conservation and distribution of available water to South Dade and Everglades National Park and extended flood protection.

3.1.8 River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970

This Act (P.L. 91-282) provided funding for the accelerated construction of canals and pump stations to meet the increased water requirements of the ENP. The Act further provided for the delivery from the project of a minimum of 315,000 acre-feet of water according to a monthly distribution and to locations stated in the NPS letter of October 20, 1967, to the Chief of Engineers, or 16.5 percent of total project deliveries for all purposes, whichever is less. Senate Document (S.D.) 91-895 which accompanied the law, provided a formula for deciding when the 16.5 percent quantity applied. The formula was found to be faulty and has not been applied since the earliest months of the application of this Act.

3.1.9 Supplemental Appropriations Act of 1984

This Act, (P.L. 98-181) modified the schedule for delivery of water from the C&SF Project to the ENP as required in the River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970. It also authorized, for a period of two years, an experimental program for the delivery of water to ENP for the purpose of determining an improved schedule for water delivery.

3.1.10 Joint Resolution of 1985

Section 115 of this Resolution (P.L. 99-190) amended the Supplemental Appropriations Act of 1984 (P.L. 98-181) by extending the date for completion of the experimental water delivery program to ENP to January 1, 1989.

3.1.11 Water Resources Development Act (WRDA) of 1988

The WRDA 1988 (P.L. 100-676) amended the Supplemental Appropriations Act of 1984 by extending the date for completion of the experimental water delivery program to ENP to January 1, 1989.

3.1.12 Everglades National Park Protection and Expansion Act of 1989

This Act (P.L. 101-229) modified the boundaries of the ENP to provide for the protection of lands, waters, and natural resources within the park and authorized the construction of modifications, based on the experimental program, to the C&SF Project to improve water deliveries to ENP and, to the extent practicable, to restore the natural hydrological conditions within ENP.

Section 104 (b)-(h) also authorized and directed the Secretary of the Army (Secretary) to construct a flood protection system for the residential area in the East Everglades and adjacent agricultural areas, if the Secretary determines those areas will be adversely affected by operation of the project. To protect agricultural areas, in accordance with this Act, the Secretary must find that there is a substantial reduction in the areas' present economic utility which is attributable solely to the project modification or the residential flood protection system. The Secretary was directed to review the operation of the modified project within 18 months, and periodically thereafter, to determine whether agricultural areas are being adversely affected and to protect the areas if necessary. However, any preventive measure shall be implemented in a manner that presents the least prospect of harm to the natural resources of ENP. The Secretary was also directed to coordinate the construction program with the Secretary of the Interior to permit the Park's expansion (land acquisition) program to proceed concurrently.

Section 104(j) required the preparation of a General Design Memorandum (GDM) for project works within the C-111 basin area of the East Everglades and directed that it take all measures which are feasible and consistent with the purposes of the project to protect natural values associated with ENP.

3.1.13 Energy and Water Development Appropriations Act of 1992

This Act (P.L. 102-104) authorized the continuation of the experimental water delivery program established under P.L. 98-181, Supplemental Appropriations Act of 1984, until the modifications to the C&SF Project authorized by the Supplemental Appropriations Act of 1984 (P.L. 101-229), Everglades National Park Protection and Expansion Act of 1989, were completed and implemented.

3.1.14 The Water Resources Development Act of 1992

The WRDA 1992 (P.L. 102- 580) authorized the USACE to perform the C&SF Project Reformulation Study (Reformulation Study). The Reformulation Study reexamined the C&SF Project under current needs and demands in order to determine the feasibility of operational and/or structural changes in order to optimize its authorized purposes, including environmental restoration and protection. In May 1993, USACE initiated the 18-month Reformulation Study with an anticipated 3 additional years of planning after completion of initial study.

3.1.15 The Water Resources Development Act of 1996

The WRDA 1996 (P.L. 104-303) authorized the USACE to provide for the construction of Stormwater Treatment Area 1 East (STA-1E), an enlarged stormwater detention area. WRDA 1996 also authorized the USACE to implement the recommended plan of improvement contained in a report entitled ‘‘Central and Southern Florida Project, Final Integrated General Reevaluation Report and Environmental Impact Statement, Canal 111 (C–111), South Dade County, Florida’’, dated May 1994, including acquisition by non-Federal interests of such portions of the Frog Pond and Rocky Glades areas as are needed for the project. The USACE, with the STOF as the non-Federal sponsor, was authorized to construct the Big

Cypress Seminole Indian Reservation Water Conservation Plan Project (SBC Project) under the continuing authority of Section 528(b)(3) of WRDA 1996.

3.1.16 The Water Resources Development Act of 2000

The WRDA 2000 (P.L. 106-541) authorized the USACE to begin work on the CERP. To expedite its implementation, USACE was authorized to implement modifications to the C&SF Project that; (1) were described in the CERP; and (2) would produce a substantial benefit to the restoration, preservation and protection of the South Florida ecosystem. WRDA 2000 authorized the USACE to promulgate programmatic regulations to ensure that the goals and purposes of the CERP are carried out, which resulted in the CERP Guidance Memoranda (CGM). The USACE was authorized to construct the Water Conservation Area 3 Decompartmentalization and Sheet Flow Enhancement Project – Physical Model (DPM) under the continuing authority of WRDA 2000. The DPM is a limited duration, fully controlled field test being conducted pursuant to that agreement as a design effort to gather information to formulate decompartmentalization of WCA 3 and to use for the design of CERP features.

3.1.17 Consolidated Appropriations Resolution, 2003

The Consolidated Appropriations Resolution, 2003 (P.L. 108-7) amended the Everglades National Park Protection and Expansion Act of 1989 which identified Alternative 6D (the Selected Alternative in the July 2000 Central and Southern Florida Project, Modified Water Deliveries to Everglades National Park, Florida 8.5 Square Mile Area General Reevaluation Report [GRR] and Final Supplemental Environmental Impact Statement) as the plan to be built, authorized relocation of residents, and other provisions. The MWD to ENP, 8.5 SMA GRR is further discussed in Section 7.3.3 of Chapter 7 of this SOM.

3.1.18 The Water Resources Development Act of 2007

The WRDA 2007 (P.L. 110-114) authorized the USACE to carry out the CERP project for ecosystem restoration, water supply, flood control, and protection of water quality, Central and Southern Florida, Indian River Lagoon, Florida. WRDA 2007 also authorized USACE to carry out the Site 1 Impoundment Project, in Palm Beach County Florida, a CERP project. Congressional managers developing WRDA 2007 expressed dismay at the relatively rapid cost increase and high cost of the 2005 MWD Tamiami Trail Revised General Reevaluation Report (RGRR) plan; and directed proponents in the DOI and USACE to re-evaluate the 2005 Plan and develop less costly alternatives. That direction served as the basis for the Tamiami Trail Modifications (TTM) described in the TTM Final Limited Reevaluation Report (LRR) and Environmental Assessment (EA) and its addendum (USACE 2008).

3.1.19 The Water Resources Reform and Development Act (WRRDA) of 2014

The WRRDA 2014 (P.L. 113-121) authorized the USACE to carry out the CERP C-111 Spreader Canal Western Project in south Miami-Dade County and the CERP Broward County Water Preserve Area Project.

3.1.20 The Water Resources Reform and Development Act (WRRDA) of 2016

Section 1401(4)1 of WRDA 2016 (P.L. 114-322) amended WRDA 1986 (33 U.S.C. 2310) and authorized the CERP, Central Everglades Planning Project (CEPP) features located in Martin, Lee, Palm Beach, Broward, Miami-Dade and Monroe, Counties, FL.

3.1.21 The Water Resources Development Act (WRDA) of 2018

Section 1308(a) of WRDA 2018 (P.L.115-270) authorized the Secretary to carry out the project for ecosystem restoration, C&SF, EAA, Florida in accordance with section 601 of the WRDA 2000, as recommended in the addendum to the CEPP Post Authorization Change Report, Feasibility Study and Draft EIS prepared by the SFWMD and dated May 2018, with such modifications as the Secretary considers appropriate. In accordance with Section 1308(b), the project may only be constructed after the Secretary prepares a report that addresses the concerns, recommendations, and conditions identified in the Assistant Secretary of the Army Civil Works (ASA CW) Review Assessment (May 2018). The Secretary completed that report on May 15, 2018.

3.2 Planning and Design

Throughout the history of the C&SF Project there have been many modifications to the project through various authorizations (legislature) which requires planning and design of new infrastructure and operations. This section aims to capture a brief history of these changes. The Flood Control Act of 1948 authorized Phase I of the Comprehensive Plan presented in H.D. 643. The remainder of the Comprehensive Plan was authorized by the Flood Control Act of 1954. The 1954 authorization specifically recognized that the Comprehensive Plan of improvement would require refinement and modifications which could be made at the discretion of the Chief of Engineers, as long as the modifications were within the scope and purpose of the authorization.

3.2.1 General

Many reports and Design Memoranda (DM) used in the planning and design of the flood control system were prepared as a result of the C&SF Project. Many of these reports recommended additions, deletions, or modifications to the original authorized project. These recommendations were made as a result of more detailed studies or at the request of the local sponsor. The original sponsor for the project was the Central and Southern Florida Flood Control District (C&SFFCD) created by the Florida Legislature in 1949. The C&SFFCD assumed the responsibilities of the Okeechobee Flood Control District and the Everglades Drainage District. However, in 1976 the State of Florida reorganized the flood control districts and the new local sponsors for the C&SF Project became the SFWMD and the St. Johns River Water Management District (SJRWMD). The SFWMD is the non-Federal sponsor for most of the WCAs, ENP, ENP-SDCS components of the C&SF Project. The STOF is the non-Federal sponsor for the SBC Project.

3.2.2 Water Conservation Areas–General

The functions of the WCAs as approved in the 1948 and 1954 Flood Control Acts were considered to be: (1) to act as a depository for excess water from the agricultural areas; (2) to provide the levees needed to prevent Everglades floodwaters from inundating the east coast; (3) to aid in recharging underground freshwater reservoirs; (4) to provide a water supply for east coast agricultural lands; (5) to benefit fish and wildlife in the Everglades; and (6) to release excess water to ENP and water from storage to assist in restoring and maintaining natural conditions.

3.2.3 Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration - Detailed Design Memorandum (DDM), Dated March 2004

The Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration - DDM, dated March 2004 is a documentation report that summarizes the design parameters and development for the

100% Design Submittal on the Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration, Hendry County, Florida as part of the C&SF Project under the continuing authority and responsibility of the USACE, Jacksonville District and the Seminole Tribe of Florida (STOF).

3.2.4 Water Conservation Area 1

The Flood Control Act 1948 envisioned a series of levee-encircled pools for the conservation of floodwaters. WCA-1 levees include L-7, L-39 and L-40. S-10s would serve as outlet for passage of floodwaters from WCA-1 to WCA-2. Inflow would be contributed from the L-8 Borrow Canal, rainfall over WCA-1, and pumped inflow from S-5 and S-6.

3.2.4.1 Partial Definite Project Report, Part I, dated July 10, 1951

Partial Definite Project Report, Part I, dated July 10, 1951 changed the inflow into WCA-1 by increasing the pump capacity from one half inch daily to three quarters of an inch daily. It also changed the maximum conservation stage in WCA-1 to elevation 17.0 feet, NGVD. The capacities of S-5A and S-6 at the WCAs (West Palm Beach and Hillsboro Canals, respectively) were increased to serve the entire drainage areas tributary to the canals. S-5A would pump into WCA-1 and S-6 would pump into WCA-1 when the stage was below 17.0 feet, NGVD and at other times the S-6 pumping would be into WCA-2.

3.2.4.2 Partial Definite Project Report, Part I, Addendum to Supplement 3-Design Memorandum Dated 24 March 1952

Partial Definite Project Report, Part I, Addendum to Supplement 3-DM dated 24 March 1952 presented detail design and cost information for S-5A. The March 1952 report also recommended the adoption of a horizontal pump design and further recommended that the structure be redesigned to include provisions for three additional pumps.

3.2.4.3 Partial Definitive Project Report, Part IV, Section I-Modified First Phase Plan, Dated 26 March 1952

Partial Definitive Project Report, Part IV, Section I-Modified First Phase Plan, dated 26 March 1952 decreased the capacity of S-6 since S-2 would remove agricultural drainage from a portion of the Hillsboro Canal drainage area.

3.2.4.4 Plan Selected at Conference of 29 August 1952

Plan Selected at the 29 August 1952 Conference held at the USACE and attended by representatives of the Office of the Chief of Engineers, USACE, SAD, and USACE concluded that the S-6 should be constructed to remove 3/4 of an inch daily runoff from the drainage area within the authorized 1948 encirclement.

3.2.4.5 Partial Definite Project Report, Part I, Supplement 8-Design Memorandum, Dated 6 February 1953

Partial Definite Project Report, Part I, Supplement 8-DM, dated 6 February 1953 proposed that S-5A and S-6 be constructed to full capacities based on the requirement to remove 3/4 of an inch daily runoff from the drainage area within the larger encirclement included in the 1954 authorization.

3.2.4.6 Partial Definite Project Report, Part IV, Section 4-Modified First Phase Plan, Dated 20 February 1953

Partial Definite Project Report, Part IV, Section 4-Modified First Phase Plan, dated 20 February 1953 proposed deleting S-1 and using S-5A to transfer all runoff from the West Palm Beach Canal agricultural area southward to WCA-1 to affect greater benefits and to make water available to east coast interests. The canal and S-5A would be used to transfer water from Lake Okeechobee to the conservation area when such transfer was desirable and when their full capacities were not needed for drainage of the agricultural area.

3.2.4.7 Partial Definitive Project Report, Part I-Supplement 9-Design Memorandum, Hydrology and Hydraulic Design of Hillsboro Canal and Related Works, Dated 8 June 1953

Partial Definitive Project Report, Part I-Supplement 9-DM, Hydrology and Hydraulic Design of Hillsboro Canal and Related Works, dated 8 June 1953 indicated that S-6 should release into WCA-1 at all times and that additional spillway capacity should be provided through L-39.

3.2.4.8 Part I, Supplement 25-General Design Memorandum (GDM), Plan of Regulation for WCA-1, Dated 29 November 1957

Part I, Supplement 25-GDM, Plan of Regulation for WCA-1, dated 29 November 1957 provided a new plan of improvement for WCA-1 which would provide for seasonal regulation between elevations 14 and 17 feet, NGVD, levees and three spillway units capable of storing seasonal floodwaters for use during dry periods; providing a reasonable degree of erosion resistance against wind tides and wave actions caused by hurricanes; and providing adequate spillway capacity to prevent flood crests from exceeding elevation 17.3 feet, NGVD. This GDM was approved by Chief of Engineers on 23 July 1958.

3.2.4.9 Part I, Supplement 23 (Revised), Design Memorandum, Resubmitted 16 July 1958 Superseded Part I, Supplement 23 Dated 20 June 1955

Part I, Supplement 23 (Revised), DM, resubmitted 16 July 1958 superseded Part I, Supplement 23 dated 20 June 1955. The Revised DM recommended L-39 and S-10, three spillway units capable of storing floodwaters within WCA-1 up to elevation 17.3 feet, NGVD under Standard Project Flood (SPF) conditions; withstand normal steady wind-produced tides and waves and provide a reasonable degree of erosion resistance against overtopping and wave action caused by hurricane forces; and provide adequate spillway capacity to prevent the peak ponding stage from exceeding elevation 17.3 feet, NGVD in WCA-1. The Revised DM was approved by the Chief of Engineers on 8 April 1959.

3.2.4.10 Part I, Supplement 31-Detailed Design Memorandum, Dated 13 October 1959

Part I, Supplement 31-DDM, dated 13 October 1959 presented several changes to the approved plan contained in the (Part I, Supplement 27) GDM (see Section 3.2.4.2 below). These changes were the relocation of L-38 (Section 3) approximately 100 feet west to allow for future expansion of U.S. Highway 27; the reduction of L-35B berm from 40 feet to 30 feet, NGVD in order to reduce excavation quantities; steepening of the side slopes of the L-35B borrow canal to one vertical on one horizontal; reducing the gated culvert in the North New River Canal through L-35B from four 72-inch barrels to two 72-inch barrels; and changing the structure in L-38E from two gated 72-inch pipe culverts to a steel sheet pile spillway. The Division Engineer approved the plan in the 5th Endorsement on 13 January 1960.

3.2.5 Water Conservation Area 2

The Flood Control Act 1948 envisioned a series of levee-encircled pools for the conservation of floodwaters. WCA-2 levees include LL-6, L-35, L-36 and L-39. S-11 would serve as outlet for passage of floodwaters from WCA-2 to WCA-3. Inflow would be contributed from the Hillsborough Canal and rainfall over WCA-2.

3.2.5.1 Partial Definite Report, Part I, Dated 10 July 1951

The plan of improvement for WCA-2 was presented in the Partial Definite Report, Part I, dated 10 July 1951. It included an authorized area where excess water could be stored to supply irrigation needs in developed areas south and east of the pool and as a floodway to release excess water into WCA-3.

3.2.5.2 Part I, Supplement 27-General Design Memorandum, Dated 28 February 1958

Part I, Supplement 27-GDM, dated 28 February 1958 recommended no change to the existing grade of L-6, L-35, L-35A and L-36, except a change in slope on the landward side of L-36; construction of L-35B with culverts from S-11A to L-36; construction of a reach of L-38 on the existing spoil bank elevation and placing two 72-inch gated culverts to allow regulation of the pool in WCA-2B; construction of a reach of L-38 east of the highway with a grade varying from 18 feet, NGVD at S-11C to 19 feet, NGVD at S-7; raising U.S. Highway 27 to an elevation of 17.5 feet, NGVD between S-11A and S-11C; construction of a reach of L-38 west of the highway with an elevation of 16.7 feet, NGVD and with two 72-inch gated culverts in the levee; construction of S-38 in L-36 near C-14; and a provision retained in the cost estimate for deferred construction of additional facilities which may be required if marsh vegetation does not prevent wind tides and waves from attacking the levee. The Part I, Supplement 27-GDM also recommended deletion of S-35. This GDM was approved in the 9th endorsement from the Chief of Engineers dated 16 April 1959.

3.2.5.3 Part I, Supplement 21-DM, Dated 1 November 1954

Part I, Supplement 21-DM, dated 1 November 1954 recommended increasing the crown width of L-5 to 15 feet, NGVD to permit access to S-8; constructing the levees in two stages, with construction of the first stage to the intermediate grade established in the interim report (Part V1 Section 7 of the DM for the C&SF Project, dated 2 April 1954) and the second stage to the final grade when S-7 and S-8 were constructed and the lower agricultural areas developed. A levee grade of four feet above average ground elevation was adopted as minimum intermediate grade. The Part I, Supplement 21-DM, dated 1 November 1954 was approved by the Chief of Engineers in a letter dated 3 March 1955. In the fourth endorsement dated 30 June 1955, the USACE revised the levee design and the excavated peat material was mixed with rock to provide a suitable base material. This was approved by the Division Engineer on 9 August 1955.

3.2.5.4 Part I, Supplement 42-Detailed Design Memorandum (DDM), Dated 11 February 1965

Part I, Supplement 42-DDM, dated 11 February 1965 presented a plan similar to the plan in Part I, Supplement 21 – DM, except it proposed the relocation of the levee 350 feet from the centerline of U.S. Highway 27 to allow for widening of the highway; and the two 72-inch gated culverts located under the levee was reduced to a single gated culvert. These changes were approved by the Division Engineer in a letter dated 23 March 1965.

3.2.5.5 Part I, Supplement 49-GDM and DDM, Dated 31 August 1972

Part I, Supplement 49-GDM and DDM, dated 31 August 1972 presented a modified plan of improvement for WCA-1 and WCA-2 and a proposed plan in lieu of improving conveyance across WCA-2A. C-302 across WCA-2A was proposed in the 1968 Water Resources Report for C&SF Project as part of the general concept to reduce wastage of flood control releases down the St. Lucie Canal. Instead of giving priority to flood control releases down the St. Lucie Canal, priority was given to pumping as much of the excess Lake Okeechobee water as practicable to the WCAs and ENP for beneficial use. The modified plan was approved by the Chief of Engineers on 20 April 1973.

3.2.6 Water Conservation Area 3

3.2.6.1 Phase I Comprehensive Plan (H.D. No. 643), Dated 19 December 1947

The Phase I Comprehensive Plan (H.D. No. 643) provided for encircling WCA-3 with levees so that floodwaters from adjacent areas could be put into the area and stored for beneficial uses or released into ENP. S-8 and S-9 were to release into WCA-3 from adjacent agricultural areas and S-7 was to release into either WCA-2 or WCA-3 depending on relative water levels. The Comprehensive Plan also called for a gated spillway (S-11) to release water into WCA-3 from WCA-2 and another gated spillway S-12 was to release water from WCA-3 into the undeveloped Everglades south of Tamiami Trail. S-31 in the eastern levee at Miami Canal was to allow irrigation releases and release for control of saltwater intrusion. Levees along the east coast (L-30, L-33, and L-37), gated spillways (S-11 and S-12), S-9, and S-31 were included in the Flood Control Act of 1948 while the remaining works in WCA-3 were authorized in the Flood Control Act of 1954.

3.2.6.2 Subsequent to Approval of the Comprehensive Plan

Subsequent to approval of the Comprehensive Plan, several minor changes were approved. L-4 and L-5 and S-8 were moved about three miles south to the Palm Beach-Broward County line. The alignment for L-28 was moved from one to four miles east of the original plan along the Collier County line. S-12s were moved from the vicinity of L-30 to the western end of the area in order to release directly into ENP. S-7 was designed to release only into WCA-2. These WCA-3 works were authorized in 1954.

3.2.6.3 Part I, Supplement 33-GDM, Dated 22 June 1960

Part I, Supplement 33-GDM, dated 22 June 1960 presented the facilities needed to regulate water levels in WCA-3 during a SPF and prevent water in the Everglades from aggravating flood problems on adjacent lands. Part I, Supplement 33-GDM added Levees L-67, L-67 Extension, L-68, and L-28 Extension; S-12E, S-24B, S-150, and S-151. All recommended additions to the C&SF Project were approved in the second endorsement, dated 25 August 1960, to the Chief of Engineers except L-67 Extension and L-28 Extension which were deferred until further study and coordination with the Park Service. The 25 August 1960 report was approved in the fifth endorsement from the Chief of Engineers dated 13 January 1961.

3.2.6.4 District Engineer Letter, Dated 15 August 1960

A letter from the District Engineer, dated 15 August 1960 recommended the deletion of the S-147 pump. However, the Chief of Engineers, in the 2nd endorsement dated 13 September 1960, elected to put it in a deferred status.

3.2.6.5 Part I, Supplement 34-Detailed Design Memorandum, Dated 30 September 1960 Supplements the General Detailed Memorandum-Part I, Supplement 33

Part I, Supplement 34-DDM, dated 30 September 1960 supplements the Part I, Supplement 33 GDM, and presents in detail the design criteria and construction methods for L-67A and L-29, Section 3, S-151, and a gated culvert in L-29, Section 3. L-67A was designed to reduce seepage under the existing east side levees, L-30 and L-33 of the WCA-3B. Section 3 of L-29 provides protection for U.S. Highway 41 (Tamiami Trail) and forms the south boundary of WCA-3B. S-151 provides releases from WCA-3A as needed to maintain desired water levels in WCA-3B, and provides capacity needed for low water releases through S-31 to the east coast agricultural area. Gated culvert in L-29, Section 3, was designed for water releases to the south during dry periods. Approval was made by the Chief of Engineers on 17 November 1960.

3.2.6.6 Part I, Supplement 35-DDM, Dated 7 November 1960 Supplements the General Design Memorandum-Part I, Supplement 33

Part I, Supplement 35-DDM, dated 7 November 1960 supplements the GDM-Part I, Supplement 33 GDM, and presents in detail the design criteria and methods for constructing L-29, Sections 1 and 2, and S-12A, S-12B, S-12C, S-12D, S-12E, and 14. Section 1 of L-29 extends from the south end of L-28 to 40-mile bend on the Tamiami Trail where it joins Section 2, which continues eastward to its junction with Section 3 and L-67A. The existing Tamiami Trail (U.S. Highway 41) was to be abandoned when the roadway is relocated to the top of Section 2 of the levee. S-12 (A-D) were required to provide the major releases for regulating WCA-3A by release into the ENP. S-12E was required to allow regulation of WCA-3B by release into the ENP. Control Section 14 provided gravity drainage from the lower reaches of L-28 borrow pit, via L-29, Section 2, borrow pit, through the Tamiami Trail into the ENP. Approval was made by the Chief of Engineers on 27 December 1960.

In response to a 6 December 1960 request from the District Engineer to construct a berm for wildlife enhancement along L-67A, an evaluation was made to determine whether additional Congressional authorization would be required for construction. However, in a letter dated 19 January 1961, the District Engineer withdrew his proposal for adding the berm due to construction costs. Instead a 12-inch peat layer above elevation 11.0 feet, NGVD that would support a lush growth of grass was proposed that would be suitable for deer grazing. The Division Engineer gave his approval to this modification on 7 February 1961.

3.2.6.7 Part I, Supplement 30-GDM, Dated 15 September 1959

Part I, Supplement 30-GDM, dated 15 September 1959 proposed adding S-139 and S-140; a diffusion canal from L-4(W) borrow canal to WCA-3; inlet structures at points of local inflow; enlargement of Levee tieback and L-4 (W) borrow canals; and two new canals (Big Cypress Canal and L-28 [Section 2] borrow canal). The report also recommended the deletion of S-16. In a letter dated 1 October 1959 the Division Engineer returned the DM for revision contending that S-140 would be one of the largest in the world. The pump station had a very high initial cost, very high maintenance and depreciation cost, and was not considered a very good engineering or economic solution to the drainage problem. The Division Engineer recommended that a gravity canal extending from the upper end of Big Cypress Canal to the vicinity of S-140 be investigated; an alternate alignment to L-28 (Section 2) that would provide storage for the drainage area; the deletion of Big Cypress Canal and S-139; and sizing S-140 to handle a larger area. In a letter dated 20 October 1959, the District Engineer addressed the Division Engineers recommendation. Ultimately a conference was held on 24 November 1959 with representatives from USACE, SAD, Office of the Chief

Engineer (OCE), and the USACE in attendance to discuss the proposed changes. Ultimately, approval was only given to extend L-28 approximately five miles by Chief of Engineers.

3.2.6.8 Addendum 1, Part I, Supplement 30, Dated 15 September 1959

Addendum 1, to Part I, Supplement 30 recommended the removal of runoff from the 10-year storm without appreciable damages. The plan would also add the Interceptor Canal; Big Cypress Canal; enlargement of L-4 (W) borrow canal and L-3 tieback borrow canal; S-139, S-140 and S-147; culverts in L-28; and inlet structures along L-28 borrow canal. S-16 and S-17 would be deleted and S-14 would remain in the plan. The Division Engineer recommended approval of this plan in a letter dated 21 June 1960, however the Chief of Engineers stated in a letter dated 31 August 1960 that no action would be taken until the views of the Flood Control District were furnished.

3.2.6.9 Addendum 2, Part I, Supplement 30, Dated 13 June 1961

Addendum 2, dated 13 June 1961, presented a new plan which incorporated the views of the Flood Control District. This addendum provided a single pump station (S-140) instead of two pump stations (S-139 and S-140); extended the interceptor canal to the northern and western extremities of the Seminole Indian Reservation to provide an outlet for excess water; placed Pump Station S-147 in deferred status; and left an 11-mile gap in L-28 immediately south of the interceptor canal with filling the gap in deferred status until the development of eastern Collier County. In summary the additions were Pump Station S-140 and S-147; the interceptor canal, including two feeder canals, each with a headwater (HW) control structure; two culverts in L-28-south of the interceptor canal; L-3 tieback borrow canal enlargement; and the necessary lateral inflow culverts. The plan also recommended the deletion of S-16 and S-17. The addendum was approved by the Chief of Engineers on 28 August 1961.

3.2.6.10 Part I, Supplement 32-DDM, Dated 2 March 1962

Part I, Supplement 32-DDM, dated 2 March 1962 recommended that the previously approved Addendum 2, Part I, Supplement 30, be modified to tieback to higher ground. The tieback would block any release from WCA-3 through the 11-mile gap in L-28 and would eliminate the possibility that water would be released south along the west side of L-28. The addition of the tieback was approved in a letter from the Chief of Engineers on 11 April 1962.

3.2.6.11 Part I, Supplement 36-DDM, Dated 31 May 1961

Part I, Supplement 36-DDM, dated 31 May 1961 presented a program for the establishment of comprehensive permanent networks of hydrologic and meteorological stations considered necessary for the operation of the project works in WCA-3 and adjoining areas. It also presented a temporary program which would provide sufficient data to determine the approximate seepage rate under interior levees in WCA-3 and the total number of levees required to reduce seepage out of the pool to acceptable rates. Approval was made by the Chief of Engineers on 9 August 1961.

3.2.6.12 Part I, Supplement 37-DDM, Dated 27 April 1962

Part I, Supplement 37-DDM, dated 27 April 1962 presented the same basic plan as Part I, Supplement 33-GDM except S-31 and S-150 were changed from concrete box culverts to corrugated metal pipe culverts. These changes were made to arrive at the most economical structures. They were approved by the Chief of Engineers on 8 June 1962.

3.2.6.13 Part I, Supplement 38-DDM, Dated 22 March 1962

Part I, Supplement 38-DDM, dated 22 March 1962 provided supplemental information to Part I, Supplement 33 –GDM and presented detailed information on the design criteria and methods for the construction of L-68A.

3.2.6.14 Part I, Supplement 41-DDM, Dated 19 June 1964

Part I, Supplement 41-DDM, dated 19 June 1964 presented the design criteria for S-140 and supplemented Part 1, Supplement 30, including addendums 1 and 2. S-140 was designed to serve 110 square miles north and east of the interceptor canal and west of L-28. The plan was approved by the Chief of Engineers on 19 February 1965.

3.2.6.15 Part I, Supplement 42-DDM, Dated 11 February 1965

Part I, Supplement 42-DDM, dated 11 February 1965 supplemented both Part I, Supplement 33 and 27 by providing design criteria for the west levee (L-38) only.

3.2.6.16 Part I, Supplement 53-GDM, and DDM, Dated September 1977

Part I, Supplement 53-GDM and DDM, dated September 1977 presented a supplemental plan of the hydrologic and hydraulic design data necessary to determine the physical features for construction of two canal water control structures S-339 and S-340 located on C-123 (Miami Canal). These structures would prevent over drainage by holding upstream water levels at, or near, ground level. The plan was approved by Chief of Engineers on 3 May 1978.

3.2.6.17 Part I, Supplement 54- GDM and EIS, Dated June 1992

Part I, Supplement 54-GDM and EIS, dated June 1992 proposed changes to the method of operation and changes to the canals and structures that would if implemented, as nearly as possible, return the hydrology of ENP to historic conditions. The plan proposed major modifications at S-345 and S-349, construction of S-355A and S-355B; removal of L-67 Extension and filling the borrow canal and construction of a levee around a residential area. The Record of Decision was signed by the Assistant Secretary of the Army on 13 May 1993.

3.2.6.18 Letter Report on S-343A, S-343B, S-344, and Modification of L-28 and L-67 Extension, Dated 13 April 1983

Letter Report on S-343A, S-343B, S-344, and Modification of L-28 and L-67 Extension, dated 13 April 1983 proposed structural modifications to the C&SF Project, as requested by ENP, which would improve the capability of the project to provide water supply to ENP in a more beneficial manner. The proposed modifications would also benefit the eastern portion of BCNP by restoring overland flow to an area just south of L-28 Tieback; prevent over drainage of the eastern BCNP under dry conditions; and provide a means of making regulatory releases from WCA-3A into Big Cypress Preserve. The proposed structural modifications included the construction of S-343A, S-343B and S-344, three 150-foot-long gaps in the L-28 tieback, and six 150-foot-long plugs placed at intervals in the L-28 borrow canal to the west of L-28. The letter report was approved by the Deputy Division Commander on 20 May 1983.

3.2.6.19 Letter Report on S-346 and S-347 in the L-67 Extension and Borrow Canal, Dated 23 August 1983

Letter Report on S-346 and S-347 in the L-67 Extension and Borrow Canal, dated 23 August 1983 presented design criteria for two controlled culvert structures in the L-67 Extension borrow canal. These two structures were to reduce the rate of S-12 release flowing into ENP down the L-67 Extension borrow canal and to enable the release of minimum water deliveries to the park down the borrow canal only when such deliveries would not otherwise be possible. The report was approved by the Deputy Division Commander on 26 August 1983.

3.2.6.20 Part I, Supplement 55-Feature Design Memorandum No. 1, Dated September 1993

Part I, Supplement 55-Feature DM No. 1, dated September 1993 presented design and cost estimates for modifications to the C&SF Project water management features required for improved water deliveries to ENP. These features include the construction of S-345A, S-345B, and S-345C; S-349A, S-349B, and S-349C; S-355A and S-355B; and the modification of S-334.

3.2.6.21 Central and Southern Florida Ecosystem, Critical Restoration Project, Western C-11 Basin Phase 2 Spillway 381 – DDR, Dated April 2003

The Central and Southern Florida Ecosystem, Critical Restoration Project, Western Canal C-11 (Western C-11) Basin Phase 2 Spillway 381 – DDR, dated April 2003 consists of the construction of a pump station (S-9A) and a gated spillway (S-381) located in Broward County, Florida east of WCA-3A near Weston Florida. S-9A is a four-bay pump station and S-381 is a gated spillway. DDM contains pertinent information for the construction of S-381. The purpose of this project is to improve the quality and timing of stormwater release from C-11 drainage basin to WCA-3A and WCA-3B by pumping seepage at S-9A back into WCA-3A at the same rate it enters the 7,800 feet of C-11 from the S-9A pumps to the S-381 gates. S-381 acts as a canal divide to separate the urban area to the east of the structure from the mainly natural area to the west. This DDR was approved around 6 June 2003.

3.2.7 Everglades National Park-South Dade Conveyance System (ENP-SDCS)

The first overall plan for flood control and protection for southern Miami-Dade County was presented by the USACE in the Survey Review Report on the C&SF Project, South Dade County in 1961. Additional features such as the L-31W Canal system and structures S-174 and S-175 were added by memorandum to the initial plan. Structures S-173, S-176, and S-177 were added to control flows into C-111 canal. The Flood Control Act of 1968 authorized the construction of the ENP-SDCS. The system of canals, structures and pump stations was superimposed on those that already existed above the C-111 system. The purpose of the C&SF Project with the region was to improve sheetflow of freshwater to ENP and Florida Bay. The southern bank of the C-111 project consisted of 54 spoil mounds (the rock dredged to make the canal). However, these spoil mounds impeded overbank flow from the canal to the wetlands.

3.2.7.1 Part V, Supplement 30, GDM, Dated 6 November 1959

Part V, Supplement 30-GDM added Structures S-20F and S-20G by the Chief of Engineers in the Sixth Endorsement dated 4 May 1960.

3.2.7.2 Part V, Supplement 37- GDM, Dated 12 September 1963

Part V, Supplement 37-GDM, added Canals C-102N, C-103N, C-103S, Structure S-179 and deleted S-20D, S-20E and a portion of C-103S within Florida City. These changes were approved by the Chief of Engineers in its Second Endorsement dated 29 November 1963.

3.2.7.3 Part V, Supplement 37- GDM, Addendum 1, 5 October 1967

Part V, Supplement 37-GDM, Addendum 1 added S-198. The addition of S-198 was approved by the Chief of Engineers in its Second Endorsement dated 27 February 1968. S-199 was added by the Chief of Engineers in its Seventh Endorsement dated 5 October 1967.

3.2.7.4 Part V, Supplement 39-DDM, Dated 19 November 1964

Part V, Supplement 39-DDM, dated 19 November 1964 added S-194 and S-195 to the project. These changes were approved by the Division Engineer in its Third Endorsement dated 15 February 1965.

3.2.7.5 Part V, Supplement 40-DDM, Dated 22 January 1965

Part V, Supplement 40-DDM, dated 22 January 1965 added S-196 in Canal 103, which was required to hold the HW in C-103 to elevation 6.5 feet, NGVD. The change was approved by the Division Engineer in the Third Endorsement dated 23 March 1965.

3.2.7.6 Report No. 1768 on the Public Works Appropriations Bill

The Senate Appropriations Committee, in Report No. 1768 on the Public Works Appropriations Bill, determined that the extension of C-l to the northwest was within the scope of the C&SF Project. This extension includes the continuation of the main canal westward to L-31 (C-1, Section 2, or C-1W or C-l Ext.) and the addition of a spur canal north of the main canal. C-1 Ext., C-1N, S-148 and S-149 were added to the project by letter to the Chief of Engineers to the Chairman of the House Committee on Appropriations dated 7 September 1960.

3.2.7.7 Letter Report Entitled “Control Structure 197 in Canal 111,” Dated September 1967

A letter report titled “Control Structure 197 in Canal 111,” dated September 1967, provided information about S-197. The structure enables overland flow across C-111 and thence southward to the ENP and also serves as a barrier against saltwater intrusion. The letter report was approved by the Chief of Engineers on 18 October 1967. In March 1990 the SFWMD received a Department of the Army permit (permit #89IPC-20492) to modify S-197 by adding ten barrels to the three barrels in the original design of the culvert structure.

3.2.7.8 Memorandum of Understanding, April 1973

Memorandum of Understanding (MOU) between NPS and Chief of Engineers dated April 1973 revised the water conveyance system for south Dade County and endorsed the eastern alignment of the Canal 1 (C-1) canal instead of the western alignment. NPS acceptance of the plan presented in Part V, Supplement 52-GDM, Dated 27 June 1973 was conditional on provision of a control structure in C-1 near its western terminus. Subsequent economic, environmental and engineering investigations showed that the eastern alignment was the most advantageous route because it required no new canals; precluded further

development near the park boundary; delivered the water nearer the problem areas; and was less costly. This led to the construction of structure S-338.

3.2.7.9 Part V, Supplement 52-GDM, Dated 27 June 1973

Part V, Supplement 52-GDM, dated 27 June 1973 contained the authorized plan of improvement of the conveyance canals, which included Pump Station 331 and enlargement of reaches of Levee 31N Borrow Canal, C-1 and C-103. These improvements provided supplemental water demands projected to the year 2025 to both the ENP and urban and agricultural users of South Dade County. The GDM was approved by the Chief of Engineers in its Second Endorsement dated 23 November 1973.

3.2.7.10 Part V, Supplement 52- GDM, Addendum 1, Dated 30 June 1978

Part V, Supplement 52-GDM, Addendum 1, dated 30 June 1978 presented a modified plan of improvement of the conveyance canals system as presented in the main report (Part V, Supplement 52 see section 3.2.6.9, above). This addendum covered the design consideration of enlarging the existing C-304 reach of the Miami Canal and S-151 to provide for concurrent deliveries to the coastal tributary reach of Miami Canal (C-6) including the Miami Well Field area, ENP and south Dade County.

3.2.7.11 Part V, Supplement 56-DDM, Dated March 1976

Part V, Supplement 56-DDM, dated March 1976 supplements Part V, Supplement 52-GDM and presents detail designs and costs for a conveyance canal (L-30 Borrow Canal), and two control structures S-32A and S-337 that are part of a strategy to increase flows to ENP and South Dade County.

3.2.7.12 C&SF Project for Flood Control and Other Purposed, Part 1 Supplement 54 GDM and EIS Modified Water Deliveries (MWD) to ENP June 1992

This GDM addresses the Shark River Slough (SRS) portion of water deliveries from the C&SF Project to ENP. Water deliveries to Taylor Slough and to the eastern panhandle area of the Park were to be addressed in other studies. Also, land acquisition for ENP expansion were to be addressed under the guidelines contained in PL 101-229. The purposes of this report were as follows: Follows: (1) develop a plan for an improved water delivery system for ENP; (2) provide designs and cost estimates for all structural and operational modifications necessary for implementation of the improved delivery system; (3) identify the most cost effective alternative means of mitigating potential adverse impacts to developed areas in the East Everglades, either flood protection or acquisition of real estate interests; (4) describe potential environmental benefits to be obtained as a result of hydrologic changes produced by the improved water delivery system.

3.2.7.13 C&SF Project, Final Integrated GRR and Environmental Impact Statement (EIS), C-111 South Dade County, Florida May 1994

This report covers the Canal 111 (C-111) basin and other parts of the Central and Southern Florida Project which affect flows to and through the basin including the borrow canal to L-3IN and the borrow canal to L-31W. The purpose of this GRR was restoration of the ecosystem in Taylor Slough and the eastern panhandle of ENP that were affected by construction of the flood control project in the C-111 Basin. The study also focused on preserving the current level of flood protection for the agricultural activities in the C-111 basin. In early 1995, the SFWMD and the USACE signed a Project Cooperation Agreement to modify the C-111 canal to help the Everglades ecology, while maintaining urban and agricultural flood control

benefits. Project components included detailed design, land acquisition, coordination among government agencies, and structural modifications. In 1996, water quality certification was issued for C-111 Spoil Mounds Degrading Project, allowing the removal of 750,000 cubic yards of dredged material along the southern side of the C-111 canal. And construction contract was awarded for removal of spoil mounds along southern C-111. The work was conducted in 1996 and 1997 between structures S-18C and S-197. The material was trucked to the Frog Pond area for use in construction of the C-111 project levees.

3.2.7.14 C&SF Project, Modified Water Deliveries (MWD) to Everglades National Park, Florida 8.5 Square Mile Area (SMA), General Reevaluation Report (8.5 SMA GRR) July 2000

The 8.5 SMA GRR authorized the construction of the 8.5 SMA levees, canals and the S-357 pump station. The goal of the 8.5 SMA GRR was to facilitate selection of a plan that provides a technical solution for the hydrological and ecological restoration of the Everglades National Park and mitigation for additional flooding impacts in the 8.5 SMA that would result from implementing the MWD project, both as specified in the 1989 Act, while maintaining compatibility with CERP objectives consistent with the WRDA 2000 authorization.

3.2.7.15 C&SF Project, GRR/Supplemental EIS (GRR/EIS) for the Tamiami Trail Modifications, MWD to ENP, December 2003

The purpose of this GRR was to identify a technical solution to provide modifications to Tamiami Trail so that there would be unimpeded conveyance of water from WCA-3B and the L-29 Canal to the Northeast Shark River Slough (NESRS) and the ENP south of the Tamiami Trail. This document is an integrated GDM. The contents of a Final Supplemental Environmental Impact Statement are integrated into this document (GRR/FSEIS).

3.2.7.16 C&SF Project, Final Revised GRR/Second Supplemental EIS (GRR/EIS) for the Tamiami Trail Modifications, MWD to ENP, November 2005

This document is a Revised General Reevaluation Report into which a Second Supplemental Environmental Impact Statement has been integrated (RGRR/SEIS). It revises the previous 2003 GRR/SEIS to update the alternative analysis and serves to incorporate and evaluate all features necessary for project implementation.

3.2.7.17 MWD to Everglades National Park, Tamiami Trail Modifications Final Limited Reevaluation Report (LRR) and EA, June 2008

This document supersedes the 2005 C&SF Project, Final GRR/SEIS. The purpose of this LRR was to recommend a plan in a Report to Congress that was efficient, complete and acceptable in terms of cost and specified hydrologic targets that generated desired ecological responses similar to those cited in the 2005 C&SF Project, Final RGRR/SEIS.

3.2.7.18 Everglades National Park, Tamiami Trail Modifications: Next Steps Final EIS, November 2010

This document presents an environmental analysis of six alternatives that the NPS considered, for public input and review in accordance with the National Environmental Policy Act (NEPA) of 1969. The environmentally preferred alternative for the project which most closely met the project objectives and the NPS mission was determined to be Alternative 6e. Alternative 6e introduced 5.5 miles of bridges and would raise the remaining highway to an elevation of 13.13 feet, NGVD.

3.2.7.19 **Canal 111 (C-111), South Dade County, Florida Final LRR, November 2016**

The C-111 SD LRR was prepared to ensure a complete administrative record and that all necessary approvals were documented. Numerous design changes have been needed on the C-111SD project since construction from 1996 through 2016. the This LRR describes refinements and design changes associated with all construction of the C-111 South Dade project, comparing each design change to the features authorized in the 1994 General Reevaluation Report (USACE 1994). The LRR consolidates and documents previously approved post authorization change reports (PACR) and their associated NEPA documents, encompassing numerous design changes were needed on the C-111 South Dade project during construction from 1996 through 2018.

3.3 Construction

Construction on the structures in the WCAs, ENP, ENP-SDCS areas began after authorization in 1948. The first structures were completed in 1951. **Table 3.1**: Dates of Construction and transfer of non-federal strucTures TO SFWMD within the WCAs, ENP, ENP-SDCS region

shows a list of spillways, levees, pump stations, culverts and other associated structures with dates of construction and dates when completed facilities were transferred to the SFWMD.

Table 3.1: Dates of Construction and transfer of non-federal strucTures TO SFWMD within the WCAs, ENP, ENP-SDCS region

		Construction Dates		Transferred		
Structure	Type	Initiated	Completed	to SFWMD	Modifications	Notes
S-5A	Pump Station	20 Mar 53	26 Aug 55	2 May 55		
S-5A(E)	Culvert	8 Jul 52	7 Dec 53	15 Apr 54		
S-5A(S)	Spillway	8 Jul 52	7 Dec 53	15 Apr 54		
S-5A(W)	Culvert	8 Jul 52	7 Dec 53	15 Apr 54		
S-6	Pump Station	21 Feb 55	30 Mar 57	30 Apr 57		
S-7	Pump Station	12 Sep 57	11 Dec 59	10 Feb 61		
S-8	Pump Station	12 Apr 59	16 Jan 62	9 Feb 62		
S-9	Pump Station	25 Nov 53	8 Apr 57	9 Aug 57		
S-9A	Pump Station					
S-10A, C&D	Spillways	2 Nov 58	28 Jun 60	Retained		
S-10E	Culvert			Retained	Filled with concrete.	
S-11A, B&C	Spillways	13 May 52	12 Mar 54	Retained		
S-11A, B&C*	Spillways	11 Feb 57	11 Dec 57	Retained		
S-12A,B,C&D	Spillways	24 Apr 61	20 Jan 63	Retained		
S-12E	Culvert	24 Apr 61	20 Jan 63	Note (1)		

		Construction Dates		Transferred		
Structure	Type	Initiated	Completed	to SFWMD	Modifications	Notes
S-12F	Culvert		13 Dec 67	Note (1)		
S-14	Culvert	24 Apr 61	20 Jan 63	31 Jan 63		
S-18	Spillway	26 Jun 70	16 Dec 71			
S-18C	Spillway	21 May 64	9 Mar 66	15 Apr 66		
S-24	Culvert	20 May 52	24 Sep 52	15 Oct 52		
S-24A	Culvert	20 May 52	24 Sep 52	15 Oct 52		
S-31	Culvert	2 Jul 62	15 May 63	12 Jul 63		
S-32	Culvert	15 Mar 51	2 Feb 52	15 Sep 52		
S-32A	Culvert	10 May 51	3 Jul 52	15 Sep 52		
S-34**	Culvert	15 Mar 51	2 Feb 52	15 Sep 52		
S-34***	Culvert	23 Mar 54	29 Oct 54	13 Aug 54		
S-38	Culvert	17 Feb 60	15 Jun 61	3 Jul 61		
S-38A	Culvert					
S-38B	Culvert	10 May 62	29 May 62	18 Jun 62		
S-39	Spillway	8 Aug 51	15 Oct 52	15 Sep 52		
S-39A	Culvert					
S-124	Culvert	12 Dec 65	6 May 66	21 Jun 66		
S-140	Pump Station	16 May 66	14 Jan 70	15 May 70		
S-141	Spillway	22 Jan 60	15 Jun 61	3 Jul 61		
S-142	Culvert	22 Jan 60	15 Jun 61	3 Jul 61		
S-143	Culvert	22 Jan 60	15 Jun 61	3 Jul 61		
S-144	Culvert	22 Jan 60	15 Jun 61	3 Jul 61		
S-145	Culvert	22 Jan 60	15 Jun 61	3 Jul 61		
S-146	Culvert	22 Jan 60	15 Jun 61	3 Jul 61		
S-150	Culvert	26 Oct 65	18 Mar 66	8 Mar 68		
S-151	Culvert	9 Jan 61	12 Jul 62	27 Jul 62	Reconstructed	
S-155A						
S-155B						
S-173	Culvert	5 May 66	8 Jul 67	15 Aug 67		
S-174	Spillway	17 Jul 68	28 Oct 70	29 Nov 71	Removed	
S-175	Culvert	17 Jul 68	28 Oct 70	29 Nov 71	Removed	

		Construction Dates		Transferred		
Structure	Type	Initiated	Completed	to SFWMD	Modifications	Notes
S-176	Spillway	16 May 66	8 Jul 67	15 Aug 67		
S-177	Spillway	2 May 66	16 Jul 67	15 Aug 67		
S-178	Culvert	2 May 66	16 Jul 67	15 Aug 67		
S-190	Spillway	19 Feb 65	24 May 67	12 Jul 67		
S-194	Culvert	21 Apr 65	15 Jul 66	15 Sep 66		
S-196	Culvert	13 Dec 65	23 Jul 66	25 Aug 67		
S-197	Culvert	27 May 68	12 Feb 69	8 Jul 69	Original structure replaced in 2012	
S-199 New	Pump Station					
S-199	Spillway	Aug 70	18 Dec 71	28 Jul 72	Removed	
S-200	Pump Station					
S-319	Pump Station					
S-328	Culvert	1999	2003			
S-331	Pump Station	13 Feb 79	1 Feb 83	13 Jun 83		
S-332	Pump Station	14 Dec 78	Aug 80	18 Aug 80	Not Operational. Pumping units were removed.	
S-332B	Pump Station	29 Jan 00	12 Apr 00	2010		
S-332C	Pump Station	2002	2003	2010		
S-332D	Pump Station		Dec 1997	1997		
S-333	Spillway	Feb 76	11 Oct 78	15 Dec 78		
S-332DX1	Culvert		2009	21 Feb 2017		
S-334	Spillway	Feb 76	11 Oct 78	15 Dec 78		
S-335	Spillway	30 Mar 77	15 Feb 79	8 Sep 78		
S-336	Culvert	Feb 76	11 Oct 78	15 Dec 78		
S-337	Culvert	26 Jan 77	3 Jan 79	8 Sep 78		
S-338	Culvert	26 Aug 77	13 Feb 79	Apr 79		
S-339	Spillway	13 Feb 79	8 Aug 80	20 May 81		
S-340	Spillway	13 Feb 79	20 Nov 80	20 May 81		
S-343A	Culvert	18Jul 83	23 Jun 86	14 Jun 91		
S-343B	Culvert	18Jul 83	23 Jun 86	14 Jun 91		
S-344	Culvert	18 Jul 83	23 Jun 86	14 Jun 91	Pipes Rebuilt	
S-346	Culvert	18 Jul 83	23 Jun 86	14 Jun 91		
S-347	Culvert					
S-355A	Spillway	31 Aug 96	1998	Retained		

		Construction Dates		Transferred		
Structure	Type	Initiated	Completed	to SFWMD	Modifications	Notes
S-355B	Spillway	31 Aug 96	1998	Retained		
S-356	Pump Station	1 May 02	31 Jul 2002	03 Aug 2017		
S-357	Pump Station		22 Oct 2009	04 Oct 2012		
S-357N	Culvert	2017	Feb 2018	May 2018		
S-362	Pump Station					
L-4	Levee	16 Jan 56	10 May 57	24 May 57		
L-5	Levee	18 Sep 56	21 Nov 57	16 Dec 57		
L-6	Levee	24 Jan 56	12 Aug 57	30 Aug 57		
L-7	Levee	24 Nov 52	22 Jun 55	1 Jul 55		
L-28 (Sec. 1)	Levee	16 Jan 56	10 May 57	24 May 57		
L-28 (Sec. 2)	Levee	29 Mar 60	15 Jun 61	20 Mar 61		
L-28 (Sec. 2 Rem. & Sec. 3)	Levee	22 Aug 62	28 Jun 63	22 Jul 63		
L-28 (Sec.5 & Sec. 5 Tieback)	Levee	25 May 62	12 May 63	1 Sep 65		
L-29	Levee	9 Jan 61	12 Jul 62	27 Jul 62		
L-30	Levee	10 May 51	3 Jul 52	15 Sep 52		
L-31N	Levee	16 May 66	8 Jul 67	15 Aug 67		
L-31W	Levee	17 Jul 68	28 Oct 70	30 Apr 71		
L-33	Levee	15 Mar 51	6 Feb 62	15 Sep 52		
L-35	Levee	11 Mar 50	18 Aug 50	1 Jan 52		
L-35A	Levee	3 Jan 50	22 Jul 50	1 Jan 52		
L-35B	Levee	17 Feb 60	15 Jun 61	3 Jul 61		
L-36	Levee	7 Mar 50	17 May 51	1 Jan 52		
L-38	Levee	13 Apr 59	15 Jun 61	3 Jul 61		
L-38E (Sec. 1)	Levee	13 Apr 59	28 Feb 60	18 Mar 60		
L-38E (Sec. 2 & 3)	Levee	17 Feb 60	15 Jun 61	14 Jul 61		
L-38W	Levee	26 Oct 65	18 Mar 66	8 Mar 68		
L-39	Levee	2 Nov 58	28 Jun 60	19 Jul 60		
L-40	Levee	11 Nov 50	29 Dec 52	15 May 53		
L-67A & B	Levee	9 Jan 61	12 Jul 62	27 Jul 62		

		Construction Dates		Transferred		
Structure	Type	Initiated	Completed	to SFWMD	Modifications	Notes
L-67 EXT	Levee	6 Jun 66	9 Nov 67	26 Jul 68 Note (2)		
L-68A	Levee	9 Oct 62	19 Aug 63	12 Sep 63		
L-327	Levee		2003	2010		
L-328	Levee		2003	2010		
L-329	Levee		2003	2010		
L-320	Levee	2007	2009	2010		
L-322	Levee		2003	2010		
L-323	Levee		2003	2010		
L-357W	Levee	2015	2018	Feb 2019		
L-315	Levee	2015	2018	Feb 2019		
L-316	Levee	2015	2018	Feb 2019		
L-31W	Levee		2009	2010		
High Head Cell Southern Berm	Berm		2003	2010		Includes S-327 weir and S-327 partial degrade
Cell 1 Southern Berm	Berm		2003	2010		
Cell 2 Southern Berm	Berm		2003	2010		Includes S-329 weir.
L-360E	Berm	2016	2018	Future Transfer Expected		
L-360W	Berm	2016	2018	Future Transfer Expected		
L-359	Berm	2016	2018	Future Transfer Expected	Includes Levee Gap and partial S-360W weir demo	To facilitate connection to the NDA
L-318	Berm	2016	2018	Future Transfer Expected		Includes S-318 weir.
L-321N	Berm	2016	2018	Future Transfer Expected		Includes S-321A weir.

		Construction Dates		Transferred		
Structure	Type	Initiated	Completed	to SFWMD	Modifications	Notes
L-321S	Berm	2016	2018	Future Transfer Expected		Includes S-321B, S-321C weirs.

Note (1): Removed in 1990

Note (2): Four miles degraded in 2002.

* Second Phase

** Main Structure

*** Secondary Structure

3.4 Related Projects

This section covers additional Federal and non-Federal projects and/or infrastructure which are hydrologically connected or interact with the WCA, ENP, ENPD-SDCS component of the C&SF Project.

3.4.1 Everglades Construction Project (ECP) and Everglades Nutrient Removal (ENR) Project

The State of Florida, as a result of the Everglades Forever Act (Ch. 373.4592, F.S.) and the Everglades Settlement Agreement, began the construction of the non-Federal Everglades Construction Project (ECP). The ECP consists primarily of five large constructed wetlands, referred to as Stormwater Treatment Areas (STAs) designed to reduce the levels of phosphorus from waters entering the Everglades Protection Area. The ENR Project was a pilot project for testing and refining treatment design and operation of the full-scale constructed wetlands and was approximately 10 percent (4,000 acres) of the planned STAs.

3.4.2 Stormwater Treatment Areas (STAs)

The STAs which consist of the Federal STA-1E, and non-Federal STA-1W, STA-2, STA-3/4, and STA-5/6 replaced the ENR project. The STAs are adjacent to and release directly into WCA-1, WCA-2A and WCA-3A. The STAs will be discussed in detail in the Volume 3 of the SOM. See **Figure 3-1**: Stormwater Treatment Areas and Water Conservation Areas

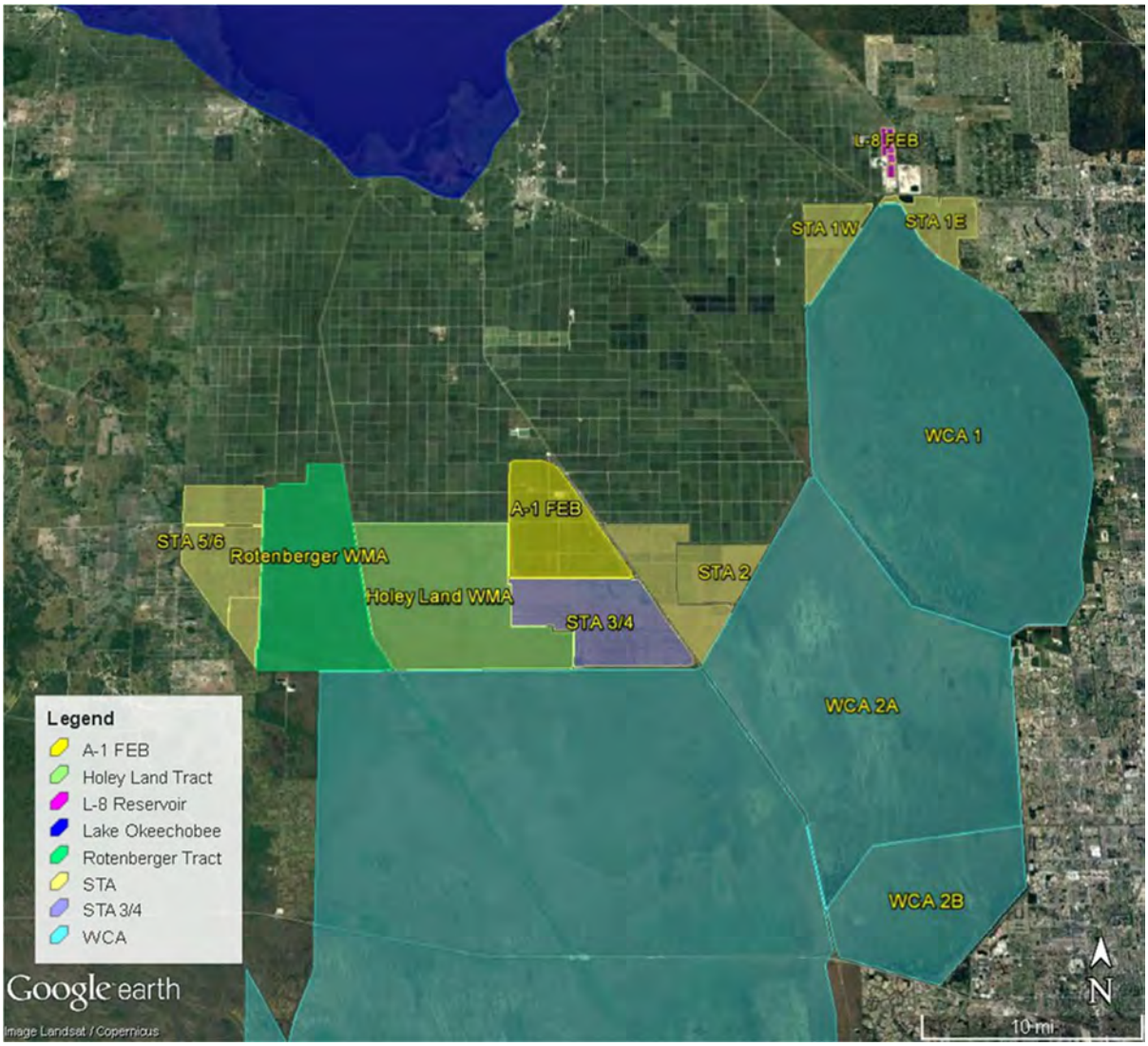

Figure 3-1: Stormwater Treatment Areas and Water Conservation Areas

3.4.2.1 Stormwater Treatment Area 1 West (STA-1W)

The ENR (3,800 acres) was modified and expanded to create the STA-1W project (6,500 acres). The ENR Project is a "constructed," or man-made, wetland designed to biologically remove phosphorous from agricultural runoff before it enters the Everglades. The project encompasses nearly 4,000 acres and is located adjacent to L-7 which borders the Arthur R. Marshall Loxahatchee Wildlife Refuge (WCA-1). The project is located near a major pump station, S-5A, which drains a 230-square-mile section of the EAA. Construction of STA-1W began in 1997 and included modifications to the ENR internal levees and water control structures to provide additional peak flow capacity through Cells 1 through 4 (Engineer of Record, Hutcheon Engineers). Operation of Cells 1 through 4 (i.e., the Eastern and Western flow-ways) continued during the construction modifications. Cells 5A and 5B (Northern Flow-way) were completed in March 1999. Flow through operation of the Northern Flow-way commenced in July 2000. Full operation of STA-1W commenced in October 2000 when the G-310 outflow pump station was completed. STA-1W was further expanded in 2019 with the construction Cells 6 through 8 also known as Expansion #1. Expansion #1 increased the total effective treatment area to approximately 11,000 acres. STA-1W releases are

through the G-310 and G251 pump stations into the WCA-1 L-7 canal which borders the western perimeter of the WCA. For additional information, refer to the SFWMD Operation Plan for Stormwater Treatment Area 1 West in the SOM Volume 3.

3.4.2.1.1 Pump Station G-251

The G-251 Pump Station is located on the western boundary of the L-7 Canal approximately 8.6 miles north of S-6 and is an outflow pumping station for STA-1W. This pumping station consists of six 75 cfs electric motor driven pumps, with a combined capacity of 450 cfs. G-251 is used in concert with G-310 to pump treated agricultural runoff water from STA-1W to WCA-1.

3.4.2.1.2 Pump Station G-310

The G-310 Pump Station is located at the south corner of STA-1W approximately 0.25 miles west of G-251. This pumping station consists of two (2) 100 cfs pumps, two (2) 470 cfs pumps, and two (2) 950 cfs pumps with a maximum combined capacity of 3,040 cfs. Pump station G-310 serves as the primary outflow pump station for STA-1W. G-310 is used in concert with G-251 to pump treated agricultural runoff water from STA-1W to WCA-1.

3.4.2.2 Stormwater Treatment Area 1 East (STA-1E)

STA-1E (Federal) is located approximately 20 miles west of West Palm Beach, Florida, south of State Road 80 and C-51, adjacent to the northeast boundary of WCA-1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge). STA-1E features include levees, water management structures, and pump stations. STA-1E consists of three parallel treatment paths, or flow-ways, with eight treatment cells flowing from north to south. This created wetland marsh system will provide an effective treatment area of 5,132 acres within the eight treatment cells, and an additional 1,046 acres in the distribution cells upstream of the eight cells. For additional information, refer to the SFWMD Interim Operation Plan for Stormwater Treatment Area 1 East of the SOM Volume 3.

3.4.2.2.1 Pump Station S-362

S-362 is a seven-unit pump station located in the south corner of STA-1E. It is comprised of five (5) diesel engine-driven pumps (three (3) 960 cfs pumps and two (2) 550 cfs pumps) and two (2) additional 110 cfs electric motor driven pumps, with a combined nominal capacity of 4,200 cfs. S-362 is the outlet from STA-1E to WCA-1 via L-40 borrow canal.

3.4.2.3 Stormwater Treatment Area 2 (STA-2)

STA-2 (non-Federal) is a critical component of the ECP that is located immediately west of WCA-2 and consists of four parallel treatment paths, or flow-ways, flowing from north to south. STA-2 is situated generally on and surrounding the former Brown's Farm Wildlife Management Area, Woerner Farm and the Okeelanta Farm. The original STA-2 consisted of three treatment cells (1, 2 and 3) with 6,338 acres of effective treatment area and began operation in 2000. However, the treatment area was expanded with the addition of the Compartment B Build-out for a total STA-2 treatment area of 15,057 acres. Water is sent to STA-2 from a variety of sources, including agricultural runoff and releases from the S-6/S-2 Basin, a portion of the runoff from the S-5A Basin via the Ocean and Hillsboro Canals, runoff from Chapter 298 drainage districts situated on the easterly shore of Lake Okeechobee, and several others. STA-2 releases

are through the G-335 gated spillway and G-436 pump station into the western WCA-2A. For additional information, refer to the SFWMD Operation Plan for STA- 2 in the SOM Volume 3.

3.4.2.3.1 **Pump Station G-335**

G-335 (non-Federal) is a six-unit pump station located in the southeast corner of STA-2. It is comprised of two (2) 950 cfs diesel engine driven pumps, two (2) 470 cfs diesel engine driven pumps and two (2) 100 cfs electric motor driven pumps for a nominal discharge capacity of 3,040 cfs and includes six pumps with a combined capacity of approximately 3,040 cfs (design capacity 3,370 cfs). G-335 is the primary outlet from STA-2 to WCA-2. G-335 along with G-436 serves as one of the primary outflow pumping stations for STA 2 (cells 1 through 3). The structure moves treated agricultural runoff into WCA-2 via L-6 canal.

3.4.2.3.2 **Pump Station G-436**

G-436 (non-Federal) is a five-unit pump station located adjacent to and south of G-335. G-436 is located adjacent to and south of S-335. The station is comprised of three 533 cfs diesel engine driven pumps and two 100 cfs electric motor driven pumps for a nominal discharge capacity of 1,600 cfs. The 100 cfs electric motor driven pumps allow for remote operation during low flow conditions. All pumps are vertical axial flow pumps.G-436 is a diesel powered 533 cfs pump and two electric powered 100 cfs pumps that are used under low flow conditions. G-436 along with G-335 serves as one of the primary outflow pumping stations for STA 2 (cells 4 through 8). The structure moves treated agricultural runoff into WCA-2 via L-6 canal. This pumping station releases into the L-6 canal and ultimately into WCA-2A.

3.4.2.4 **Stormwater Treatment Area 3/4 (STA-3/4)**

STA-3/4 (non-Federal) is part of the ECP and is positioned immediately east and north of the Holey Land Wildlife Management Area, north of WCA-3A and west of U.S. Highway 27. It provides a total effective treatment area of 16,327 acres with six treatment cells to treat stormwater runoff originating within the S-2/S-7, S-3/S-8, S-236 and C-139 Basins as well as Lake Okeechobee, all located generally north of the project. For additional information, refer to the SFWMD Operation Plan for STA-3/4 in the SOM Volume 3.

3.4.2.4.1 **S-7**

S-7 is a three-unit pump station located in the North New River Canal at the western corner of WCA-2A, about 30 miles southeast of the town of Belle Glade and immediately east of U.S. Highway 27. This pump station is comprised of three (3) 830 cfs diesel engine driven pumps for a total discharge capacity of 2,490 cfs. Pump Station S-7 is used to provide a hydraulic gradient for discharges from STA-3/4. The station also has an adjacent gated spillway that allows water to enter WCA-2A via gravity when downstream stages are low. In addition to moving water from STA-3/4, S-7 may also be used (when G-371 is open) to divert North New River Canal flows around STA-3/4, either for water supply deliveries to the Lower East Coast or in the event of extended durations of excessively high water depths in STA3/4 during extreme events.

3.4.2.4.2 **S-8**

S-8 is a four-unit pump station located in the Miami Canal at the northern boundary of WCA-3A, about 30 miles southwest of the town of Belle Glade and 15 miles west of U.S. Highway 27. This pump station is comprised of four (4) 1,040 cfs diesel engine driven pumps for a total discharge capacity of 4,160 cfs. The operational purpose of S-8 is to discharge waters from STA-3/4 and STA-5 to the Miami Canal in WCA-3A.

3.4.2.4.3 **G-404**

G-404 (non-Federal) is a three-unit pump station located in Broward County in the L-4 Canal at the confluence of the Miami Canal and the L-4 Canal. G-404 is located just north of Pump Station S8, adjacent to and south of Structure G-357, and adjacent to the southeastern corner of the Rotenberger Wildlife Management Area. This pump station is comprised of three (3) 200 cfs diesel engine driven pumps for a total discharge capacity of 600 cfs.

The two operational objectives for G-404 are as follows, (1) To supply the northwest corner of WCA-3A with treated discharges from STA-3/4 and STA-5; (2) To provide supplemental irrigation water supply to the Big Cypress Seminole Indian Reservation (G-404 will be operated in conjunction with G-409 in this scenario).

3.4.2.4.4 **Structure S-150**

Structure S-150 is located on the L-5 Canal west of the confluence with the North New River Canal This structure is located adjacent to U.S. Highway 27, just west of Pump Station S-7, and adjacent to the northeastern corner of the Water Conservation Area 3A. This structure has historically been used to pass S-2/S-7 basin waters into WCA-3A, and to provide regulatory discharge from Lake Okeechobee so long as not to affect the water supply to WCA-2A via Pump Station S-7.

3.4.2.5 **Stormwater Treatment Areas 5 / 6 (STA 5/6)**

STA-5 and STA-6 were components of the ECP, located immediately west of the Rotenberger Wildlife Management Area. The original STA-5 facility consisted of 4,110 acres of effective treatment area and began operation in 2000. In 2006, a third flow-way was added to STA-5 (i.e., the initial expansion on land referred to as Compartment C”), yielding a total of approximately 6,095 acres of effective treatment area. The original STA-6 facility consisted of 870 acres of effective treatment area and began operation in 1997. STA-6 was expanded by 1,387 acres in 2006 with the addition of Section 2, yielding a total of approximately 2,257 acres of effective treatment area for STA-6. In 2010, STA-5 and STA-6 were expanded by about 5,000 acres (referred to as the “Compartment C Build-out”) resulting in a combined STA-5/6 (non-Federal) facility with a total of approximately 13,685 acres of effective treatment area.

3.4.2.5.1 **G-407**

G-407 (non-Federal) is located in the L-3 Borrow Canal west of the southern tip of STA-5/6 and immediately northwest of the Oil Well Bridge. G-407 consists of two 10 feet wide by 9 feet high reinforced concrete box culverts approximately 40 feet long. Both manual and remote operation of this structure are possible. G-407 has a design release capacity of 2,000 cfs and serves as the diversion structure for STA-5/6. Under most circumstances, G-407 will remain closed and runoff from the C-139 Basin is directed to STA-5/6 for treatment. When opened, G-407 will route runoff to the L-3 Canal after which it can be conveyed to the northwest corner of WCA-3A.

3.4.2.5.2 **G-409**

G-409 (non-Federal) is located in Hendry County south of STA-6 in the L-3 Borrow Canal at the point commonly referred to as “Confusion Corner” Figure 3-2. G-409 has three 30-inch diameter vertical axial flow pumps with a total release capacity of 190 cfs. The objective of G-409 is to supply irrigation water to the Seminole Big Cypress Reservation from the Miami Canal. Waters are then delivered to various

locations within the eastern portion of the Seminole Big Cypress Reservation for irrigation and also to the North L-28 Feeder Canal and West L-28 Feeder Canal.

Figure 3-2: Confusion Corner

3.4.3 C-139 Annex Restoration Project (C-139 Annex)

The C-139 Annex Restoration Project (non-Federal) is located immediately south of the C-139 basin and adjacent to STA-5/6. The major water management features associated with the C-139 Annex are a network of internal canals and a structure [(U.S. Sugar Outlet Structure (USSO)] whose main functions are to remove excess water from the basin when needed. The USSO structure is a gated culvert that controls releases from the C-139 Annex allowing excess water to flow from the C-139 Annex south into to the North L-28 Feeder Canal.

3.4.4 Rotenberger Wildlife Management Area (RWMA)

RWMA (non-Federal) encompasses approximately 35,000 acres. It is located in southwest Palm Beach County, immediately west of the Miami Canal, north of the L-4 borrow canal, and east of STA-5/6. It consists of sawgrass prairies, maiden cane, cattails, shrubs and isolated tree islands. Historical landscape patterns and reports indicate that the northern portion of Rotenberger was a sawgrass-dominated community while the southern portion was a ridge and slough community

(C. McVoy, personal communication, 2003). Beginning in the 1950s, Rotenberger was cut off from surface water inflows and only received direct rainfall (SFWMD, 2004). As a result, it experienced marked ecological disturbances related to increased drainage, decreased hydroperiod, drought, and fire severity. These changes led to a transition in the vegetation community including an expansion of species that are characteristic of high nutrient, impacted soil conditions as well as repeated invasions by plant species indicative of upland communities (Garrett and Ferree, 2010; Leeds et al., 2009).

Project components include an inflow pump station (G-410) with associated spreader canal, and four outlet structures (G-402A/B/C/D) with associated upstream collection canals. During normal operations, the source of water for restoration of the RWMA will be treated from STA-5/6. Inflow pump station G-410 is located on the east side of the STA-5/6 release canal, and release into a 3.5-mile distribution canal inside the RWMA. For additional information, refer to the SFWMD Operation Plan for RWMA in the SOM Volume 3.

3.4.4.1 G-402A/B/C/D

The G-402 A-C structures act as outflows from RWMA into the Miami Canal. They are 54 inch diameter corrugated metal pipe culverts with slide gates, located on the eastern perimeter levee of the WMA, immediately west of the Miami Canal (L-23). The G-402D structure is a 42 inch diameter corrugated metal pipe culvert with slide gates also located on the eastern perimeter levee (L-23 West) of RWMA, immediately west of the Miami Canal (L-23). The structures have a combined design release capacity of 240 cfs. These structures serve as the primary outflow control structures from the RWMA to the Miami Canal.

3.4.5 Holey Land Wildlife Management Area

The Holey Land (non-Federal) is a 35,336 acre impoundment located in the southwest corner of Palm Beach County, Florida. During World War II and Korean War, the southern portion of the area was used as a bombing range, hence the name “Holey”. Currently, no physical evidence of this disturbance is discernable from viewing the surface or topography of the area. However, the area had been degraded by decades (1940s – 1980s) of over drainage, and invasion by upland plant species. Over drainage also caused much of the topography of Holey Land to change due to oxidation and the resulting subsidence of

organic peat soils. The unnaturally dry conditions increased muck fires that further changed the topography by causing localized areas of even lower elevation.

FWC is primarily responsible for managing the flora and fauna of the area and works closely with the SFWMD whose responsibilities include overall hydrological operations, as well as construction and maintenance of inflow and outflow structures. The FWC goal for management of the Holey Land is to promote historical vegetation communities.

To restore the natural Everglades habitat of the Holey Land, a restoration project consisting of a levee system, culverts, and pumps was constructed and completed in late 1989. FWC and SFWMD entered into an agreement for an "Initial Operational Plan" with a water regulation schedule from 11.5 feet, NGVD to 13.5 feet, NGVD. The range of the schedule was lowered in 1993 to 11.0 feet, NGVD to 13.0 feet, NGVD. An explosive growth of cattail and negative impacts to deer herds occurred when water levels exceeded 12feet, NGVD. In 1995 the water regulation schedule was once again lowered to between 10.5 feet, NGVD to 12 feet, NGVD.

In 1997 the FWC developed a Holey Land Wildlife Management Area Conceptual Management Plan, which emphasized restoring the vegetation of the Holey Land. This initial document was modified in 2003 and became a draft Memorandum of Understanding (MOU). The draft MOU prompted discussion about water levels and water quality issues that needed to be addressed to bring about a successful restoration effort. In 2005, the G-200A inflow pump to Holey Land was decommissioned, which limited the SFWMDs ability to implement the management strategies in the Draft MOU.

During the 2007/2008 droughts water supply storage and operational alternatives were investigated, which included exploring water storage options within the Holey Land. Several options were considered and documented in a SFWMD "Engineering White Paper", which concluded that the Holey Land, even under best case scenarios, would make a poor temporary reservoir because seepage from this area is relatively high.

With the Holey Land WMA being a rainfall driven system with no real capacity for getting water into or out of the system. The only operational criteria being implemented is during the dry season when water levels are kept at minimum levels between 10.3 feet, NGVD to 10.7 feet, NGVD to prevent potential muck fires from igniting in the area. This used to be done by sending water via gravity from the Miami Canal through the manually operated G-372HL box culvert. However, G-372HL was upgraded to a pump station. The current G-372HL pump station can now can pass water from seepage collected in the western levee of the A-1 Flow Equalization Basin (FEB)/STA3/4 Seepage Canal or water that is taken directly from the STA 3/4 inflow canal. Operations can be implemented to take treated or un-treated water, but the latter is not desirable. Another way of providing water to the Holey Land WMA is via pump station G-200A, with the intake located on the east bank of the Miami canal just south of structure G-373. The temporary trade-off of having untreated water conveyed into the Holey Land was thought to have less impact than having potential muck fires ignite, which are very difficult to extinguish. In addition, during periods of excess water, the three outflow culverts G-204, G-205, and G-206 have very limited capacity for releasing water because the water stages in the receiving L-5 canal are typically at or above the Holey Land when STA-3/4 is operating.

Beginning in 2008, SFWMD and FWC scientists began to meet with the objective of developing a new operational schedule and suggested infrastructure for improving hydroperiods and hydro patterns for ecosystem restoration and maintenance for the Holey Land. This effort resulted in agreement on a new

10.75 feet, NGVD to 12.00 feet, NGVD regulation schedule with proposed infrastructure improvements for the Holey Land and was presented to the SFWMD Everglades Restoration Design and Engineering staff.

3.4.6 Site 1 Impoundment

The Site 1 Impoundment Project is part of the CERP and will be located just southeast of WCA-1. The purpose of the Site 1 Impoundment Project is to capture and store local runoff during wet periods and then use that water to supplement water deliveries to the Hillsboro Canal during dry periods thus reducing demands for releases from Lake Okeechobee and the LNWR (WCA-1). Constructing and operating the impoundment will reduce the need for releases from LNWR during the dry season to meet local water demands and will facilitate the maintenance of more natural, desirable, and consistent water levels within the LNWR. The impoundment is meant to reduce groundwater seepage from LNWR. Phase 1 (modifications to the L-40 and miscellaneous features) of the project is currently under construction by SFWMD (2020), with Phase 2 (impoundment) is not yet authorized.

3.4.7 Seminole Big Cypress Reservation Water Conservation Plan Critical Project (SBC Project)

The Seminole Big Cypress Basin is located in the northwest corner of the Seminole Big Cypress Reservation. It is bound by the West Feeder Canal to the south, the Reservations western boundary to the west, and the existing field ditch system to the east and north. The Federal SBC Project features in this area provide water quality improvements, ecosystem restoration, water storage capacity, and flood control. Features include Water Resource Areas (WRAs), Irrigation Storage Cells (ISCs), levees, water management structures, and pump stations. The non-Federal water management features related to the SBC Project are listed below. SBC Project features are further detailed in the SBC Project WCPs which are an Annex to the WCAs, ENP, ENP-SDCS WCP (Chapter 7).

3.4.7.1 Levees

There are no non-federal levees related to the SBC Project.

3.4.7.2 Structures

3.4.7.2.1 Structure PC-17

SFWMD operates and maintains PC-17, which is located adjacent to the L-28 North Feeder Canal approximately 2.0 miles upstream of S-190. PC-17 is a single barrel steel culvert 72-inches in diameter and 88 feet long through the west levee of L-28-I. The flashboard risers are located on the canal side of the levee and the release end is on the land side of the levee. The riser width is 94 inches, riser height is 12 feet, and board length is 47 inches. PC-17 releases water from the Water Resource Area 4 East in Basin 4 into the North Feeder Canal.

3.4.7.2.2 G-357

SFWMD operates and maintains G-357, which is located in the Miami Canal at the confluence with the L-4 Borrow Canal, adjacent to the G-404 pump station, north of S-8. G-357 has two 10 feet by 10 feet concrete box culverts fitted with motorized lift gates. G-357 can be utilized to control the flow of water between the L-4 Borrow Canal and the Miami Canal.

3.4.7.3 Pump Stations

3.4.7.3.1 Pump Station G-404

The description of this structure can be found in Section 3.4.2.4.3.

3.4.7.3.2 Pump Station G-409

The description of this structure can be found in Section 3.4.2.5.2.

3.4.8 North Springs Improvement District (NSID)

The NSID owns and operates a pump station located adjacent to S-38B on the L-36 borrow canal. NSID is permitted to release into WCA-2A only when pumping to the L-36 borrow canal would cause flooding in the Hillsboro Canal or C-14 basins.

3.4.9 Water Conservation Area 1

3.4.9.1 G-94A, G-94C, G-94D (S-4, S-2, S-1)

G-94A, G-94C, and G-94D (non-Federal) located in L-40 are identical gated culverts. G-94A and G-94C are used for water supply to the Lake Worth Drainage District (LWDD). G-94D is used to provide water supply to the AID. These structures were constructed and are maintained by SFWMD. AID operates G-94D under a permit from SFWMD. G-94A and G-94C are operated by LWDD under a permit from SFWMD. The volume of water that flows through these structures constitutes a small percentage of the total water budget of WCA-1. G-94A, G-94C, and G-94D each contain two 72-inch diameter corrugated metal pipes with manually operated sluice gates.

3.4.9.2 G-338

G-338 (non-Federal) is located in the Supply Canal of STA-2, approximately 400 feet downstream of S-6 and is connected to the Hillsboro Canal via a short spur canal. G-338 may provide water supply to downstream users, transfer water from WCA-1 (LNWR) to STA-2 or divert flows from S-6. G-338 is a 12 feet by 14 feet concrete box culvert with a manually operated gate that has a design release of 975 cfs.

3.4.9.3 G-300

G-300 (non-Federal STA-1 Diversion Structure) is located in the L-40 Borrow Canal approximately 0.5 miles southeast of S-5A and adjacent to the west side of the STA-1E. G-300 is a concrete spillway with two 20 feet by 8.4 feet vertical lift gates that can be manually or remotely operated. G-300 may divert untreated stormwater into WCA-1 (LNWR) should the inflow capacity of STA-1E and/or STA-1W be exceeded. G-300 can be operated with G-301 to divert the entire capacity of S-5A in the event of an extreme rainfall.

3.4.9.4 G-301

G-301 (non-Federal STA-1 Diversion Structure) is located in the L-7 Borrow Canal approximately 0.5 miles southwest of S-5A and adjacent to the west side of the STA-1W. G-301 is a concrete spillway with three 11.7 feet by 22 feet vertical lift gates that can be manually or remotely operated. G-301 may divert untreated stormwater into WCA-1 (LNWR) should the inflow capacity of STA-1E and/or STA-1W be

exceeded. G-301 can be operated with G-300 to divert the entire capacity of S-5A in the event of an extreme rainfall.

3.4.10 Water Conservation Area 2

3.4.10.1 G-335

G-335 (non-Federal) is a six-unit pump station is located in the southeast corner of STA-2. It is comprised of two (2) 950 cfs diesel engine driven pumps, two (2) 470 cfs diesel engine driven pumps and two (2) 100 cfs electric motor driven pumps for a nominal discharge capacity of 3,040 cfs and includes six pumps with a combined capacity of approximately 3,040 cfs (design capacity 3,370 cfs). G-335 is the primary outlet from STA-2 to WCA-2. G-335 along with G-436 serves as one of the primary outflow pumping stations for STA 2 (cells 1 through 3). The structure moves treated agricultural runoff into WCA-2 via L-6 canal.

3.4.10.2 G-436

G-436 (non-Federal) is a five-unit pump station located adjacent to and south of G-335. G-436 is located adjacent to and south of S-335. The station is comprised of three 533 cfs diesel engine driven pumps and two 100 cfs electric motor driven pumps for a nominal discharge capacity of 1,600 cfs. The 100 cfs electric motor driven pumps allow for remote operation during low flow conditions. All pumps are vertical axial flow pumps. G-436 is a diesel powered 533 cfs pumps and two electric powered 100 cfs pumps that are used under low flow conditions. G-436 along with G-335 serves as one of the primary outflow pumping stations for STA 2 (cells 4 through 8). The structure moves treated agricultural runoff into WCA-2 via L-6 canal. This pumping station releases into the L-6 canal and ultimately into WCA-2A.

3.4.11 Water Conservation Area 3

3.4.11.1 G-89

G-89 (non-Federal) is a three-barrel, CMP culvert, located at the northwest corner of WCA-3A. G-89 is controlled by stop logs in a CMP riser pipe which may be opened for irrigation demands west of WCA-3A.

3.4.11.2 G-204

G-204 (non-Federal) is located north of WCA-3A under L-5. G-204 has five 66-inch corrugated metal pipe culverts. G-204 is used to release water from Holey Land WMA to WCA-3A via the L-5 Canal.

3.4.11.3 G-205

G-205 (non-Federal) is located north of WCA-3A under L-5. G-205 has six 72-inch corrugated metal pipe culverts. G-205 is used to release water from Holey Land WMA to WCA-3A via the L-5 Canal.

3.4.11.4 G-206

G-206 (non-Federal) is located north of WCA-3A under L-5. G-206 has five 66-inch corrugated metal pipe culverts. G-206 is used to release water from Holey Land WMA to WCA-3A via the L-5 Canal.

3.4.12 ENP-South Dade Conveyance System (ENP-SDCS)

3.4.12.1 **G-211**

G-211 (non-Federal) is located south of the L-31N Borrow Canal and C-1W intersection, south of S-335 and north of S-331. G-211 has six 72-inch corrugated metal pipe culverts with a design release of approximately 1,100 cfs. G-211 serves as a divide structure in the L-31N Borrow Canal that facilitates drainage of areas between S-331 and G-211 without lowering the L-31N Borrow Canal between G-211 and S-335.

3.4.12.2 **G-737**

G-737 (non-Federal) is located in the L-31W Levee (South Dade Frog Pond), approximately 1.8 miles downstream and south of S-200. G-737 has three 71-inch by 47-inch pipe arch culvert Flow is controlled by with manually operated slide gates. G-737 releases water from the South Dade Frog Pond to the L-31W Borrow Canal to Florida Bay via Taylor Slough.

3.5 Dam Safety History/Issues

A brief summary of the WCA-3A high water concerns, the ERTP interim risk reduction measures, and an update on the status of further ongoing investigations by the USACE, is provided within the remainder of this section; for a more comprehensive discussion, the reader should refer to the 2011 ERTP Final EIS (USACE 2011c). During 2010-2011, concurrent with the formulation of the ERTP, the USACE conducted a preliminary review of the original WCA-3A design documents and has analyzed historical hydrologic data and U.S. Geological Survey (USGS) rating curve measurements in the area. Based on this review, documented in Appendix A-5 of the November 2011 Final EIS for the ERTP, SAJ concluded the S-12s may not be capable of achieving their original design release of 32,000 cfs and that the current configuration of WCA-3A would result in a predicted increase in the Standard Project Flood (SPF) stage for WCA-3A of between 1.3 and 1.4 feet, compared to the WCA-3A design assumptions. Based on the hydrologic insights gained from the preliminary analysis, the significant change to the original design assumptions, and the diminished extent of emergent vegetation within WCA-3A, the USACE, Jacksonville District recommended the lowering of Zone A of the WCA-3A Regulation Schedule (compared to IOP) as an interim risk reduction measure under ERTP. With the ERTP Record of Decision (ROD) in October 2012, the correlating WCP implemented the 1960 WCA-3A 9.5 to 10.5 feet, NGVD Regulation Schedule as a required component for the interim water management criteria for WCA-3A Zone A. Prior to implementation of ERTP in October 2012, Zone A of the IOP Regulation Schedule for WCA-3A ranged seasonally from 10.0-10.75 feet, NGVD.

In addition to the interim risk reduction measure implemented under ERTP, the USACE recommended completion of a detailed engineering assessment to evaluate the combined effects of the potential S-12s release limitations and the WCA-3A Regulation Schedule modifications on the frequency and duration of high water events. The detailed engineering assessment was to include a rigorous evaluation of SPF conditions within WCA-3A/WCA-3B and the upstream WCA-1 and WCA-2 within the context of the regional C&SF Project system infrastructure and operations. As the initial step towards the recommended detailed engineering assessment, the USACE initiated efforts to develop a comprehensive flood routing model of the C&SF Project WCA system in 2014 as part of the USACE' C&SF System Baseline and Modification Modeling (BAMM) Project. The purpose of the BAMM analysis is to determine if cumulative system wide alterations to the C&SF Flood Control Project have altered peak SPF stages within each of the WCAs.

Within the ERTP Final EIS, the Jacksonville District originally proposed a two-phased analysis approach for the WCA-3A high water events. Phase 1 was completed with implementation of the ERTP in October 2012 and included the interim water management criteria for WCA-3A. The Phase 1 effort was limited to a water budget spreadsheet hydrologic and hydraulic assessment. Phase 2 includes the BAMM effort, which will include the need to integrate the results of the BAMM modeling analysis as part of a broader engineering assessment of the public health and safety aspects associated with the levees and structures of the WCAs. Phase 2 also includes a more comprehensive evaluation of the hydraulic, geotechnical and structural engineering effects of the system alterations; incorporation of current USACE risk analysis requirements, focusing on potential human health and safety concerns resulting from increased WCA stages; and evaluation of potential water management operating criteria and/or infrastructure modification options to mitigate adverse changes to the high-water performance of the WCAs. USACE is currently nearing completion of an updated WCA flood routing analysis study, the BAMM, with intended completion in October 2020.

3.6 Principal Regulation Issues

3.6.1 Difficulty in Achieving Design Release Downstream of S-12s

Experience has shown that actual releases from S-12A, S-12B, S-12C and S-12D have been approximately 40 percent less than the design rating curves. However, this has been validated only up to a headwater stage of 10.1 feet, NGVD. The BAMM analysis takes this into account.

3.6.2 Tamiami Trail Roadway Constraint

The water level in the L-29 Canal is constrained to a maximum operating limit of 8.5 feet, NGVD to ensure the stability and safety of the Tamiami Trail (U.S. 41) Highway between S-333 and S-334, consistent with the MWD Tamiami Trail Modifications completed in 2013. All inflows to the L-29 Canal shall also be discontinued in advance of certain stage and weather events as previously coordinated with the Florida Department of Transportation (FDOT) and prescribed in Chapter 7 of the SOM for the final operating plan with the maximum L-29 Canal limit up to 8.5 feet, NGVD.

3.6.3 MWD 8.5 Square Mile Area (8.5 SMA)

USACE is required to provide flood mitigation for the 8.5 SMA, also referred to as the Las Palmas Community. The 8.5 SMA project features are designed to provide mitigation for the increased water levels that will occur once the MWD project is fully implemented and the associated additional water flows are delivered to ENP. The 8.5 SMA flood mitigation features do not work independently, as full mitigation is dependent on the MWD 8.5 SMA features, the C-111SD project features (including the NDA), and the adjacent S-331 pump station.

3.6.4 Seasonal Closure of S-12A, S-12B, S-343A and S-343B

The seasonal closure operations for S-12A, S-12B, S-343A and S-343B structures are as follows:: When conditions allow, USACE will delay opening and/or implement early closure of S-12A, S-12B, S-343A and S-343B structures beyond the required seasonal closure periods (default closure period from 01 October through 14 July) to further limit flow into western Shark River Slough; the minimum required seasonal closure periods for these water control structures are summarized below:

1. S-12A: Required closure period from 01 November though 14 July; required seasonal closure will be extended from 01 October through 14 July if the "high-water strategy" criteria specified under component I are not triggered;
2. S-12B: Required closure period from 01 December though 14 July; required seasonal closure will be extended from 01 October through 14 July if the "high-water strategy" criteria specified under component I are not triggered;
3. S-343A and S-343B: Closed from 01 October though 14 July.

3.6.5 S-332D Release Restrictions

S-332D releases are subject to calendar based restrictions as well as seasonally varying operational criteria for southerly flows into the S-332D Flow-way. S-332D flows above the calendar based CSSS release limits are permitted to maintain canal stages for flood risk management as long as the excess flow is diverted through S-332DX1.: These restrictions are listed below:

Calendar based restrictions:

1. 500 cfs (15 July to 31 December)
2. 325 cfs (01 January to 31 January)
3. 250 cfs without the use of S-332DX1 or 375 cfs with S-332DX1 release of 125 cfs (01 February to 14 July)

Seasonally varying operational criteria:

1. Transition period (1 January to 14 February) operating range from 3.8 feet NGVD to 4.8 feet NGVD.
2. CSSS nesting period (15 February to 31 July) operating range from 4.0 feet NGVD to 4.8 feet NGVD.
3. South Miami-Dade Typical Planting Season (1 August to 31 December) operating range from 3.8 feet NGVD to 4.4 feet NGVD.

3.6.6 Taylor Slough Rapid Recession

Recession rates in the Taylor Slough marsh can occur faster than naturally induced after prolonged use of the C-111 Southern Detention Area (SDA) pumping is abruptly halted, particularly after a significant rain event. This rapid recession of the marsh can be harmful to fish communities. Therefore, transitional operations are included in the Water Control Plan (Chapter 7) for the C-111 SDA and S-332D have been introduced to support maintenance of the marsh hydraulic ridge and its gradual recession.

3.6.7 Problems with Water Storage in Water Conservation Area 2B and 3B

WCAs-2B and WCA-3B overlie the Biscayne Aquifer. Regulation schedules are not utilized for WCAs-2B and WCA-3B due to high rates of seepage from these areas.

3.6.8 Water Supply Releases from Water Conservation Areas During Low Water Conditions

During low water conditions it is difficult to draw water out of the interior of the WCAs. The regulation schedules for WCA-1, WCA-2A, and WCA-3A include a minimum canal level below which water releases

are not permitted unless water is supplied from another source (see Chapter 7 for current minimum canal levels/floor).

3.6.9 Maintenance of Marsh Vegetation in Water Conservation Areas to Prevent Wind Tides

A major factor in the selection of limits for the regulation schedule governing WCA-3A was the maintenance of marsh vegetation. If large areas of open water develop as a result of a loss of vegetation, the increased size of potential hurricane-induced wind tides would necessitate the construction of prohibitively costly levees.

3.6.10 Regulatory Outlet Water Conservation Area 3B

The regulatory outlet for WCA-3B was originally S-12E, which was located along the L-29 Canal immediately east of S-333. However, S-12E never functioned as intended due to tailwater conditions which were higher than designed. Subsequent construction of the ENP-SDCS made S-12E a non-functional structure. S-12E gates were removed and its culverts were filled with concrete. Currently, regulatory releases from WCA-3B are made on a secondary basis through S-31 or S-337 to the East Coast. Some flow may also be released through S-355A and S-355B into the L-29 Borrow Canal. However, these structures are rarely used due to tailwater conditions limiting the head differential across the structures.

3.6.11 Competing Needs for Water

WCA-3A was designed to provide flood control, municipal and agricultural water supply, prevention of saltwater intrusion, preservation of a wetlands environment for Everglades' plant and wildlife species, and fresh water supply for ENP. Unfortunately, these project functions require different water management practices to achieve their optimum benefits. High water problems have caused stress on the deer population due to the deer being forced to congregate on restricted areas of high ground. When these conditions last beyond six weeks, severe competition for forage results in decline in the physical condition of the deer herd and an increase in the susceptibility to parasites and disease. High water can also destroy alligator and turtle nests and tree islands, which are critical habitat for many plants and animals in the WCAs. Low water levels can cause effects such as saltwater intrusion; municipal and agricultural water shortages; muck fires; disruption of food availability for wading birds, alligators and other aquatic organisms; and loss of fish and wildlife habitat. Low water has an overall impact on the delicate ecosystem of the ENP.

3.6.12 Everglades Ecosystem

The Everglades system has evolved over many years of climatic fluctuations, including extreme events such as hurricanes, floods, and droughts. Natural stochastic variations within this system are necessary for its continued health and survival, but are difficult to mimic within the limits of the man-made C&SF Project. Construction of the three WCAs, with attendant internal canal systems, created two pronounced impacts on hydroperiods (1) water tends to pond in the southern portions of each WCA, sometimes at depths that have adverse effects on some Everglades plant communities such as wet prairies and tree islands; and (2) the northern portion of each WCA dries too quickly, too often causing loss of wading bird habitat, increasing the frequency of fires which cause the subsidence of peat soils and damage to tree islands and wet prairie communities. Areas which have experienced shortened hydroperiods have experienced vegetation shifts to woody vegetation (willow and wax myrtle) while the lower elevations have experienced shifts to more aquatic flora. Some attempts to correct hydroperiod impacts in the past include the construction of S-339 and S-340 in WCA-3A to disperse canal flow from the Miami Canal into

the northern marsh in wet periods, and to stop over drainage of these northern marshes in dry seasons. These alterations tend to slightly reduce the depth of water in the southern, ponded area. Northern WCA-3A is largely dominated by sawgrass and lacks the natural structural diversity of plant communities seen in southern WCA-3A. The Combined Operational Plan (COP) defines operations for the constructed features of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) and Canal 111 (C-111) South Dade project components. The COP was developed by the MWD and C-111 South Dade project objectives and constraints, and lessons learned from a series of MWD Incremental Field Tests conducted under the authority of the MWD project (i.e. Increment 1, Increment 1.1 and 1.2, and Increment 2) to raise the L-29 canal maximum operating limit for the purpose of increasing flows to Northeast Shark River Slough (NESRS) in ENP. The COP developed Tamiami Trail Flow Formula (TTFF) determines releases from WCA-3A to ENP to achieve; surface water flow deliveries that resemble more natural processes, gradual rate changes to deliver surface water flows, surface water flow distributed across the entire slough.

3.7 Modifications to Regulations

3.7.1 Interim Action Plan

Florida DEP and the SFWMD instituted the Interim Action Plan (IAP) in 1979 as a means of reducing back-pumping of nutrient-enriched water into Lake-Okeechobee from EAA. Under this plan, pump stations S-2 and S-3 were no longer routinely operated to move water north into the lake, but only operated under emergency conditions for flood control or water supply purposes. Runoff from the EAA produced by normal rainfall is released into the WCAs. Based on the operational premises of the IAP, implementation of Level I Best Management Practices (BMPs) in the Taylor Creek/Nubbin Slough Basins and establishment of nutrient loading criteria for the lake and its tributaries, the FDEP issued a Temporary Operating Permit to the SFWMD in 1980 and a Lake Okeechobee Operating Permit (LOOP) in 1983 for the water control structures around Lake Okeechobee. Operation of the IAP has increased the amount of water that is released to the WCAs and decreased the amount of water entering the Lake from the EAA. It is estimated that phosphorus loading released to the WCAs through pump stations S-6, S-7, and S-8 have increased approximately ten percent on an annual average basis since the implementations of the IAP in 1979.

3.7.2 Water Conservation Area 1

3.7.2.1 Initial Interim Regulation

The Basic Report 1951 studied two WCPs for WCA-1. The first plan consisted of providing the minimum requirements for flood control, using the conservation area as a floodway for passing water through the area as quickly as the vegetation, terrain, and outlet capacity would allow. The second plan, which was the recommended plan, included provisions for storage of water for agricultural use in addition to the flood protection specified in the first plan. The second plan called for a maximum conservation elevation of 17.0 feet, NGVD. Part I, Supplement 25 recommended a schedule which ranged from elevation 14 to 17 feet, NGVD. Regulation of water levels began July 1960 when the gates of the S-10s were first closed. From July 1960 to May 1969 WCA-1 was regulated according to the second plan. Under this schedule extreme fluctuations in water levels occurred nearly every other year.

3.7.2.2 1969 Revised Interim Regulation

In 1969, the USACE recommended a new schedule that revised the interim regulation raising the lower elevation from 14 to 15 feet, NGVD. This schedule was designed to reduce the frequency of occurrence of low stages and provide additional storage for water supply. WCA-1 followed this schedule from May

1969 to June 1975 on an interim basis. The FWS conducted a study of the effects of water levels in WCA-1 on fish and wildlife resources. The FWS report dated May 1972 recommended returning the previous regulation range of 14 to 17 feet, NGVD. Implementation of the schedule did not begin until February 1974, and only for a few days. It was discontinued at the request of the LNWR manager because of fear of upsetting the established nests of endangered Everglade snail kites, and the 1969 Revised Interim regulation schedule (15 to 17 feet, NGVD) was reinstated.

3.7.2.3 **1975 Revised Interim Regulation**

In March 1975 the FWS submitted another report and again requested a 14 to 17 feet, NGVD schedule. A flexible schedule was developed in an April 1975 workshop which weighed the various water management objectives and system capabilities. The resulting schedule was implemented in July 1975.

3.7.2.4 **1995 Regulation Schedule**

In March 1995, a FONSI was signed changing the WCA-1 Regulation Schedule. This action was a result of the USACE consultation with the SFWMD at the request of FWS. This change in the Regulation Schedule ranges from 15.75 to 17.5 feet, NGVD and was based on the changing conditions of demand, supply, and public interests. The objective was to maximize benefits for the various, often competing interests in water use by allowing the water levels to drop during the dry season through consumption and evapotranspiration.

3.7.3 Water Conservation Area 2

3.7.3.1 **Initial Regulation**

The Basic Report 1951 called for WCA-2 to be a 204-square mile reservoir for storage of excess water from WCA-1 and from the agricultural areas. The flood control storage would protect the adjacent developed areas along the east coast and provide storage for agricultural use and water supply in the Deerfield and Fort Lauderdale areas. In general, Part I of the Basic Report proposed to maintain the conservation pool at elevation 15.9 feet, NGVD. Under this schedule, much of the vegetation would have been eliminated by maintaining higher water levels causing large open water areas to develop. These open water areas would allow major wind tide and large waves to be generated during hurricanes, thus requiring a high and costly levee system.

3.7.3.2 **Early Regulation**

Part I, Supplement 27-GDM indicated from studies analyzing the available water supplies, flood volumes, irrigation requirements, and the desires of fish and wildlife interests that a seasonal regulation schedule would be desirable for WCA-2. This supplement also studied the feasibility of constructing an interior levee, creating two pools (WCA-2A and WCA-2B) in lieu of raising existing levees to the grade required to provide protection against wind tides and wave run-up. The report recommended that the interior levee be constructed and that WCA-2A be regulated between 12 and 14.5 feet, NGVD and WCA-2B between 8 and 10 feet, NGVD. Regulation of WCA-2A began in July 1961 when the S-11s were closed and continued until May 1970.

3.7.3.3 1969 Regulation

In 1969, the USACE performed a study of alternative schedules that would provide the most benefits without increasing flood hazards in the area. This 1969 study recommended raising the lower limit for WCA-2A from 12.0 to 13.0 feet, NGVD. Benefits from this change were: an increase in pool stages during the spring recession period; the capability to store an increment of water early in the wet season which would otherwise have to be released; and a reduction in the frequency of release at the S-11s which would then reduce the adverse effects of stage drawdown under the existing schedule.

3.7.3.4 1970s Observed Changes

WCA-2A schedule was modified in 1970 and ranged from 13.0 to 14.5 feet, NGVD. However, observed changes in the ecology of WCA-2A prompted SFWMD scientists in the early 1970s to initiate efforts to lower the water schedule and provide for annual drying of the interior marsh. Extended high water killed significant stands of trees, eroded islands, and caused other undesirable vegetation changes in the area. During 1973, an extreme drawdown of WCA-2A was undertaken.

3.7.3.5 1980 Regulation Update

In 1980, the regulation schedule was revised at the request of SFWMD to an interim plan of 9.5 to 12.5 feet, NGVD for reasons stated in paragraph 3.7.3.4. This was an extreme drawdown that was in place for eight years. In 1989, the USACE adopted an official schedule of 11 to 13 feet, NGVD that is currently in effect.

3.7.4 Water Conservation Area 3

3.7.4.1 Initial Regulation

The Basic Report 1951, Part I had two WCPs for WCA-3. The first plan developed the minimum works required for flood control within the area, considered as a floodway. The water would pass through the area as fast as vegetation, terrain, and outlet capacity would permit, with only incidental storage in the natural basin north of Tamiami Trail. The second plan studied the feasibility of providing agricultural-water use storage in addition to flood protection. Four WCA-3A upper pool levels, 7.5, 10.0, 13.5, and 14.0 feet, NGVD were studied to determine the comparative desirability of the four levels for creating additional storage. The Basic Report recommended that WCA-3 be utilized as a floodway (no upper pool limit) until the need developed for additional water supply.

3.7.4.2 Part I, Supplement 33-GDM, dated 22 June 1960

Part I, Supplement 33-GDM recommended the construction of an interior levee (L-67) to divide the WCA into WCA-3A and WCA-3B. L-67 would be designed to reduce seepage losses for WCA-3A. The report also proposed a regulation range of 9.5 to 10.5 feet, NGVD. This schedule went into effect in 1963. Seepage losses would make it impractical to store water in WCA-3B; therefore, no regulation schedule was proposed for this area.

Review of the Regulation Schedule for WCA-3A, dated October 1980, discussed the review of the regulation schedule; gave a summary of the findings, and statements of positions of all concerned Federal, State, and local agencies; and presented the conclusions and recommendations for the operation of WCA-3A and how the project functions require different water management practices to achieve their optimum

benefits. High water caused problems to the area's deer population, low water caused a number of environmental and economic effects, and flood release caused problems to ENP. After reviewing the regulation schedule, it was recommended not to change the schedule at that time.

In 1985, SFWMD developed and was granted permission to experiment with water releases based on rainfall and evaporation over the Everglades. The Rainfall Plan distributed water over a broader area than the original operating schedule whenever possible. The schedule ranges 9.5 to 10.5 feet, NGVD, but included five zones to modify release to ENP when water levels are above or below the optimum target.

3.7.4.3 Everglades Restoration Transition Plan (ERTP)

In March 2012, the WCA-3A Interim Regulation Schedule was revised and ranges from 8.75 to 10.5 feet, NGVD. This regulation schedule removed Zone B and Zone C and added Zone E1. The Zones D, E and E1 of the remaining zones allow release to ENP to be modified when water levels are above or below the optimum target. Parts A, B, and C were also approved as part of the ERTP.

3.7.4.4 Increment 1

The Increment 1 Regulation Schedule was revised in May 2015. The Increment 1 Regulation Schedule continued to use Zones D, E and E1 of the ERTP Regulation Schedule to allow release to ENP to be modified when water levels were above or below the optimum target. However the Increment 1 Action Line which ranged from 10.0 to 10.75 feet, NGVD was added to allow water managers to consider additional water management actions to lower WCA-3A.

3.7.4.5 Increment 1 Plus (Increment 1.1 and 1.2)

Increment 1 Plus was revised in December 2016. Increment 1 Plus used the same Regulation Schedule Zones D, E and E1 as the Increment 1 Regulation Schedule as well as the Action Line to allow water managers to consider additional water management actions to lower WCA-3A. However, the criteria associated with Increment 1 Plus Action Line reflects incremental changes to the Increment 1 criteria.

3.7.4.6 Increment 2

Increment 2 Plus was revised in November 2017. Increment 2 uses the same Regulation Schedule Zones D, E and E1 as the Increment 1 and Increment 1 Plus Regulation Schedules as well as the Action Line to allow water managers to consider additional water management actions to lower WCA-3A. However, the criteria associated with Increment 2 Action Lines reflects further incremental changes to the Increment 1 Plus criteria.

3.7.4.7 Combined Operational Plan (COP)

COP developed a proposed Regulation Schedule, which includes only Zone A and Zone B for WCA-3A and eliminates Zones D, E and E1. The regulation schedule ranges from 9.5 to 10.5 feet, NGVD. Releases are up to maximum when in Zone A (subject to seasonal closures and downstream constraints) and calculated by the new Tamiami Trail Flow Formula (TTFF) when in Zone B. The proposed regulation schedule also includes an Extreme High Water Line designed to allow water managers to consider additional water management actions to lower WCA-3A. The WCA-3A regulation schedule "floor" elevation was changed from 7.0 feet, NGVD measured at S-333 headwater to 7.5 feet, NGVD measured at Site 69W gage. Further details on the TTFF and the WCA-3A regulation schedule are in the WCP (Chapter 7).

3.7.5 Everglades National Park-South Dade Conveyance System (ENP-SDCS)

3.7.5.1 Minimum Delivery Schedule

Two studies in the 1960s allowed development of interim Shark River Slough (SRS) water delivery schedules. A minimum SRS delivery schedule was adopted by Congress in 1970 through the River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970 (P.L. 91-282; see Section 3.1.7). A median annual flow of 260,000 acre-feet was adopted as the minimum annual delivery requirement for the slough based on a rough average by the NPS of the two studies. The median release value of 37,000 acre-feet was recommended for Taylor Slough as the minimum annual requirement. The minimum delivery schedule for the ENP's eastern panhandle designated at S-18C in P.L. 91-282 the 1970 Act was 18,000 acre-feet.

The Supplemental Appropriations Act of 1984, Public Law 98-118, authorized an experimental program for the delivery of water to the ENP for the purpose of determining an improved schedule for such delivery. This "Experimental Program" was to last for two years, but was subsequently extended until 1989. The Energy and Water Development Appropriations Act, 1992, Public Law 102-104, extended the Experimental Program until modifications of the C&SF Project authorized under section 104 of Public Law 101-229, the MWD to ENP Project, are completed and implemented.

Because the COP is the plan for full implementation contemplated under Public Law PL 102-104, it does not call for continuation of Minimum Deliveries as identified in Public Law PL 91-282, but is aimed at more natural deliveries to ENP that are tied to rainfall and are based on the operations developed under the Experimental Program. Nevertheless, the modeling shows that the COP should far exceed the Minimum Deliveries required under Public Law PL 91-282 on an annual basis. These rainfall based water deliveries to ENP which evolved into the TTFF will be made through the S-12A, S-12B, S-12C, S-12D and S-333. Other water deliveries to ENP will be made through S-332B, S-332C, S-332D, S-199 and S-200.

3.7.5.2 Seven Point Plan

By 1983, there was a significant deterioration in the park's ecological conditions. Also, the IAP implemented by the SFWMD and FDEP called for the maximum volume of water to be pumped from the EAA into the WCAs. At that time the ENP requested that the SFWMD and the USACE institute seven protective measures that have subsequently been termed the Seven Point Plan (**Table 3.2**).

Table 3.2: Everglades National Park Seven Point Plan

1	Fill in L-28 Canal and Remove Levee Segments. L-28 Canal was over-draining the eastern Big Cypress during the dry season, and the levee prevented high water from moving into Big Cypress as it traditionally did. Removal of the levee would provide some flood relief to ENP and restore high-water flow through several historical drainage channels.
2	Fill in L-67 Extended Canal and Remove Levee. Water deliveries to the ENP through this canal at times caused abnormal flooding of the ENP during the dry season, and the levee prevented historical hydrological connection with deep-water areas in NESRS.
3	Restore WCA-3B to the Everglades System. Divert as much flow as is environmentally acceptable into WCA-3B.
4	Distribute Water Deliveries Along the Tamiami Canal. Distribute water deliveries from WCA-3A along the full length of the Tamiami Canal from L-28 to L-30. The prevention of flow to NESRS from WCA-3A has stressed aquatic communities within ENP.
5	Establish a Water Quality Monitoring Program. Establish a water quality monitoring program to provide methods to detect degradation of delivery waters to ENP.
6	Defer Implementation of New Drainage Districts. Defer implementation of new drainage districts such as proposed for the East Everglades, until the full impact of any potential flood releases to ENP are thoroughly addressed and all possible mitigation of impacts to the ENP is considered.
7	Field Test a New Water Delivery System to ENP. The present water delivery system to the Park is not working. The proposed new delivery schedule based upon a reference station in the BCNP that predicted water deliveries to SRS based upon current rainfall and normal runoff, rather than upon upstream water management. Any quantities above that predicted would be considered flood releases and all efforts should be made to divert these excess flows.

3.7.5.3 **Experimental Delivery Plan 1985 to 1998**

In March 1983, the ENP requested action that would reduce untimely and spatially restricted flood releases of water from WCA-3A into the ENP. With the passage of the Supplemental Appropriations Act of 1984 (P.L. 98-181; see Section 3.1.8), Congress authorized the USACE in December 1983, in P.L. 98-181, with the concurrence of the NPS and the SFWMD, to conduct an experimental program of water deliveries from the C&SF Project to the ENP. The Experimental Delivery Plan field tested water delivery methods to assess potential impacts on the ENP and other parts of the Everglades ecosystem, as well as on the authorized C&SF Project functions of flood control and water supply. The objectives of the plan were:

- Reduce water releases to the Park's SRS Basin through the S-12 structures, especially during normal dry season recession periods.
- Restore flow distribution across the entire width of SRS, the natural flowway into the Park. This would not only contribute significantly to objective 1, but would also help restore hydroperiods in the eastern portion of the historic SRS Basin (Northeast Shark River Slough [NESRS]).
- Allow volume and timing of deliveries to fluctuate as they did historically in response to rainfall and antecedent water conditions in the southern Everglades.
- Maintain downstream SRS water levels at pre-project levels.
- Maintain water quality so that resource degradation does not occur.

3.7.5.3.1 **Flow-Through Plan June 1983 through May 1985**

The Flow-Through Plan was a two year plan starting in June 1983. The S-12s gates were kept open to provide unregulated discharges to SRS. There were three shortcomings of this plan: 1) discharge to SRS was uncontrolled and therefore, depended on upstream water management practices, 2) the natural dry season secession of the flow hydrograph was inhibited, and 3) no systematic discharge was made to NESRS.

3.7.5.3.2 **30-day Test and Wet Season 90-day Test at S-12C and S-333**

A 30-day test at S-12C and S-333 was conducted during the dry season from 19 April 1984 to 18 May 1984 and a 90-day test was conducted during the wet season from 1 August 1984 to 30 November 1984. Results of the tests showed that large volumes of water could be released to NESRS through S-333 and the L-29 Borrow Canal. They also showed that for dry season conditions, releases of water to NESRS posed no threat of flooding to nearby residential and agricultural areas.

3.7.5.3.3 **Rainfall Plan (Test Iteration 1)**

The Rainfall Plan was a two year plan starting in July 1985 designed to restore a more natural hydrologic condition to SRS including the NESRS area. The intent of the Rainfall Plan was to distribute deliveries from WCA 3A between the S-12s (45%) and S-333 (55%). S-333 operation was subject to L-29 stage below 7.5 feet NGVD and G-3273 below 6.8 feet NGVD for more than 24 hours. The trigger stages at S-176 were modified to compensate for the increased discharges at S-333/S-331, while at the same time maintaining the level of flood protection downstream. Since the start of the test in 1985 and to this date, the Rainfall Plan has been the basis for determining the target flows and operations at S-12s and S-333.

3.7.5.3.4 **Test Iteration 2 through Test Iteration 5**

Test Iteration 2 through Test Iteration 5 were extensions of the Test Iteration 1 with no significant changes to the operating criteria.

3.7.5.3.5 **Taylor Slough Demonstration Project (Test Iteration 6)**

On July 1, 1993, the USACE, SFWMD and the ENP began the sixth iteration of the Experimental Water Delivery Program. This iteration was also known as the Taylor Slough Demonstration Project and included the elements contained in the previous five tests for water deliveries to NESRS. Two new components were added in the south end of the system. First, the stage in the L-31N Borrow Canal was raised from elevation 4.5 to 5.0 feet, NGVD, during the wet season. Prior to initiation of the test, the approved optimum level of the L-31N Borrow Canal was 5.5 feet, NGVD. The approved optimum level was lowered during the program as part of the test mitigation raising the operating level partially back to the pre-test level was being done at the request of the ENP staff to prevent back seepage from water pumped at S-331 and S-332. ENP hydrologists showed that lower stages in the L-31N Borrow Canal caused large volumes of water to seep from ENP back into the L-31N Borrow Canal. In addition, three portable pumps were placed at S-332 to pump additional flow into the Taylor Slough area of ENP.

3.7.5.3.6 **Test Iteration 7-Experimental Program of Water Deliveries to Everglades National Park**

In October 1995, a concurrency agreement amongst the USACE, NPS/ENP, and the SFWMD was signed for the Operating Criteria for Test 7 as contained in the Preliminary Environmental Assessment and Finding

of No Significant Impact for Test Iteration 7, Experimental Program of Water Deliveries to ENP, for the Central and Southern Florida Project and for Flood Control and Other Purposes, dated August 1995. The test objectives were to "evaluate methods to restore a more natural hydroperiod to ecosystems within ENP including NESRS and Taylor Slough, enhance flow to Florida Bay via Taylor Slough, as well as reduce large freshwater releases through S-197 into Manatee Bay and Barnes Sound." The test goals were to deliver water to NESRS and Taylor Slough in consonance with rainfall to the degree possible without compromising the flood control function and try to maintain desirable canal stages and pass as much excess water as possible westward into the L-31W Borrow Canal and Taylor Slough. During storm events, the flood control criteria would override normal operations. Test 7 was divided into two distinct phases. Phase I will consist of operations during construction of Phase II components. Phase II would include operation of new components. These components included the additional pumping capacities at structures S-331 and S-174, and flood protection to the L-31N Basin. It was concluded in the February 1999, U.S. Fish and Wildlife Service (FWS) BO on the CSSS that the continuation of the water management operations under Test Iteration 7, Phase 1 of the Experimental Program of Water Deliveries to ENP would jeopardize the continued existence of the sparrow.

3.7.5.4 General Design Memorandum-Modified Water Deliveries to Everglades National Park (MWD to ENP)

In June 1992, the USACE proposed changes to the method of operation and changes to the canals and structures that would, if implemented, as nearly as possible, return the hydrology of ENP to historic conditions. Reference Table 3.3 for a list of the relevant NEPA documents for construction of this project. The four major modifications were:

- Construction of structures S-345 and S-349 in L-67A to allow water to be passed from WCA-3A to WCA-3B.
- Construction of structures S-355A and S-355B in L-29 to allow water to be passed from WCA-3B to NESRS.
- Removal of L-67 Extension and filling of the borrow canal.
- Construction of a levee around a residential area in the East Everglades west of L 31N to mitigate for additional flow into NESRS.

Table 3.3 Relevant NEPA for Construction of Modified Water Deliveries (MWD) and C-111 South Dade to ENP Features

Title	Date
C-111, Central and Southern Florida project for Flood Control and Other Purposes, Final General Reevaluation Report and Environmental Impact Statement, U.S. Army Corps of Engineers, Jacksonville District	May 1994
1998 Emergency Deviation from Test 7 of the Environmental Program of Water Deliveries to Everglades National Park to Protect the Cape Sable Seaside Sparrow, Central and Southern Florida project for Flood Control and Other Purposes, Final Environmental Assessment, U.S. Army Corps of Engineers, Jacksonville District.	January 1999
General Reevaluation Report and Final Supplemental Environmental Impact Statement, 8.5 Square Mile Area, U.S. Army Corps of Engineers, Jacksonville District.	July 2000
C-111 Engineering Documentation Report, U.S. Army Corps of Engineers, Jacksonville District.	May 2007

Title	Date
Modified Water Deliveries to Everglades National Park Tamiami Trail Modifications Final Limited Reevaluation Report and Environmental Assessment, U.S. Army Corps of Engineers, Jacksonville District.	June 2008
Environmental Assessment for Expansion of C-111 Detention Area and Associated Features South Miami-Dade County, U.S. Army Corps of Engineers, Jacksonville District	May 2012
Environmental Assessment; Design Refinement for the 8.5 Square Mile Area, U.S. Army Corps of Engineers, Jacksonville District.	August 2012
Environmental Assessment; Modifications to the C-111 South Dade project, L-31W, U.S. Army Corps of Engineers, Jacksonville District.	December 2016
Canal 111 (C-111) South Dade County, Florida: Final Limited Reevaluation Report, U.S. Army Corps of Engineers, Jacksonville District	December 2016
Environmental Assessment Modified Water Deliveries to Everglades National Park project: Removal of Unconstructed Conveyance and Seepage Control Features, U.S. Army Corps of Engineers, Jacksonville District.	May 2017

3.7.5.5 Interim Structural and Operational Plan (ISOP) for Hydrologic Compliance with the Cape Sable Seaside Sparrow Biological Opinion for the Year 2000

On February 19, 1999, the FWS issued a Final Biological Opinion (BO) on the Cape Sable seaside sparrow (CSSS) under provisions of the ESA. The CSSS is listed as an endangered species under the ESA. FWS concluded that continuation of the water management operations under Test 7, Phase 1 of the Experimental Program of Water Deliveries to ENP would jeopardize the continued existence of the CSSS. In each of the preceding two years, there has been a need to take emergency actions to protect the CSSS, which had been focused on the western population (Habitat A). The BO included a Reasonable and Prudent Alternative (RPA) to avoid jeopardizing the species - additional water management targets for the eastern populations (Habitats C, D, E and F). Factors concerning hydrologic conditions and water management operations are described in the RPA. The proposed Interim Structural and Operational Plan (ISOP) was designed to maintain the level of protection in the western habitat while beginning protective actions for the eastern habitats for the year 2000. ISOP also included the construction of S-332B Interim Pump Station, S-332B western detention area and weir corrugated discharge pipes. This plan was superseded by the Interim Operational Plan (IOP).

3.7.5.6 Habitat West of Shark River Slough

Because of high regional water levels going into the dry season in November 1999, there was concern that year, as in past years, that the operation of the S-12 structures as specified in the Test 7 criteria would result in water levels too high to allow successful nesting of the CSSS in its habitat west of SRS (**Figure 3-3**). This could lead to the loss of population A and an unacceptable risk of extinction of the entire species. The FWS advised that to avoid this risk, for the year 2000 water management operations should be adjusted so that there would be at least 60 continuous days of sufficiently dry conditions on the habitat during the breeding season, March 1 to July 15. This would be evidenced by water levels at or below 6.0 feet, NGVD, measured at a nearby indicator gage, NP-205.

3.7.5.7 Habitat on the Eastern Flank of Shark River Slough (RPA)

Water levels in CSSS Habitat E (**Figure 3-3**) are characterized by the FWS as too low, leading to higher than normal fire frequencies and invasion of woody vegetation, which adversely affected the CSSS. To re-hydrate this area, the reasonable and prudent alternative (RPA) calls for at least 30 percent of the regulatory water releases occasionally required from WCA-3A to be re-routed into NESRS instead of released through the S-12 structures, beginning on March 1, 2000. This rose to 45 and 60 percent in March 1, 2001 and March 1, 2002 respectively.

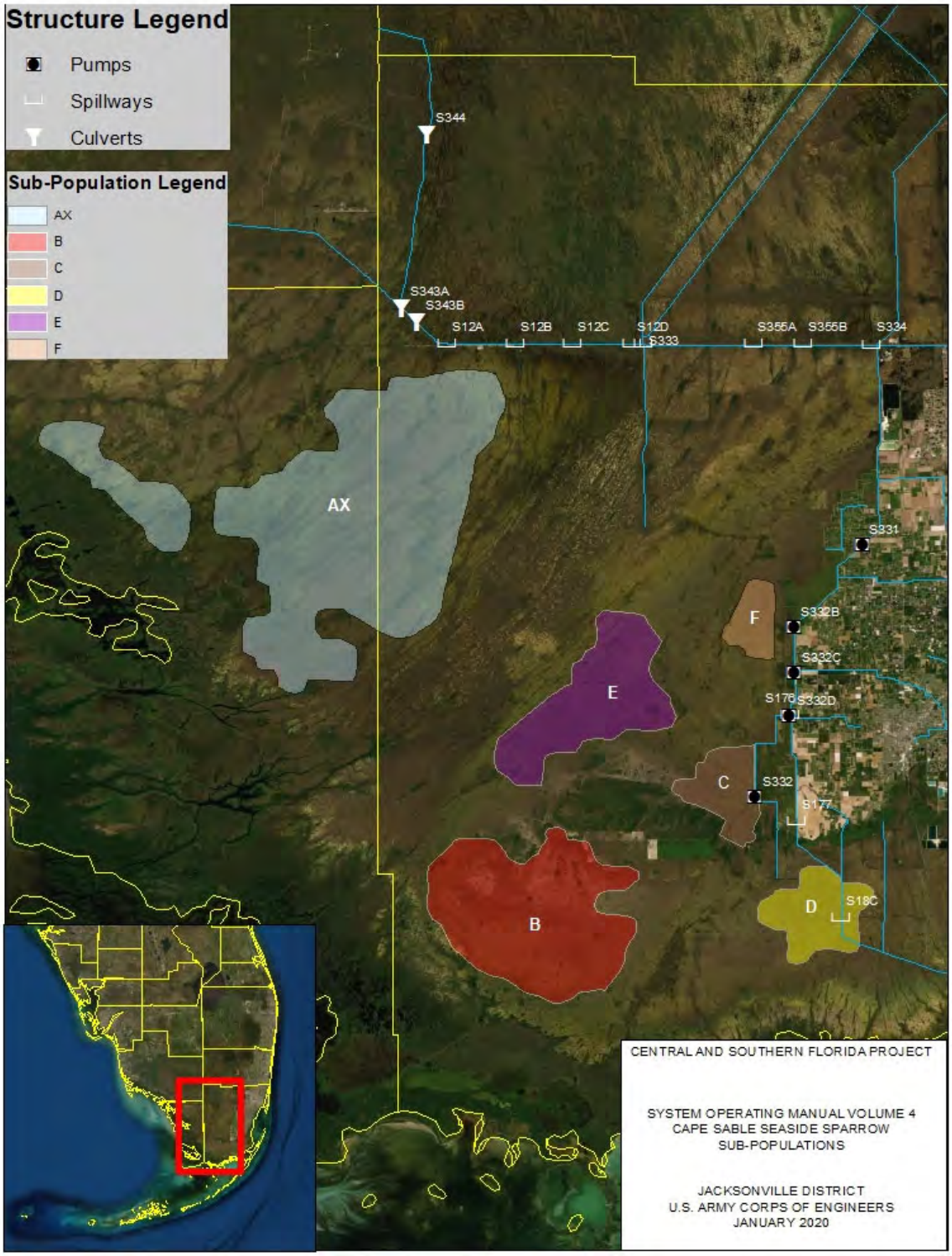

Figure 3-3: CSSS Habitat Map

3.7.5.8 Eastern Habitats

Sparrow habitats C, D, and F (**Figure 3-3**) lie on the eastern edge of the Everglades near the L-31N Borrow Canal and C-111. Water levels in Habitats C and F are characterized by the FWS as too low and Habitat D as too high as a result of water management operations of the adjacent canals. The RPA recommends raising the canal levels or otherwise producing similar hydrologic conditions to those that would have resulted from implementation of Test 7, Phase II of the Experimental Program. The FWS concludes that Test 7, Phase II hydrologic conditions would establish and maintain favorable habitat for the sparrow.

3.7.5.9 Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow-May 2002

On February 19, 1999, the FWS issued a Final BO under provisions of the ESA for actions required to assure the survival of the endangered CSSS, related to operation of components of the C&SF Project in Miami-Dade County. The BO referenced specifically rapid implementation of structural and operational changes under the MMWD Project, to existing operations under Test 7 of the Experimental Program of Water Deliveries, and to the C-111 Canal Project. The BO concluded that continuation of Test 7, Phase I operations would cause adverse modification of CSSS critical habitat and would jeopardize the continued existence of the CSSS. The BO presented RPAs to the then existing operations that would avoid jeopardizing the CSSS. The RPA recommended that the following hydrological conditions be met for protection of the CSSS: 1) a minimum of 60 consecutive days of water levels at or below 6.0 feet, NGVD at the NP 205 gage between March 1 and July 15; 2) ensure that 30, 45, and 60 percent of required regulatory releases crossing Tamiami Trail enter ENP east of L-67 extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that meet or exceed those produced by the 30, 45, and 60 percent targets; and 3) produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase II operations (USACE 1995); and implement the entire MWD project no later than December, 2003. Emergency deviations from Test 7 were authorized in 1998, 1999, 2000, and 2001 by Council on Environmental Quality (CEQ) to allow the USACE to conduct water control operations to protect the CSSS (USACE 1999b; USACE 1999c; USACE 2000). These ISOP operations enabled the USACE to maintain water levels, particularly in the western CSSS populations, that would maximize breeding seasons for the sparrow. During implementation of the ISOP, the USACE received confirmation from the FWS that producing the hydrologic equivalent of the 30, 45, and 60 percent conditions, as opposed to the actual release percentages, would also meet the FWS RPA conditions until the implementation of MWD. The proposed actions under this IOP would allow the USACE to meet or provide the hydrologic equivalent of the FWS RPA conditions, while managing the system for purposes authorized under the C&SF Project.

3.7.5.10 Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow-December 2006

The USACE was required to issue a supplement to its 2002 FEIS by an order issued in March 2006 by the U.S. District Court for the Southern District of Florida, Miami Division, resolving a lawsuit by the Miccosukee Tribe regarding the NEPA compliance and other matters related to IOP. This FSEIS discussed IOP Alternative 7R model output, structural features of Alternative 7R, and actual operations since IOP began in 2002. Structural features unique to Alternative 7R include pump stations S-356 and S-332C, degrading four miles of L-67 levee extension, and three new impoundment basins at S-332B, S-332C, and S-332D. Construction features of Alternative 7R were first authorized under the MWD Project as described in the 1992 GDM and EIS, and under the C-111 Project as described in the 1994 Integrated GRR/EIS.

Construction features differed somewhat from the conceptual designs in the referenced reports. New pump stations were built as interim structures for use in protecting sparrow habitat during the wet seasons, subject to further design in conjunction with associated seepage reservoirs that are being constructed. Alternative 7R incorporated the system operations of Alternative 7 and the WCP for WCA-3A, providing for emergency operations in anticipation of high rainfall events. In conjunction with the FSEIS, the USACE re-initiated consultation under Section 7 of the ESA with the FWS for endangered species, including the snail kite and CSSS and received an updated BO November 17, 2006. In the updated BO, the FWS concluded that continued operation of IOP Alternative 7R was not likely to jeopardize the continued existence of the CSSS, Everglade snail kite, or wood stork and was not likely to destroy or adversely modify designated critical habitat for the CSSS or Everglade snail kite.

3.7.5.11 **Everglades Restoration Transition Plan (ERTP) December 2011**

In early 2009, USACE and FWS identified the need for reexamination of IOP water management operations. In June 2009, due to endangered species concerns within WCA-3A and the fact that the 2006 FWS IOP BO was set to expire on November 17, 2010, USACE and FWS began informal consultation on the Everglades Restoration Transition Plan (ERTP). IOP was determined to no longer be a viable option for water management within WCA-3A and SDCS based upon the current status of endangered species within WCA-3A.

The purpose of ERTP was to define water management operating criteria for C&SF Project features and the constructed features of the MWD and C-111 South Dade Projects until a COP was implemented. ERTP objectives included improving conditions in WCA-3A for the endangered Everglades snail kite, wood stork and wading bird species while maintaining protection for the CSSS and Congressionally-authorized purposes of the C&SF Project. The proposed action was a modification of IOP with operational flexibilities to provide further hydrological improvements amenable to multiple listed species. Results of modeling efforts were evaluated in relation to the ERTP performance measures (PMs) and ecological targets (ETs) to select the alternative which best met the ERTP objectives, PMs and ETs. ERTP incorporated more flexible operating criteria to better manage WCA-3A for the benefit of multiple species and represented a positive step towards balancing the competing needs of a complex system. ERTP also integrated consideration of new information consisting of current meteorological, hydrological and species conditions, project specific PMs and Periodic Scientists Calls that serve as a forum to provide input to the USACE decision-making process for WCA-3A water management operations.

ERTP represented a paradigm shift in water management within the WCA-3, ENP and SDCS system. Under IOP, there were hard and fast structural closure dates designed to protect nesting season requirements of CSSS-A. The structures will open or close on the specified dates independent of WCA-3A water levels, CSSS nesting or other endangered species requirements. Under ERTP, the needs of multiple species, including other endangered bird species, and their habitats are considered along with current hydrological and climatological conditions. ERTP incorporates protective measures for CSSS-A (most structures retain existing IOP closure dates), but also includes a lowered regulation schedule to meet both the WCA-3A interim high water management criteria and endangered species needs. The WCA-3A Regulation Schedule proposed under ERTP contains extended regulation zones that allow for “up to maximum” releases, providing for management of recession rates and seasonal water levels, which are important for snail kite, wood stork and wading bird nest success. As with any change, there is resistance to flexibility in water management operations. Therefore, USACE committed to conducting Periodic Scientists Calls (PSCs) to provide a forum for stakeholders to provide input to be considered in the USACE decision making process for WCA-3A water management operations. The USACE will consider all input based upon, but not limited

to, hydro-meteorological conditions, forecasted conditions, species needs and the often competing multiple C&SF project purposes.

ERTP represented a bridge between IOP and COP, which will supersede ERTP and define water management for the completed MWD and C-111 Projects. Formal consultation on the Cape Sable seaside sparrow, Everglade snail kite and wood stork resulted in a Biological Opinion from the USFWS in November 2010 and a supplemental BO in March 2012 concluding that implementation of the ERTP recommended plan is not likely to jeopardize the continued existence of these species.

3.7.5.12 G-3273 Constraint Relaxation/S-356 Field Test and S-357N Operational Strategy

The G-3273 Constraint Relaxation/S-356 Field Test and S-357N Operational Strategy was the first in a planned series of three related, incremental efforts that were to result in a Comprehensive Operating Plan (COP) to be incorporated into a revised WCAs, ENP, ENP-SDCS WCP. Two field tests (Increment 1 and Increment 2) were to be conducted to assist future development of the COP. COP (Increment 3) was planned to fully realize the natural system benefits that were used to justify the considerable Federal and State expenditures associated with the MWD and C-111 South Dade Projects. Concurrent with construction efforts to complete the flood mitigation and seepage management features envisioned in the MWD and C-111 South Dade Projects, the incremental approach to the development of COP will: (1) allow interim benefits towards restoration of the natural systems; (2) reduce uncertainty of operating the components of the MWD and C-111 South Dade Projects; and (3) provide information to complete COP efficiently.

3.7.5.13 Increment 1

The USACE initiated the Increment 1 under the authority of the MWD Project, to evaluate raising or removing the existing G-3273 stage constraint for inflow into NESRS and operated the S-356 pump station for control of seepage into the L-31N Borrow Canal in October 2015. Increment 1 was a planned deviation from the 2012 WCP (ERTP). The 2012 WCP, which includes the WCA-3A Regulation Schedule, Rainfall Plan and the Interim Operating Criteria for the 8.5 SMA Project continued to govern water management operations during Increment 1, with the exception of operating criteria for S-333, S-334, S-356, S-197, and S-357N . Increment 1 maintained the L-29 Borrow Canal maximum operating limit of 7.5 feet, NGVD while relaxing the G-3273 stage constraint and utilized S-356 for the management of seepage to the L-31N Borrow Canal. During Increment 1, it was anticipated that the combined flows to NESRS through S-333 and S-356 would be more than what would have otherwise been released through S-333 under the 2012 WCP. Additionally, it was anticipated that during implementation of water management operations associated with the Increment 1, under typical hydrometeorological conditions, the combined flows through S-173 and S-331 to the C-111 Basin would be less than what would have been released through these features under the 2012 WCP. Increment 1 also included a testing protocol to assist in defining operating criteria for the new 8.5 SMA S-357N water management structure.

3.7.5.14 Increment 1 Plus (Increment 1.1 and 1.2)

Through several extensions, the latest of which extended the expiration date until July 22, 2016, the USFWS and USACE were able to continue work on revising the ERTP while retaining the ESA coverage afforded by the 2010 ERTP BO. USFWS issued a new BO for ERTP on July 22, 2016, developed in formal ESA consultation with the USACE. As a result of this consultation, it has been determined that current conditions within CSSS habitat, threaten the survival of the sparrow, and as a result, USFWS issued a “jeopardy” opinion, which explains that unless alternatives to current water operational practices are

explored and implemented, continued implementation of ERTP is likely to jeopardize the continued existence of the CSSS. The revised BO, issued July 22, 2016 presented a RPA that would avoid jeopardizing the CSSS. The RPA identifies operational modifications and expediting restoration initiatives for some of the structures in the southern portion of the Everglades ecosystem to provide suitable nesting habitat for the endangered CSSS. Main elements of the RPA are: habitat performance targets; actions to move water east; surveys and studies; and adaptive management. These RPA actions include additional seasonal closures to outlet structures within WCA 3A (S-12A, S-12B, S-343A, S-343B, S-344), with the flexibility to open under high water conditions between October and November, and adjustments in operations in the SDCS that will enable additional flows to Biscayne Bay during the dry season and increased flows toward eastern ENP to extend hydroperiods during the early dry season. In response to the BO, the USACE committed to taking specific actions to comply with the BO terms and conditions and implementing the RPA.

Upon review of monitoring data associated with Increment 1 and the 2016 Temporary Emergency Deviation, it became apparent that modifications were necessary to Increment 1 to maintain the congressionally authorized flood mitigation requirements within the 8.5 SMA, to facilitate completion of ongoing construction of the MWD and C-111 South Dade Projects, and to address the requirements of the 2016 USFWS BO. During Increment 1 and the 2016 Temporary Emergency Deviation, the USACE learned how 8.5 SMA and the ENP-SDCS responded to increased water levels in NESRS prior to the full build out of MWD and C-111 South Dade Project features.

The USACE included additional operational flexibility within the revised Increment 1.1 and 1.2 to operate the L-29 Borrow Canal to a maximum operating limit of 7.8 feet, NGVD subject to downstream constraints. Increment 1.1 and 1.2 also addressed the mandated terms and conditions of the 2016 ERTP BO, which included expanded closure periods for S-12A, S-12B, S-343A, S-343B, and S-344 as mandated by the RPA. NEPA documentation for Increment 1.1 and 1.2 was completed on February 16, 2017 with signing of a FONSI incorporating an EA. During implementation of Increment 1.1 and 1.2, the 2012 WCP, which includes the WCA-3A Regulation Schedule, and Rainfall Plan continued to govern water management operations with the exception of operating criteria for S-12A, S-12B, S-328, S-151, S-331, S-333, S-334, S-335, S-337, S-338, S-343A, S-343B, S-344, S-355A, S-355B, S-356, S-357, S-357N, S-332B, S-332C, S-332D, S-194, S-196, S-176, S-177 and S-197. Similar to Increment 1, the water level constraint at G-3273 was not a predetermined constraint under Increment 1.1 and 1.2, allowing NESRS to receive more water, relative to the 2012 WCP. S-356 was also utilized for control of seepage to the L-30 Canal. Under Increment 1.1 and 1.2, the ability to raise the L-29 Borrow Canal maximum operating limit from 7.5 feet, NGVD (Increment 1.1) up to 7.8 feet, NGVD (Increment 1.2), was contingent upon compliance with downstream constraints including: (1) acquisition of required real estate interest and any associated improvements for the private ownership along Tamiami Trail and receipt of Tamiami Trail Bridge and roadway channel and flowage easements from the Florida Department of Transportation (FDOT); (2) completion of the C-358 Canal (Richmond Drive Seepage Collection Canal) and installation of S-357N (C-358 control structure); and (3) completion of sufficient portions of Contract 8 (construction of the C-111 NDAL-315 western levee, the L-357W Extension Levee between Richmond Drive and the 8.5 SMA Detention Cell) and completion of the Contract 8A berms inside the 8.5 SMA Detention Cell. Prior to construction completion and operation of the NDA , these constructed features of the MWD and C-111 South Dade Projects were deemed necessary to raise the L-29 Borrow Canal maximum operating limit up to 7.8 feet, NGVD while maintaining required water levels in the residential and agricultural areas in southeastern Miami-Dade County.

3.7.5.15 **Increment 2**

The USACE proposed to modify the Operational Strategy currently defined in the February 2017 Increment 1.1 and 1.2 EA and FONSI and evaluated the increased restoration flows to NESRS by way of raising the maximum operating limit in the L-29 Borrow Canal up to 8.5 feet, NGVD while ensuring continued flood mitigation within 8.5 SMA. The USACE evaluated further relaxation or potential removal of the G-3273 stage constraint, and modifications to structural operations that direct more flow to ENP. This allows for increased deliveries from WCA-3A into NESRS for the benefit of natural resources and further reductions to the frequency and duration of Column 2 operations implemented under the 2012 WCP. Additionally, operational flexibility is necessary to facilitate completion of construction of the MWD and C-111 South Dade Project features in a similar manner to Increment 1.1 and 1.2. Increment 2 seeks to increase flow to NESRS while providing operational flexibility needed to: (1) maintain operating limits in the L-29 Borrow Canal that ensure the stability and safety of the Tamiami Trail (U.S. 41 Highway) between S-333 and S-334; (2) support MWD Project construction for the installation of S-357N, if needed; (3) facilitate the remaining Southern Detention Area (SDA) construction of C-111 South Dade Contract 8A and any remaining construction components of the NDA Contract 8; (4) maintain authorized flood mitigation for 8.5 SMA; (5) maintain pre-existing flood protection along the L-31N and C-111 Canals; (6) provide supplemental flows to Taylor Slough; and (7) provide operational flexibilities for prescribed extreme high water conditions in WCA-3A.

3.7.5.16 **Combined Operational Plan (COP)**

The Experimental Delivery Program as identified in the Supplemental Appropriations Act of 1984, Public Law 98-118) ends with the implementation of COP. The COP is an integrated operational plan for MWD to ENP and the C-111 SD projects. The COP operations do not call for continuation of minimum deliveries as identified in Public Law 91-282 but will convey more natural deliveries to ENP based on environmental conditions tied to rainfall and stages in ENP and WCA-3A. The COP operations improve water deliveries (timing, location, volume) into ENP and take steps to restore natural hydrologic conditions in NESRS, Taylor Slough, Rocky Glades, and the eastern Panhandle of ENP. Information and water management operating criteria identified from Increment 1, Increment 1.1, Increment 1.2, and Increment 2 were used to develop the COP. COP developed a revised WCP (Chapter 7) which is supported by appropriate NEPA documentation.

4 WATERSHED CHARACTERISTICS

4.1 General Characteristics

The area is a vast, nearly flat, expanse of wetlands with permeable limestone in the northern half but highly impermeable limestone in the southeastern part. The watershed drainage pattern is influenced by the management of WCAs, canals, levees and structures to provide water supply, flood risk management and environmental benefits to the basin. The three general regions covered here are: 1) the WCAs, which represent northern Everglades habitat and includes the majority of intact natural Everglades; 2) the southern Everglades habitat, which occurs in ENP and the southern third of WCA-3; and 3) the East Everglades, which includes the NESRS and a developed area along the slough's eastern boundary. The EAA and Hendry County to the north and BCNP to the west have an impact on these regions; therefore, they are also briefly characterized below. As a whole, the Everglades represents one of the most striking freshwater ecosystems in the country.

4.1.1 Seminole Big Cypress (SBC) Basin

The SBC Basin includes the SBC Project located within the Big Cypress Seminole Indian Reservation in southeastern Hendry County; north of the BCNP, southwest of the EAA, and west of the northwest corner of WCA-3A. The SBC Project features are located in the northwest portion of the Big Cypress Seminole Indian Reservation in Basins 1, 2, and 4.

4.1.2 Water Conservation Areas (WCAs)

The WCAs contain approximately 1,346 square miles which encompass and preserve a large part of the Everglades. A series of levees encircles each of the WCAs and forms their boundaries. The WCAs encompass and preserve approximately 40 percent of the Everglades. The Everglades is a vast shallow depression of organic soil, a product of living plants. The WCAs are principally a large sawgrass plain that includes sloughs, prairies and open water areas, interspersed with hammocks and myrtle and bay heads. The vegetation, when undisturbed by fire or prolonged flooding, effectively covers the ground to heights of 3 to 6 feet, NGVD. The flat slope of the land and the thick vegetation restrict water flow.

4.1.2.1 Water Conservation Area 1 (WCA-1)

WCA-1, with an area of 221 square miles, is approximately 21 miles long from north to south. Ground elevations slope gradually both to the north and to the south from the west center of the area. Elevations vary from greater than 16 feet, NGVD, in the northwest to less than 12 feet, NGVD, in the south.

4.1.2.2 Water Conservation Area 2 (WCA-2)

WCA-2, just south of WCA-1, with an area of approximately 210 square miles, is subdivided by L-35B into WCA-2A and WCA-2B. WCA-2 measures approximately 21 miles long from north to south. Ground elevations slope southward at 2 to 3 feet in 10 miles, ranging in elevation from greater than 13 feet, NGVD in the northwest to less than 7 feet, NGVD, in the south. The Hillsboro Canal runs just north of Levee 39 (L-39) which borders WCA-1 and WCA-2. The North New River Canal runs between WCA-2 and WCA-3.

4.1.2.3 Water Conservation Area 3 (WCA-3)

WCA-3, the largest of the three conservation areas, with an area of approximately 915 square miles, is approximately 40 miles long from north to south. Ground elevation slopes southeasterly 1 to 3 feet in a ten-mile range from greater than 13 feet, NGVD, in the northwest to 6 feet, NGVD, in the southeast. WCA-3 is subdivided into WCA-3A and WCA-3B by parallel levees, L-67A and L-67C in the southeastern corner of WCA-3 which reduce seepage out of WCA-3. Pump Stations S-9 and S-9A, located in L-37 at C-11, convey water from the Western C-11 Basin into WCA-3A. The Miami Canal traverses both WCA-3A and WCA-3B from the northwest to southeast and conveys water to the LEC. L-28, located along the BCNP/WCA-3A boundary, contains a gap, to allow for natural drainage from BCNP to WCA-3A. The L-29 Borrow Canal is located on the southern end of WCA-3and receives water from WCA-3A and WCA-3B. The Tamiami Trail (U.S. Highway 41), on the south side of the L-29 Borrow Canal east of S-333, has numerous culverts that transfer water into ENP. Additionally, the physical roadway of Tamiami Trail (U.S. Highway 41) is undergoing a series of construction phases to enable increased flow to pass under the eastern 10 miles of road adjacent to the L-29 Borrow Canal between S-333 and S-334. Over three miles of bridges have been installed, with a 1-mile stretch on the eastern side and a 2.3-mile stretch on the western side that allow unimpeded flow from the L-29 Borrow Canal to ENP. West of S-333 the L-29 Borrow Canal is located north of Tamiami Trail which is located on top of L-29.

4.1.3 Everglades National Park (ENP)

ENP is in the southwestern tip of the state, extending from the southern boundary of WCA-3 to Florida Bay and the Gulf of Mexico. ENP comprises approximately 2,300 square miles, including the associated islands and gulf waters; the mainland area is approximately 1,500 square miles with most of the area below elevation 4 feet, NGVD. The highest elevation is approximately 6 to 7 feet, NGVD near the Tamiami Trail. Shark River flows through ENP to Whitewater Bay. Taylor Slough flows southwesterly through ENP to the coast. The coastal areas of ENP are highly susceptible to the influence of salinity from tidal action. Eight different vegetative associations are located in the area: sawgrass Everglades, mangrove forest, salt marsh, cypress forest, pine forest, mixed West Indian hardwood hammock forest, bayhead, and Cape Sable saw palmetto salt prairie.

4.1.4 Las Palmas Community (8.5 Square Mile Area)

The 8.5 Square Mile Area (8.5 SMA), also referred to as the Las Palmas Community, is an inhabited area bounded on the west by ENP and separated from intensively developed urban lands to the east by the L-31N Borrow Canal. The 8.5 SMA has comparatively low ground surface elevations and a surficial aquifer system with high transmissivity. The lowest ground surface elevations are below 7 feet, NGVD along the ENP/8.5 SMA boundary with the general topography sloping east to west.

4.1.5 Everglades National Park-South Dade Conveyance System (ENP-SDCS)

The ENP-SDCS area is bounded on the north by L-29, on the east by L-31N, on the south by ENP, and on the west by ENP. ENP-SDCS includes; NESRS, a developed area (residential, agriculture, and industrial) adjacent to the L-31N Borrow Canal, C-111, and Taylor Slough. The ENP-SDCS receives water from upstream WCAs, local runoff, and groundwater seepage. Water in the SDCS can be conveyed to tide via the ECC, pumped to the C-111 detention areas (S-332D DA, NDA and SDA), or utilized to meet agricultural water supply demands. The topography of ENP-SDCS sloping from 7 feet NGVD at U.S. Highway 41 (Tamiami Trail) to the coast.

4.1.6 Contributing Drainage Areas

4.1.6.1 Everglades Agricultural Areas (EAA)

The lands located north of the WCAs and directly south of Lake Okeechobee are considered the EAA. This area of approximately 1,130 square miles is lower than surrounding land and is encircled by levees. To protect against floodwater; a network of Federal and non-Federal (local drainage districts, agriculture) infrastructure which includes canals, structures, and levees to provide for removal of excess water to WCA-1, WCA-2 and WCA-3 by way of STAs (1E, 1W, 2, 3/4 and 5/6). Excess water may also be pumped into Lake Okeechobee through the S-2, S-3 and S-4 pumping stations. However this is not the primary or preferred path to remove excess water from the EAA. Ground elevations are generally between 13 and 15 feet, NGVD; however, University of Florida Institute of Food and Agricultural study efforts indicate ongoing subsidence within the EAA. The EAA contains the most highly developed agricultural land in the C&SF Project area. The crops grown are sugarcane, sod, and truck crops. A portion of the area is devoted to beef-cattle production on improved pasture.

4.1.6.2 Big Cypress National Preserve (BCNP)

The terrain in the eastern half of the BCNP slopes southeast toward WCA-3A and ENP (approximately 17 feet, NGVD, to approximately 8 feet, NGVD). BCNP water drains into WCA-3A through a gap in L-28 along the central boundary between the two areas. S-343A, S-343B, and S-344, located on the L-28, transfer water from WCA-3A to BCNP. Water that leaves BCNP flows into ENP.

4.1.6.3 Southeast Hendry County

The terrain in southeastern Hendry County slopes southeast toward BCNP and WCA-3A. Hendry County water is conveyed to WCA-3A by the L-28 Interceptor Canal.

4.2 Topography

The topography of the WCAs range from 17 feet, NGVD in the northern part of WCA-1 to near 7 feet, NGVD in the southern end of WCA-3A. This gives an average slope of approximately 3 inches per mile for that entire area. The topography of ENP and the East Everglades is nearly flat, sloping from 7 feet, NGVD at U.S. Highway 41 (Tamiami Trail) to the coast which results in relatively slow overland flow.

A ridge and slough system of patterned, freshwater peat lands extends throughout the Water WCAs into Shark River Slough (SRS) in ENP. The ridge and slough wetlands drain into tidal rivers that flow through mangrove estuaries into the Gulf of Mexico. Higher elevation wetlands that flank either side of SRS are characterized by marl substrates and exposed limestone bedrock. Those wetland areas located to the east of SRS include the drainage basin for Taylor Slough, which flows through mangrove forests into northeast Florida Bay. The Everglades wetlands merge with the forested wetlands of BCNP to the west of WCA 3.

4.3 Geology and Soils

The Florida peninsula is the emerged part of a wider projection of the continental land mass called the Florida Platform. Southern Florida occupies the southeastern corner of the platform. The emerged portion of the Florida Platform encountered in the region consists of a thick (5,000 ft or more) sequence of marine limestones that were deposited from Eocene to Quaternary time. Shallow subsurface sediments on which the Everglades were developed consist of marine limestones that were deposited during high sea level

stands during the last two million years. Surface sediments consist of Holocene freshwater peat and muck that characterize the Everglades ecosystem.

The primary geological feature that controls regional hydrogeology is the permeability of subsurface limestones and comprise the Biscayne Aquifer.. Groundwater, surface water, and water management are all affected by the underlying highly permeable limestone. In areas of high permeability, rainfall infiltrates into the underlying rock, but it also may discharge quickly to canals and streams during dry periods. In some rock strata, groundwater flows for considerable distances before re-emerging at the surface as springs or as seepage to canals or streams. Seepage losses through and under the C&SF Project levees, as determined by detailed field investigations during the course of project design studies. Seepage rates in the Biscayne Aquifer flowing toward the southeastern portion of WCA-3 are extremely high. For example, Sonenshine (2001) estimated that horizontal seepage flow rates beneath L-30 ranged between 150 cfs and 450 cfs per linear foot of levee during the wet season, using numerical simulations. Some benefits accrue from this seepage, especially to the east coast agricultural and urban interests and to ENP, in making up part of the supply to those areas. However, the seepage in excess of the area's water needs is lost to coastal releases and cannot be stored for later use. So, if the seepage losses could be reduced, this would result in a considerable potential supply. Various seepage-reduction measures have been used in western arid regions but these are neither suitable nor cost effective for this area. Until new cost effective techniques are developed, seepage-loss reduction will continue to be limited to the use of multiple levees to slow flow, avoidance of high-seepage-loss area for use as storage areas, and use of a muck and sand mixture for levee base and cover material.

4.3.1 Seminole Big Cypress (SBC) Basin

Soils throughout the SBC Project area generally consist of loose dry sands. In addition, rock outcroppings or “caprock” is throughout the site extending above the existing ground surface, generally consisting of weathered to competent limestone.

4.3.2 Water Conservation Area 1 (WCA-1)

Soils throughout WCA-1 are classified as Loxahatchee peat. The peat thickness varies between approximately seven to nine feet, and is subject to large volumetric changes when drained. Peat is underlain by the Fort Thompson Formation, or undifferentiated Quaternary marine carbonate and quartz sand and shell.

4.3.3 Water Conservation Area 2 (WCA-2)

Surface soils in WCA-2 consist primarily of Holocene peat and muck that range in thickness between approximately three to five feet. Peat is underlain by the Fort Thompson Formation, or undifferentiated Quaternary marine carbonate and quartz sand and shell.

4.3.4 Water Conservation Area 3 (WCA-3)

Surface soils in WCA-3 consist of Holocene peat and muck that ranges generally from one to four feet thick. Underlying the peat are discontinuous beds of calcareous silt, up to three feet thick. The hard to medium-hard, sandy, porous limestone found in the Fort Thompson Formation underlies most of WCA-3A and all of WCA-3B. The karstic limestone of the Fort Thompson Formation is characterized by large conduits that transmit large volumes of groundwater toward the Atlantic coast.

4.3.5 Everglades National Park-South Dade Conveyance System (ENP-SDCS)

The Fort Thompson Formation underlies most of the ENP. The upper portions of the Fort Thompson Formation include the Biscayne Aquifer. The Tamiami Formation is the underlying formation in the north western tip of ENP (the teapot spout section found in Monroe County). Although rock outcrops occur, most areas are at least thinly covered by peat or marl. .

4.4 Vegetation

Sediment erosion and production is not a significant issue in the WCAs, ENP, ENP-SDCS, or adjacent areas. Due to the favorable climate in south Florida, vegetation (aquatic and terrestrial plants) grows rapidly. In addition, freezing temperatures that kill vegetation are rare. These conditions result in the expansion of vegetation into undesirable locations. Occasionally, floating aquatic vegetation or tussocks are moved by wind or current and have the potential to impede flow through water management structures within the C&SF Project area. Terrestrial plants can also impede releases to downstream areas.

4.5 Climate

The climate of south Florida is broadly classified as humid sub-tropical because it has two definite seasons; a dry season and a wet season. The warm rainy season typically extends from May through October, characterized by high humidity, intense solar radiation, and unstable atmospheric conditions that cause frequent local thunderstorms. The dry season normally lasts from November through April with frontal storms bringing cool temperatures, and moderate rainfall of low intensity. Some fronts are accompanied by severe weather producing thunderstorms, tornadoes, and large amounts of rainfall. Although the fronts can sometimes bring freezing temperature, damaging frosts rarely occur. Usually, an adequate blanket of water prevents excessive frost damage and oxidation of the peat soils.

Climate change in the project area could result in higher average ambient temperatures and increased evapotranspiration. Rainfall events may become less frequent and larger in magnitude. Regional surface water storage systems (i.e. canals) will most likely experience more rapid water loss when compared to current water levels, ultimately impacting availability of water supplies. Sea level change is one of the more certain consequences of climate change, and because it affects the land/ocean interface. Future rates of sea level change are expected to result in significant impacts on coastal canals and communities, with loss of flood risk management levels and increased saltwater intrusion being the primary effects.

4.5.1 Temperature

The monthly average temperatures recorded at National Oceanic and Atmospheric Administration (NOAA) stations in the region for the period from 2000 through 2019 are provided in Table 4-1 at the end of this chapter and may also be found at the following website: https://w2.weather.gov/climate/xmacis.php?wfo=mfl. The temperatures are moderately high from June through September and pleasantly cool from November through April. Frequent afternoon thundershowers tend to lower temperatures in the summer, and nights are usually cool. January is the coldest month; July and August are the hottest months, with many days above 90°F. Additional climate information may be found at the following website: https://sercc.com/climateinfo/historical/historical_fl.html.

4.5.2 Precipitation

Florida generally experiences large amounts of rainfall. The monthly total precipitation for the period of 2000 through 2019 for selected stations in the project area is shown in Table 4-2 at the end of this chapter. Seasonal rainfall patterns in south Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes. In the wet season, convective showers occur almost daily. Typically, 75% the average annual rainfall occurs during the wet season months of May through October. Tropical storms and hurricanes also provide major contributions to wet season rainfall and the heavier and more prolonged rainfall generally occurs from August through October due to tropical systems. During the dry season (November through April), rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. However, due to the variability of climate patterns (La Niña and El Niño), dry periods may occur during the wet season and wet periods may occur during the dry season. Prolonged periods of deficient rainfall are occasionally experienced even during the time of the expected rainy season. Several such dry periods, over the course of one to two years can lead to significantly lowered water tables and lake levels, which in turn may cause serious water shortages for communities in the area of the project. Eight typical rainfall patterns have been identified over Florida:

(1) **Isolated Air Mass**: Local, convective showers are due to daytime heating. Generally, if rain occurs it is limited to a small area and short duration.

(2) **Sea Breeze**: Sea breeze generally occurs on undisturbed days during warm months. Associated showers form along the coast and move inland during the day. There are many types of disturbances including cold air aloft and weak cyclonic flow.

(3) **Sea Breeze and Disturbances**: If sea breeze is associated with a larger scale disturbed pattern, more widespread rain is possible.

(4) **Mesoscale Thunderstorms and Showers**: These systems are often perturbations along old frontal troughs. Mesoscale shower and thunderstorms are quite common over Florida in summer months, usually due to cold air aloft.

(5) **Squall Lines**: Not common in Florida. Lines of thunderstorms are sometimes along a cold front and act like a squall line

(6) **Warm and Cold Fronts**: Frontal passages normally occur in the winter months. Frontal passages do not guarantee rain. During the summer months it is more common to have weak frontal zones that act as convergence zones and have few of the characteristics of winter fronts.

(7) **Tropical and Subtropical Cyclones**: A significant portion of wet season rainfall is associated with tropical systems. The amount of rainfall is not necessarily related to the strength or classical structure of the system. Tropical cyclones consist of tropical waves, tropical depressions, tropical storms, and hurricanes.

(8) **Stationary Upper Level Low Pressure Systems**: Truly stationary upper level low-pressure systems are rare. Over Florida, these systems are usually found in June, September, or early October. Upper level low-pressure systems combined with a front can produce heavy, sustained rain over a wide area. Large rainfalls in the dry season are usually due to these systems.

4.5.3 Evapotranspiration (ET)

ET, which is the loss of water from soil and water surfaces and by transpiration from plants, is a major element of south Florida's hydrologic cycle. Although ET is affected by many factors, temperature is

considered the most important. Minimum ET rates occur during the winter months (January and December) and increase to maximum rates during the spring months (April and May). Pan evaporation is used to determine the amount of ET for an area. Pan evaporation is evaporation observed at a standard National Weather Service (NWS) Class A pan installation by observers following standard techniques. Monthly, seasonal, and annual pan evaporation values for selected stations in the C&SF Project area is shown in **Table 4-1**.

Table 4-1: Pan Evaporation in Inches at Selected Stations*

	Belle Glade Exp Station	Fort Lauderdale Exp Station	Hialeah	Tamiami Trail 40 Mile Bend
January	3.40	3.83	3.83	3.05
February	4.09	4.33	4.54	3.64
March	5.72	6.24	6.16	5.05
April	6.62	7.54	6.93	5.91
May	7.07	7.83	7.52	6.12
June	6.45	6.92	6.90	5.75
July	6.41	7.15	7.10	5.62
August	6.27	6.97	6.64	5.45
September	5.37	5.94	5.81	4.97
October	4.79	5.52	5.72	4.49
November	3.68	4.31	4.53	3.62
December	3.24	3.81	3.92	3.01
May-Oct	36.35	40.33	39.69	32.39
Nov-Apr	26.74	30.06	29.91	24.28
Annual	63.10	70.39	69.59	56.67
Period of Record	**(01/1943-12/1992)**	**(11/1953-06/1979)**	**(7/1948-01/1998)**	**(01/1942-11/1998)**

Note: Sites data is provisional and can be found using DBHYDRO: https://www.sfwmd.gov/science-data/dbhydro

4.5.4 Winds

Winds are persistent year round, but on average, are strongest in the late winter or early spring (March). During the wet season, the prevailing winds are easterly. In the dry season wind direction is variable. ET rates increase with wind speed and therefore wind has an effect on regional hydrology. Wind action during the winter intensifies the drying of marshes and causes increased water demands for agricultural irrigation. Very strong winds associated with hurricanes probably do not affect ET losses, but they are an important physical process shaping the Everglades and Florida Bay. High winds and associated wave actions can redistribute such physical features as barrier islands, inlets, channels, and sand shoals and disrupt established plant and animal communities such as coral reefs, seagrass beds, and mangroves.

4.5.4.1 Tropical Disturbance, Tropical Depression, Tropical Storm, Hurricane

The occurrence of tropical storms of varying intensities is a critical factor in developing regulation schedules for a reservoir. The necessary regulation schedule must maintain water levels that would be safe even with the occurrence of hurricane wind tides and wave action and at the same time have enough storage to control storm runoff and store enough water for dry-season irrigation requirements. Total storm rainfall is difficult to anticipate. Storm rainfall has little direct relation to the size or intensity of the storm, although the so-called Cape Verde hurricanes which originate far out in the Atlantic tend to produce more rainfall than others originating near shore. Stationary low-pressure systems combined with fronts, and tropical and subtropical cyclones are systems capable of producing large amounts of rain over widespread areas. The region is subject to tropical cyclones from June through November. NOAA classifies tropical cyclones as follows:

(1) **Tropical Disturbance**: Rotary circulation slight or absent at surface but sometimes better developed aloft; no closed isobars and no strong winds; also known as tropical wave or easterly wave.

(2) **Tropical Depression**: One or more closed isobars and some rotary circulation at the surface, highest wind speed 39 miles per hour (mph).

(3) **Tropical Storm**: Closed isobars, distinct rotary circulation, wind speed 39 to 73 mph.

(4) **Hurricane**: Closed isobars, strong and very pronounced rotary circulation, wind speed 74 mph or greater. However, more often than not hurricanes produce at least six to eight inches of rainfall. Hurricanes strike most frequently during August, September, and October with a return frequency of approximately every three years. Numerous tropical disturbances have affected the Florida peninsula between 1885 and 2018, and many of these have reached hurricane intensity. The most notable hurricanes that affected the C&SF Project were: Hurricane of October 1906, Great Hurricane of September 1926, Great Hurricane of Labor Day 1935, Hurricane "Yankee" in November 1935, Great Hurricane of September 1945, Great Hurricane of September 1947, Hurricane Donna in 1960, Hurricane Betsy in 1965, Hurricane Andrew in 1992, Hurricane Irene in 1999, the October 2000 storm (unnamed), and Hurricanes Charley, Frances, Ivan and Jeanne in 2004, Katrina and Wilma in 2005, and Irma in 2017. Additional hurricane information may be found at the following website: https://www.nhc.noaa.gov/.

4.6 Storms and Floods

Although intense rainfalls amounting to four inches or more are common in Florida, serious flooding usually is the result of prolonged heavy seasonal rainfall (August through October) aggravated by tropical disturbances. This seasonal rainfall occurs in thunderstorms which vary greatly in intensity and may occur in an extended squall line or form in locally unstable air. They rarely occur during the winter season, but may occur as often as two days out of three during the summer months. For the agricultural and Everglades area, the available rainfall records show the greatest rainy season amounts occurred in 1947, 1953, 1960, 1981, 1982, 1985, 1991, 1999, 2000, 2004, 2005, 2008, 2012, 2014, 2015, and 2017.

4.6.1 Flood of 1947

The 1947 flood was very severe affecting all of the counties of the southern half of the Florida peninsula and was a major consideration for the authorization of the C&SF Project. Affected counties included Highlands County, Okeechobee County, Glades County, Martin County Broward County, Palm Beach

County, Hendry County, Collier County, and Miami-Dade County. Nearly 2,500,000 acres were flooded, some of the flooding lasted six months, and damages totaled near $55,000,000.

4.6.2 Flood of 1960

September 1960 was one of the wettest months within the history of the C&SF Project, predominately caused by rainfall resulting from Hurricane Donna and the effects of Tropical Storm Florence. This rainfall created extensive flooding throughout much of the area. Rainfall averaged from 20 to 40 inches over the greater portion of central and southern Florida for the period July 21 to September 30. Damages to agriculture and urban land in the area were estimated at more than $14 million, with agricultural damage alone over $11 million.

4.6.3 Hurricane Betsy — September 7-9, 1965

A tropical storm formed in the southwestern Atlantic and reached extreme southern Florida as Hurricane Betsy on September 8. Rainfall amounts were approximately 5 inches in the Miami area and were as much as eight inches over ENP. Flooding was of little consequence and actually brought water levels to normal since the area was experiencing an acute water shortage for wildlife. Completed project works in the area affected by Hurricane Betsy functioned as designed. Flood stages that occurred in the South Miami-Dade area resulted from overland tidal inundation and overflow of the completed portion of L-31E.

4.6.4 Storm Event — April 24-25, 1979

The areas of highest rainfall intensity for April 24 and 25 occurred in the eastern areas of Miami-Dade, Broward and southern Palm Beach Counties. The “Preliminary Report on The Severe Storm of April 24-25, 1979,” prepared by SFWMD, indicates that the highest rainfall was 18.83 inches which occurred several miles west of Delray Beach. S-9, adjacent to WCA-3, received 9.10 inches of rain and portions of WCA-1 and WCA-2 received over 6 inches. Persistent flooding occurred in areas adjacent to the project area such as the C-11 and C-9 basins and releases from the Conservation Areas to the ECC were closed on the night of April 25.

4.6.5 Tropical Storm Dennis — August 16-18, 1981

The passage of Tropical Storm Dennis brought local relief to a prolonged rainfall deficiency, but resulted in the most extensive flooding in South Miami-Dade since 1960. The area of highest rainfall intensity during Tropical Storm Dennis as indicated in the document entitled “Report on Tropical Storm Dennis, August 16-18, 1981” which was prepared by SFWMD, occurred in a 15 to 20 miles wide strip parallel to L-31N and L-30. The area from Florida City to the Tamiami Canal reported 18 or more inches of rainfall within the storm period. Water levels in the WCAs increased from nearly dry to the regulation schedules as a result of rainfall associated with Tropical Storm Dennis. S-18C was opened full at noon on August 17. The peak S-18C headwater stage occurred approximately 18 hours later. A peak release of 2,170 cfs at S 18C exceeded the design discharge of 2,100 cfs.

4.6.6 Rainstorm — April 23-26, 1982

The SFWMD report entitled “Preliminary Report on Rainstorm of April 23-26, 1982” indicates that between 9 and 15 inches of rain occurred in the greater Miami area over the period of April 23 to April 24. Most flooding that occurred was in areas along the east coast and very little rainfall occurred in the WCAs.

4.6.7 Tropical Storm Bob — July 22-24, 1985

Tropical Storm Bob formed as a tropical depression in the southeast Gulf of Mexico on July 21 and moved eastward reaching maximum intensity of 50 mph, with gusts up to 70 mph and made landfall near Fort Myers. Tropical Storm Bob was rather unusual for the fact that no storm, in over 100 years of data, had moved eastward across southern Florida in late July. The heaviest amounts of rainfall were experienced on the southwest coast of Florida with 2-day amounts exceeding 20 inches near Everglades City. Parts of Monroe and Collier Counties exceeded the 1% annual exceedance probability (AEP, a storm that has a 1 in 100 chance of occurring in any given year) rainfall amounts. However, rainfall amounts in the other portions of the project area averaged approximately 4 to 6 inches for the 2-day period. Pumping was terminated at S-331 and structures S-174, S-176, S-177, S-18C and the culvert at S-197 were opened fully. S-338, located in C-1, was also opened full in an attempt to remove some of the water from L 31N Borrow Canal north of S-331. The earthen plug at the lower end of C-111, near S-197, was removed and pumping resumed at S-331.

4.6.8 Storm Event — January 15-17, 1991

When the storm of January 15-17 occurred, south Florida was more than 2 months into the dry season and there was consideration of imposing water restrictions. The decline in the level of the WCAs was a cause for concern for water supply and represented a threat to wildlife. Information discussed in the document “Storm Event of January 15-17, 1991” prepared by the SFWMD, indicates that the major part of the storm was concentrated along a narrow strip from the west coast of Florida in Collier County to the east coast of Florida in Palm Beach County, with rainfall amounts averaging approximately 8 inches. Fifteen rainfall stations in south Florida set new records for the month of January. During the storm, floodwaters were pumped from the EAA into the WCAs which helped to replenish the storage in the WCAs.

4.6.9 Storm Event — October 8-10, 1991

The intense rainfall of October 8-10 was concentrated over eastern Broward and Miami-Dade counties. The magnitude of the storm may be best represented from the 1-day maximum rainfall amounts, which ranged from 13.5 inches in Hollywood to 2 inches in the Tamiami area of Miami-Dade County. The document “Storm Event of October 8-10, 1991” prepared by the SFWMD shows that the 1-day rainfall at Hollywood had a return period of greater than 100 years. In other areas, the return period was approximately 1-in-10 years. Rainfall in the area of the SDCS ranged from 4 to 8 inches for the entire storm. While rainfall in the WCAs and ENP was less than 2 inches, there were releases for water deliveries to the ENP at the S-12s and S-333 mandated by the Rainfall Plan. S-5A and S-6 pumped water to the EAA and S-140 pumped to WCA-3.

4.6.10 Hurricane Andrew - August 16-28, 1992

Hurricane Andrew crossed the northern tip of Elliot Key, Florida on August 24, then made landfall in mainland Florida at Fender Point in Biscayne National Park (located at approximately SW 280 Street, ENE of Homestead Air Force Base). The tropical cyclone struck southern Miami-Dade County, Florida as a Category 5 hurricane. On the southeast Florida coast, peak storm surge arrived near the time of high astronomical tide. The height of the storm tide (the sum of the storm surge and astronomical tide, referenced to mean sea level) ranged from 4 to 6 feet in northern Biscayne Bay increasing to a maximum value of 16.9 feet at the Burger King International Headquarters, located on the western shoreline in the center of the Bay. Hurricane Andrew resulted in sufficient rainfall to cause local floods even though the

hurricane was relatively small and generally moved rather fast. The 1993 NHC Report on Hurricane Andrew included event rainfall totals of approximately 7.8 inches in Broward County (S-124) and 7.4 inches in Miami-Dade County (S-21A). After striking Florida, Andrew moved northwest across the Gulf of Mexico to make a second landfall in south-central Louisiana.

4.6.11 Hurricane Irene — October 13-17, 1999

Hurricane Irene moved across southeast Florida parallel to the coast, dropping torrential rains with tropical storm and Category 1 hurricane force winds. The center of Hurricane Irene moved offshore near Jupiter later on the morning of October 16, 1999. Between October 13 and 17, many sites in Broward, Miami-Dade, Martin and Palm Beach counties received more than 10 inches of rainfall. The maximum rainfall at a site was 17.46 inches near S-41 near the coast of Boynton Beach in Palm Beach County. The maximum rainfall at a site in Broward County was 14.15 inches at the rain gage station: FTL at the Fort Lauderdale Airport. Sites in Broward, Miami-Dade and Palm Beach counties received the 24-, 48- and 72-hour maximum rainfall that would occur once in 100 years. Flows through water control structures and water levels in Lake Okeechobee, the WCAs, and canals showed significant increase due to the hurricane. The SFWMD pumped 646,654 acre-feet of water in October with 466,388 acre-feet being pumped from October 13 to October 31, 1999. The pumping for October 1999 was greater than the combined sum of pumping volumes for October in the previous 3 years. Seventy seven percent of the pumping volume was pumped into the WCAs through G-251, S-5A, S-6, S-7, S-8 and S-9. A few pump stations and several structures achieved record high daily average release rates. The total inflow and outflow for Lake Okeechobee for October was 565,136 acre-feet and 179,346 acre-feet, respectively. From October 13 to 31, the inflow to Lake Okeechobee was 381,065 acre-feet and the outflow was 173,175 acre-feet. Outflow through coastal structures was 1,108,107 acre-feet for October with 976,757 acre-feet released from October 13 to 31. Releases into the ENP were 365,785 acre-feet with 276,672 acre-feet occurring between October 13 and 31. Inflow and outflow to STAs generally increased. There were many instances where historical high water levels were attained. S-332 had a record maximum pumping rate of 539 cfs on October 17, 1999. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Irene at the following link: https://www.nhc.noaa.gov/data/tcr/AL131999_Irene.pdf

4.6.12 Unnamed Storm — October 3-4, 2000

This storm dropped 15.3 inches at the Miami International Airport. The combined effect of this storm and Hurricane Irene one year earlier resulted in a locally sponsored/constructed flood protection improvements in C-3, C-4 and C-6 Basins.

4.6.13 Hurricanes Charley, Frances, Ivan and Jeanne — August - September, 2004

Hurricanes Charley, Frances, Ivan, and Jeanne made landfall in South Florida in 2004. A similar series of events had not been observed since 1871. High rainfall, high surface water flows, and a rise in lake water levels were experienced. Most of the rainfall occurred on the Upper and Lower Kissimmee River Basins, the headwaters of Lake Okeechobee, which is the central component of the south Florida water management system. In these basins, the monthly rainfall amounts were in the 1% AEP range for the month of September. The resulting surface water flow raised the water level in Lake Okeechobee, a 436,000 acre lake, by 5.38 feet between August 12 and October 13, 2004, resulting in a storage increase of 2.37 million acre-feet.

Hurricane Charley made landfall on the southwest coast of Florida near Cayo Costa on the evening of August 13, 2004, with a maximum sustained wind of 145 mph. The center passed near Kissimmee and

Orlando early on August 14 and crossed into the Atlantic Ocean at Daytona Beach. For the purpose of hydrologic impact analysis of the 2004 hurricanes, the five-day cumulative rainfall before, during and after the landfall day of each hurricane is reported as the rainfall amount from the hurricane. For Hurricane Charley, the highest areal rainfall was observed in the Upper Kissimmee Basin followed by the east Caloosahatchee basin and southwest coastal areas and corresponds with the path of the hurricane. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Charley at the following link: https://www.nhc.noaa.gov/data/tcr/AL032004_Charley.pdf

Hurricane Frances made landfall over the southern end of Hutchinson Island on Florida's southeast coast on the evening of September 5, 2004. It traveled west-northwest through central Florida and entered the northeastern Gulf of Mexico on September 6, 2004. The highest areal rainfall was observed in the Palm Beach area followed by the Martin-St. Lucie and Upper Kissimmee basins, corresponding with the hurricane's path. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Frances at the following link: https://www.nhc.noaa.gov/data/tcr/AL062004_Frances.pdf .

Hurricane Ivan made three U.S. mainland landfalls initially coming ashore west of Gulf Shores, Alabama on September 16, 2004. Ivan gradually weakened while producing heavy rainfall in the southern Appalachians while it moved to the Mid-Atlantic States. On September 19, Ivan moved over the Delmarva Peninsula (Delaware/Maryland) and entered the western Atlantic Ocean as an extra tropical cyclone. Ivan turned south and southwest toward Florida, moving over the southern Florida peninsula emerging in the Gulf of Mexico, eventually making landfall in southwestern Louisiana on September 24. The highest areal rainfall was observed in the Martin-St. Lucie basin, followed by the Palm Beach, east EAA, and WCA-1, which generally corresponds with the path of the storm event over the Florida peninsula. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Ivan at the following link: https://www.nhc.noaa.gov/data/tcr/AL092004_Ivan.pdf.

Hurricane Jeanne made landfall on the southeast coast of Florida at the southern end of Hutchinson Island just east of Stuart early on September 26, 2004. It went west to 30 miles north of Tampa and moved north to central Georgia. The highest areal rainfall was observed in the Upper Kissimmee, Palm Beach, Martin-St. Lucie, and lower Kissimmee basins, corresponding with the hurricane's path. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Jeanne at the following link: https://www.nhc.noaa.gov/data/tcr/AL112004_Jeanne.pdf.

In September 2004, several other basins observed monthly rainfall in excess of the 2% AEP monthly rainfall amounts; Martin-St. Lucie (17.86 inches); and Palm Beach (17.69 inches).

4.6.14 Hurricanes Dennis, Katrina, Rita, and Wilma — July - October, 2005

Hurricane Dennis (mid-July 2005) did major damage in Cuba but passed west of south Florida on its way north through the Gulf of Mexico drenching Miami-Dade and Broward Counties. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Dennis at the following link: https://www.nhc.noaa.gov/data/tcr/AL042005_Dennis.pdf.

Hurricane Katrina (August 23-26, 2005) developed in the Bahamas and made landfall on the Miami-Dade/Broward line August 25 as a Category 1 hurricane. The hurricane moved slowly west-southwest on a 6-hour trip across the southern tip of Florida. Loss of life and heavy flooding resulted from very high intensity rainfall. Homestead registered 13.24 inches in a 24-hour period. Flooding was reported in the Homestead area and C-1 Basin. L-31N Borrow Canal and C-111 were seriously impacted. Because the C-4 Storm Detention Reservoir was activated, serious flooding did not occur in the C-4 Basin. Katrina later

made landfall near New Orleans causing catastrophic fatalities and property damage. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Katrina at the following link: https://www.nhc.noaa.gov/data/tcr/AL122005_Katrina.pdf.

Hurricane Rita (September 20, 2005) formed in the Turks and Caicos Islands and missed landfall in south Florida to the south as it passed through the Florida Straits, but caused significant rainfall in south Miami-Dade, as well as the Keys and ENP. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Rita at the following link: https://www.nhc.noaa.gov/data/tcr/AL182005_Rita.pdf.

Hurricane Wilma (October 24, 2005) caused major damage to Cancun, Mexico, as a Category 4 storm that lingered for several days. It also caused major damage and flooding impacts in south Florida—notably direct impacts on Lake Okeechobee. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Wilma at the following link: https://www.nhc.noaa.gov/data/tcr/AL252005_Wilma.pdf.

4.6.15 Tropical Storm Fay - August 17-23, 2008

According to the National Hurricane Center (NHC), Fay originated as a tropical wave off the coast of Africa on August 6, 2008. On August 15, 2008, a low-pressure area over the Mona Passage became Tropical Storm Fay and moved over eastern Dominican Republic. The next day, the storm passed east of Haiti. On August 17, the storm reached Cuba. By August 18, it had moved northeast of the Florida Keys after a landfall on the Keys. On the morning of August 19, 2008, Tropical Storm Fay landed in southwest Florida, near Cape Romano, moving inland across Lake Okeechobee and moving on to the Atlantic Ocean near Melbourne. The mean Doppler surface wind velocity over Lake Okeechobee was estimated at 69 mph. The SFWMD weather station L005 in Lake Okeechobee observed a 15-minute mean maximum wind speed of 59 mph on August 19, 2009, at 12:45 pm. After lingering for three days off the coast of the Kennedy Space Center, Fay made its third landfall in Florida in Volusia County. The storm moved west and northwest across Florida and crossed into Gulf of Mexico. It made a fourth landfall in the panhandle of Florida. Rainfall from the tropical system affected all of the state, with central and south Florida getting storm-related rainfall from August 17-23, 2008. Please refer to National Hurricane Center's Tropical Cyclone Report for Topical Storm Fay at the following link:
https://www.nhc.noaa.gov/data/tcr/AL062008_Fay.pdf.

4.6.16 Tropical Storm Isaac — August 24-28, 2012

Tropical Storm Isaac moved west-northwest through the Straits of Florida on August 26, with the center passing across the lower Keys late that afternoon. Tropical Storm Isaac continued on a west-northwest track over the southeast Gulf of Mexico making landfall in Port Fourchon, Louisiana on August 29. The NWS Miami-South Florida Weather Forecast Office Tropical Storm Isaac Report described an area of 10 plus inches of rainfall across roughly one-third of Palm Beach County, stretching from Jupiter Farms south to Boca Raton, then into northern metro Broward County from Coral Springs to Lauderhill. In addition, maximum rainfall amounts were both measured and estimated in the 15 to 20 inches range across the Wellington and The Acreage communities. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Isaac at the following link: https://www.nhc.noaa.gov/data/tcr/AL092012_Isaac.pdf.

4.6.17 Heavy Rainfall Event — January 9–10, 2014

At the beginning of 2014, the January 9–10 rainfall event on coastal St. Lucie, Martin, and Palm Beach counties was a rare event, with a one-day maximum rainfall at several sites experiencing approximately a 1% annual chance probability (1 in 100 chance of occurring in any given year) event. According to the

NWS, the storm was caused when a cold front that passed through the area warmed up and moved back north, while from the east and southeast, warm moist air flow on top of it (The Palm Beach Post, January 13, 2014). The NWS reported more than 22 inches of rainfall in Boynton Beach, which was the hardest hit area (The Palm Beach Post, January 15, 2014). It was also reported that 12 inches of rainfall fell in the first two hours. Rainfall intensity of 2.2 inches in 15 minutes was observed in eastern Palm Beach County in the C-15 Basin, with a maximum of over 7 inches in one hour. In the same basin, radar estimated rainfall of 15.1 inches fell at a site in three and a half hours. Rainfall of 15.75 inches in less than six hours was reported at the LWDD office. In St. Lucie County, 8.68 inches of rainfall fell in 3 hours at a location in the mid-coastal area on January 9 (4:00 p.m. to 7:00 p.m.). In Martin County, 6.23 inches of rainfall fell in four hours at a location in the North Folk area.

The impact of the extreme rainfall resulted in the closing a section of Interstate 95 from Boynton Beach Boulevard to Hypoluxo Road (approximately 3 miles), street flooding that stranded vehicles, and local school closures. As many as 140 homes in Palm Beach County had flooding (Palm Beach Post, January 14, 2014). The District reported that its primary system water control structure gates were fully open. The tertiary (neighborhood) and secondary (LWDD) canal systems were overwhelmed with the high intensity of rainfall and associated flash flood. It was noted that the primary drainage system was helped by the fact that the flooding was close to the ocean, making it a short distance to move the floodwaters that reached the primary canals. St. Lucie, Martin, and Palm Beach counties were affected.

4.6.18 Heavy Rainfall Event — February 2015

As a result of a front that stalled on South Florida, February 28, 2015, high rainfall caused flooding in some locations. According to the NWS, the stalled front drenched eastern and southern Palm Beach and Broward counties. Areas that had high rainfall were Stuart (9.6 inches), Pembroke Pine in Broward (8.84 inches), Jupiter (7.07 inches), Royal Palm Beach (5.92 inches), and Boca Raton (5.66 inches).

4.6.19 Heavy Rainfall Events — December 2015

From December 3 to 6, 2015, south Miami-Dade experienced heavy rainfall causing flooding of farms. The flooding caused crop loss for vegetable farmers of the area. The Miami Herald on December 14, 2015, citing the county agricultural manager, estimated crop losses between 40 and 100 percent. The paper also reported on December 15, 2015, that Federal assistance was asked from the United States Department of Agriculture to declare flooded farm lands a disaster to get relief in the form of loans. Rainfall for the December 3-6 2015, as measured at monitoring sites S-177, S-180, and S-20G structures and areal rainfall average for Miami-Dade area are listed below in **Table 4-2**. Additional information on this event can be found in the 2017 South Florida Environmental Report, Volume 1, Chapter 2 (https://apps.sfwmd.gov/sfwmd/SFER/2017_sfer_final/v1/chapters/v1_ch2.pdf).

Table 4-2: Heavy Rainfall Events - December 2015

Recording Date *	Rainfall (inches)			
	Miami-Dade	S-177	S-18C	S-20G
December 3, 2015	0.75	0.55	0.99	0.45
December 4, 2015	3.50	3.19	4.53	4.36
December 5, 2015	0.81	0.52	0.63	1.29
December 6, 2015	3.48	4.64	5.18	6.56
Total	**8.54**	**8.9**	**11.33**	**12.66**

Recording Date *	Rainfall (inches)			
	Miami-Dade	S-177	S-18C	S-20G
* Rainfall observation from 7:00 a.m. previous day to 6:59 a.m. recording day.				

4.6.20 El Niño Event — December 2015 - January 2016

In December 2015 and January 2016, normally the dry season, South Florida experienced an extremely unusual amount of rainfall from El Niño conditions. In fact, January 2016 was the wettest January for most of South Florida since records began in 1932 for the month of January. Rainfall over WCA-3A in January 2016 was 9.5 inches, more than 400 percent of average January rainfall. This extraordinary natural phenomenon resulted in WCA-3A extreme water level rise and caused severe impacts to natural resources. The rapid rise, especially since it occurred during a time of year when water levels are historically low, inundated tree islands and other wildlife habitat.

Immediate action beyond what was allowed under existing regulatory criteria was necessary to move significant volumes of water out of WCA-3A. On February 11, 2016, FDEP issued an emergency final order authorizing SFWMD and USACE to lower water levels by moving water out of WCA-3A to ENP through Shark River Slough. This lead to SAD approving the Temporary Emergency Deviation to Affect Relief of High Water Levels Within Water Conservation Area 3A, L-29 Canal and South Dade Conveyance System Operational Strategy.

Water levels in WCA-3A crested at elevation 11.50 feet, NGVD in mid-February and returned to below the highest zone (Zone A) of the regulation schedule by May 9, 2016, after the emergency operations. Approximately 700,000 acre-feet of water was released from WCA 3A during the 90-day emergency operations period, February 12–May 11, 2016. ENP received more than one-half million acre-feet of water during the emergency operations period.

USACE and SFWMD implemented emergency operations in a manner that minimized harmful impacts, including flooding and degradation of water quality, to the environment, the public, adjacent properties, and downstream receiving waters. USACE South Florida Operations Office (SFOO) and SFWMD field station staff and crews and contractors constructed numerous temporary features to move more water and to mitigate the effects of higher water levels to wildlife, businesses, and communities.

These operations were documented in the February 2016 Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) titled “Temporary Emergency Deviation to Affect Relief of High Water Levels Within Water Conservation Area 3A L-29 Canal and South Dade Conveyance System Operational Strategy”. The SFWMD documented this event within its 2017 South Florida Environmental Report, Volume 1, Chapter 2 and it may be found at the following link:
https://apps.sfwmd.gov/sfwmd/SFER/2017_sfer_final/v1/chapters/v1_ch2.pdf.

4.6.21 Extreme Rainfall Event — June 1-8, 2017

The extreme high rainfall of June 1- 8, 2017, averaged 9.27 inches over the whole SFWMD. In comparison, the average SFWMD rainfall for the month of June is 7.85 inches. The rainfall system moved as a continuous band of rainfall from Gulf of Mexico over South Florida crossing into the Atlantic for several days. Both the intensity and duration of rainfall resulted in extreme wet conditions in many parts of South Florida. The main band with the highest rainfall crossed from southwestern Florida to southeastern Florida

covering Collier, Hendry, Broward, and Palm Beach counties with over 22 inches of rainfall at isolated spots and areal average rainfall of over 15 inches. The extreme rainfall event followed dry conditions in South Florida, which helped mitigate the resulting flooding. Impacts of the event included flooding in Broward and Palm counties, Fort Lauderdale and Miami airports delays, and closing of Sawgrass Mills Mall and Miami Zoo for a time.

In response to this event FDEP issued an emergency final order on June 23, 2017, authorizing the SFWMD and USACE to take immediate action to deviate from permitted water management practices to move significant volumes of flood water out of the WCAs. USACE implemented two planned temporary deviations to affect relief of high water levels within WCA 3A. The first deviation is documented in the June 2017 EA and FONSI titled "Planned Temporary Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A". The second deviation is documented in the September 2017 EA and FONSI titled "Planned Temporary Deviation from the 2012 Water Control Plan for Water Conservation Area 2A". The SFWMD documented this event and subsequent operations within its 2019 South Florida Environmental Report, Volume 1, Appendix 2-1: After Action Report Emergency Measures Due to High Water Conditions in the South Florida Region during the 2017 Wet Season (https://apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/v1/v1.pdf).

4.6.22 Hurricane Irma — September 9–11, 2017

Hurricane Irma moved away from the northern coast of Cuba on September 9 and on September 10, Irma strengthened to a Category 4 hurricane as it accelerated toward the Florida Keys. Hurricane Irma made landfall in Cudjoe Key, Florida on the morning of September 10 as a 130 mph Category 4 hurricane. The center moved into central Florida overnight and into northern Florida later on September 11, as it weakened. The NWS Miami-South Florida Weather Forecast Office Report described the highest rainfall amounts from Hurricane Irma occurring over inland portions of Collier County and western sections of Hendry and Glades counties where the eye of Irma passed. These areas received anywhere from 9 to 15 inches of rainfall, with estimates of up to 20 inches in the Felda, Florida area as well as the Big Cypress National Preserve. Elsewhere, rainfall totals were mainly in the 6 to 10 inch range. Please refer to National Hurricane Center's Tropical Cyclone Report for Hurricane Irma at the following link: https://www.nhc.noaa.gov/data/tcr/AL112017_Irma.pdf.

The Governor declared a state of emergency on September 4, 2017 for every county in Florida due to the forecasted strength of Hurricane Irma. USACE implemented an Emergency Deviation from the 2012 Water Control Plan and the Modified Water Deliveries to Everglades National Park Project Increment Plus Operational Strategy on September 15, 2017 in order to provide relief from high water stages within WCA 3A and the SDCS on September 15, 2017 due to Hurricane Irma. This deviation was documented in an EA and FONSI titled "Emergency Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A and the South Dade Conveyance System Post Hurricane Irma and Planned Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A" dated October 2017. The SFWMD also documented this event and subsequent operations within its 2019 South Florida Environmental Report, Volume 1, Appendix 2-2: Hurricane Irma, September 8–11, 2017, Impact on South Florida Water Management System (https://apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/v1/v1.pdf).

4.7 Runoff Characteristics

The generally flat topography prevailing throughout the region, its thick vegetation, and the absorptive nature of its soil combine to produce low runoff characteristics. The major canals between Lake

Okeechobee and the WCAs serve as collecting sumps for agricultural area runoff to be pumped to the STAs and then released to the WCAs. Under the original C&SF SPF conditions, storage in the three WCAs total approximately 900,000 acre-feet but will fluctuate with regulation schedules of the WCAs. Because of the slow movement of water in the densely vegetated areas, rapid removal of flood storage from the interior of those areas via the canals is limited. During periods of high releases from the spillways, canal water levels will often be below ground level in the adjacent marshes while water depths in the densely vegetated marshes are approximately one to two feet. The design discharge for the S-10s, S-11s, and S-12s, is 14,800 cfs, 16,700 cfs, and 32,000 cfs, respectively. The interior canals in WCA-3A, Miami Canal, L-68A, and L 67A Canals, L-67A Extension Canal, also serve as distribution channels for delivery of water to SRS and ENP. The below Table 4-5 may be used to calculate the general stage response corresponding to various release rates within the WCAs.

Table 4-3: WCAs Releases and Stage Response

	Area		Rate (CFS)	Rate (CFS)	Rate (CFS)
	(mi²)	(Acre)	0.1 feet per week	0.01 feet per day	1 inch (0.083 ft) per day
WCA-1	221	141,440	1,020	714	5,953
WCA-2A	173	110,720	799	559	4,660
WCA-2B	37	23,680	171	120	997
WCA-3A	787	503,680	3,634	2,544	21,199
WCA-3B	128	81,920	591	414	3,448
Total WCAs	1,346	861,440			

4.8 Water Quality

The water quality in the WCAs, ENP and the East Everglades is influenced by urban and agricultural activities elsewhere in the watershed. The quality of water that leaves the EAA contains higher concentrations of nitrogen and phosphorus and other constituents than is generally found in local rainfall. However, the 2019 South Florida Environmental Report (SFER) by SFWMD documents that Everglades water quality in relation to total phosphorus continues to show improvement: "In Water Year 2018, inflow TP concentrations for the Everglades Protection Area ranged from 8.8 parts per billion (ppb) for ENP to 28.5 ppb for WCA 3. TP concentrations at interior regions ranged from 4.7 ppb in ENP to 10.5 ppb in WCA 2. Individual interior marsh monitoring stations ranged from 2.9 ppb in some unimpacted portions of the marsh to 36.1 ppb at sites that are highly influenced by canal inputs. The investments made over the last two decades are making a difference, improving the Everglades water quality with over 90% of the SFWMD EPA at or below 10 ppb TP."

Of particular concern is floodwater released from the EAA into WCA-3A. The Everglades is a nutrient poor system and the introduction of nutrients, particularly phosphorus, from the agricultural areas is thought to have significantly affected sawgrass and wet prairie habitat in the WCAs through which EAA releases pass en route to ENP. Currently, water reaching the ENP has generally been of good quality. As mentioned above, the water quality in relation to total phosphorous is improving. However, the NPS has expressed concern over excessive nutrients in surface water entering ENP from the WCAs. Water is the most critical ecological factor in the ENP. When in 1970, the U.S. Congress guaranteed minimum water deliveries to the ENP, it also required that these waters be of good quality. Regulations for water quality are a function

of the State of Florida. As the State representative, it is the responsibility of SFWMD to petition the USACE for changes in flood risk management and navigation regulations where it sees that water quality benefits may be achieved in the WCAs, ENP, ENP-SDCS region without significant loss of benefits for the congressionally authorized project purposes. The monitoring stations for the WCAs are discussed in Chapter 5-Data Collection and Communication Network, and further water quality discussion is provided in Chapter 7-Water Control Plan.

4.9 Channel and Floodway Characteristics

The WCAs are completely contained by levees, except for three gaps in the WCA-2A and WCA-3A levees. These consist of a 1-mile gap in the L-6 levee or Western WCA-2A boundary, a 215-foot gap in the L-4 levee or northern WCA-3A boundary and an approximately 7-mile gap in the L-28 levee on the BCNP/WCA-3A boundary. The gap in the L-6 levee along the western boundary of WCA-2A allows releases from STA-2 to be distributed into the WCA-2A marsh. The STA-2 eastern boundary levee remains opposite of the gap to provide protection to the EAA. The gap in the L-4 levee allows releases from STA-3/4 to be distributed to western WCA-3A. The 7-mile gap in the L-28 levee allows water to flow unrestricted between the BCNP and WCA-3A. There were also three additional gaps placed in the southern L-28 South levee that allows water to flow into the BCNP. Movement of water through the WCAs and the Everglades is characterized by its low velocity, sheet flow, flat slopes and a high resistance to flow in the marsh areas. The SBC Project, northwest of WCA-3A, releases water to BCNP and WCA-3A. WCA-1 releases water to WCA-2A, which releases water to WCA-2B and WCA-3A. WCA-3A releases water to WCA-3B, ENP, and ENP-SDCS but WCA-3A water may also flow through the gap to BCNP at the BCNP/WCA-3A boundary. WCA-3B releases water to: ENP, which reaches tide through sheet-flow, and the ENP-SDCS which releases water to tide.

Water in the WCAs, ENP, ENP-SDCS region is managed with a system of canals, pump stations, and water management structures. The main canals are the: West Palm Beach Canal, Miami Canal, North New River Canal, South New River Canal, Hillsboro Canal, and Tamiami Canal (Reference plate 2-1). In general, for canal design, a velocity of 2.5 feet per second was used for areas with sandy material and 3.5 feet per second for canals in rock. Velocities of up to 5 feet per second were considered permissible for bridges in hard limestone. Side slopes for canals were based on the type of materials encountered. Side slopes of 1 vertical on 2 horizontal were used for sand and clay; 1 on 3 for fine sand; and side slopes of 1 on 1 were used in limestone. Canal sections were based on the most economical section that would carry the design release at the available design water surface and slope, except that bottom elevation in small canals was held to 10 feet below normal water level wherever practicable.

The major outlet structures for the WCAs are the S-10s for WCA-1, the S 11s for WCA-2A and S-333 and the S-12s for WCA-3A. Their design capacities are 14,400 cfs, 16,700 cfs, and 32,000 cfs, respectively. The pump stations associated with the WCAs are S-5A, S-6, S-7, S-8, S-9, S-9A, and S-140. S-140 was designed for a runoff of 7/16 inch-per-day and all the other pump stations except for S-9A, were designed for a runoff of 3/4 inch per-day. S-9A was designed to pump seepage back into WCA-3A. L-31W and L-31N Canals prevent flooding from ENP into the agricultural and urban areas to the east. The ENP-SDCS includes 3 main canals (L-29, L-31N and C-111) that convey water to tide or other C&SF Project features within the East Coast Canals (SOM Volume 5) region. Water in L-29 may flow south into NESRS. S-356 pumps water from L-31N into L-29. However, S-334 may also release water from L-29 into L-31N. S-332B, S-332C, and S-332D pump water from the L-31N Borrow Canal to the S-332D DA, NDA and SDA. Due to high transmissivity of the NDA and SDA, the majority of this water eventually enters the groundwater through seepage both to ENP to the west and back to the L-31N Borrow Canal to the east.

4.10 Upstream Structures

Lake Okeechobee, the EAA, Lake Istokpoga, and the Kissimmee River include water management structures that are upstream of the WCAs. Within the EAA there are numerous minor pumps operated by Chapter 298, Florida Statutes, drainage districts and individual farms that transfer water to EAA canals. SOM Volume 3-Lake Okeechobee and Everglades Agricultural Area and SOM Volume 2-Kissimmee River-Lake Istokpoga Basin describe the upstream structures and the parties responsible for regulation of these structures. The EAA which encompasses approximately 1,158 square miles includes a network of canals, levees, pump stations, and water management structures operated by the SFWMD that allow the transfer of EAA water to STAs which is then released to the WCAs. The major pump stations associated with the transfer of stormwater runoff (which includes the EAA and other sources) to or from the STAs are S-5A, S-6, S-7, and S-8. S-5A transfers water from the EAA and other sources to STA-1E and STA-1W which is released to WCA-1. S-6 transfers water from the EAA and other sources to STA-2 which is released to WCA-2A. S-7 transfers water from the STA-3/4 to WCA-3A. S-8 transfers water from the STA-3/4 and STA-5 to the Miami Canal in WCA-3A. While it is not a preferred path, water may be back pumped north into Lake Okeechobee or routed south to bypass the STAs and be released directly into the WCAs. In addition, S-9 and S-9A transfers water to WCA-3A from C-11 Basin.

4.11 Downstream Structures

The WCAs, ENP, ENP-SDCS features of the C&SF Project release water either to tide or adjacent features within the East Coast Canals Basin of the C&SF Project. The SOM Volume 5-East Coast Canals describes the C&SF Project features operated by SFWMD and the various local drainage district network of canals, levees, pump stations, and/or water management infrastructure downstream of the WCAs, ENP, ENP-SDCS component of the C&SF Project.

4.12 Economic Data

4.12.1 Population

The 2010 Census resulted in a total population for the State of Florida of 18,801,310. The population of Florida counties within and adjacent to the WCAs, ENP, ENP-SDCS components of the C&SF Project are shown in **Table 4-4**.

Table 4-4: 1990 and 2010 Population by county

County	Population (1990 Census)	Population (2010 Census)
Broward	1,255,488	1,748,066
Collier	152,099	321,520
Hendry	25,773	39,140
Miami-Dade	1,937,094	2,496,435
Monroe	78,024	73,090
Palm Beach	863,518	1,320,134
Total	4,311,996	5,998,385

https://data.census.gov/cedsci/

4.12.2 Agriculture

In 2017, there was approximately 721,751 acres of farmland within the Palm Beach, Broward, Collier, Miami-Dade, and Monroe Counties. Palm Beach County has the largest total cropland of 487,845 acres of which 275,442 acres was harvested for sugar cane in 2017. Palm Beach County leads the nation in the production of sugar cane, sweet corn and sweet bell peppers 36% of the county's land is dedicated to agriculture. Traditional forms of agriculture that require hundreds of acres of land are no longer viable in Broward County. Landscape nurseries and horse farms are the two main forms of modern agriculture in Broward County. The agriculture within Miami-Dade County is one of the most diverse in the country. The tropical climate provides a year-round growing season and the ability to produce an extremely wide range of crops.

4.12.3 Industry

The main industrial activity in the watershed (WCAs, ENP, ENP-SDCS) and downstream areas is tourism. The Greater Everglades provide opportunities for sightseeing, wildlife viewing, photography, hiking, bicycling, boat touring, boating, kayaking, canoeing, camping, fishing, and hunting at various locations including ENP, EWMA, and LNWR. Visitation at ENP in 2017 was 1,018,557 while LNWR attracts over 432,837 visitors annually (2018). Recreation in these areas increases tourist activity and provides economic benefits to the communities within and surrounding the area.

4.12.4 Flood Damages

Excerpts from the Annual Flood Damage Reduction Report to Congress representing the annual flood damages prevented by the C&SF Project, which includes components of the WCAs, ENP, ENP-SDCS, from fiscal year 1998 through 2018, are shown in **Table 4-5.**

Table 4-5: Annual Flood Damages Prevented by the C&SF Project

Fiscal Year	Flood Damages Prevented	Flood Damages Prevented: Escalated to 2020 dollars
FY 1998	$77,628,900	**$154,463,973**
FY 1999	$65,872,600	**$126,775,398**
FY 2000	$52,101,700	**$97,524,591**
FY 2001	$52,594,200	**$94,584,776**
FY 2002	$4,595,800	**$7,899,961**
FY 2003	$35,111,400	**$58,375,973**
FY 2004	$38,578,754	**$62,404,724**
FY 2005	$21,592,313	**$33,959,189**
FY 2006	$0	**$0**
FY 2007	$0	**$0**
FY 2008	$80,318,000	**$113,356,646**
FY 2009	$36,670,000	**$49,918,511**
FY 2010	$6,759,800	**$9,089,911**
FY 2011	$73,706	**$98,823**

Fiscal Year	Flood Damages Prevented	Flood Damages Prevented: Escalated to 2020 dollars
FY 2012	$20,374,000	**$26,672,183**
FY 2013	$10,083,000	**$12,845,407**
FY 2014	$7,215,900	**$8,945,834**
FY 2015	$1,363,000	**$1,635,102**
FY 2016	$16,743,000	**$19,360,764**
FY 2017	$43,652,000	**$48,633,327**
FY 2018	$1,340,000	**$1,439,715**
FY 2019	$6,116,000	

Table 4-6: Monthly Mean Average Temperatures

Monthly Mean Avg. Temperatures recorded at West Palm Beach International, AP station													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	65.9	69.0	71.5	75.2	79.0	82.0	83.4	83.7	82.3	78.9	73.0	69.8	76.2
Maximum	71.8	75.3	77.0	80.2	81.3	84.4	86.2	85.0	84.1	81.6	78.1	76.3	78.0
Minimum	59.9	60.9	64.1	71.3	76.3	80.3	81.6	82.5	80.1	76.3	69.0	58.8	74.0

Monthly Mean Avg. Temperatures recorded at Fort Lauderdale Area station													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	67.9	70.7	73.0	79.6	79.8	82.7	83.8	84.1	82.9	80.0	74.5	71.4	77.3
Maximum	73.0	75.4	77.5	79.8	81.8	85.0	85.2	85.7	84.5	82.6	78.9	77.5	78.9
Minimum	62.2	66.4	66.4	72.9	77.9	80.0	81.7	82.9	81.2	77.6	71.3	60.7	74.9

Monthly Mean Avg. Temperatures recorded at Miami International AP, FL station													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	68.3	71.1	73.5	76.8	80.3	82.9	84.1	84.3	83.2	80.3	74.8	71.8	77.6
Maximum	73.2	76.3	78.6	80.4	82.4	85.5	85.7	85.7	85.2	83.5	78.4	77.2	79.1
Minimum	63.2	64.6	67.7	73.6	77.6	80.3	82.4	83.1	81.6	78.1	71.4	61.4	75.7

Table 4-7: Monthly Total Precipitation

Monthly Total. Precipitation recorded at West Palm Beach International AP, FL station													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	2.44	2.46	3.20	3.70	5.31	8.41	5.65	8.77	8.10	5.00	2.74	3.48	59.24
Maximum	10.42	8.08	10.83	8.05	15.69	20.09	8.97	22.66	29.40	15.02	6.89	11.06	78.72
Minimum	0.11	0.14	0.36	0.26	0.40	2.89	1.59	3.03	1.39	0.91	0.75	0.75	42.27

Monthly Total. Precipitation recorded at Fort Lauderdale Area, FL station													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	1.92	2.36	2.42	2.87	5.85	8.09	6.46	7.73	7.52	5.46	3.16	2.98	56.81
Maximum	7.41	5.23	5.71	7.29	17.84	17.10	15.49	14.54	14.16	15.52	10.92	10.11	76.45
Minimum	0.04	0.01		0.66	0.23	1.09	1.72	2.04	1.33	0.73	0.42	0.13	40.60

Monthly Total. Precipitation recorded at Miami International AP, FL station													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average	1.48	1.97	2.32	3.49	6.47	10.79	8.02	9.57	10.02	6.71	2.60	2.60	66.06
Maximum	7.57	4.69	5.24	8.95	16.59	19.62	12.76	15.92	17.99	18.95	7.55	9.82	86.94
Minimum	0.21	0.05	0.19	0.23	1.71	3.60	4.11	4.43	3.25	0.72	0.34	0.28	52.09

https://w2.weather.gov/climate/xmacis.php?wfo=mfl

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5 DATA COLLECTION AND COMMUNICATION NETWORKS

Operation and monitoring of the C&SF Project includes a vast network of data collection gages and networks to communicate that data to USACE as well as the non-Federal sponsor (SFWMD). The gages span the WCA, ENP, ENP-SDCS basin and the networks are run by USACE, SFWMD, The United States Geologic Survey (USGS), and ENP. Individual CERP projects include their own Water Control Data Acquisition System Plans (WCDASP) and these will be included in the exhibits for this chapter.

5.1 Hydrometeorological Stations

There is a coordinated monitoring effort between the USACE and the SFWMD on all relevant hydrologic and meteorological sites for the purpose of operating and maintaining the functionality of the C&SF Project. The USGS and Everglades National Park (ENP) also play important roles in maintaining and providing data from the hydrologic and meteorological sites.

5.1.1 Facilities

There is a coordinated monitoring effort between the USACE and the SFWMD on all relevant hydrologic and meteorological sites for the purpose of operating and maintaining the functionality of the C&SF Project, including WCAs, ENP, ENP-SDCS Basin. The USGS and ENP also play important roles in maintaining and providing data from the hydrologic and meteorological sites.

ER-1110-2-249, Engineering and Design, Management of Water Control Data Systems, dated 31 August 1994, defines the Water Control Data System (WCDS) as a dedicated special-purpose system of all hardware and software which has been acquired and is being used for acquisition, transmission, processing, display, and dissemination of hydrologic, meteorological, water quality, and project data for the purpose of supporting the water management mission of the USACE. The Jacksonville District Water Management Section and the Operations Division Multi-Project Branch are the WCDS functionaries.

The WCDS mission maintains sufficient resources to perform concurrent real-time hydrometeorological data acquisition and analysis for authorized project purposes. The USACE current WCDS consists of various incoming data streams, a central database, and reporting functions. Gages throughout the system which are included in these data streams are owned, operated and maintained by various partners described in subsequent sub-sections below. The USACE databases consists of both Hydrologic Engineering Center Data Storage System software (HEC DSS or DSS) and custom Oracle databases (Corps Water Management System – CWMS). Information about hydrologic forecasting can be found in Chapter 6 of this SOM.

5.1.1.1 United States Geological Survey (USGS)

The USACE collects data throughout the system to assist in the management of the system. The USACE owns many data collection sites which are serviced and maintained through the Cooperative Water Resources Data Program (GAGE). The USACE can also access and retrieve data from other publically available USGS gages. These gaging stations transmit data from the field via Geostationary Operational Environmental Satellite (GOES) in Standard Hydrometeorological Exchange Format (SHEF), and the data is ultimately collected and stored in the USACE WCDS databases. Also, numerous gaging stations are owned and operated by the USGS and monitor surface and groundwater water levels. The USGS water resources database is the National Water Information System (NWIS) and the data is available to the public through NWIS Web (http://waterdata.usgs.gov/fl/nwis).

USACE collects the data from USGS via the publicly available GOES system.

A summary of the gages collected by the USGS are shown in **Table 5-1** found at the end of this Chapter. These data are generally available in real time over the internet and through the GOES system; some less critical data are manually collected and are only uploaded intermittently. **Table 5-1** is a snapshot of a dynamic list of sites that are regularly added and removed as the system infrastructure is constructed or removed. This table will be updated as needed. The extensive list of gages listed in Table 5-1 can be viewed within the USGS interactive map on the web (https://maps.waterdata.usgs.gov/mapper/index.html?state=fl)

Data collected by the USACE are transmitted back to the USGS. The data gets transmitted to the USGS in SHEF using a variety of secure protocols including secure file transfer protocols (sftp)

South Florida Water Management District (SFWMD)

SFWMD operates a Supervisory Control and Data Acquisition (SCADA) network in the WCAs, ENP, and SDCS Basin which is used for collecting data as well as remote and automated operation of structures. The water management structures are equipped with several types of telemetry recorders, which measure water level, water velocity, gate position, and rainfall. These include on-site and remote recorders. The SFWMD post processes some of the data and calculates flows at many locations.

The SFWMD transmits its data to the USACE database in real-time. This data is reliable for use in making operational decisions in real-time. The SFWMD online database called DBHydro has these datasets in real-time as well, and additionally provides Quality Assurance/Quality Control (QA/QC) and publishes the final data. USACE has access to the data collected by the SFWMD as they become available. The site names and data types are listed in Table 5 2, at the end of this Chapter. Table 5 2 is a snapshot of a dynamic list of sites that are regularly added and removed as the system infrastructure is constructed or removed. This table will be updated as needed. The extensive list of gages listed in Table 5-2can be viewed within the SFWMD interactive map on the web (https://apps.sfwmd.gov/WAB/EnvironmentalMonitoring/index.html).

SFWMD real-time hydrometeorological data is publically available at the SFWMD website which can be found at: https://www.sfwmd.gov.

5.1.1.2 Everglades National Park (ENP)

Everglades National Park owns and maintains gages within its borders. The data from these gages is transmitted to USACE and other partners via GOES and the internet. These gages measure surface and groundwater water levels as well as rainfall. Generally this data is reliable and comes into the GOES system in real time, there are some more remote and non-critical (gages which are not necessary for making real time operational decision) which are manually collected and data is only uploaded intermittently. **Table 5-2**, at the end of this chapter, contains a list of these gages. **Table 5-2** is a snapshot of a dynamic list of sites that are regularly added and removed as infrastructure is constructed or removed. This table will be updated as needed.

5.1.2 Reporting

Reporting is mainly done via website by USACE as well as their partners (SFWMD, USGS, and ENP). Reporting under each agency is described in the following sections.

U.S. Army Corps of Engineers (USACE)

The USACE WCDS consists of both HEC-DSS and custom Oracle databases (CWMS). The WCDS provides a means for storing and maintaining data in a centralized location; providing input to and storing output from application programs; transferring data between application programs; and displaying the data in graphs or tables. The WCDS is utilized to maintain both real-time data acquisition and historical archiving of data.

Data is reported out to stakeholders and partners through the Jacksonville District Water Management webpages. Jacksonville District webpages are updated and maintained regularly and data can be displayed via graphics, plots, tables, text reports, and more. These can be found at https://www.saj.usace.army.mil/WaterManagement/

Water data for USACE can be found at https://water.usace.army.mil/.

5.1.2.1 U.S. Geological Survey (USGS)

Data gathered by the USGS for the USACE through the GAGE Program is reported in near real-time. Data reported by the USGS in real-time is provisional until finalized by the USGS (as noted by data quality flags). This data can be retrieved from the USGS NWIS web site (http://waterdata.usgs.gov/fl/nwis) and is used to prepare daily operation reports, water budgets, and monthly summary of operations.

5.1.2.2 South Florida Water Management District (SFWMD)

The SFWMD provides access to their data via web interface. Data reported by the SFWMD in real-time is provisional until finalized by the SFWMD (as noted by data quality flags). The public and partners can access their website (https://www.sfwmd.gov) for all data needs.

5.1.2.3 Everglades National Park (ENP)

ENP does not currently display or report their data via website. Data within the GOES system can be publicly accessed by anyone with the appropriate receivers. Some data is available at the SFWMD webpage. Data that is specifically included in the Adaptive Management Plan (Appendix C of the COP EIS) which is not provided in the data tables within this chapter include gages collected by ENP including: LPG3, LPG5, LPG7, LPG8, LPG16, LPG17, and Tamiami Trail soil moisture monitoring gages. These gages are available over the GOES system but are not currently available online.

5.1.3 Maintenance

Under the GAGE Program agreement, the USGS maintains the USACE gages. Problems with gages should be reported to the USGS. The SFWMD and ENP also maintain their network of gages within the basin.

5.2 Water Quality Stations

The USACE Jacksonville District does not operate or contract for the operation of water quality stations in the WCAs, ENP, or ENP-SDCS Basin at this time. SFWMD has many water quality monitoring gages located throughout the basins. This data is available at SFWMD's website (https://www.sfwmd.gov). For more information about water quality monitoring, see Adaptive Management Plan (Appendix C of the COP EIS). The Water Control Data Acquisition System Plan (WCDASP) for Decomp Physical Model (DPM) Phase 2 is a subset of the Water Control Data System and does rely partly on water quality monitoring to determine S-152 operations as discussed in the 2017 DPM Phase 2 Operational Strategy.

5.3 Sediment Stations

The USACE Jacksonville District does not operate or contract for the operation of sediment stations in the WCAs, ENP, or ENP-SDCS Basin at this time.

5.3.1 Facilities

Not applicable.

5.3.2 Reporting

Not applicable.

5.3.3 Maintenance

Not applicable.

5.4 Recording Hydrologic Data

The agency responsible for operation and maintenance of the stations is responsible for archiving and maintaining the official station records as well as informing the Corps of structures and/or gages which are out of service. The SFWMD provides a weekly summary of all gages/structures offline via email. USACE operates the S-10s, S-11s, S-12s, and the S-355s within the WCA, ENP, ENP-SDCS Basin. The official recording for these structures is done by the USGS as part of the GAGE Program. All other gages within the WCA, ENP, ENP-SDCS Basin are officially recorded by the SFWMD, USGS, or ENP. The meteorological data collected by NOAA is published in Climatological Data for Florida, Hourly Precipitation for Florida, and Storm Data. Some near real-time meteorological data and forecasts can be obtained from the NOAA State Forecast Office in Miami (https://www.weather.gov/mfl/), or from the Southeast River Forecast Center (SERFC) (https://www.weather.gov/serfc/) in Peachtree City, Georgia.

5.5 Communication Network

USACE field data collection is transmitted via satellite (GOES) and network connections with remote sites. SFWMD collects and maintains their data and transmits to USACE. USGS and ENP field data collection is transmitted via satellite (GOES) to USACE. The USACE operates and maintains remotely operated equipment to be more efficient. S-10A, S-10C, S-10D, S-12C and S-12D are capable of being remotely controlled. A remotely controlled system is defined in ER-1110-2-1156, Engineering and Design, Safety of Dams – Policy and Procedures as being a water control system that can be operated from an offsite location by offsite personnel without requiring the operator to physically travel to the site for local operation.

5.5.1 Regulating Office with Project Office

The regulation schedules for the WCAs are developed by the USACE in consultation with the SFWMD, and approved by the USACE. The communication between the USACE and the SFWMD is done by phone/teleconference and email. A weekly water management coordination call is setup to ensure continuity of operations and discuss operational decisions between USACE and the SFWMD. Normal day-to-day coordination between USACE and SFWMD are currently handled on an “as needed” basis. During emergencies, communications are more frequent (Chapter 9 - Water Control Management).

5.5.2 Between South Florida Water Management District and Others

In 1977, SFWMD's real-time water management data acquisition system became fully automated. The telemetry and communications network is controlled from the SFWMD's Communications Center in West Palm Beach. It provides centralized collection of water management data from remote sites and the means to process and display the data for use in the formulation of management decisions. They also carry out remotely controlled and automated operations for many of their structures.

5.5.3 Communication with Project

Communication between the Jacksonville District and SFWMD is on a daily basis through phone calls or emails. During storms or other emergencies communication will be more frequently.

5.5.4 Between Regulating Office and Project Office

Communication between the non-Federal sponsors (SFWMD and STOF) and the Jacksonville headquarters is done through data transmissions, email, and phone. SFWMD operators and field offices coordinate with their Communications Center in West Palm Beach via data transmissions, email, and phone.

5.5.5 Between Regulating/Project Office and Others

Communications and data transfer related to SFWMD or STOF water management occurs between the Jacksonville District Water Management Section and the SFWMD Office of Operations or the STOF Environmental Resource Management Department, respectively. These offices communicate often with others through several methods including, but not limited to, press releases/conferences, website, social media, email, and phone. Specific questions should be directed to USACE corporate communications office (PublicMail.CESAJ-CC@usace.army.mil).

5.6 Project Reporting Instructions

Data will continue to be reported to the USACE in the same manner that has been described previously. The data will be collected by the SFWMD and furnished to the USACE on a real-time basis.

5.7 Warnings

A flood warning system is not incorporated into the WCA, ENP, ENP-SDCS component of the C&SF Project. The NWS is the Federal agency responsible for developing and disseminating flood forecasts through the Miami Weather Forecast Office.

Table 5-1 USGS Stations

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
251032080473400	ALLIGATOR CREEK NEAR GARFIELD BIGHT, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow	No
022908295	BOTTLE CREEK AT ROOKERY BRANCH NEAR HOMESTEAD, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation, Flow, Temperature, Specific	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
				Conductivity, Salinity	
02290878	BROAD RIVER NEAR THE CUTOFF, FL	Access Data	LOSTMANS	Elevation, Flow, Temperature, Salinity	No
02290769	CANAL 111 AT S-18-C NEAR FLORIDA CITY, FL	Access Data	C-111 SOUTH	Elevation, Flow	No
02290888	CHATHAM RIVER NEAR THE WATSON PLACE, FL	Access Data	CHATAM/TURNER	Elevation, Flow, Salinity	No
251154080471900	CUTHBERT LAKE OUTLET NEAR FLAMINGO, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow	No
251152080370900	EAST CREEK NEAR HOMESTEAD, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow	No
250802081035500	EAST SIDE CREEK NEAR LAKE INGRAHAM, FL	Access Data	CAPE SABLE	Elevation, Flow, Specific Conductivity, Salinity, Turbidity	No
254707080370201	EDEN 10 IN WATER CONSERVATION AREA 3-B	Access Data	CONSERVATION AREA 3B	Elevation	No
262258080273501	EDEN 11 IN WATER CONSERVATION AREA 2-A	Access Data	CONSERVATION AREA 2A	Elevation	No
260042080351701	EDEN 12 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No
261035080221701	EDEN 13 IN WATER CONSERVATION AREA 2-B	Access Data	CONSERVATION AREA 2B	Elevation	No
260410080452701	EDEN 14 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No
253044080555900	EDEN 3 IN EVERGLADES NATIONAL PARK	Access Data	EVERGLADES NATIONAL PARK	Elevation, Temperature, Specific Conductivity, Salinity	No
260536080302501	EDEN 4 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
260725080451001	EDEN 5 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No
260355080541401	EDEN 6 IN BIG CYPRESS NATIONAL PRESERVE	Access Data	L-28 GAP	Elevation	No
255708080295501	EDEN 7 IN WATER CONSERVATION AREA 3-B	Access Data	CONSERVATION AREA 3B	Elevation	No
255200080405001	EDEN 8 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation, Temperature, Specific Conductivity, Salinity	No
261319080353201	EDEN 9 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No
252036080324300	EVERGLADES 4 IN C-111 BASIN NR HOMESTEAD, FL	Access Data	C-111 COASTAL	Groundwater Elevation	Yes
251716080342100	EVERGLADES 5A IN C-111 BASIN NR HOMESTEAD, FL	Access Data	TAYLOR SLOUGH	Elevation	No
253937080304001	G - 596	Access Data	8.5 SQ. MILE AREA	Groundwater Elevation	Yes
252425080320001	G - 613	Access Data	C-111 AG	Groundwater Elevation	Yes
254500080360001	G - 618	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	No
254000080460001	G - 620	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
252928080332401	G - 789	Access Data	C-111 AG	Groundwater Elevation	No
252612080300701	G - 864	Access Data	C-111 AG	Groundwater Elevation	No
252619080310201	G - 864A	Access Data	C-111 AG	Groundwater Elevation	No
251922080340701	G -1251	Access Data	TAYLOR SLOUGH	Groundwater Elevation	Yes
253233080301001	G -1363	Access Data	L-31NS	Groundwater Elevation	No
254054080295401	G -1487	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
252656080350301	G -1502	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
253952080321501	G -3272	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
252007080335701	G -3336	Access Data	C-111 COASTAL	Groundwater Elevation	No
252332080300501	G -3355	Access Data	C-111 SOUTH	Groundwater Elevation	No
253400080340401	G -3437	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
254446080295501	G -3574	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
254206080294701	G -3575	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
254442080305201	G -3576	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
254207080300201	G -3577	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
254210080304801	G -3578	Access Data	EVERGLADES NATIONAL PARK	Groundwater Elevation	Yes
252312080320301	G -3620	Access Data	C-111 SOUTH	Groundwater Elevation	No
252115080293701	G -3621	Access Data	C-111 SOUTH	Groundwater Elevation	Yes
253708080304201	G -3626	Access Data	8.5 SQ. MILE AREA	Groundwater Elevation	Yes
253632080321101	G -3627	Access Data	L-31NS	Groundwater Elevation	Yes
253539080320501	G -3628	Access Data	NDA	Groundwater Elevation	Yes
251241080385301	G -3764	Access Data	TAYLOR SLOUGH	Elevation, Temperature, Specific Conductivity, Salinity	No
251457080395802	G -3777	Access Data	TAYLOR SLOUGH	Elevation, Temperature, Wind Speed, Wind Direction, Specific Conductivity, Salinity	No
252506080300601	G -3901	Access Data	C-111 AG	Groundwater Elevation	No
252229080284201	G -3940	Access Data	C-111 SOUTH	Groundwater Elevation	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
252551081050900	HARNEY RIVER NEAR FLAMINGO FL	Access Data	CAPE SABLE	Elevation, Temperature, Salinity, Specific Conductivity	No
262100080190001	HILLSBORO CA AT S-10-A NR DEERFIELD BCH., FL	Access Data	CONSERVATION AREA 1	Elevation Headwater, Elevation Tailwater	Yes
262200080210001	HILLSBORO CA AT S-10-C NR DEERFIELD BCH., FL	Access Data	CONSERVATION AREA 1	Elevation Headwater, Elevation Tailwater	Yes
262300080220001	HILLSBORO CANAL AT S-10-D NR DEERFIELD BCH., FL	Access Data	CONSERVATION AREA 1	Elevation Headwater, Elevation Tailwater	Yes
251355080312800	JOE BAY 2E, NEAR KEY LARGO, FL	Access Data	C-111 COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
261543080495000	L-28 CANAL ABOVE S-140 NEAR CLEWISTON, FL	Access Data	L-28	Elevation, Flow	No
261533080571600	L-28 INTERCEPTOR CANAL BLW S-190 NEAR CLEWISTON FL	Access Data	CONSERVATION AREA 3A	Elevation, Flow	No
255154080371300	L-67A CANAL AT S-152 NR COOPERTOWN, FL	Access Data	CONSERVATION AREA 3A	Elevation, Flow, Specific Conductivity, Salinity	No
022907647	LEVEE 31 NORTH EXTENSION 1 MILE NR WEST MIAMI FL	Access Data	L-29 CC	Elevation, Flow	No
02290765	LEVEE 31 NORTH EXTENSION AT 3 MILE NR WEST MIAMI F	Access Data	L-29 CC	Elevation, Flow	No
02290766	LEVEE 31 NORTH EXTENSION AT 4 MILE NR WEST MIAMI F	Access Data	L-29 CC	Elevation, Flow	No
02290767	LEVEE 31 NORTH EXTENSION AT 5 MILE NR WEST MIAMI F	Access Data	L-29 CC	Elevation, Flow	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
02290768	LEVEE 31 NORTH EXTENSION AT 7 MILE NR WEST MIAMI F	Access Data	L-29 CC	Elevation, Flow	No
02290918	LOSTMANS RIVER BELOW SECOND BAY, FL	Access Data	LOSTMANS	Elevation, Temperature, Salinity	No
251003080435500	MCCORMICK CREEK AT MOUTH NEAR KEY LARGO, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
253644081013001	MO - 214	Access Data	EVERGLADES NATIONAL PARK	Elevation, Specific Conductivity, Salinity	No
252820080505401	MO - 215	Access Data	EVERGLADES NATIONAL PARK	Elevation, Specific Conductivity, Salinity	No
02290829502	MO -199	Access Data	EVERGLADES NATIONAL PARK	Elevation, Specific Conductivity, Salinity, Temperature	No
254344081095101	MO - 216	Access Data	CHATAM/TURNER	Elevation, Specific Conductivity, Salinity, Temperature	No
251209080350100	MUD CREEK AT MOUTH NR HOMESTEAD, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
261150080270001	N. NEW RIVER CANAL AT S-11-A NR ANDYTOWN, FL	Access Data	CONSERVATION AREA 2A	Elevation Headwater, Elevation Tailwater	Yes
261200080275001	N. NEW RIVER CANAL AT S-11-B NR ANDYTOWN, FL	Access Data	CONSERVATION AREA 2A	Elevation Headwater, Elevation Tailwater	Yes
261300080280001	N. NEW RIVER CANAL AT S-11-C NR ANDYTOWN, FL	Access Data	CONSERVATION AREA 2A	Elevation Headwater,	Yes

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
				Elevation Tailwater	
253828080391100	N.E. SHARK RIVER SLOUGH NO. 4 NORTH OF GROSSMAN	Access Data	EVERGLADES NATIONAL PARK	Elevation	No
263537080211400	NORTH LOXAHATCHEE CONSERVATION AREA NO. 1	Access Data	CONSERVATION AREA 1	Elevation	No
022908205	NORTH RIVER UPSTREAM OF CUTOFF NEAR FLAMINGO, FL	Access Data	CAPE SABLE	Elevation, Flow, Temperature, Salinity, Specific Conductivity	No
254130080380500	NORTHEAST SHARK RVR SLOUGH NO1 NR COOPERTOWN, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation	No
254315080331500	NORTHEAST SHARK RVR SLOUGH NO2 NR COOPERTOWN, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation	No
251033080440800	OYSTER CREEK NEAR FLAMINGO, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow	No
251115081075800	RAULERSON BROTHERS CANAL AT CAPE SABLE, FL	Access Data	CAPE SABLE	Elevation, Flow	No
251032080432200	SEVEN PALM LAKE NEAR FLAMINGO, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
252230081021300	SHARK RIVER BELOW GUNBOAT ISLAND NR FLAMINGO, FL	Access Data	CAPE SABLE	Elevation, Flow, Temperature, Salinity, Specific Conductivity, Signal-to-noise ratio	No
254754080344300	SHARK RIVER SLOUGH NO.1 IN CONS.3B NR COOPERTOWN	Access Data	CONSERVATION AREA 3B	Elevation	No
262240080258001	SITE 17 NR L-38, CONS AREA 2A NR CORAL SPRINGS, FL	Access Data	CONSERVATION AREA 2A	Elevation	Yes

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
261710080190001	SITE 19 IN CONSERVATION AREA 2A NR CORAL SPRINGS	Access Data	CONSERVATION AREA 2A	Elevation	Yes
261023080443001	SITE 62 IN CONSERVATION AREA 3A NR ANDYTOWN, FL	Access Data	CONSERVATION AREA 3A	Elevation, Precipitation	Yes
261117080315201	SITE 63 IN CONSERVATION AREA NO. 3A NR ANDYTOWN FL	Access Data	CONSERVATION AREA 3A	Elevation, Precipitation	Yes
255828080401301	SITE 64 IN CONSERVATION AREA 3A NR COOPERTOWN FL.	Access Data	CONSERVATION AREA 3A	Elevation, Precipitation	Yes
254848080432001	SITE 65 IN CONSERVATION AREA 3A NR COOPERTOWN, FL	Access Data	CONSERVATION AREA 3A	Elevation	Yes
255300080370001	SITE 69 IN CONSERVATION AREA 3BNR COOPERTOWN, FL	Access Data	CONSERVATION AREA 3B	Elevation, Precipitation, Salinity, Specific Conductivity, Temperature	Yes
263180080205001	SITE 7 IN CONS AREA NO. 1 NR SHAWANO, FL	Access Data	CONSERVATION AREA 1	Elevation, Precipitation	Yes
255250080335001	SITE 71 IN CONSERVATION AREA 3B NR COOPERTOWN, FL.	Access Data	CONSERVATION AREA 3B	Elevation	Yes
260037080303401	SITE 76 IN CONSERVATION AREA 3B NR ANDYTOWN, FL	Access Data	CONSERVATION AREA 3B	Elevation	Yes
263000080120001	SITE 8C NR L-40 IN CONS AREA NO.1 NR BOYNTON BCH.	Access Data	CONSERVATION AREA 1	Elevation, Precipitation	Yes
263050080145001	SITE 8T IN CONS AREA NO.1 NR BOYNTON BCH, FL	Access Data	CONSERVATION AREA 1	Elevation, Precipitation	Yes
262750080175001	SITE 9 IN CONSERVATION AREA NO.1 IN BOYNTON BCH FL	Access Data	CONSERVATION AREA 1	Elevation, Precipitation	Yes
260810080222001	SITE 99 NR L-35A IN CONS AREA 2B NR SUNRISE, FL	Access Data	CONSERVATION AREA 2B	Elevation	Yes

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
262528080202700	SOUTH LOXAHATCHEE CONSERVATION AREA NO. 1	Access Data	CONSERVATION AREA 1	Elevation	No
251341080291200	STILLWATER CREEK NEAR HOMESTEAD, FL	Access Data	C-111 COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
254543080491101	TAMIAMI CANAL AT S-12-A, NR MIAMI, FL	Access Data	CONSERVATION AREA 3A	Elevation Headwater, Elevation Tailwater, Flow	Yes
02289019	TAMIAMI CANAL AT S-12-B NR MIAMI, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation Headwater, Elevation Tailwater, Flow	Yes
254543080405401	TAMIAMI CANAL AT S-12-D NEAR MIAMI, FL	Access Data	CONSERVATION AREA 3A	Elevation Headwater, Elevation Tailwater, Flow, Gate Opening, Precipitation, Temperature, Turbidity, Specific Conductivity	Yes
254540080361500	TAMIAMI CANAL AT S-355A NEAR MIAMI, FL	Access Data	CONSERVATION AREA 3B	Elevation Headwater, Elevation Tailwater	Yes
254540080325700	TAMIAMI CANAL AT S-355B NEAR MIAMI, FL	Access Data	CONSERVATION AREA 3B	Elevation Headwater, Elevation Tailwater	Yes
02289041	TAMIAMI CANAL BELOW S-12-C, NEARMIAMI, FLA	Access Data	EVERGLADES NATIONAL PARK	Elevation Headwater, Elevation Tailwater, Flow, Gate Opening	Yes
02289085	TAMIAMI CANAL EAST END 1 MILE BRIDGE NR MIAMI, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation, Flow	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
02289060	TAMIAMI CANAL OUTLETS L-30 TO L-67A NR MIAMI, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation, Flow	No
02289080	TAMIAMI CANAL WEST END 1 MILE BRIDGE NR MIAMI, FL	Access Data	EVERGLADES NATIONAL PARK	Elevation, Flow	No
251127080382100	TAYLOR RIVER AT MOUTH NEAR HOMESTEAD, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
02289035	THREE MILE CANAL BELOW G409 NEAR CLEWISTON, FL	Access Data	L-28	Elevation, Flow, Nitrogen	No
255014080355801	TI-9 IN WATER CONSERVATION AREA 3-B	Access Data	CONSERVATION AREA 3B	Elevation	No
251253080320100	TROUT CREEK AT MOUTH NEAR KEY LARGO, FL	Access Data	C-111 COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
02290930	TURNER RIVER NR CHOKOLOSKEE ISLAND, FL	Access Data	CHATAM/TURNER	Elevation, Temperature, Salinity	No
253047080555600	UPSTREAM BROAD RIVER NEAR EVERGLADES CITY FL	Access Data	EVERGLADES NATIONAL PARK	Elevation, Flow, Temperature, Salinity, Specific Conductivity	No
251241080385300	UPSTREAM TAYLOR RIVER NEAR HOMESTEAD, FL	Access Data	TAYLOR SLOUGH	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
255634080450001	W-11 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No
260007080464401	W-18 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No

USGS Site Number	USGS Site Name	Link	Watershed	Available Data	Coop Program
254759080483201	W-2 IN WATER CONSERVATION AREA 3-A	Access Data	CONSERVATION AREA 3A	Elevation	No
251433080265000	WEST HIGHWAY CREEK NEAR HOMESTEAD, FL	Access Data	C-111 COASTAL	Elevation, Flow, Temperature, Specific Conductivity, Salinity	No
251203080480600	WEST LAKE OUTLET TO LONG LAKE NEAR FLAMINGO, FL	Access Data	TAYLOR SLOUGH COASTAL	Elevation, Flow	No
255151080371501	WETLAND AT S-152 OUTFLOW NEAR COOPERTOWN, FL	Access Data	CONSERVATION AREA 3B	Temperature, Specific Conductivity, Salinity	No
255154080371303	WETLAND BELOW S-152 IN WCA-3 NR COOPERTOWN, FL	Access Data	CONSERVATION AREA 3B	Elevation, Temperature, Specific Conductivity, Salinity	No

Table 5-2 SFWMD and ENP Stations

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
2A159					•	SFWMD	CONSERVATION AREA 2A	Data
ALLYGW					•	SFWMD	CONSERVATION AREA 3A	Data
ANGEL					•	SFWMD	EVERGLADES NATIONAL PARK	Data
BCA10		•	•			SFWMD	EVERGLADES NATIONAL PARK	Data
BCA20		•	•			SFWMD	EVERGLADES NATIONAL PARK	Data
BERM3			•			SFWMD	S332D DETENTION AREA	Data
C111AK5					•	SFWMD	C-111 SOUTH	Data
C111AK6					•	SFWMD	C-111 SOUTH	Data
C111VC1					•	SFWMD	C-111 AG	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
C111VC2					•	SFWMD	C-111 AG	Data
C111W11					•	SFWMD	C-111 AG	Data
C111W12					•	SFWMD	C-111 AG	Data
C111W14					•	SFWMD	C-111 AG	Data
C111W15					•	SFWMD	C-111 SOUTH	Data
C111W16					•	SFWMD	C-111 SOUTH	Data
C111W17					•	SFWMD	C-111 SOUTH	Data
CSSSD1			•			SFWMD	C-111 COASTAL	Data
CSSSD2			•			SFWMD	C-111 COASTAL	Data
CSSSD3			•			SFWMD	C-111 COASTAL	Data
CT50R			•			ENP	C-111 COASTAL	Data
DS3			•			SFWMD	SDA	Data
ENPBR		•	•			ENP	LOSTMANS	Data
ENPCA		•	•			ENP	CHATAM/TURNER	Data
ENPCN		•	•			ENP	EVERGLADES NATIONAL PARK	Data
ENPCW		•	•			ENP	CAPE SABLE	Data
ENPGI		•	•			ENP	CAPE SABLE	Data
ENPHC		•	•			ENP	C-111 COASTAL	Data
ENPHR		•	•			ENP	CAPE SABLE	Data
ENPLN		•	•			ENP	CAPE SABLE	Data
ENPLO		•	•			ENP	LOSTMANS	Data
ENPNR		•	•			ENP	CAPE SABLE	Data
ENPSR		•	•			ENP	CAPE SABLE	Data
ENPTE		•	•			ENP	CAPE SABLE	Data
ENPTR			•			ENP	TAYLOR SLOUGH	Data
ENPWE		•	•			ENP	CAPE SABLE	Data
ENPWP		•	•			ENP	CHATAM/TURNER	Data
ENPWW		•	•			ENP	LOSTMANS	Data
EP1			•			ENP	C-111 COASTAL	Data
EVER8		•	•			ENP	C-111 SOUTH	Data
FPDA8					•	SFWMD	S332D DETENTION AREA	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
FRGPD2					•	SFWMD	S332D DETENTION AREA	Data
G210	•					SFWMD	CONSERVATION AREA 1	Data
G211	•		•			SFWMD	L-31N CC	Data
G251	•		•			SFWMD	CONSERVATION AREA 1	Data
G300	•		•			SFWMD	CONSERVATION AREA 1	Data
G301	•		•			SFWMD	CONSERVATION AREA 1	Data
G310	•		•			SFWMD	CONSERVATION AREA 1	Data
G3273					•	SFWMD	EVERGLADES NATIONAL PARK	Data
G3338					•	SFWMD	C-111 SOUTH	Data
G3339					•	SFWMD	C-111 SOUTH	Data
G336G	•		•			SFWMD	CONSERVATION AREA 2A	Data
G338			•			SFWMD	CONSERVATION AREA 1	Data
G3A10			•			SFWMD	CONSERVATION AREA 3A	Data
G3A11			•			SFWMD	CONSERVATION AREA 3A	Data
G3A12			•			SFWMD	CONSERVATION AREA 3A	Data
G3AN11			•		•	SFWMD	CONSERVATION AREA 3A	Data
G3AN14					•	SFWMD	CONSERVATION AREA 3A	Data
G3ANE		•	•		•	SFWMD	CONSERVATION AREA 3A	Data
G3ANW		•	•		•	SFWMD	CONSERVATION AREA 3A	Data
G3AS		•	•			SFWMD	CONSERVATION AREA 3A	Data
G3AS31			•		•	SFWMD	CONSERVATION AREA 3A	Data
G3AS32					•	SFWMD	CONSERVATION AREA 3A	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
G3AS33		•			•	SFWMD	CONSERVATION AREA 3A	Data
G3AS34					•	SFWMD	CONSERVATION AREA 3A	Data
G3ASW		•	•			SFWMD	CONSERVATION AREA 3A	Data
G3ASWX		•		•		SFWMD	CONSERVATION AREA 3A	Data
G3BS11			•		•	SFWMD	CONSERVATION AREA 3B	Data
G3BS12					•	SFWMD	CONSERVATION AREA 3B	Data
G3BS13					•	SFWMD	CONSERVATION AREA 3B	Data
G3BS14					•	SFWMD	CONSERVATION AREA 3B	Data
G64	•					SFWMD	CONSERVATION AREA 3A	Data
G69	•					SFWMD	EVERGLADES NATIONAL PARK	Data
G737	•		•			SFWMD	TAYLOR SLOUGH	Data
G94A	•		•			SFWMD	CONSERVATION AREA 1	Data
G94B	•					SFWMD	CONSERVATION AREA 1	Data
G94C	•		•			SFWMD	CONSERVATION AREA 1	Data
G-968					•	SFWMD	CONSERVATION AREA 3B	Data
HES27				•	•	SFWMD	FEEDER CANAL	Data
HES28				•	•	SFWMD	FEEDER CANAL	Data
HUMBLE					•	SFWMD	L-31NS	Data
JBTS		•	•			SFWMD	C-111 COASTAL	Data
L28S2			•			SFWMD	CONSERVATION AREA 3A	Data
L31NN			•		•	SFWMD	EVERGLADES NATIONAL PARK	Data
L31NS			•	•	•	SFWMD	EVERGLADES NATIONAL PARK	Data
L31NW02					•	SFWMD	L-31NS	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
L31NW03					•	SFWMD	C-111 AG	Data
L31NW06					•	SFWMD	L-31NS	Data
L37WCA3A			•			SFWMD	CONSERVATION AREA 3A	Data
LASPALM11			•	•		ENP	8.5 SQ. MILE AREA	Data
LASPALM12			•	•		ENP	8.5 SQ. MILE AREA	Data
LASPALM13			•	•		ENP	8.5 SQ. MILE AREA	Data
LASPALM14			•	•		ENP	8.5 SQ. MILE AREA	Data
LASPALM15					•	ENP	NDA	Data
LOOP1			•			SFWMD	EVERGLADES NATIONAL PARK	Data
LOOP2			•			SFWMD	EVERGLADES NATIONAL PARK	Data
LPC1			•			SFWMD	8.5 SQ. MILE AREA	Data
LPDC1			•			SFWMD	8.5 SQ. MILE AREA	Data
LPG1			•			SFWMD	8.5 SQ. MILE AREA	Data
LPG2			•			SFWMD	8.5 SQ. MILE AREA	Data
LPG3			•			ENP	EVERGLADES NATIONAL PARK	Data not availabl e online
LPG5			•			ENP	EVERGLADES NATIONAL PARK	Data not availabl e online
LPG7			•			ENP	EVERGLADES NATIONAL PARK	Data not availabl e online
LPG8			•			ENP	EVERGLADES NATIONAL PARK	Data not availabl e online
LPG16			•			ENP	EVERGLADES NATIONAL PARK	Data not availabl e online
LPG17			•			ENP	EVERGLADES NATIONAL PARK	Data not availabl e online

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
LXWS		•		•		SFWMD	CONSERVATION AREA 1	Data
NESRS3			•			SFWMD	EVERGLADES NATIONAL PARK	Data
NP-112			•			ENP	TAYLOR SLOUGH	Data
NP-201		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-202		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-203		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-205		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-206		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-31W			•			ENP	TAYLOR SLOUGH	Data
NP-33		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-34		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-35		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-36		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-44		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-46			•			ENP	TAYLOR SLOUGH	Data
NP-62			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-67			•			ENP	TAYLOR SLOUGH	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
NP-72			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-A13		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-C27			•			ENP	C-111 COASTAL	Data
NP-CHP		•	•			ENP	TAYLOR SLOUGH	Data
NP-CR2		•	•			ENP	TAYLOR SLOUGH	Data
NP-CR3			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-CV5N			•			ENP	C-111 SOUTH	Data
NP-CY2			•			ENP	TAYLOR SLOUGH	Data
NP-CY3		•	•			ENP	TAYLOR SLOUGH	Data
NP-DO1			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-DO2			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-DO3			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-EPS		•	•			ENP	C-111 COASTAL	Data
NP-EV6			•			ENP	C-111 COASTAL	Data
NP-EV7		•	•			ENP	C-111 COASTAL	Data
NP-FMB		•		•		ENP	EVERGLADES NATIONAL PARK	Data
NP-N10		•	•			ENP	TAYLOR SLOUGH	Data
NP-N14			•			ENP	TAYLOR SLOUGH	Data
NP-NCL			•			ENP	TAYLOR SLOUGH	Data
NP-NESS20		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-NMP			•			ENP	TAYLOR SLOUGH	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
NP-OL			•			ENP	TAYLOR SLOUGH	Data
NP-OT3		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-P37		•	•			ENP	TAYLOR SLOUGH	Data
NP-P38		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-RG1		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-RG2		•	•			ENP	EVERGLADES NATIONAL PARK	Data
NP-RG3			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-RG4			•			ENP	SDA	Data
NP-RG5			•			ENP	SDA	Data
NP-ROB		•	•			ENP	C-111 AG	Data
NP-SP1			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-SPARO			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-SR1			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-TMC			•			ENP	EVERGLADES NATIONAL PARK	Data
NP-TSB		•	•			ENP	TAYLOR SLOUGH	Data
NP-TSH			•			ENP	TAYLOR SLOUGH	Data
NTS-1			•			ENP	TAYLOR SLOUGH	Data
NTS18			•			ENP	SDA	Data
PB1108					•	SFWMD	CONSERVATION AREA 1	Data
PC17A	•		•		•	SFWMD	FEEDER CANAL	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
R-127		•			•	ENP	TAYLOR SLOUGH	Data
R-158					•	ENP	TAYLOR SLOUGH	Data
R3110		•	•			ENP	TAYLOR SLOUGH	Data
RAULBRO			•			ENP	CAPE SABLE	Data
ROYAL PA		•				ENP	TAYLOR SLOUGH	Data
RUTZKE					•	SFWMD	TAYLOR SLOUGH	Data
S14	•		•			SFWMD	EVERGLADES NATIONAL PARK	Data
S140			•			SFWMD	CONSERVATION AREA 3A	Data
S140W		•		•		SFWMD	CONSERVATION AREA 3A	Data
S141			•			SFWMD	CONSERVATION AREA 2B	Data
S142	•		•			SFWMD	CONSERVATION AREA 3A	Data
S143			•			SFWMD	CONSERVATION AREA 2A	Data
S144	•		•			SFWMD	CONSERVATION AREA 2B	Data
S145	•		•			SFWMD	CONSERVATION AREA 2A	Data
S146	•					SFWMD	CONSERVATION AREA 2B	Data
S150	•		•			SFWMD	CONSERVATION AREA 3A	Data
S151	•					SFWMD	CONSERVATION AREA 3B	Data
S151H			•			SFWMD	CONSERVATION AREA 3A	Data
S151T			•			SFWMD	CONSERVATION AREA 3B	Data
S173	•					SFWMD	L-31NS	Data
S176	•		•			SFWMD	C-111 AG	Data
S177	•	•	•			SFWMD	C-111 AG	Data
S178	•		•			SFWMD	C-111 SOUTH	Data
S18C	•	•	•			SFWMD	C-111 SOUTH	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
S190	•		•			SFWMD	CONSERVATION AREA 3A	Data
S190		•	•		•	SFWMD	CONSERVATION AREA 3A	Data
S194	•		•			SFWMD	L-31NS	Data
S196	•		•			SFWMD	L-31NS	Data
S197			•			SFWMD	C-111 COASTAL	Data
S199	•		•			SFWMD	C-111 COASTAL	Data
S200	•		•			SFWMD	C-111 AG	Data
S31			•			SFWMD	CONSERVATION AREA 3B	Data
S32A	•					SFWMD	L-30 CC	Data
S328	•		•			SFWMD	TAYLOR SLOUGH	Data
S331	•	•	•			SFWMD	L-31NS	Data
S332B	•		•			SFWMD	SDA	Data
S332BN	•		•			SFWMD	SDA	Data
S332BS	•		•			SFWMD	SDA	Data
S332C	•		•			SFWMD	L-31NS	Data
S332CS			•			SFWMD	SDA	Data
S332D	•		•			SFWMD	S332D DETENTION AREA	Data
S332DX1	•		•			SFWMD	S332D DETENTION AREA	Data
S333	•		•			SFWMD	EVERGLADES NATIONAL PARK	Data
S334	•	•	•			SFWMD	EVERGLADES NATIONAL PARK	Data
S335	•		•			SFWMD	L-29 CC	Data
S336	•	•	•			SFWMD	L-29 CC	Data
S337	•		•			SFWMD	L-30 CC	Data
S338	•		•			SFWMD	L-29 CC	Data
S339	•		•			SFWMD	CONSERVATION AREA 3A	Data
S340	•		•			SFWMD	CONSERVATION AREA 3A	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
S343A	•		•			SFWMD	EVERGLADES NATIONAL PARK	Data
S343B	•		•			SFWMD	EVERGLADES NATIONAL PARK	Data
S344	•		•			SFWMD	CONSERVATION AREA 3A	Data
S355A	•		•			SFWMD	EVERGLADES NATIONAL PARK	Data
S355B	•		•			SFWMD	EVERGLADES NATIONAL PARK	Data
S356	•					SFWMD	EVERGLADES NATIONAL PARK	Data
S356GW					•	SFWMD	L-29 CC	Data
S357	•	•		•		SFWMD	8.5 SQ. MILE AREA	Data
S357N	•	•		•		SFWMD	8.5 SQ. MILE AREA	Data
S362	•		•			SFWMD	CONSERVATION AREA 1	Data
S38	•		•			SFWMD	CONSERVATION AREA 2A	Data
S39	•		•			SFWMD	CONSERVATION AREA 1	Data
S7	•	•	•			SFWMD	CONSERVATION AREA 2A	Data
S8	•		•			SFWMD	CONSERVATION AREA 3A	Data
S9	•	•	•			SFWMD	CONSERVATION AREA 3A	Data
S9A	•		•			SFWMD	CONSERVATION AREA 3A	Data
WC2AN1			•			SFWMD	CONSERVATION AREA 2A	Data
WC2AS1			•			SFWMD	CONSERVATION AREA 2A	Data
WCA1ME				•		SFWMD	CONSERVATION AREA 1	Data
WCA2E4			•			SFWMD	CONSERVATION AREA 2A	Data

DBHydro Site Name	Flow	Rain	Stage	Weather	Ground water	Agency	Watershed	Link
WCA2F4			•	•	•	SFWMD	CONSERVATION AREA 2A	Data
WFEED	•		•		•	SFWMD	FEEDER CANAL	Data

6 HYDROLOGIC FORECASTS

Water levels in the WCAs, ENP, ENP-SDCS Project area are monitored daily by the USACE and SFWMD by use of staff gages and data collection platforms (DCPs) placed at the locations pertinent to water management. Daily weather forecasts are provided by the SFWMD and NWS. The NWS is the Federal agency responsible for developing and disseminating flood forecasts but does not produce flood forecasts for any locations within the WCAs, ENP, ENP-SDCS Project area. The NWS Miami-South Florida Weather Forecast Office issues weather related warnings and watches for the WCAs, ENP, ENP-SDCS Project area and adjacent areas that can be obtained at: https://www.weather.gov/mfl/.

6.1 Role of USACE

The USACE Jacksonville District Water Management Section conducts water management activities for the WCAs and operates the main outlets to WCA-1 (S-10A, S-10C, and S-10D), WCA-2A (S-11A, S-11B, and S-11C), WCA-3A (S-12A, S-12B, S-12C, and S-12D), and WCA 3B (S-355A and S-355B). The Water Management Section also monitors real-time and historic hydrometeorological data associated with water management activities, within WCAs, ENP, ENP-SDCS Project area, conducted by the non-Federal sponsors (SFWMD, STOF).

6.2 Role of Other Agencies

As non-Federal sponsors of the C&SF Project, SFWMD and the STOF are responsible for monitoring hydrometeorological data and information for the prediction of hydrologic conditions associated with the water management decision making process. The NWS is the Federal agency responsible for providing weather forecasts, watches, and warnings. The State of Florida (SFWMD and FDEP) is responsible for monitoring water quality aspects related to the WCAs, ENP, ENP-SDCS Project area.

6.3 Flood Condition Forecasts

Flood condition forecasts are not made for the WCAs, ENP, ENP-SDCS Project area. The total storage volumes and peak Standard Project Flood (SPF) elevations for WCAs, ENP, ENP-SDCS components of the C&SF Project are contained in Chapter 7 and Chapter 8, respectively. Currently, there is no operational model for the WCAs, ENP, ENP-SDCS Project area in use for real time forecasting. The SFWMD conducts monthly positional analysis forecasts for all three WCAs using regional simulation models (hydrology and operations), driven by historical climatological inputs and current system conditions, and generates water levels and inflows/outflows projections. These forecasts are evaluated by water managers and used in addition to other tools to plan for future operations but do not capture rapidly changing localized flood conditions. Meteorological forecasts issued by SFWMD can be found at the following link: https://www.sfwmd.gov/weather-radar/sfwmd-forecast. Currently, there exists one CWMS model within the C&SF Project area (but outside the WCA, ENP, ENP-SDCS project area) which includes areas within Volume 2 and 3 of this SOM which are the Kissimmee Chain of Lakes and Lake Okeechobee and Everglades Agricultural Area to primarily forecast water levels in Lake Okeechobee. The WCAs CWMS model will be developed in the future for forecasting water levels in the WCAs.

6.4 Conservation Purpose Forecasts

Both the USACE and SFWMD have several gages to monitor water levels within the project area. The SFWMD provides weekly ecological conditions and water supply reports to USACE and SFWMD water

managers. This information may be used for operational planning for the purposes of conservation for ecological benefits and for water supply. These weekly reports may be found at the following website: https://www.sfwmd.gov/science-data/operational-planning. The USACE, in consultation with SFWMD, has formulated regulation schedules for these areas that take into consideration the congressionally authorized project purposes which include flood risk management, water supply for municipal, industrial, and agricultural uses, prevention of saltwater intrusion, water supply for Everglades National Park, protection of fish and wildlife resources, groundwater recharge, recreation, and navigation. Conservation requirements are taken into account during formulation of the regulation schedules, therefore are not part of the operational requirements within the C&SF Project.

6.5 Long-range Forecasts

Long range (up to a year) forecasts are made monthly or bi-monthly based on a statistical analysis of historical data gathered in the WCAs by the sponsor (SFWMD) and are considered in the water management decision making process. SFWMD produces quantile graphics for several significant water bodies, canals and gauge locations. The lines can also be called "iso-percentile lines". These graphics represent a statistical summary of the simulated stages for a given location. They provide the probability of the stage being below a given value, for every day of the year, based on a current initial stage and the rainfall regime experienced by that feature each year for the 41-year simulation period, running 365 days from initialization. For instance, for all the stages shown on the 80% line, the probability of being below that stage is 80%, while the probability of being above is 20%. The 50th percentile is the median stage each day, thus half the years on that day were above that value and half were below. One shouldn't expect that a given iso-percentile line comes from a single simulated year. They are usually formed with values coming from different years. This provides a useful probabilistic indication of where the stage level could go.

The regulation schedules are adjusted periodically based on new data and predictions of future water use in the WCAs. Adjustments to the regulation schedules may include periodic drawdowns for environmental reasons; holding water stages in the WCAs higher than normal during unusual, prolonged wet or dry conditions; and/or making releases for water supply to agricultural users during drought conditions. These adjustments may necessitate preparation of National Environmental Protection Act (NEPA) documentation. In addition, the three-month precipitation outlook provided by the NWS is also considered for water management operations for the WCAs. This information is available at https://www.weather.gov/hun/climateforecast. The regulation schedules and the processes for changing them are described in Chapter 7.

The NWS and SFWMD develop daily and weekly (7-day) quantitative precipitation forecasts (QPF) for the WCAs, ENP, ENP-SDCS Project area. These QPFs are available at https://www.sfwmd.gov and https://www.wpc.ncep.noaa.gov/#page=ovw. Forecast scenarios are not simulated by the USACE. Rather, hydrometeorological data, regulation schedules and other operating criteria, stage-storage relationships, analysis of past stage behavior following discharge changes, weather forecasts and knowledge of the WCAs, ENP, ENP-SDCS Project area are primarily utilized in the water management decision-making process.

The NOAA Climate Prediction Center (CPC) provides information on the ENSO cycle and other phenomena such as the North Atlantic Oscillation and Madden Julian Oscillation. The ENSO cycle may be represented by one of three phases; El Niño, Neutral, and La Niña. The terms El Niño and La Niña represent opposite extremes of the ENSO cycle. A full ENSO cycle has historically taken 2-7 years to complete with the El Niño

phase typically lasting 9-12 months and the La Niña phase typically lasting 1-3 years. El Niño episodes are associated with increased storminess and precipitation across the southern U.S. during portions of the Fall, Winter, and Spring seasons. Conversely, less storminess and precipitation in the southern states during portions of these seasons are associated with La Niña episodes. The neutral phase of the cycle represents precipitation patterns closer to historical averages.

In addition, the CPC, in collaboration with the Hurricane Research Division (HRD) and the National Hurricane Center (NHC), produces an Atlantic Hurricane Season Outlook. The ENSO cycle is one of several factors which can influence overall tropical cyclone activity during a given season. El Niño episodes can contribute to conditions which are less favorable for hurricane activity in the Atlantic Basin while La Niña episodes can contribute to conditions more favorable for hurricane activity in the Project area.

6.6 Drought Forecast

The websites cited in Section 6.4 may also be used for drought forecasts. Long range and seasonal forecasts for droughts are available at https://www.weather.gov/akq/Extended. The volume and duration of releases from the WCAs are primarily determined by regulation schedules, other operating criteria, and/or hydrometeorological conditions/data. Stage-storage relationships, examining past stage behavior following discharge changes, weather forecasts, and monthly positional analysis forecasts for all three WCAs by SFWMD and/or knowledge of the project area are utilized for operational decision-making. Operational planning will rely on the best available and actionable scientific information about observed and expected hydrologic changes that affect drought.

Operational strategies should be formulated with consideration of both severity and duration of future potential droughts. The USACE Civil Works Technical Report 2015-03 , Recent U.S. Climate Change and Hydrology Literature Applicable to U.S. Army Corps of Engineers Missions South Atlantic Gulf Region 03, documents studies by Chen et al (2012) and Cook et al (2014) of trends in the frequency and severity of droughts. These studies did not show trends for either frequency or intensity of droughts in the South Atlantic Gulf Region. However, researchers identified a statistically significant decline in drought frequency (droughts per century over the past 1,000 years) and a “general increase in soil moisture as defined by the Palmer Drought Severity Index (PDSI) over the same period.”

6.7 Water Quality Assessments

SFWMD has numerous water quality gages in the WCAs, ENP, ENP-SDCS Project area. Real-time water quality data can be found at https://www.sfwmd.gov/science-data/environmental-monitoring. Additionally, State and USFWS scientists provide environmental and water quality conditions, information, and recommendations on water management activities for various locations within the WCAs, ENP, ENP-SDCS Project area to the Jacksonville District Water Management Section.

The State of Florida is responsible for regulating water quality and is responsible for achieving state water quality standards. The State constructed STA-1W, STA-2, STA-3/4, and STA-5/6 and USACE constructed STA-1E. The State is operating the five STAs which directly interact with the C&SF Project. The State also monitors nutrients and water quality entering the WCAs. SFWMD, acting on behalf of the state, may petition the USACE for operational changes within the C&SF system where it sees that water quality benefits may be achieved in the project area. Additionally, Phase 2 of the Decomp Physical Model (DPM) Field Test may continue through 2021, subject to constraints noted in the 2017 Operational Strategy for Water Conservation Area 3 Decompartmentalization (DECOMP) and Sheet Flow Enhancement Project – Physical Model Phase 2. S-152 is operated in accordance with this 2017 DPM Operational Strategy. During

Phase 2 of the DPM, operation of S-152 will be consistent with the FDEP Permit for DPM Phase 2 (including any modifications to the permit). When water quality constraint criteria per this FDEP permit are exceeded, S-152 releases may be reduced or discontinued.

7 WATER CONTROL PLAN

This Water Control Plan (WCP) defines and describes the operational plan for the Water Conservation Areas (WCAs), Everglades National Park (ENP), and ENP-South Dade Conveyance System (SDCS) to meet all of the Central and Southern Florida (C&SF) Project congressionally authorized purposes. The Central and Southern Florida Ecosystem Restoration Critical Project, Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project (SBC Project) is also represented in the System Operating Manual (SOM)-Volume 4. The SBC Project WCPs for Basin 1, 2 and 4 are not updated as part of this WCP and provided in Appendix G of SOM- Volume 4.

7.1 General Project Purposes, Goals, Objectives, and Benefits

The C&SF Project that is represented in this SOM, includes the WCAs, ENP, ENP-SDCS, and SBC Projects. The local sponsor for the SBC Project is the Seminole Tribe of Florida (STOF). The local sponsor for the remaining portions of the C&SF Project covered in this WCP is the South Florida Water Management District (SFWMD). The U.S Army Corps of Engineers (USACE) operates and maintains the main outlets for Water Conservation Areas (WCAs); (S-10A, S-10C, and S-10D in WCA-1), (S-11A, S-11B, and S-11C in WCA-2A), (S-12A, S-12B, S-12C, and S-12D in WCA-3A), and (S-355A and S-355B in WCA-3B). The local sponsors operate the remainder of the project in accordance with regulations prescribed by USACE.

The congressionally authorized project purposes for the WCAs, ENP, ENP-SDCS component of the C&SF Project include flood risk management, water supply for municipal, industrial, and agricultural uses, prevention of saltwater intrusion, water supply for ENP, protection of fish and wildlife resources, groundwater recharge, recreation, and navigation. The WCP defines water management operations for the system that are intended to meet the project purposes

This WCP combines the 2012 WCP water management operations for WCA-1 and WCA-2 with the new water management operations for WCA-3, ENP, and ENP-SDCS that were developed in the Combined Operational Plan (COP). The COP is an integrated operational plan for two modifications of the C&SF Project – known as Modified Water Deliveries (MWD) to ENP and the Canal 111 (C-111) South Dade (SD) Projects. The purpose of the COP was to define the water management operations for the WCA-3A and WCA-3B outlets, structures in the L-31N and the C-111 basins constructed as part of the C&SF Project and the recently constructed components of the MWD to ENP and C-111 SD Projects.

The COP is the last step to implement operational changes to convey water from WCA-3A to the ENP using the constructed features of the pre-CERP Foundation projects (i.e., MWD to ENP and C-111 SD Projects). Development and implementation of the COP is the final action required before both the MWD to ENP and C-111 SD Projects can be considered complete. The COP is anticipated to be in place until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay.

The COP goals, derived from the MWD to ENP and C-111 SD Projects purposes include:

1. Improve water deliveries (timing, location, volume) into ENP and take steps to restore natural hydrologic conditions in ENP given current C&SF infrastructure and features expected to be completed by the time of implementation, to the extent practicable by:
    a. Changing schedule of water deliveries so that it fluctuates in accordance with local meteorological conditions, including providing for long term and annual variation in ecosystem conditions in the Everglades (Timing) (P.L. 101-229, Section 101b).
    b. Restoring North East Shark River Slough (NESRS) as a functioning component of the Everglades hydrologic system (Location) (P.L. 101-229, Section 101b).
    c. Adjusting the magnitude of water released to ENP to minimize effects of too much or too little water (Volume) (1992 MWD GDM, Section 44).
2. Maximize progress toward restoring historic hydrologic conditions in the Taylor Slough, Rocky Glades, & Eastern Panhandle of ENP.
3. Protect the intrinsic ecological values associated with WCA-3A and ENP.
4. Minimize the damaging freshwater flows to Manatee Bay/Barnes Sound through the S-197 structure and increase flows through Taylor Slough and coastal creeks (1994 C-111 GRR, Section 5.2).
5. Include consideration of cultural values and tribal interests & concerns within WCA-3A and ENP.

Water management operations at the main outlets for WCA-1, WCA-2, and WCA-3 are determined through a decision-making process that considers all the congressionally authorized project purposes for the WCAs. The decision-making process to determine quantity, timing, and duration of the potential releases from the WCAs include consideration of diverse information related to water management. This information includes but is not necessarily limited to: C&SF Project conditions, estuary conditions and projected needs (e.g., Biscayne Bay, Florida Bay), WCAs conditions and projected needs, WCA water levels, ENP conditions and projected needs, East Coast Canals (ECC) available capacity, ENP-SDCS available capacity, current climate conditions, climate forecasts, hydrologic outlooks, projected WCAs level ascension and recession rates, and water supply conditions and projected needs. This information helps address uncertainties in meeting the projects objectives due to modeling accuracy or future conditions not originally anticipated in the modeling period of record and supports a more flexible and adaptive decision-making process. If new information becomes available through implementation of the COP WCP and/or the COP Adaptive Management and Monitoring Plan (AMMP) that would necessitate a need to modify water management operations, this information will be incorporated as appropriate in accordance with laws and regulations including the National Environmental Policy Act of 1970 (NEPA).

A limited suite of CERP-related water control structures, which are currently owned and operated by SFWMD, are identified and discussed in this WCP. The SFWMD will operate state-owned structures in accordance with their Florida Department of Environmental Protection (FDEP) issued permits and any future modifications of the FDEP permits. These structures interact with the C&SF system to provide benefits consistent with the project purposes. The WCP includes the state-owned structures only to gather all pertinent operational criteria into one document.

All elevations in this document are in feet in relation to the National Geodetic Vertical Datum of 1929 (NGVD) unless otherwise stated. This document will be updated to the North American Vertical Datum of 1988 (NAVD) upon completion of datum updates throughout the management system and monitoring program.

7.2 Project Relationships

The projects within this document are hydraulically linked to project features within adjacent WCPs, including Lake Okeechobee and Everglades Agricultural Area (EAA) (future SOM-Volume 3), and the ECC (future SOM-Volume 5). The WCAs, ENP, ENP-SDCS and adjacent regions interact together to provide for C&SF Project purposes.

7.3 Major Constraints

This subsection discusses 10 major constraints that affect water management operations throughout the project area.

7.3.1 Protection of the Cape Sable Seaside Sparrow and Other Listed Species

The operational criteria for structures; S-12A, S-12B, S-343A, S-343B, and S-332D have seasonal closures to protect the Cape Sable Seaside Sparrow (CSSS) downstream habitats. These operations are detailed in this chapter and in the USFWS Biological Opinion (BO) issued May 5, 2020, which may be accessed at the following website:

http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

This updated BO relaxes the S-344 and S-332D seasonal operation restrictions, as coordinated with USFWS. The operations for these structures are detailed in **subsection 7.4.8.4**.

Successful recovery of CSSS requires continued collaborative efforts among federal, tribal, and state partnering agencies. The USACE, within its authorities, will continue to work with the USFWS to find other helpful initiatives which could be enacted by partners and stakeholders to aid in this important effort.

7.3.2 U. S. Highway 41/Tamiami Trail South of L-29 Borrow Canal

The “Contract between the United States of America and Florida Department of Transportation (FDOT) for Relocation, Rearrangement, or Alteration of Facilities Modified Water Deliveries to Everglades National Park Project (Relocation Agreement)” dated September 25, 2008, outlines the operational constraints for the L-29 Borrow Canal. The operational constraints are for the L-29 Borrow Canal, between S-333 on the west and S-334 on the east, to ensure the continued safety and stability of the roadway sub-base infrastructure along this segment of Tamiami Trail (U.S. Highway 41).

In coordination with FDOT, USACE has implemented additional constraints that are not explicitly spelled out in the Relocation Agreement. L-29 Borrow Canal may operate between 8.3 feet NGVD and 8.5 feet NGVD for up to 90 days per water year (starting on 1 May and ending on 30 April of the following year), with the opportunity to increase the duration of stages beyond 90 days based on real-time monitoring of the subbase in Tamiami Trail (U.S. Highway 41) and FDOT written approval. The Tamiami Trail (U.S. Highway 41) roadway subbase and roadway will be continuously monitored during

implementation of COP using the monitoring plan in Appendix H of the COP Environmental Impact Statement (EIS).

The requirements of the Relocation Agreement, including any subsequent amendments to this agreement between the USACE and FDOT, shall remain unchanged until full completion of Tamiami Trail Next Steps roadway construction, currently anticipated by 2024.

7.3.3 8.5 Square Mile Area (SMA)

The 8.5 SMA (Las Palmas Community) Project features are designed to mitigate for increased flood risk as a result of increased water levels in NESRS and other areas of ENP resulting from the MWD to ENP Project. The 8.5 SMA Project features are to be operated to maintain the water levels within the project area between L-357W and L-31N at pre-MWD levels and to preserve or enhance the hydropatterns of land located west of L-357W (ENP and the publicly owned natural areas), consistent with the evaluation methodology previously applied for the 2000 General Reevaluation Report and Final Supplemental Environmental Impact Statement (GRR/EIS). The hydrologic modeling and flood risk evaluations conducted to support development of the COP included application of an evaluation methodology which is consistent with evaluation metrics used for the 2000 GRR/EIS authorization. As required by the 2000 GRR/EIS Record of Decision, periodic flooding east of the proposed levee, before and after project implementation, will remain unchanged from conditions in existence prior to implementation of the MWD to ENP Project.

The combination of local conditions, including, but not limited to, proximity to NESRS, comparatively low ground surface elevations, and the high transmissivity of the surficial aquifer system, make the areas along the 8.5 SMA western boundaries challenging to maintain water levels below ground surface elevations and require real-time monitoring and modifications to water management alternatives to ensure flood mitigation success. The 8.5 SMA monitoring plan is located in the AMMP (Part C.6 of Appendix C of the COP EIS, Water Quality and Hydrology Monitoring Plan for 8.5 SMA Flood Mitigation). The constructed features of the 8.5 SMA Project available for water management operations include: the canals C-357 and C-358, the 8.5 SMA Detention Area/flow way and the C-111 North Detention Area (NDA), pump stations S-357 and S-331, and structure S-357N. S-357 and S-357N provide primary flood mitigation to the residents of the 8.5 SMA, and S-331 provides secondary flood mitigation benefits only during high water conditions in NESRS. Specific structure operations for 8.5 SMA flood mitigation are detailed in **subsection 0** and **Table 7-3**.

7.3.4 Water Supply Releases to Lower East Coast from WCAs during Low Water Conditions

During low water conditions, it is difficult to draw water from the interior of the WCAs. The regulation schedules for WCA-1, WCA-2A, and WCA-3A include a "floor" or minimum water levels below which water supply releases (municipal and industrial use, agricultural irrigation, and prevention of saltwater intrusion) from these WCAs must be preceded by an equivalent volume of inflow from Lake Okeechobee and/or WCAs. The water levels in these WCAs may continue to recede due to evaporation and seepage. There is no requirement to maintain the minimum elevations. Releases from WCA-3A recommended by the TTFF to ENP do not require this preceding water delivery when below the floor water level. The operational criteria for the WCAs are further defined in **subsection 7.4.8**.

7.3.5 Maintenance of Marsh Vegetation in WCAs to Prevent Wind Tides

A major factor in water management for WCA-3A is the maintenance of marsh vegetation. Prolonged high and low water levels are detrimental to the establishment and maintenance of marsh vegetation. If large areas of open water develop as a result of a loss of vegetation, risk of potential hurricane-induced wind tides increases. In Part I, Supplement 33 GDM for WCA-3 (1960), it was noted that one of the factors for establishing the regulation schedule and levee heights was the retention of marsh vegetation that would prevent large wind tides and waves from developing during hurricanes. It was determined through the GDM analysis that a marsh vegetation that could prevent wind tides could be retained with a seasonal regulation schedule varying between 9.0 to 11.0 feet NGVD. After consideration of other factors such as water supply and fish and wildlife resources, a seasonal regulation schedule varying from 9.5 to 10.5 feet NGVD was selected. The regulation schedule varies from high stages in the winter (dry season) to low stages in the beginning of the summer (wet season). Based on the assumption of marsh vegetation preventing wind tides, the levee design criteria in the GDM was to provide two and a half feet of freeboard above the Standard Project Flood (SPF) profile, and about four feet above the period of record stage at that time.

7.3.6 WCA-2B and WCA-3B

Regulation schedules are not used for WCA-2B and WCA-3B due to high rates of seepage from these areas. However, releases from WCA-2A and WCA-3A to WCA-2B and WCA-3B, respectively, can be made. The southeast corner of WCA-3B has a very high transmissivity rate that results in significant accumulation of water in the L-30 Borrow Canal. S-338 may not always be capable of routing WCA-3A releases and seepage from WCA-3B to tide due to structure capacity limitations and downstream-conditions.

7.3.7 WCA-3B Release Capability

The outlet for WCA-3B was originally S-12E. However, S-12E never functioned as intended due to tailwater conditions which were higher than designed. Subsequent construction of the ENP-SDCS has made S-12E a non-functional structure; the gates have been removed and a steel plate has been welded to it to prevent flow through the structure. The G-69 structure was also removed in 2007 as the function of that structure was tied to the L-67 pilot test. The currently available release routes from WCA-3B are: 1) to tide through S-31 and S-26 via C-6) (Miami Canal) , 2) to ENP through S-355A and S-355B into the L-29 Borrow Canal, and 3) to the L 31N through S-337 and S-335. The original design release capability from WCA-3B (through the S-355A, S-355B, S-31, and S-337) is approximately 3,305 cfs. Water levels in the L-29 Borrow Canal influence the S-355A and S-355B tailwater and have the potential to prevent or limit release capacity from the S-355s.

7.3.8 WCA-3A Release Capability

The S-12s are not capable of achieving the original design capacity of 32,000 cfs. Outlet capacity of the S-12s has either reduced over time or was never as large as assumed for the original design routings. The topography adjacent to the S-12s results in very little head differential across the structures under normal water levels. There has been a change in the discharge rating curves for the S-12s over time. The U.S. Geological Survey (USGS) periodically updates the discharge rating curve for each of the S-12s. Experience has shown that actual S-12 releases have been about forty percent less than the design rating curves. The most recent discharge rating curve available should be used for determination of S-12s' release capability.

The original design headwater of the S-12s was 12.4 feet and the peak average elevation for WCA-3A under the SPF event was 13.90 feet (C&SF Part I, Supplement 33). This stage level is reached only one time in the 41-year period of record of simulated COP operations, and the median value of the nearest gage A3-28 (Site 65) (USGS Site ID: 254848080432001) is approximately 9.0 feet NGVD. The result is that the S-12 structures are very rarely operating near their design criteria, and generally the system will be operated in a manner where the S-12s will very rarely demonstrate flows near their design capacity. The as-built crest elevation of the L-29 Borrow Canal and crown elevation of Tamiami Trail (U.S. Highway 41) in the S-12A to S-12D reach has been established to protect against the risk of overtopping from an adjacent flood of elevation 11.5 feet NGVD (corresponds to WCA-3A three gage average stage of 12.45 feet, based on historical regression). See **subsection 7.3.9** for further information.

7.3.9 S-12 Stability and Risk of Overtopping

The stability analysis conducted during design of the S-12s is predicated on a maximum design headwater elevation of 12.4 feet with the differential head across the structure limited to 5.5 feet. The as-built crest elevation of L-29 and crown elevation of Tamiami Trail (U.S Highway 41) in the S-12A to S-12D reach has been established to protect against the risk of overtopping from an adjacent flood stage of 12.4 feet NGVD. The exceedance of these design conditions should be considered an immediate increase in risk to levee stability and would require decisive and prescribed measures to reduce the WCA-3A stage. In addition, application of the FDOT road base impact criteria to this reach of Tamiami Trail (U.S. Highway 41) (estimated crown elevation of 14.95 feet) would result in a not to exceed regulated water stage of approximately elevation of 11.5 feet, adjacent to the roadbed (corresponds to WCA-3A three gage average stage of 12.45 feet, based on historical regression).

The top of the gates at the S-12s (A/B/C/D) is 11.0 feet NGVD. When the S-12s headwater approaches this level, the S-12s may be opened an amount only to prevent water from overtopping the structure gates to protect gate instrumentation.

7.3.10 Pump Station Mechanical Longevity

The mechanical longevity of an individual pump unit can be affected by numerous conditions, some of which are addressed in the pump manufacturer's Operation and Maintenance Manual(s). Other factors affecting pump station longevity have been realized through the experience of site-specific conditions at the pump station location and these factors are addressed through specific procedures at the pump station. Individual pump units at pump stations will be operated to avoid conditions that could lead to mechanical breakdowns of the pump units. This includes, but is not limited to, avoiding repeated cycling of pumps units between "On" and "Off", rotating the use of pump units from different pump stations that service the same body of water, and engaging the use of individual pump units of a pump station or pump stations that service the same body of water in a staggered manner including when it is prior to "On" criteria occurring. The pump station operator should establish specific procedures to maximize pump unit availability.

7.4 Operational Strategy to Meet Project Objectives

The complexity of water management operations is a clear consequence of the multiple, varied, and sometimes-conflicting goals for the regional system (e.g., flood risk management, water supply, environment, navigation). Day-to-day water management operations for the structures within the WCAs and ENP-SDCS will necessitate the use of operating criteria and other related information

contained within this WCP and SOM. The WCP and the SOM Structure Descriptions and Rating Curves (Appendix A of the SOM) contain a compilation of water control criteria, guidelines, diagrams, and specifications that govern the release functions of the pertinent structure(s) for the congressionally authorized project purposes. In general, they indicate controlling or limiting rates of release, levels, and storage space required for the project purposes.

7.4.1 Achieving Natural System Goals, Objectives, and Benefits

Normal operations are expected to achieve the goals and objectives for the system which are detailed above in **subsection 7.1** and as recorded in the COP EIS (until superseded by any future EIS or EA). This section first discusses the individual operational considerations and project objectives and then concludes with the system operational criteria. The operational criteria and overall strategy for the water management operations are expected to accomplish the goals of the C&SF system and COP. As future projects are developed and installed, these changes should interact with the existing system in order to accomplish the restoration goals of the larger C&SF Project.

7.4.2 Flood Risk Management

During high water events, water is passed southward from WCA-1 into WCA-2A; from WCA-2A into WCA-3A; and from WCA-3A into ENP and/or the ENP-SDCS. The water control structures typically pass the water from north to south to allow for a smooth articulation of water through the WCAs and into ENP and/or ENP-SDCS. Releases from the WCAs to tide via ECC can also be made. When the ECC are full, discharging water eastward from the WCAs could cause or aggravate local flooding. This is also possible if the ECC are being utilized for release to tide from the WCAs and a significant rainfall event over the ECC occurs. Therefore, water from the WCAs can only be released to tide via the ECC when rainfall over adjacent areas has not produced large amounts of runoff and canal capacity exists (SOM Volume 5 details the ECC). The release capacity to tide through the structures that connect the WCAs to the coastal canal system is often relatively small compared to the primary structures (e.g., S-10s, S-11s, and S-12s) so favorable conditions for an extended period are required to make meaningful releases through the coastal structures. For example in WCA-1, S-39 has a design capacity of approximately five percent of that of a single S-10 structure.

7.4.2.1 Water Conservation Areas

The WCAs collect floodwaters which historically flowed from north to south across the broad flat peninsula and the east coast protection levee, along the WCAs eastern boundaries, prevent floodwaters from flowing into the areas that are now developed along the southeast coast of Florida. Levees L-40, L-36, L-35A, L-35, L-37, L-33, L-30, L-31N, and L-31W form the east coast protection levee. The WCAs regulation schedules all have a flood risk management zone that maximize releases out of the WCAs to limit and reduce levee safety concerns.

The S-10, S-11, and S-12 spillways were sized to pass the SPF. The basic purpose of these spillways is to provide a means of controlling flow and providing conveyance for all flood releases up to the Spillway Design Flood (SDF). Rapid removal of flood storage in the WCAs is limited due to the slow movement of water in the densely vegetated WCAs, relative to the potentially high rates of inflows that come from upstream structures combined with rainfall. The relatively flat terrain and dense vegetation often lead to sloping pool conditions in the WCAs and backwater effects. When conditions in the coastal canals permit, some additional releases to tide can be made by SFWMD from the WCAs.

The USACE is currently nearing completion of an updated WCA flood routing analysis study, the Baseline and Modification Model (BAMM). The intent of the BAMM study is to identify and quantify the cumulative changes to design stage and flow conditions within the WCA system (WCA-1, WCA-2, and WCA-3) due to infrastructure and operational changes that have occurred since the originally authorized C&SF design. The BAMM effort includes development of a new regional flood routing model and model simulations of SPF hydraulic routings for each of the WCAs. The BAMM flood routing results will be used by the USACE to conduct comprehensive risk analysis of levees and structures within the WCAs, including hydraulic, hydrological, geotechnical, and structural engineering, if results warrant. The USACE will evaluate any substantial WCA design deficiencies and determine the resulting path forward based on human health and safety and other C&SF Project requirements.

7.4.2.2 ENP-South Dade Conveyance System

The C&SF Project features in South Miami-Dade County maintain optimum stages for the purposes of flood risk management, water supply, reducing seepage from ENP, groundwater recharge, and prevention of saltwater intrusion. The C-111 SD structures (S-196, S-194, S-176, S-177, S-18C, and S-197) were designed to pass 40 percent of the SPF without exceeding design stages, and to control releases during floods in excess of design to prevent damaging velocities at the structures and in the canal. June 2020

7.4.2.3 Lake Okeechobee and the Everglades Agricultural Area

Releases can be made from Lake Okeechobee and the EAA to the WCAs. To maintain EAA canal levels, EAA canal water is typically pumped into STAs prior to delivery to the WCAs. For more detailed discussion, refer to Master Water Control Manual (MWCM) Volume 3, Lake Okeechobee and Everglades Agricultural Area. (future SOM Volume 3)

7.4.3 Water Quality

The State of Florida is responsible for regulating water quality and is responsible for achieving state water quality standards. USACE is responsible for developing water control plans for operation of the C&SF system. SFWMD, acting on behalf of the state, may petition the USACE for operational changes within the C&SF system where it sees that water quality benefits may be achieved in the project area. USACE considers such requests and whether they interfere with achievement of the congressionally authorized project purposes.

The consent decree in United States v. South Florida Water Management District, Case No. 88-1886-Civ-Moreno ("Consent Decree"), a 1988 lawsuit the United States filed against the State of Florida, commits the State to taking such action as is necessary so that waters delivered to the ENP and Loxahatchee National Wildlife Refuge (LNWR or WCA-1) achieve state water quality standards. The Federal (USACE, ENP, and LNWR) and State parties (SFWMD and FDEP) agreed that the actions set forth in the Consent Decree were necessary to halt or prevent imbalances in natural populations of aquatic flora and fauna and other water quality violations in ENP and LNWR. The Consent Decree is still being implemented and its requirements, among other things, include State construction and operation of Stormwater Treatment Areas (STA). The State constructed STA-1W, STA-2, STA-3/4, and STA-5/6 and USACE constructed STA-1E. The State is operating all 5 STAs.

The consent decree provides for a Technical Oversight Committee (TOC), with a representative from each settling party, to make technically based recommendations concerning research, monitoring,

and Consent Decree compliance. The TOC regularly discusses the status of compliance and potential causes when there are exceedances of consent decree limitations.

Appendix A of the Consent Decree sets flow dependent limits on total phosphorus for water released into ENP Shark River Slough (SRS). Generally, increased water flows across Tamiami Trail results in a lower allowable phosphorus concentration limit. The Long-Term Limit for ENP Shark River Slough has a fixed lower total phosphorus concentrations limit (7.6 ppb annual flow-weighted mean - FWM) and does not prevent or limit flows that exceed base period flows as observed in Appendix A.

Since the Parties entered into the Consent Decree, there have been water quality concerns associated with flows to the Everglades Protection Area which includes ENP, LNWR and the WCAs. The SFWMD, FDEP, and the Environmental Protection Agency (EPA) engaged in technical discussions starting in 2010. In 2012, the State committed to a suite of additional water quality projects, known as Restoration Strategies, to address then existing flows to the Everglades Protection Area and work in conjunction with the STAs constructed under the Consent Decree to meet the Water Quality Based Effluent Limit (WQBEL) established for the STAs. The WQBEL and Restoration Strategies were incorporated into the Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit and associated State Consent Order, which were endorsed by EPA. Work on Restoration Strategies began immediately and that work is scheduled, pursuant to the NPDES permit and Consent Order, to be completed and fully operational by the end of 2025. Based upon current and best available technical information, the State, USACE and its federal partners believe at this time that the State Restoration Strategies, implemented in accordance with the NPDES permit and Consent Order along with the STAs constructed under the Consent Decree, will be sufficient and are anticipated to achieve water quality requirements for existing flows to the Everglades Protection Area. In the interim, the upstream pollution control remedies being implemented under State law, the Consent Decree STAs, and constructed components of Restoration Strategies are making significant progress in reducing phosphorus levels entering the Everglades Protection Area. Based on the State of Florida's current implementation schedule for Restoration Strategies, confirmation of attainment of the WQBEL for inflows to the Everglades Protection Area will require up to five years of monitoring after the features are fully functional in 2025.

COP represents a significant step in changing C&SF operations to redistribute flows and increase water volume to ENP above existing flows. COP has been formulated and evaluated based on the existing inflows to the Everglades Protection Area, consistent with the assumptions used for the development of Restoration Strategies.

The USACE and its Federal and State partners recognize that achieving long-term hydrologic improvement may temporarily impact water quality, particularly as measured by the current Consent Decree, Appendix A, compliance methodology. Because COP will significantly alter the timing and distribution of flows into ENP, while also increasing the volume of water delivered to SRS, the Federal parties conducted a water quality evaluation to assess the effect of COP on compliance with Appendix A. That analysis shows that COP has the potential in the near term to result in more frequent exceedances of the Appendix A limits due to the following: 1) the redistribution of flows from west to east across Tamiami Trail; 2) higher flow volumes across Tamiami Trail into ENP, an increase from 571k to 733k acre-feet average annual flows (a 28% increase), that will result in lower Appendix A limits; and/or 3) increased volume and duration of flows during low-stage water deliveries through the S-333 and S-12D to SRS, when localized higher phosphorus concentration water predominates. The potential water quality impacts associated with COP are directly influenced by the quality of water

delivered to the upstream areas (WCA-3A) and low water conditions in WCA-3A. Restoration Strategies are expected to address the upstream water quality concerns associated with the nutrient levels in the water delivered to WCA-3A. Components of the CERP Central Everglades Planning Project (CEPP) project (including plugs along the Miami canal, the Blue Shanty flow way, and distributed inflow points at the northern boundary of WCA-3A from the EAA basin) are expected to improve sheet flow and reduce dry out conditions in WCA-3A. Once Restoration Strategies are fully implemented, the WQBEL is achieved, and the CEPP features are completed, the increased flows expected to be delivered to the NESRS should not result in any increased potential for violations of Appendix A.

Consistent with the authorizing legislation for the MWD to ENP and C-111 SD Projects, the COP formulation goals and objectives prioritized restoration of natural hydrologic conditions in ENP over other identified planning considerations, including water quality. To address the potential near-term water quality concerns associated with the increased COP flows to NESRS the multi-agency water quality sub-team evaluated potential water quality mitigation strategies by leveraging sensitivity modeling simulations. Based on review of the modeling results, the analysis conducted by this team found that through the application of water quality adaptive management strategies, water quality could be improved relative to the No Action baseline. The COP AMMP (Appendix C of the COP EIS) developed strategies to help improve water quality delivered to ENP from WCA-3A, however, these strategies may reduce the quantity of water delivered to ENP for a limited duration. These AMMP water quality strategies are also detailed as Annex in **subsection 7.15.1.** Recommendations from the water quality team will be presented to the periodic scientist meeting for WCA-3A prior to implementation of these water quality strategies. USACE shall make the operational decision whether or not to implement the water quality strategies in consideration of water quality and all the congressionally authorized project purposes.

Many of the water quality concepts outlined in CEPP may also be considered during the implementation and operation of COP. In an effort to address these potential impacts and determine updates to Appendix A to reflect increased inflows into ENP since the Consent Decree was entered, the parties to the Consent Decree have established a process and scope for evaluating and identifying necessary revisions to the Appendix A compliance methodology utilizing the scientific expertise of the TOC. The TOC may consider all relevant data, including the 20 years of data collected since Appendix A was implemented. Ultimately, such evaluations and changes to the Appendix A compliance methodology would be recommended by the Consent Decree's TOC for potential agreement by all parties.

7.4.4 Water Conservation/Water Supply

One of the objectives of the C&SF Project is to retain enough water in storage to meet water supply needs of the project area including municipal and industrial uses, agricultural supplemental irrigation, and prevention of saltwater intrusion. The WCAs can function to store water from rainfall events which may later be released when additional water is needed in the developed areas. At times, water supply releases are also made from the WCAs to the EAA. When there is insufficient water available in the WCAs and sufficient water is available in Lake Okeechobee, water may be transferred from Lake Okeechobee through the WCAs to meet water supply needs.

SFWMD moves water from WCAs into regional canal system to maintain canal stages, which provides recharge to the aquifer for existing legal uses and other beneficial uses. Some of the beneficial uses that have been identified specifically in legislation or later approved plans are water supply for

municipal and industrial use, agricultural irrigation, ENP, and for salinity control and dilution of pollutants in project canals. SFWMD's Water Supply Plans can be found using the following link:

https://www.sfwmd.gov/portal/page/portal/xweb%20-%20release%203%20water%20supply/water%20supply%20planning

The surficial aquifer system provides water for six water use categories established by the FDEP (public water supply, domestic self-supply, industrial, and power generation water supply, agricultural and landscape irrigation) along the southeast coast. The surficial aquifer system, including the water table and Biscayne aquifers, underlies approximately 3,000 square miles of Miami-Dade, Broward, and southern Palm Beach counties. It is a surficial, highly permeable, wedge-shaped aquifer that is approximately 200 feet thick at the coast but thins to a few feet thick near its western boundary 35 to 40 miles inland. Seepage and water supply releases from the WCAs prevent saltwater intrusion along the coast and recharge the surficial aquifer system. Due to the high degree of connectivity between the surficial aquifer system and surface water, changes in surface water elevations have a direct impact on groundwater levels and saline water intrusion.

7.4.4.1 Water Supply Operations to the Lower East Coast

In the Lower East Coast, low coastal elevations over highly porous formations, combined with extensive groundwater use, require critical management of surface and groundwater levels to control saltwater intrusion. SFWMD can make water supply releases to the east coast to prevent saltwater intrusion and recharge the surficial aquifer system from the WCA's when sufficient water is available in the WCA's and/or Lake Okeechobee through S-5A(S), S-39, S-38, S-143, S 141, S-142, S-34E, S-31, S-337, S-151, S-333, and S-334. Inland movement of saltwater in tidal canals and streams is basically a function of the relative densities of freshwater and saltwater, the rates of freshwater release, and tidal action. The coastal spillways prevent a saltwater wedge from moving up the canals and maintain a sufficient freshwater head to prevent saltwater intrusion in the aquifer. In order to prevent salt-water intrusion and meet water supply demands in the ENP-SDCS south of S-331, water supply deliveries typically begin when the water levels fall below the stages listed in **Table 7-1**. These stages are not meant to be maintained at these levels because even with water supply deliveries, the water levels in the canals usually decline considerably below these stages. For additional operating criteria, refer to **subsection 7.4.8**. It is anticipated that water supply deliveries to the SDCS will not be needed when S-356 is pumping. If S-356 is pumping and S-334 and/or S-335 are to be utilized to deliver water supply to ENP-SDCS, then S-356 will stop pumping.

Table 7-1. Water Supply Deliveries Allowed when Approaching Identified Canal Stages in ENP-SDCS.

Canal	Reach	Elevation (feet NGVD)
Levee 31N Borrow Canal	S-331/S-173 to S-176	4.0
Canal 111	S-176 to S-177	3.0
Canal 111	S-177 to S-18C	2.0
Canal 111	S-18C to S-197	1.0

7.4.4.2 Water Supply Operations to ENP

One of the objectives of the C&SF Project is to improve water supply deliveries to ENP. The WCAs function to store water from rainfall events which may later be released when additional water is needed in ENP as identified by the Tamiami Trail Flow Formula (TTFF) and/or routing water towards Taylor Slough. See **subsections 7.4.8.1.3.1** and **7.4.8.2.2,** respectively.

7.4.5 Recreation

Recreation is an authorized project purpose for the C&SF Project. WCA-1 is designated as the Arthur R. Marshall LNWR. WCA-2 and WCA-3 together compose the Everglades and Francis S. Taylor Wildlife Management Area (EWMA), which are managed by Florida Fish and Wildlife Conservation Commission (FWC). There are abundant recreational facilities within the project area, both private and public. The Greater Everglades, which includes ENP, the EWMA, and LNWR provide opportunities for sightseeing, wildlife viewing, photography, hiking, bicycling, boat touring, boating, kayaking, canoeing, camping, fishing, and hunting. ENP receives over a million visitors per year, as does the EWMA, while LNWR receives about 400,000 visitors annually. Recreation in these areas increases tourist activity and provides economic benefits to the communities within and surrounding the area.

Recreation is considered in the decision-making process and may influence water management operations on rare occasions. When water levels are too high or too low, FWC issues recreational closures. When the average of the Site 62 (gage 3-2/"Deer gage") (USGS ID: 261023080443001) and Site 63 (gage A-3)(USGS Site ID: 261117080315201) gages is 9.30 feet NGVD, water stages are on average 1.0 feet below the ground surface over approximately 25% of WCA-3A North. At or below this water level, the risk of muck fires is increased and FWC will close the area to public access. Muck fires burn the soil and can cause extensive damage, in particular the loss of tree islands that provide critical upland habitat for wildlife species. If the water levels reach the criteria for FWC to close the area to public access, then the same water levels (9.30 feet NGVD average of Site 62/63 gages) will be utilized to recommend re-opening the area. However, since the Site 62 and Site 63 gages are approximately 5 miles south of the WMAs and may not reflect actual conditions near the L-5 levee, where most off-road vehicle activity occurs, FWC will assess field conditions prior to re-opening the area. When the average of the Site 62 and Site 63 gages is ≥11.60 feet NGVD, essential wildlife behaviors are disrupted, recreation is impacted, and public access may be limited by FWC Executive Order. These closures are further detailed in **subsections 7.4.6.2** and **7.4.8.1.3**, respectively.

7.4.6 Fish and Wildlife

Preservation of fish and wildlife is an authorized project purpose. The WCAs are public hunting and fishing areas and provide exceptional opportunities for high quality wildlife-dependent recreation. Florida Bay and the Gulf Coast region of ENP also provide excellent fishing opportunities. The effects of the regulation schedules on fish, wildlife, and vegetation in the WCAs were and are important considerations in determining seasonal water levels along with recession and ascension rates. The regulation schedules for WCA-1, WCA-2A, and WCA-3A include a "floor" elevation; these are minimum levels that were established to help reduce adverse impacts on fish and wildlife resources. The WCAs also preserve an Everglades wetland environment interspersed with tree islands that provide important habitat for a diversity of plant and wildlife species. These tree islands habitats can be adversely affected by prolonged high and low water conditions.

7.4.6.1 Protected Species and Their Habitat

Forty-five federally listed threatened and endangered species are either known to exist or potentially exist within the Everglades (WCAs, ENP, coastal areas) including the Florida panther, Florida manatee, smalltoothed sawfish, Cape Sable Seaside Sparrow, Everglade snail kite, wood stork, American alligator, American crocodile, and Eastern indigo snake. In addition, designated critical habitat also occurs in the area including: marl prairie areas in ENP and the East Everglades for the CSSS; all of WCA-3A, all of WCA-1, and portions of SRS for the Everglade snail kite; coastal areas along Florida Bay for the American crocodile; and coastal areas around ENP for the Florida manatee.

State-listed species in the Everglades include the Big Cypress fox squirrel, Everglades mink, Florida sandhill crane, little blue heron, reddish egret, roseate spoonbill, Southeastern American kestrel, and tricolored heron. The Everglades contain some of the largest and most important wading bird colonies in North America. The EWMA provides numerous and abundant nesting opportunities for Florida's wading birds; the Alley North colony in WCA-3A is often the largest colony in the Greater Everglades.

USACE reinitiated Endangered Species Act (ESA) consultation on Everglades Restoration Transition Plan (ERTP) in November 2014, as a result of an exceedance of an Incidental Take Re-initiation Trigger from the November 2010, ERTP Biological Opinion (BO) for the Cape Sable Seaside Sparrow (CSSS). USFWS issued a new BO for ERTP in July 2016, developed in formal ESA consultation with the USACE. As a result of this consultation, USFWS determined that current conditions within CSSS habitat threatened the survival of the CSSS, and as a result, USFWS issued a "jeopardy" BO which explained that unless alternatives to current water operational practices (which then included the 2012 WCP) were explored and implemented, continued implementation of ERTP was likely to jeopardize the continued existence of the CSSS. The revised BO, issued in July 2016, presented a Reasonable and Prudent Alternative (RPA) that would avoid jeopardizing the CSSS. The RPA identified operational modifications and proposed expediting restoration initiatives for some of the structures in the southern portion of the Everglades ecosystem to provide suitable nesting habitat for the endangered CSSS.

The 2016 ERTP BO also acknowledged the efforts to increase flows into NESRS under the MWD to ENP Project and required USACE to implement the COP in 2019. The USFWS and USACE have agreed to amend the BO to reflect the revised anticipated date for COP, currently August 2020.

Formal consultation for COP began with submittal of a Biological Assessment to the USFWS in December 2019 and a BO for COP was received from USFWS on May 5, 2020. The updated operational constraints retain the seasonal closures at S-343A, S-343B, S-12A, and S-12B but relax the seasonal operation restrictions at S-344 and S-332D compared to the 2016 RPA. The operations for these structures are detailed in **subsection 7.4.8.4**.

The BO issued May 5, 2020, may be accessed at the following website:

https://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

7.4.6.2 Terrestrial Wildlife

Terrestrial wildlife, such as deer, marsh rabbits, bobcats, and raccoons, are native and common within the WCAs. During periods of high-water levels, resident deer and other terrestrial mammals in the WCAs can be negatively impacted to the point of population reduction.

When water levels in WCA-3A exceed the FWC high water criterion (when the combined average of the Site 62 and Site 63 gages is greater than 11.60 feet NGVD), and impacts to wildlife are imminent, essential wildlife behaviors are disrupted, recreation is impacted, and public access may be limited by FWC Executive Order. Prolonged high-water levels pose an increasing threat to state and federally listed species, and high water conditions that last longer than 60 days are detrimental to wildlife health and habitats, and can have long-lasting impacts.

When water levels exceed the FWC high water criterion and impacts are imminent, FWC Commissioners or the Office of the Executive Director may call an Emergency High Water Meeting. USACE, USFWS, Department of the Interior (DOI), SFWMD, FDEP, Florida Department of Agriculture and Consumer Services (FDACS), STOF, and the Miccosukee Tribe of Indians of Florida (MTIF) may be invited to attend in order to share information, assess the status of the regional water management system, and develop management strategies and options for relief from high water conditions that create deleterious ecological conditions.

7.4.7 Navigation

While the C&SF project is authorized for navigation, there are no authorized project features for navigation within this SOM; however, recreational boating in ENP and the WCAs and associated project canals is very popular. The minimum stages for the conservation pools in the WCAs help reduce adverse impacts on recreational boating during drought periods.

7.4.7.1 Access to Cultural Areas Downstream of S-12A

To provide the MTIF boat access to cultural and religious areas, the MTIF may request S-12A releases up to 100 cfs during periods of time when the structure would have otherwise remained closed (1 October to 14 July). The USACE must request consultation with USFWS to avoid impacts on CSSS subpopulation A. The duration of this release would not exceed five consecutive days. The initial release would be managed as a field test to determine any potential effects associated with the release on CSSS subpopulation A. If no adverse impacts occur, subsequent releases would be coordinated and monitored appropriately.

During the decision making process to determine whether to implement the request from the MTIF hydro-meteorological data such as, but not limited to, water levels at gage NP-205, rainfall, and rainfall forecasts will be utilized. Other pertinent details related to this decision-making process are in the USFWS BO for COP:

https://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents

During implementation of the S-12A up to 100 cfs release for access to MTIF cultural areas, relevant environmental data will be monitored. If NP-205 stage is observed to increase or anticipated to increase above 5.7 feet NGVD, S-12A will be closed. Water levels at gage SPARO, located between S-12A and NP-205, also provides additional insight into the effectiveness of S-12A releases for providing access to cultural areas while still avoiding impacts on CSSS subpopulation A.

7.4.8 Overall Plan for Water Management

This section defines and describes the day-to-day operating criteria and other information for the WCAs, ENP, and ENP-SDCS features to meet all of the C&SF Project congressionally authorized purposes.

7.4.8.1 Water Conservation Areas

The WCAs, located south and east of the EAA and west of the urbanized East Coast, comprise an area of about 1,350 square miles (approximately 864,000 acres) (see **Figure 7-1**). The WCAs make up a large portion of the original Everglades. Surface water inflows from the EAA typically enter these areas following treatment from one of the STAs. Flow across the WCAs is generally slow due to flat slopes and relatively dense vegetative cover. The flat ground slopes and dense vegetation often lead to sloping pool conditions as water traverses in general from north to south through the WCAs. The topography and interior canals are slightly different in each WCA resulting in slightly different responses. For example, within WCA-1 the sloping condition can be a bit more extreme as there is a perimeter canal inside the perimeter levees that surround the natural area. During dry periods there is a separation from the canals to the marsh with the marsh being higher as it slowly drains to the perimeter canal. During periods of high discharges into WCA-1 the canal stage can get higher than the marsh and thus push water into the interior areas of the marsh. In WCA-2A and WCA-3A there can be a separation between the marsh and canal systems adjacent to the structures as the water is discharged from the areas as well as when water levels recede during dry conditions.

An interior levee across the southern portion of WCA-2 subdivides it into WCA-2A and WCA-2B. This levee reduces water losses due to seepage into the extremely porous aquifer that underlies WCA-2B, and obviates the need to raise existing levees to the grade needed to provide protection against wind tides and wave run-up. Two interior levees, L-67A and L-67C run diagonally from pump station S-9 in a southwest direction to S-333 subdividing WCA-3 into WCA-3A and 3B. These levees reduce water losses due to seepage into the porous aquifer that underlies WCA-3B.

Regulation schedules contain instructions and guidance on how project water management structures are to be operated to maintain water levels in the WCAs. The regulation schedule prescribes the seasonal and monthly limits of storage which guides project regulation for the planned purposes. The regulation schedules vary from high stages in the late fall and winter to low stages at the beginning of the wet season. This seasonal range permits the storage of rainfall and runoff during the wet season for use during the dry season. In addition, it serves to maintain and preserve the vegetative regime including tree islands in the WCAs, which are essential to fish and wildlife and the prevention of wind tides. Regulation schedules must take into account the various and sometimes-conflicting project purposes.

Conceptually, reservoir storage is commonly divided into the inactive zone, the conservation zone, and the flood risk management zone. The distribution of water between the flood risk management and conservation zones varies seasonally in the WCA's. The regulation schedules for WCA-1, WCA-2A, and WCA-3A include a "floor" or minimum water levels (14.0 feet, 10.5 feet, and 7.5 feet NGVD respectively) below which water supply releases (for municipal and industrial use, agricultural irrigation and prevention of saltwater intrusion) from these WCAs must be preceded by an equivalent volume of inflow from Lake Okeechobee and/or WCAs. For example in WCA-3A, if the water level measured at the Site 3-69W gage fell below 7.5 feet NGVD, water could be transferred from Lake

Okeechobee and/or WCA-2A through WCA-3A to meet downstream water supply demands. The water levels in these WCAs may continue to recede due to evaporation and seepage. There is no requirement to maintain the minimum elevations. Releases from WCA-3A recommended by the TTFF to ENP do not require this preceding water delivery when below the floor water level.

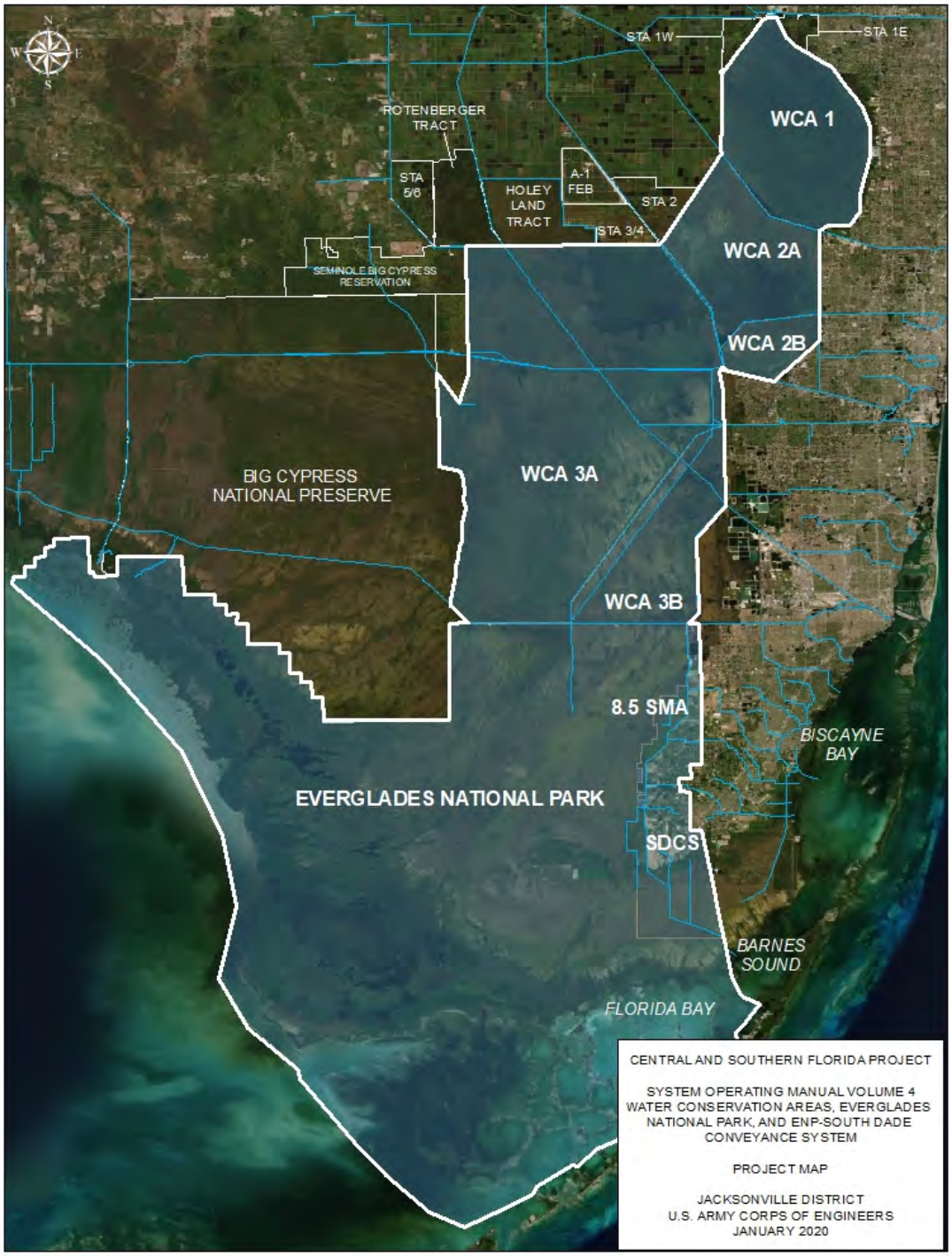


Figure 7-1. Project Map.

7.4.8.1.1 Water Conservation Area 1

WCA-1 resides within the Arthur R. Marshall LNWR (see **Figure 7-2**) boundary which has an area of 221 square miles and is completely contained by L-7, L-40, and L-39. Inflows to the area were previously controlled by pump stations S-5A and S-6 (until 2000 when S-6 pump station flows were routed south for treatment in STA-2 and then released to WCA-2A). These pump stations are designed to remove 3/4 of an inch of agricultural area runoff from their tributary drainage area per day. S-5A pumps water from the West Palm Beach Canal (C-51) and has a design capacity of 4,800 cfs. S-319 also pumps water from the West Palm Beach Canal with a design capacity of 3,980 cfs to provide flood risk management to the C-51W Basin. WCA-1 inflows (S-5A and S-319) are directed through STA-1E and STA-1W whose releases are now the primary inflows to WCA-1. Releases from STA-1E are through S-362 and G-311. G-311 is designed to pass flows both direction so that S-319 flows could be diverted to STA-1W or through G-300/G-301 to WCA-1. Releases from STA-1W are through G-310 and G-251 into WCA-1. In the event that the STAs cannot handle additional inflow, then untreated water from G-300, G-301, G-338 (SFWMD owned and operated structures) and S-6 may be diverted directly to WCA-1. .

WCA-1 is regulated primarily by the S-10s, which consists of three spillways; S-10A, S-10C, and S-10D. The design capacity of the S-10s is 14,800 cfs under SPF stages. Water can also be released to the east into the Hillsboro Canal via S-39. This is a single bay gated spillway with a design capacity of 800 cfs. S-5AS can be used to release water from WCA-1, by way of G-300 and G-301, to the L-8 Borrow Canal and the West Palm Beach Canal and upon coordination between SFWMD and the Lake Worth Drainage District, G-94A and G-94C may be used to release up to 200 cfs to the Lake Worth Drainage District system.

The WCA-1 regulation schedule is shown in **Figure 7-3**. From 1 January through 30 June the indicator water level gage for regulation is 1-8 Canal (1-8C) (USGS Site ID: 263000080120001). During 1 July through 31 December the 1-8C gage is used as the indicator gage, except during rising stages when the 1-8C stage exceeds the average of the interior gages, 1-7 (USGS Site ID: 263180080205001), 1-8T (USGS Site ID: 263050080145001), and 1-9 (USGS Site ID: 262750080175001). In that case, the average interior stage (gages 1-7, 1-8T, 1-9) is used as the indicator stage. The S-10s have no required minimum low flow release. The regulation schedule is intended to produce favorable conditions for wetland fish and wildlife resources, including species listed under provisions of the ESA. This regulation schedule was put into effect to achieve the benefits of allowing higher water levels during wet years in the northern portion of the LNWR; increase the hydroperiod of interior marshes of the LNWR such that dry-out does not occur on an annual basis; increase the proportion of the interior marsh of the LNWR that serves as nursery areas for aquatic organisms; improve the timing of winter stage drawdown in the LNWR to benefit wading birds; restore conditions in the LNWR similar to those found when the areas were used by snail kites for nesting; and allow for the storage of a greater quantity of water within the C&SF system during wet and normal rainfall years.

The fourth and current WCA-1 regulation schedule was implemented in May 1995. In this schedule Zone A1 (15.75-17.5 feet NGVD) is the flood risk management zone from 1 January through 30 June. In Zone A1, releases are made up to maximum capacity at the S-10s and up to maximum capacity at S-39 when agreed between USACE and SFWMD water managers and documented by e-mail, meeting minutes or some other form of written communication. From 1 July through 31 December, attempts are to be made to maintain water levels within Zone A2 of the regulation schedule. In Zone A2, S-10 releases are based on weather forecasts and water level trends and water supply releases are made

as needed. In Zone B (14.0 feet NGVD to 17.0 feet NGVD), the water supply zone, water supply releases are made from WCA-1 as needed. In Zone A2 and Zone B, if Lake Okeechobee stage is above WCA-1 stage or no more than one foot below WCA-1 stage, water supply releases must be preceded by an equivalent volume of inflow. In Zone C (below 14.0 feet NGVD), the conservation zone, there would be no net release of water from WCA-1. Below this elevation no further releases will be permitted from the area unless a supply of water from another storage area is transferred to WCA-1. Experience has shown that it is difficult to draw water out of the interior of WCA-1 when the stage is below 15.5 feet NGVD.

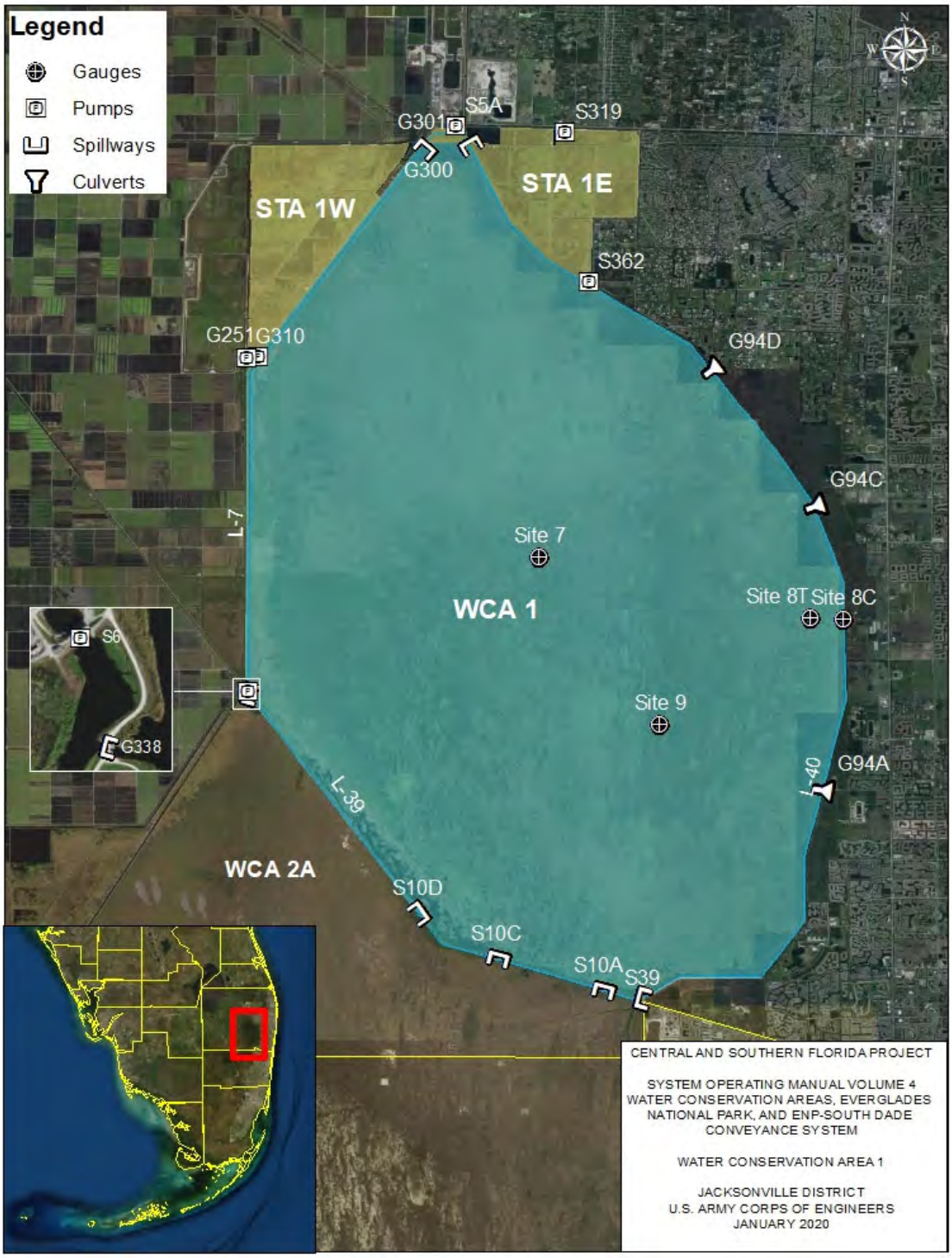
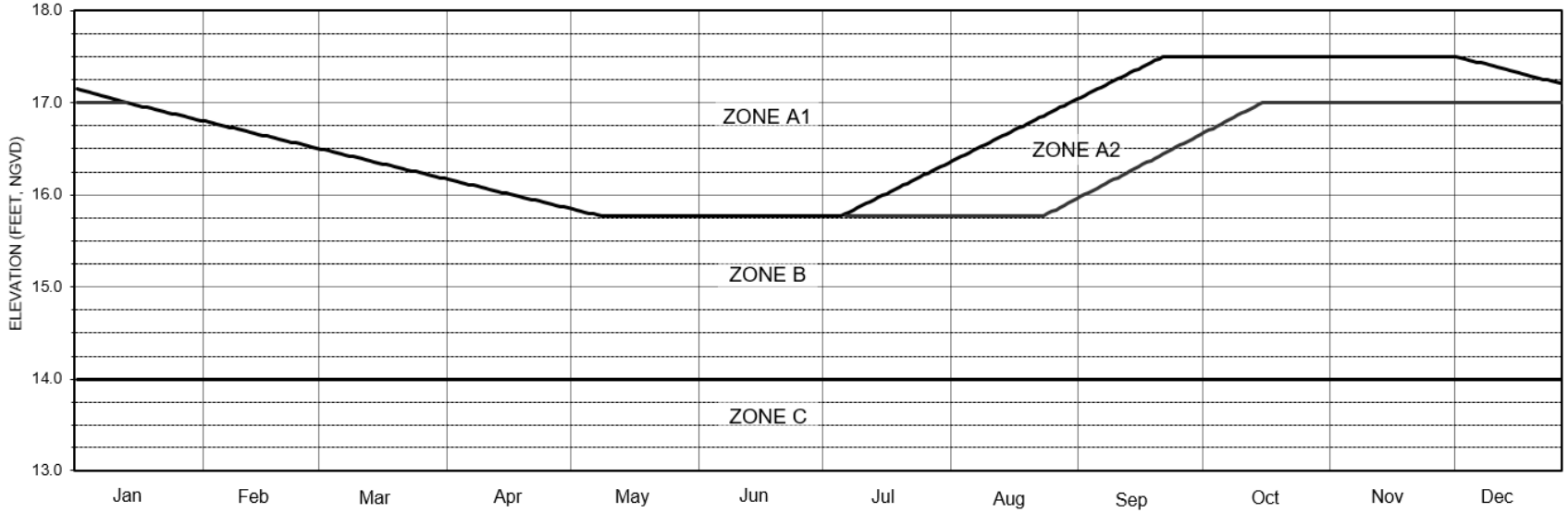


Figure 7-2. WCA-1 Map



ZONE	RELEASES
A1	Up to maximum at S-10 (and S-39 when agreed between Corps and SFWMD). Water Supply Released as needed.
A2	S-10 releases based on Corps forecasts. Water Supply releases as needed. If Lake Okeechobee Stage is above WCA 1 stage or no more than one foot below WCA 1 stage, then water supply releases from WCA 1 must be preceded by an equivalent volume of inflow.
B	Water supply as needed. If Lake Okeechobee Stage is above WCA 1 stage or no more than one foot below WCA 1 stage, then water supply releases from WCA 1 must be preceded by an equivalent volume of inflow.
C	No net releases from WCA 1. Any water supply releases must be preceded by an equivalent volume of inflow.

Dates	Use Gauge	Conditions
1 Jan – 30 Jun	1-8 Canal	All
1 Jul - 31 Dec	1-8 Canal	Except as noted below
	Avg 1-7, 1-8T, 1-9	During rising stages when canal stage exceeds average

CENTRAL AND SOUTHERN FLORIDA PROJECT
REGULATION SCHEDULE
Water Conservation Area 1
US ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA
03 May 1995

Figure 7-3. WCA-1 Regulation Schedule

7.4.8.1.2 Water Conservation Area 2A

WCA-2A lies between the WCA-1 and WCA-3 (see **Figure 7-4**). The Hillsboro Canal runs between WCA-1 and WCA-2A and the North New River Canal runs between WCA-2A and WCA-3A. In addition to the S-10s, WCA-2A receives inflow from pump station S-7 (following treatment in STA-3/4) and pump stations G-335 and G-436 (following treatment in STA-2). STA-2 releases via pump stations G-335 and G-436 through culvert structures G-336A-F and G-336G into WCA-2A. The S-7 station has a design capacity of 2,490 cfs, and pumps water from the North New River Canal (following treatment in STA-3/4). Pumping begins when the canal level exceeds 11.5 feet NGVD to 12.0 feet NGVD, unless the water level in WCA-2A is low enough to allow gravity flow from the canal through the spillway at S-7; or the water level in WCA-3A is low enough to permit gravity flow through S-150 into WCA-3A. S-6 has a design capacity of 2,925 cfs, and pumps water from the Hillsboro Canal into STA-2. Pumping should begin when canal stages exceed 11.5 feet NGVD to 12.0 feet NGVD.

The main outlets from WCA-2A are the S-11s, which consists of three spillways: S-11A, S-11B, and S-11C. The design capacity of the three structures is 17,200 cfs under SPF stages. Water can also be transferred into WCA-2B through S-144, S-145, and S-146. These structures have design capacity of 210 cfs each. S-143, with a design capacity of 500 cfs, releases water to the east into the North New River Canal through S-34E. S-38, with a design capacity of 500 cfs, releases water into the C-14 canal.

The WCA-2A regulation schedule is shown on **Figure 7-5**. When the WCA-2A stage is in Zone A, flood releases are made up to maximum capacity at the S-11s; up to maximum capacity at S-144, S-145, and S-146; and up to maximum practicable at S-143 and S-38. The L-35B and L-38 Borrow Canals should not be drawn down below 10.5 feet NGVD. Releases from WCA-2A to WCA-2B from S-144, S-145, and S-146 are to be terminated if the WCA-2B stage (measured at Site 99 gage (USGS Site ID: 260810080222001)) exceeds 11.0 feet NGVD. In Zone B, only releases for water supply to the Lower East Coast service Area for municipal and industrial uses, agricultural supplemental irrigation, and to prevent saltwater intrusion are made. In Zone C, the conservation zone, a minimum elevation in the borrow canals of 10.5 feet NGVD, measured at S-11B HW gage, will be observed. Below this elevation no further releases will be permitted from the area unless preceded by an equivalent volume of inflow. The S-11s have no required minimum low-flow release.

From 1 January through 31 January, the Site 2-17 gage (USGS Site ID: 262240080258001) is the indicator gage for regulation; however, if the Site 2-17 stage recedes to 11.5 feet NGVD, the indicator gage becomes the S-11B HW gage. From 1 February through 30 June the S-11B HW gage is the indicator gage for regulation. Then from 1 July through 31 December the Site 2-17 gage is the indicator gage for regulation.

Water releases from WCA-2B are made via S-141. S-141 is a three-bay spillway structure that controls the water level in WCA-2B, and permits releases from the area to the North New River Canal through S-34E. Whenever the pool elevation in WCA-2B exceeds 11.0 feet NGVD, as measured at Site 99, S-141 will be operated for flood releases through S-34E if canal capacity is available and inflows from S-144, S-145, and S-146 will be suspended. Water levels in WCA-2B are mainly dependent on seepage and rainfall. A regulation schedule is not utilized for WCA-2B due to high rates of seepage from the area.

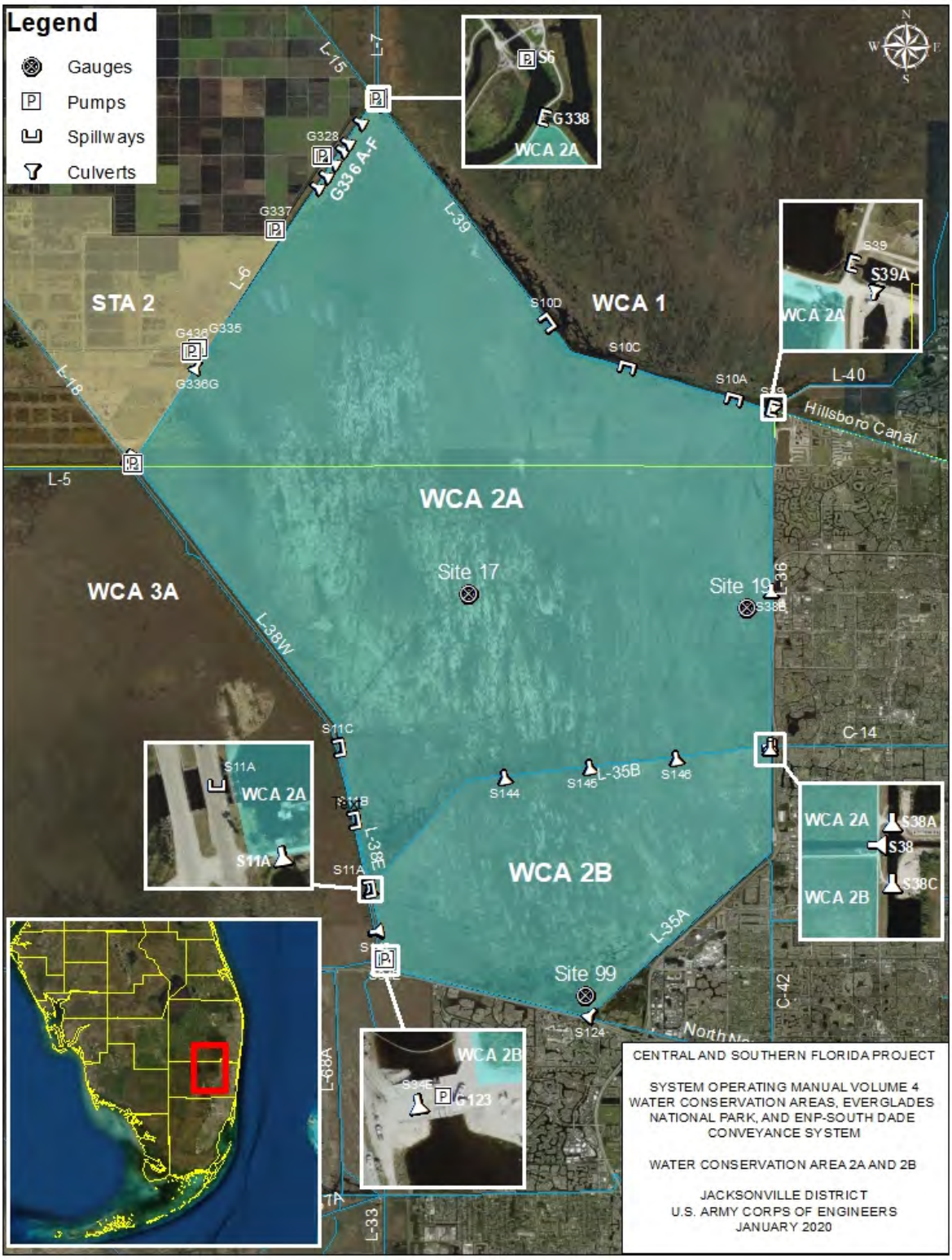
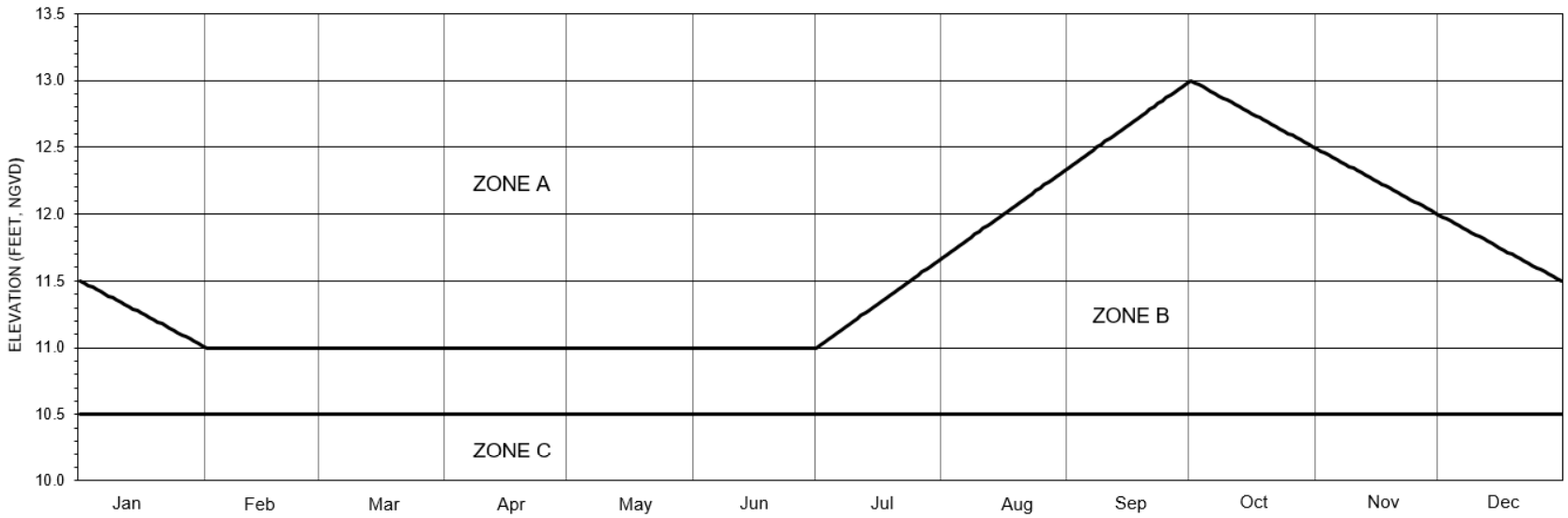


Figure 7-4. WCA-2A Map



ZONE	RELEASES		
A	Up to maximum at S-11; up to maximum capacity at S-144, 145, & 146; up to maximum practicable at S-143 & S-38 when requested by the Corps of Engineers but not to exceed 11.0 ft, NGVD, in WCA 2B. L-35B & L-38 borrow canals should not be drawn down below 10.5 ft, NGVD.		
B	Water Supply. L-35B & L-38 borrow canals are below 10.5 ft, NGVD.		
C	Conservation zone. When water levels are below 10.5 ft, NGVD at S-11B HW, water supply releases must be preceded by an equivalent volume of inflow. L-35B & L-38 borrow canals should not be drawn down below 10.5 ft, NGVD.		
Notes	Dates	Use Gauge	Conditions
	1 Jan - 31 Jan	2-17	If 2-17 stage recedes to 11.5 ft, NGVD, switch to S-11B HW gauge.
	1 Feb - 30 Jun	S-11B HW	All
	1 Jul - 31 Dec	2-17	All

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REGULATION SCHEDULE
Water Conservation Area 2A
US ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA
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Figure 7-5. WCA-2A Regulation Schedule

7.4.8.1.3 Water Conservation Area 3A

WCA-3A lies south of STA 5/6, Rotenberger and Holey Land Wildlife Management Areas, STA 3/4, STA 2, and WCA-2 (see **Figure 7-6**). The updated 2020 WCA-3A regulation schedule is shown in **Figure 7-7**. The WCA-3A stage is the 3-station average of gages A-3 (Site 63) (USGS Site ID: 261117080315201), A-4 (Site 64) (USGS Site ID: 255828080401301), and A3-28 (Site 65) (USGS Site ID: 254848080432001).

In addition to receiving releases from the S-11s, WCA-3A receives inflow from S-150 and S-190 by gravity and from pumping at S-8, S-9, S-9A, G-404 and S-140. Inflows from S-8 and S-150 consist of STA-3/4 and STA-5/6 treated water. S-9 and S-9A removes runoff from the South New River Canal (C-11W Basin) up to the design capacity of 2,880 cfs and 500 cfs, respectively. Pumping occurs at S-9/S-9A with S-381 open (bladder of the obermeyer structure is deflated), to maintain the stage in the South New River Canal below 3.6 feet NGVD. When S-381 is closed, S-9A is used to return seepage from WCA-3A. G-404 pumps treated water, up to the design capacity of 570 cfs, from STA-5 to the northwest corner of WCA-3A and provides water supply for the STOF and the EAA. S-140 removes water from the L-28 Borrow Canal up to the design capacity of 1,305 cfs. S-140 pumps are used to to maintain canal levels below 10.5 feet NGVD, unless gravity flow into WCA-3A is possible from the S-140. S-190 is a gravity structure on the L-28 Interceptor Canal that maintains optimum upstream water control stages in the North and West Feeder Canals and prevents the over drainage of these canals.

The S-12s (S-12A, S-12B, S 12C, and S-12D), S-333, and S-333N are the main outlets from WCA-3A to ENP for water deliveries. However, both S-12A and S-12B have a closure period (1 October through 14 July, with limited conditional openings during October for S-12A/B and November for S-12B) for the protection of CSSS subpopulation A (further defined in **Table 7-3**). The S-12s consist of four 6-gate spillways with a combined capacity designed to be 32,000 cfs under the SPF stages. However, as noted in **subsection 7.3.8**, the S-12s are not capable of achieving the original design capacity. S-333 is a single-bay gated spillway with a design capacity of 1,350 cfs. In addition to water deliveries to ENP, S-333 also releases from WCA-3A to the ENP-SDCS for water supply and when conditions result in the transfer of S-333 releases to S-334. S-333N is being constructed adjacent to S-333 to move water from WCA-3A to L-29 Borrow Canal. S-333N has a design capacity of 1,150 cfs. S-333N is scheduled to be constructed and operational by August 2020. S-333N will be operated in accordance with FDEP permit 0362076-001 or any subsequent modifications issued to SFWMD.

S-343A and S-343B may release, the design capacity of 195 cfs each, from WCA-3A into the Big Cypress National Preserve when the WCA-3A water stage is in Zone A. These structures have a closure period (1 October through 14 July) for the protection of the CSSS subpopulation A. S-344 may release, the design capacity of 135 cfs, from WCA-3A to the Big Cypress National Preserve when the WCA-3A water stage is in Zone A.

S-142, with a design capacity of 430 cfs, releases from WCA-3A into the North New River Canal through S-34E. S-151 releases from WCA-3A to the C-304 (Miami Canal) in WCA-3B for flood diversion and for the purpose of providing water supply to Miami area canals and the ENP-SDCS. S-151 may release up to the design capacity of 1,105 cfs subject to the headwater at S-31 not exceeding 9.0 feet NGVD.

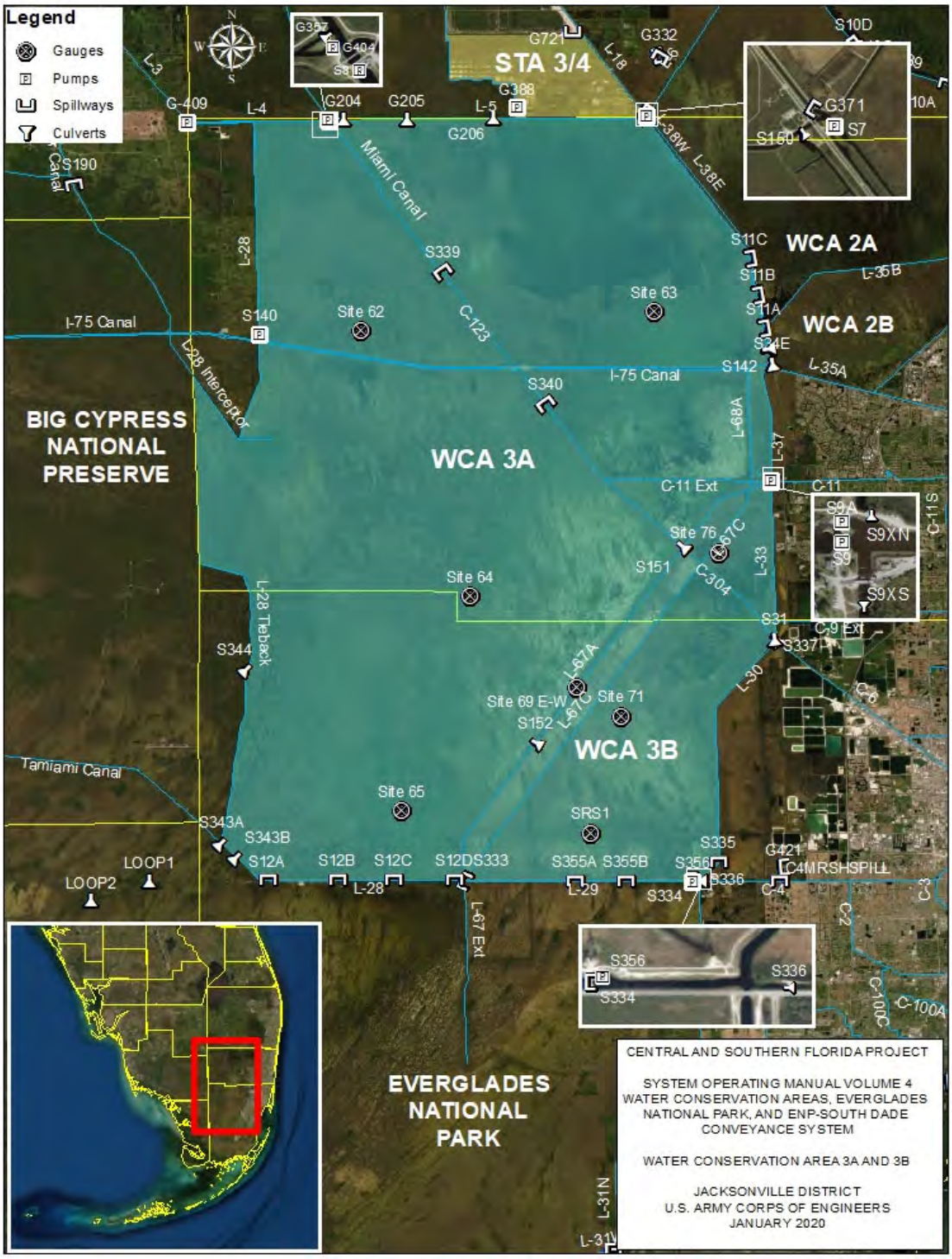
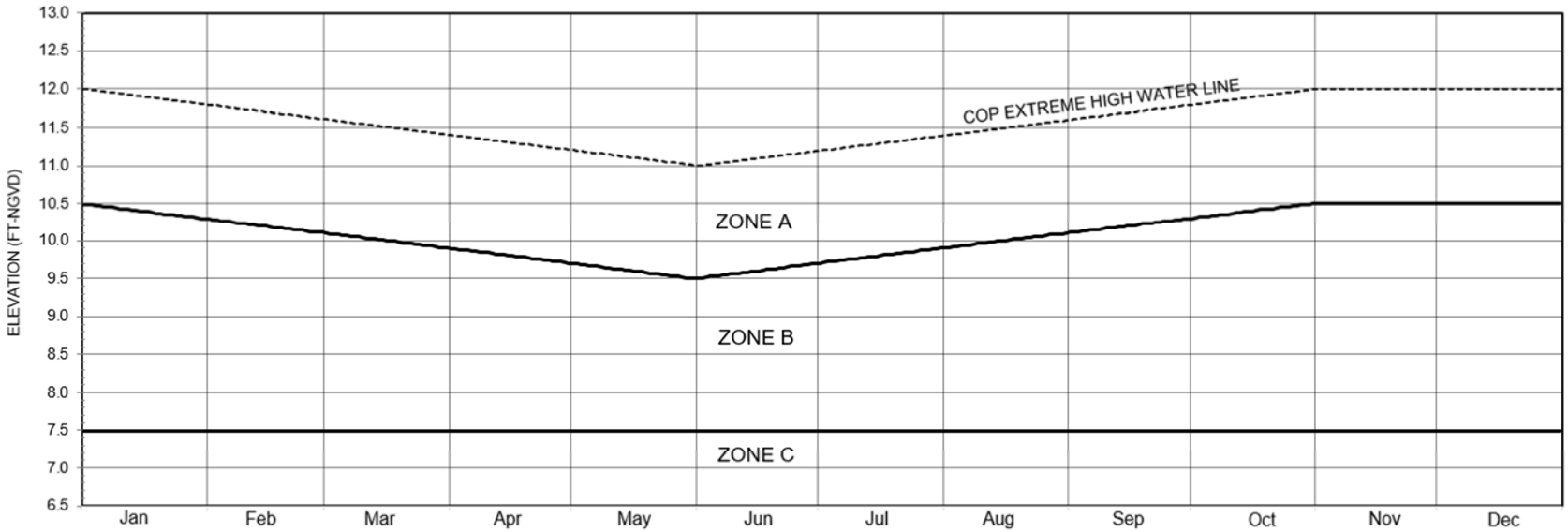


Figure 7-6. WCA-3A and WCA-3B Map



ZONE	RELEASES
A	Maximum releases at S-333, S-12D, S-12C, S-12B, S-12A, S-343B, S-343A, S-344, and S-151 subject to downstream constraints.
B	Up to the TTFF weekly target flows at S-333, S-12D, S-12C, S-12B, and S-12A (listed in priority order) to prioritize water deliveries to NESRS first and WSRS second, subject to downstream constraints. Water supply releases as needed.
C	Up to the TTFF weekly target flows at S-333, S-12D, S-12C, S-12B, and S-12A (listed in priority order) to prioritize water deliveries to NESRS first and WSRS second. When water levels are below elevation 7.5 feet, NGVD at Site 3-69W gage, water supply releases must be preceded by an equivalent volume of inflow.
Notes	Use 3-station average elevation (Site 63, 64, and 65) for WCA-3A Regulation except for Zone C. All elevations are in feet, NGVD 1929.
	When water levels are above the COP Extreme High Water Line (EHWL), a thorough evaluation of C&SF system conditions will be triggered. Details of EHWL are listed in Section 7.4.8.1.3.2.
	CSSS "A" RPA Closures: S-343A and S-343B are closed from 1 October through 14 July. S-12A and S-12B are closed from 1 October through 14 July with high water exit strategy.

CENTRAL AND SOUTHERN FLORIDA PROJECT
REGULATION SCHEDULE
Water Conservation Area 3A
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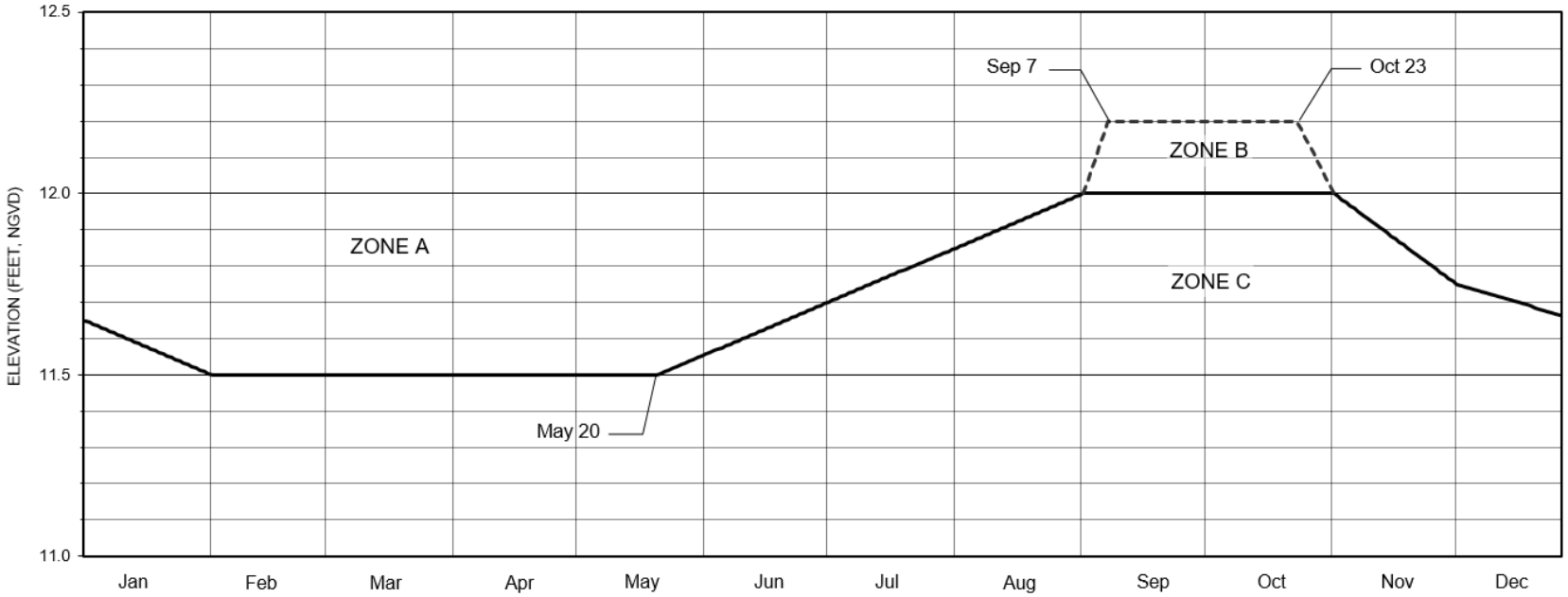
Figure 7-7. WCA-3A Regulation Schedule

S-152 releases water from WCA-3A to WCA-3B and is part of the Decompartmentalization and Sheetflow Enhancement Physical Model (DPM) project. S-152 and the associated 3,000-foot L-67C levee gap are temporary features for the DPM, which is a field-scale test that is being conducted to determine the best plan for future decompartmentalization of WCA-3, as envisioned in CERP. The DPM operational window is anticipated to be from November 2017 through 2021. S-152 releases up to the design capacity of 750 cfs from WCA-3A to WCA-3B under the following restrictions:

- L-67A must be above 7.5 feet NGVD.
- Site 71 gage (USGS ID: 255250080335001) and SRS-1 in WCA-3B must be below 8.5 feet NGVD.
- Water quality constraint criteria per FDEP Permit Number 0304879 (or any subsequent modifications issued to USACE) must be met.
- Closed when S-355A and S-355B are closed due to L-29 canal stage constraints.

S-339 and S-340 are structures on the C-123 (Miami Canal) that prevent over drainage of the northern end of WCA-3A, and force water through the marsh. These structures also provide the ability to transfer water to ENP and to Miami-Dade County canals including ENP-SDCS. These structures are normally closed but opened fully in accordance with the Operations Schedule for Canal 123, Structures 339 and 340 (**Figure 7-8**). The Site 62 gage (gage 3-2/"Deer gage") (USGS ID: 261023080443001) is the indicator gage for operation of these structures.

The 2020 WCA-3A Regulation Schedule has three zones: Zone A, Zone B, and Zone C as well as an Extreme High Water Line (EHWL) above Zone A. Zone A is above Zone B and delineated by a seasonally varying line that ranges from a maximum of 10.5 feet NGVD (1 November) to a minimum of 9.5 feet NGVD (1 July). In Zone A, maximum releases at S-333, S-333N, S-12D, S-12C, S-12B, S-12A, S-343A, S-343B, S-344, and S-151 subject to the closure periods and downstream constraints. An FDEP permit (issued to SFWMD) regulates operation of S-333N. When water stages are in Zone B or Zone C, the WCA-3A release targets are computed by the TTFF for S-333, S-333N, S-12D, S-12C, S-12B, S-12A (listed in priority order) to prioritize releases to Northeast Shark River Slough (NESRS) first and Western Shark River Slough (WSRS) second. Zone C defines the “floor” or minimum elevation for WCA-3A (7.5 feet NGVD, measured at Site 3-69W gage) (USGS Site ID: 255300080370001). Below this stage, no further releases for water supply to the Lower East Coast for municipal and industrial uses, agriculture supplemental irrigation or prevention of saltwater intrusion unless preceded by an equivalent volume of inflow (not applied to the TTFF releases). The TTFF is further described in **subsection 7.4.8.1.3.1**. The EHWL ranges from a minimum of 11.0 feet NGVD (1 June) to a maximum of 12.0 feet NGVD (01 November to 1 January) and is further described in **subsection 7.4.8.1.3.2**.



STRUCTURE OPERATION		
ZONE	S-340	S-339
A	* Open after 7 days in Zone	Open if S-8 pumping of 15,000 acre-feet or more expected next 14 days and S-340 open.
B	* Open after 30 to 14 days as the elevation varies from 12.0 to 12.2, respectively.	
C	Close after 0.25 feet below schedule unless transferring water from S-8 to Dade County or ENP.	
Notes	* Consecutive days in Zones A and B are cumulative. Use Site 62 (Gage 3-2) for the S-339 and S-340 regulation schedule. All elevations are in feet, NGVD 1929.	

CENTRAL AND SOUTHERN FLORIDA PROJECT
REGULATION SCHEDULE
Canal 123 Structures 339 and 340
US ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA
September 1997
File No. 400-32, 477

Figure 7-8. S-339 and S-340 Regulation Schedule

7.4.8.1.3.1 Tamiami Trail Flow Formula

The TTFF replaces the Rainfall Plan (RFP) and determines releases from WCA-3A to ENP (when WCA-3A stage is in Zone B or Zone C of the regulation schedule).The TTFF will be calculated and documented weekly. The TTFF is a set of water management operating protocols for WCA-3A key outlet structures to ENP.. The operational protocols shifted the system towards enhanced ecosystem and landscape performance yet maintained constraints imposed by flood risk management, water supply and other key systems requirements. The TTFF was developed by COP and leveraged decades of infrastructure improvements.

The TTFF improves upon the RFP, achieves hydrologic targets including:

- Surface water flow deliveries that resemble more natural processes
- Gradual rate changes to deliver surface water flows
- Surface water flow distributed across the entire slough

The TTFF uses a network of stage, potential evapotranspiration (PET), and rainfall gages in WCA-3A and ENP to guide real-time operations to convey water from WCA-3A across Tamiami Trail to ENP to meet ecological, flood risk management, and water supply needs in WCA-3A and ENP. The TTFF uses multiple stage stations for the start of the current week and the previous week's flow in a linear approximation formula to compute a flow target for the coming week. The flow formula and its variables are listed below.

$$\mathrm{Q}_{\mathrm{t}}^{\mathrm{sum}} = \beta^1 * \mathrm{S}_{\mathrm{t}}^{\mathrm{avg1}} + \beta^2 * \mathrm{S}_{\mathrm{t}}^{\mathrm{nesrs2}} + \beta^3 * \mathrm{Q}_{\mathrm{t-1}}^{\mathrm{sum}} + \beta^4 * \mathrm{R}_{\mathrm{t}}^{\mathrm{Avg}} + \beta^5 * \mathrm{PET}_{\mathrm{t}} + \beta^6 * \mathrm{ZA}_{\mathrm{t}}$$

where

$\boldsymbol{Q_t^{sum}}$ is the target daily releases (sum of S-12A, S-12B, S-12C, S-12D, S-333, and S-333N) to be implemented for the current (upcoming) week, t (cfs).

$\boldsymbol{S_t^{avg1}}$ is the average of observed stages (feet NGVD) at WCA-3A stages A-3 (Site 63), A-4 (Site 64) and A3-28 (Site 65) for the start of the current week *t*,

$\boldsymbol{S_t^{nesrs2}}$ is the observed stage (feet NGVD) at ENP gage NESRS2 (USGS Site ID: 254315080331500) for the start of the current week t,

$\boldsymbol{Q_{t-1}^{sum}}$ is the daily average of observed releases (sum of S-12C, S-12D, S-333, S-333N, S-12A, and S-12B) that occurred during the previous week t-1 (cfs). If flow occurs at S-334 for water supply to the Lower East Coast and/or to Taylor Slough, the sum of S-333 and S-333N flows need to be adjusted to consider S-333 plus S-333N flows reaching NESRS.,

$\boldsymbol{R_t^{avg}}$ is the areal average for the total weekly rainfall (inches) for the entire WCA-3A, Mullet Slough, and WCA-3B for current week t,

$\boldsymbol{PET_t^1}$ is the total weekly potential evapotranspiration (inches) at the 3AS3WX location, and

$\mathbf{ZA_t}$ is the Zone A regulation stage (feet, NGVD) value for time step t (beginning of current week).

βs are TTFF coefficients (see **Table 7-2** below).

Table 7-2. TTFF coefficients and associated standard error.

Parameter	S_t^{avg1}	S_t^{nesrs2}	Q_{t-1}^{sum}	R_t^{avg}	PET_t^1	ZA_t
Coefficient	318.42	-44.62	0.644	24.32	-96.31	-221.79
Standard Error	18.22	18.50	0.016	7.23	28.83	13.67

The TTFF is applied at the beginning of the current week t, time at which rainfall and PET for that week are not known, so the application of the formula requires the use of expected or forecasted values. Forecast rainfall, R_t^{avg}, is obtained from the 7-day Quantitative Precipitation Forecast (QPF) issued by the SFWMD's meteorologists. This process offers improved spatial resolution and provides specific knowledge/expertise from District Meteorologists. Any time an update is produced for south Florida weather forecast by the SFWMD's Meteorologists, the 7-day QPF for WCA-3 value is also updated and made available to staff in charge of implementing the TTFF. The WCA-3 rainfall area is the aggregation of WCA-3A, WCA-3B and Mullet Slough. The TTFF deliveries to ENP are not subject to the WCA-3A minimum elevation criterion that requires WCA-3A releases to be preceded by an equivalent volume of inflow.

Since in most of the cases observed rainfall and PET will not agree with the corresponding forecast, a correction term is applied to the computed target release for the current week t which is obtained as the difference between the recomputed target releases for the previous week t-1, using observed rainfall and PET for the preceding 7-day period and using the target release computed at that point in time (i.e., 7 days ago). The application of the weekly correction to the release target makes the approaches to obtain forecast rainfall and PET less critical. The coefficients for rainfall and PET in the TTFF indicate that if 1-inch error in any direction (over or underestimate) is made on the selected forecast for rainfall and PET, the impact for that week will be approximately at most ± 120 cfs.

The TTFF balances ecological restoration objectives of the MWD to ENP and C-111 SD Projects completed infrastructure by redistributing the existing WCA-3A and ENP water budget, while remaining forward compatible with future expected flow increases into WCA-3A. The decision-making process to determine releases from the WCAs maintains the flexibility outlined in **subsection 7.1**. Release decisions made by USACE that differ from the TTFF, which are anticipated to be infrequent, should be unique and will be defined by a desired outcome or time-period. These release decisions will be documented in the periodic inter-agency meetings for the AMMP (meeting frequency 1-2 times per year) and other established meetings (e.g., WCA-3 Periodic Scientists Calls and AMMP technical sub-team meetings) to help inform future AMMP considerations.

While refinement of the TTFF to improve upon some of the inherent limitations acknowledged in linear generalization of the optimal signal is possible, these efforts can be pursued in subsequent CEPP operational plan development activities anticipated in upcoming years. Additionally, the COP AMMP (Appendix C of the COP EIS) developed strategies to help improve the performance of the TTFF during dry conditions. These strategies are also included as an Annex in the WCP (**subsection 7.15.2**) and may be implemented to modify the TTFF target flows to ENP during specific drought conditions. Annex 8 of Appendix H of the COP EIS provides more detail on the development of the TTFF.

7.4.8.1.3.2 Extreme High Water Line

The 2020 WCA-3A regulation schedule includes the EHWL to provide operational flexibility for water management operations when extreme high water levels in WCA-3A exist. The purpose of the EHWL is to provide a capacity for regional water managers to effectively respond to extreme high water levels in WCA-3A. The operations described here are not expected to be triggered frequently and are intended to be available as the last resort if needed to help reduce risks to the WCA-3A perimeter levee system, the population of people who would be put at risk if the levee system failed, hurricane evacuation routes, and wildlife and tree islands from extreme high water conditions.

The EHWL is shown in **Figure 7-7** and ranges from 11.0 to 12.0 feet NGVD. When WCA-3A water levels are above the EHWL, this will trigger a thorough evaluation of the C&SF system conditions from Lake Okeechobee and its watershed to the WCAs, EAA, ECC, ENP, and ENP-SDCS, including consideration of other related actions which may be undertaken by the State of Florida. The information from this evaluation along with input provided from ENP will be used by USACE and SFWMD to decide on whether or not to implement any or all actions authorized by the EHWL. The conditions detailed below outline the additional operational flexibility for water management operations authorized by the EHWL.

Condition 1. When WCA-3A stage is above the EHWL but below 12.3 feet and the SFWMD position analysis (P90) does not project it to rise above Elevation 12.7 feet NGVD within the next 60 days, S-333 may have priority over S-356. S-334 may also be used up to its maximum capacity of 1,200 cfs to send water to tide and the eastern ENP boundary subject to SDCS system constraints. Under this condition, first priority will be water deliveries to the eastern boundary structures of ENP if capacity is available. S-332B, S-332C, and S-332D will be used to send water to C-111 NDA, C-111 South Detention Area (SDA), and S-332D Detention Area. Second priority will be given to S-336, S-338, S-194, and S-196 to make maximum practicable WCA-3A releases to tide (coastal release structures) subject to downstream conditions.

Condition 2. When WCA-3A stage is above the EHWL but below 12.3 feet NGVD and the SFWMD position analysis (P90) projects it to rise above Elevation 12.7 feet NGVD within the next 60 days, S-333 may have priority over S-356. S-334 may also be used up to its maximum capacity of 1,200 cfs to send water to tide through the use of all remaining coastal release structures including S-197 subject to SDCS system constraints. Extreme High Water Condition 1 priorities remain and will be maximized before sending additional water south to S-197. When in Extreme High Water Condition 2 and S-18C HW is above 2.3 ft. NGVD, S-197 releases may be increased up to a daily average of 1,200 cfs to accommodate additional flows through S-334. The expectation is that routing excess water from WCA-3A to S-197 would occur when S-334 is releasing at least 100 cfs. The total available capacity at S-197 will be decreased to 600 cfs when S-18C HW falls below 2.3 feet NGVD.

Condition 3. When WCA-3A stage is above 12.3 feet NGVD then S-197 may be increased up to 2,400 cfs until WCA-3A stage falls below 12.0 feet NGVD. S-333 may have priority over S-356. S-334 may be utilized up to its maximum capacity of 1,200 cfs subject to SDCS system constraints and through use of all remaining available coastal release structures including S-197. The releases up to 2400 cfs through S-197 are to handle the potential 800 cfs through the canal system from WCA-3A and up to 1600 cfs from the local basin to maintain canals in this area in their low range. Extreme High Water Condition 1 priorities remain and will be maximized before sending additional water south to S-197.

In addition, the WCA-3A releases to the L-29 Borrow Canal and through the SDCS have the following constraints under extreme high water conditions:

1. The L-29 Borrow Canal maximum operating stage is 8.5 feet NGVD subject to the FDOT constraints (refer to **subsection 7.3.2**). S-333 and S-356 releases will be reduced or terminated when L-29 Borrow Canal stage exceeds 8.5 ft. NGVD to lower the L-29 below 8.5 feet NGVD as required.
2. S-333N operates in accordance with the criteria specified in the FDEP CERPRA permit (#0362076-001) issued to SFWMD.
3. When the average stage in L-31N at the HW of S-332B, S-332C, and S-332D can be maintained below 4.4 feet NGVD then;
    a. When daily combined pumping at S-332B, S-332C, and S-332D is less than 1,125 cfs, S-334 may be used to deliver up to 250 cfs to S-332B, S-332C, S-332D, S-200, and S-199. S-334 releases above 250 cfs shall be passed through S-176 and S-177 to S-18C and S-197.
    b. When daily combined pumping at S-332B, S-332C, and S-332D is less than 1,000 cfs S-334 may be used to deliver up to 400 cfs to S-332B, S-332C, S-332D, S-200, and S-199. S-334 releases above 400 cfs shall be passed through S-176 and S-177 to S-18C and S-197.
4. When the daily average stage in L-31N using the HW of S-332B, S-332C, and S-332D can be maintained below 4.2 feet NGVD then there is no limit on the S-334 releases (up to 1,200 cfs) as long as the other L-31N canal reaches are maintained within or below their respective ranges.
5. If potential storm or an actual flooding condition in the L-31N Canal basin requires the use of S-356 as a flood risk management reduction measure, then S-334 operation will cease until S-356 HW can be maintained between 5.5 feet NGVD and 5.8 feet NGVD.
6. 8.5 SMA flood mitigation must be maintained and S-333/S-333N releases to NESRS may be suspended if the adherence with the 8.5 SMA flood mitigation criteria is not achieved as further defined in **subsection 0**. The intent of a reduction and a temporary suspension of WCA-3A releases to NESRS is to allow 8.5 SMA to recover from a prolonged hydroperiod that exceeded the flood mitigation criteria. An after-action report will be required anytime WCA-3A releases to NESRS are stopped because 8.5 SMA flood mitigation criteria are not being met.

Operations as per the EHWL Conditions 1, 2 or 3 will end with a transition period not to exceed 14 days or when the WCA-3A stage is at least 0.2 feet below the EHWL, whichever occurs first.

7.4.8.1.4 Water Conservation Area 3B

A regulation schedule is not used for WCA-3B due to the limited inflow and high rates of seepage from the area. Releases from WCA-3B can be made through S-31, S-337, S-355A, and S-355B. See **Table 7-3** for additional S-31 and S-337 operating criteria to avoid fish kills.

WCA-3B inflow and outflow structures shall be operated consistent with FWC guidance below for achieving inundation and recession/ascension targets in WCA-3B to the extent that achieving or trying to achieve the identified goals does not conflict with 1) flood risk management, 2) water supply, or 3) the other operational constraints listed above.

7.4.8.1.4.1 FWC Hydrologic Management Strategy for WCA-3B (Measured at Site 71)

1. Dry Season Low Range Surface Water Depth: 0.06 to 0.96 feet (6.6 feet NGVD to 7.5 feet NGVD).
2. Wet Season High Surface Water Depth: Approximately 2.0 feet (8.5 feet NGVD).
3. 1 January Target Surface Water Depth Range: 1.16 to 2.06 feet (7.7 feet NGVD to 8.6 feet NGVD).

4. Recession Rate Guidelines (1 January – 1 June): Approximately 0.05 to 0.07 feet per week to benefit snail kites, wood storks, and wading birds.
5. Ascension Rate Guidelines (1 June – 1 October): Maximum of 0.25 feet per week and approximately 0.05 feet per week minimum.
6. Tree Island Threshold: Surface Water Depths >2.0 feet for no more than 60 days per year (8.5 feet NGVD).

7.4.8.2 Everglades National Park

COP was developed with the goal of improving water deliveries into ENP and is a step forward in restoring the natural hydrologic conditions in ENP given the current C&SF infrastructure and features. The operations are intended to restore NESRS by improving the quantity and timing of water deliveries (TTFF) as well as restore hydraulic conditions in Taylor Slough, Rocky Glades, and the Eastern Panhandle of ENP by utilizing and adjusting the completed C&SF project features.

The physical roadway of Tamiami Trail (U.S. Highway 41) is also undergoing a series of construction phases to enable increased flow to pass under the eastern 10 miles of road adjacent to the L-29 Borrow Canal between S-333 and S-334. Over three miles of bridges have been installed, with a 1-mile stretch on the eastern side and a 2.3-mile stretch on the western side. Federal and State funding has also been allocated to further modify the road base in this area to support L-29 Borrow Canal stages up to 9.7 feet NGVD to facilitate future increased flows envisioned in CERP implementation. **Figure 7-9** shows the ENP, ENP-SDCS map.

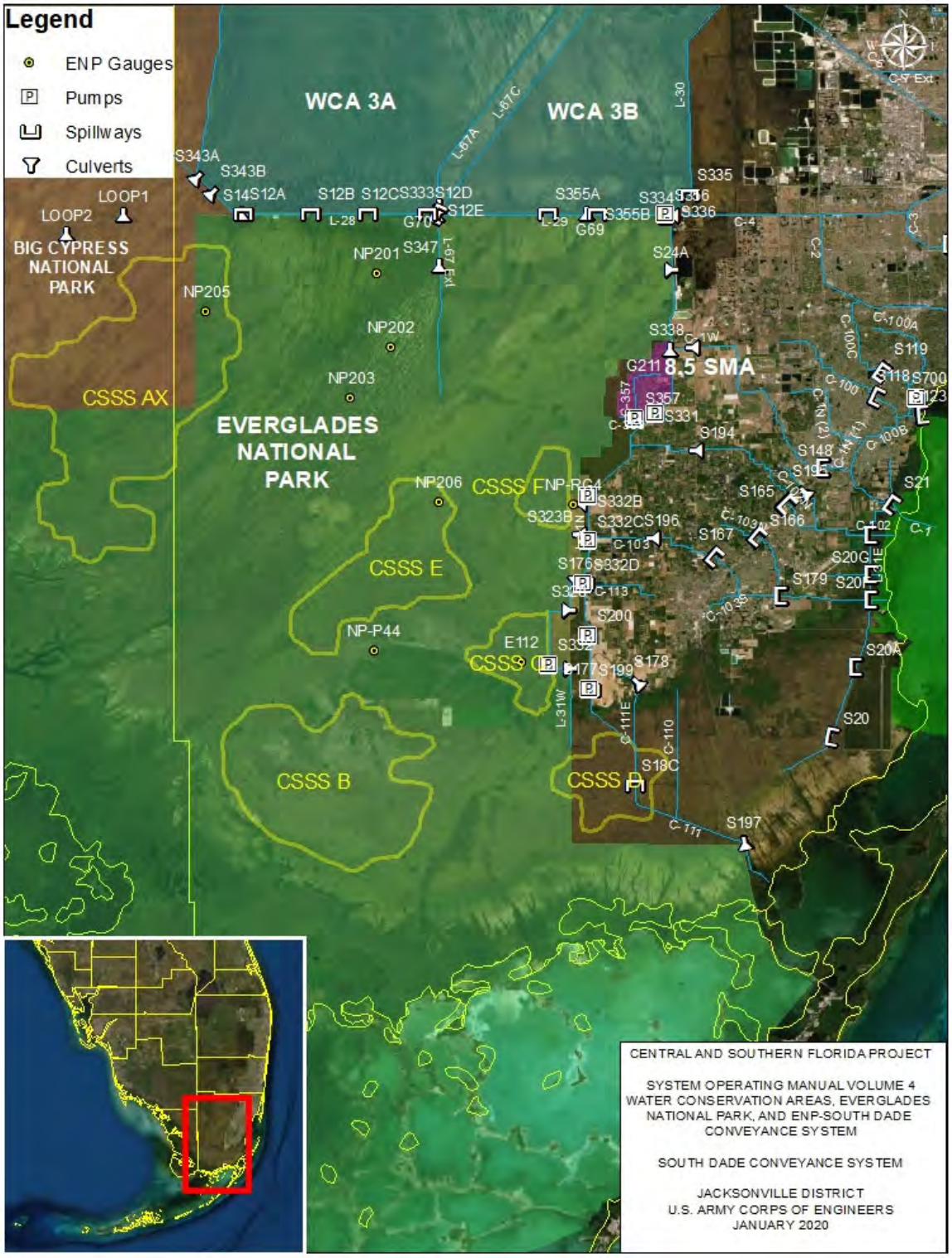


Figure 7-9. ENP and ENP-SDCS Map

7.4.8.2.1 Northeast Shark River Slough

The L-29 Borrow Canal conveys water released through S-333 or S-356 to ENP/NESRS. The L-29 Borrow Canal will be maintained up to 8.5 feet NGVD for up to 90 cumulative days per water year (1 May through 30 April), with the opportunity to increase the duration based on written FDOT approval. The number of cumulative days will be measured when L-29 Borrow Canal stage exceed 8.3 feet NGVD. L-29 Borrow Canal stage higher than 8.5 feet NGVD for longer than 90 days will need FDOT written approval.

In order to avoid exceeding 8.5 feet NGVD in the L-29 Borrow Canal, the 5-day QPF will be monitored and stages in the L-29 Borrow Canal will be reduced based on the forecasted QPF. This criteria is further defined in **Table 7-3**. Once the L-29 Borrow Canal reaches a stage of 8.5 feet NGVD, all inflows to the L-29 Borrow Canal (S-333, S-333N, S-355A, S-355B, and S-356) will be suspended and S-334 may be used to ensure the L-29 Borrow Canal stage remains at or below 8.5 feet NGVD.

7.4.8.2.2 Routing Water towards Taylor Slough (Florida Bay)

SDCS operations utilize the C-111 NDA, C-111 SDA, and the S-332D Flow-way to maintain canal stage targets in the lower L-31N canal. Prolonged use of the C-111 SD detention areas, particularly following significant rain events, has the tendency to set up a large stage difference between the marsh in Rocky Glades to the west and the canal stage in the lower L-31N and C-111 Canals. This is expected and is how the system is designed to work, as it is the water level in the detention areas that provides the hydraulic ridge that supports this stage difference. The hydraulic ridge can dissipate quickly following an abrupt cessation of pumping. This abrupt cessation can lead to a rapid reduction in the water level of the ENP marsh near the detention areas. However, drying down of the marsh occurs naturally during the dry seasons. The rate of marsh recession that can occur when pumping is halted after a significant rain event is much faster than naturally induced recession rates, and rapid recession can be particularly harmful to fish communities. The new seasonal operations for S-332B, S-332C, S-332D, S-200, and S-199 support maintenance of the hydraulic ridge and its gradual recession.

Analyses performed during COP indicate that supplemental water deliveries up to 400 cfs may be made from L-30 Canal (upstream of S-335) from 1 August through 14 February. The following S-335 operating criteria provide these flows:

1. Release up to 200 cfs when S-335 HW stages are 5.3 to 6.0 feet NGVD.
2. Release up to 400 cfs when S-335 HW stages are 6.0 to 6.5 feet NGVD.
3. Supplemental releases suspended when the S-335 TW stage equals or exceeds 6.1 feet NGVD or when S-176 HW stage equals or exceeds 4.7 feet NGVD.

Similar releases up to 200 cfs may also be made between 14 February and 1 May when the S-335 HW is above 6.0 feet NGVD.

Additionally, WCA-3A may also be used to maintain the hydraulic ridge along the C-111 detention areas and/or provide deliveries to Taylor Slough. This operation will be limited to 200 cfs when WCA-3A stages are greater than 9.80 feet NGVD average at Site 62 and Site 63 gages. This water level is 0.5 feet above the FWC muck fire closure criteria for northern WCA-3A (9.3 feet NGVD)). These deliveries, if provided, will be coordinated by USACE with SFWMD and ENP. This flow limit will be measured at S-334 or S-337. This operation is intended to support gradual recession rates in the marsh by providing additional water to the S-332B, S332C, S332D, S-200, and S-199 pump stations. When S-332C headwater elevation falls

below 3.8 feet NGVD during the dry season, all pump operations for Taylor Slough deliveries and the maintenance of the hydraulic ridge will cease.

7.4.8.2.3 Water Deliveries to the Eastern Panhandle of ENP via C-111

The purposes of S-18C are to maintain a desirable freshwater head to prevent saltwater intrusion through C-111, pass flood flows up to 40 percent SPF without exceeding design stages upstream, and act as a control point for water deliveries to the eastern panhandle of ENP. Spoil material on the southern side of the C-111 between S-18C and -S-197 was removed to improve sheetflow of freshwater from S-18C to ENP and Florida Bay as well as to moderate the frequency of S-197 gate openings. Water flows across the bank along C-111 into the Eastern Panhandle of ENP. Gate operations are remotely controlled to maintain S-18C HW stages between 2.3 and 2.65 feet NGVD.

S-197 maintains water control stages in C-111 and prevents saltwater intrusion during high tides. Typically, S-197 is closed to divert water from S-18C over land to the eastern panhandle of ENP. S-197 releases water only for flood risk management according to S-197 operating criteria (**Table 7-3**). The COP operations are designed to minimize the damaging freshwater flows to Manatee Bay/Barnes Sound through the S-197 structure and preserve the design capacity of 2,400 cfs for rare use only during extreme flooding events.

7.4.8.3 Everglades National Park-South Dade Conveyance System (L-31N & C-111)

The ENP-SDCS water levels are optimized in COP to provide environmental benefits, flood risk management, and water supply, and to prevent saltwater intrusion. Canal stages and structure operations prompting water supply are listed in **Table 7-1**. Normal system operational guidance is provided in **Table 7-3**. **Subsection 7.5** also contains reference to Pre-Storm / Storm / and Storm Recovery Operations for SDCS. **Figure 7-10** shows the ENP-SDCS project map.

7.4.8.3.1 South Dade County

The purposes of the C&SF Project works in South Miami-Dade County were to remove the 40 percent of SPF runoff from the entire 206 square mile effective drainage area, reduce depth and duration of larger floods, provide water control to prevent over drainage in the area, prevent saltwater intrusion, and provide facilities to convey up to 500 cfs to ENP when normal runoff is available. The construction of the ENP-SDCS modified the existing project works in South Miami-Dade County. More detailed discussions of the South Miami-Dade County Project works are contained in Volume 5, East Coast Canals Master Water Control Manual.

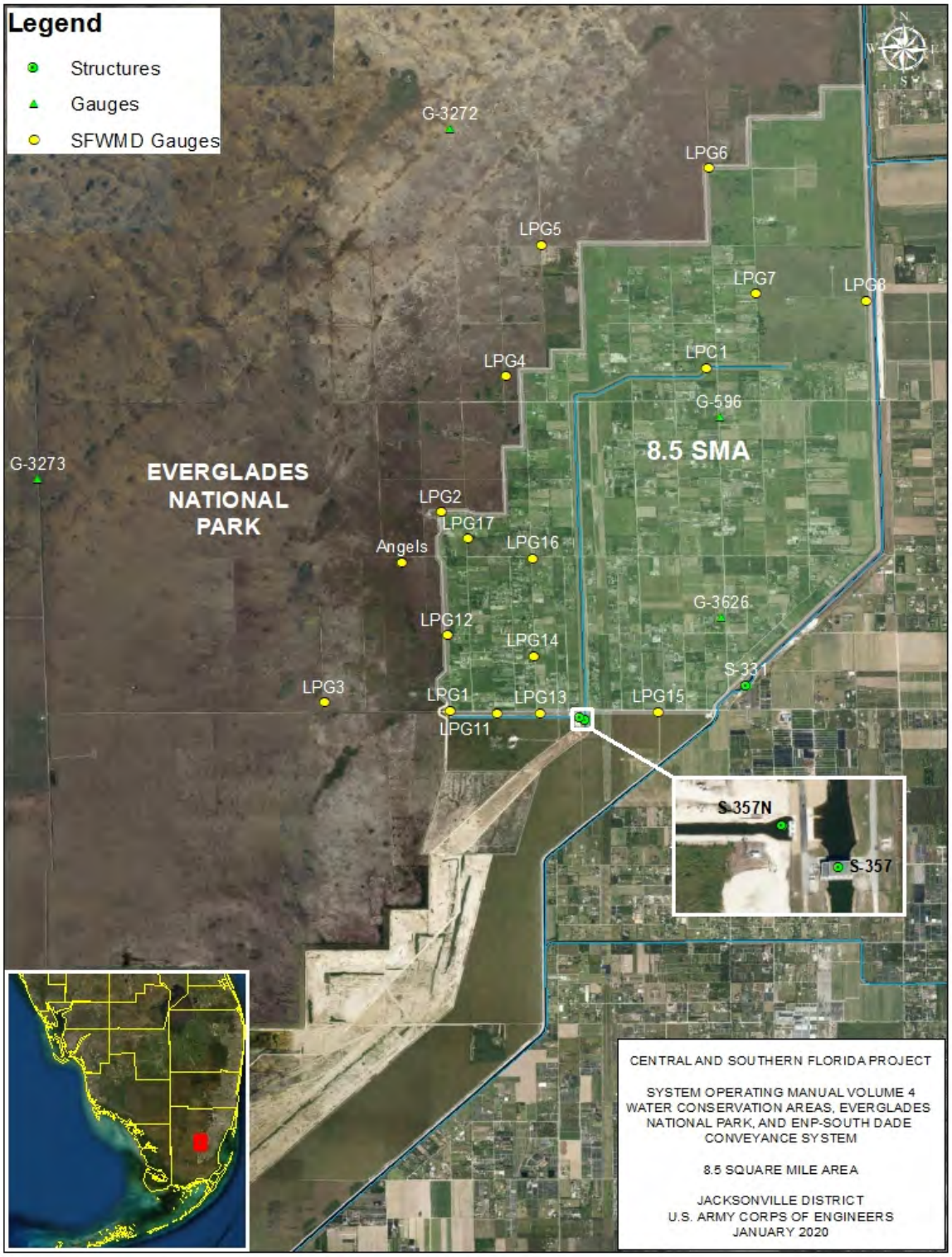


Figure 7-10. 8.5 SMA Detail Map

7.4.8.3.2 8.5 Square Mile Area

The 8.5 Square Mile Area (SMA), also referred as the Las Palmas Community, project features are designed to mitigate for increased flood risk as a result of increased water levels in NESRS and other areas of ENP resulting from the MWD to ENP Project. The constructed features of the 8.5 SMA Project and C-111 SD Project available for water management operations include: the canals C-357 and C-358, the 8.5 SMA Detention Area/flow way and the C-111 NDA, pump stations S-357 and S-331, and structure S-357N (See Figure 7-10). S-357 and S-357N provide primary flood mitigation to the residents of the 8.5 SMA and S-331 provides secondary flood mitigation benefits only during high water conditions. Detailed structure operations are listed in **Table 7-3**.

COP modeling demonstrated all interior areas of 8.5 SMA met the flood mitigation requirements, consistent with the 2000 GRR/EIS. However modeling also indicated that there are portions of 8.5 SMA along the western ENP boundary that remain very challenging and require real-time monitoring to ensure compliance.

The USACE will monitor rainfall at S-331 and recession rates at indicator gages located within and around the 8.5 SMA (LPG-1, LPG-2, LPG-16, and LPG-17) to ensure flood mitigation (hydroperiod duration targets and constraints) are met. The flood mitigation criteria must be maintained. If the flood mitigation criteria are projected to be exceeded, flows into NESRS may be temporarily suspended to help reduce water levels in the 8.5 SMA. An after-action report will be required anytime WCA-3A releases to NESRS are suspended because 8.5 SMA flood mitigation criteria are not being met.

When both S-357 and S-331 operate at the lowest canal settings and the 8.5 SMA target hydroperiod duration is projected to be exceeded, WCA-3A flows to NESRS may be temporarily suspended until water levels in 8.5 SMA, specifically the area west of C-357 Canal, recede below ground surface elevations. This decision will be based on near-term and intermediate-term (1-3 weeks) forecasted rainfall as well as projected recession rate at the 8.5 SMA indicator gages.

Additionally, WCA-3A flows to NESRS will be temporarily suspended if:

a. Water levels in 8.5 SMA are projected to exceed 6 inches below the lowest first floor elevation (lowest first floor elevation estimated at 8.5 feet NGVD) of residential properties near to L-357W Levee within 48 hours, OR

b. The 8.5 SMA continuous hydroperiod duration constraint (**Figure 7-11**) for a rainfall event at LPG-2 or LPG-1 (or future in-kind replacement locations) is projected to be exceeded, OR

c. The 8.5 SMA discontinuous hydroperiod duration constraint (**Figure 7-11**) for LPG-2 or LPG-1 (or future in-kind replacement locations) is projected to be exceeded.

If flows are suspended into NESRS, the L-29 Borrow Canal water level will be reduced until water levels in 8.5 SMA, specifically the area west of C-357 Canal recede below ground surface elevations. 8.5 SMA flood mitigation criteria were developed in accordance with Part C.6 of Appendix C of the COP EIS (Water Quality and Hydrology Monitoring Plan for 8.5 SMA Flood Mitigation) and the MWD to ENP Incremental Field Test.

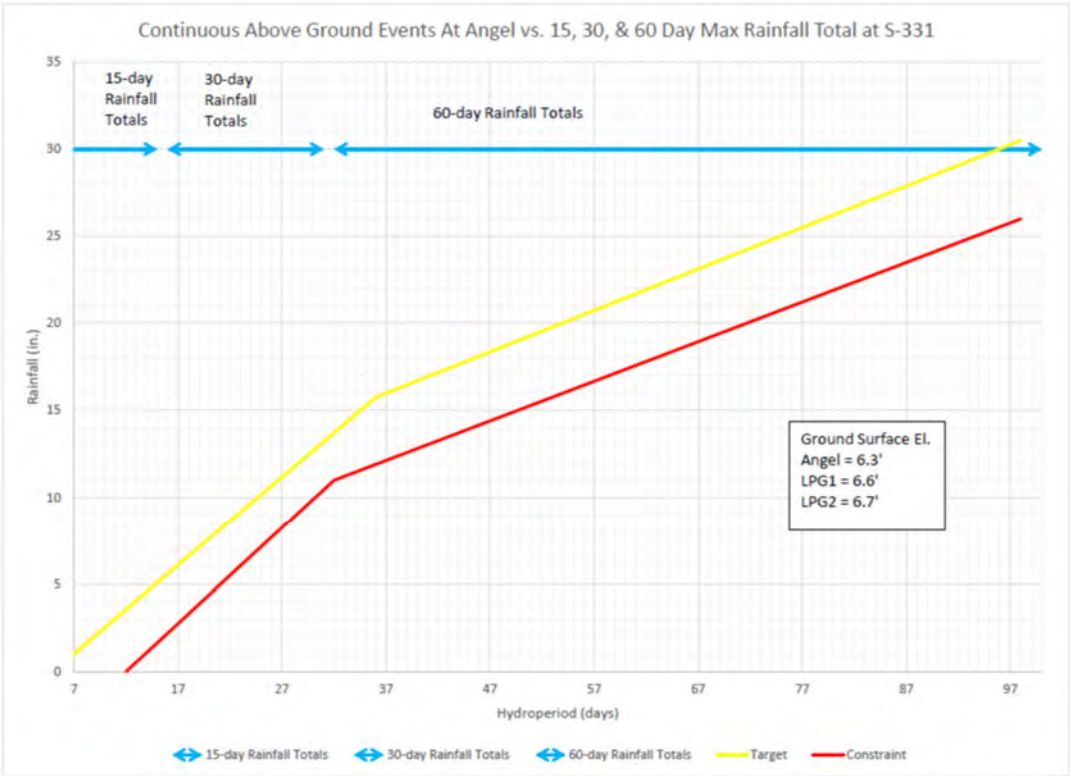


Figure 7-11. 8.5 SMA Hydroperiod Target and Constraint

7.4.8.4 Standing Instructions to Project Operators Summary Table

The Operating Criteria table (**Table 7-3**) lists structures and operating criteria for the WCAs, ENP, and ENP-SDCS according to their respective hydrologic basins or canals from north to south. If there is a perceived conflict between the criteria in **Table 7-3** compared to the criteria described in complementary text of this Chapter or if the table lacks clarity, then the criteria as described in the body of the text shall be consulted and shall control.

The Flood Risk Management (FRM) and Environmental Restoration (ER) operational ranges prescribed in **Table 7-3** were developed from a combination of operational experience, modeling results, analysis of historical data, and the expected performance of existing and proposed features. These ranges are not simple ON and OFF ranges used for pumps or simple OPEN and CLOSE used for gates in some earlier C&SF hydrologic modeling analyses.

When stages are above the FRM&ER HIGH stage criteria, timely action (e.g., gate adjustment or pumping changes) will be made to lower the stage at a rate consistent with the current conditions (e.g., height above the HIGH stage, rate of rise, recent basin rainfall, and expected inflows) and forecasted conditions, seasonal variability, and antecedent conditions. Within the range between the FRM&ER HIGH and FRM&ER LOW stage criteria, the operators have full discretion to adjust pumps or gates or a combination of both to achieve the stage deemed most appropriate for the current and forecasted conditions as long as they remain consistent with prescribed objectives and constraints. Changes in pumps or pumping rate (number or RPM of pumps) can be implemented to rotate pumps or compensate for unavailable pumps. For basins with high rates of surface and groundwater interactions, compliance with the operation range should be based upon the daily average stage. For canal stages being maintained by pump stations,

compliance with the operation range should allow the use of daily averages (0000 to 2400 hours) with the lowest operating stage maintained above the lower limit for each pump.

When the canal stage falls below the FRM&ER LOW stage criteria, timely operational changes will be made to either raise the canal stage back to the operational range or transition into appropriate operational stages above the FRM&ER LOW stage (e.g. water conservation).

Table 7-3. Operating Criteria.

Basin / Canal	Operational Component	Description and Operating Criteria
WCA-1	S-10A, S-10C, S-10D	WCA-1 is regulated by three main outlet structures, S-10A, S-10C, and S-10D with a combined design capacity of 14,800 cfs under SPF stages. The S-10s release water from WCA-1 to WCA-2A based on water levels in WCA-1 and its regulation schedule (**Figure 7-3**).
WCA-1	S-39	S-39 releases water from WCA-1 to the Hillsboro Canal. Its primary purpose is to provide for water supply needs along the Hillsboro Canal during the dry season. It also can be used to release excess water from WCA-1 when downstream capacity is available. S-39 has a design capacity of 800 cfs.
WCA-2A	S-11A, S-11B, and S-11C	WCA-2A is regulated by three main outlet structures, S-11A, S-11B, and S-11C with a combined design capacity of 17,200 cfs under SPF stages. The S-11s release water from WCA-2A to WCA-3A based on water levels in WCA-2A and its regulation schedule (**Figure 7-5**).
WCA-2A	S-144, S-145, and S-146	Water can be transferred into WCA-2B via S-144, S-145, and S-146, located in L-35B. These structures each have a design capacity of 210 cfs. When WCA-2A is in Zone A, regulatory releases can be made into WCA-2B until the Site 99 gage reaches 11.0 feet NGVD.
WCA-2A	S-143	S-143 releases water from WCA-2A to supply water needs along the North New River Canal during the dry season and can be used to release excess water from WCA-2A when capacity is available in the North New River Canal and when the water is not needed in WCA-3A and the stage downstream of S-34E is not above 6.0 feet NGVD. S-143 has a design capacity of 500 cfs.
WCA-2A	S-38	S-38 releases water from WCA-2A to supply water needs in the area served by C-13 and C-14 during the dry season. It also can be used to release excess water from WCA-2A when capacity is available in C-13 and C-14 and when the water is not needed in WCA-3A. S-38 has a design capacity of 500 cfs.
WCA-2B	S-141	S-141 releases water from WCA-2B to the North New River Canal. When Site 99 gage elevation > 11.0 feet NGVD, S-141 is open for flood releases through S-34E if canal capacity is available and subject to downstream constraints. A regulation schedule is not utilized for WCA-2B due to high rates of seepage from the area. S-141 has a design capacity of 435 cfs.
WCA-2A/2B	S-34E	S-34E releases water from WCA-2A or WCA-3A to supply water needs along the North New River Canal during the dry season. It also can be used to release excess water from WCA-2A, WCA-3A and/or WCA-2B when

Basin / Canal	Operational Component	Description and Operating Criteria
		capacity is available in the North New River Canal and when the water is not needed in WCA-3. S-34E has a design capacity of 600 cfs.
WCA-3A	WCA-3A Regulation Schedule and TTFF	WCA-3A is regulated by the S-12A, S-12B, S-12C, S-12D, S-333, S-333N, S-344, S-343A, S-343B, S-151, and S-152 structures. The primary structures for WCA-3A water deliveries to ENP are the S-12s and S-333. Releases are based on the 2020 WCA-3A Regulation Schedule **(Figure 7-7**) and TTFF (**subsection 7.4.8.1.3.1**). WCA-3A stage is the three (3)-station average of gages A-3 (Site 63), A-4 (Site 64) and A3-28 (Site 65). There are three zones in the WCA-3A Regulation Schedule: Zone A Zone B, and Zone C as well as an Extreme High Water Line (EHWL). Zone A is above Zone B and delineated by a seasonally varying line that ranges from a maximum of 10.5 feet NGVD (1 November) to a minimum of 9.5 feet NGVD (1 July). In Zone A, up to maximum releases at S-333, S-333N (per FDEP permit issued to SFWMD), S-12D, S-12C, S-12B, S-12A, S-343B, S-343A, S-344, and S-151 subject to downstream constraints and closure periods. When water stages are in Zone B or Zone C, the WCA-3A release targets are computed by the TTFF for S-333, S-333N, S-12D, S-12C, S-12B, S-12A (listed in priority order) to prioritize releases to Northeast Shark River Slough (NESRS) first and Western Shark River Slough (WSRS) second. Zone C defines the "floor" or minimum elevation for WCA-3A (7.5 feet NGVD, measured at Site 3-69W gage) (USGS Site ID: 255300080370001). Below this stage, no further releases for water supply to the Lower East Coast for municipal and industrial uses, agriculture supplemental irrigation or prevention of saltwater intrusion unless preceded by an equivalent volume of inflow. The EHWL ranges from a minimum of 11.0 feet NGVD (1 June) to a maximum of 12.0 feet NGVD (01 November to 1 January) and is further described in subsection 7.4.8.1.3.2.
WCA-3A	WCA-3A Tamiami Trail Flow Formula	TTFF will provide weekly release targets across Tamiami Trail. (See **subsection 7.4.8.1.3.1** and Appendix H of the COP EIS) *Note: Replaces WCA-3A Rainfall-based Management Plan.*
WCA-3A	COP Extreme High Water Line (EHWL)	COP EHWL ranges between 11.0 to 12.0 feet NGVD (see **Figure 7-7** and **subsection 7.4.8.1.3.2**)
WCA-3A	Water Supply Releases from WCAs	During low water conditions, it is difficult to draw water from the interior of the WCAs. The regulation schedules for WCA-1, WCA-2A, and WCA-3A include a "floor" or minimum water levels below which water supply releases from the WCAs must be preceded by an equivalent volume of inflow. The water levels may continue to recede due to evaporation and seepage. There is not a requirement to maintain the minimum elevation. Monitoring gages for the WCAs floors are: WCA-1 - Gage 1-8C at 14.0 feet NGVD WCA-2A - S-11B HW stage at 10.5 feet NGVD WCA-3A - Gage 3-69W at 7.5 feet NGVD Water supply releases from WCA-3A are delivered for water supply to east and south Miami-Dade County to maintain minimum canal levels and prevent salt-water intrusion.

Basin / Canal	Operational Component	Description and Operating Criteria
WCA-3A	S-142	S-142 releases water from WCA-3A to supply water needs along the North New River Canal during the dry season. It can also release excess water from WCA-3A when capacity is available in the North New River Canal. S-142 has a design capacity of 500 cfs.
WCA-3A	S-339	S-339 structure is a sheet pile barrier dam on C-123 (the Miami Canal) about 6 miles north of I-75. It was designed to prevent over drainage of the northern portion of WCA-3A by forcing flows from C-123 Canal out into the marsh, and to transfer water to the ENP, the Metropolitan Miami, and the south Miami-Dade County areas. The structure is closed most of the time, but it is opened fully in accordance with the operations schedule (**Figure 7-8**). The optimum headwater elevation is 11.0 feet NGVD. S-339 has a design capacity of 1,100 cfs.
WCA-3A	S-340	S-340 structure is a sheet pile barrier dam on C-123 (the Miami Canal) about 2.7 miles south of I-75. It was designed to prevent over drainage of the northern portion of WCA-3A by forcing flows from C-123 Canal out into the marsh, and to transfer water to the ENP, the Metropolitan Miami, and the south Miami-Dade County areas. The structure is closed most of the time, but it is opened fully in accordance with the operations schedule (**Figure 7-8**). The optimum headwater elevation is 9.3 feet NGVD. S-340 has a design capacity of 1,100 cfs.
WCA-3A	S-344	S-344 releases water from WCA-3A to Big Cypress National Preserve. The structure is open when WCA-3A is in Zone A and closed when WCA-3A is below Zone A subject to the below downstream constraint. Downstream constraint: Loop Rd 1 Gage should be kept below 8.5 feet NGVD to avoid flooding Loop Road. Loop Rd 1 Gage is shown in Figure 7-9. S-344 has a design capacity of 135 cfs.
WCA-3A	S-343A and S-343B	S-343A and S-343B release water from WCA-3A to Big Cypress National Preserve. The structures are open 15 July through 30 September when WCA-3A is in Zone A and closed 1 October through 14 July. The structures are also closed at all times when WCA-3A is below Zone A and are subject to the below downstream constraint. Downstream constraint: Loop Rd 1 Gage should be maintained below 8.5 feet NGVD to avoid flooding Loop Road. S-343A and S-343B each has a design capacity of 195 cfs.
WCA-3A	S-12A/B/C/D	S-12A/B/C/D, all are operated in accordance with WCA-3A regulation schedule and TTFF, except for S-12A and S-12B which have the following seasonal closure criteria for the marl prairie and CSSS subpopulation A. Seasonal Closure Criteria: S-12A and S12-B closed from 1 October through 14 July with the following limited conditional opening: S-12A and/or S-12B will be conditionally opened during October under the following conditions. 1. WCA-3A stage based on 3 gage average of Site 63, Site 64, and Site 65 on 30 September is greater than 10.5 feet NGVD; or

Basin / Canal	Operational Component	Description and Operating Criteria
		2. WCA-3A stage is projected to rise above 10.75 feet NGVD during October, based on consideration of projected inflows and direct rainfall. 3. S-12A and/or S-12B will be closed when the WCA-3A stage falls below 10.25 feet NGVD, OR on 1 November, whichever comes first. S-12B will be conditionally opened during November under the following conditions: 1. WCA-3A stage on 31 October is greater than 11.0 feet NGVD; or 2. WCA-3A stage is projected to rise above 11.25 feet NGVD during November, based on consideration of projected inflows and direct rainfall. 3. S-12B will be closed when the WCA-3A stage falls below 10.75 feet NGVD, OR on 1 December, whichever comes first. S-12C no closure period. S-12D no closure period. Additional Year-Round Operational Criteria: S-12A Year-round: To provide access to cultural areas, when TTFF results in S-12 target flows, S-12A up to 100 cfs release is available when requested by the Tribe. (See **subsection 7.4.7.1**.) S-12A Cultural Access Release: S-12A up to 100 cfs release is available when TTFF results in S-12 target flows and is requested by the MTIF. From 1 October through 14 July, the MTIF and USACE must request informal consultation with USFWS to avoid impacts on CSSS subpopulation A. The duration of this release will not exceed five consecutive days. S-12A up to 100 cfs release may only occur when 3-gage average (Sites 63, 64, 65 in WCA-3A) is greater than 8.4 feet NGVD. During S-12A up to 100 cfs release, data such as but not limited to NP-205 stage and area rainfall will be monitored. If NP-205 stage increases or is anticipated to increase above 5.7 feet NGVD, S-12A will close. S-12C/D Year-round: S-12C and/or S-12D release up to WCA-3A Regulation Schedule (Zone A maximum) or TTFF (target flow). S-12s Flow Distribution: S-12 opening sequence to meet Target Flows is prioritized from east to west (S-12D, S-12C, S-12B then S-12A) as each structure reaches their maximum flow capacity; S-12A/B/C/D may be opened if their headwater is greater than 11.0 feet NGVD to pass an amount only enough to prevent overtopping of gates to protect gate instrumentation. For S-12A and S-12B, the USACE will assess upstream conditions and will close S-12A/B gates when headwater levels drop below 10.75 feet NGVD.
WCA-3A	S-151	S-151 releases water from WCA-3A to the C-304 (Miami Canal) in WCA-3B for both flood risk management and water supply. S-151 may make maximum releases to WCA-3B when WCA-3A is in Zone A and when the Site 71 gage is less than 8.5 feet NGVD and S-31 HW is less than 9.0 feet NGVD. S-151 operates together with S-31 and S-337 to permit releases from WCA-3B and WCA-3A for water supply to Miami-Dade County and SDCS.

Basin / Canal	Operational Component	Description and Operating Criteria
		S-151 may also be used with S-337 to provide water for environmental deliveries to Taylor Slough or to maintain the hydraulic ridge, subject to criteria further defined in **subsection 7.4.8.2.2**. S-151 has a design capacity of 1,105 cfs.
WCA-3A	S-152	S-152 releases water from WCA-3A to WCA-3B Per Decompartmentalization and Sheetflow Enhancement Physical Model (DPM) phase 2, S-152 operating criteria listed below: 1. May be operated when L-67A Canal stage at S-152 HW exceeds 7.5 feet NGVD. 2. Closed when WCA-3B site 71 or SRS-1 stage equals or exceeds 8.5 feet NGVD. 3. S-152 releases may be reduced or discontinued when S-355A and S-355B are closed due to L-29 Borrow Canal stage constraints. 4. Releases may be reduced or discontinued when water quality constraint criteria per the FDEP Permit are exceeded. Note: This is a temporary structure for the DPM, which is a field-scale test that is being conducted to determine how best to design and formulate plans for future decompartmentalization of WCA-3A, as envisioned in CERP. The phase 2 of the DPM operational window is anticipated to be from November 2017 through 2021. S-152 has a design capacity of 800 cfs, however a maximum release of 640 cfs was observed on Jul 14, 2017 during an emergency deviation.
WCA-3B	S-355A/B	S-355A and S-355B release water from WCA-3B to the L-29 canal. The structures are open whenever hydraulic gradient allows flow from WCA-3B to L-29 Borrow Canal with low risk of backflow from L-29 Borrow Canal to WCA-3B. Constraints on the Operation of S-355A and S-355B. 1. The S-355A and S-355B water control structures will be operated to comply with the following constraints: a. Releases from S-355A or S-355B or a combination of both shall be limited as required to prevent the L-29 Borrow Canal stage from exceeding the 8.5 feet NGVD L-29 Borrow Canal stage constraint. b. Releases from S-355A or S-355B or a combination of both shall be limited as required to prevent impacts to the existing project purposes of the C&SF Project including but not limited to flood damage reduction and water supply. The S-355A and S-355B water control structures shall be closed if any of the two conditions above are not met, and when there is a potential for reverse flow (from L-29 Borrow Canal to WCA-3B) through the structures. The actual open and close levels of the structures will depend on the water conditions, forecasts, and other system constraints.

Basin / Canal	Operational Component	Description and Operating Criteria
WCA-3B / C 304 / Miami Canal	S-31	S-31 releases water from WCA-3B and WCA-3A C-304 to the C-6 (both parts of the Miami Canal). To prevent fish kills when opening S-31 or S-337, S-151 should be open and passing an equal or greater volume of water than the combined release of S-31 and S-337." S-31 can also be used to release water from WCA-3A under EHWL operations subject to channel capacity in the Miami Canal. S-31 has a design capacity of 700 cfs.
L-30	S-337	S-337 operates together with S-31 and S-151 to permit releases from WCA-3B and WCA-3A and to supply water for Miami-Dade County. The structure is open only when S-151 is also opened equal or greater amount of combined discharge at S-31 and S-337 to prevent fish kills that can occur between S-151 and S-337 and downstream capacity is available. S-337 may also be used to provide water for environmental deliveries to Taylor Slough or to maintain the hydraulic ridge, subject to criteria further defined in **subsection 7.4.8.2.2**. S-337 has a design capacity of 605 cfs.
L-30	S-335	S-335 releases water from the L-30 canal to the L-31N canal. The structure has an operating range for flood risk management of 6.5 to 7.5 feet NGVD. S-335 is closed when the TW stage equals or exceeds 6.1 feet NGVD. S-335 may: 1. Release up to 200 cfs when S-335 HW stages are 5.3 to 6.0 feet NGVD from 1 August through 14 February. 2. Release up to 400 cfs when S-335 HW stages are 6.0 to 6.5 feet NGVD from 1 August through 14 February 3. These additional S-335 operations are suspended when TW stage equals or exceeds 6.1 feet NGVD or when S-176 HW stage equals or exceeds 4.7 feet NGVD. 4. Releases made for this purpose should be considered coincident to any releases being made for water supply to south Miami-Dade County. S-335 releases up to 200 cfs may continue between 14 February and 1 May when S-335 HW is above 6.0 feet NGVD. S-335 has a design capacity of 525 cfs.
WCA-3A	Water Deliveries to Maintain Hydraulic Ridge and provide water to Taylor Slough	To minimize the rapid reduction in the water level of ENP west of the C-111 NDA/SDA water managers may convey water from WCA-3A to maintain the hydraulic ridge along the C-111 NDA/SDA and/or provide deliveries to Taylor Slough. Water deliveries from WCA-3A will be limited to 200 cfs when average stage at Site 62 and Site 63 gages is greater than 9.80 feet NGVD (FWC muck fire closure criteria for northern WCA-3A is 9.30 feet NGVD). These deliveries will be coordinated by USACE with SFWMD and ENP. This flow limit will be measured at S-334 or S-337. This operation is intended to support gradual recession rates in the ENP marsh by providing additional water to the S-332B, S332C, S332D, S-200, and S-199 pump stations. When S-332C headwater elevation falls below 3.8 feet NGVD during the dry season, all pump operations for the maintenance of the hydraulic ridge will cease. S-332BN may be utilized for supplemental water deliveries

Basin / Canal	Operational Component	Description and Operating Criteria
		when S-332D, S-332BW, or S-332C is not available because of a routine maintenance or repair. During the water delivery operations, S-176 HW stage will be maintained between 3.8 and 4.3 feet NGVD.
L-29		L-29 Borrow Canal may operate between 8.3 feet NGVD and 8.5 feet NGVD for up to 90 days per water year* (starting on 1 May and ending on 30 April of the following year), with the opportunity to increase the duration of stages beyond 90 days based on real-time monitoring of the Tamiami Trail (US-41 Highway 41) sub-base (interim FDOT constraint until Tamiami Trail Next Step (TTNS) construction is completed), 8.5 SMA flood mitigation criteria and consideration of increased low-water stages within WCA 3A. Outside the 90-day FDOT limit, L-29 Borrow Canal level will be maintained below 8.3 feet NGVD subject to downstream constraints and L-29 Borrow Canal rainfall event driven criteria below. L-29 Borrow Canal elevation with regard to these criteria will be measured at the higher of the S-333 TW or the S-334 HW. The L-29 Borrow Canal will be operated to ensure the stability and safety of the Tamiami Trail (U.S. Highway 41) between S-333 and S-334, based upon coordination with the FDOT concerning implementation of the Relocation Agreement dated September 25, 2008. The below requirements shall remain unchanged until full completion of TTNS construction (projected 2024). When the stage in the L-29 Borrow Canal reaches a stage of 8.5 feet NGVD, input from all structures that release water into the canal (S-333, S-355A/B, and S-356) shall be suspended until the level in the L-29 Borrow Canal recedes below 8.5 feet NGVD. If rainfall beyond what was forecasted causes the L-29 Borrow Canal to exceed 8.5 feet NGVD, inflow structures will be operated with the intention of limiting event durations with L-29 Borrow Canal stages above 8.5 feet NGVD to a target maximum duration of 72 hours. The Tamiami Trail roadway subbase and roadway will be continuously monitored during implementation of COP using the monitoring plan in Appendix H of the COP EIS. Continued L-29 Borrow Canal inflows which result in cumulative days with L-29 Borrow Canal stages at 8.5 feet NGVD for longer than 90 days will require written approval from the FDOT, given evaluation of the monitoring data by the USACE, SFWMD, and FDOT. L-29 Event Driven Criteria*: For example, the below NOAA Weather Prediction Center Quantitative Precipitation Forecasts (QPF) ranges will be used to maintain L-29 Borrow Canal below 8.5 feet NGVD. 8.4’ If the 5-day QPF is for 2 to 3 inches L-29 structural inflows shall be reduced until the stage is below 8.4 feet NGVD 8.3’ If the 5-day QPF is for 3 to 4 inches L-29 structural inflows shall be reduced until the stage is below 8.3 feet NGVD 8.2’ If the 5-day QPF is for 4 to 5 inches L-29 structural inflows shall be reduced until the stage is below 8.2 feet NGVD 8.1’ If the 5-day QPF is for 5 to 6 inches L-29 structural inflows shall be reduced until the stage is below 8.1 feet NGVD.

Basin / Canal	Operational Component	Description and Operating Criteria
		* Stopping flows shall occur per the priority order prescribed for S-356 and S-333. If the 8.5 SMA hydroperiod duration constraint is violated, L-29 Canal stage may be lowered to elevation 7.8 feet NGVD.
L-29	S-333	S-333 releases water from WCA-3A to the L-29 Borrow Canal. The S-333 releases are in accordance with WCA-3A regulation schedule, the TTFF, and L-29 Borrow Canal maximum operating limits. S-333 is available to meet TTFF, water supply, environmental water deliveries, and the Extreme High Water Line operations. S-333 may be temporarily suspended from releasing to NESRS when 8.5 SMA hydroperiod duration constraint is violated; S-334 will not be open under these conditions unless S-334 is needed to maintain the L-29 Borrow Canal stage at or below the adjusted constraint of 8.5 feet NGVD to ensure the stability and safety of the Tamiami Trail (U.S. Highway 41). S-333 has a design capacity of 1,350 cfs. S-333N can also be used in place of or in conjunction with S-333 to achieve the S-333 operational intent.
L-29	S-333N (owned and operated by SFWMD)	S-333N is a CEPP project structure and is currently under construction with completion estimated for August 2020. S-333N will release water from WCA-3A to the L-29 Borrow Canal per FDEP permit 0362076-001, or any future modification issued to SFWMD. S-333N may be operated by SFWMD under Emergency Limited Operations for WCA-3A High Water Relief under the following conditions: 1. When the average stages at gages Site 62 and Site 63 exceed elevation 11.6 feet NGVD for 72 hours. Releases from the S-356 shall have priority over the S-333N releases. 2. S-333N is closed when the L-29 Borrow Canal stage limits the operations of the S-356, or when the average of the Site 62 and Site 63 gages recedes below an elevation of 11.0 feet NGVD. 3. During operations of S-333N, the following operations shall take place: a. There shall be no use of S-334 to divert WCA-3A regulatory releases to the L-31N Canal. b. S-356 will have priority over the S-333N and S-356 will be operated up to its full available capacity prior to opening G-211 and as the water levels recede in WCA-3, G-211 will be closed before the pumping at S-356 is reduced. If water is needed downstream, G-211 may be opened before S-356 is maximized or S-356 may be reduced before G-211 is closed. S-333N HW is in WCA-3A and its TW is in the L-29 Borrow Canal. S-333N has a design capacity of 1,150 cfs.
L-29	S-334	S-334 releases water from the L-29 Borrow Canal for water supply, environmental water deliveries, and flood risk management. Under the Extreme High Water Line operations as detailed in **subsection 7.4.8.1.3.2**, S-334 may be operated up to its design capacity of 1,200 cfs subject to SDCS flow constraints and through the use of all remaining available coastal release structures.

Basin / Canal	Operational Component	Description and Operating Criteria
		Primary Route: L-29, L-31N, and C-111 canals and through S-333, S-334, G-211, S-331, S-176, S-177, and S-18C structures Priority order of outflow structures: S-332D, S-332BW, S-332C, S-332BN, S-338, S-194, S-196, S-200, S-199, S-336, and S-197 S-334 may be used to maintain the L-29 Borrow Canal stage at or below the adjusted constraint of 8.5 feet NGVD to ensure the stability and safety of the Tamiami Trail (U.S. Highway 41) between S-333 and S-334, provided S-333 is closed, and subject to downstream constraints. If S-334 is operated in accordance with this condition, S-334 is closed as soon as 8.3 feet NGVD in L-29 Borrow Canal is reached following the post-event recession.
L-31N	S-356	S-356 pump station manages water stages in the L-31N and L-30 canals between S-334 and G-211 by pumping water to the L-29 Borrow Canal. The pump station has an operating range from 5.5 feet NGVD to 5.8 feet NGVD. S-356 usually has priority over S-333. When WCA-3A is above the Extreme High Water Line, S-333 has priority over S-356 and S-356 may be used to control the stage in L-31N between 5.5 and 5.8 feet NGVD to the extent there is capacity in L-29 canal and not to exceed the L-29 canal maximum operating limit of 8.5 feet NGVD. However, S-356 has priority over S-333 when SDCS is in pre-storm, storm, and storm recovery operations. S-356 will be secured when S-334 is making releases under the EHWL operations or when S-334 is used to maintain L-29 canal stage at or below 8.5 feet NGVD. S-356 has a design capacity of 500 cfs.
L-31N	S-336	S-336 releases water from the L-30, L-31N, or L-29 Borrow Canal to supply water to Miami-Dade County and Biscayne Bay when the HW stage at either S-25B or S-22 falls below the optimum stage of 2.0 feet NGVD during dry periods. S-336 may also be used to make flood releases when downstream conditions have conveyance capacity. S-336 has a design capacity of 145 cfs.
L-31N	S-338	S-338 releases water to the east, from the L-31N canal to the C-1W canal. The structure has an operating range from 5.5 feet NGVD to 5.7 feet NGVD. S-338 has a design capacity of 170 cfs.
L-31N	G-211	G-211 is a divide structure for the L-31N canal between S-335 and S-331. The structure has an operating range from 5.5 feet NGVD to 6.0 feet NGVD. G-211 is primarily used to convey water supply and environmental deliveries to south Miami-Dade County. S-356 is the first priority for keeping the reach of the L-31N Canal upstream of the G-211 from exceeding its normal operating range. G-211 has a design capacity of approximately 1,100 cfs.
L-31N	S-331	S-331 pump station manages water stages in the L-31N canal. S-331 has an operating range of 4.5 feet NGVD to 5.0 feet NGVD from 14 February

Basin / Canal	Operational Component	Description and Operating Criteria
		through 31 July and 4.3 feet NGVD to 4.6 feet NGVD from 01 August through 1 January. A transition between the two operating ranges is to be accomplished between 1 January and 14 February. S-331 pumping will cease when TW stage is above 6.0 feet NGVD. S-331 operations are available to assist S-357 in meeting 8.5 SMA flood mitigation requirements. See S-357 operational criteria below. S-331 has a design capacity of 1,160 cfs. The pump station has three diesel units with each rated for 387 cfs at 3.0-foot static head. When S-331 is operating to assist in providing drainage to 8.5 SMA then up to 200 cfs can be routed to S-197 as long as S-18C HW > 2.3 feet NGVD. Flow from S-331 resulting in operation of S-332B, S-332C, and S-332D within 0.2 feet of the top of the range should result in use of available capacity at S-199 and S-200 (in coordination with SFWMD), and then, if needed, releases of up to 200 cfs at S-197. Priority would be to utilize available capacity at S-332B/C/D, S-199, and S-200 prior to opening S-197. S-331 may be used for water supply, water deliveries to Taylor Slough and maintenance of the hydraulic ridge, and environmental water deliveries to Biscayne Bay. Tailwater elevation of 6.0 feet NGVD at S-331 creates an undesirable condition relative to adjacent agricultural and residential areas.
L-31N	S-173	S-173 is a gated-culvert adjacent to S-331. S-173 may be used for water supply, water deliveries to Taylor Slough and maintenance of the hydraulic ridge, and environmental water deliveries to Biscayne Bay, consistent with the S-331 operational criteria. S-173 has a design capacity of 100 cfs.
L-31N	S-194	S-194 releases water from the L-31N canal east to the C-102 canal. The structure has an operating range from 4.1 to 4.7 feet NGVD. S-194 has a design capacity of 190 cfs.
L-31N	S-196	S-196 releases water from the L-31N canal east to the C-103 canal. The structure has an operating range from 4.1 feet NGVD to 4. 7 feet NGVD. S-196 has a design capacity of 200 cfs.
L-31N	L-31N Reach between S-331 and S-176	Structure release priorities and operating ranges: Priority 1. S-332D 3.8 feet NGVD to 4.8 feet NGVD S-332BW 3.8 feet NGVD to 4.8 feet NGVD S-332C 3.8 feet NGVD to 4.8 feet NGVD S-332BN 3.8 feet NGVD to 4.8 feet NGVD Priority 2. S-196 4.1 feet NGVD to 4.7 feet NGVD S-194 4.1 feet NGVD to 4.7 feet NGVD S-176 4.5 feet NGVD to 5.0 feet NGVD (last in-line within Tier 2 unless S-200 and S-199 pumping capacities are available) If S-331 is operating to assist in providing drainage to 8.5 SMA and/or facilitate the EHWL operations, the operating ranges are:

Basin / Canal	Operational Component	Description and Operating Criteria
		Priority 1 S-332D 3.8 feet NGVD to 4.6 feet NGVD S-332BW 3.8 feet NGVD to 4.6 feet NGVD S-332C 3.8 feet NGVD to 4.6 feet NGVD S-332BN 3.8 feet NGVD to 4.6 feet NGVD Priority 2 S-196 4.1 feet NGVD to 4.6 feet NGVD S-194 4.1 feet NGVD to 4.6 feet NGVD S-176 4.3 feet NGVD to 4.6 feet NGVD Seasonal ranges for the pump stations are detailed below.
L-31N	S-332B	S-332BN releases water into the C-111 NDA with two 125 cfs-diesel units. S-332BW releases water into the C-111 SDA with one 75 cfs-electric unit and two 125 cfs-diesel units. After S-332B is replaced, it will have four 125 cfs diesel units and two 75 cfs electric pumps; the maximum design capacity for the WCP will be unchanged at 575 cfs, with the additional electric pump station used for operational flexibility. When S-332B is replaced with a permanent pump station, up to 250 cfs can be diverted to C-111 NDA. S-332B operational criteria vary seasonally, as prescribed below: 1. Transition period (1 January to 14 February) operating range: 3.8 feet NGVD to 4.8 feet NGVD. 2. CSSS nesting period (15 February through 31 July) operating range: 4.0 feet NGVD to 4.8 feet NGVD. 3. South Miami-Dade Typical Planting Season (1 August to 31 December) operating range: 3.8 feet NGVD to 4.4 feet NGVD.
L-31N	S-332C	S-332C releases water into the C-111 SDA with one 75 cfs-electric unit and four 125 cfs-diesel units. After S-332C is replaced with permanent station, it will have four 125 cfs diesel units and two 75 cfs electric pumps; the maximum design capacity for the WCP will be unchanged at 575 cfs, with the additional electric pump station used for operational flexibility. S-332C operational criteria vary seasonally, as prescribed below: 1. Transition period (1 January to 14 February) operating range: 3.8 feet NGVD to 4.8 feet NGVD. 2. CSSS nesting period (15 February through 31 July) operating range: 4.0 feet NGVD to 4.8 feet NGVD. 3. South Miami-Dade Typical Planting Season (1 August to 31 December) operating range: 3.8 feet NGVD to 4.4 feet NGVD.
L-31N	S-332D	S-332D releases water into the S-332D Flow-way with one 75 cfs-electric unit and four 125 cfs-diesel units. S-332D flows above the calendar based CSSS release limits are permitted to maintain canal stages for flood risk management as long as the excess flow is diverted through S-332DX1.: 1. 500 cfs (15 July to 31 December) 2. 325 cfs (01 January to 31 January)

Basin / Canal	Operational Component	Description and Operating Criteria
		3. 250 cfs without the use of S-332DX1 or 375 cfs with S-332DX1 release of 125 cfs (01 February to 14 July) S-332D operational criteria vary seasonally, as prescribed below: 1. Transition period (1 January to 14 February) operating range from 3.8 feet NGVD to 4.8 feet NGVD. 2. CSSS nesting period (15 February to 31 July) operating range from 4.0 feet NGVD to 4.8 feet NGVD. 3. South Miami-Dade Typical Planting Season (1 August to 31 December) operating range from 3.8 feet NGVD to 4.4 feet NGVD.
S-332D High Head Cell	S-332DX1	S-332DX1 connects the S-332D Flow-way to the C-111 SDA. S-332DX1 is typically closed from 15 July to 31 December to prioritize releases to S-332D Flow-way toward Taylor Slough. S-332DX1 may be open to divert S-332D flows above the calendar based CSSS release limits, in which case the S-332D restrictions do not apply as long as the S-332D flows above calendar based CSSS release limits are diverted through S-332DX1.
L-31N	C-111 North Detention Area (NDA)	No stage constraint; emergency overflow weir crest elevation is 10.0 feet NGVD. S-357 and S-332BN pump water into the C-111 NDA.
L-31N	C-111 South Detention Area (SDA)	No stage constraint; emergency overflow weir crest elevation is 10.0 feet NGVD. S-332BW and S-332C pump water into the C-111 SDA.
L-31N	S-176	S-176 is the divide structure between the L-31N Borrow Canal and C-111 between S-331 and S-177. The structure has a normal operating range from 4.5 feet NGVD to 5.0 feet NGVD*. S-176 may release up to 200 cfs when S-332B/C/D restricted by CSSS habitat or nesting conditions identified in the COP Biological Opinion (consistent with the ERTP 2016 Biological Opinion) provided that S-176 HW can be maintained within its operational range; Additional releases may be used anytime of the year, without causing S-18C HW to exceed 2.9 feet NGVD, to reduce the likelihood of triggering a Level 2 or Level 3 opening at S-197. *When S-331 is used to provide drainage to 8.5 SMA and/or to facilitate the EHWL operations, the operating range may be lowered to 4.3 feet NGVD to 4.6 feet NGVD. For the duration of these S-331 operations up to 200 cfs can be routed to S-197 as long as S-18C HW > 2.3 feet NGVD. Flow from S-331 resulting in operation of S-332B, S-332C, and S-332D within 0.2 feet of the top of the S-332B/C/D range should result in use of available capacity at S-199 and S-200, and then, if needed, releases of up to 200 cfs at S-197. Priority would be to utilize available capacity at S-332B/C/D, S-199, and S-200 prior to opening S-197. S-176 has a design capacity of 630 cfs.
C-111	S-200 (owned and operated by SFWMD)	S-200 is operated per the current FDEP Permit issued to SFWMD. S-200 is intended to work in unison with the Frog Pond Detention Area and Aerojet Canal features to create a 6-mile long hydraulic ridge along the eastern boundary of ENP. The operating criteria below are from the FDEP

Basin / Canal	Operational Component	Description and Operating Criteria
		permit0293559-011. Based on the stage at S-177 HW, the operating range is: 1. Transition from 1 January to 14 February: 3.0 feet NGVD to 4.0 feet NGVD. 2. 15 February to 31 July: 3.3 feet NGVD to 4.0 feet NGVD. 3. 1 August to 31 December: 3.0 feet NGVD to 3.4 feet NGVD. Pumping at S-200 will cease if stage at monitoring station R3110 > 4.95 feet NGVD during the critical portion of the CSSS nesting season from 15 March through 30 June. S-200 has a design capacity of 300 cfs (four 75 cfs electric pumps).
C-111	S-199 (owned and operated by SFWMD)	S-199 is operated per the current FDEP Permit issued to SFWMD. S-199 is intended to work in unison with the Frog Pond Detention Area and Aerojet Canal features to create a 6-mile long hydraulic ridge along the eastern boundary of ENP. The operating criteria below are from the FDEP permit 0293559-011. Based on the stage at S-177 HW, the operating range is: 1. Transition from 1 January to 14 February: 3.0 feet NGVD to 4.0 feet NGVD. 2. 15 February to 31 July: 3.3 feet NGVD to 4.0 feet NGVD. 3. 1 August to 31 December: 3.0 feet NGVD to 3.4 feet NGVD. Pumping at S-199 will cease if stage at monitoring station EVER4 (USGS Site ID: 252036080324300) > 2.36 feet NGVD during the critical portion of the CSSS nesting season from 15 March through 30 June. S-199 has a design capacity of 300 cfs (four 75 cfs electric pumps).
C-111	S-177	S-177 is in the C-111 south of S-176. The structure has an operating range from 3.6 feet NGVD to 4.2 feet NGVD. If the rainfall over the past 14 days exceeds 5.5 inches or if significant rainfall is forecasted, then S-177 may be opened to lower S-177 HW to 3.3 feet NGVD. When flows at S-332B/C/D are restricted to achieve the CSSS habitat or nesting conditions, up to 200 cfs may be conveyed through S-177 when S-177 HW is below its operational range. S-177 has a design capacity of 1,400 cfs.
C-111	S-18C	S-18C is used for flood risk management, to maintain a desirable freshwater head against northerly saltwater intrusion, and to provide water to the panhandle of ENP. The structure has an operating Range from 2.3 to 2.65 feet NGVD S-18C has a design capacity of 2,100 cfs.
C-111	S-197	S-197 releases water from the C-111 to tide. The operation of S-197 is based on the S-18C HW (S-18C gates fully open) and releases are based on the Levels below: 1. Level 1. When S-18C HW > 2.7 feet NGVD, open S-197 up to 200 cfs; close when S-18C HW < 2.5 feet NGVD. Flow may be adjusted from 0 to 200 cfs within the range. When transition from Level 2, wait 24 hours and reassess. 2. Level 2. When S-18C HW > 2.9 feet NGVD, operate S-197 up to 800 cfs; reduce to Level 1 when S-18C HW < 2.4 feet NGVD.

Basin / Canal	Operational Component	Description and Operating Criteria
		3. Level 3. When S-18C > 3.3 feet NGVD, operate S-197 up to 2400 cfs; reduce to Level 2 when S-18C HW < 2.4 feet NGVD. Operating intent is to transition down to lower flows while holding S-18C HW < 2.4 feet NGVD. When S-331 is operating to assist in providing drainage to 8.5 SMA then up to 200 cfs can be routed to S-197 as long as S-18C HW > 2.3 feet NGVD. Priority would be to utilize available capacity at S-332B/C/D, S-199, and S-200 prior to opening S-197. When in Extreme High Water Condition 2 and S-18C HW is above 2.3 feet NGVD, S-197 releases may be increased up to a daily average of 1,200 cfs to accommodate additional flows through S-334 which exceed the SDCS flow constraints for S-332B, S332C, and S-332D. The total available capacity at S-197 will be decreased to 600 cfs when S-18C HW falls below 2.3 feet NGVD. S-197 has a design capacity of 2,400 cfs.
C-357 (8.5 SMA)	S-357	S-357 pumps water from the C-357 and C-358 canals to the C-111 NDA. The pump station has a normal operational range of 3.5 feet NGVD to 6.0 feet NGVD. S-357 will be operated according to the below criteria. 1a. Angels < 6.0 feet NGVD, C-357 will be maintained between 5.5 feet NGVD and 6.0 feet NGVD. 1b. 6.0 ≤ Angels < 6.4 feet NGVD, C-357 will be maintained between 5.0 feet NGVD and 6.0 feet NGVD. 1c. Angels ≥ 6.4 feet NGVD, C-357 will be maintained between 4.5 feet NGVD and 5.5 feet NGVD. 1d. Angels ≥ 6.7 feet NGVD and LPG-2 ≥ 6.6 feet NGVD, C-357 will be maintained between 4.0 feet NGVD and 5.0 feet NGVD until LPG-2 < 6.4 feet NGVD. 1e. Angels ≥ 7.2 feet NGVD, and LPG-2 is projected to remain ≥ 6.6 feet NGVD for 7 days or more (based on forecast and current recession rate), C-357 will be maintained between 3.5 feet NGVD and 4.5 feet NGVD until LPG-2 < 6.4 feet NGVD. 2. LPG-2 ≥ 7.0 feet NGVD for more than 24 hours, C-357 will be maintained between 3.5 feet NGVD and 4.5 feet NGVD until LPG-2 < 6.4 feet NGVD. 3. When G-3273 > 7.5 feet NGVD and LPG-2 recession rate is less than 0.75”/day following the rainfall event, S-357 HW will be lowered to 2.5 feet NGVD to 3.0 feet NGVD and S-331HW will be lowered to 2.8 feet NGVD to 3.5 feet NGVD until LPG-2 can be maintained between 6.2 feet NGVD and 6.6 feet NGVD. At elevated water levels above 7.5 feet NGVD at G-3273, both S-357 and S-331 pump stations will need to be operated in tandem in order to manage the increased seepage from NESRS into 8.5 SMA while providing the required flood mitigation. Operating intent is to transition S-331 to normal operations prior to S-357 returning to normal operations, based on consideration of the target hydroperiod duration shown in Figure 7-11. S-357 has a design capacity of 575 cfs When both S-357 and S-331 operate at the lowest canal settings and the 8.5 SMA target hydroperiod duration is projected to be exceeded ,

Basin / Canal	Operational Component	Description and Operating Criteria
		WCA-3A flows to NESRS may be temporarily suspended (based on forecasted rainfall) until water levels in 8.5 SMA, specifically the area west of C-357 Canal recede below ground surface elevations. WCA-3A flows to NESRS will be temporarily suspended if: a. Water levels in 8.5 SMA are projected to exceed 6 inches below the lowest first floor elevation (lowest first floor elevation estimated at 8.5 feet NGVD) of residential properties near to L-357W Levee within 48 hours, OR b. The 8.5 SMA continuous hydroperiod constraint (Figure 7-11) for a rainfall event at LPG-2 or LPG-1 (or future in-kind replacement locations) is projected to be exceeded,OR c. The 8.5 SMA discontinuous hydroperiod constraint (Figure 7-11) for LPG-2 or LPG-1 (or future in-kind replacement locations) is projected to be exceeded. 8.5 SMA flood mitigation criteria were developed in accordance with Part C.6 of Appendix C of the COP EIS (Water Quality and Hydrology Monitoring Plan for 8.5 SMA Flood Mitigation) and the MWD to ENP Incremental Field Test.
C-358 (8.5 SMA)	S-357N	S-357N releases water from the C-358 canal to the C-357 canal. S-375N assists to meet the authorized level of flood mitigation to the residents of the Las Palmas Community (8.5 SMA). The structure has an operating range of 3.0 feet NGVD to 5.0 feet NGVD during wet conditions and 4.0 feet NGVD to 6.0 feet NGVD during dry conditions. S-357N will be limited to 100 cfs during normal operations with the ability to utilize up to 325 cfs design capacity to assist 8.5 SMA flood mitigation.
C-111E	S-178	S-178 releases water from the C-111E to the C-111 upstream of S-18C. The structure is typically open year round but may close if S-178 HW falls below 2.0 feet NGVD. S-178 remains full open for tropical storms and hurricanes S-178 has a design capacity of 500 cfs.
S-332D Flow Way	S-328	S-328 releases water from Cell 1 of S-332D Detention Area into the adjacent segment of the L-31W Canal. The structure is opened when S-332D flows are 250 cfs (2 diesel units) or greater and when hydraulic gradient allows flow towards the L-31W Canal. The intent is to have the water go through the S-332D detention area towards Taylor Slough through S-205 first before opening S-328. S-328 has a design capacity of 500 cfs.
C-200 Canal	G-737 (owned and operated by SFWMD)	G-737 is downstream of S-200 in the Frog Pond Detention Area. The structure is operated per FDEP permit (issued to SFWMD). G-737 may be opened when there is a positive (westward) head across the structure; upstream S-200 pump station operations adhere to the CSSS seasonal constraint at R3110. G-737 has a design capacity of 125 cfs.

Basin / Canal	Operational Component	Description and Operating Criteria
L-31W Canal	S-205	The S-205 weir is located on the east side of the L-31W Canal at the south end of the S332D Flow-way. It is composed of an approximately 500-foot fixed-crest weir at 6 feet NGVD and an integrated weir with a 96-foot adjustable flashboard riser section (adjusts between 4.25 feet NGVD and 6 feet NGVD). The flashboards will remain in place year-round unless extreme conditions occur and require removing the flashboards to increase flows west toward L-31W canal.

7.5 Pre-storm/Storm Operations

It is important to emphasize that the C&SF Project is multi-purpose in design, and that pre-storm operations may not prevent flooding, such as experienced after Hurricane Irene in October 1999 or the no name storm in October 2000. The condition of the groundwater system at the time of a storm event is significant and is highly dependent on the amount and extent of rainfall that has already occurred prior to subsequent events. Further, there are areas of Miami-Dade County and South Florida in general, which are at low elevations and for which no amount of drawdown can prevent flooding for large rainfall events. The water levels discussed in this document are target levels and may not be attainable with the antecedent conditions, available capacity, and time available.

These regulations describe operating criteria for Hurricanes/Tropical Storms as well as other significant events that could cause flooding impacts if operations are not adjusted.

7.5.1 Hurricane and Tropical Storm Regulations

The hurricane season is from June through November. When there are tropical depressions, tropical storms, and/or hurricanes in the Atlantic/Caribbean Basin, the National Hurricane Center (NHC) issues tropical cyclone public advisories, forecast advisories, forecast discussions, and strike probability forecasts every 6 hours. It should be noted that the large bands of heavy rain associated with tropical storms and hurricanes often extend considerable distance beyond the areas of tropical or hurricane force wind.

These regulations may be supplemented by, but not superseded by, SAJ All-Hazards Plan. The All-Hazards Plan should be consulted for related emergency preparation and actions and can be found here: https://intranet.usace.army.mil/sad/saj/EM/Pages/Home.aspx. The SFWMD maintains a Comprehensive Emergency Management Plan (CEMP) which provides overall guidance using an all-hazard approach for managing disasters and emergencies. The CEMP describes the policies, strategies, operational goals, and objectives through which SFWMD will mobilize resources and conduct response and recovery activities after a large-scale disaster. Sections within the emergency operations structure with specific emergency responsibilities or support roles are required to develop and maintain SOPs to carry out assigned responsibilities. Separate from emergency operations SOPs, all SFWMD divisions are responsible for establishing Suggested Operating Procedures (SOPs) that should include (but are not limited to) identifying emergency tasks specific to their organization's mission critical functions and assigning individual responsibilities for these tasks, and vital systems and records.

When a hurricane or tropical storm alert is initiated, USACE personnel from the South Florida Operations Office (SFOO) will inspect the S-10s, S-11s, and S-12s and make sure they are operating properly. The

USACE, Jacksonville District, Water Management Section will provide the desired gate settings to the SFOO personnel to be used during the alert period. Generally, these structures will be fully opened prior to the storm impacting the area and readjusted, if needed, as soon as safety allows after the storm has passed. SFWMD and USACE will meet frequently to discuss on-going operations and ways to avoid and minimize flooding impacts.

7.5.2 Pre-storm / Storm / and Storm Recovery Operations for SDCS

This section provides criteria (pre-storm operations) to be used in preparing the SDCS/Miami-Dade County for forecasted storm events. The SDCS is composed of L-31N, L-31W, and C-111 canal system and control structures. Currently, for the ECC System, the canal system and control structures to the east of L-31N, the SFWMD implements canal drawdown operations based on impending rainfall events. The goal for the SDCS is to implement a similar set of canal drawdown operating criteria which seek to balance the needs of the natural system with the authorized purposes of the C&SF Project, which is multipurpose in scope and includes flood risk management and water supply.

The SFWMD employs meteorologists who monitor the tropics and evaluate tropical cyclone products issued by the NHC and the Weather Prediction Center (WPC). The meteorologists advise the SFWMD Operations Office of tropical systems which require enhanced monitoring over the next 120 hours as well as of specific tropical cyclones with the potential to bring tropical storm strength winds within the next 72 hours. The SFWMD Operations Office has defined operational procedures to be implemented depending on the timing or amount of advance warning prior to the onset of tropical storm force winds. The SFWMD operational procedures are delineated based on time prior to onset of Tropical Storm force winds; the specific operating procedures for these time frames will be described in further detail in this document. Time frames are briefly summarized as follows:

1. 72 to 48 hours prior to the impact of tropical storm force winds is the earliest level of preparation when the system is evaluated and initial adjustments made to operations depending on the forecast and nature of the storm. Coordinate with USACE and local drainage districts.
2. 48 to 24 hours prior to the impact of tropical storm force winds, continue pre-storm operations and coordination with USACE and local drainage districts.
3. 24 to 12 hours prior to the impact of tropical storm force winds, bring telemetry-controlled sites to final pre-storm configuration, establish alternate emergency control station if necessary.

The remaining levels of preparation are 12 to 0 hours prior to the impact of tropical storm force winds; during the event; and recovery after the event. It is important to note that some storms form close to land and make landfall with less than 48 hours of advance warning (e.g., Tropical Storm Emily, 2017).

7.5.2.1 Notification and Briefing Process

The USACE District Engineer and SFWMD/USACE Executive level will be briefed prior to initiation of pre-storm operations. This may occur up to five days prior to the projected storm arrival or as soon as the cone of uncertainty issued by the NOAA National Hurricane Center shows south Florida to likely be in the path of a storm. SAD will be notified on operations outside of the WCP that are initiated and/or emergency deviations that are initiated (see section 7.10 for deviation procedures).

7.5.2.2 Drawdown Implementation

Between 24 and 72 hours prior to forecast arrival of tropical storm force winds:

The initiation of the pre-storm drawdown criteria (**Table 7-4**) will be triggered for the SDCS when Miami-Dade County is within the cone of uncertainty as developed by the NHC. These pre-storm drawdown levels are not less than the level at which water supply deliveries are made during dry periods, that is 1.5 feet below optimum canal levels, except the reach north of G-211, which is 1.0 foot below current, normal operating levels. These levels are target levels and may not be attainable.

Table 7-4. Pre-Storm Drawdown Targets.

Canal	Reach	Target Level for Draw-down (feet NGVD)
L-31(N)	S-335 to G-211	5.0
L-31(N)	G-211 to S-331	4.0*
L-31(N)	S-331 to S-176	4.0
C-111	S-176 to S-177	3.0
C-111	S-177 to S-18C	2.0
C-111	S-18C to S-197	No change
C-357	S-357 HW	3.5

*If the water surface elevation measured at 8.5 SMA LPG1 or LPG2 is 5.5 feet NGVD or below, then 4.0 would be the target; otherwise, 3.5 feet NGVD at the headwater of S-331 will be the target.

In an effort to achieve the specified drawdown targets, a sequence of operational actions is recommended as described in **Table 7-5**. The goal is to achieve one target before preceding the next sequence, however, it may not be possible to achieve the target level and operations will proceed as based on the best available information at the time. If practical with the existing conditions and time available the L-31(N) reach from S 331/S 173 to S-176 will be lowered using only S-332B, S-332C, and S 332D.

Table 7-5. Pre-Storm Drawdown Sequencing.

Sequence	Canal	Reach	Target Draw-Down Level (feet NGVD)
1	L-31(N)	S-331 to S-176	4.0
1	C-111	S-176 to S-177	3.0
2	L-31(N)	G-211 to S-331	4.0*
2	L-31(N)	S-335 to G-211	5.0

* If the water surface elevation measured at 8.5 SMA LPG1 or LPG2 is 5.5 feet NGVD or below, then 4.0 would be the target, otherwise, 3.5 feet NGVD at the headwater of S-331 will be the target.

12 to 24 hours prior to forecasted arrival of tropical storm force winds.

Continue operations as previously described, but with the following considerations:

1. **S-331:** Pump when downstream conditions allow.
2. **S-332B/C/D**: Continue Pumping. Operations are controlled from S-331, which is manned during storm events.

Recovery (conditions immediately after the storm ends or if the storm forecast changes such that Miami-Dade County is no longer likely to be affected).

Operations during Recovery consist of: 1) Maximizing releases at water control structures to minimize flooding and 2) make the transition back to the operational regime in place prior to the storm. (**Table 7-6**)

Operations may also be returned to the operational regime that was in place prior to implementing pre-storm operations as soon as the Miami-Dade County is no longer within the cone of uncertainty.

Plan for Worst Case: Recovery will be necessary if storm conditions result in significant rainfall in the Miami-Dade County area. The target for operations would be to return to the operational regime in place prior to the storm. However, use of water control structures under emergency flood risk management mode will begin or continue until recovery is complete. The following operations are suggested to continue to operate in emergency flood risk management mode:

Table 7-6. Recovery Operations.

Structure	Status
S-331	Pump when downstream conditions allow
S-197	Open depending on conditions
S-332B/C/D	Continue Pumping. Operation is controlled from S-331 control building which is manned during storm events.

It is not possible to describe the sequence of operational actions during recovery prior to a particular storm event. The sequence of operational actions will depend largely on the rainfall distribution and rainfall amounts resulting from the storm.

Back to Normal Mode (operational regime in place prior to the storm)

The following conditions must be met before ceasing emergency flood risk management and resuming normal operation regime:

1. The Department of the Interior (DOI) will advise USACE of any overflow problems or adverse impacts to the CSSS Subpopulation F that may be occurring for USACE to use in their decision regarding pumping reductions at S-332B and S-332C.
2. Otherwise, stages in canal reaches must be within the specified operating ranges in place prior to the change in pre-storm or storm operations to resume normal mode.

When these conditions are met, the normal mode, as defined by the operational regime in place prior to the storm, may be resumed. This section may be modified depending on additional information, as it becomes available.

7.5.3 Operations for Other than Named Events

SFWMD will monitor antecedent conditions, groundwater levels, canal levels, and rainfall. If these conditions indicate a strong likelihood of flooding, SFWMD will advise USACE of intent to initiate pre-storm operations and will work together to define the pre-storm operations. USACE will advise ENP and USFWS of the conditions, consult with the MTIF and inform them and SAD of the decision to implement pre-storm drawdown or otherwise alter system wide operations from those contained in the table.

In addition, the Chairman of the MTIF or his designated representatives will monitor the conditions in WCA-3A and other tribal lands and predicted rainfall. If the MTIF determines these conditions indicate jeopardy to the health or safety of the MTIF, the Chairman will make a recommendation to USACE to change the operations in WCA-3A. USACE will review the data and advise SAD and appropriate agencies of the conditions, and the District Commander will personally consult with the Chairman prior to making a decision whether to implement changes to the WCA-3A operations.

7.6 Consistency with the Identification of Water and Reservations or Allocations for the Natural System

The operating criteria in this WCP are consistent with the operating criteria used to identify the water made available for the natural system during wet, average, and dry periods and also consistent with the water reservations or allocations for the natural system made by the State in accordance with section 601 of WRDA 2000.

7.7 Consistency with Savings Clause and State Assurance Provisions

WRDA 2000 provides the framework for all structural and operational changes to the C&SF project as a result of CERP implementation. Since COP does not implement CERP, the Savings Clause Provisions do not apply.

7.8 Drought Contingency Plans

Regional Drought Contingency Plans (DCP) are written to provide a decision making process to implement water-conservation measures during droughts, review the operational flexibility of the regional system in a drought, and address the potential problems associated with an extreme drought. The DCP for WCAs, ENP, and ENP-SDCS can be found in Appendix B of this SOM.

The SFWMD has established rules and regulations that establish priorities and define procedures for water conservation and restricting water use during conditions of water shortage

SFWMD's Water Shortage Plan is codified in Chapter 40E-21 (Water Shortage Plan) and Chapter 40E-22 (Regional Water Shortage Plan), Florida Administrative Code. This plan is required under Subsection 373.246(1) Florida Statutes. The purposes of the plan are to protect the water resources of the SFWMD from harm; to assure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social and health-related impacts; to provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage, and to promote greater security for permitted water users. The Water Shortage Plan includes rules that outline priorities and define procedures for restricting water use during water shortages under direction of the SFWMD's Governing Board. The Water Shortage Plan published by the SFWMD is part of the DCP and can be found using the following link:

https://www.sfwmd.gov/sites/default/files/documents/40e-21_0.pdf

Water shortage activities are managed through the SFWMD's Emergency Operations Center. The SFWMD's Comprehensive Emergency Management Plan (CEMP) follows the framework of the National Incident Management System (NIMS). The use of NIMS is a nationwide effort that is federally mandated for local, state, and federal agencies per Homeland Security Presidential Directive 5.

7.9 Flood Emergency Action Plans

The Flood Emergency Action Plans outlines operating criteria for projects that require flood damage reduction operations. The plans include an explanation of existing and proposed operating criteria, release scheduling procedures during a flood, use of storage, downstream notification procedures, and special safety concerns. Although there are currently no Flood Emergency Action Plans in the region, it is anticipated that future CERP projects will include these plans.

7.10 Deviation from Normal Regulation

Deviations from the WCP are occasionally needed to avoid or reduce negative impacts related to water management operations. Deviations are temporary variations from the WCP based on engineering judgment, engineering experience, and prevailing circumstances, and require USACE, South Atlantic Division (SAD) approval. Any deviations must follow ER 1110-2-240, be consistent with the project authorization, and be within existing authorities. USACE can request deviations or the non-federal sponsor, MTIF, STOF, and other agencies can request deviations from normal operating criteria. The USACE, Jacksonville District, Water Management Section is responsible for handling the deviation requests and transmitting them through the District Commander to the Division Commander (USACE, SAD) for final decision. Deviation requests usually fall into the categories emergencies, unplanned minor deviations, or planned deviations. Water control plan deviations shall consider USACE Environmental Principles in accordance with authorization and approved purposes and comply with NEPA, the Endangered Species Act (ESA), and related laws and regulations.

7.10.1 Emergencies

Examples of emergencies that may result in a need to deviate from normal operating criteria include: drowning and other accidents; failure of the operation facilities; chemical spills; treatment plant failures; and other temporary pollution problems. Water control actions necessary to abate the problem should be implemented immediately unless such action would create equal or worse conditions. USACE, Jacksonville District must be informed of the problem and the emergency operating changes as soon as practicable. A written confirmation showing the deviation and conditions will be furnished to USACE, Jacksonville District by the operating agency after the incident. USACE, Jacksonville District will communicate with USACE, SAD. In addition, USACE will inform the non-federal sponsor, the State of Florida (FDEP and SFWMD), the DOI, the MTIF, and the STOF as appropriate.

7.10.2 Unplanned Minor Deviations

There are unplanned instances that create a temporary need for minor deviations from the normal operating criteria, although they are not considered emergencies. Construction accounts for the major portion of these incidents requiring minor deviations. Examples of activities that may require short-term deviations include construction of utility stream/canal crossings, bridge work, and major construction contract. Changes in releases are sometimes necessary to carry out maintenance and inspection of

facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration is given to upstream watershed conditions, potential flood threat, the existing condition of the lake/reservoir/storage area, and possible alternative measures. In the interest of maintaining good public relations, requests for minor deviations are generally granted, providing there are no adverse effects on the overall regulation of the project for the authorized purposes. Approval for these minor deviations normally will be obtained from USACE, SAD by telephone. Written confirmation explaining the deviation and its cause will be furnished to the USACE, Jacksonville District Water Management Section by the operating agency. USACE, Jacksonville District will communicate with USACE, SAD. In addition, USACE will inform the non-federal sponsor, the State of Florida (FDEP and SFWMD), the DOI, the MTIF, and the STOF as appropriate prior to approval.

7.10.3 Planned Deviations

Each circumstance should be analyzed on its own merits. The requesting agency will provide sufficient data on flood potential, lake/reservoir/storage area and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, letter to USACE, Jacksonville District. USACE, Jacksonville District will analyze each proposed deviation and will request approval from USACE, SAD. In addition, USACE will inform the non-federal sponsor, the State of Florida (FDEP and SFWMD), the DOI, the MTIF, and the STOF as appropriate prior to approval.

7.11 Rate of Release Change

Generally, a daily step change of 500 cfs is the maximum amount of change desired at the S-10s, S-11s, and S-12s. Gradual transitions are intended to support the health of wildlife. Risks that should be considered in association with gate changes include but are not limited to wildlife, water quality, flood, and exotic species.

During the initial transition from dry season flows to wet season flows at S-333, for a change of flow greater than 100 cfs an attempt should be made to use two to four incremental adjustments through the day to ramp up flows to the target release instead of a single change from 0 cfs to limit disturbing the sediment near the structure.

7.12 Seepage Control

There are many areas throughout the project area that are highly porous and overlie the Biscayne Aquifer. Seepage into the canals can reduce the conveyance capacity but the normal operations specified in **subsection 7.4** take into account seepage control.

7.13 Aquifer Storage and Recovery System Plan

This section is not applicable and the project area does not include an Aquifer Storage and Recovery System.

7.14 Consistency with the Adaptive Management Program and Periodic CERP Updates

Adaptive management has been recognized as a critical element of CERP since promulgation of the enabling legislation (WRDA 2000). Congress authorized the use of an adaptive management approach for CERP, to allow the Plan to proceed in the face of existing uncertainties and incomplete scientific data.

Adaptive Management for the Plan is defined as the "continuous improvements to the Plan to respond to new information, new or updated modeling; information developed through the assessment principles contained in the plan; and future authorized changes to the Plan in order to ensure that the goals and purposes of the Plan are fulfilled."

The adaptive management strategy for CERP is intended to guide the implementation of the Comprehensive Plan. It will be used to assess the responses of the south Florida ecosystem, and to determine whether these responses match expectations, including anticipated performance levels. An essential element of adaptive management is the development and conduct of a scientifically rigorous assessment program to analyze and understand responses of the system to implementation of the Comprehensive Plan which includes monitoring component to address biological, hydrological, and water quality parameters. In accordance with the programmatic regulations, Restoration Coordination and Verification (RECOVER) is required to prepare a technical report, at least once every five years, that presents an assessment of whether the goals and purposes of the Comprehensive Plan are being achieved, including whether the interim goals and interim targets are being achieved or are likely to be achieved. Based upon results of the monitoring and assessment efforts, operational changes may be recommended to improve individual project performance and/or Comprehensive Plan performance. Although the MWD to ENP Project, C-111 SD Project, and COP are not part of CERP, COP developed an AMMP (Appendix C of the COP EIS) and its primary objective is to identify the monitoring necessary to inform decision-makers, COP partner agencies, and the public on achieving project success. The monitoring identified in the COP AMMP will be used by decision makers, COP partner agencies, and the public to inform water managers on opportunities to better balance meeting multiple COP objectives while avoiding constraints.

COP's planning process was based on knowledge of the Greater Everglades; understanding of the problems and opportunities; and the evaluation of alternatives and estimation of the potential project performance. However, while the WCP and EIS are based on a wealth of knowledge, some uncertainty inevitably exists in such a complex system. Such uncertainties include fine-tuning the computer models used to accurately predict performance and meet constraints under real world conditions, determining how to best optimize actions to meet the needs of competing objectives and use the water available safely to the best advantage (e.g., flood risk management versus flows into ENP), and how to address and adapt COP to changes in both the environment (e.g., sea level rise) and due to human activities (e.g., additional operational structures implemented through CEPP). The COP adaptive management process is a tool to help address such remaining uncertainties.

AMMP uncertainties that require WCP revisions and updates shall consider USACE Environmental Principles in accordance with authorization and approved purposes and comply with NEPA, the Endangered Species Act (ESA), related laws and regulations, and SAD approval. The use of any AMMP should be followed by analysis and documentation of the lessons learned.

Section 7.15 below identifies two uncertainties that were evaluated during the development of COP and outlines specific operational guidance that may be utilized by water managers.

7.15 Annexes

This subsection addresses two uncertainties that are part of the AMMP (Appendix C of the COP EIS). These uncertainties are placed here since they define specific operational guidance that may be utilized by water managers. The table and figures in this section maintain the original Appendix C naming conventions.

7.15.1 COP AM Uncertainty #16b (Water Quality in NESRS)

Water quality concerns at S-333 and S-12D and downstream ecological response: Will there be downstream biogeochemical effects associated with modifying inflows and hydrologic conditions in ENP, that result in detrimental effects on nutrient movement, availability, and ecological responses? This includes consideration of hydrologic effects on nutrient loading, nutrient release from soils, transport, and water-quality related ecological indicators, such as periphyton tissue nutrients, cattail expansion, and algal bloom events.

COP Objective or Constraint: COP Objectives 1a, 1b, 1c, 3.

Region(s): Northeast Shark River Slough (NESRS)

Associated Features: S-12s, S-333, S-334, S-356; timing, location, and volume of deliveries

Driver or uncertainty type: Operational driver. Water quality at S-333 tends to degrade when water levels at the structure are low, resulting in spikes of nutrient, specifically total phosphorus concentrations, when these waters are delivered to NESRS. This affect is also observed at the S-12 structures with declining impacts on total phosphorus from west (S-12D) to east (S-12C). Spikes in total phosphorus delivered to NESRS result in excess phosphorus loads (above levels protective of the marsh) and thus a potential for the cascade of nutrient impacts described in this uncertainty.

What is expected to be learned by addressing this uncertainty (i.e., how will COP benefit from addressing this uncertainty)? By observing ecosystem response for this uncertainty, impacts on downstream resources in the NESRS marsh will be illuminated. If the operational deliveries for S-333 are addressed through alternative management options/strategies that are protective of the ecological values of NESRS, then COP will benefit with higher potential for improved ecological conditions within NESRS.

Expectations or hypotheses to be tested to address the uncertainty, and attribute(s) that will be measured to test each:

- Increased flow will not alter current periphyton system-wide indicator report status
- Additional flows will not result in an increase in algal bloom events (frequency, spatial extent, duration, and/or magnitude) in Florida Bay and Lower Southwest coast relative to current conditions
- No acceleration in cattail distribution expansion rate relative to current conditions
- No alteration of current spatial distribution of soil and vegetation nutrient pools relative current conditions
- Discharging through S-333 and S-12D at headwater conditions proposed by COP (stage above headwater trigger more often and for longer duration) will not result in degraded water quality and/or adverse ecological response in the marsh.

*Note For practical operations, several stage triggers shall be established for conditions when stages are declining and separately for conditions when stages are rising. Continued data collection will be used to refine these triggers. The current guideline is conditions should be closely monitored by the water quality team when the S-333 HW stages are descending towards 9.2 feet NGVD. When the ascending S333 HW stages are above or closely approaching 9.2 feet NGVD , and following review of the actual water quality

data by the water quality team confirming the improved condition, the water quality data will not need to be as closely tracked.

What is expected to be learned by measuring this attribute?

- Through monitoring flow and nutrients, COP will learn about nutrient response to structure configuration (i.e., S-333 and S-334 flowing or S-333 and S-334 closed; S-333N versus S-333 operations) and operations. While the pre-COP testing generally addressed the water quality questions regarding S-356 pumping (no negative impacts noted), the S-356 pumping and nutrient response should continue to be monitored/evaluated.
- Monitoring of periphyton in the downstream marsh will allow COP to learn about changes in the periphyton nutrient content or algal blooms as demonstrated in the CERP RECOVER System Status Report (see CERP RECOVER 2014, 2019).
- Monitoring of macrophytes, such as cattail, will allow COP to learn about changes in rates of sensitive macrophyte expansion/retraction relative to current rates or presence/absence.
- Monitoring of the spatial nutrient front will allow COP to learn about movement of the spatial nutrient front or changes in nutrient rates of release from soils along soil and/or vegetation transect relative to existing conditions.

What is the time frame in which changes to this attribute are expected to be measurable?

- Flow and water quality monitoring at existing frequency. Discrete total phosphorus changes can be nearly immediately detected, but determination of any statistically significant change from historic levels could take 3 to 10 years, depending on the change magnitude.
- Periphyton (TP content, biomass, composition): 3 months to 1 year
- Cattail expansion: 3 to 5 years
- Soil nutrient front: 3 to 10 years

Is this attribute complimented by other monitoring programs within and/or outside of COP?

- COP should take advantage of existing monitoring which includes monitoring performed by the South Florida Water Management District, United States Geological Survey, Everglades National Park, and cooperators.

When during COP's life cycle should this monitoring begin and end?

- It has already begun and should continue 10 years after complete implementation of COP.

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: A baseline monitoring period of 3 years for soil nutrient content (1 every year) to measure long-term nutrient trends and 3 years of bi-annual (wet/dry season) periphyton tissue nutrients in areas of concern (e.g. downstream of S-12D, NESRS NC Transects) to measure early indication of nutrient changes is recommended to adequately establish existing conditions. Monitoring of soil nutrient content annually and bi-annual periphyton tissue nutrients beginning with implementation of S-356/G-3273 Relaxation Increment 1 test and carried through operation and management is necessary to document any changes in nutrient distribution resulting from incremental increases in deliveries past Tamiami Trail with each constructed feature.

Triggers/thresholds that indicate good performance or need for adaptive management action in response to COP:

Structure monitoring:

- Need for adaptive management action: increases in nutrients above existing conditions indicates potential for adverse impacts to downstream ecology;
- Good performance: maintaining or reducing nutrient levels represents good performance

Periphyton:

- TP content
  - Need for adaptive management action: if TP content in periphyton tissue increases above baseline;
  - Good performance: if TP content in periphyton tissue remains or declines below baseline
- Biomass
  - Need for adaptive management action: if biomass decreases below baseline;
  - Good performance: if biomass remains or increases above baseline
- Composition
  - Need for adaptive management action: if species composition shifts to more cyanobacteria relative to baseline;
  - Good performance: if species composition shifts to more desmids and diatoms relative to baseline

Cattail:

- Need for adaptive management action: if cattails expansion rate increases above rates observed during the base period;
- Good performance: if cattails expansion rate reduces or remains the same as baseline

Soil:

- Need for adaptive management action: if soil nutrient front expansion rate exceeds the baseline rate;
- Good performance: if soil nutrient front expansion rate remains or reduces below baseline rate

Management options that may be chosen based on test results: Adjust operations to change spatial and/or temporal distribution of water; model refinement and coupling to improve ability to forecast effects of operations and adaptive operational changes. The overarching goal is to avoid delivering water with elevated concentrations of TP to NESS, while minimizing the effect on the overall volume of water delivered to ENP. Specific operational options include:

1. Maintain discharges below 150 cfs through the combined S-12D and S-333 when S-333 headwater stage is below a level historically associated with elevated phosphorus concentrations (in the range of 9.2 ft or below for the S333 HW stage); this action will cease when either a) or b) occur:

a) S333_H stage increases to 9.2 ft. or higher or

b) S333_H stage increases 1 ft. above the May 15th stage.

2. Shift a fraction of the S-12D discharges to S-12C, and/or
3. Reduce dry-season recession rates by reducing outflow volumes in WCA-3A through S-12s and S-333 between December and May in water years with December stage lower than 10 feet NGVD29 (3 gage average in WCA-3A) to maintain higher stages in L-29 coming out of the dry season and reduce frequency and/or duration of low stage conditions associated with elevated phosphorus.

* Note that implementation of option 3 will require close coordination between USACE, SFWMD, and ENP senior leadership to apply and will be re-evaluated by interagency staff at a frequency not to exceed every 4 weeks. The intent of the adaptive management measures, if implemented, is that any temporary reduction in volumes delivered to the ENP due to the water quality adaptive management strategies will be limited in duration. Because stages in WCA 3A and ENP affect the weekly flow volumes calculated by the TTFF, short-term flow reductions would be naturally corrected by the weekly TTFF delivery calculation. Any reduction in deliveries would not need to be explicitly accounted for or replaced by deliveries independent of the TTFF weekly calculation. If implemented for longer durations, the adaptive management measures do have a greater potential to reduce the volume of water delivered to ENP, which is not the intent of the measure and one of the reasons for periodic re-evaluation. If it becomes clear that TTFF deliveries will need to be reduced over an extended period (more than 4 weeks), the interagency team will need to carefully weigh the risks of receiving water with elevated TP concentrations versus overdrying Shark Slough and other downstream areas. When reductions in volumes delivered to the ENP exceeds 4 weeks due to the implementation of the water quality adaptive management measures, significant alterations to annual deliveries to the ENP will be documented, and the adaptive management implementation will include a plan to mitigate impacts, if observed.

Additional options that have not been tested and will require additional analysis, NEPA review, and deviation to the WCP for implementation include:

1. Avoid first flush events through S-333 following low stage-low flow periods at the S-333 headwater,
2. Avoid discharges greater than 150 cfs through S-333 for a period of one to two week to allow water levels at the S-333 headwater to increase above a stage historically associated with elevated phosphorus concentrations,
3. Utilize the S-333N discharge structure in place of S-333 assuming the low stage impact on phosphorus concentrations has a lower magnitude of increase.

Decision-making Process: Once the WCA 3A stages are declining towards 9.2 feet NGVD and before reaching 9.2 feet NGVD at the S-333 Headwater during the dry season to wet season transition and/or when the WCA 3A three gage average is at 10 feet or below on December 1, a water quality group consisting of the DOI, the SFWMD, the FDEP and other agencies with expertise in water quality (led by the USACE) will initiate discussions to evaluate conditions for potential recommendations to implement the above strategies. This group shall then further coordinate these recommendations to determine suitability for implementation. The duration of any water quality adaptive management measures shall initially evaluated at an interval not to exceed four weeks (can be shorter duration). Additional increments, if implemented, shall also be evaluated at least every four weeks. These strategies will only be implemented on a case-by-case basis and will include evaluation of the near real time water quality conditions provided by the SFWMD (preliminary water quality data from the S-333, S-152, S-12's and

other appropriate structures), weather forecasts, water supply conditions, etc. Recommendations from the water quality team will be shared with the USACE water managers and then brought forth to the periodic scientist meeting for WCA 3A prior to implementation of these water quality strategies. USACE, after receiving input, shall make the operational decision whether or not to implement the water quality strategy in consideration of water quality and all authorized project purposes.

Table 7-7 summarizes the monitoring recommendations and provides funding estimates.

Table 7-7. COP AM Uncertainty ID#16b (Water Quality in NESRS) management option matrix.

Uncer-tainty Tracking ID#	Attribute or Indicator	Specific Property to be Measured and Frequency	Time-frame to detect change of attributes	Region or Specific Area (Locations to Monitor)	Decision Criteria: Trigger(s) for Management Action	Estimated Additional Annual Cost	Management Action Options Suggestions
UNC #16b – Water Quality in NESRS	TP concentration at structures plus additional water quality measures	Flow, TP nutrient concentration, turbidity and other water quality measures in water flowing into park	3 to 10 years	ENP-Northeast Shark River Slough, at structures S-12D, S-333	• Need for adaptive management action: increases if nutrients above existing conditions indicates potential for adverse impacts to downstream ecology; • Good performance: maintaining or reducing nutrient levels represents good performance	Existing	Adjust operations to change spatial and/or temporal distribution of water; model refinement and coupling to improve ability to forecast effects of operations and adaptive operational changes. 1. Maintain discharges below 150 cfs through the combined S-12D and S-333 when S-333 headwater stage is below a level historically associated with elevated phosphorus concentrations; this action will cease when either a) or b) occur: a) S333_H stage increases to 9.2 ft. or higher or b) S333_H stage increases 1 ft. above the May 15th stage. 2. Shift a fraction of the S-12D discharges to S-12C, and/or 3. Reduce dry-season recession rates by reducing outflow volumes for WCA-3A through S-12s and S-333 between December and May in water years with December stage lower than 10 feet NGVD29 (3 gage average in WCA-3A) to maintain higher stages in L-29 coming out of the dry season and reduce frequency and/or duration of low stage conditions associated with elevated phosphorus.

Uncer-tainty Tracking ID#	Attribute or Indicator	Specific Property to be Measured and Frequency	Time-frame to detect change of attributes	Region or Specific Area (Locations to Monitor)	Decision Criteria: Trigger(s) for Management Action	Estimated Additional Annual Cost	Management Action Options Suggestions
Same as above	Periphyton • TP content • Biomass • Composition	Periphyton in downstream marsh, bi-annual	3 months to 1 year	ENP-Northeast Shark River Slough, downstream of S-12D, NESRS NCTransects	• TP content o Need for adaptive management action: if TP content in periphyton tissue increases above baseline; o Good performance: if TP content in periphyton tissue remains or declines below baseline • Biomass o Need for adaptive management action: if biomass decreases below baseline; o Good performance: if biomass remains or increases above baseline • Composition o Need for adaptive management	Existing	Same as above

Uncer-tainty Tracking ID#	Attribute or Indicator	Specific Property to be Measured and Frequency	Time-frame to detect change of attributes	Region or Specific Area (Locations to Monitor)	Decision Criteria: Trigger(s) for Management Action	Estimated Additional Annual Cost	Management Action Options Suggestions
					action: if species composition shifts to more cyanobacteria relative to baseline; o Good performance: if species composition shifts to more desmids and diatoms relative to baseline		
Same as above	Cattail expansion	Local mapping of cattail in downstream marsh	3-5 years	Same as above	• Need for adaptive management action: if cattails expansion rate increases above rates observed during the base period; • Good performance: if cattails expansion rate reduces or remains the same as baseline	Existing	Same as above
Same as above	Soil nutrient front	Soil nutrient content in downstream marsh, annual	3-10 years	Same as above	• Need for adaptive management action: if soil nutrient front expansion rate	Existing	Same as above

Uncer-tainty Tracking ID#	Attribute or Indicator	Specific Property to be Measured and Frequency	Time-frame to detect change of attributes	Region or Specific Area (Locations to Monitor)	Decision Criteria: Trigger(s) for Management Action	Estimated Additional Annual Cost	Management Action Options Suggestions
					exceeds the baseline rate; • Good performance: if soil nutrient front expansion rate remains or reduces below baseline rate		

7.15.2 COP AM Uncertainty ID #12b (Tamiami Trail Flow Formula [TTFF] and Drought)

Is there an opportunity to deliver water to NESRS in a specific manner such that the delivery enhances stages in Shark River Slough, and perhaps freshwater flows to Florida Bay by delivering more water during the dry season without harming the ecological condition of WCA-3?

COP Objectives or Constraints: The COP objectives 1a, 1b, 1c, 3.

Region(s): NESRS, WCA 3, southern Shark River Slough, and Florida Bay

Associated Features: S-333, S-12 C and D (outflow of WCA 3/inflow to Shark River Slough portion of ENP), as well as S-11A-C, S-8, and S-140 (inflows into WCA 3).

Driver or uncertainty type: Hydrology/Operations

What is expected to be learned by addressing this uncertainty (i.e., how will COP benefit from addressing this uncertainty)? We are presented with the opportunity to learn whether the style of water delivery can produce measurable responses in southern SRS, and whether these responses can contribute meaningfully to reducing salinity concentrations in the chronically hypersaline portion of central Florida Bay.

Expectations or hypotheses to be tested to address the uncertainty, and attribute(s) that will be measured to test each: Statement of hypothesis: Can delivering additional flows into NESRS during a transition from the wet season to the dry season result in measurably increased water levels in SRS without increasing detrimental low water impacts to WCA-3 ecological conditions and water supply?

What is expected to be learned by measuring this attribute, i.e., how will COP benefit from knowledge gained about this attribute?

- If the seasonal timing of delivery to NESRS can be altered to reduce salinity concentrations in central Florida Bay then water managers will have developed a new tool for protecting Florida Bay during period of moderate water scarcity.

What is the time frame in which changes to this attribute are expected to be measurable?

- During a design test, results should be identifiable during a six month period, starting November and ending in May of the following year.

Is this attribute complimented by other monitoring programs within and/or outside of COP? If so, provide reference to other monitoring. Note the monitoring paid for by others in the COP Management Options spreadsheet.

- Yes, our continuous monitoring of structure flows,water surfaces surfaces in terrestrial marshes, and salinity concentrations in coastal embayments will be used to measure the effects of the field test.

When during COP's life cycle should this monitoring begin and end?

- Continuous monitoring of structure flows, water surfaces in terrestrial marshes, and salinity concentrations in coastal embayments will continue throughout both COP and CERP activities. Water surface and structure flow monitoring will not end during the COP process.

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: The design test was developed in response to concerns presented during development of the TTFF to better mimic the performance of ALT-O. Within the broader context of dynamic review of the COP TTFF planned through the COP Adaptive Management process and prescribed in the COP Adaptive Management and Monitoring Plan, parameters for a design test are proposed to test the hydrological and ecological response during a transition from the wet season to the dry season. The criteria for considering a test are:

Testing only occurs during the period between November 1st and May 30th. Testing only occurs after we've had at least 80 days of seasonal closure in WCA 3 in the dry season prior to the test, indicating a dry antecedent condition with likely multi-year impacts requiring special considerations (this occurs only 3 times in the 41 year period of record used in COP simulations – **Figure 7-12**). Testing may occur as we move into additional seasonal closures in WCA 3, and testing is considered anytime P35 in ENP is projected to move below 1.0 ft belowground, or P33 is projected to move below 0.5 ft belowground.

Testing will be stopped if any of the following drought intensity thresholds are reached:

- 0.8 ft belowground in northern WCA-3A (WCA3_NE and WCA3-3 gages)
- 0.5 ft belowground in southern/central WCA-3A (WCA3_3A-28 and WCA3_69 gages)
- 0.8 ft belowground in WCA-3B (WCA-3B_71 gage)

These thresholds correspond to the 93th-98th percentile low stage levels of these gages as defined by Alt Q and Alt O of the COP simulation models (**Figure 7-13**). The triggers are rarely reached in the simulations of COP performance and are important because soil consuming peat fires become a risk when water levels are more than 1.0 ft belowground, and risk rises significantly after 1.5 ft belowground threshold is crossed (Smith et al. 2003). Simulations indicate that these thresholds are unlikely to be a concern during the November –January period that would typically be the "early" portion of the design test, but would become critically relevant during March – typically the peak of drought intensity in the system.

When the criteria for the design test have been met, the test period will allow general flexibility to increase the TTFF prescribed deliveries up to 400 cfs above the TTFF recommended flows for significant portions of the period, also allowed to introduce nonlinearities in lowest flow conditions (sometimes lower flows than suggested by the TTFF – during the driest of conditions, sometimes tripling-quadrupling very low - 25-100 cfs flows – perhaps during the early onset of the wet season). The ultimate design decisions should be described during the operational period based on comparison of modeled analogous conditions. Although our modeling provides the basis for the design of this field test, the actual implementation of the test must be done in the specific context that occurs, with specific physical limits and constraints imposed upon the test. Because there are strong limits on our ability to accurately forecast rainfall, the designed test is limited in duration to 6-8 week intervals and must be re-evaluated to ensure safe operating conditions every 6-8 weeks.

MONTHLY COUNT OF LOW WATER CLOSURE DAYS in WCA3A
COP ALTQ

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Year													
1965	0	0	0	0	17	15	0	0	0	0	0	0	32
1966	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	2	31	6	0	0	0	0	0	0	38
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	24	31	18	0	16	5	0	0	0	84
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	20	31	30	1	0	0	0	0	0	82
1974	0	0	25	30	31	25	0	0	0	0	0	0	110
1975	0	0	15	30	31	30	1	0	0	0	0	0	107
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	13	20	0	2	4	0	0	0	0	39
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	31	30	30	0	0	0	0	0	91
1982	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	7	19	31	22	0	0	0	0	0	0	79
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	4	28	14	30	19	0	0	0	0	0	95
1990	0	0	9	30	31	30	0	0	0	0	0	0	90
1991	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	8	14	0	0	0	0	0	0	0	22
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	8	8	0	0	0	0	0	0	16
2005	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	60	195	315	213	41	20	5	0	0	0	870

Figure 7-12. Monthly count of low water closure days in WCA3 – COP Alt Q, with years when TTFF drought conditions test would be implemented indicated by heavy black outline. Design test implementable only in 1973-1974, 1989-1990, and 1990-1991.

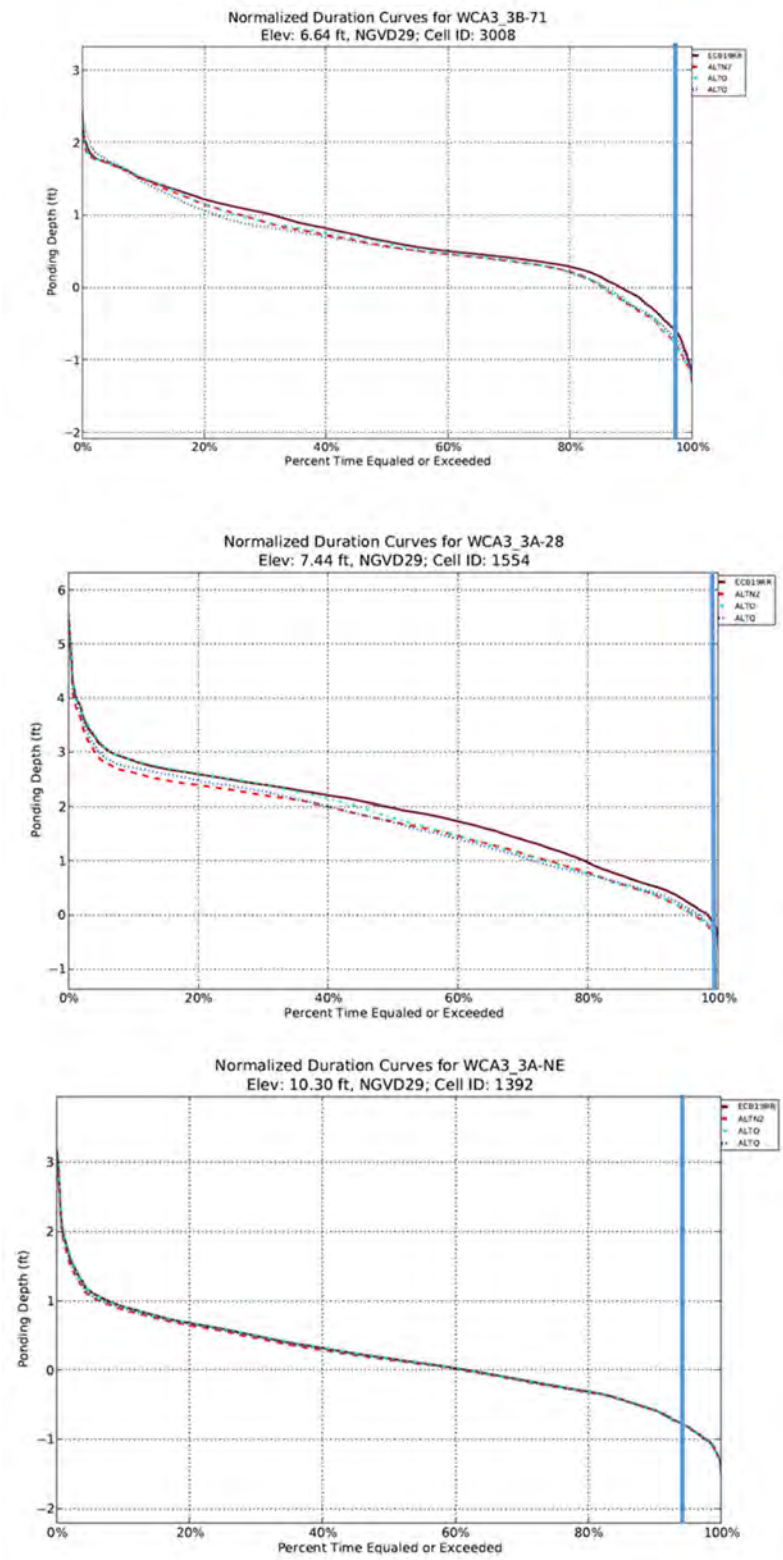


Figure 7-13. Normalized duration curves of depths at specific gages in WCA3. a) Gage WCA3_3B_71 (top), b) WCA3_3A_28 (middle), and c) WCA3_3A-NE (lower). Curves for WCA_3_3-69 and WCA3-3 gages are similar but not shown.

Review of representative years from the modeling indicates that that the field test may increase expected deliveries by 32,000 – 80,000 acre feet over the entire November-May period above the level of delivery by the Tamiami Trail Flow Formula identified in Alt Q (which delivered 75,000 acre ft in 1973-74, 50,000 acre ft in 1989-90, and 180,000 acre ft in 1990-91 respectively during the November 1 – May 30 period). These additional deliveries correspond to the differences in deliveries observed in Alt O and Alt Q during these three specific years identified in **Figure 7-12** (1973-1974, 1989-1990, and 1990-1991), and the anticipated effect of the design test may result in a minor-negligible effect on WCA-3A, in addition to a minor benefit realized by the SRS portion of ENP. A comparison between alternatives O and Q indicate that maximum effect of the design test would reduce stages in WCA 3A 0.1-0.5 ft over roughly 35% of WCA 3A. Stage level reductions no more than 0.3-0.5 ft occur within the first 0.5 miles upstream of the L29 canal, 2-4 miles upstream of the L-67 canal, while 0.1-0.3 ft stage reductions occur 0.5-3 miles upstream of the L29 canal and 4-10 miles upstream of the L67 canal respectively. Since our ability to predict rainfall volumes over a seasonal drydown is a significant uncertainty, water managers may stop the test if less than 2 inches of basin-wide average rain of WCA3 in any month and forecast rains present a significant risk of drying WCA-3A beyond the constraint thresholds outlined above.

Triggers/thresholds that indicate good COP performance or need for adaptive management action. These are described in the methodology of the test provided above, since the constraints and thresholds are central to the methodology of the design test.

At each PDT+ meeting the team will identify if a field test is possible in the upcoming wet-dry season transition (based upon closures in WCA-3A during the previous season and anticipated water levels in WCA3). If suitable conditions appear likely, the managers will be notified of intent to further investigate whether conditions warrant initiation of the field test, and a series of monthly meetings will be used to formulate the specific field test strategy. Results from the test will be summarized in a report and delivered to resource managers no later than 6 months after the completion of the field test, to ensure availability of this information in advance of the next dry season. The report will document the proposed design, the actual operations utilized, the hydrologic and ecologic effects on ENP and WCA3 (in terms of depth duration effects at key gages identified above).

Management options that may be chosen based on test results.
Option 1: Adopt operational strategy that provides a moderate increase to TTFF inflows into Central and Southern Shark River Slough during seasonal transitions.

Option 2: Based on consideration of constraints and forecast conditions, maintain adherence to the COP TTFF based delivery strategies.

This uncertainty is further defined in a management option matrix below in **Table 7-8.**

Table 7-8. COP AM Uncertainty ID #12b (Tamiami Trail Flow Formula and Drought) management option matrix.

Uncertainty Tracking ID#	Attribute or Indicator	Specific Property to be Measured and Frequency	Timeframe to detect change of attributes	Region or Specific Area (Locations to Monitor)	Decision Criteria: Trigger(s) for Management Action	Estimated Additional Annual Cost	Management Action Options Suggestions
UNC #12b – Tamiami Trail Flow Formula (TTFF) and Drought	Seasonal timing of delivery of flows to NESRS	Daily averages of stage	Event driven when criteria for conducting test occur. Duration of test should be 6 months.	S-333, S-12 C and D (outflow of WCA3/inflow to Shark River Slough portion of ENP), as well as S-11 A-C, S-8, and S-140 (inflows into WCA3).	• If test is able to be successfully implemented without unexpected violation of constraints (e.g., causes water quality concerns), then the test operational strategy (with the drought intensity threshold constraints) will become part of the regular water control plan operational strategy. • If unexpected violation of constraints occur that appear unresolvable (e.g., water quality concerns or excessive drying of WCA-3A), then operations will return to using the Tamiami Trail Flow Formula as described in the Water Control Plan.	Existing unless additional model runs are required	**Option 1**: Adopt operational strategy that provides a moderate increase to TTFF inflows into Central and Southern Shark River Slough during seasonal transitions. **Option 2**: Based on consideration of constraints and forecast conditions, maintain adherence to the COP TTFF based delivery strategies.

8 EFFECT OF WATER CONTROL PLAN

The purpose of this chapter is to describe the effects of the Water Control Plan (WCP), operations of the WCA, ENP, and ENP-SDCS component of the C&SF Project.

8.1 General

The WCP (Chapter 7) operations balance the Congressionally-authorized project purposes which include flood risk management, water supply for municipal, industrial, and agricultural uses, prevention of saltwater intrusion, water supply for ENP, protection of fish and wildlife resources, groundwater recharge, recreation, and navigation. The multiple, varied, and sometimes conflicting goals for the regional system (i.e. flood risk management, water supply, environment, navigation, etc.) add to the complexity of the day-to-day water management operations. The updated WCP combines the 2012 WCP water management operations for WCA-1 and WCA-2 with the new water management operations for WCA-3, ENP, and ENP-SDCS that were developed in the COP. The COP is an integrated operational plan for two modifications of the C&SF Project – known as MWD to ENP and the C-111 SD Projects. The COP balances ecological restoration objectives of the MWD to ENP and C-111 SD Projects completed infrastructure by redistributing the existing WCA-3A and ENP water budget.

Anticipated changes to the existing environment are detailed in the COP EIS. The WCP operations change the amount and timing of releases from WCA-3A to ENP through implementation of the TTFF. This is anticipated to provide the following benefits compared to the modeled existing condition baseline.

1. Increases the availability of water deliveries from WCA-3A to ENP through NESRS and improves hydrologic conditions in Taylor Slough, the Rocky Glades, and the eastern panhandle of ENP.

2. Increases the annual inflow to ENP by approximately 162,000 acre-feet per year on average, an increase of 28%.

3. Increases the proportion of the water that enters ENP east of S-333 by 19%. This changes the spatial distribution of the water delivered into ENP across Tamiami Trail (U.S. Highway 41) which helps restore NESRS as a functioning component of the Everglades hydrologic system.

4. Increases the annual inflow to Taylor Slough by approximately 6,000 acre-feet per year on average (an increase of 7%) to maximize progress toward restoring historic hydrologic conditions in Taylor Slough.

5. Increases the annual inflow to the Eastern Panhandle of ENP by approximately 30,000 acre-feet per year on average (an increase of 27%).

6. Reduces the releases to Manatee Bay and Barnes Sound through S-197 by 41,000 acre-feet per year on average (a decrease of 69%). Average number of days with non-zero deliveries through S-197 would also be reduced by 78% (from 223 to 48 days per year).

The additional water flowing into ENP would help to restore pre-drainage vegetative communities and habitat for fish and wildlife while providing incremental restoration of natural processes critical for the development of peat soils and tree islands, which are essential features of the Everglades ridge and slough

landscape. Increased freshwater flows to Florida Bay would reduce salinities, resulting in better conditions for the diversity of seagrasses and other estuarine plant and animal species that inhabit the Bay.

Potential unavoidable adverse effects as discussed in the COP EIS that may occur as a result of WCP are summarized below and include;

1. Increases risk to accessibility of tree islands for cultural and religious practices by the MTIF; decreases in water levels in WCA-3A may limit airboat access to tree islands during extremely dry periods. Access during these times may be limited to walking and/or use of swamp buggies.

2. Increases risk to soils in WCA-3 due to the potential for reduced water levels; however hydrologic modeling conducted in support of the COP, indicated that the majority of WCA-3 is expected to be above the threshold to maintain peat accumulation in the Everglades marsh relative to the existing condition baseline.

3. Increases risk to recreational access in WCA-3 during extremely dry periods; differences in the number of days the FWC considers closure in the EWMA due to low water stages was modeled to be less than a 2% period of record change relative to the existing condition baseline.

4. Increases risk for phosphorous loading in ENP and exceedance of the Consent Decree's Appendix A Shark River Slough annual phosphorus concentration limit; however, due to the trend of improving water quality delivered to ENP and the expectation that the SFWMD Restoration Strategies (RS) will accelerate the improvement trend, it is expected that the potential risk for increased phosphorus concentrations delivered to the ENP will be reduced in the future.

5. Potential for high volume releases through S-197 to Barnes Sound/Manatee Bay associated with the Extreme High Water Line (EHWL). Under this condition releases at S-197 may be increased up to a maximum of 2400 cfs as summarized in the WCP (Chapter 7). This operational flexibility is not expected to be triggered frequently and is intended to be available if needed to help reduce risks to the WCA-3A perimeter levee system, a population at risk of 70,600 people, hurricane evacuation routes, and wildlife and tree islands from extreme high water conditions.

Concerns expressed by stakeholders included the performance of the TTFF during regional droughts in the WCAs, ENP, and Florida Bay, the effects of the EHWL on flood risk in agricultural areas of Miami-Dade County, and potential effects of S-197 releases to the Eastern Panhandle and Manatee Bay and Barnes Sound. The COP Adaptive Management and Ecological Monitoring Plan (AMMP) was developed to identify the monitoring necessary to inform decision-makers, partner agencies, and the public on progress towards achieving restoration success, as well as address uncertainties related to potential adverse effects to avoid and/or minimize those effects.

The WCP operations provide a significant increase in freshwater needed for the restoration of NESRS and Taylor Slough, however, additional actions are needed such as the completion of CERP components that would increase freshwater flows to achieve Everglades restoration. The COP is anticipated to be in place until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay. If new information becomes available through implementation of the WCP and/or the AMMP that would necessitate a need to modify water management operations, this information will be incorporated as appropriate in accordance with laws and regulations including the NEPA.

8.2 Flood risk management

A major design function of the project canals and structures in the WCAs, ENP, ENP-SDCS project areas is flood risk management. Hydraulic design of these water management structures conform to the standard design criteria and procedures established in EM 1110-2-1602, Engineering and Design Hydraulic Design of Reservoir Outlet Works, and EM 1110-2-1603, Engineering and Design Hydraulic Design of Spillways. Descriptions of the water management structures are found in Appendix A of this SOM.

The WCAs provide a detention reservoir for excess water from the EAA and parts of the east coast region, and for releases from Lake Okeechobee. Levees associated with the WCAs prevent Everglades floodwaters from inundating the east coast urban areas and provide flood protection to MTIF lands. The ENP-SDCS provides flood protection to developed areas in Miami-Dade County adjacent to the eastern boundary of ENP.

For the WCP operations (based on the recommended plan identified in the COP EIS), the hydrologic modeling indicated no significant increases to regional groundwater stages during normal to wet conditions which would impact the levels of service for flood control within the Lower East Coast Service Areas (LECSAs), as detailed in Section 4.14 and Section 4.15 of the COP EIS. The COP EIS flood risk management evaluation is focused principally on the urban and agricultural basins east of the WCAs and ENP (east of the East Coast Protective Levee), including LECSA 1 (Palm Beach County), LECSA 2 (Broward County), LECSA 3 (Miami-Dade County), and the 8.5 SMA. Flood risk management performance for the urban and agricultural parcels adjacent to the L-31N and C-111 primary canals is principally based on the water level controls along these primary SDCS canals. The recommended plan lowers the frequency and duration of high water stages in WCA-3A, which corresponds to further reduced public health and safety risk associated with the WCA-3A perimeter levee system. As part of the MWD to ENP Incremental Field Tests, South Dade canal operations for reaches along the L-31N (south of S-331) and C-111 canals were generally lowered with the additional inclusion of seasonal criteria at the S-332 pump stations, compared to the long-term operational paradigms prescribed within the previous WCPs under the IOP (2002-2012) and ERTP (2012-2015). The MWD to ENP Incremental Field Tests started in 2015, to simultaneously promote both increased deliveries to Taylor Slough and the hydraulic ridge and reduced flood risk for the adjacent agricultural and urban areas. Extensive analyses during the COP iterative modeling rounds, including specifically crafted sensitivity simulations, demonstrated there is no significant trade-off between ecological performance benefits within ENP and the lowering of the normal canal operating ranges with the COP.

Compared to the existing condition baseline (ECB19RR) identified in the COP EIS, no notable changes to groundwater stages were indicated within LECSA 1, consistent with the COP not modifying the Regulation Schedules for WCA-1 and WCA-2. LECSA 2 groundwater stages are slightly reduced by less than 0.05 feet along the Miami canal immediately east of WCA-3B, resultant from increased utilization of the L-30 canal and eastern WCA-3B to provide additional water deliveries to the SDCS to extend ENP hydroperiods adjacent to the C-111 SD NDA and SDA and to increase deliveries to Taylor Slough and toward Florida Bay. The L-30 canal stages (north of S-335) indicate a moderate reduction (0.1-0.2 feet) to flood control stages during normal to extreme wet conditions. Minor increases to groundwater stages, up to 0.05 feet, are evident across most of western LECSA 3, extending up to 3 miles east of the East Coast Protective Levee proximal to the water control structures along the C-1W canal (S-338), C-102 canal (S-194), and C-103 canal (S-196). The L-31N canal stages (north of G-211) indicate no significant change during normal to wet conditions. The L-31N canal stages (between G-211 and S-331) indicate a moderate reduction (0.1-0.2 feet) to flood control stages during normal to extreme wet conditions. No increase to groundwater stage

results from the reduced utilization of the S-331 pump station to provide flood mitigation to the adjacent 8.5 SMA and the concurrent increased utilization of the S-357 pump station because COP includes revised flood control operations at S-331 to maintain L-31N stages between 4.5 to 5.0 during the CSSS nesting window (14 February – 15 July) and between 4.3 to 4.6 during other times of the year. During wet years, such as 1995 and 1999, moderately increased stages up to 0.4 feet are indicated north and east of the S-331 pump station along the C-1W canal. The L-31N canal stages east of the C-111 SD NDA and SDA (between S-331 and S-176) indicate a minor stage increase during moderately wet conditions, with no increase for extreme wet conditions or during normal to wet conditions. Further south along the C-111 canal, for normal to wet hydrologic conditions, no significant changes are observed for the canal reach east of the SFWMD C-111 Spreader Canal Project (between S-176 and S-177) or for the canal reach between S-177 and S-18C. For the 8.5 SMA, hydrologic conditions are not unchanged for all areas, but circumstances are generally improved. The 8.5 SMA congressionally authorized Flood Mitigation constraint compliance is achieved for all interior 8.5 SMA locations. The COP modeling indicated that 1-2% of the 8.5 SMA will experience an increase in peak stage but received a flood risk reduction resultant from reduced inundation duration of 66-74%.

The SBC Project WCPs (located in Appendix G) include WRAs, ISCs, levees, water management structures, and pump stations which are designed to improve flood risk management on the Seminole Big Cypress Reservation.

8.2.1 Spillway Design Flood (SDF)

The basic purpose of the spillway is to provide a means of controlling the flow and providing conveyance from reservoir to tailwater for all flood releases up to the SDF. The standard project flood (SPF) is a minimum value used for terminal structure design release. The SPF for the WCAs, ENP and ENP-SDCS project area is defined as the most severe storm or sequence of storms considered reasonably characteristic of south Florida. The SPF rainfall is the 1% annual exceedance probability (AEP, the rainfall that has a 1 in a 100 chance of occurring in any given year) rainfall for the period of record with values increased by 25 percent. Design criteria for structures were developed by using the SPF and considering various other factors such as wind setup, wave run-up, and vegetation characteristics.

The S-10s, S-11s, and S-12s were sized to pass the SPF. Thus for them the SDF is the SPF. Rapid removal of flood storage in the WCAs is limited due to the slow movement of water in the densely vegetated WCAs, relative to the potentially high rates of inflows that come from the combination of upstream structures and rainfall.

The C&SF Project features in ENP-SDCS maintain optimum stages for the purpose of flood risk management and also provide water supply, groundwater recharge, and prevent saltwater intrusion. The C-111 Basin structures (S-196, S-194, S-176, S-177, S-18C, and S-197) were designed to pass 40 percent of the SPF without exceeding design stages, and to control releases during floods in excess of design to prevent damaging velocities at the structures and in the canal. Thus for these structures, the SDF is 40 percent of the SPF.

8.2.2 Inflow Design Flood (IDF)

The USACE is currently nearing completion of an updated WCA flood routing analysis study, the Baseline and Modification Model (BAMM), with intended completion of July 2020. The intent of the BAMM study is to identify and quantify the cumulative changes to design stage and flow conditions within the WCAs (WCA-1, WCA-2, and WCA-3) due to infrastructure and operational changes that have occurred since the

originally authorized C&SF Project design. The BAMM effort includes development of a new regional flood routing model and model simulations of SPF hydraulic routings for each of the WCAs. The BAMM flood routing results will be used by the USACE to conduct comprehensive risk analysis of levees and structures within the WCAs, including hydraulic, hydrological, geotechnical, and structural engineering, if results warrant. The USACE will evaluate any substantial WCA design deficiencies and determine the resulting path forward based on human health and safety and other C&SF Project requirements. The Inflow Design Flood (IDF) details are expected to be developed as part of the BAMM effort. **Table 8-1** lists the BAMM results for SPF elevations in WCA-1, WCA-2A, WCA-2B, WCA-3A, and WCA-3B and SPF flows for the S-10s, S-11s, and S-12s.

Table 8-1: WCAs BAMM SPF Elevations and Flows

WCA	BAMM SPF Elevations (NGVD)
WCA-1	19.3 feet
WCA-2A	16.6 feet
WCA-2B	11.5 feet
WCA-3A	14.2 feet
WCA-3B	10.4 feet
Structure	BAMM SPF Flows (cfs)
S-10s	13,100
S-11s	9,850
S-12s	7,800

8.2.3 Reservoir Design Flood (RDF)

The WCA Reservoir Design Flood (RDF) details are the same as discussed in section 8.2.2.

8.2.4 Other Floods

Not applicable.

8.3 Recreation

Recreational activities such as sightseeing, wildlife viewing, photography, hiking, bicycling, boat touring, boating, kayaking, canoeing, camping and fishing are popular in the WCAs and ENP. The largest remaining subtropical wilderness in the continental United States, ENP is a unique and highly diverse wetland system which attracts visitors from around the world. There are information centers/nature observation sites, primitive campsites, walking trails, boat ramps and other day use facilities in ENP and the EWMA. The water levels within these areas impact recreation and public access both directly and indirectly. FWC considers recreational closures in the EWMA due to both high and low water stages as outlined in the WCP.

Due to lowering of water levels in WCA-3, the operations developed in the WCP, may potentially reduce airboat access and recreational fishing within the marsh during extremely dry periods; however, access to canals for recreation would not change relative to the modeled existing condition baseline. Specific access

points along Tamiami Trail west of the L-67 Extension canal face an increased risk of being inaccessible for recreational finishing, air boating, and paddling to an estimated average of 5% period of record change.

8.4 Water Quality

Hydrological and environmental conditions within the Everglades have changed a great deal in comparison to conditions that existed during the mid-19th century. Before construction of the C&SF Project, water moved freely across the shallow Everglades, miles of sawgrass, wet prairies and open water sloughs from Lake Okeechobee southward to the coastal estuaries of Florida Bay. Disruption of historical flow patterns due to the regional drainage improvements of the C&SF Project and the development of agriculture south of Lake Okeechobee has caused major changes in the quality of water released south to the Everglades. With the exception of rainfall and flows into the system from the eastern BCNP, the Everglades are regulated by a man-made water management system (C&SF Project) and water is routed more quickly through a complex network of canals and impoundments.

Water quality delivered to the WCAs and ultimately ENP has significantly improved due to the mandatory Best Management Practices (BMPs) imposed on the EAA and a series of STAs and Flow Equalization Basins (FEBs) treating EAA runoff and some Lake Okeechobee water, prior to flowing into the WCAs. Restoration Strategies (RS), a State of Florida funded effort, is expected to result in further reduction of nutrients and/or nutrient spikes released to the WCAs. The interior marsh nutrient conditions in the WCAs has significantly improved since the passage of the 1994 Everglades Forever Act, as demonstrated by the reduction of nutrient concentrations measured at the numerous marsh monitoring stations within the WCAs. There are still significant soil nutrient loads in the WCAs that will slowly improve as compared to the surface water conditions. Very significant improvements have occurred but further improvements are still needed. RS features are expected to continue this improvement trend of reduced deliveries of high nutrient concentration water to the WCAs.

Because the WCP operations will significantly alter the timing and distribution of flows into ENP, while also increasing the volume of water delivered to SRS, there is the potential for adverse impacts on water quality. However, due to the trend of improving water quality delivered to ENP and the expectation that the SFWMD RS will accelerate the improvement trend, it is expected that the potential risk for increased phosphorus concentrations delivered to the ENP will no longer exist in the future. During the interim period of potential increased risk to water quality, the COP analysis indicates that with the implementation of water quality AMMP (Appendix C of the COP EIS) strategies included in the WCP, the short term-risk can be diminished. By 2023, independent of improvements expected from RS and CEPP, phosphorus concentrations delivered to the ENP can be improved over the existing condition baseline. The AMMP (Appendix C of the COP EIS) water quality strategies may reduce the quantity of water delivered to ENP, but they were developed and designed to avoid any net reduction of water volumes delivered to the ENP during a given water year. The intent of the adaptive management measures, if implemented, is that any temporary reduction in volumes delivered to the ENP due to the water quality adaptive management strategies will be limited in duration and re-evaluated every 4-6 weeks. Because the stage conditions in WCA-3A affect the TTFF, short-term flow reductions would be naturally corrected by the weekly TTFF delivery calculation. Any reduction in deliveries would not need to be explicitly accounted for or replaced by deliveries independent of the TTFF weekly calculation. If implemented for longer durations, the adaptive management measures do have a greater potential to reduce the volume of water delivered to ENP, which is not the intent of the measure. If it becomes clear that TTFF deliveries will need to be reduced over an extended period (more than 4 weeks), an interagency team will need to be assembled to carefully weigh the risks of receiving water with elevated TP concentrations versus

overdrying Shark Slough and other downstream areas, and to develop a plan for mitigating impacts or otherwise replacing reduced deliveries as quickly as possible.

8.5 Fish and Wildlife

The effects of recession rates, ascension rates, water levels and hydroperiods on fish, wildlife and vegetation in the WCAs are important considerations in determining and developing the regulation schedule water levels. There are two primary environments which support Everglades fish in the WCAs, ENP and ENP-SDCS project area. They are the vast expanse of open water aquatic sloughs and wet prairies and the deep water canal environments within the WCAs and ENP-SDCS. While canals contain water throughout the year, the extant marsh areas experience seasonal drying. As a result, marsh fish populations will vary from season to season and year to year in response to the changing water levels. Besides supporting a valuable recreational fishery for the region, fish communities provide a major food source for Everglades wading birds, alligators, and other carnivorous reptiles and mammals. Fish community structure and abundance is highly dependent on water levels. A potential increase in foraging conditions for wading birds is expected to improve in portions of ENP due to increases in the availability of water; however, implementation of Chapter 7 (WCP) may increase the probability that wading bird colonies in northern WCA-3A would experience drier conditions due to reduced water depths in WCA-3A.

Forty-Five Federally-listed threatened and endangered species are either known to exist or potentially exist within the Everglades (WCAs, ENP, coastal areas) including the Florida panther, Florida manatee, Cape Sable Seaside Sparrow, Everglade snail kite, wood stork, American alligator, American crocodile, and Eastern indigo snake. State listed species in the Everglades include the, Everglades mink, black skimmer, least tern, white-crowned pigeon, little blue heron, tricolored heron, reddish egret, roseate spoonbill, Florida sandhill crane, and Southeastern American kestrel. The Everglades contain some of the largest and most important wading bird colonies in North America.

The COP is being pursued to address the mandated Reasonable and Prudent Alternative (RPA) of the July 22, 2016 Everglades Restoration Transition Plan (ERTP) Biological Opinion (BO) and subsequent coordination between the USFWS and the USACE, which requires the USACE to proceed as scheduled, and as allowable by law, for completing NEPA analysis for the COP by August of 2020. The RPA identified operational modifications and proposed expediting restoration initiatives for some of the structures in the southern portion of the Everglades ecosystem to provide suitable nesting habitat for the endangered Cape Sable Seaside Sparrow (CSSS). The implementation of the COP is expected to influence wetland hydroperiods causing changes in nesting and marl prairie suitability for the CSSS and other federally listed threatened and endangered species under the purview of the USFWS. The new BO is included in the 2020 COP EIS.

Terrestrial wildlife, such as deer, marsh rabbits, bobcats, and raccoons, are also native and common within the WCAs. As water levels rise, terrestrial wildlife respond by moving to elevated locations such as tree islands, spoil islands, and surrounding levees. As water levels continue to rise, the areas of high ground become more limited, making large and small mammals much more vulnerable to stress, disease, starvation, and predation. When restricted to higher ground, preferred food sources are limited, and wildlife must resort to less nutritious foods. Over time, fat reserves become exhausted and malnutrition and death will occur.

The FWC and USFWS monitor conditions and provide important information when there is concern that high-water levels could negatively affect wildlife populations and their habitats. In the EWMA, the deer

herd management goal is to maintain the density at or slightly below the predicted high-water carrying capacity. To assist with this goal, management strategies such as antler restrictions, conservative harvest rates, careful monitoring of the deer herd, public access restrictions during periods of high water, and ecological recommendations provided to water managers are used. A large proportion of an Everglades deer diet is aquatic herbs (Labisky 2003, Loveless 1959). Everglades deer are generally healthy and free of parasites and disease, but when deer are crowded on elevated sites and suffering from stress and malnutrition, there is increased susceptibility to parasitism and disease (Loveless 1959). The FWC position paper entitled Hydrologic Requirements for the Everglades and Francis S. Taylor Wildlife Management Area dated November 20, 2013 (https://myfwc.com/media/6679/4bevergladespositionpaper.pdf) provides biologically based guidance for managing water levels to ensure the conservation, protection, and restoration of fish and wildlife populations, habitats, species diversity, and cultural resources. FWC biologists use deer as an indicator of increased wildlife use of levees and under normal conditions, less than 10 deer will be observed during a spotlight survey on the L-5 levee. The observation of more than 10 deer on the L-5 levee is an indicator that high water conditions are having a detrimental effect on wildlife health and habitats. FWC biologists report wildlife monitoring results through the existing WCA-3 Periodic Scientists Call

8.6 Water Supply

The WCAs, ENP, ENP-SDCS project features provide water supply benefits for municipal and industrial users, water supply for irrigation of agriculture, water supply for ENP, and to prevent saltwater intrusion and dilution of pollutants in project canals. In addition, water is delivered to coastal spillways through project canals to prevent saltwater intrusion into nearby groundwater wells. When there is insufficient water available in the WCAs, water is transferred from Lake Okeechobee through the WCAs and/or between the WCAs to meet water supply demands.

The surficial aquifer system, including the water table and Biscayne aquifers, underlies approximately 3,000 square miles of Miami-Dade, Broward, and southern Palm Beach counties. It is a surficial, highly permeable, wedge-shaped aquifer that is approximately 200 feet thick at the coast but thins to a few feet thick near its western boundary 35 to 40 miles inland. The surficial aquifer system provides water for six water use categories established by the FDEP (public water supply, domestic self-supply, industrial and power generation water supply, agricultural and landscape irrigation) along the southeast coast. Seepage and water supply releases from the WCAs prevent saltwater intrusion along the coast and recharge the surficial aquifer system. Due to the high degree of connectivity between the surficial aquifer system and surface water, changes in surface water elevations have a direct impact on groundwater levels and saline water intrusion. A prolonged reduction in canal stages will affect groundwater levels, which could result in movement of saline water into the Biscayne aquifer, causing harmful impacts to water supply well fields during drought conditions. Maintaining canal stage elevations for water supply and prevention of saline water intrusion are essential purposes of the C&SF Project. Analysis of the model results for COP indicated that WCP operations maintain the pre-project levels of service for water supply.

8.7 Hydroelectric Power

There are no hydroelectric power plants within the C&SF Project.

8.8 Navigation

There are no authorized project features for commercial navigation within the WCAs, ENP, ENP-SDCS project area. However, the many miles of canals in the project do offer excellent fishing and boating

opportunities. In WCA-2A, the L-38E, L-38, and L-35B borrow canals offer approximately 21 miles of unrestricted access for watercraft. Navigation is generally unobstructed in the canals except during low water periods when rocks are often exposed or when areas become clogged with aquatic vegetation. Decreases in water levels in WCA-3A may limit airboat access to tree islands by the MTIF during extremely dry periods. Independent of implementation of the WCP, tribal airboat access is currently limited during the dry season; however durations of limited access would be expected to be extended during periods of below average annual rainfall.

8.9 Drought Contingency Plans

The Drought Contingency Plan for the WCAs, ENP, and ENP-SDCS component of the C&SF Project is found in Appendix B. SFWMD's Water Shortage Plan is codified in Chapter 40E-21 (Water Shortage Plan) and Chapter 40E-22 (Regional Water Shortage Plan), Florida Administrative Code. This plan is required under Subsection 373.246(1) Florida Statutes. The purposes of the plan are to protect the water resources of the SFWMD from harm; to assure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social and health-related impacts; to provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage, and to promote greater security for permitted water users. The Water Shortage Plan includes rules that outline priorities and define procedures for restricting water use during water shortages under direction of the SFWMD Governing Board. Water shortage activities are managed through the SFWMD Emergency Operations Center.

8.10 Flood Emergency Action Plan

Although there are currently no Flood Emergency Action Plans for the WCAs, ENP, ENP-SDCS region, it is anticipated future CERP Projects will include these plans. Additionally, the USACE Jacksonville District All-Hazards Plan should be consulted for related emergency preparation and actions. The SFWMD maintains a Comprehensive Emergency Management Plan (CEMP) which provides overall guidance using an all-hazard approach for managing disasters and emergencies. The CEMP describes the policies, strategies, operational goals, and objectives through which the SFWMD will mobilize resources and conduct response and recovery activities after a large-scale disaster. The SFWMD CEMP follows the framework of the National Incident Management System (NIMS). The use of NIMS is a nationwide effort that is federally mandated for local, state, and federal agencies per Homeland Security Presidential Directive 5.

8.11 Frequencies

The following sections contain plots and tables that are from the COP modeling effort that informed WCP operations. The plots compare the existing condition baseline (ECB19RR) to the proposed plan (ALTQ) as defined in the COP EIS.

8.11.1 Inflow Probability

The determination of SPF inflows into the WCAs used in BAMM was based on an evaluation of structure inflow design capacity, historical maximum inflows, and Standard Project Storm (SPS) runoff from contributing WCA areas.

8.11.2 Pool Elevation Duration and Frequency

The figures in this section show the average stages and duration curves for WCA-1, WCA-2A, WCA-2B, WCA-3A, and WAC-3B (**Figure 8-1**–**Figure 8-10**). The tables in this section show the peak stage elevations for each year for the period of record modeled (1965-2005) for WCA-1, WCA-2A, WCA-2B, WCA-3A and WAC-3B (**Table 8-2**–Table 8.6).

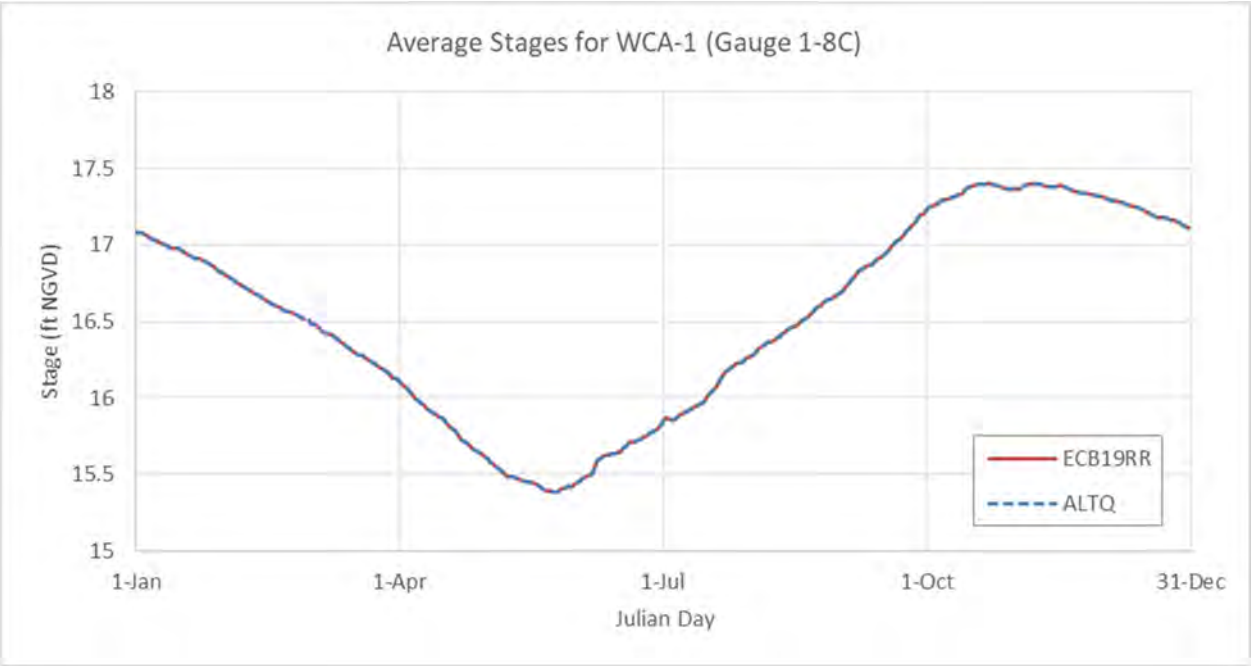


Figure 8-1. WCA-1 Average Stage

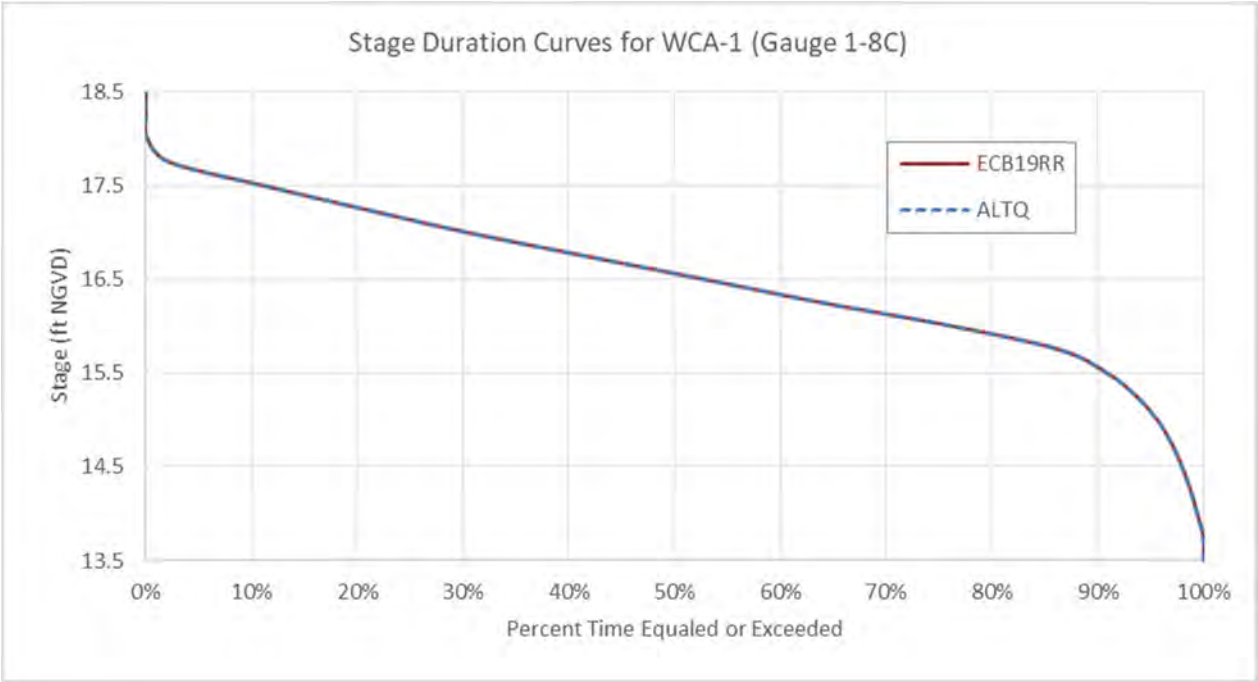


Figure 8-2. WCA-1 Stage Duration Curve

Table 8-2: WCA-1 Peak Stage Elevations (1965-2005)

	WCA-1	(feet NGVD)
Year	ALTQ	ECB19RR
1965	17.95	17.95
1966	17.95	17.95
1967	17.72	17.72
1968	17.77	17.77
1969	18.04	18.04
1970	17.29	17.29
1971	17.59	17.59
1972	17.36	17.36
1973	17.68	17.68
1974	17.76	17.76
1975	17.72	17.72
1976	17.13	17.13
1977	17.67	17.67
1978	17.89	17.89
1979	17.81	17.81
1980	17.30	17.30
1981	17.79	17.79

	WCA-1	(feet NGVD)
1982	17.78	17.78
1983	18.05	18.05
1984	17.50	17.50
1985	17.89	17.89
1986	17.65	17.65
1987	17.86	17.86
1988	17.38	17.38
1989	16.63	16.63
1990	17.01	17.01
1991	17.28	17.28
1992	17.94	17.94
1993	17.72	17.72
1994	18.29	18.29
1995	18.09	18.09
1996	17.66	17.66
1997	17.78	17.78
1998	18.04	18.04
1999	18.03	18.03
2000	17.35	17.35
2001	17.85	17.85
2002	17.35	17.35
2003	17.50	17.50
2004	17.82	17.82
2005	17.62	17.62

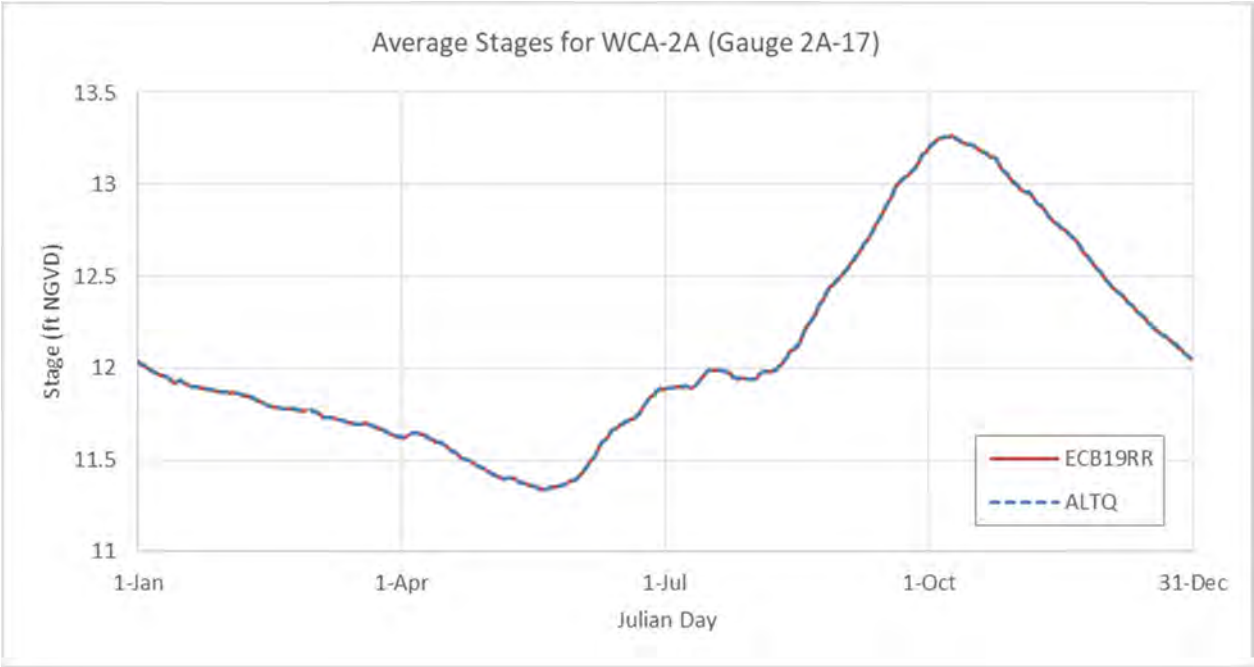


Figure 8-3. WCA-2A Average Stage

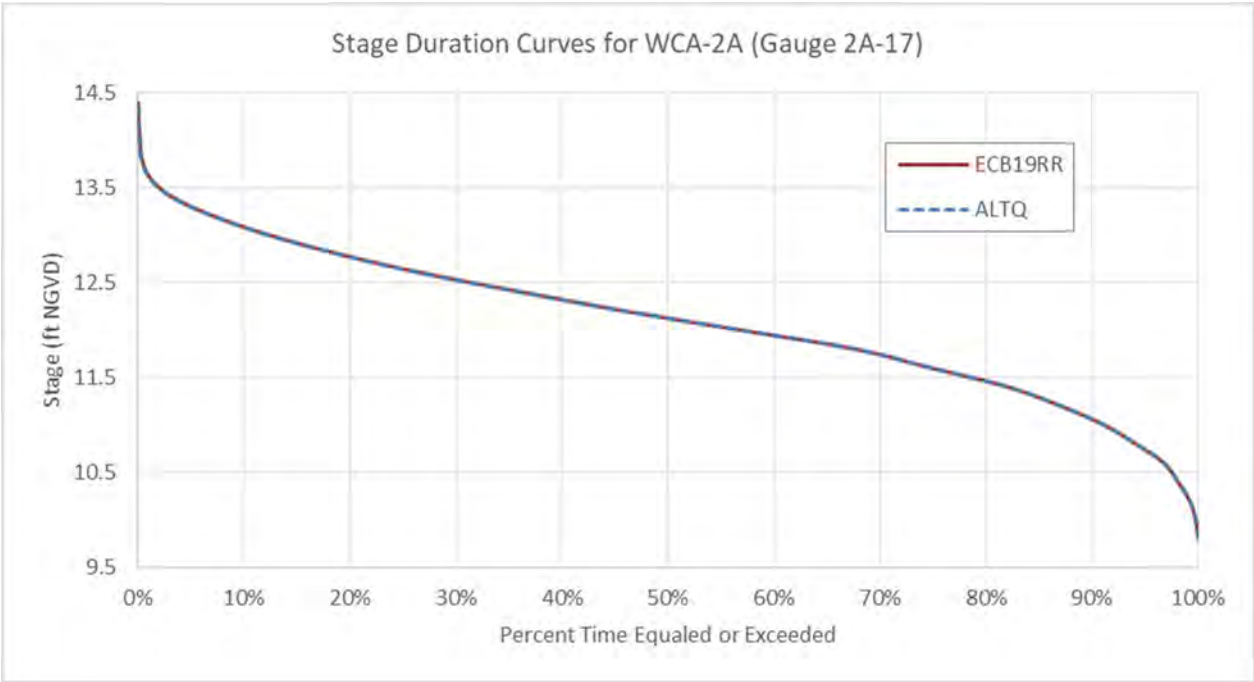


Figure 8-4. WCA-2A Stage Duration Curve

Table 8-3: WCA-2A Peak Stage Elevations (1965-2005)

	WCA-2A	(feet NGVD)
Year	ALTQ	ECB19RR
1965	13.51	13.51
1966	13.67	13.67
1967	13.50	13.50
1968	13.64	13.65
1969	13.69	13.69
1970	13.19	13.19
1971	13.36	13.36
1972	13.11	13.11
1973	13.20	13.20
1974	13.41	13.41
1975	13.77	13.77
1976	13.41	13.42
1977	13.30	13.30
1978	13.25	13.25
1979	13.79	13.78
1980	13.22	13.22
1981	13.47	13.47
1982	13.77	13.77
1983	13.57	13.57
1984	12.99	12.99
1985	13.74	13.74
1986	13.21	13.18
1987	13.15	13.15
1988	13.12	13.12
1989	12.77	12.77
1990	12.98	12.98
1991	13.35	13.35
1992	13.79	13.78
1993	13.60	13.60
1994	14.18	14.23
1995	13.91	13.97
1996	13.35	13.36
1997	13.41	13.41
1998	13.49	13.49
1999	13.93	13.93
2000	13.53	13.53
2001	13.68	13.68

	WCA-2A	(feet NGVD)
2002	13.25	13.25
2003	13.30	13.30
2004	13.57	13.57
2005	13.38	13.38

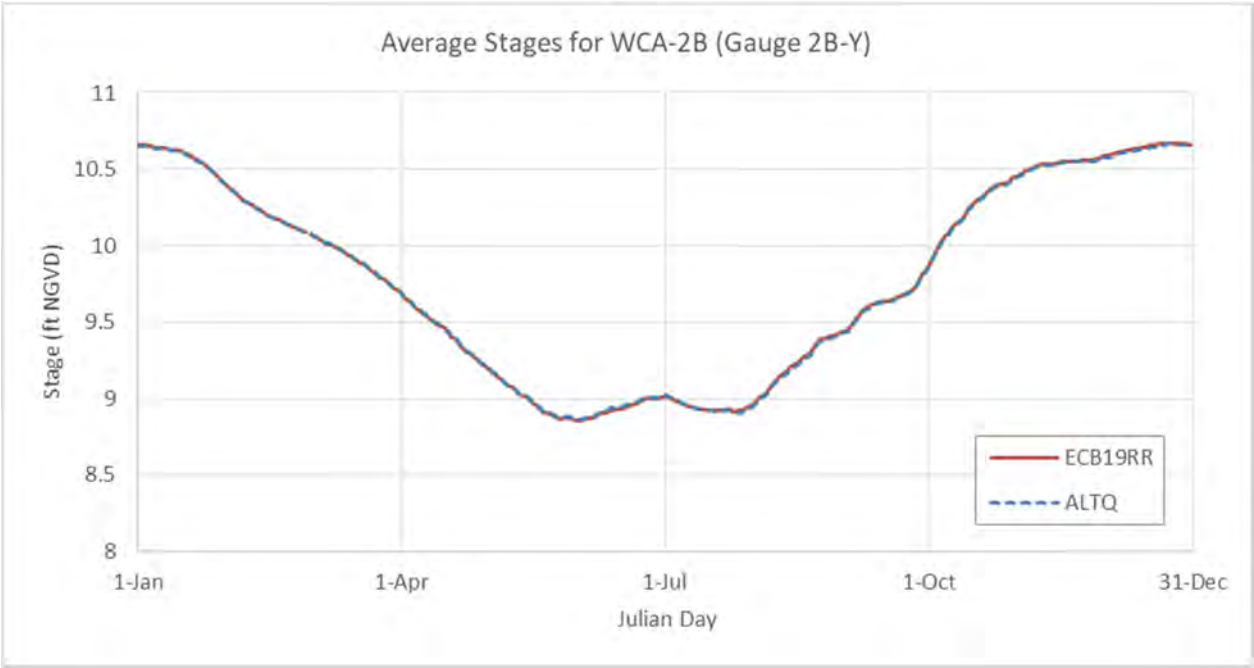


Figure 8-5. WCA-2B Average Stage

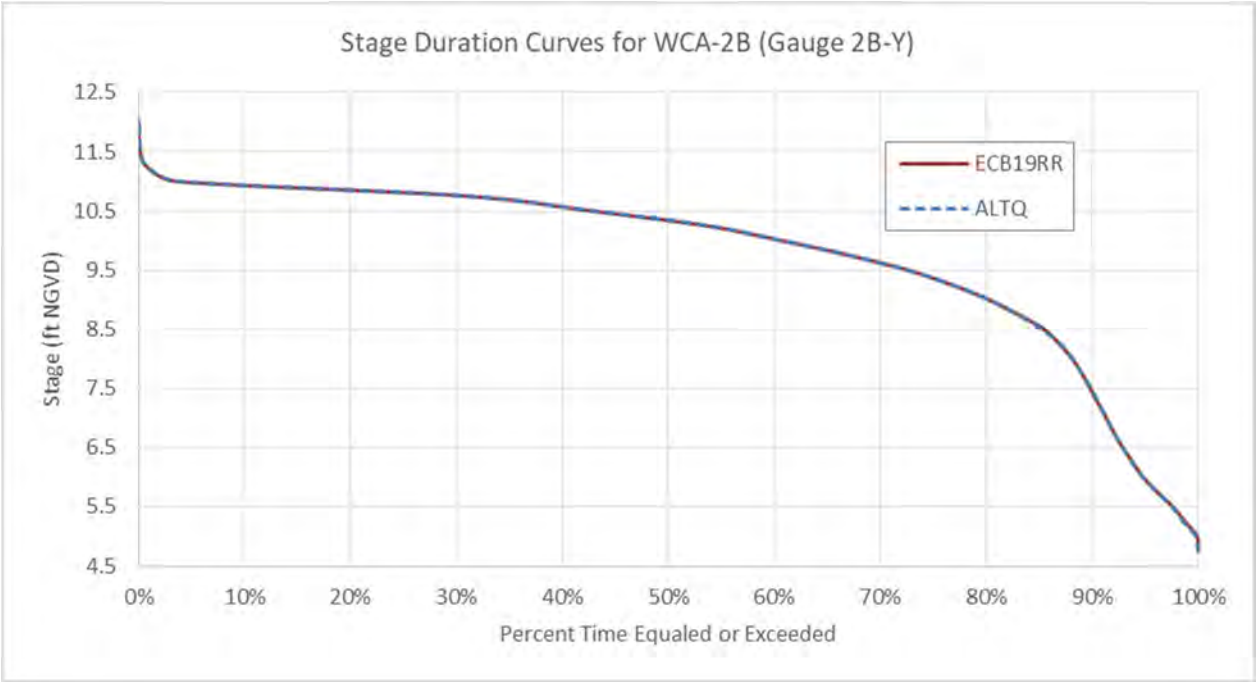


Figure 8-6. WCA-2B Stage Duration Curve

Table 8-4: WCA-2B Peak Stage Elevations (1965-2005)

	WCA-2B	(feet NGVD)
Year	ALTQ	ECB19RR
1965	10.95	10.95
1966	11.33	11.33
1967	10.94	10.95
1968	11.18	11.18
1969	11.81	11.81
1970	11.30	11.32
1971	10.99	10.99
1972	11.02	11.02
1973	10.97	10.97
1974	10.95	10.95
1975	10.90	10.90
1976	10.92	10.92
1977	10.91	10.91
1978	11.01	11.01
1979	10.99	10.99
1980	10.90	10.90
1981	11.00	11.00

	WCA-2B	(feet NGVD)
1982	11.21	11.22
1983	11.13	11.12
1984	11.01	11.01
1985	10.95	10.95
1986	11.07	11.04
1987	10.96	10.95
1988	10.67	10.69
1989	9.24	9.32
1990	9.85	9.85
1991	11.15	11.15
1992	11.34	11.33
1993	11.05	11.05
1994	11.57	11.57
1995	11.27	11.28
1996	10.89	10.89
1997	11.18	11.18
1998	11.33	11.33
1999	11.59	11.62
2000	10.84	10.84
2001	10.97	10.97
2002	10.89	10.89
2003	11.10	11.10
2004	10.88	10.88
2005	10.97	10.97

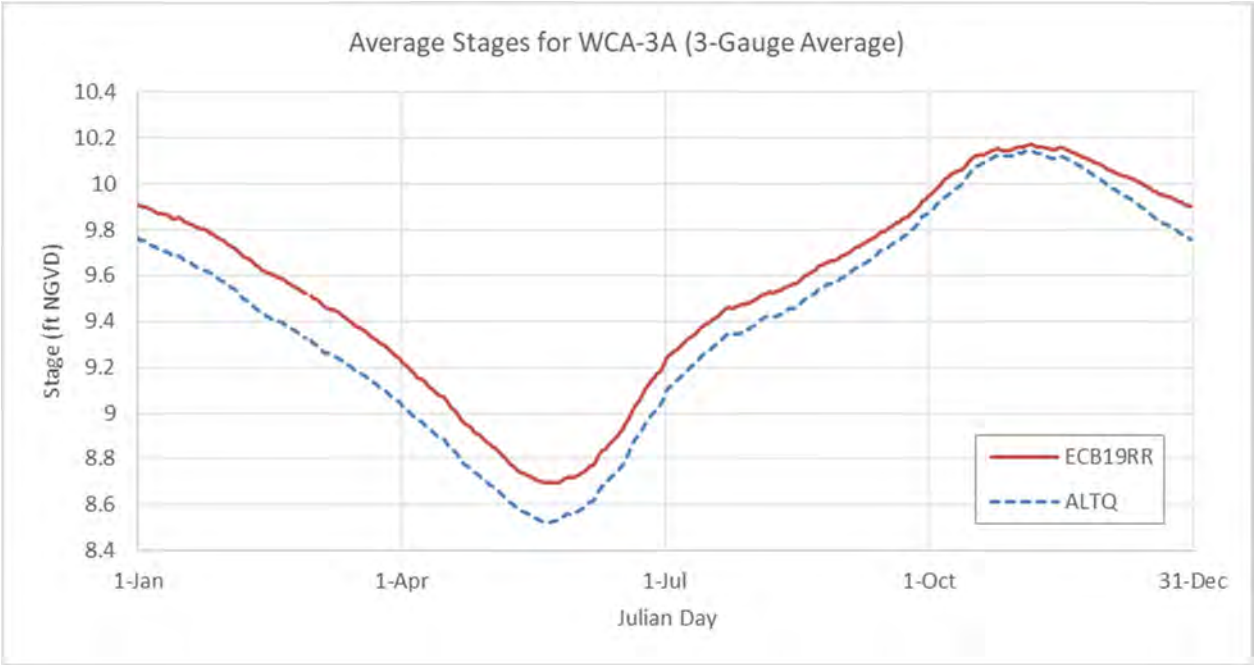


Figure 8-7. WCA-3A Average Stage

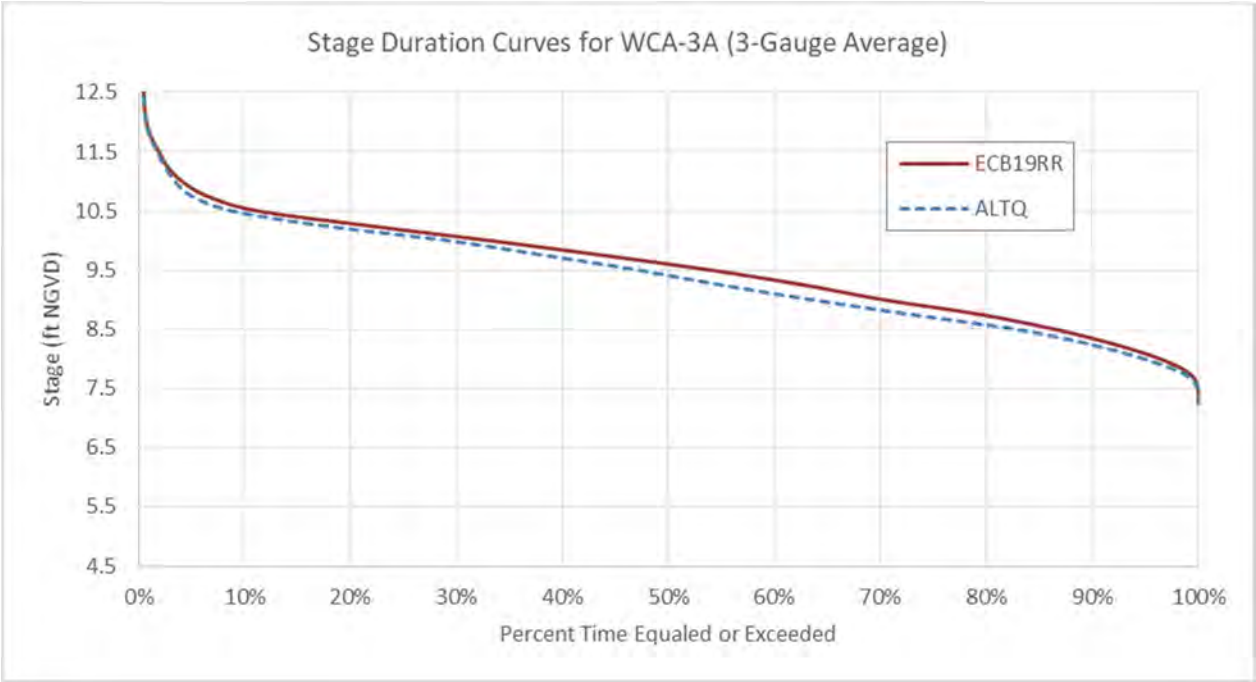


Figure 8-8. WCA-3A Stage Duration Curve

Table 8-5: WCA-3A Peak Stage Elevations (1965-2005)

	WCA-3A	(feet NGVD)
Year	ALTQ	ECB19RR
1965	10.72	10.60
1966	10.93	10.79
1967	10.34	10.31
1968	11.48	11.37
1969	11.76	11.68
1970	11.19	11.04
1971	9.72	9.59
1972	10.38	10.22
1973	8.97	9.11
1974	10.01	9.98
1975	10.12	10.24
1976	10.28	10.33
1977	9.49	9.34
1978	10.39	10.40
1979	10.46	10.48
1980	10.40	10.41
1981	10.13	10.18
1982	11.21	11.11
1983	11.20	11.02
1984	10.49	10.43
1985	10.46	10.52
1986	10.41	10.27
1987	10.39	10.22
1988	10.30	10.18
1989	8.94	8.80
1990	9.11	9.11
1991	10.57	10.55
1992	10.74	10.60
1993	11.23	11.19
1994	13.13	13.02
1995	13.08	12.98
1996	10.74	10.59
1997	10.66	10.57
1998	10.96	10.86
1999	11.98	11.91
2000	10.75	10.61
2001	10.72	10.60

	WCA-3A	(feet NGVD)
2002	10.17	10.07
2003	10.40	10.50
2004	10.13	10.21
2005	10.38	10.53

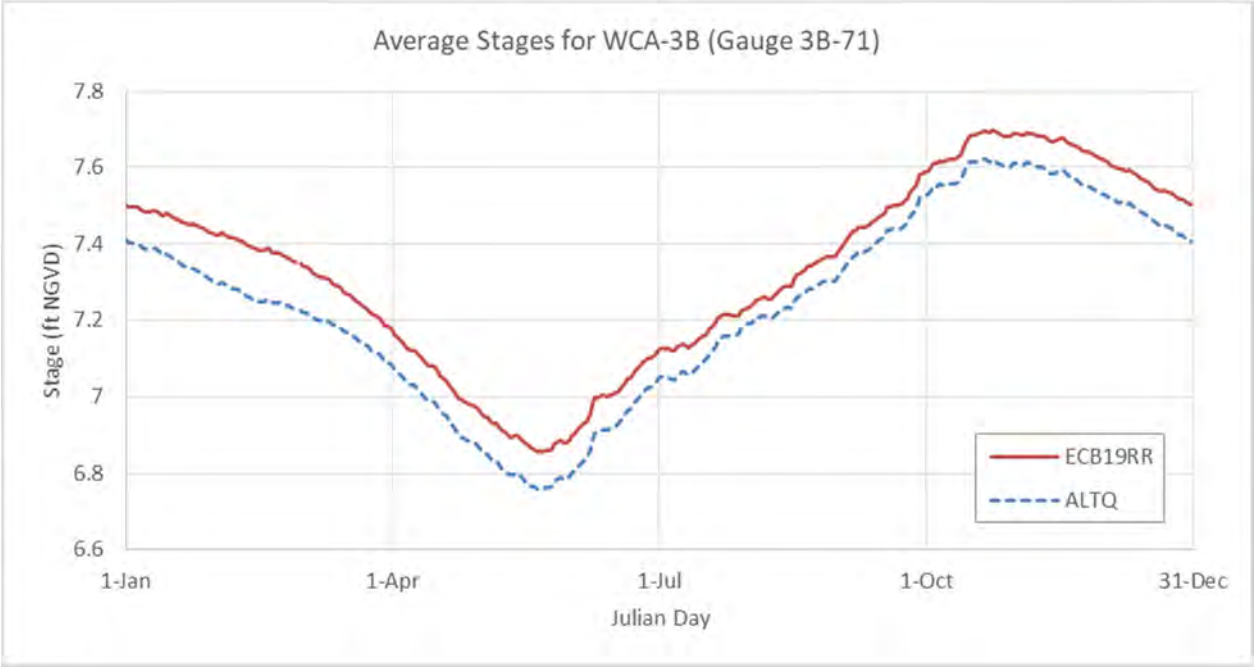


Figure 8-9. WCA-3B Average Stage

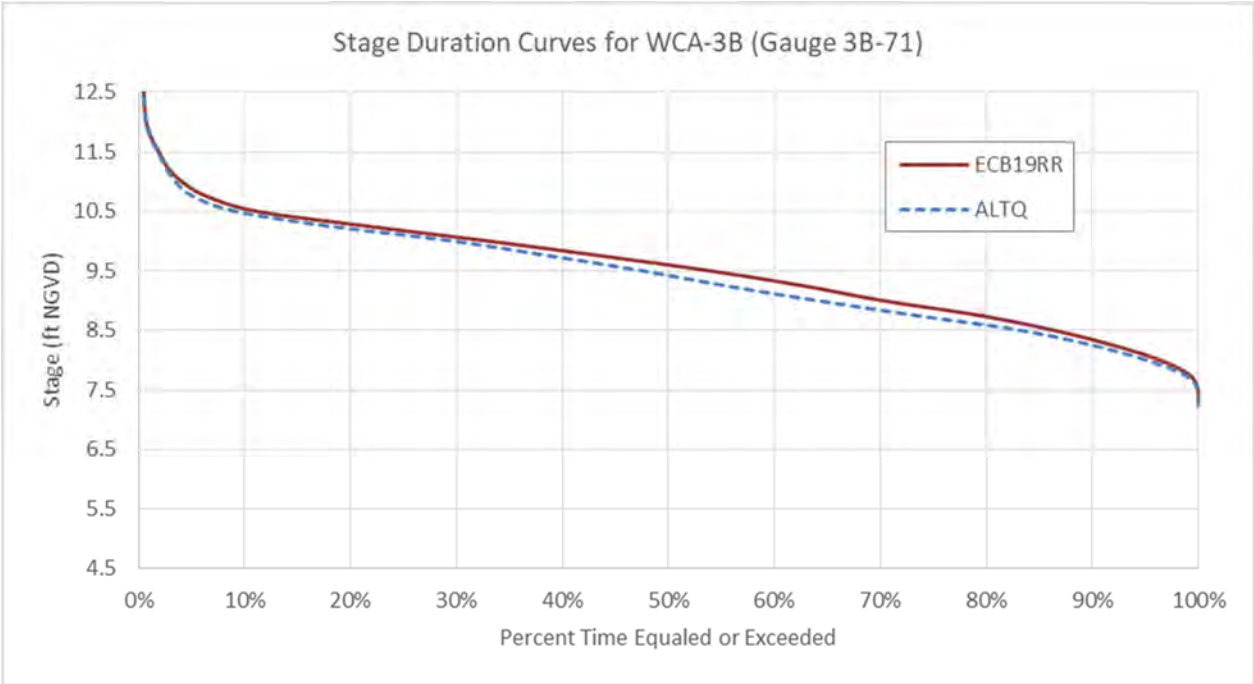


Figure 8-10. WCA-3B Stage Duration Curve

Table 8-6: WCA-3B Peak Stage Elevations (1965-2005)

	WCA-3B	(feet NGVD)
Year	ALTQ	ECB19RR
1965	7.80	8.12
1966	8.52	8.50
1967	7.62	7.94
1968	8.79	8.79
1969	8.82	8.96
1970	8.48	8.42
1971	7.31	7.32
1972	8.02	8.04
1973	7.22	7.20
1974	7.29	7.33
1975	7.49	7.52
1976	7.64	7.68
1977	7.14	7.15
1978	7.75	8.02
1979	7.61	7.86
1980	7.54	7.93
1981	7.69	7.77
1982	8.58	8.61

	WCA-3B	(feet NGVD)
1983	8.43	8.47
1984	7.71	7.78
1985	7.58	7.83
1986	7.98	8.08
1987	7.58	7.80
1988	7.54	7.70
1989	6.99	7.02
1990	6.81	6.84
1991	8.26	8.35
1992	8.21	8.29
1993	8.40	8.42
1994	9.21	9.07
1995	9.11	8.93
1996	8.44	8.39
1997	8.21	8.35
1998	8.48	8.45
1999	8.92	8.99
2000	8.39	8.32
2001	7.66	7.98
2002	7.61	7.76
2003	7.68	7.69
2004	7.31	7.33
2005	7.65	7.79

8.11.3 Key Control Points

The figures in this section show the flow duration curves for the S-10s, S-11s, S-12s and S-333s (**Figure 8-11**–**Figure 8-14**). The tables in this section show the peak flow for each year for the period of record modeled (1965-2005) for the S-10s, S-11s, S-12s and S-333s (**Table 8-7**–**Table 8-10**)

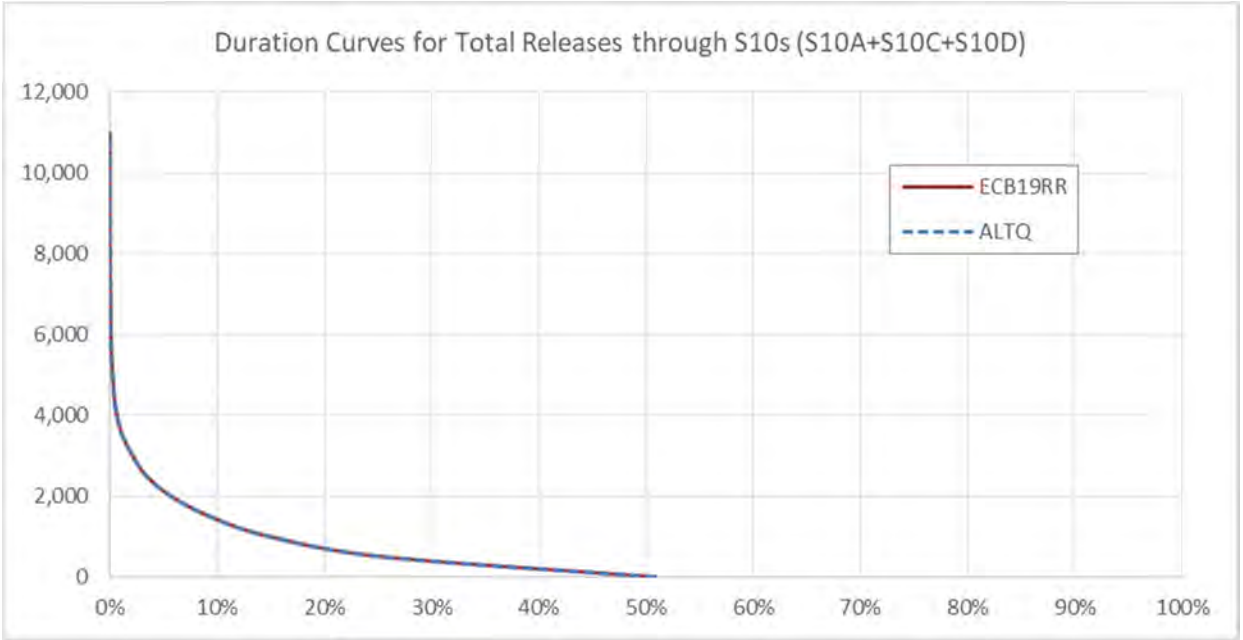


Figure 8-11. S-10s Flow Duration Curve

Table 8-7: S-10s Peak Flow (1965-2005)

	S10s	(cfs-day)
Year	ALTQ	ECB19RR
1965	4,322	4,321
1966	7,351	7,350
1967	2,744	2,744
1968	5,341	5,340
1969	5,804	5,804
1970	5,850	5,850
1971	1,025	1,026
1972	4,399	4,400
1973	627	627
1974	4,426	4,426
1975	1,674	1,674
1976	2,762	2,762
1977	2,931	2,931
1978	3,556	3,555
1979	2,643	2,643
1980	2,985	2,985
1981	3,445	3,445
1982	5,135	5,130
1983	6,018	6,017
1984	5,153	5,153
1985	3,234	3,234
1986	5,409	5,409
1987	3,976	3,976
1988	2,840	2,840
1989	-	-
1990	-	-
1991	2,983	2,986
1992	5,750	5,743
1993	3,355	3,355
1994	10,638	10,636
1995	6,588	6,587
1996	3,032	3,028
1997	4,045	4,045
1998	5,966	5,966
1999	5,311	5,311
2000	3,076	3,076
2001	3,391	3,391
2002	3,744	3,741
2003	1,668	1,669
2004	2,175	2,175
2005	2,630	2,630

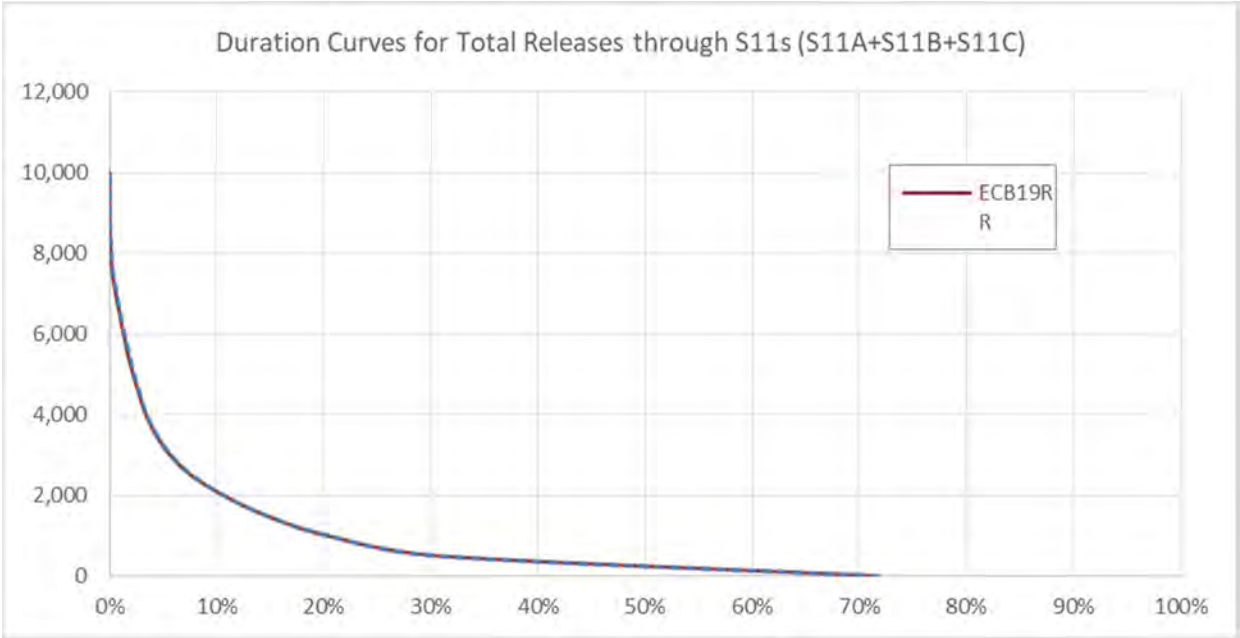


Figure 8-12. S-11s Flow Duration Curve

Table 8-8: S-11s Peak Flow (1965-2005)

	S11s	(cfs-day)
Year	ALTQ	ECB19RR
1965	5,250	5,219
1966	8,656	8,619
1967	5,499	5,667
1968	8,651	8,657
1969	8,172	8,136
1970	5,830	5,567
1971	1,938	1,938
1972	7,499	7,507
1973	1,236	1,266
1974	5,286	5,357
1975	7,451	7,406
1976	7,540	7,526
1977	6,131	6,374
1978	7,944	7,700
1979	4,322	4,289
1980	5,885	5,868
1981	8,860	8,933
1982	8,195	8,064
1983	7,299	7,329
1984	7,324	7,435
1985	5,316	5,349
1986	8,425	8,224
1987	5,780	4,886
1988	4,654	4,392
1989	25	26
1990	511	488
1991	7,034	6,843
1992	7,815	7,547
1993	5,486	5,219
1994	8,185	8,531
1995	7,833	7,694
1996	7,018	6,814
1997	7,163	6,909
1998	8,019	8,009
1999	9,903	9,858
2000	1,765	1,801
2001	4,551	4,462
2002	5,155	5,130
2003	5,702	5,765
2004	1,810	1,807
2005	6,018	5,945

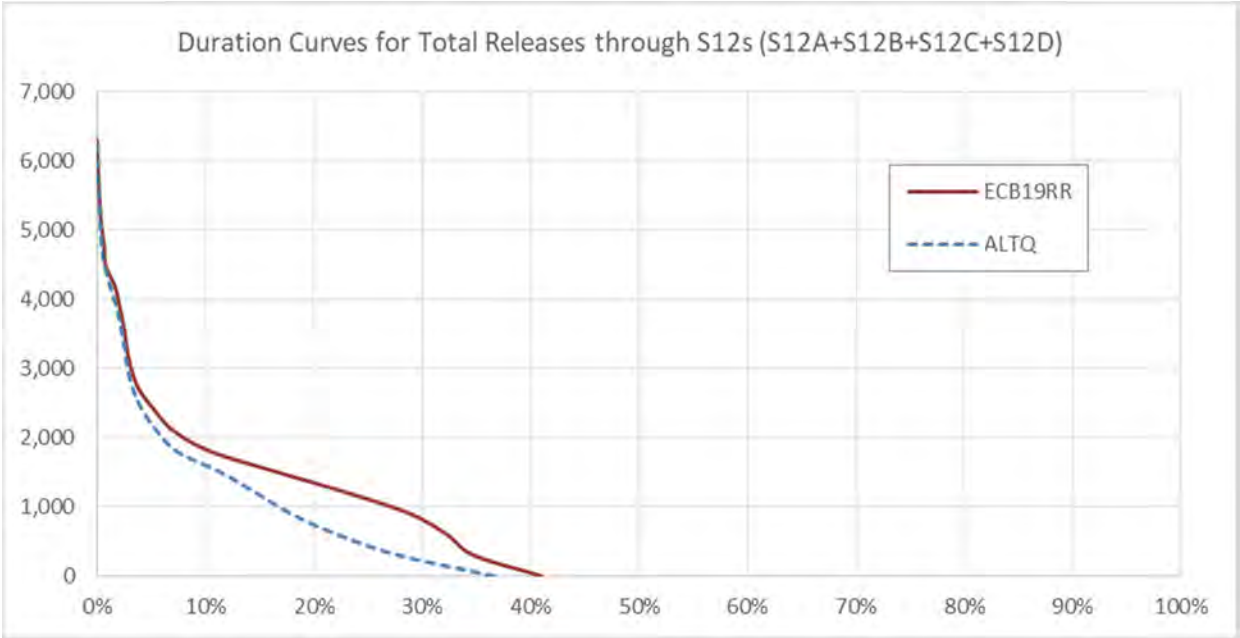


Figure 8-13. S-12s Flow Duration Curve

Table 8-9: S-12s Peak Flow (1965-2005)

	S12s	(cfs-day)
Year	ALTQ	ECB19RR
1965	1,602	1,713
1966	2,517	2,950
1967	274	1,377
1968	4,218	4,480
1969	4,139	4,436
1970	2,514	2,742
1971	-	-
1972	1,525	1,795
1973	-	307
1974	-	446
1975	-	1,137
1976	1,963	1,829
1977	-	-
1978	1,704	1,846
1979	653	1,442
1980	1,195	1,368
1981	482	1,506
1982	3,371	3,646
1983	2,021	2,380
1984	1,098	1,558
1985	1,521	1,489
1986	1,807	2,045
1987	749	1,467
1988	1,584	1,657
1989	-	-
1990	-	-
1991	2,018	2,189
1992	2,253	2,575
1993	3,575	3,830
1994	5,640	5,730
1995	5,943	6,300
1996	1,696	2,060
1997	2,277	2,459
1998	1,752	2,082
1999	5,481	5,759
2000	1,723	1,981
2001	1,530	1,731
2002	737	1,531
2003	2,411	2,108
2004	-	1,080
2005	1,852	1,823

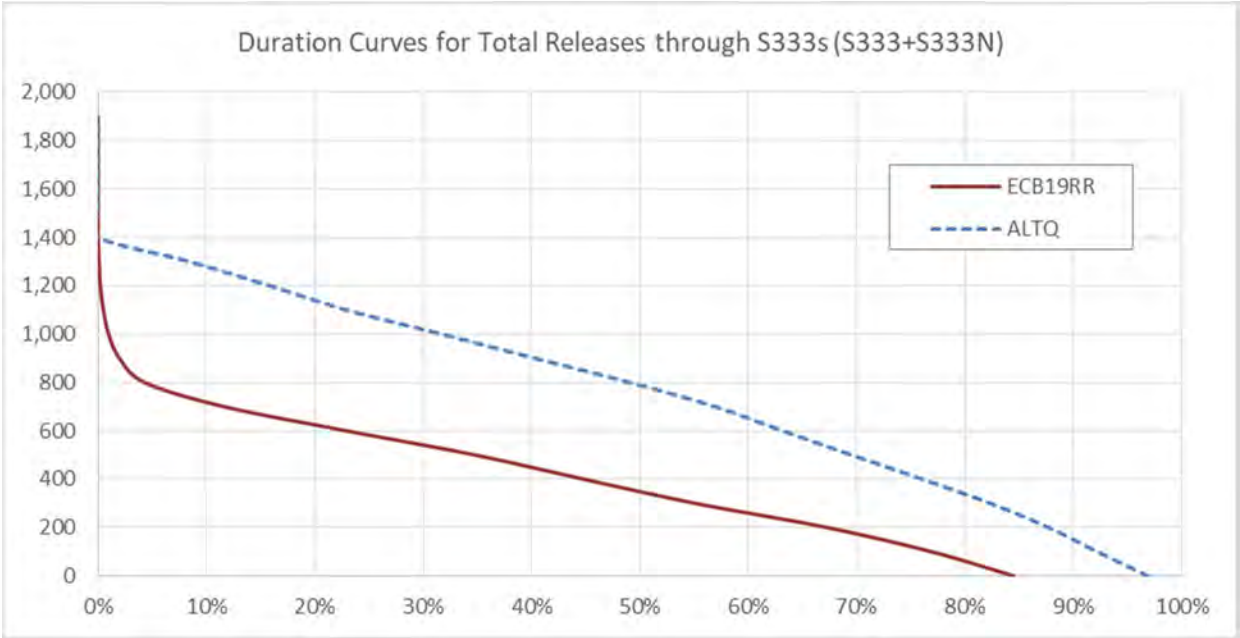


Figure 8-14. S-333s Flow Duration Curve

Table 8-10: S-333s Peak Flow (1965-2005)

	S333s	(cfs-day)
Year	ALTQ	ECB19RR
1965	1,350	1,350
1966	1,350	887
1967	1,350	1,038
1968	1,350	994
1969	1,350	918
1970	1,350	898
1971	950	714
1972	1,350	1,195
1973	492	930
1974	1,152	1,350
1975	1,330	1,087
1976	1,350	1,139
1977	775	815
1978	1,350	1,306
1979	1,350	857
1980	1,350	836
1981	1,295	756
1982	1,623	1,048
1983	1,350	1,314
1984	1,350	866
1985	1,350	1,350
1986	1,350	785
1987	1,350	949
1988	1,350	892
1989	394	742
1990	567	975
1991	1,350	1,264
1992	1,350	1,074
1993	1,350	773
1994	1,350	847
1995	1,816	620
1996	1,350	1,045
1997	1,350	682
1998	1,350	811
1999	1,350	995
2000	1,328	1,070
2001	1,350	924
2002	1,350	980
2003	1,350	828
2004	1,291	995
2005	1,350	926

8.12 Other Studies

The COP EIS includes proposed water management operating criteria intended to address the identified effects of water management. These effects are addressed within the COP EIS through the following planning objectives:

1. Improve water deliveries (timing, location, volume) into ENP and take steps to restore natural hydrologic conditions in ENP given current C&SF infrastructure and features expected to be completed by the time of implementation, to the extent practicable by:
    a. Changing schedule of water deliveries so that it fluctuates in consonance with local meteorological conditions, including providing for long term and annual variation in ecosystem conditions in the Everglades (Timing) (P.L. 101-229, Section 101b)
    b. Restoring NESRS as a functioning component of the Everglades hydrologic system (Location) (P.L. 101-229, Section 101b)
    c. Adjusting the magnitude of water released to ENP to minimize effects of too much or too little water (Volume) (1992 MWD GDM, Section 44)
2. Maximize progress toward restoring historic hydrologic conditions in the Taylor Slough, Rocky Glades, & eastern Panhandle of ENP.
3. Protect the intrinsic ecological values associated with WCA 3A and ENP.
4. Minimize the damaging freshwater flows to Manatee Bay/Barnes Sound through the S197 structure and increase flows through Taylor Slough and coastal creeks (1994 C-111 GRR, Section 5.2)
5. Include consideration of cultural values and tribal interests & concerns within WCA-3A and ENP.

A listing of the historical documents intended to address effects related to WCA, ENP, ENP-SDCS water management activities since 1983 are shown in **Table 8-11**.

Table 8-11: Significant Milestones preceding COP

Year	Milestone
1983	Authorization of the Experimental Program
1989	ENP Protection and Expansion Act of 1989
1990	Draft GDM on MWD
1990	BO on MWD
1992	Final GDM on MWD
1993	BO and EA for Test 6 of the Experimental Program - Taylor Slough Iteration
1994	C-111 GRR
1995	Implement Test 6 of the Experimental Program
1995	Extension of Test 6
1995	EA for Test 7 of the Experimental Program
1995	Implement Test 7, Phase I of the Experimental Program
1995	Initiate Test 7 Hydrologic and Ecological Monitoring

Year	Milestone
1997	FWS Request USACE to Reinitiate Section 7 Consultation
1998	Implement 1998 Emergency Deviation from Test 7, Phase I
1999	BO on the Experimental Program, MWD, and C-111 Project
1999	Implement Emergency Deviation from Test 7, Phase I
2000	Implement ISOP 2000 Emergency Deviation
2000	8.5 SMA Plan GRR, Final Supplemental EIS and ROD
2001	Completion of Test 7 Hydrologic and Ecological Monitoring Report
2001	Implementation of ISOP 2001 Emergency Deviation
2001	Draft EIS for IOP for Protection of CSSS
2001	Supplemental Draft for IOP for Protection of CSSS
2002	Amended BO on IOP
2002	Final EIS for IOP for Protection of CSSS
2002	ROD for IOP for Protection of CSSS
2003	8.5 SMA Plan 2nd ROD for Alternative 6D
2005	Final Revised GRR and Supplemental EIS for Tamiami Trail Modifications
2006	ROD for Tamiami Trail Modifications
2006	Draft Supplemental EIS for IOP for Protection of CSSS
2006	New BO on IOP
2006	Final Supplemental EIS for IOP for Protection of CSSS
2007	Design Modifications for C-111 Project EA and Engineering Documentation Report (EDR)
2007	Critical Habitat Revised Designations for the CSSS
2008	Tamiami Trail Modifications LRR/EA/Finding of No Significant Impact (FONSI)
2008	8.5 SMA S-357 Water Control Plan Draft EA
2009	Canal-111 Spreader Canal Project Implementation Report (PIR)
2009	Canal-111 Spreader Canal BO
2009	USACE Initiates Consultation on ERTP
2010	ERTP Biological Assessment (BA) and BO
2011	C-111 Spreader Canal Western Project Final EIS
2011	8.5 SMA Interim Operation Criteria EA
2011	8.5 SMA Design Refinement EA
2012	Expansion C-111 Detention Area EA
2012	ERTP Final EIS
2015	G-3273 Constraint Relaxation/S-356 Field Test & S-357N Operational Strategy EA
2016	Modifications to the C-111 South Dade NDA and SDA EA FONSI
2016	Modifications to the C-111 South Dade, L-31W EA
2016	C-111 South Dade Final Limited Reevaluation Report
2016	L-29 Canal and SDCS Temporary Emergency Deviation EA
2016	L-29 Canal and SDCS Temporary Emergency Deviation Supplemental EA
2016	S-344 Temporary Emergency Deviation EA

Year	Milestone
2017	G-3273 Constraint Relaxation/S-356 Field Test & S-357N Operational Strategy: Increment 1 Plus (Increment 1.1 and 1.2) Supplemental EA
2017	MWD to ENP: Removal of Unconstructed Conveyance and Seepage Control Features EA
2017	WCA-3A Planned Temporary Deviation EA
2017	WCA-2A Planned Temporary Deviation EA
2017	WCA-3A & SDCS Emergency Deviation and WCA-3A Planned Deviation EA
2018	L-29 Canal and G-3273 Constraint Relaxation (Revised Increment 2)

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9 WATER MANAGEMENT

9.1 Responsibilities and Organization

Section 208.10, Title 33 of the Code of Federal Regulations (33 CFR § 208.10, included in Appendix D) requires all structures and facilities constructed by the United States for local flood protection be continuously maintained and operated to obtain the maximum benefit of the project by an appropriate local entity. Section 208.11, Title 33 of the Code of Federal Regulations (33 CFR § 208.11, included in Appendix D) prescribes the responsibilities and general procedures for regulating reservoir projects that are capable of flood risk management or navigation and the use of the storage allocated for such purposes. The intent of the regulation is to establish an understanding between project owners, operating agencies, and the USACE. All WCAs, ENP, ENP-SDCS components of the C&SF Project other than the S-10s, S-11s, S 12s, and S-355s are maintained and operated by the non-Federal sponsor (SFWMD) in accordance with 33 CFR §§ 208.10 and 208.11 and approved water management operating criteria (WCPs, POMs, SOMs) prescribed by the Secretary of the Army to ensure that congressionally authorized project purposes are met.

9.1.1 U.S. Army Corps of Engineers (USACE)

The USACE serves in an advisory capacity to the non-Federal sponsor regarding the inspection, operation, regulation, maintenance, improvements or alterations to any of the structures or facilities associated with the WCAs, ENP, ENP-SDCS components of the C&SF Project. Under the terms of the local cooperation agreement, the non-Federal sponsor (SFWMD or STOF, depending on the component) must "maintain and operate all the completed works (C&SF Project features), and all the works that are completed in the future, in accordance with the regulations prescribed by the Secretary of the Army." The USACE ensures that the non-Federal sponsor (SFWMD, STOF) follows these regulations and that the WCAs, ENP, ENP-SDCS components of the C&SF Project are operated to meet the congressionally authorized project purposes.

The major outlets of the WCAs (S-10s, S-11s, S-12s) and the S-355s are operated by the USACE Jacksonville District Water Management Section. The USACE Jacksonville District Water Management Section also oversees and advises the SFWMD and STOF in their implementation of the WCPs (Chapter 7 and Appendix G). The USACE Jacksonville District Water Management Section processes requests for deviation from normal operation (Section 7-10) and transmits deviation requests to the USACE South Atlantic Division for approval. The USACE Jacksonville District Water Management Section develops/updates this document and the WCP (Chapter 7) while the South Atlantic Division is approves these documents. Communications and data transfer related to SFWMD or STOF water management decisions and activities are between the USACE Jacksonville District Water Management Section and the SFWMD Office of Operations or the STOF Environmental Resource Management Department, respectively. A list of pertinent USACE Jacksonville District Water Management Section staff positions is found in **Table 9-1**, shown on the next page.

Table 9-1: Pertinent USACE Jacksonville District Water Management Section Personnel

Position	Area of Responsibility	Phone Number
Jacksonville District Water Manager	Water Management – WCAs, ENP, ENP-SDCS	XXX-XXX-XXXX
Jacksonville District	Hydrometeorological Data - Data Transfer,	XXX-XXX-XXXX

Position	Area of Responsibility	Phone Number
Water Control Data System Manager	Database Management	
Jacksonville District Chief, Water Management Section	Supervisor Water Management	XXX-XXX-XXXX

9.1.2 South Florida Water Management District (SFWMD)

As a non-Federal sponsor of much of the C&SF Project, the SFWMD operates and maintains the majority of the water management features of the WCAs, ENP, ENP SDCS components of the C&SF Project. SFWMD is not responsible for the: S-10s, S-11s, S-12s and the S-355s or the structures under the responsibility of the STOF. Day-to-day water management activities are determined by the SFWMD Office of Operations. Communications and data transfer relating to water management decisions and activities are between the SFWMD Office of Operations and the USACE Jacksonville District Water Management Section. Pertinent SFWMD Office of Operations staff positions are listed in **TABLE 9-2**. The SFWMD Office of Operations is located at SFWMD Headquarters in West Palm Beach, Florida.

The SFWMD employs meteorologists who produce daily and weekly (7-day) quantitative precipitation forecasts (QPF) for locations within the WCAs, ENP, and ENP-SDCS Project area. The forecasts and hydrometeorological data are made available via the internet. The SFWMD water managers use the SFWMD generated QPF, with consideration of NWS products, in the water management decision making process. The SFWMD meteorologists also monitor the tropics and evaluate tropical cyclone products issued by the National Hurricane Center (NHC) and the Weather Prediction Center (WPC). The meteorologists advise the SFWMD Operations Office of tropical systems that require enhanced monitoring over the next 120 hours as well as of specific tropical cyclones with the potential to bring tropical storm strength winds within the next 72 hours.

TABLE 9-2: PERTINENT SFWMD OFFICE OF OPERATIONS PERSONNEL

Position	Area of Responsibility	Phone Number
SFWMD, Office of Operations Control Center	Water Management	Via SFWMD Main Line: 561-686-8800
Clewiston Field Station	Water Management	863-983-1431
Fort Lauderdale Field Station	Water Management	954-452-4814
Homestead Field Station	Water Management	305-242-5933
Miami Field Station	Water Management	305-513-3420
West Palm Beach Field Station	Water Management	561-791-4100

9.1.3 Seminole Tribe of Florida (STOF)

The STOF is a federally recognized tribe of Native Americans responsible for operating and maintaining the Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project (SBC

Project) water management features of the WCAs, ENP, ENP-SDCS components of the C&SF Project. Day to-day water management activities are determined by the STOF Environmental Resource Management Department. Communications and data transfer relating to water management decisions and activities are between the STOF Environmental Resource Management Department and the USACE Jacksonville District Water Management Section. The Director of the STOF Environmental Resource Management Department is listed in **Table 9-3**. The STOF Environmental Resource Management Department is located in Hollywood, Florida.

Table 9-3: Pertinent STOF Environmental Resource Management Department Personnel

Position	Area of Responsibility	Phone Number
Director, Environmental Resource Management Department	Water Management	XXX XXX-XXXX

9.1.4 Other Federal Agencies

The NPS and the USFWS manage ENP and the LNWR, respectively. ENP and LNWR provide input to the USACE Jacksonville District Water Management Section for use in the decision-making process for proposed, ongoing, and future water management activities. Several other Federal agencies are indirectly involved within the WCAs, ENP, ENP-SDCS region or adjacent areas. These agencies include the: EPA, USGS, NOAA, Bureau of Indian Affairs, and Natural Resources Conservation Service (NRCS). The NWS is a part of NOAA and disseminates weather, water, and climate data, forecasts and warnings for locations within the WCAs, ENP, ENP-SDCS region as well as adjacent areas through the Miami Weather Forecast Office. The USGS disseminates various data, including, but not limited to, hydrometeorological data for locations within the WCAs, ENP, ENP-SDCS region as well as adjacent areas through the Fort Lauderdale and Miami USGS Offices.

9.1.5 State and County Agencies

Other than the SFWMD, no other State or County agencies operate or maintain the WCAs, ENP, ENP-SDCS components of the C&SF Project. However, other State or County agencies may have interest in the effects of the implemented water management activities or may be responsible for aspects of the water resource or related flora and fauna. These State and County agencies include, but are not limited to, FDEP, FWC, Florida Department of Agriculture and Consumer Services (FDACS), and numerous local governments. These various agencies may provide input to the Jacksonville District Water Management Section for use in the decision-making process for proposed, ongoing, or future water management activities.

9.1.6 Other Native American Tribes

The Miccosukee Tribe of Indians of Florida (MTIF) is a federally recognized tribe of Native Americans that have land within or near the WCAs, ENP, ENP-SDCS components of the C&SF Project. The MTIF is not responsible for operation or maintenance of the WCAs, ENP, ENP-SDCS components of the C&SF Project. However, they and the STOF may have interest in the effects of the implemented water management activities or may be responsible for aspects of the water resource or related flora and fauna. The MTIF and the STOF may provide input to the USACE Jacksonville District Water Management Section for use in the decision making process for proposed, ongoing, or future water management activities.

9.1.7 Private Organizations

Private organizations are not responsible for operation or maintenance of any of the WCAs, ENP, ENP-SDCS components of the C&SF Project. Private organizations may provide input to the USACE Jacksonville District Water Management Section for use in the decision-making process for proposed, ongoing, or future water management activities.

9.2 Interagency Coordination

In addition to making water management related information available through the Internet or electronic data transfer, coordination may occur on an as needed basis between the USACE, SFWMD, or STOF and the press, community leaders, or Federal, State, County and local agencies. The frequency of coordination and content of water management related information presented is based upon the level of importance. High water or drought events are examples which would involve more active interagency coordination efforts with detailed, specific water management related information. There is also coordination between the USACE Jacksonville District Water Management Section and the STOF as well as the MTIF. Specific coordination meetings are addressed in the COP AMMP (Appendix C in COP EIS).

The SFWMD maintains a fully staff Operations Control Center (OCC) that operates 24 hours a day, 7 days a week and 365 days a year. The OCC monitors and controls all key features throughout the SFWMD area of responsibility and have multiple redundancy systems built into them. Examples of redundancy systems are but not limited to local and remote control capabilities from several locations, auxiliary pumps/gates, fully staff field stations with specific roles and responsibilities, comprehensive pre-positioned equipment for maintenance and repair and reliable backup communication systems. Also, SFWMD maintains a comprehensive weekly “Structure/Canal Status Report” detailing the status of each key feature (i.e. structure, gate, pump, lock, etc). The OCC operations are overseen by SFWMD Water Managers. USACE and SFWMD Water Managers maintain weekly (or daily based on weather or system conditions) meetings to coordinate water management operations and address issues including water management options to address ‘operational malfunctions’.

9.2.1 Local Press and USACE Bulletins

Both the USACE and SFWMD have a dedicated staff that disseminate water management related information to the public and other agencies through various means including the Internet, press releases, and regularly scheduled meetings with government agencies and the public. The USACE Jacksonville District Water Management Section may also provide for similar dissemination of any water management related information related to water management activities throughout the WCAs, ENP, ENP-SDCS components of the C&SF Project, as appropriate. Depending upon the subject matter, coordination between the non-Federal sponsors (SFWMD, STOF), other Federal agencies (ENP, USFWS, USGS, NWS, etc.) and the USACE may occur to ensure consistent information is presented.

9.2.2 National Weather Service (NWS)

Through the Miami Weather Forecast Office and the NHC, the NWS is the Federal agency responsible for precipitation and other weather-related forecasts for the WCAs, ENP, and ENP-SDCS Project area. The NWS makes regional and local weather-related forecasts as well as regional hydrometeorological data available to the USACE, SFWMD, and STOF through the Internet. Coordination of water management related information and hydrometeorological data for the WCAs, ENP, ENP-SDCS components of the C&SF Project occurs between the NWS, USACE, SFWMD, and STOF on an as needed basis.

9.2.3 U.S. Geological Survey (USGS)

The USGS utilizes the Internet and electronic data transfer to provide and retrieve water management related data. Chapter 5 describes the data reporting procedure between USACE and USGS. Coordination of water management related information and hydrometeorological data occurs between the USGS and the USACE as well as USGS and SFWMD on an as needed basis.

9.2.4 Power Marketing Agency

This subsection is not applicable to the WCAs, ENP, ENP-SDCS components of the C&SF Project.

9.2.5 Other Federal, State, and Local Agencies

The USACE Jacksonville District Water Management Section, SFWMD, and STOF coordinate with many agencies to ensure that the congressionally authorized project purposes are met. In addition, periodic discussions occur between the USACE Jacksonville District Water Management Section, the non-Federal sponsors, and the various stakeholders within and adjacent to the region potentially affected by water management activities associated with the WCAs, ENP, ENP-SDCS components of the C&SF Project. These agencies may include but are not limited to the: ENP, USFWS, EPA, NOAA, FDEP, and FWC.

9.3 Interagency Agreements

The MTIF and the STOF, are federally recognized tribes that have land within the WCAs, ENP, and ENP-SDCS region of the C&SF Project. The STOF, the state, and SFWMD entered into an agreement, the 1987 Water Rights Compact Among The Seminole Tribe of Florida, The State of Florida And The South Florida Water Management District, which follows the provisions of substantive Florida water law. The Water Rights Compact is the sole source of regulation of water resources on STOF lands. Through a Memorandum of Agreement, the MTIF and SFWMD have obligated themselves to structuring and implementing a comprehensive Water Rights Compact governing state/tribal cooperative water management.

The USGS, through the Cooperative Water Resources Data Program, also performs operation and maintenance at various gage locations within the WCAs, ENP, ENP-SDCS region as well as adjacent areas on behalf of the Jacksonville District Water Management Section. As part of the Program, USGS conducts gage maintenance, streamflow measurements, as well as hydrometeorological data collection and dissemination to support water management activities within the WCAs, ENP, and ENP-SDCS region.

9.4 Commissions, River Authorities, Compacts, and Committees

This subsection is not applicable to the WCAs, ENP, ENP-SDCS components of the C&SF Project.

9.5 Non-federal Hydropower

This subsection is not applicable to the WCAs, ENP, ENP-SDCS components of the C&SF Project.

9.6 Reports

The reporting of hydrometeorological data and information that affects water management activities in the WCAs, ENP, ENP-SDCS components of the C&SF Project occurs through several different forms. These

reports are produced by the SFWMD, USACE, NWS, NHC, as well as USGS and typically are accessible through the Internet. A sample of available reports is listed in Table 9-4, shown on the next page.

Table 9-4: Hydrometeorological Reports

Title	Agency	Contents
SAJ Water Management Daily Report	USACE	Hydrometeorological Conditions Pertinent to the C&SF Project
WCAs, ENP, ENP-SDCS Morning Report	USACE	Daily Water Stages
C&SF Project Status Update	USACE	Daily Operations Update for the C&SF
SDCS Status Update	USACE	Daily Operations Update for the South Dade Conveyance System
National Drought Mitigation Center U.S. Drought Monitor	NDMC	Weekly Drought Information
NHC Graphical Tropical Weather Outlook	NHC	Active Tropical Weather Information
Drought Severity Index	NWS	Palmer Drought Index
U.S. Quantitative Precipitation Forecast	NWS	5 and 7-day Quantitative Precipitation Forecast
U.S. Monthly & Seasonal Outlooks	NWS	Long Range Weather Forecast
USGS Water Data for Florida	USGS	Water Resources Data collected throughout Florida
Current Weather Conditions Radar Loop	SFWMD	Hydrometeorological Data
SFWMD Daily QPF	SFWMD	Daily Quantitative Precipitation Forecasts
SFWMD Monthly Historical Rainfall	SFWMD	Monthly Historical Rainfall Maps
SFWMD Real-Time Site Status Reports	SFWMD	Real-time Water Levels and Flow Volumes for Water Control Structures throughout the SFWMD Water Management System
DBHYDRO	SFWMD	Hydrologic, Meteorologic, Hydrogeologic, and Water Quality Data
South Florida Environmental Report (SFER)	SFWMD	Annual Report Documenting Restoration scientific and engineering accomplishments in the Kissimmee Basin, Lake Okeechobee, Everglades, and South Florida coastal areas.

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SYSTEM OPERATING MANUAL

VOLUME 4

WATER CONSERVATION AREAS,

EVERGLADES NATIONAL PARK,

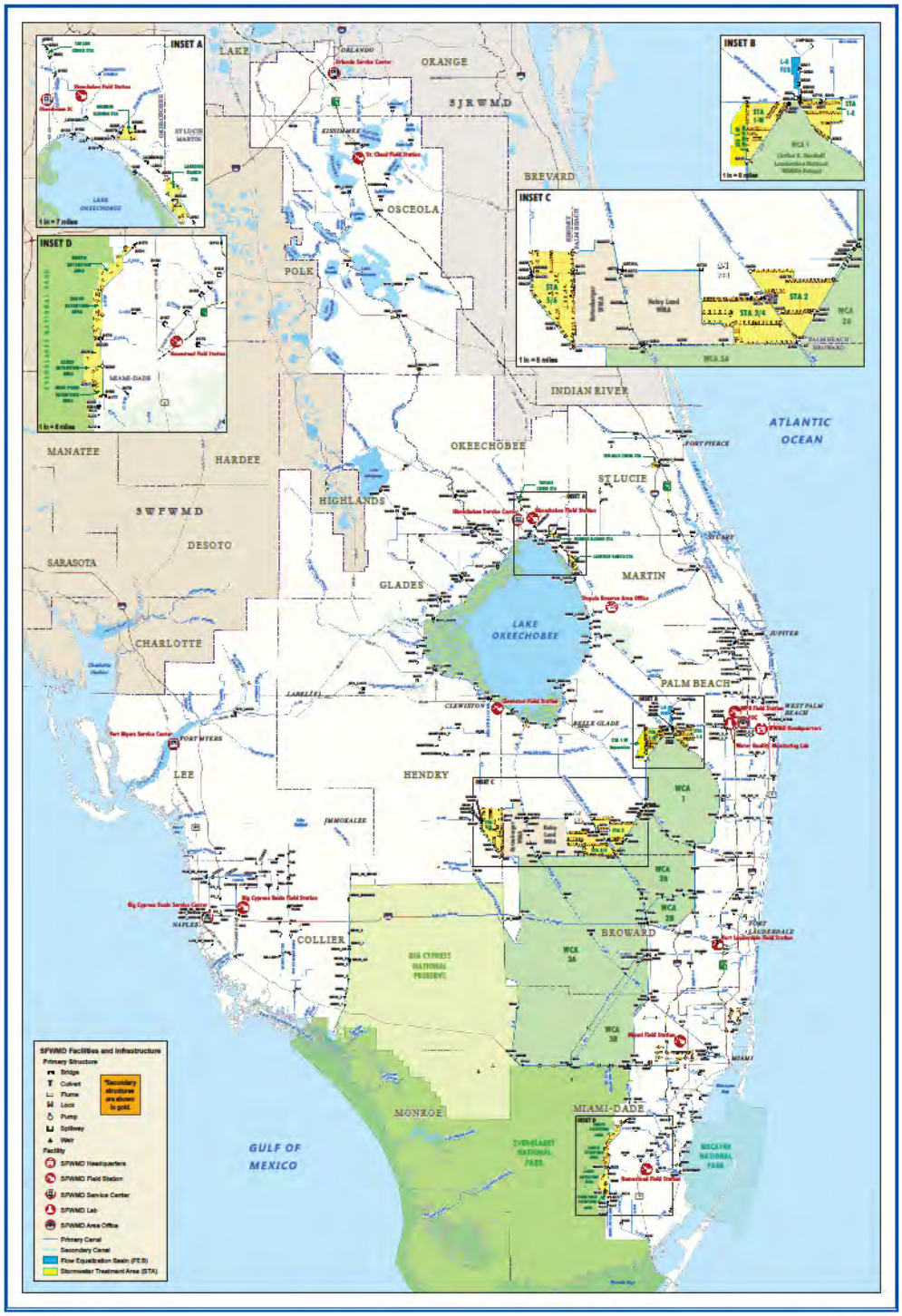
AND ENP-SOUTH DADE CONVEYANCE SYSTEM

PLATES

JACKSONVILLE DISTRICT

U.S. ARMY CORPS OF ENGINEERS

JANUARY 2020



BASE CREDITS:
State plane projection, Florida east zone
NAD 83-HARN, US feet.

South Florida Water Management District
3301 Gun Club Rd., West Palm Beach, Florida 33406
(561) 686-8800; www.sfwmd.gov

FACILITY AND INFRASTRUCTURE MAP

0 5 10 20 30 Miles

0 5 10 20 30 40 50 Kilometers

IMPORTANT DISCLAIMER:
This map is a conceptual or planning tool only.The South Florida Water Management District does not guarantee or make any representation regarding the information contained herein. It is not self-executing or binding, and does not affect the interests of any persons or properties, including any present or future right or use of real property.

May 2019

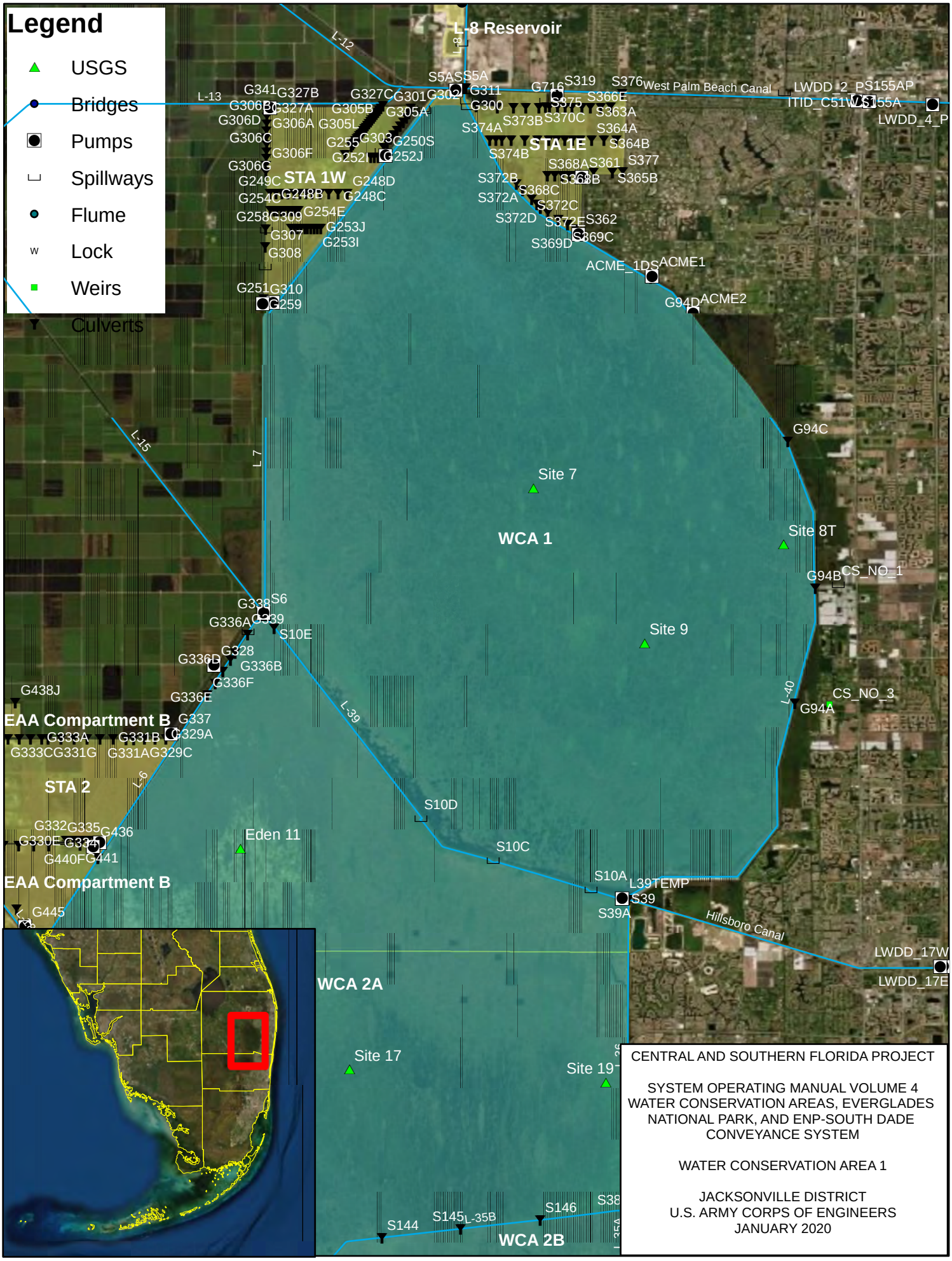
GEOSPATIAL SERVICES

CENTRAL AND SOUTHERN FLORIDA PROJECT

SYSTEM OPERATING MANUAL VOLUME 4
WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK,
AND ENP-SOUTH DADE CONVEYANCE SYSTEM

FACILITY AND INFRASTRUCTURE MAP

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JUNE 2020



CENTRAL AND SOUTHERN FLORIDA PROJECT

SYSTEM OPERATING MANUAL VOLUME 4
WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK, AND ENP-SOUTH DADE CONVEYANCE SYSTEM

WATER CONSERVATION AREA 1

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

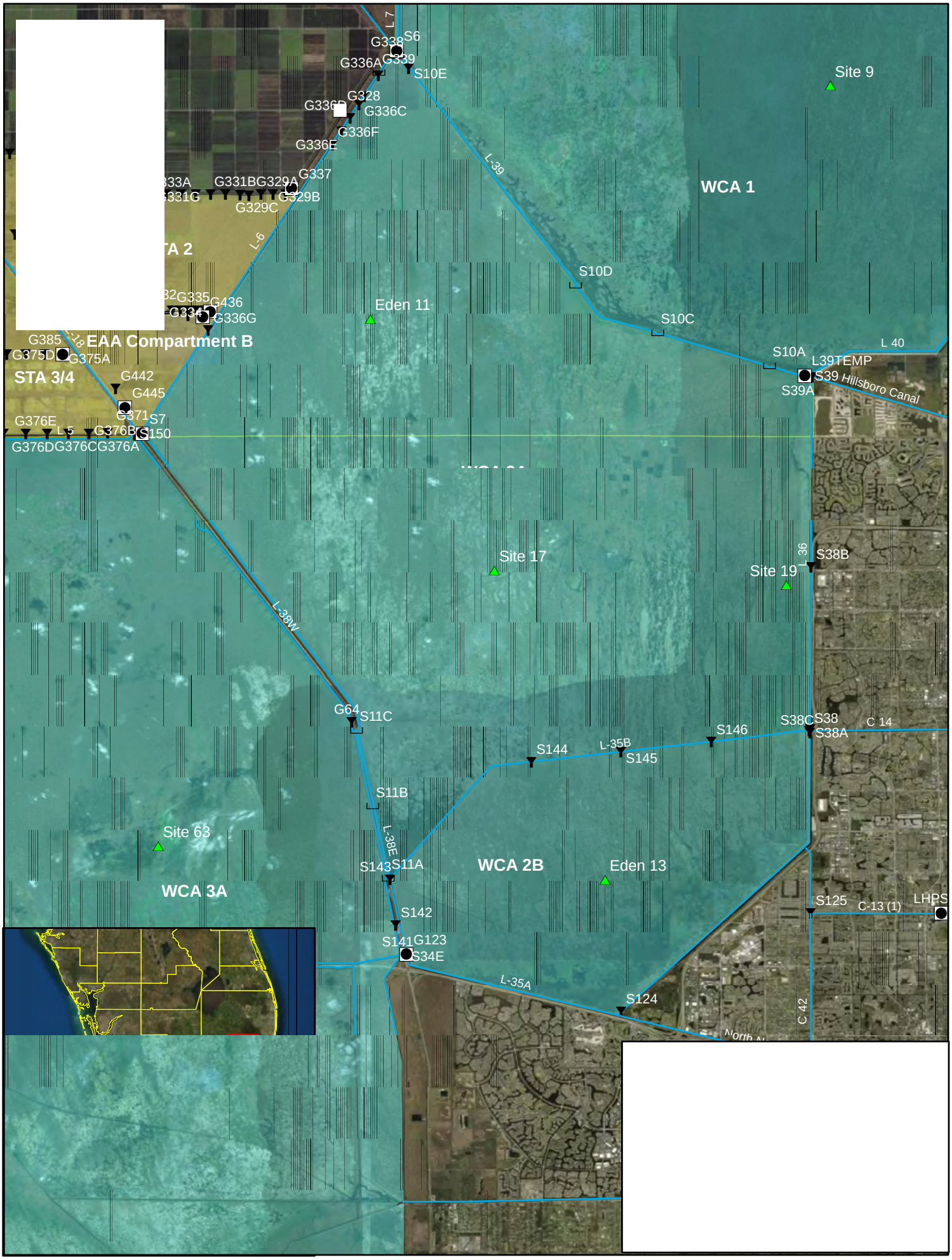
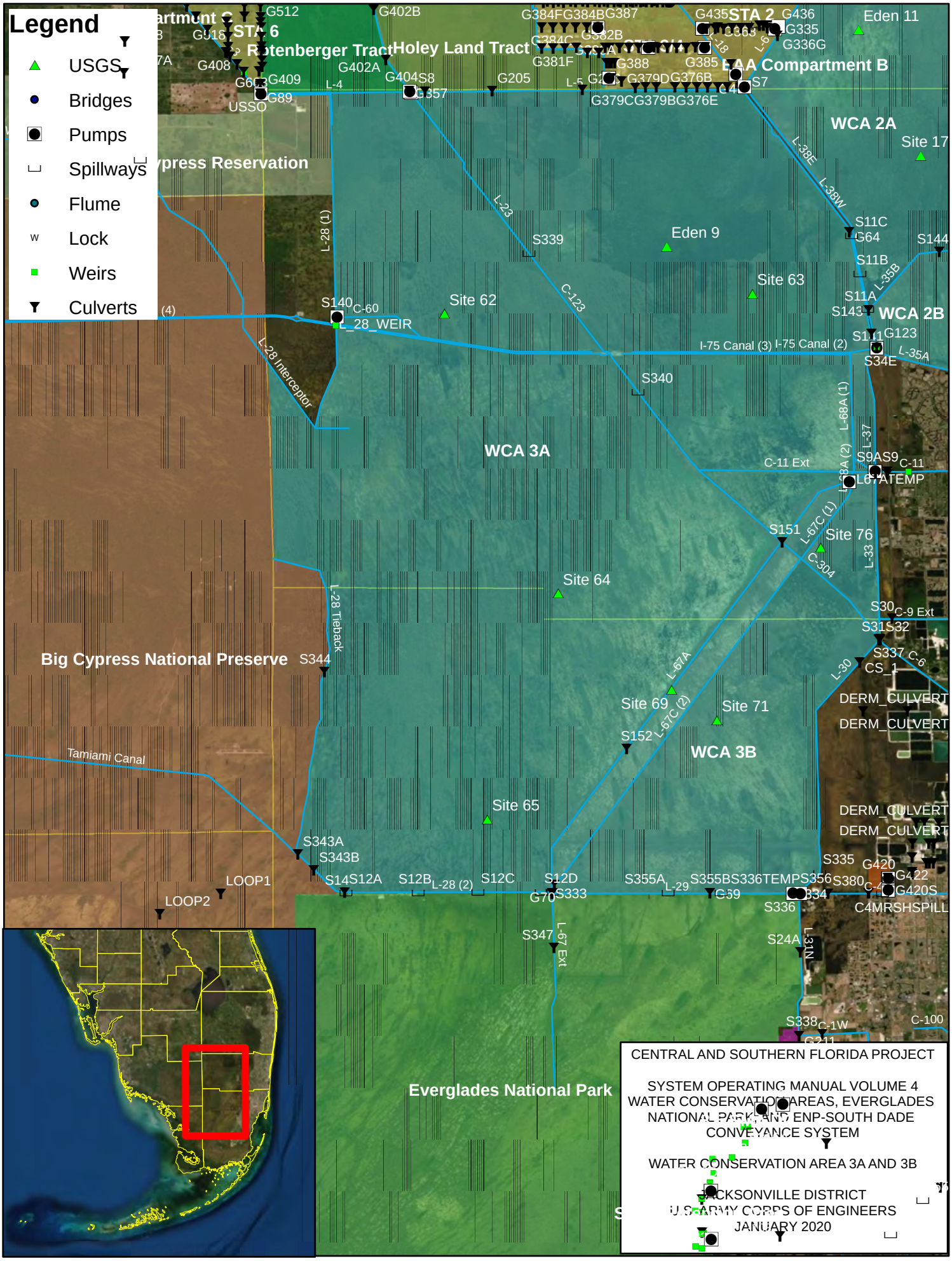

L 7
G338
S6
G339
G336A
S10E
Site 9
G328
G336B
G336C
G336F
G336E
G337
G331B
G329A
G331G
G329B
G329C
L-39
WCA 1
L-6
S10D
G335
G436
G334
G336G
Eden 11
S10C
G385
EAA Compartment B
G375D
G375A
L 40
S10A
L39TEMP
S39
S39A
Hillsboro Canal
STA 3/4
G442
G445
G371
S7
G376E
L-5
G376B
S150
G376D
G376C
G376A
Site 17
Site 19
L 36
S38B
L-38W
G64
S11C
S38C
S38
S38A
C 14
S146
S144
L-35B
S145
S11B
Site 63
L-38E
S143
S11A
WCA 2B
Eden 13
WCA 3A
S125
C-13 (1)
LHPS
S142
S141
G123
S34E
L-35A
S124
C 42

PLATE 2-3

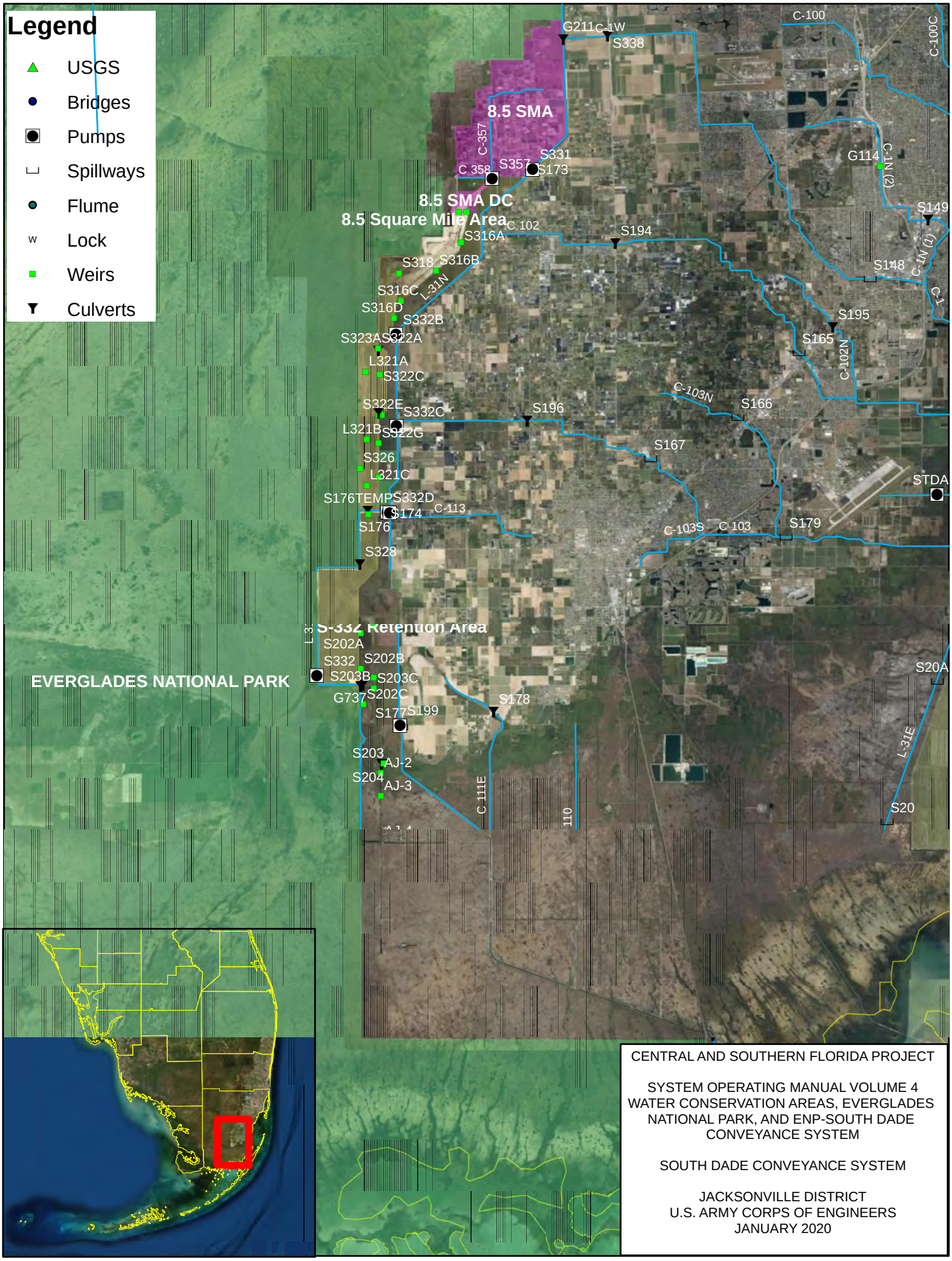


CENTRAL AND SOUTHERN FLORIDA PROJECT

SYSTEM OPERATING MANUAL VOLUME 4
WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK AND ENP-SOUTH DADE CONVEYANCE SYSTEM

WATER CONSERVATION AREA 3A AND 3B

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

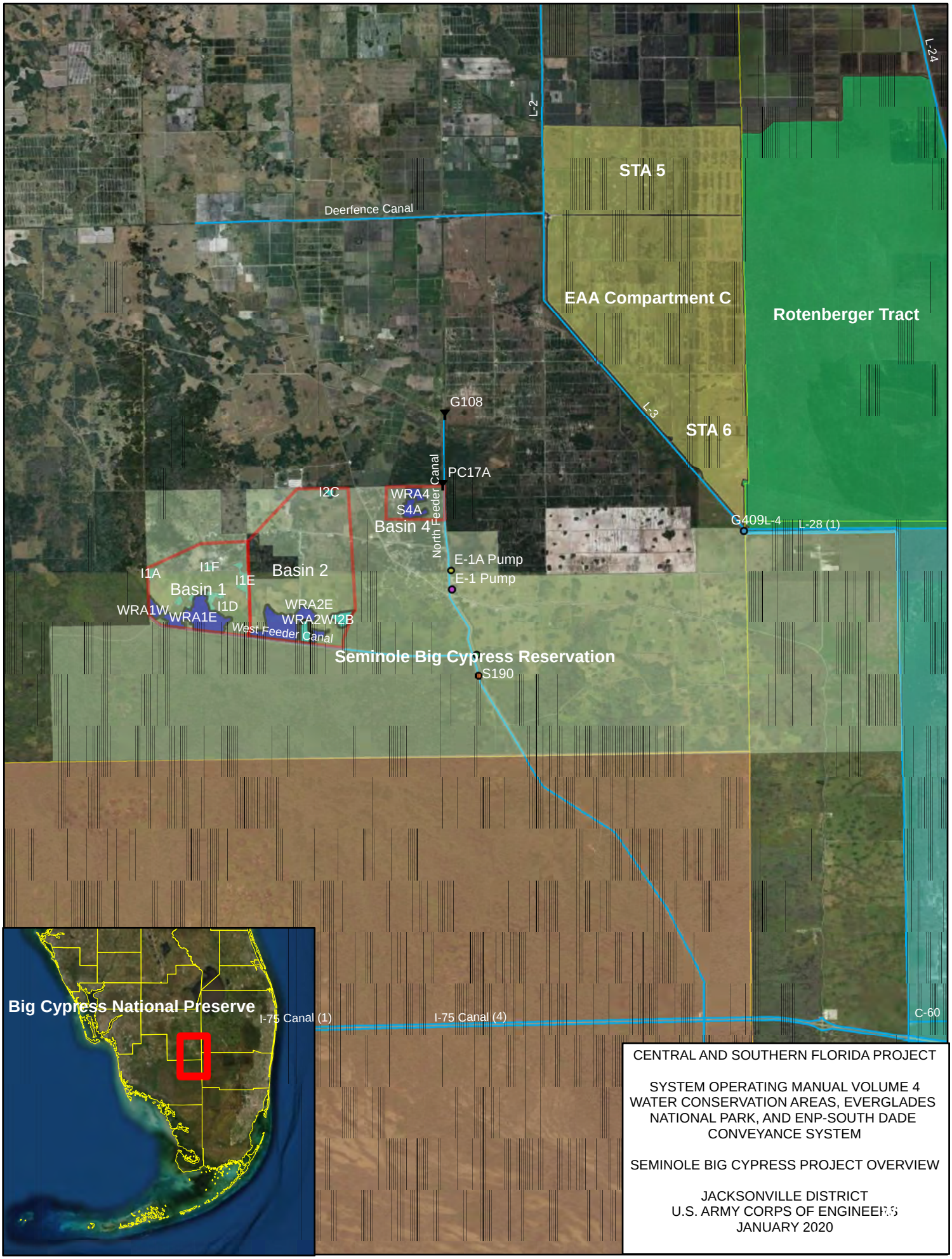


CENTRAL AND SOUTHERN FLORIDA PROJECT

SYSTEM OPERATING MANUAL VOLUME 4
WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK, AND ENP-SOUTH DADE CONVEYANCE SYSTEM

SOUTH DADE CONVEYANCE SYSTEM

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020



CENTRAL AND SOUTHERN FLORIDA PROJECT

SYSTEM OPERATING MANUAL VOLUME 4
WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK, AND ENP-SOUTH DADE CONVEYANCE SYSTEM

SEMINOLE BIG CYPRESS PROJECT OVERVIEW

JACKSONVILLE DISTRICT
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JANUARY 2020

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SYSTEM OPERATING MANUAL
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APPENDICES

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SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX A

STRUCTURE DESCRIPTIONS

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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S-34E - STRUCTURE [NAVD88 = NGVD29 + (-1.49)]

S-34E is located in the North New River Canal, where the L38E canal meets the L35 canal, just northeast of the I-75 and US-27 intersection in west Broward County. This area is formerly known as Andy town, FL.

PURPOSE

This structure permits release of water from Conservation Area 2A or 3A to supply water needs along the North New River Canal during the dry season. It also can be used to discharge excess water from Conservation Area 2A, 3A and/or 2B when capacity is available in the North New River Canal and when the water is not needed in Conservation Area 3.

OPERATION

Note: All elevations reference National Geodetic Vertical Datum (NGVD), 1929. This structure is manually operated under either flood or normal conditions. The structure is operated together with S-141, S-142 or S-143.

Flood Conditions

The gates of this structure are opened whenever:

1. Excess storage is present in Conservation Area 2A and/or 2B prior to hurricane season; that is, when the stage in Conservation Area 2A is above the Regulation Schedule.
2. The excess water in Conservation Area 2A is not needed in Conservation Area 3.
3. The tailwater elevation will not exceed 6.0 feet.
4. Water Conservation Area 3A is above the regulation schedule.

NORMAL CONDITIONS

When operations are not required under Flood Conditions, releases shall be made, as necessary, to supply downstream water requirements so as to maintain an optimum stage at Sewell's Lock, between elevation 3.5 and 4.5.

S-39A –STRUCTURE [NAVD88 = NGVD29 - 1.53 FEET]

DESCRIPTION

The structure is a rectangular double-barrel, 10 feet wide x 8 feet high reinforced-concrete, gated culvert, located in southern Palm Beach County at the northern end of the L-36 borrow canal near its junction with the Hillsboro Canal. S-39A is adjacent to Water Conservation Areas (WCA) 1 and 2A. The structure replaced a deteriorated three-barrel, 72-inch diameter corrugated metal pipe culvert with flashboards mounted on a steel frame.

S-39A gates can either be remotely operated from the SFWMD Operation Control Center or controlled on-site. The structure is currently maintained by the West Palm Beach Field Station.

PURPOSE

The S-39A structure, together with water control structure S-38B, controls the seepage rate from WCA-2A by regulating the water level in the north half of the L-36 borrow canal. S-39A also passes discharges from North Springs Improvement District (NSID) to the Hillsboro Canal and ultimately to tide via G-56. The size of the structure was increased to better accommodate flow from NSID.

OPERATION

Normally the structure will operate to maintain a stage range which moderates seepage from WCA-2A and will open to release excess water arising from seepage or NSID discharges or a combination of both.
The stage range maintained will consider the NSID's L-36 stage limits for pumping into the L-36 and the availability of water. Based on the operational range of 7.5/7.0 feet NGVD29 in the Master Water Control Manual Volume 4, the lowest range for normal operations will be 7.5/7.0 feet NGVD29. The range may be raised if analysis indicates that the higher range will not impact NSID pumping. Based on the expected state in the Hillsboro Canal, the stage may be raised one foot (8.5/8.0 feet NGVD29) without impacting NSID. During tropical events, automatic control can be turned off and the gate left fully open.

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STRUCTURE 141

This structure is a sheet pile overflow section in Levee 38E located at the southwest corner of Conservation Area No. 2B, about 20 miles west of Fort Lauderdale, at Andytown. Control is effected by timber flash boards set in the six bays of the structure.

PURPOSE

This structure affords the sole means of releasing water from Conservation Area 2B. It discharges into the North New River Canal between S-143 and S-34. It can be used to discharge excess water from Conservation Area 2B when capacity is available in the North New River Canal.

OPERATION

S-150 – CONTROL STRUCTURE [NAVD88 = NGVD29-1.46]

DESCRIPTION

The original five-barrel corrugated metal pipe (CMP) culvert, connecting L-5 Canal to L-38W Canal on the northeast perimeter of Water Conservation Area 3A (WCA-3A) and along the county lines of Palm Beach and Broward County, was replaced. The new structure is a (3) three-barrel cast-in-place reinforced concrete box culvert with automatically operated single leaf slide gates on the upstream of the structure. The gate can be controlled by either the on-site control or remotely from the SFWMD Operation Control Center. The new S-150 structure was commissioned in April 2015. The structure is currently maintained by the Ft. Lauderdale Field Station.

PURPOSE

This structure, together with S-8 Pump station, permits release of water from Lake Okeechobee and the agricultural area south of the lake, and Stormwater Treatment Area (STA) 3/4 into WCA-3A. S-150 functions in this capacity only under gravity conditions (headwater elevation exceeds the tailwater).

OPERATION

DRAFT

S-194 – CONTROL STRUCTURE [NAVD88 = NGVD29 - 1.55 FEET]

DESCRIPTION

This structure was a double-barreled reinforced concrete pipe culvert with manually operated sluice gates that was replaced in 2019. The replacement structure has two concrete box culverts, located on C-102 (Princeton) Canal west of Krome Avenue (SR 997), about 6 miles upstream from S-165 and 7 miles north of Homestead. Control is effected by remotely controlled dual-leaf slide gates mounted on a reinforced concrete structure.

PURPOSE

This structure operates as a drainage divide and controls stages in C-102 to the west. It is sized to convey either water supply or excess water from the L-31N Canal to the east when capacity is available.

OPERATION

DRAFT

S-197 – STRUCTURE [NAVD88 = NGVD29 - 1.55 FEET]

DESCRIPTION

Structure S-197 is a four (4) barrel cast-in-place concrete box culvert located upstream of the mouth of the C-111 Canal about 3 miles from the shore of Manatee Bay and 750 ft east of U.S. Highway 1 in Southern Miami-Dade County. Flow through the culvert is controlled by vertical slide gates. The gates are manually operated by the Homestead field station (remote and local automatic control is being added to this structure and should be completed before the 2020 wet season).

The structure was originally built in 1969 by the COE with three (3) gates. In 1980, ten (10) additional culverts were constructed to increase the total design capacity to 2,400 cfs. In 2012, the structure was replaced with a four-barrel box culvert. The design capacity of the replaced structure remains at 2,400 cfs.

PURPOSE

The S-197 releases water to tide through the C-111 outlet, maintains optimum water control stages upstream in the C-111 Canal, prevents saltwater intrusion during high tides and blocks reverse flow during storm surges. This structure usually remains closed to divert discharges from S-18C overland to the panhandle of the Everglades National Park (ENP). S-197 is opened for flood control when the overland flow capacity, with S-197 closed, is insufficient. The testing of small releases (e.g. 400 cfs or less) while holding the C-111 stages high enough to maintain overland flow to the ENP pan handle was initiated with the Increment 1 Test (2015).

OPERATIONS

DRAFT

S-332B – PUMP STATION [NAVD88 = NGVD29 - 1.57 FEET]

DESCRIPTION

S-332B is a five-unit pump station with a design capacity of 575 cfs. It is equipped with four (4) 125 cfs diesel engine-driven pumps, and one (1) 75 cfs electric motor driven pump with flap gates on downstream (discharge) side. The structure is located on the west bank of the L-31N, in Miami-Dade County.
Construction of S-332B began on January 29, 2000 and was completed on April 12, 2000. This is a pump station authorized by the USACE. This structure is currently maintained by the Homestead Field Station.

PURPOSE

The S-332B, S-332C, and S-332D pump stations along with the S-176 gated spillway, are operated to maintain the L-31N Canal reach between S-331 and S-176 in accordance with Increment 2.0 (Appendix A, Part 1). S-332B is a component of the Modified Water Delivery (MDW) to Everglades National Park (ENP) project, which is used to manage increased seepage anticipated from increased deliveries to ENP as a result of the MWD to ENP project.

OPERATION

DRAFT

S-332C – PUMP STATION [NAVD88 = NGVD29 - 1.55 FEET]

DESCRIPTION

S-332C is a five-unit pump station with a design capacity of 575 cfs. It is equipped with four (4) 125 cfs diesel engine-driven pumps, and one (1) 75 cfs electric motor driven pump with flap gates on downstream (discharge) side. The structure is located on the west bank of the L-31N, in Miami-Dade County.
S-332C detention area and a connector cell was completed in 2003. The hydraulic design parameters for the S-332C pump station are the same as the S-332B pump station. This structure is currently maintained by the Homestead Field Station.

PURPOSE

S-332C discharges into the middle section of the South Detention Area (SDA). The S-332B, S-332C, and S-332D pump stations along with the S-176 gated spillway, are operated to maintain the L-31N Canal reach between S-331 and S-176 in accordance with Increment 2.0 (Appendix A, Part 1). S-332C is a component of the Modified Water Delivery (MDW) to Everglades National Park (ENP) project, which is used to manage increased seepage anticipated from increased deliveries to ENP as a result of the MWD to ENP project.

OPERATION

DRAFT

S-332D – PUMP STATION [NAVD88 = NGVD29 - 1.55 FEET]

DESCRIPTION

S-332D is a five-unit pumping station with a design capacity of 575 cfs. It is equipped with four (4) 125 cfs diesel engine-driven pumps, and one (1) 75 cfs electric motor driven pumps with flap gates on downstream (discharge) side. The structure is located is located at the junction of the L-31N and the L-31W canal, near the S-176 gated spillway, about 5 miles west of Homestead. Construction of S-332D was completed in December 1997 and the SFWMD began operating it in July of 2000. The pump station is currently maintained by the Homestead Field Station.

PURPOSE

The primary purpose for the S-332D station is to pump water from the L-31N canal, upstream of S-176, into a S-332D Detention Area to facilitate flows to Florida Bay via Taylor Slough.
S-332D is a component of the Modified Water Delivery (MDW) to Everglades National Park (ENP) project, which will be used to manage increased seepage anticipated from increased deliveries to ENP as a result of full implementation of the MWD to ENP project. The S-332B, S-332C, and S-332D pump stations along with the S-176 gated spillway, are operated to maintain the L-31N Canal reach between S-331 and S-176 in accordance with Increment 2.0 (Appendix A, Part 1).

OPERATION

DRAFT

S-333N SPILLWAY [NAVD88 = NGVD29 + (-1.54)]

DESCRIPTION

The S-333N structure is a two-bay, reinforced concrete, gated spillway, located adjacent to existing S-333 structure at the intersection of the L-67A and L-29 Canals in the Miami-Dade County. The structure consists of two (2) 14.6 feet high and 14.0 feet wide gates with sill elevations of -3.06 feet NGVD29. The discharge from the structure is controlled by two (2) cable operated, vertical lift roller gates, operated remotely through District telemetry or with local control.

The structure allows the District to more efficiently and effectively convey surface water from the L-67A to L-29 Canal, where it will be able to flow south, under Tamiami Trail (US41) and through the bridges and into the Everglades National Park's (ENP) Northeast Shark River Slough (NESRS). The S-333N can also supply water to S-334.

PURPOSE

The purpose of the S-333N structure is to provide additional operational flexibility by increasing the available discharge capacity from Water Conservation Area 3A (WCA-3A) to the NESRS. S-333N can convey an additional 1,150 cfs flow along with S-333 (1,350 cfs design capacity) to provide a combined design capacity of 2,500 cfs from Water Conservation Area 3A (WCA-3A) to NESRS.

OPERATIONS

DRAFT

S-344 – CONTROL STRUCTURE [NAVD88 = NGVD29 - 1.48 FEET]

DESCRIPTION

S-344 is a two (2) barrel aluminum gated culvert with risers and is located about 9.0 miles north of U.S. Highway 41 (Tamiami Trail), in the northwest part of Miami-Dade County. The structure is located on the L-28 canal in the south-west corner of Water Conservation Area 3A (WCA-3A). The structure receives water from WCA-3A and discharges to the L-28 canal in the Big Cypress National Preserve (BCNP), which ultimately outlets to Everglades National Park (ENP) further south. The original gated CMP culvert built in 1963 was replaced by an in-kind gated pipe culvert with risers by the South Florida Water Management District (SFWMD) in March 2018. The structure is operated and maintained by the SFWMD Miami Field Station.

The structure is controlled by two (2) 6.0 feet (H) x 8.0 feet (W) vertical slide gates. In addition, there are wooden extension boards on top of the gates to prevent overtopping.

PURPOSE

S-344 permits discharge from WCA-3A during periods of excessively high stages and extends the hydroperiod in the BCNP during dry periods.

OPERATION

DRAFT

DRAFT

STRUCTURE S-356 – [NAVD = NGVD - 1.56 FEET]

Structure S-356 is a pump station consisting of four (4) diesel engine-driven pumps and is located along L-29 Canal (Tamiami Canal) adjacent to the S-334 gated spillway, in Miami Dade County. The original structure was constructed in June 2002 by the United States Army Corps of Engineers (USACE), which was transferred to the South Florida Water Management District (SFWMD) in August 2017. The pump station is currently maintained by the Miami Field Station. It consists of a platform with four pumps, four discharge pipes, an outlet structure, and a control house. Each discharge pipe is approximately 300 feet long and they are located west of the station. Each pipe is 48-inches in diameter and is made of steel. The pump collects water from the confluence of the L-30 and L-31N Canals, east of the S-356 structure and discharges into the L-29 Canal, west of the S-356 structure.

PURPOSE

The pump station is intended to manage water stages in the L-31N and L-30 Canals between S-334 and G-211. It is a component of the Modified Water Delivery (MDW) to Everglades National Park (ENP) project, which will increase deliveries to ENP once the project is fully implemented.

OPERATION

DRAFT

STRUCTURE S-357N – [NAVD = NGVD - 1.56 FEET]

Structure S-357N is a three (3) barrel High Density Polyethylene (HDPE), circular gated structure located on the C-358 seepage collection canal, which is just south and runs parallel to Richmond Drive. It is upstream of the S-357 Pump Station and immediately west of the intersection of C-357 and C-358 canals in the southern end of 8.5 Square Mile Area (8.5 SMA) in Miami-Dade County. Each pipe is 7.0 feet in diameter and is equipped with tie-down anchor blocks, handrails, access hatch and lightning protection system. The control structure consists of three manually operated double leaf slide gate systems which were designed to accommodate variable flow regimes: (1) weir flows by lowering the top gate; (2) orifice flows by raising the lower gate; or (3) submerged or un-submerged, uncontrolled flows by raising both the top and bottom gates above the top (crown) of the culvert.

The construction of the structure was completed in March 2018 by the US Army Corps of Engineers. the operation and maintenance responsibilities of the structure is expected to be handed over to the SFWMD In April 2018.

The culvert is located at the southern end of 8.5 SMA, east of Everglades National Park, and is an important component of 8.5 SMA Flood Mitigation Plan due to increased waterflows and stages in Northeast Shark River Slough (NESRS), as a result of the Modified Water Deliveries (MWD) to the Everglades National Park (ENP) project.

PURPOSE

The S-357N control structure hydraulically connects the C-358 Seepage Canal to the C-357 Canal in order to provide flood mitigation for 8.5 SMA by discharging groundwater inflows from the southwest corner of 8.5 SMA into the upstream side of S-357 pump station via C-358, which is then pumped south by the S-357 pump station to a flow way leading to L-359 Detention area.

OPERATION

EXHIBIT A

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WATER CONSERVATION AREAS - EVERGLADES NATIONAL PARK - ENP-SOUTH DADE CONVEYANCE SYSTEM STRUCTURES

Structure	Description	Page No.	Pertinant Data Page No.
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S-5A(S)	Spillway	A-S5A(S)-1	A-S5A(S)-2
S-5A(E)	Culvert	A-S5A(E)-1	A-S5A(E)-2
S-5A(W)	Culvert	A-S5A(W)-1	A-S5A(W)-2
S-6	Pumping Station	A-S6-1	A-S6-3
S-7	Pumping Station	A-S7-1	A-S7-4
S-8	Pumping Station	A-S8-1	A-S8-4
S-9	Pumping Station	A-S9-1	A-S9-3
S-9A	Pumping Station	A-S9A-1	A-S9A-1
S-10A	Spillway	A-S10A-1	A-S10A-3
S-10C	Spillway	A-S10C-1	A-S10C-3
S-10D	Spillway	A-S10D-1	A-S10D-3
S-10E	Culvert	A-S10E-1	A-S10E-2
S-11A	Spillway	A-S11A-1	A-S11A-3
S-11B	Spillway	A-S11B-1	A-S11B-3
S-11C	Spillway	A-S11C-1	A-S11C-3
S-12A	Spillway	A-S12A-1	A-S12A-3
S-12B	Spillway	A-S12B-1	A-S12B-3
S-12C	Spillway	A-S12C-1	A-S12C-3
S-12D	Spillway	A-S12D-1	A-S12D-3
S-12E	Culvert	A-S12E-1	A-S12E-2
S-14	Culvert	A-S14-1	A-S14-2
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S-18C	Spillway	A-S18C-1	A-S18C-2
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S-24A	Culvert	A-S24A-1	A-S24A-2
S-31	Culvert	A-S31-1	A-S31-2
S-32	Culvert	A-S32-1	A-S32-2
S-32A	Culvert	A-S32A-1	A-S32A-2
S-34	Culvert	A-S34-1	A-S34-2
S-38	Culvert	A-S38-1	A-S38-2
S-38A	Culvert	A-S38A-1	A-S38A-2
S-38B	Culvert	A-S38B-1	A-S38B-2
S-39	Spillway	A-S39-1	A-S39-2
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S-143	Culvert	A-S143-1	A-S143-2
S-144	Culvert	A-S144-1	A-S144-2
S-145	Culvert	A-S145-1	A-S145-2
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S-150	Culvert	A-S150-1	A-S150-2
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S-175	Culvert	A-S175-1	A-S175-3
S-176	Spillway	A-S176-1	A-S176-3
S-177	Spillway	A-S177-1	A-S177-2
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S-194	Culvert	A-S194-1	A-S194-2
S-196	Culvert	A-S196-1	A-S196-2
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S-332	Pump Station	A-S332-1	A-S332-3
S-332DX1	Culvert	A-S332DX1-1	A-S332DX1-1
S-333	Spillway	A-S333-1	A-S333-3
S-334	Spillway	A-S334-1	A-S334-2
S-335	Spillway	A-S335-1	A-S335-2
S-336	Culvert	A-S336-1	A-S336-2
S-337	Culvert	A-S337-1	A-S337-2
S-338	Culvert	A-S338-1	A-S338-2
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		Submerged Uncontrolled	A-S5A(S)-4
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~~S-6~~	REMOVED	~~Discharge Rating Curve~~	~~A-S6-4~~
		~~Operation Chart~~	~~A-S6-5~~
		~~Back Siphoning~~	~~A-S6-6~~
~~S-7~~	REMOVED	~~Submerged Controlled~~	~~A-S7-5~~
		~~Operation Chart~~	~~A-S7-6~~
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		~~8.5 ft. MSL Tailwater~~	~~A-S7-7~~
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~~S-8~~	REMOVED	~~Submerged Controlled~~	~~A-S8-4~~
		~~Operation Chart~~	~~A-S8-5~~
		~~Submerged Controlled For:~~	
		~~8.5 ft. MSL Tailwater~~	~~A-S8-6~~
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STRUCTURE 5A (S-5A)

Location. S-5A is on the south side of State Road 80 (U.S. Hwy 441) and West Palm Beach Canal (C-51) about 20 miles west of West Palm Beach, Florida. S-5A is located in the vicinity of the intersection of L-40 and the West Palm Beach Canal between C-51 and the borrow canals of Levees 7 and 40. Structure 5A is west of S-5A(W) and S-5A(S).

Description. Pump station S-5A consists of a reinforced concrete structure with a concrete superstructure. The pumping station is equipped with six horizontal propeller pumps each with a rated speed of 714 rpm. At this speed, each pump has a capacity of 800 cfs at a static head of 11.1 ft. The total capacity for the six pumps is 4,800 cfs at design head. Semi-automatic flap gates are provided at each pump discharge to assist in priming and to prevent possible backflow. A 6-foot electrically operated trash rake is located on the intake side of the structure. Needle beams for use at the pump intake bay and bulkhead sections for use at the pump discharge side are provided for dewatering or to stop backflow through any one of the pumps if necessary.

Purpose. S-5A pumps surplus water via the West Palm Beach Canal from the agricultural area northwesterly of the pumping station into WCA No.1. S-5A is designed to remove 3/4 inch agricultural runoff per day from the 230 sq. mile drainage area which includes the L-10 and L-12 basins. When the primary purpose will not be impeded, S-5A may also remove excess water from the L-8 and C-51 basins and from Lake Okeechobee when the Lake is above its regulation schedule.

Normal Regulation. Pumping should begin when the West Palm Beach Canal level exceeds 11.5 ft. during the irrigation phase or 10.5 ft. during the drainage phase. The irrigation phase generally occurs in the winter and the drainage phase in the summer. Brief periods of very wet or very dry weather at any time of year can initiate a change from one phase to the other. The water surface at the pump station should not be drawn down below 8.3 ft., NGVD. If the water surface on the intake bay falls below 6.3 ft. during pump operation, the speed of all pumps operating should be reduced to not less than 600 rpm. If the water surface elevation in the intake pool remains below 6.3 ft., then one or more pumping units should be shut down until the minimum pool elevation is re-established. The pumps should be started and stopped slowly, one pump at a time, to avoid high velocities and surges in the canal. The primary S-5A drainage area (the L-10 and L-12 basins) receives surplus water primarily from pumped discharge, and secondarily by gravity discharge from adjacent lands. Just the pumped discharge alone into this area above S-5A exceeds the discharge capacity of S-5A. This can have a major impact on the operation of this pump station, especially if a major storm is imminent. An early warning agreement exists

between the South Florida Water Management District and all major interests who pump into the L-10 and L-12 basins. Each of these interests has agreed to notify SWFMD of the time and projected quantities of their intended discharge into L-10 and L-12. It is important to obtain hydrologic data frequently on rainfall, water levels, and pumping rates because the project operation is dependent upon this data.

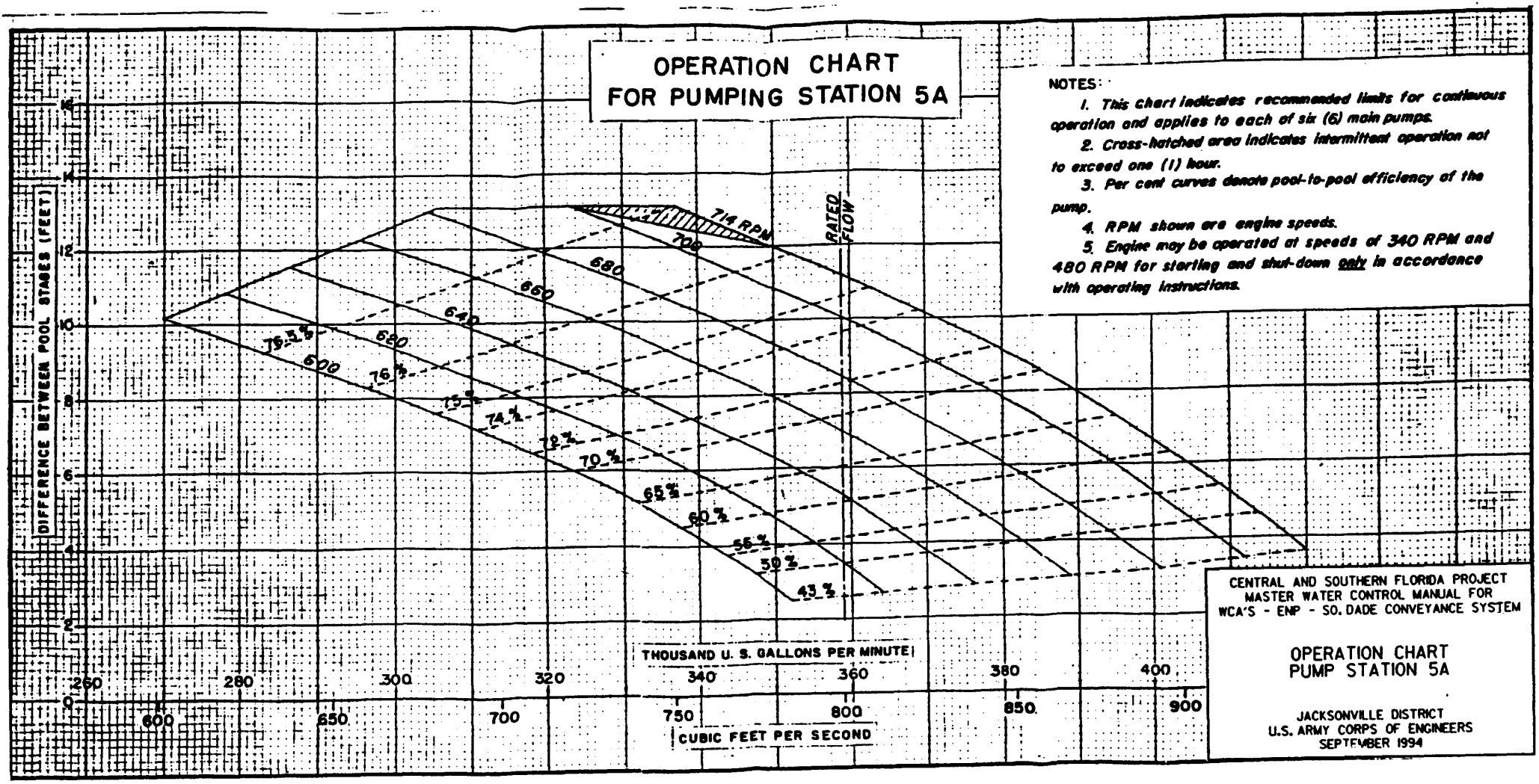
Flood Regulation. Pumping should begin when the West Palm Beach Canal level exceeds 11.5 ft. during the irrigation phase or 10.5 ft. during the drainage phase. If the tailwater elevation at Canal Point, Big Mound, or S-5A is above 12.0 ft., or there is a rise in stage of 0.5 ft. per hour and there has been no change in District pumping or hurricane operations then pumping should be initiated. When stages are above 16.0 ft. at Sand Cut or the tailwater at S-5A(E) is above 13.0 ft. and the inflows from their basins will not jeopardize flood control in the L-10 and L-12 basins then the appropriate gates should be opened and S-5A placed in operation.

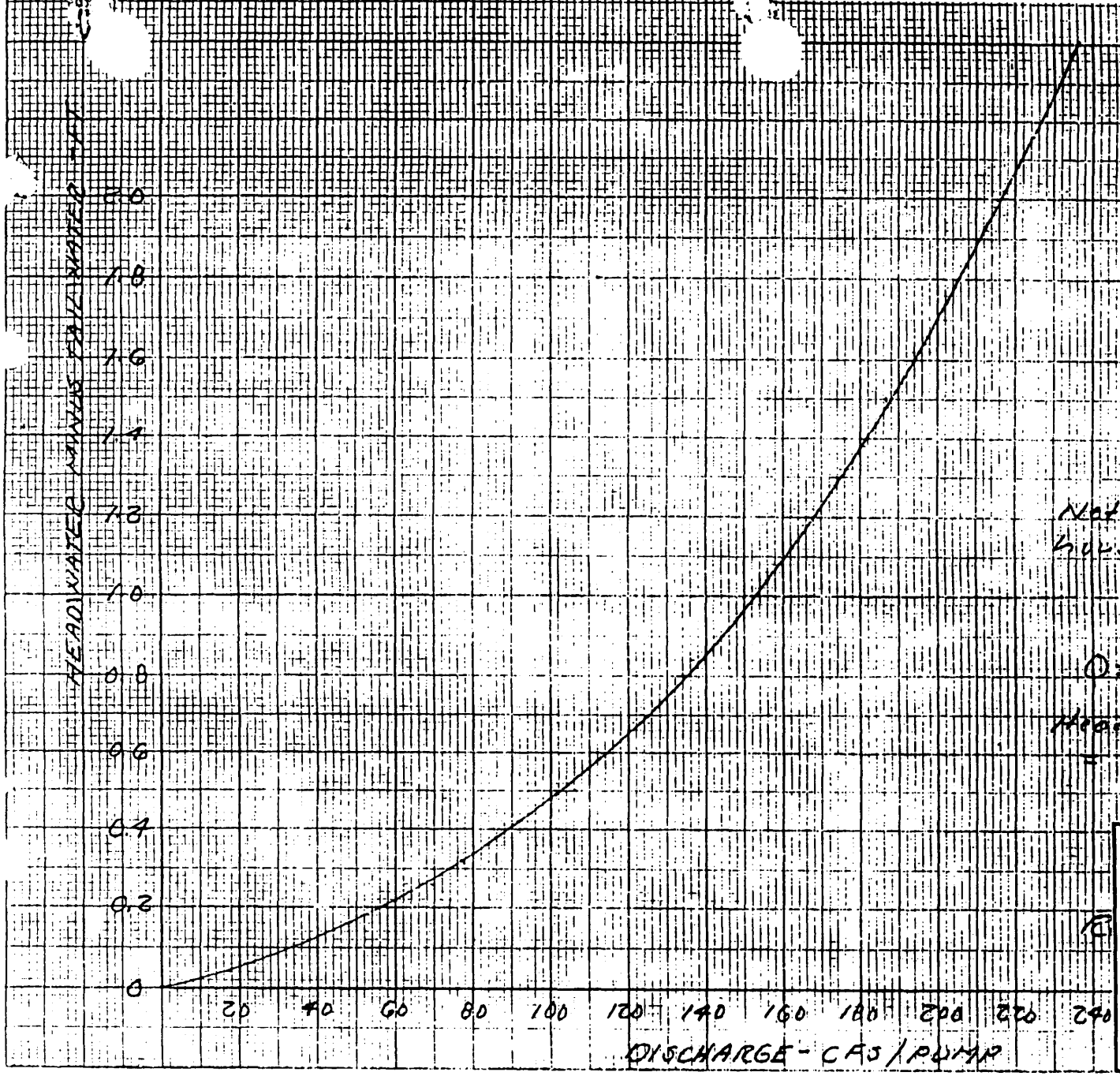
Constraints. The water surface at the pump station should not be drawn down below 6.3 ft., NGVD. The pumps should not be operated between 345 and 420 rpm and between 490 and 600 rpm as indicated on the engine tachometer. All operations through these speed zones should be done as quickly as possible. The rated speed is 714 rpm. At this speed the pumps will pump 800 cfs or greater within the following ranges of head, provided both conditions are not exceeded: (a) when the intake pool gage reads 8.3 ft., NGVD or higher; (b) when the pool gage reads 19.4 ft., NGVD or lower. The pumps should be started and stopped slowly, one pump at a time, to avoid high velocities and surges in the canal. Backflow during hurricanes can be prevented by closing the gates at the end of the discharge tube.

STRUCTURE 5A (S-5A)

Summary of Hydraulic Design

Location	West Palm Beach Canal
Drainage Area (sq. miles)	230
Design Total Discharge (cfs)	4,800
Water Surface Elevation (ft.)	
Maximum, non-pumping	11.5; 10.5
Start Pumps	
Irrigation Phase	11.5
Drainage Phase	10.5
Normal Drawdown, drainage	NA
Normal Drawdown, lake regulation	Variable
Maximum Drawdown, with pumping	8.3
Discharge Pool (WCA No.1A criteria)	
Water Surface Elevation (ft.)	
Maximum, non-pumping	13.0
Maximum, pumping @ full capacity	19.4
Design Head	
Maximum	11.1
At Rated Capacity	11.1
Best Efficiency	9.2
Minimum, one pump operating	5.2
Pumps	
Type	Vertical axial flow
Number	6
Design Rating (cfs)	
Per Pump	800
Total (all pumps)	4,800
Impeller	
Speed (rpm)	125
Size (dia., inches)	116
Invert Elevation (ft.)	NA
Engine Horsepower (ea)	1600
Engine Speed (rpm)	714
Gates (per bay)	
Number	2
Location	Discharge tube
Type	Flap gate
Control	Semi-automatic
Size (width x height, ft.)	13.0 ft. x 12.0 ft.


OPERATION CHART
FOR PUMPING STATION 5A
NOTES:
1. This chart indicates recommended limits for continuous operation and applies to each of six (6) main pumps.
2. Cross-hatched area indicates intermittent operation not to exceed one (1) hour.
3. Per cent curves denote pool-to-pool efficiency of the pump.
4. RPM shown are engine speeds.
5. Engine may be operated at speeds of 340 RPM and 480 RPM for starting and shut-down only in accordance with operating instructions.
DIFFERENCE BETWEEN POOL STAGES (FEET)
THOUSAND U. S. GALLONS PER MINUTE
CUBIC FEET PER SECOND
RATED FLOW
714 RPM
700
680
660
640
620
600
79½%
76%
74½%
72%
70%
65%
60%
55%
50%
43%
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
OPERATION CHART
PUMP STATION 5A
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

SIPHON RATING
PUMP STATION 5A

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JUNE 1970

STRUCTURE 5A(S) (S-5A(S))

Location. S-5A(S) is in the L-8 Borrow Canal south of the West Palm Beach Canal where L-7 intersects the L-40 Borrow Canal. The structure is about 20 miles west of West Palm Beach, Florida.

Description. S-5A(S) is a two-bay gated spillway with vertical lift gates. The gates can be controlled at the structure or remotely controlled from Pump Station 5A.

Purpose. This spillway passes gravity flow from L-8 Canal into WCA No. 1. It functions with S-5A(E), S-5A(W), and S-5A to control flood runoff from the L-8 area and, when stages in the canals are low, it is used to make irrigation releases from WCA No. 1 to the L-10, L-12, L-8, and C-51 basins.

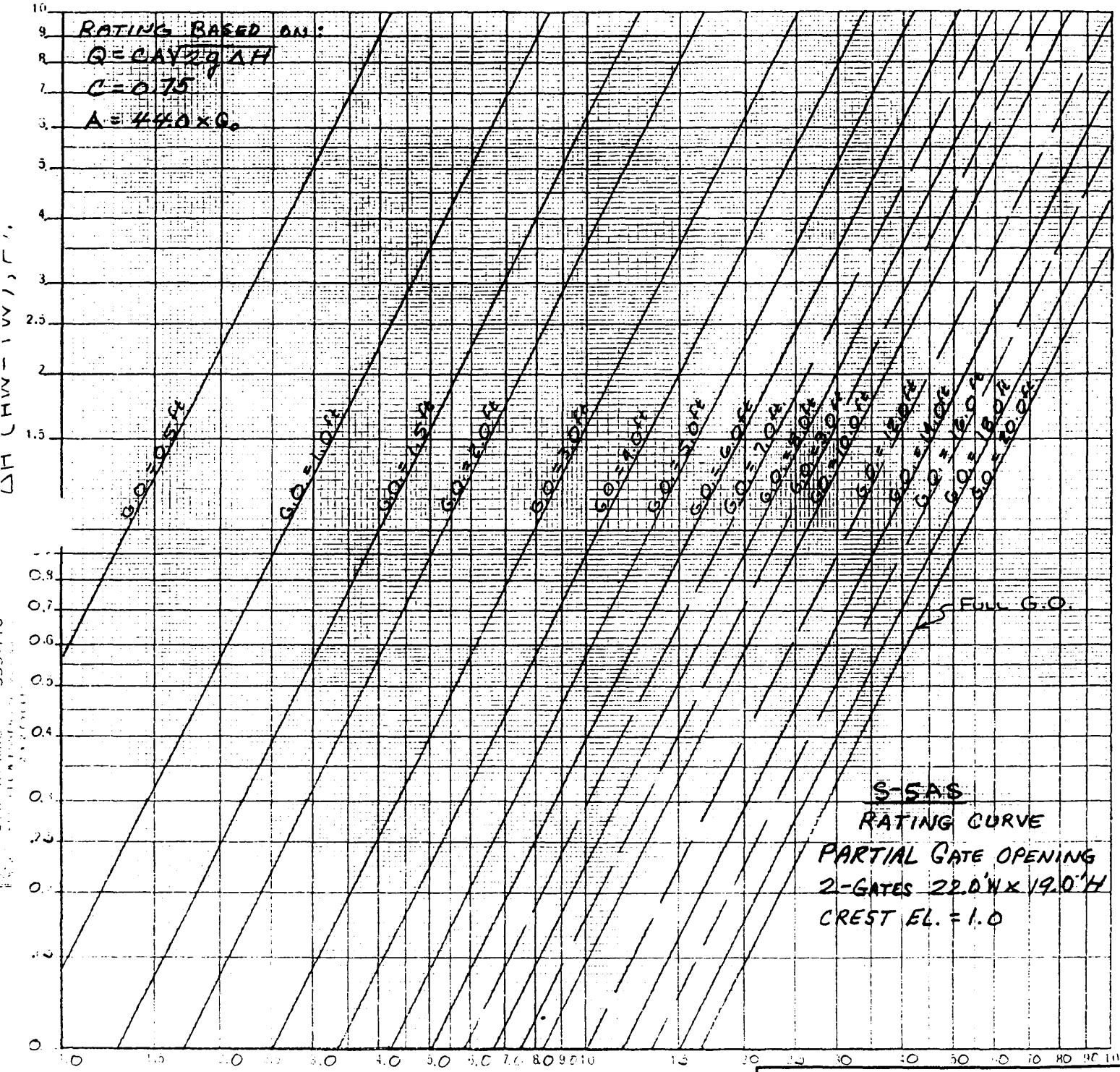
Normal Regulation. The gates at S-5A(S) are usually fully open since it is desirable to pass water from L-8 Canal into WCA No. 1 at all times (except during extreme low water) when heads are favorable. However, it is not desirable to back hurricane generated high water into the L-8 drainage system. Therefore, if during a hurricane the winds are blowing from a northeasterly direction with torrential rains the gates should remain open as long as the head remains favorable. However, if the winds shift and start blowing from the southeast or southwest quadrants and S-5A(S) becomes subject to the full wind-tide setup and wave action in WCA No. 1 then the gates should be closed remotely from S-5A.

Major Constraints. The gates are designed for an operating head of 4 ft. with a maximum differential in head of 9.0 ft. and a static head of 16 ft., which may occur if only one side of the gate is dewatered with normal pool at elevation 17.0 ft., NGVD and sill elevation at 1.0 ft., NGVD.

STRUCTURE 5A(S) (S-5A(S))

Summary of Hydraulic Design

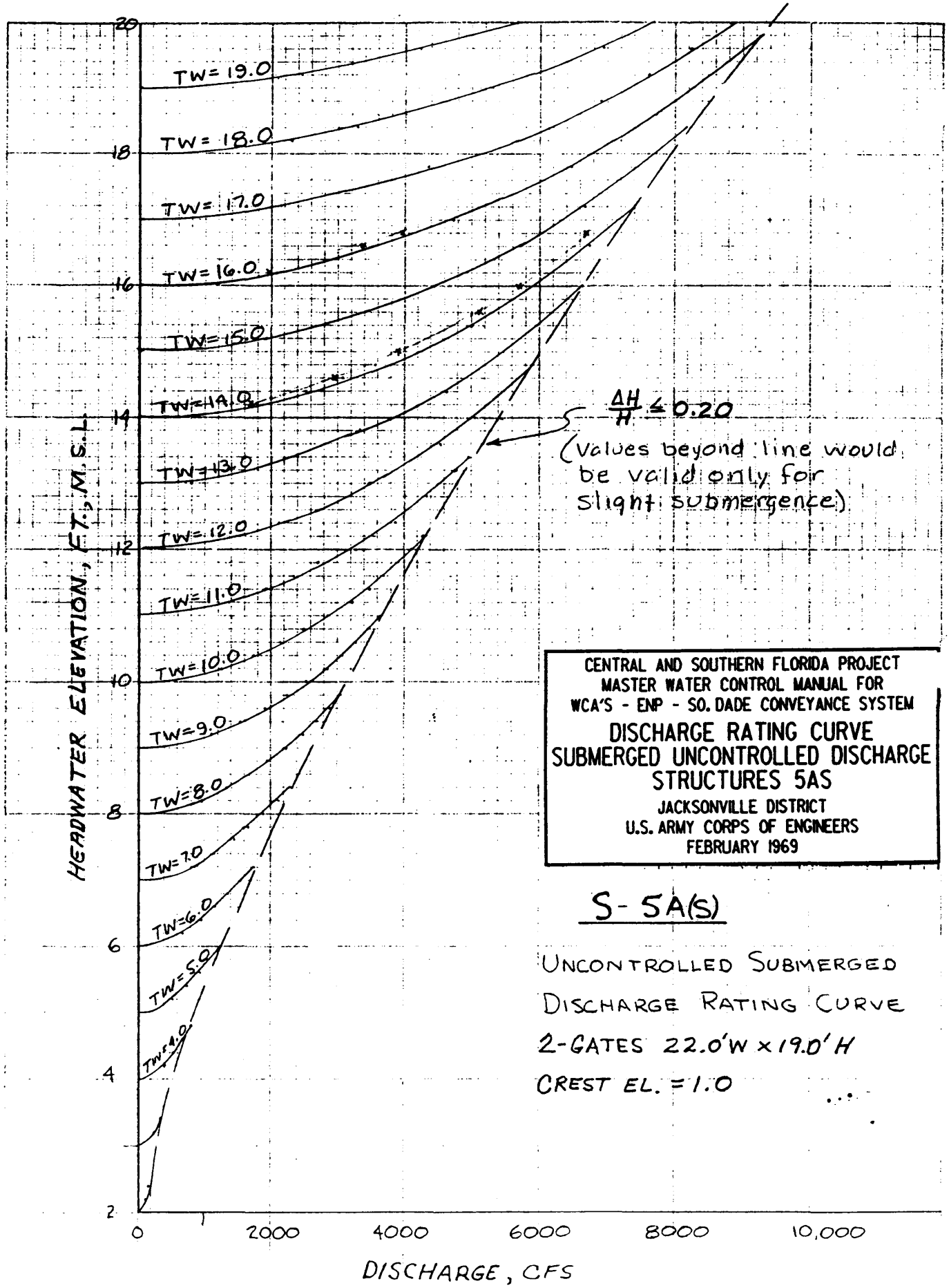
Location	L-8 Borrow Canal
Design Conditions	
Discharge (cfs)	2000
Type	uncontrolled submerged
Headwater Elevation (ft.)	18.0
Tailwater Elevation (ft.)	17.9
Maximum Head Differential (ft.)	9.0
Optimum Conditions	
Headwater Elevation (ft.)	14.0 - 16.0
Tailwater Elevation (ft.)	14.0 - 17.0
Crest	
Shape	trapezoidal
Elevation (ft.)	1.0
Net Length (ft.)	44.0
Gates	
Type of Gate	vertical lift
Number	2
Width x Height (ft.)	22.8 x 19.33
Top of Gates Elevation (ft.)	20.33
Top of Gates Elevation (ft.)	40.8
Dewatering Capabilities	steel needle beams and aluminum needles



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED DISCHARGE
STRUCTURES 5AS

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1969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20
18
16
14
12
10
8
6
4
2
HEADWATER ELEVATION, FT., M.S.L.
0
2000
4000
6000
8000
10,000
DISCHARGE, CFS
ΔH/H ≤ 0.20
(Values beyond line would be valid only for slight submergence)
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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING CURVE
SUBMERGED UNCONTROLLED DISCHARGE
STRUCTURES 5AS
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1969
S-5A(S)
UNCONTROLLED SUBMERGED
DISCHARGE RATING CURVE
2-GATES 22.0'W x 19.0'H
CREST EL. = 1.0

2-69

STRUCTURE 5A(E) (S-5A(E))

Location. S-5A(E) is located on the West Palm Beach Canal (C-51) where L-40 intersects the canal. The structure is about 20 miles west of West Palm Beach, Florida.

Description. S-5A(E) is a double-barreled reinforced concrete box culvert. Control is by motor operated sluice gates. The structure is designed to pass a maximum of 700 cfs under favorable head conditions.

Purpose. This structure functions with S-5A(W), S-5A(S), and S-5A to control irrigation releases along the West Palm Beach Canal east of Levee 40 during periods of flow deficiency and to pass flood runoff from the L-8 Canal and C-51 into Water Conservation Area No. 1 via the S-5A pumping station.

Normal Regulation. When flood conditions are not imminent, the gates will be operated, subject to water availability, to meet the agricultural needs in C-51 east of Conservation Area No. 1.

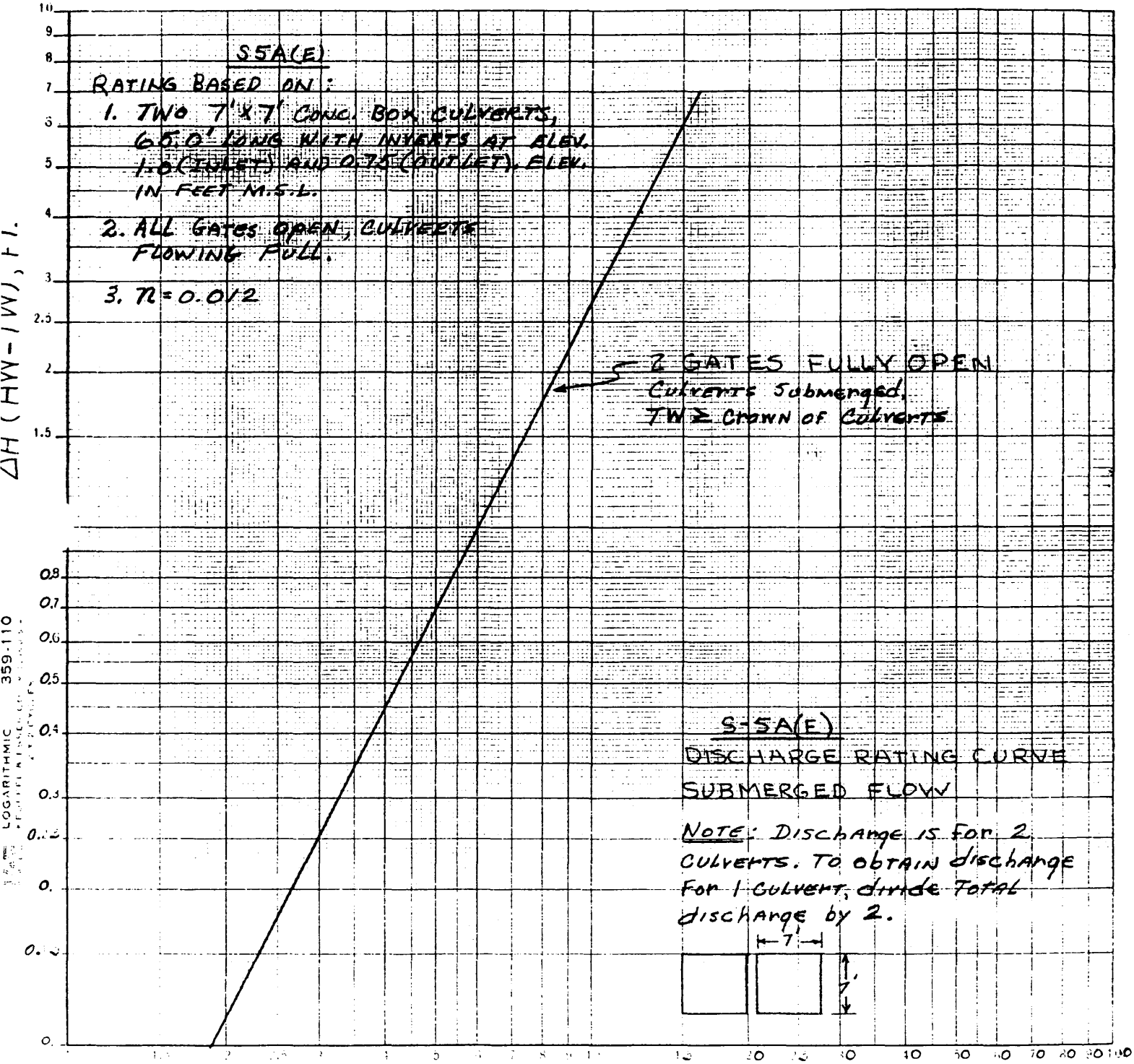
Flood Regulation. During flood conditions the gates will be closed whenever releases would aggravate flood conditions downstream. The gates will be opened whenever damage stages will not be exceeded below the structure and excess water in the West Palm Beach Canal, Levee 8 Canal, or WCA No. 1 is increasing flood potential in the Agricultural Area southeast of the lake.

Major Constraints. The maximum head on the structure when it is operated is 7.4 ft., a condition obtained during pumping at S-5A with S-5A(S) open, raising the pool level of WCA No. 1 and L-8 Canal to 19.4 ft., NGVD on the west side of the structure and with a normal water level of 12.0 ft., NGVD, on the east end of the structure.

STRUCTURE 5A(E) (S-5A(E))

Summary of Hydraulic Design

Location	West Palm Beach Canal
Design Conditions	
Discharge (cfs)	700
Type	uncontrolled submerged
Headwater Elevation (ft.)	11.5
Tailwater Elevation (ft.)	10.0
Maximum head differential, operating (ft.)	7.4
Structure	
Type	reinforced concrete box culvert
Number of barrels	2
Size (ft.)	7 x 7
Length (ft.)	65
Gates	
Type	sluice
Number	2
Width x Height (ft.)	7 x 7
Control	manual
Dewatering Capabilities	stop logs



DISCHARGE, (100 CFS)

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED UNCONTROLLED
STRUCTURE 5A (E)

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 5A(W) (S-5A(W))

Location. S-5A(W) is located on the West Palm Beach Canal (C-51) west of L-40 and the L-8 canal. The structure is about 20 miles west of West Palm Beach, Florida.

Description. S-5A(W) is a double-barreled reinforced concrete box culvert. Control is by motor operated sluice gates. The gates of the structure are located on the east end of the culverts since, during pumping, the West Palm Beach Canal to the west is drawn down to 8.3 ft., NGVD developing a maximum head on the culvert equivalent to the pool to pool head of the pumping station. The structure is designed to pass a maximum of 700 cfs at such times as necessary but not during times when pumping is being conducted at S-5A.

Purpose. This structure functions with S-5A(E), S-5A(S), and S-5A to control irrigation releases along the West Palm Beach Canal east of Levee 40 during periods of flow deficiency and to pass flood runoff from the L-8 Canal and C-51 into Water Conservation Area No. 1 via the S-5A pumping station.

Normal Regulation. The gates on the structure are normally closed. When flood conditions are not imminent, the gates will be operated, subject to water availability, to meet water use requirements in C-51 east of Conservation Area No. 1 and in the L-8 basin.

Flood Regulation. During flood conditions the gates will be closed whenever the stage east of the structure exceeds that to the west. The gates will be opened whenever excess water is increasing flood potential in the developed area and the stage east of the structure is below that to the west.

STRUCTURE 5A(W) (S-5A(W))

Summary of Hydraulic Design

Location	West Palm Beach Canal
Design Conditions	
Discharge (cfs)	700
Type	uncontrolled submerged
Headwater Elevation (ft.)	13.0
Tailwater Elevation (ft.)	11.5
Maximum head differential, operating (ft.)	2.0
Structure	
Type	reinforced concrete box culvert
Number of barrels	2
Size (ft.)	7 x 7
Length (ft.)	80
Gates	
Type	sluice
Number	2
Width x Height (ft.)	7 x 7
Control	manual
Dewatering Capabilities	stop logs

STRUCTURE 6 (S-6)

Location. Pumping Station 6 is in the Hillsboro Canal at the junction of L-6 and L-7, about 20 miles southeast of Belle Glade, Florida.

Description. S-6 has three vertical axial flow pumps, each with a rated speed of 706 rpm. The total capacity for the self-priming pumps is 2,925 cfs under a design head of 8.3 ft. Each pump is provided with an individual intake bay for separate dewatering, inspection and servicing. To prevent backflow under all normal heads the siphon inverts of the vertical pumps are set at elevation 20.0 ft. To prevent backflow for tailwater elevations higher than 20.0 ft, electrically operated roller-bearing vertical lift gates are provided at the discharge end of the pump siphon to span the splitter and pier. The gates are designed for a differential head of 4.3 ft. The pump station was repowered in May 1991.

Purpose. S-6 pumps surplus water via the Hillsboro Canal from Lake Okeechobee and the Agricultural Area northwesterly of the pumping station into WCA No.1. S-6 is designed to remove 3/4 inch agricultural runoff per day from the 146 sq. mile drainage area served by the Hillsboro Canal. The pumping station can also be back-syphoned to supply irrigation water to the Agricultural Area.

Regulation. Pumping should begin when the Hillsboro Canal level exceeds 11.5 - 12.0 ft., NGVD, unless the excess water is needed to utilize conservation storage in Lake Okeechobee, and there is available pumping capacity at Pumping Station 2 or potential gravity discharge through S-351 to remove flood water from the agricultural area between S-2 and S-6 at a desirable rate. At the request of the District Engineer, U.S. Army Corps of Engineers, Jacksonville District, S-6 may be used to provide regulatory discharge from Lake Okeechobee when canal capacity is not needed for removal of surplus water from agricultural area. Under the design head the pumping station capacity is 2,925 cfs.; however, canal dimensions limit the Lake Okeechobee regulatory capacity to 800 cfs. Backflow during hurricanes can be prevented by closing the gates at the end of the discharge tube.

Constraints. The water surface at the pump station should not be drawn down below 10.0 ft., NGVD. If the water surface on the intake bay falls below 10.0 ft. during pump operation, the speed of all pumps operating should be reduced to not less than 500 rpm. If the water surface elevation in the intake pool remains below 10.0 ft. then one or more pumping units should be shut down until the minimum pool elevation is re-established. The pumps should be started and stopped slowly, one pump at a time, to avoid high velocities and surges in the canal. The pumps are free of harmful criticals throughout the normal operating range

between 500 and 700 rpm inclusive.

Note: It is speculated there will be an eventual subsidence of the peat overlayer throughout the drainage area, making the desirable drawdown limit 8.0 ft. The pumping machinery has been designed to operate at rated condition of head and capacity at this lower elevation.

STRUCTURE 6 (S-6)

Summary of Hydraulic Design

Location	Hillsboro Canal
Drainage Area (sq. miles)	146
Total Design Discharge (cfs)	2,925
Intake Canal Water Surface Elevation (ft.)	
Maximum	13.0
Start Pumps	11.5 to 12.0
Normal Drawdown, drainage	10.0
Normal Drawdown, lake regulation	10.0
Maximum Drawdown, with pumping	10.0
Discharge Pool (WCA No.1A criteria)	
Water Surface Elevation (ft.)	
Minimum, non-pumping	10.0
Maximum Stage of Record, pumping	18.3
Maximum SPF, pumping	18.5
Design Head (ft.)	
Maximum	8.5
At Rated Capacity	8.3
Best Efficiency	8.3
Minimum, one pump operating	3.9
Pumps	
Type	Vertical axial flow
Number	3
Design Rating (cfs)	
Per Pump	975
Total (all pumps)	2,925
Impeller Speed (rpm)	88
Impeller Size (dia., inches)	135
Invert Elevation (ft.)	6.0
Engine Horsepower (ea)	1240
Engine Speed (rpm)	706
Gates (per bay)	
Number	1
Location	Discharge tube
Type	Vertical-lift
Control	Electrical
Size (width x height, ft.)	10.3 X 21

STRUCTURE 7 (S-7)

Location. Pumping Station 7 is located in the North New River Canal where the northeast corner of WCA No. 3A and the westernmost corner of WCA No. 2A meet. S-7 is about 28 miles southeast of Belle Glade and just east of U.S. Highway 27.

Description. Station S-7 consists mainly of (1) a reinforced concrete substructure supporting three horizontal pumps, (2) a reinforced concrete gated spillway, (3) a superstructure consisting of concrete block walls and reinforced concrete rigid frames, and (4) a three-bay reinforced concrete intake structure with a trash rake platform and service bridge. Each of the three pumps has an engine speed of 720 rpm and a design rating of 830 cfs. The total design discharge for all three pumps is 2,490 cfs. Each pump is provided with an individual intake bay for separate dewatering, inspection and servicing. The backflow and spillway gates are vertical-lift gates. The backflow gates have two rectangular flap gates each.

Purpose. S-7 pumps runoff from the agricultural area and maintains levels in the North New River Canal by pumping water from the canal into WCA No. 2A. The pumping station can also be used for regulation of Lake Okeechobee when capacity is not needed for agricultural drainage. S-7 is designed to remove 3/4-inch of runoff per day from the 125 square mile tributary drainage area. The gravity spillway controls flows which bypass the pumps. It was provided to aid in passing the large quantities of debris that accumulate at the structure and to provide for gravity discharge when stages are low in WCA No. 2A. The spillway is used primarily for irrigation releases from WCA No. 2A to the Agricultural Area during the dry season.

Regulation. Pumping begins when the New North River Canal level exceeds 11.5-12.0 ft., NGVD unless the water level in WCA No. 2A is low enough to allow gravity flow from the canal through the spillway at S-7; or the water level in WCA No. 3A is low enough to permit gravity flow through S-150 into WCA No. 3A. After initial drawdown the speed and number of pumps should be regulated to maintain the pump intake water surface elevation at 10.8 ft. The water surface at the pump station should not be drawn down below 8.7 ft. When runoff quantities exceed S-7 capacity, S-3 at the north end of North New River Canal can be used to discharge the excess runoff to the Lake. The first priority for Lake Okeechobee regulatory releases is to discharge water south through the agricultural canals as soon as local runoff is removed. As a result of Hump Removal, the design discharge for regulatory releases through the North New River Canal and S-7 is 1,600 cfs with a design pump intake water surface elevation of 9.5 ft. at S-7.

Low Flow Regulation. S-7 is capable of discharging from Lake Okeechobee, up to 800 cfs, to WCA No. 2A with the Lake stages as low as 10.8 ft.

Constraints. The water surface at the pump station should not be drawn down below 8.7 ft. If the water surface on the intake bay falls below 8.7 ft. during pump operation, the speed of all pumps operating should be reduced to not less than 640 rpm. If the water surface elevation in the intake pool remains below 8.7 ft. then one or more pumping units should be shut down until the minimum pool elevation is re-established. The pumps should be started and stopped slowly, one pump at a time, to avoid high velocities and surges in the canal. During extended periods of operation, pump speed may be decreased in order to improve operating efficiency and fuel economy, although such operation will simultaneously result in a decrease in capacity. The Operation Chart defines the entire recommended range over which pumping can be accomplished. The pumps are entirely free from criticals throughout the speed range from 0 to 720 rpm.

STRUCTURE 7 (S-7)

Summary of Hydraulic Design

Location	North New River Canal
Drainage Area (sq. miles)	125
Design Total Discharge (cfs)	2,490
Intake Canal	
Run-off, based on 3/4" per day (cfs)	2,490
Water Surface Elevation (ft.)	
Maximum	13.0
Start Pumps	11.5 to 12.0
Normal Drawdown, drainage	10.8
Normal Drawdown, lake regulation	8.7
Maximum Drawdown, with pumping	8.7
Discharge Pool (WCA No.2A)	
Water Surface Elevation (ft.)	
Minimum, non-pumping	10.5
Maximum, stage of record	16.1
Maximum, SPF	17.0
Pool to Pool Heads (ft.)	
Average, for drainage	4.9
Normal, maximum for drainage	5.3
Maximum, for drainage (2% of time)	6.2
Average, for lake regulation	7.4
Maximum, for lake regulation (2% of time)	8.3
Pumps	
Type	Horizontal axial flow
Number	3
Design Rating (cfs)	
Per Pump	830
Total (all pumps)	2,490
Impeller	
Speed (rpm)	68
Size (dia., inches)	144
Invert Elevation (ft.)	16.8
Engine Horsepower (ea)	895
Engine Speed (rpm)	720
Gates (per bay)	
Number	1
Location	Pump discharge
Type	Vert.lift/flapgates
Control	manual
Size (width, ft.)	20.0
Top of Gate, (fully closed position)	12.8
Top of Flap Gate	7.8
Dewatering Capability	Yes
Gravity Spillway	
Type	Box Culvert
Number of Barrels	1
Size (width x height, ft.)	14.7 x 13.2
Length (ft.)	43.0

STRUCTURE 7 (S-7)

Summary of Hydraulic Design
(Cont'd)

Gates	
Type	Vertical-lift
Control	Manual
Number	1
Size (width x height, ft.)	15.2 x 11.0
Top of Gate (fully closed position)	13.5

STRUCTURE 8 (S-8)

Location. Structure 8 is located in the Miami Canal at the junction of Levees 4, 5 and 23 at the northwest corner of Water Conservation Area 3A.

Description. S-8 is a four bay pumping station with a gated spillway. S-8 has four axial-flow horizontal pumps, each having a rated speed of 707 rpm. At this speed, each pump has a design capacity of 1,040 cfs or greater with pool-to-pool heads not in excess of 4.5 ft. and intake pool gage between elevation 13.0 and 9.0 ft, NGVD. The total pump station capacity under design head is 4,160 cfs. The four backflow gates and the spillway gate are vertical-lift gates. The backflow gates have two rectangular flap gates each. Dewatering of any intake and discharge bay is possible while the remaining pumps operate.

Purpose. The purpose of the pumping station is to discharge excess drainage water, via the Miami Canal, from the agricultural area north of the pumping station into WCA No. 3A. The gravity spillway controls flows which bypass the pumps. The pumping station can also be used for regulation of Lake Okeechobee when capacity is not needed for agricultural drainage. S-8 is designed to remove 3/4 inch of runoff per day from the 208 sq. mile tributary drainage area.

Regulation. Pumping should begin at S-8 whenever the water level in the Miami Canal within the agricultural area tributary to the pumping station exceeds 12.5 to 13.0 ft., NGVD unless gravity flow into WCA No. 3 is possible at an adequate rate through the spillway gate. The water surface at the pump station should not be drawn down below 10 ft., NGVD. After initial drawdown the speed and number of pumps should be regulated to maintain the pump intake water surface elevation at 13.0 ft., NGVD. When runoff quantities exceed Structure 8 capacity, S-3 at the north end of Miami Canal can be used to discharge the excess runoff to the Lake. The first priority for Lake Okeechobee regulatory releases is to discharge water south through the agricultural canals as soon as local runoff is removed. As a result of Hump Removal, the design discharge for regulatory releases through the Miami Canal and S-8 is 2,000 cfs with a design pump intake water surface elevation of 9.5 ft., NGVD.

Low Flow Regulation. S-8 is capable of discharging from Lake Okeechobee, up to 1,000 cfs, to WCA No. 3A with the Lake stages as low as 10.8 ft., NGVD.

Constraints. The water surface at the pump station should not be drawn down below 10.0 ft., NGVD. If the water surface on the intake bay falls below 10.0 ft during pump operation, the speed of all pumps operating should be reduced to not less than 646 rpm. If the water surface elevation in the intake pool remains

below 10.0 ft. then one or more pumping units should be shut down until the minimum pool elevation is re-established. The pumps should be started and stopped slowly, one pump at a time, to avoid high velocities and surges in the canal. During extended periods of operation, pump speed may be decreased in order to improve operating efficiency and fuel economy, although such operation will simultaneously result in a decrease in capacity. The Operation Chart defines the entire recommended range over which pumping can be accomplished. The main pumping units at Station 8 are free from severe or harmful criticals throughout the speed range from 0 to 707 rpm. However, there are minor criticals at 288 rpm and 444 rpm and these speeds should be avoided in the starting up and slowing down phases.

STRUCTURE 8 (S-8)

Summary of Hydraulic Design

Location	Miami Canal
Drainage Area (sq. miles)	208
Total Design Discharge (cfs)	4,170
Intake Canal	
Run-off, based on 3/4" per day (cfs)	4,170
Water Surface Elevation (ft.)	
Maximum, non-pumping	12.5
Start Pumps	12.0
Normal Drawdown, lake regulation	11.0
Maximum Drawdown, with pumping	10.0
Discharge Pool (WCA No. 3)	
Water Surface Elevation (ft.)	
Minimum Water Surface, non-pumping	9.5
Normal, with pumping	16.5
Pool to Pool Heads	
Normal (Maximum design), drainage	4.5
Normal for Lake Regulation	2.9
Assumed for 500 cfs flow thru gravity spillway	0.2
Pumps	
Type	Horiz. axial flow
Number	4
Design Rating (cfs)	
Per Pump	1,040
Total (all pumps)	4,160
Impeller size (approx. dia, inches)	152
Impeller speed (rpm)	67
Engine Horsepower (ea)	895
Engine Speed (rpm)	707
Gates (per bay)	
Number	1
Location	Pump discharge
Type	Vert.lift/flapgate
Control	manual
Size (width x height, ft.)	21.0 x 10.5"
Gravity Spillway	
Type	Box Culvert
Number of Barrels	1
Size (width x height, ft.)	16.5 x 14.4
Length (ft.)	78.5
Capacity with 0.2 ft. Head (cfs)	500
Invert Elevation (ft.)	0.1
Gates	
Type	Vertical-lift
Control	Manual/electric
Number	1
Size (width x height, ft.)	17.25 x 12.4
Top of Gate (fully closed position)	13.42
Sill Elevation (ft.)	1.0

STRUCTURE 9 (S-9)

Location. Pump Station 9 is located at the junction of L-37 and the South New River Canal, C-11. The structure is about 1/2 mile west of U. S. Highway 27 at the westerly end of C-11.

Description. S-9 uses three vertical-shaft axial flow pumps. All three pumps have had their engines replaced and now have a rated speed of 733 rpm. Each pump has a design capacity of 960 cfs or greater with pool-to-pool heads not in excess of 10.4 ft and intake pool gage between elevation 4.0 and 3.0 ft., NGVD. The pumps are self-priming. Each bay has 2 vertical lift gates with flap gates at the downstream end of the discharge tube for backflow protection. Bulkhead gates are used for dewatering and are stored at the site.

Purpose. The pumping station is designed to remove 3/4 inch run-off per day (1,410 cfs) from the east coast tributary area of 71 square miles. The pump station was also designed to pump seepage under Levees 33 and 37 back into WCA No. 3. The quantity of seepage is estimated to be 1,460 cfs. The pump station was therefore designed with a capacity of at least 2,870 cfs in order to be able to pump the combined run-off and seepage into WCA No. 3.

Regulation. Pumping should begin at S-9 when the stage in the South New River Canal exceeds 4.0 ft., NGVD. The rate of pumping should be regulated so the canal will be drawn down to elevation 1.0 ft., NGVD. Water surface at the pump station should not be drawn down below the maximum drawdown elevation of 0.0 ft., NGVD. During wet periods hydrologic data should frequently be obtained on rainfall, water levels and pumping rates from stations given in Part VI, General Studies and Reports, Section 11--Design Memorandum, meteorologic and Water-Level Networks, Parts I and V on the Central and Southern Florida Project.

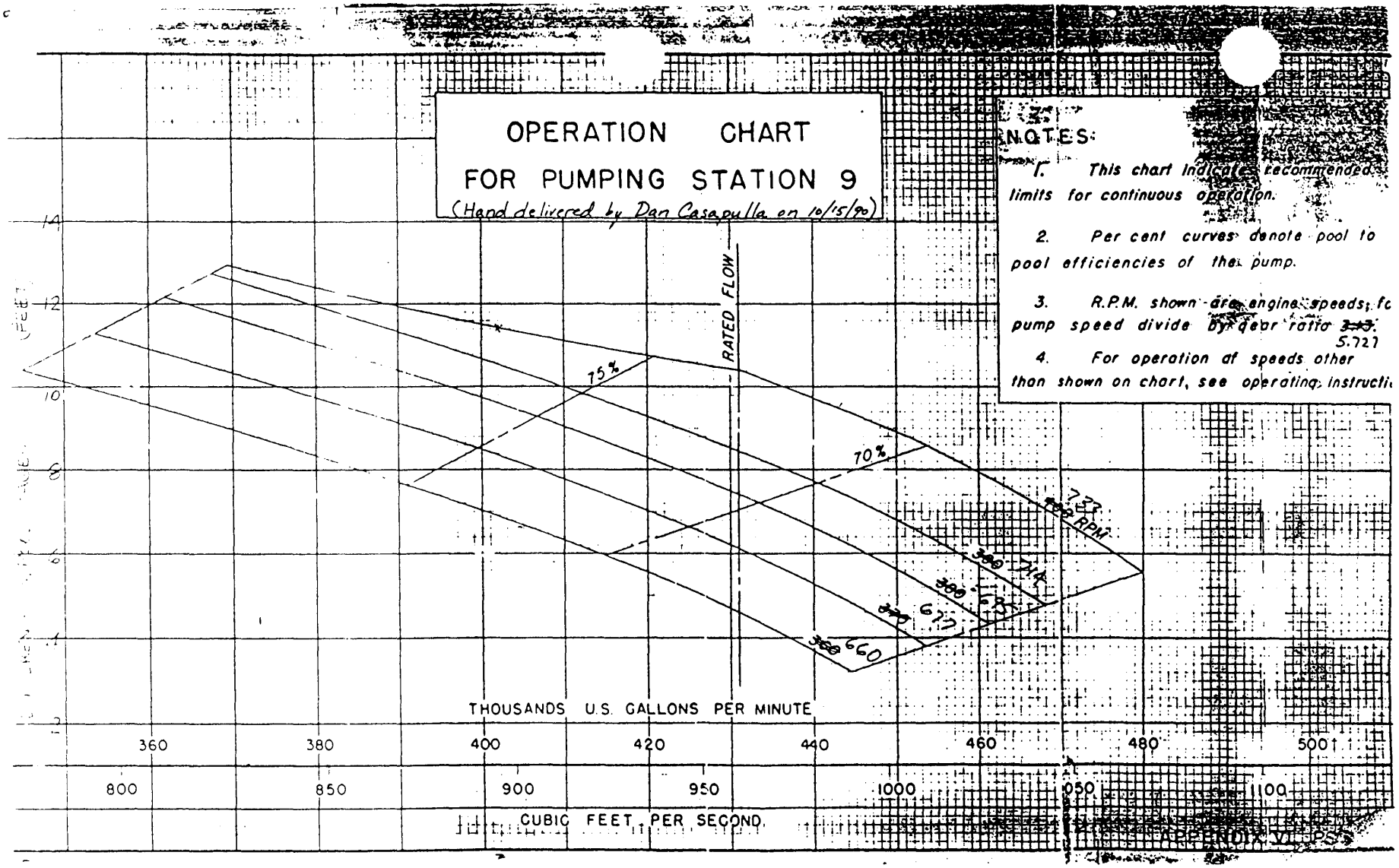
Constraints. During pump operations, the water surface elevation on the intake bay should be kept at or above 1.0 ft., NGVD. However, if the water surface on the intake bay falls below the maximum drawdown elevation of 0.0 ft., NGVD, during pump operation, the speed of all pumps operating should be reduced to not less than 660 rpm. If the water surface elevation in the intake pool remains below 0.0 ft., NGVD then one or more pumping units should be shut down until the minimum pool elevation is re-established. The pumps should be started and stopped slowly, one pump at a time to avoid high velocities and surges in the South New River Canal or the L-37 and L-33 borrow canals. The pumps are free from harmful criticals throughout the entire speed range from 275 rpm to 733 rpm. However, evidence of backlash may be audibly detected while operating in the vicinity of 275 rpm.

Therefore, the minimum speed for operation of the pumps should be established by the operator as either 275 rpm or the lowest speed found to be free from backlash, whichever speed is higher. All operation, either accelerating or decelerating, through the range between zero and the established minimum speed should be accomplished as rapidly as practicable.

STRUCTURE 9 (S-9)

Summary of Hydraulic Design

Location	C-11
Drainage Area (sq. miles)	71
Pump Design	
Discharge Rate (cfs)	2,880
Headwater Elevation (ft.)	4.0
Tailwater Elevation (ft.)	14.4
Intake Canal Data	
Run-off Based on 3/4" per day (cfs)	1,410
WCA Seepage (cfs)	1,460
Maximum Water Surface Elevation (ft.)	
Maximum, non-pumping	4.0
Normal Drawdown	1.0
Maximum Drawdown, pumping	0.0
Hydraulic Heads	
Best Efficiency Point (ft.)	8.0
Rated Capacity of Pumps (ft.)	10.4
Minimum, assuming one pump operating (ft.)	5.7
Storage in Canal and Borrow Pit, free water only (acre-ft.)	50
Pumps	
Type	Vert prop, axial flow
Number & Size (inches)	3 @ 122
Design Rating (cfs)	960
Impeller Speed (rpm)	128
Engine Horsepower (ea)	1655
Engine Speed (rpm)	733
Gates	
Number	2 per bay
Total Number	6
Location	Downstream end
Type	Vert. lift/flap gates
Size (width x height, ft.)	10.25 x 21.0
Dewatering Capabilities	Yes



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATION CHART
PUMP STATION 9

JACKSONVILLE DISTRI
U.S. ARMY CORPS OF EN RS
OCTOBER 1990

STRUCTURE 9A (S-9A)

Location. Pump station S-9A is located at the western terminus of the C-11 borrow canal in the alignment of Levee 37, approximately 0.5 miles west of U.S. Highway 27, just north of and directly adjacent to the S-9 Pump Station in Broward County. The structure is positioned immediately east of Water Conservation Area 3A (WCA-3A).

Description. This structure is a four unit pumping station with a design capacity of 500 cfs. It is equipped with two 175 cfs diesel engines driven pumps, and two 75 cfs electric motor driven pumps and a trash rack system.

Purpose. The purpose of pump station S-9A is to improve the quality and timing of stormwater discharges from the Western C-11 basin into WCA-3A by back pumping seepage lost from WCA-3A back into WCA-3A at the same approximate rate it enters the canal. The use of the S-9A reduces the operational dependency placed on the larger S-9 Pumping Station.

Operation. The structure is remotely operated to maintain optimum headwater stages in the C-11 borrow canal. Additional operational guidance for S-9A is based on best professional judgment of operating personnel; taking field condition factors into consideration such as existing water levels within the C-11 borrow canal, rainfall and seasonality.

DISCHARGE CHARACTERISTICS

Design Discharge Rate (combined):	500 cfs

DESCRIPTION OF STRUCTURE

Number of Pumps:	4
Motor Size:	
2-75-cfs electric pumps:	250 hp
2- 175-cfs diesel pumps:	650 hp
Design Headwater elevation:	3.0 feet NGVD
Design Tailwater elevation:	10.5 feet NGVD
Nominal pump operating speed:	
Electric:	rpm
Diesel 175-cfs:	1800 rpm
Motor Speed:	
Electric:	588 rpm
Diesel:	1800 rpm
Pump Manufacturer (diesel only)	Caterpillar
Model Number (diesel only)	3412C

POWER SOURCE

Prime Movers	Commercial electricity Commercial Diesel

STATION POWER

Normal	Commercial electricity

Emergency Electrical generator backup

HYDRAULIC AND HYDROLOGIC MEASUREMENTS
Stilling wells and staff gages located at upstream and downstream of structure.

ACCESS: Access to S-9A is from the C-11 canal right-of-way via Griffin Road.

STRUCTURE 10A (S-10A)

Location. Structure 10A is located in Levee 39 approximately 1 mile northwest of Structure 39 on the southwest perimeter of WCA No. 1. Levee 39 extends along the Hillsboro Canal in South Palm Beach County west of Boca Raton and State Highway No. 9.

Description. S-10A is a reinforced concrete, four-bay, U-shaped spillway with concrete wing walls and training walls. The vertical-lift gates are operated from the service bridge by a vehicular-drive mechanism. Each gate is 25.7 ft. wide by 8 ft. high and is individually operated by a separate hoist assembly. A reinforced concrete service bridge supported by the abutments and piers accommodates the vehicular-drive mechanism and provides access over each unit for the levee and structure-maintenance equipment. For dewatering, timber needles and structural-steel needle beams are provided for one bay only but will suit all the bays.

Purpose. S-10A (along with S-10C and S-10D) controls water levels in WCA No. 1 and permits releases from WCA No. 1 into WCA No. 2A.

Normal Regulation. The spillways are operated to maintain equivalent level pool stages which vary from 14.0 to 17.0 ft., NGVD on a seasonal basis. The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. S-10A is generally operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stage to rise above 13.0 ft., NGVD. As a practical consideration, the spillway gate settings should be kept within 1 foot of each other.

Flood Control. The spillways provide a means of controlling and transporting the flow from WCA No. 1 to WCA No. 2A for all flood discharges up to the Spillway Design Flood (SDF). The S-10's were sized to pass the Standard Project Flood (SPF). The discharge from all three spillways under SPF conditions totals 14,800 cfs. The peak SPF stage in WCA No. 1 is about 18.3 ft. with a total storage of about 494,000 acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-10's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel for use during the alert period.

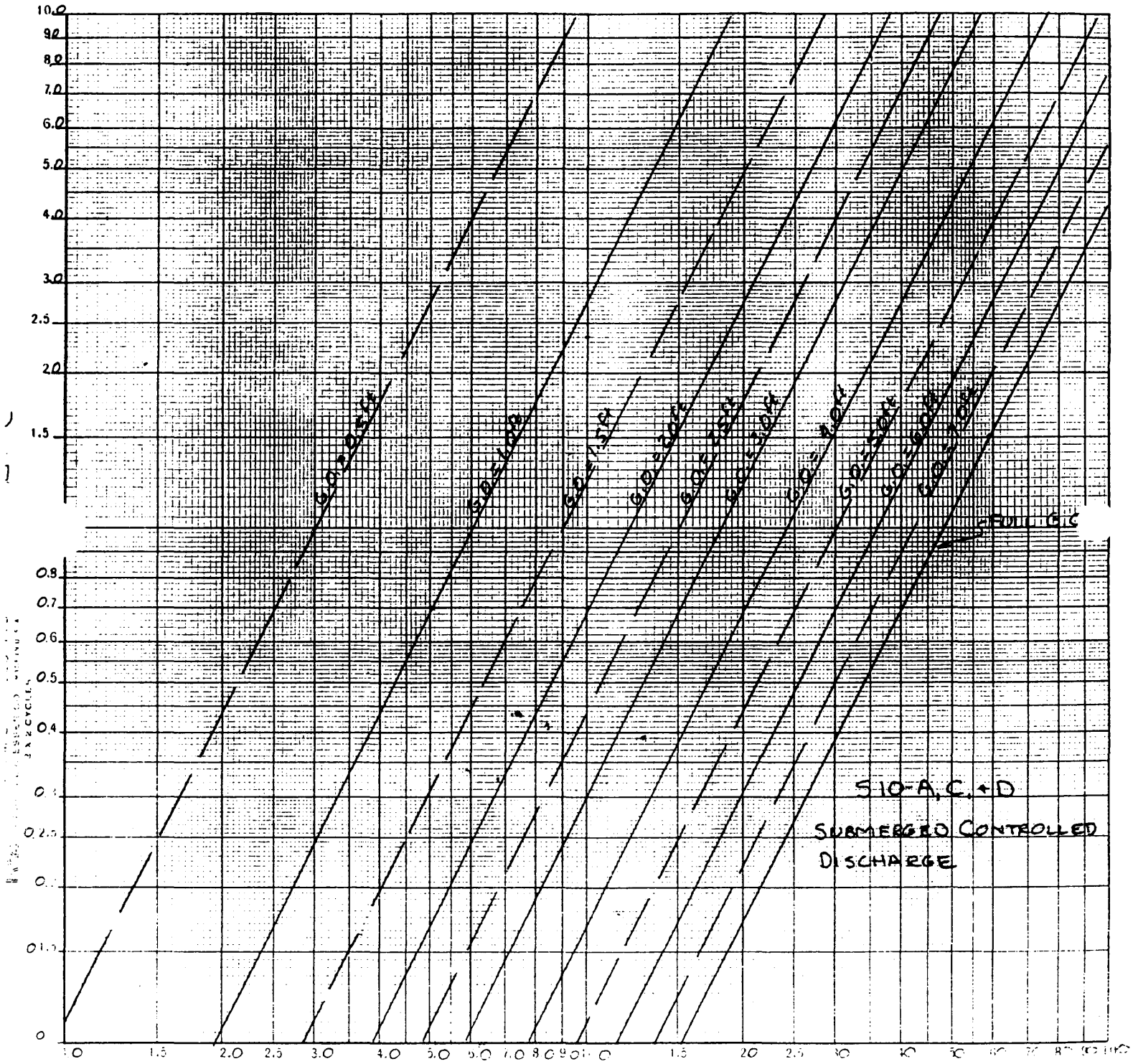
Low Flow Regulation. The S-10's have no minimum low flow discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts the minimum elevation preferred in the borrow canals is 11.0 ft., NGVD. Below this elevation no further releases should be permitted from WCA No. 1 unless a supply of water from another storage area is transferred to WCA No. 1.

Constraints. Water releases from S-10A should not be made when water stage in WCA No. 1 is 11.0 ft., NGVD or below. Because of the likelihood of low tailwater levels, concurrent high headwater levels, and uncontrolled hydraulic jumps, it is recommended that not more than one gate be inoperative in 2 of the 3 S-10 structures at the same time.

STRUCTURE 10A (S-10A)

Summary of Hydraulic Design

Location	L-39
Drainage Area - total for S-10's (sq. miles)	728
Design Conditions	
Total Discharge for 3 Spillways (cfs)	14,800
Type	Uncontrolled submerged
Headwater Elevation (ft.)	17.3
Tailwater Elevation (ft.)	16.4
SPF Condition	
Discharge (cfs)	4,680
Headwater Elevation (ft.)	24.4
Tailwater Elevation (ft.)	2.4 TO 8.5
Optimum Conditions	
Headwater Elevation (ft.)	17.0
Tailwater Elevation (ft.)	14.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	10.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	10.0
Net Length (ft.)	100.0
Gates	
Type of Gate	Vertical lift
Number	4
Width x Height (ft.)	25.7 x 8.0
Top of Gates Elevation (ft.) (fully closed position)	18.0
Control	manual
Stilling Basin	
Apron Elevation (ft.)	6.5
Apron Length (ft.)	25.0
End Sill Height (ft.)	1.5
Training Wall Minimum Elevation (ft.)	17.3
Wing Wall Angle to flow (degree)	45



DISCHARGE (100 CFS)

CENTRAL AND SOUTHERN FLORIDA PROJ.
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE 10A

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 10C (S-10C)

Location. Structure 10C is located in Levee 39 approximately 3.6 miles northwest of Structure 39. Levee 39 extends along the Hillsboro Canal in South Palm Beach County west of Boca Raton and State Highway No. 9.

Description. S-10C is a reinforced concrete, four-bay, U-shaped spillway with concrete wing walls and training walls. The vertical-lift gates are operated from the service bridge by a vehicular-drive mechanism. Each gate is 25.7 ft. wide by 8 ft. high and is individually operated by a separate hoist assembly. A reinforced concrete service bridge supported by the abutments and piers accommodates the vehicular-drive mechanism and provides access over each unit for the levee and structure-maintenance equipment. For dewatering, timber needles and structural-steel needle beams are provided for one bay only but will suit all the bays.

Purpose. S-10C (along with S-10A and S-10D) controls water levels in WCA No. 1 and permits releases from WCA No. 1 into WCA No. 2A.

Normal Regulation. The spillways are operated to maintain equivalent level pool stages which vary from 14.0 to 17.0 ft., NGVD on a seasonal basis. The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-10C is generally operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 13.0 ft., NGVD. As a practical consideration, the spillway gate settings should be kept within 1 foot of each other.

Flood Control. The spillways provide a means of controlling and transporting the flow from WCA No. 1 to WCA No. 2A for all flood discharges up to the Spillway Design Flood (SDF). The S-10's were sized to pass the Standard Project Flood (SPF). The discharge from all three spillways under SPF conditions totals 14,800 cfs. The peak SPF stage in WCA No. 1 is about 18.3 ft., NGVD with a total storage of about 494,000 acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-10's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

Low Flow Regulation. The S-10's have no minimum low flow

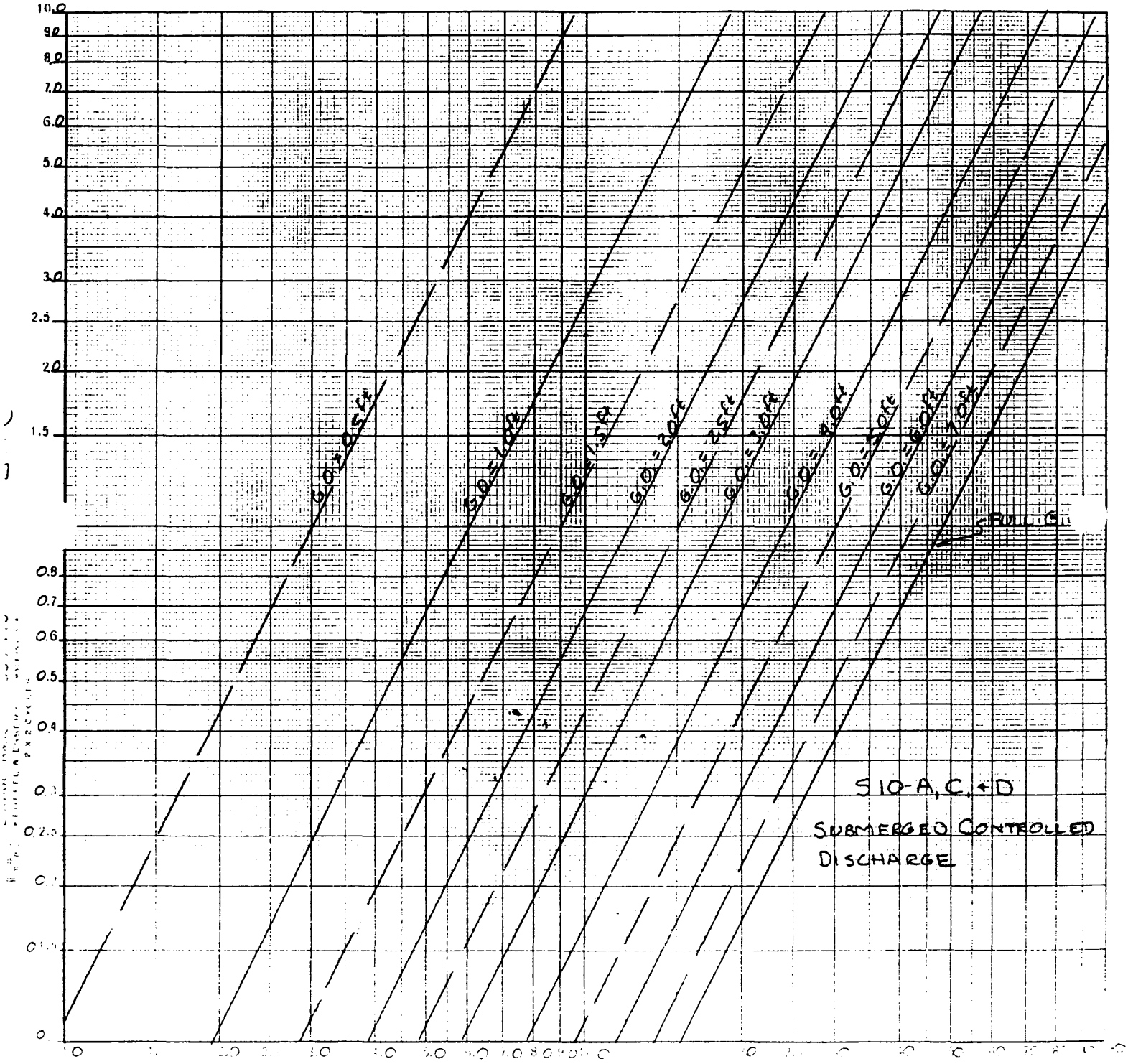
discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts the minimum elevation preferred in the borrow canals is 11.0 ft., NGVD. Below this elevation no further releases should be permitted from WCA No. 1 unless a supply of water from another storage area is transferred to WCA No. 1.

Constraints. Water releases from S-10C should not be made when water stage in WCA No. 1 is 11.0 ft., NGVD or below. Because of the likelihood of low tailwater levels, concurrent high headwater levels, and uncontrolled hydraulic jumps, it is recommended that not more than one gate be inoperative in 2 of the 3 S-10 structures at the same time.

STRUCTURE 10C (S-10C)

Summary of Hydraulic Design

Location	L-39
Drainage Area - total for S-10's (sq. miles)	728
Design Conditions	
Total Discharge for 3 Spillways (cfs)	14,800
Type	Uncontrolled submerged
Headwater Elevation (ft.)	17.3
Tailwater Elevation (ft.)	16.4
SPF Condition	
Discharge (cfs)	4,680
Headwater Elevation (ft.)	24.4
Tailwater Elevation (ft.)	2.4 to 8.5
Optimum Conditions	
Headwater Elevation (ft.)	17.0
Tailwater Elevation (ft.)	14.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	10.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	10.0
Net Length (ft.)	100.0
Gates	
Type of Gate	Vertical lift
Number	4
Width x Height (ft.)	25.7 x 8.0
Top of Gates Elevation (ft.) (fully closed position)	18.0
Control	manual
Stilling Basin	
Apron Elevation (ft.)	5.5
Apron Length (ft.)	25.0
End Sill Height (ft.)	1.5
Training Wall Minimum Elevation (ft.)	17.3
Wing Wall Angle to flow (degree)	45



DISCHARGE (100 CFS)

CENTRAL AND SOUTHERN FLORIDA PROJ.
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE 10C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 10D (S-10D)

Location. Structure 10D is located in Levee 39 approximately 5.9 miles northwest of Structure 39 on the southwest perimeter of WCA No. 1. Levee 39 extends along the Hillsboro Canal in South Palm Beach County west of Boca Raton and State Highway No. 9.

Description. S-10D is a reinforced concrete, four-bay, U-shaped spillway with concrete wing walls and training walls. The vertical-lift gates are operated from the service bridge by a vehicular-drive mechanism. Each gate is 25.7 ft. wide by 8 ft. high and is individually operated by a separate hoist assembly. A reinforced concrete service bridge supported by the abutments and piers accommodates the vehicular-drive mechanism and provides access over each unit for the levee and structure-maintenance equipment. For dewatering, timber needles and structural-steel needle beams are provided for one bay only but will suit all the bays.

Purpose. S-10D (along with S-10A and S-10C) controls water levels in WCA No. 1 and permits releases from WCA No. 1 into WCA No. 2A.

Normal Regulation. The spillways are operated to maintain equivalent level pool stages which vary from 14.0 to 17.0 ft., NGVD on a seasonal basis. The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. S-10D is generally operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 13.0 ft., NGVD. As a practical consideration, the spillway gate settings should be kept within 1 foot of each other.

Flood Control. The spillways provide a means of controlling and transporting the flow from WCA No. 1 to WCA No. 2A for all flood discharges up to the Spillway Design Flood (SDF). The S-10's were sized to pass the Standard Project Flood (SPF). The discharge from all three spillways under SPF conditions totals 14,800 cfs. The peak SPF stage in WCA No. 1 is about 18.3 ft., NGVD with a total storage of about 494,000 acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-10's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

Low Flow Regulation. The S-10's have no minimum low flow

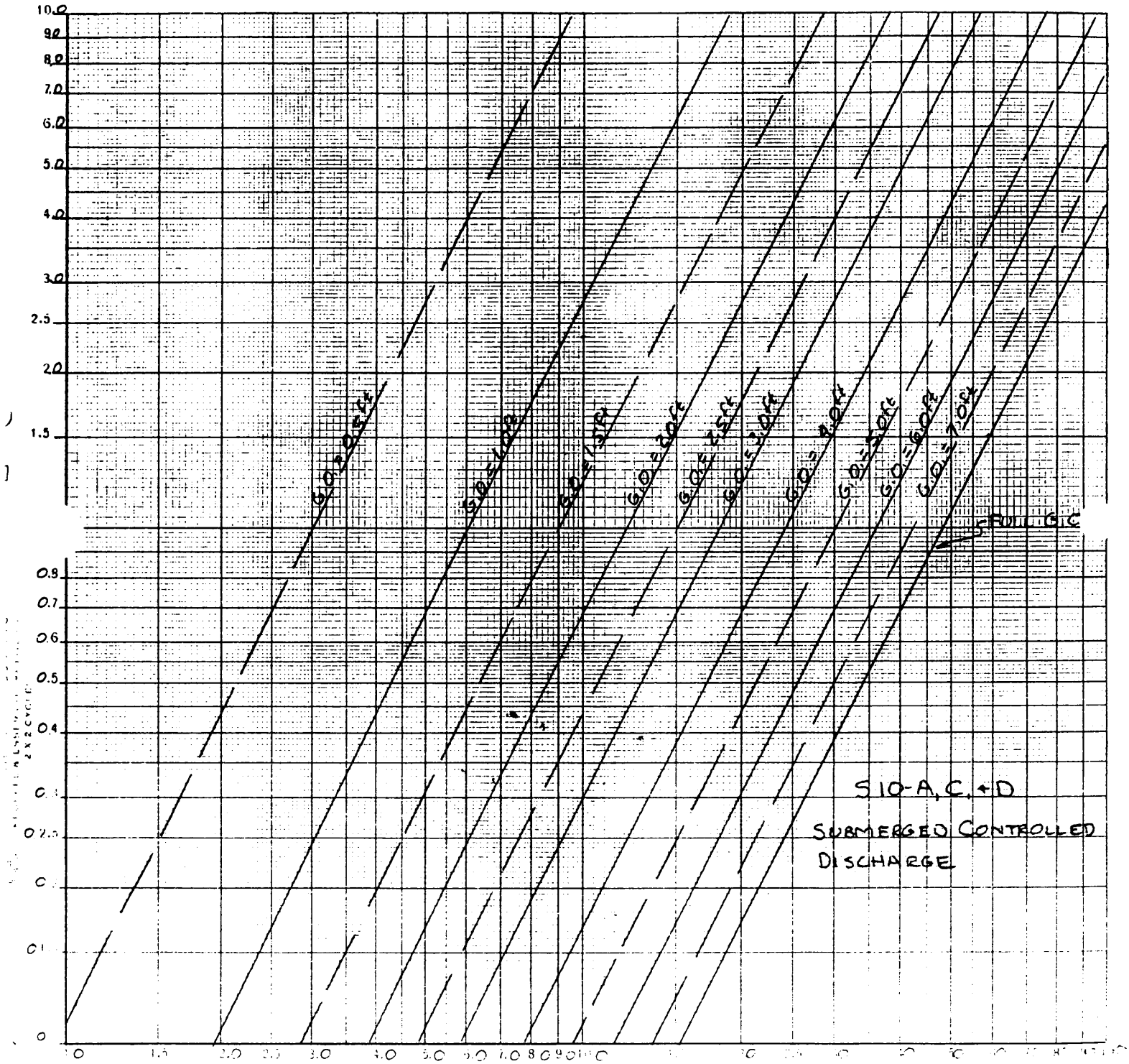
discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts the minimum elevation preferred in the borrow canals is 11.0 ft., NGVD. Below this elevation no further releases should be permitted from WCA No. 1 unless a supply of water from another storage area is transferred to WCA No. 1.

Constraints. Water releases from S-10D should not be made when water stage in WCA No. 1 is 11.0 ft., NGVD or below. Because of the likelihood of low tailwater levels, concurrent high headwater levels, and uncontrolled hydraulic jumps, it is recommended that not more than one gate be inoperative in 2 of the 3 S-10 structures at the same time.

STRUCTURE 10D (S-10D)

Summary of Hydraulic Design

Location	L-39
Drainage Area - total for S-10's (sq. miles)	728
Design Conditions	
Total Discharge for 3 Spillways (cfs)	14,800
Type	Uncontrolled submerged
Headwater Elevation (ft.)	17.3
Tailwater Elevation (ft.)	16.4
SPF Condition	
Discharge (cfs)	4,680
Headwater Elevation (ft.)	24.4
Tailwater Elevation (ft.)	2.4 to 8.5
Optimum Conditions	
Headwater Elevation (ft.)	17.0
Tailwater Elevation (ft.)	14.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	10.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	10.0
Net Length (ft.)	100.0
Gates	
Type of Gate	Vertical lift
Number	4
Width x Height (ft.)	25.7 x 8.0
Top of Gates Elevation (ft.)	18.0
Control	manual
Stilling Basin	
Apron Elevation (ft.)	7.5
Apron Length (ft.)	25.0
End Sill Height (ft.)	1.5
Training Wall Minimum Elevation (ft.)	17.3
Wing Wall Angle to flow (degree)	45



DISCHARGE (100 CFS)

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE 10D

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 10E (S-10E)

Location. S-10E is located through Levee 39 about one-half mile southeast of S-6.

Description. S-10E is a three-barreled corrugated metal pipe culvert. Control is effected by three manually operated sluice gates mounted on a steel frame erected on the upstream.

Purpose. This structure permits release of water from WCA No. 1 into the northern portion of WCA No. 2A.

Regulation. This structure is manually operated only under flood conditions as directed by the U.S. Army, Corps of Engineers, in a manner so as to follow the regulation schedule for WCA No. 1. When such regulation discharge is required, this structure will normally be opened before S-10A, C or D are opened.

STRUCTURE 10E

Summary of Hydraulic Design

Location	L-39
Design Conditions	
Discharge (cfs)	438
Type	uncontrolled submerged
Headwater Elevation (ft.)	17.3
Tailwater Elevation (ft.)	16.4
Structure	
Type	CMP
Number of barrels	3
Size diameter (ft.)	6
Length (ft.)	40
Flow line elevation (ft.)	9.0
Gates	
Type	sluice
Number	3
Width x Height (ft.)	6 x 6
Control	manual
Dewatering Capabilities	none

Flow Rate Equation:

$$Q \text{ (cfs)} = 494.78(\Delta H)^{1/2}$$

$$\Delta H \text{ (ft.)} = (Q \div 494.78)^2$$

where, $\Delta H = HW \text{ (ft.)} - TW \text{ (ft.)}$

For $Q = 750$ cfs,

$$\Delta H = (750 \div 494.78)^2$$
$$\approx 2.3 \text{ ft}$$

STRUCTURE 11A (S-11A)

Location. Structure 11A is located in Levee 38 about 1.9 miles north of where U.S. Highway 27 and State Road 84 intersect. This is about 20 miles west of Ft. Lauderdale, Florida.

Description. Structure 11A is one of three spillways which make up Structure 11. S-11A is a reinforced concrete, four-bay, gated spillway with a sloped weir, stilling basin, downstream training walls and flared upstream wing walls to improve entrance conditions. Each gate is 25 ft. wide by 9 ft. high and is individually operated by its own hoist assembly. A reinforced concrete service bridge supported by the abutments and piers accommodates the vehicular-drive mechanism and provides access over each unit for the levee and structure-maintenance equipment. For dewatering, timber stoplogs and aluminum needle beams are provided and are stored at Clewiston.

Purpose. Structures 11A, B, and C control water levels in WCA No. 2A and permit releases from WCA No. 2A into WCA No. 3A.

Normal Regulation. The spillways are operated to maintain equivalent level pool stages which vary from 11.0 ft. to 13.0 ft., NGVD on a seasonal basis. The regulation schedule is shown in this manual. When the WCA No. 2A stage is in Zone A releases should be made up to maximum capacity. In Zone B only releases for water supply should be made. The S-11B headwater gage is the indicator gage for regulation from 1 February through 30 June. The rest of the year the indicator is the 2-17 gage. From 1 January to 30 January, the S-11B headwater gage will become the indicator only if the 2-17 gage has receded to 11.5 ft.

The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-11's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 10.0 ft., NGVD. Spillway gate openings should be checked against the Maximum Allowable Gate Opening Curve to insure the gate openings are within the allowable gate opening for non-damaging operations. As a practical consideration, the spillway gate settings should be kept within 1 foot of each other.

The U.S. Army Corps of Engineers is responsible for the operation and maintenance of this project. The SFWMD, under contract with the Corps, makes gate changes at the spillways under the direction of the Jacksonville District on a cost-reimbursable basis.

Flood Control. The spillways provide a means of controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The S-11's were sized to pass the Standard Project Flood (SPF). The discharge from all three spillways under SPF conditions totals 17,200 cfs. The peak SPF stage in WCA No. 2 is about 16.6 ft., NGVD with a total storage of about 596,000 acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-11's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

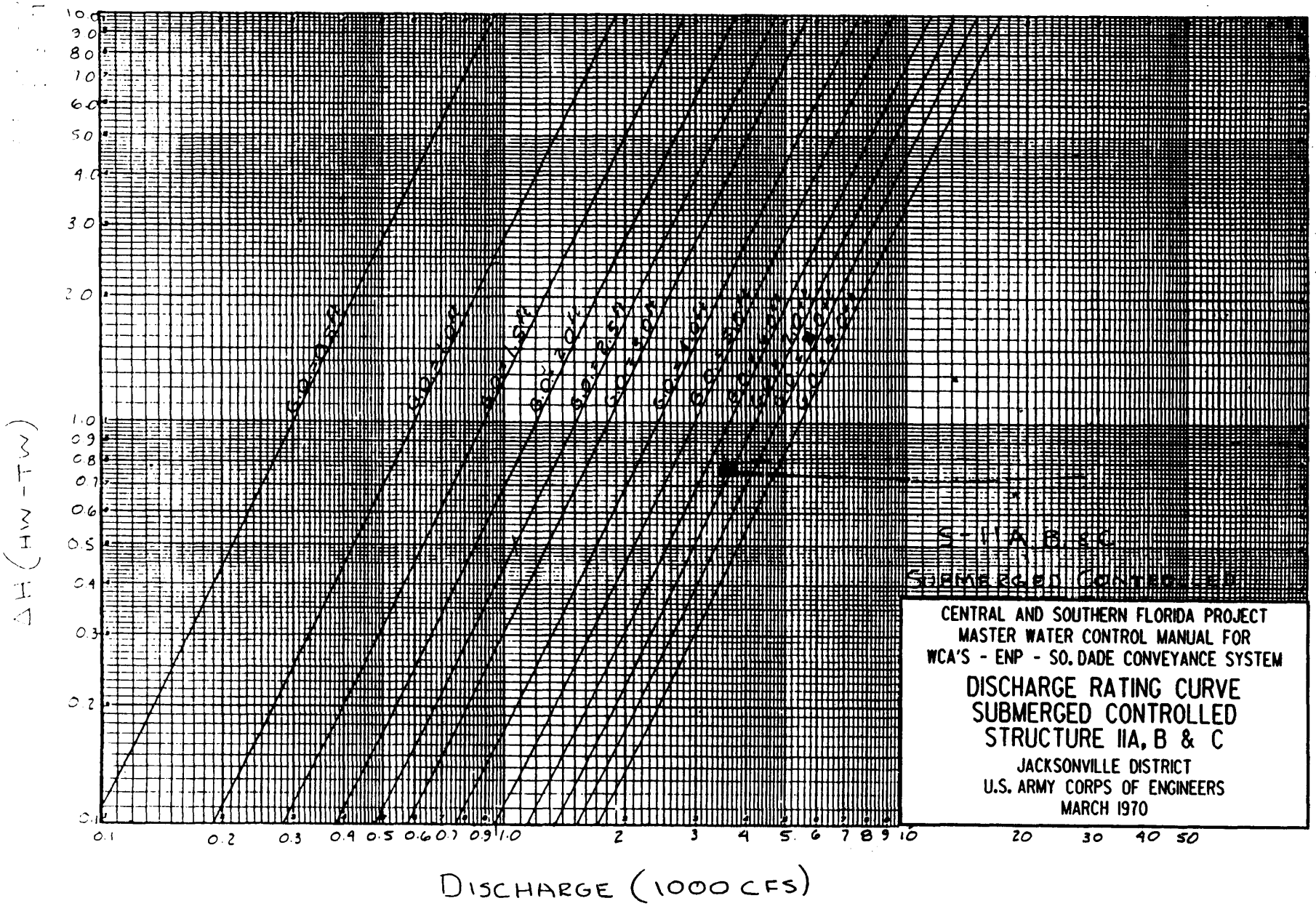
Low Flow Regulation. The S-11's have no minimum low flow required discharge. During droughts the minimum elevation preferred in the borrow canals is 10.5 ft., NGVD. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 2A.

Constraints. Water releases from S-11 should not be made when the water stage in WCA No. 2 is at 10.5 ft., NGVD or below. Because of the likelihood of low tailwater levels, concurrent high headwater levels, and uncontrolled hydraulic jumps, it is recommended that not more than one gate be inoperative in 2 of the 3 S-11 structures at the same time.

STRUCTURE 11A (S-11A)

Summary of Hydraulic Design

Location	L-38
Design Conditions	
Total Discharge of 3 S-11 Spillways (cfs)	17,200
Type	Submerged Uncontrolled
Headwater Elevation (ft.)	
Maximum	15.4
Minimum	12.0
Tailwater Elevation (ft.)	
Maximum	13.6
Minimum	8.0
SPF Condition	
Total Discharge of 3 S-11 Spillways (cfs)	17,200
Type	Submerged Uncontrolled
Headwater Elevation (ft.)	15.4
Tailwater Elevation (ft.)	13.6
Optimum Conditions	
Headwater Elevation (ft.)	12.0 to 14.5
Tailwater Elevation (ft.)	9.5 to 11.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	7.5
Net Length (ft.)	100.0
Gates	
Type of Gate	Vertical lift
Number	4
Width x Height (ft.)	25.8 x 9.0
Top of Gates Elev. (full closed)	16.5
Bottom of Gates Elev. (full open)	18.0
Control	manual
Stilling Basin	
Apron Elevation (ft.)	6.0
Apron Length, approx. (ft.)	30.0
End Sill	7.5
Training Wall Minimum Elevation (ft.)	13.0



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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE IIA, B & C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MARCH 1970

(Figure 6-2)

6-9

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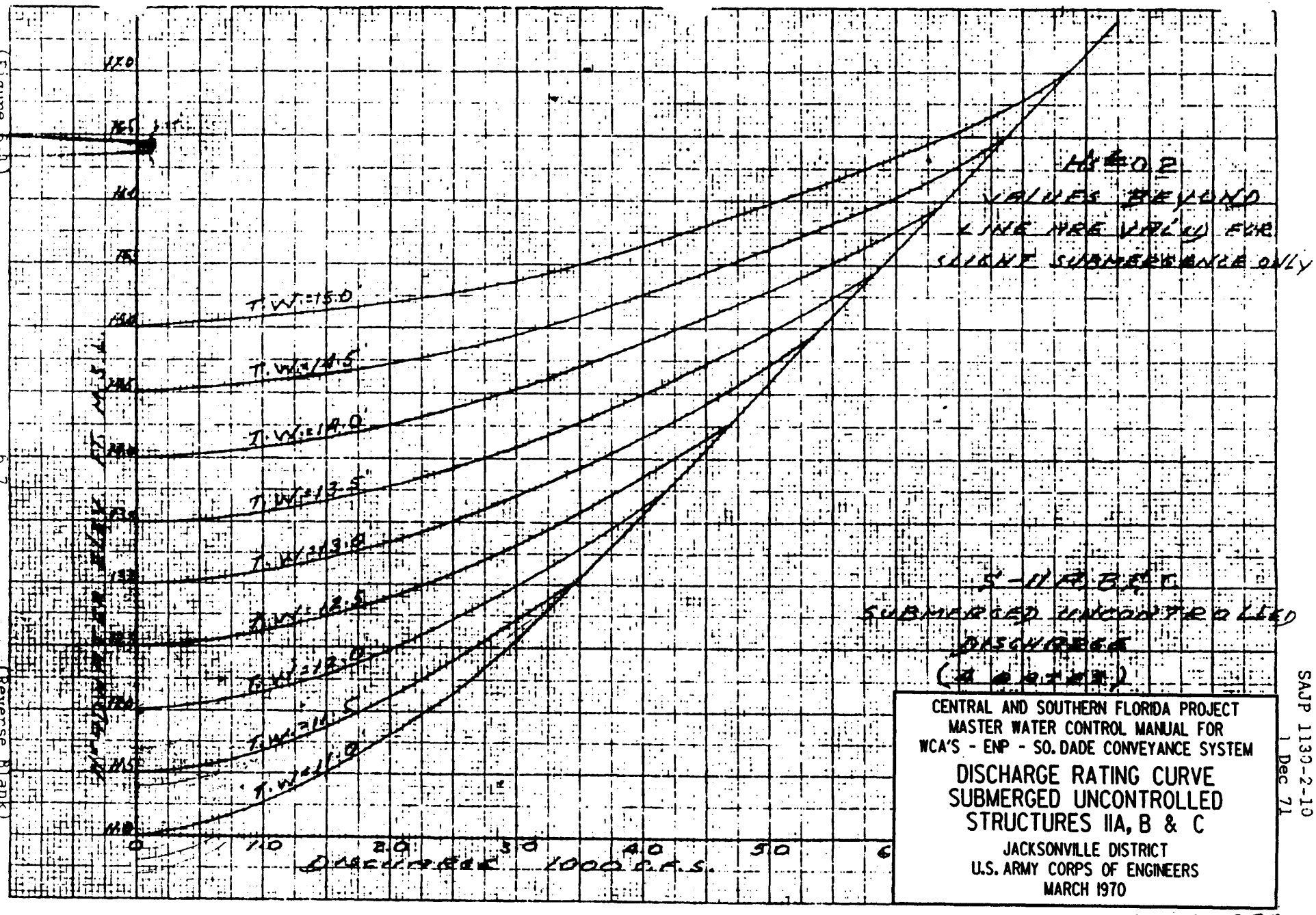

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED UNCONTROLLED
STRUCTURES IIA, B & C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MARCH 1970

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SAJP 1130-2-10
1 Dec 71

(Figure 6-1)

6-7

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STRUCTURE 11B (S-11B)

Location. Structure 11B is located in Levee 38 about 3.7 miles north of where U.S. Highway 27 and State Road 84 intersect. This is about 20 miles west of Ft. Lauderdale, Florida.

Description. Structure 11B is one of three spillways which make up Structure 11. S-11B is a reinforced concrete, four-bay, gated spillway with a sloped weir, stilling basin, downstream training walls and flared upstream wing walls to improve entrance conditions. Each gate is 25 ft. wide by 9 ft. high and is individually operated by its own hoist assembly. A reinforced concrete service bridge supported by the abutments and piers accommodates the vehicular-drive mechanism and provides access over each unit for the levee and structure-maintenance equipment. For dewatering, timber stoplogs and aluminum needle beams are provided and are stored at Clewiston.

Purpose. Structures 11A, B, and C control water levels in WCA No. 2A and permit releases from WCA No. 2A into WCA No. 3A.

Normal Regulation. The spillways are operated to maintain equivalent level pool stages which vary from 11.0 ft. to 13.0 ft., NGVD on a seasonal basis. The regulation schedule is shown in this manual. When the WCA No. 2A stage is in Zone A releases should be made up to maximum capacity. In Zone B only releases for water supply should be made. The S-11B headwater gage is the indicator gage for regulation from 1 February through 30 June. The rest of the year the indicator is the 2-17 gage. From 1 January to 30 January, the S-11B headwater gage will become the indicator only if the 2-17 gage has receded to 11.5 ft.

The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-11's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 10.0 ft., NGVD. Spillway gate openings should be checked against the Maximum Allowable Gate Opening Curve to insure the gate openings are within the allowable gate opening for non-damaging operations. As a practical consideration, the spillway gate settings should be kept within 1 foot of each other.

The U.S. Army Corps of Engineers is responsible for the operation and maintenance of this project. The SFWMD, under contract with the Corps, makes gate changes at the spillways under the direction of the Jacksonville District on a cost-reimbursable basis.

Flood Control. The spillways provide a means of controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The S-11's were sized to pass the Standard Project Flood (SPF). The discharge from all three spillways under SPF conditions totals 17,200 cfs. The peak SPF stage in WCA No. 2 is about 16.6 ft., NGVD with a total storage of about 596,000 acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-11's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

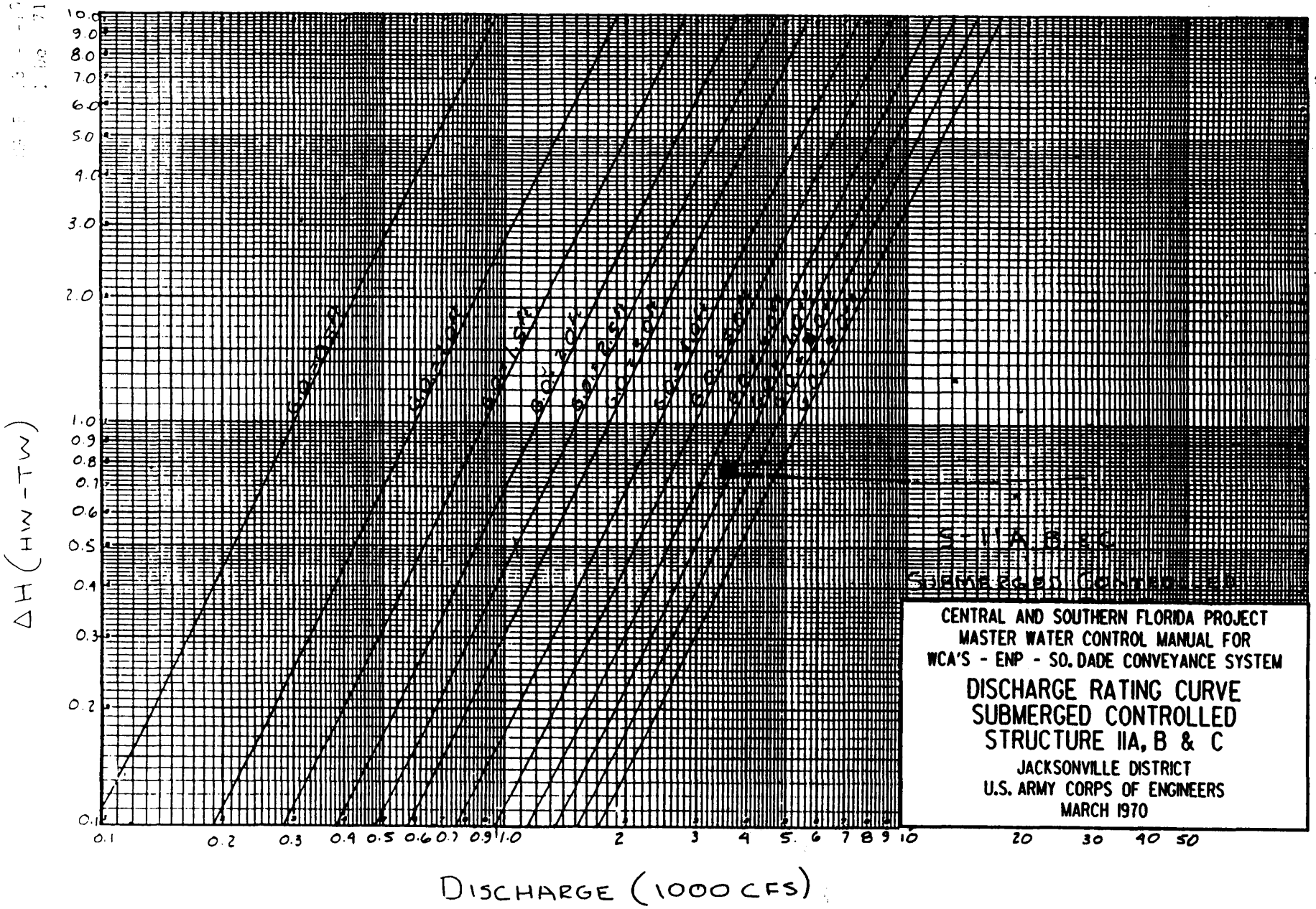
Low Flow Regulation. The S-11's have no minimum low flow required discharge. During droughts the minimum elevation preferred in the borrow canals is 10.5 ft., NGVD. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 2A.

Constraints. Water releases from S-11B should not be made when the water stage in WCA No. 2 is at 10.5 ft., NGVD or below. Because of the likelihood of low tailwater levels, concurrent high headwater levels, and uncontrolled hydraulic jumps, it is recommended that not more than one gate be inoperative in 2 of the 3 S-11 structures at the same time.

STRUCTURE 11B (S-11B)

Summary of Hydraulic Design

Location	L-38
Design Conditions	
Total Discharge of 3 S-11 Spillways (cfs)	17,200
Type	Submerged Uncontrolled
Headwater Elevation (ft.)	
Maximum	15.4
Minimum	12.0
Tailwater Elevation (ft.)	
Maximum	13.6
Minimum	8.0
SPF Condition	
Total Discharge of 3 S-11 Spillways (cfs)	17,200
Type	Submerged Uncontrolled
Headwater Elevation (ft.)	15.4
Tailwater Elevation (ft.)	13.6
Optimum Conditions	
Headwater Elevation (ft.)	12.0 to 14.5
Tailwater Elevation (ft.)	9.5 to 11.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	7.5
Net Length (ft.)	100.0
Gates	
Type of Gate	Vertical lift
Number	4
Width x Height (ft.)	25.8 x 9.0
Top of Gates Elev. (full closed)	16.5
Bottom of Gates Elev. (full open)	18.0
Control	manual
Stilling Basin	
Apron Elevation (ft.)	6.0
Apron Length, approx. (ft.)	30.0
End Sill Elevation (ft.)	7.5
Training Wall Minimum Elevation (ft.)	13.0



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WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE IIA, B & C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MARCH 1970

(Figure 6-2)

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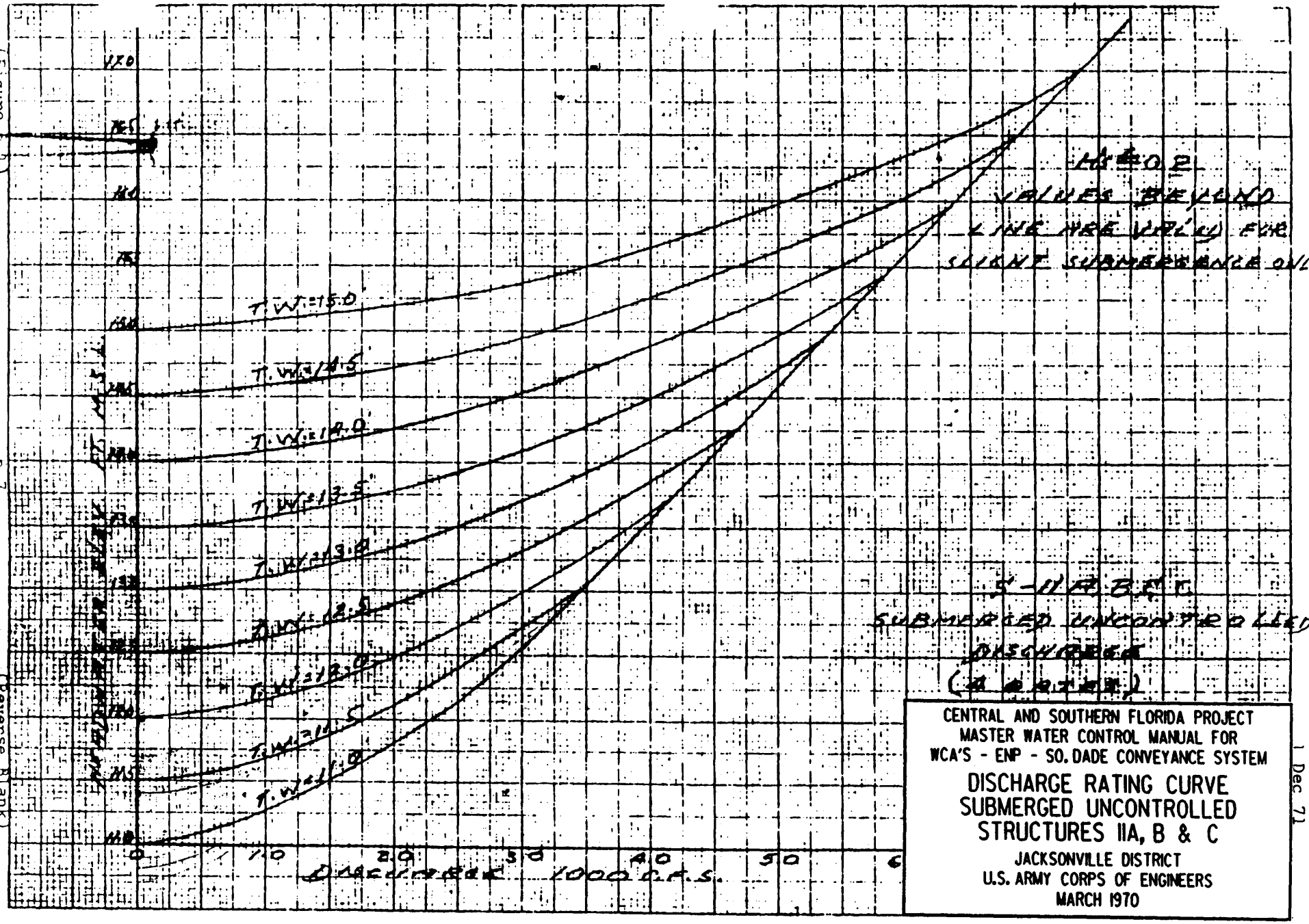

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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED UNCONTROLLED
STRUCTURES IIA, B & C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MARCH 1970

SAJP 1130-2-13
1 Dec 71

(Figure D-1)

D-7

(Reverse Blank)

STRUCTURE 11C (S-11C)

Location. Structure 11C is located in Levee 38 about 5.8 miles north of where U.S. Highway 27 and State Road 84 intersect. This is about 20 miles west of Ft. Lauderdale, Florida.

Description. Structure 11C is one of three spillways which make up Structure 11. S-11C is a reinforced concrete, four-bay, gated spillway with a sloped weir, stilling basin, downstream training walls and flared upstream wing walls to improve entrance conditions. Each gate is 25 ft. wide by 9 ft. high and is individually operated by its own hoist assembly. A reinforced concrete service bridge supported by the abutments and piers accommodates the vehicular-drive mechanism and provides access over each unit for the levee and structure-maintenance equipment. For dewatering, timber stoplogs and aluminum needle beams are provided and are stored at Clewiston.

Purpose. Structures 11A, B, and C control water levels in WCA No. 2A and permit releases from WCA No. 2A into WCA No. 3A.

Normal Regulation. The spillways are operated to maintain equivalent level pool stages which vary from 11.0 ft. to 13.0 ft., NGVD on a seasonal basis. The regulation schedule is shown in this manual. When the WCA No. 2A stage is in Zone A releases should be made up to maximum capacity. In Zone B only releases for water supply should be made. The S-11B headwater gage is the indicator gage for regulation from 1 February through 30 June. The rest of the year the indicator is the 2-17 gage. From 1 January to 30 January, the S-11B headwater gage will become the indicator only if the 2-17 gage has receded to 11.5 ft.

The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-11's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 10.0 ft., NGVD. Spillway gate openings should be checked against the Maximum Allowable Gate Opening Curve to insure the gate openings are within the allowable gate opening for non-damaging operations. As a practical consideration, the spillway gate settings should be kept within 1 foot of each other.

The U.S. Army Corps of Engineers is responsible for the operation and maintenance of this project. The SFWMD, under contract with the Corps, makes gate changes at the spillways under the direction of the Jacksonville District on a cost-reimbursable basis.

Flood Control. The spillways provide a means of controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The S-11's were sized to pass the Standard Project Flood (SPF). The discharge from all three spillways under SPF conditions totals 17,200 cfs. The peak SPF stage in WCA No. 2 is about 16.6 ft., NGVD with a total storage of about 596,000 acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-11's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

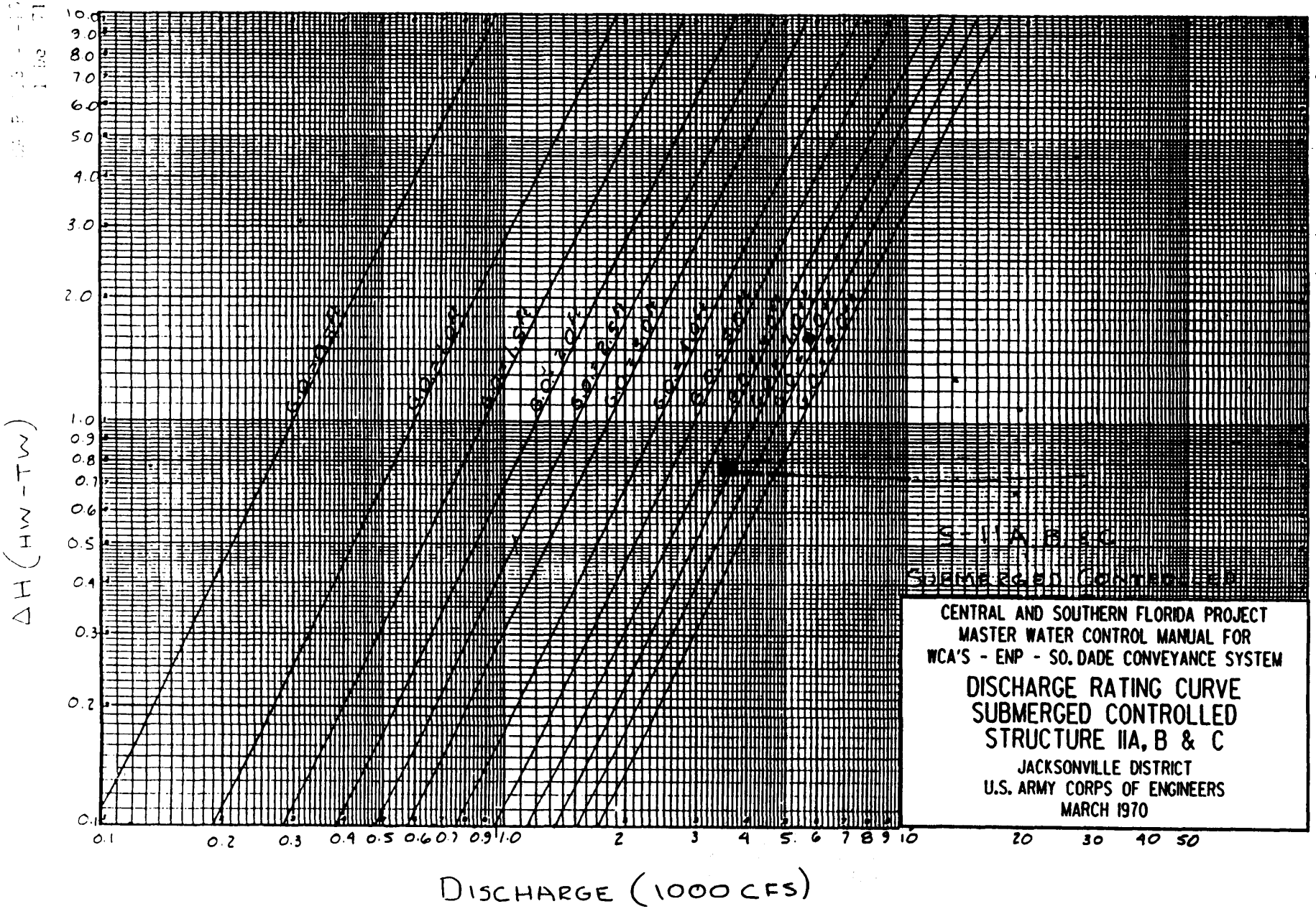
Low Flow Regulation. The S-11's have no minimum low flow required discharge. During droughts the minimum elevation preferred in the borrow canals is 10.5 ft., NGVD. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 2A.

Constraints. Water releases from S-11C should not be made when the water stage in WCA No. 2 is at 10.5 ft., NGVD or below. Because of the likelihood of low tailwater levels, concurrent high headwater levels, and uncontrolled hydraulic jumps, it is recommended that not more than one gate be inoperative in 2 of the 3 S-11 structures at the same time.

STRUCTURE 11C (S-11C)

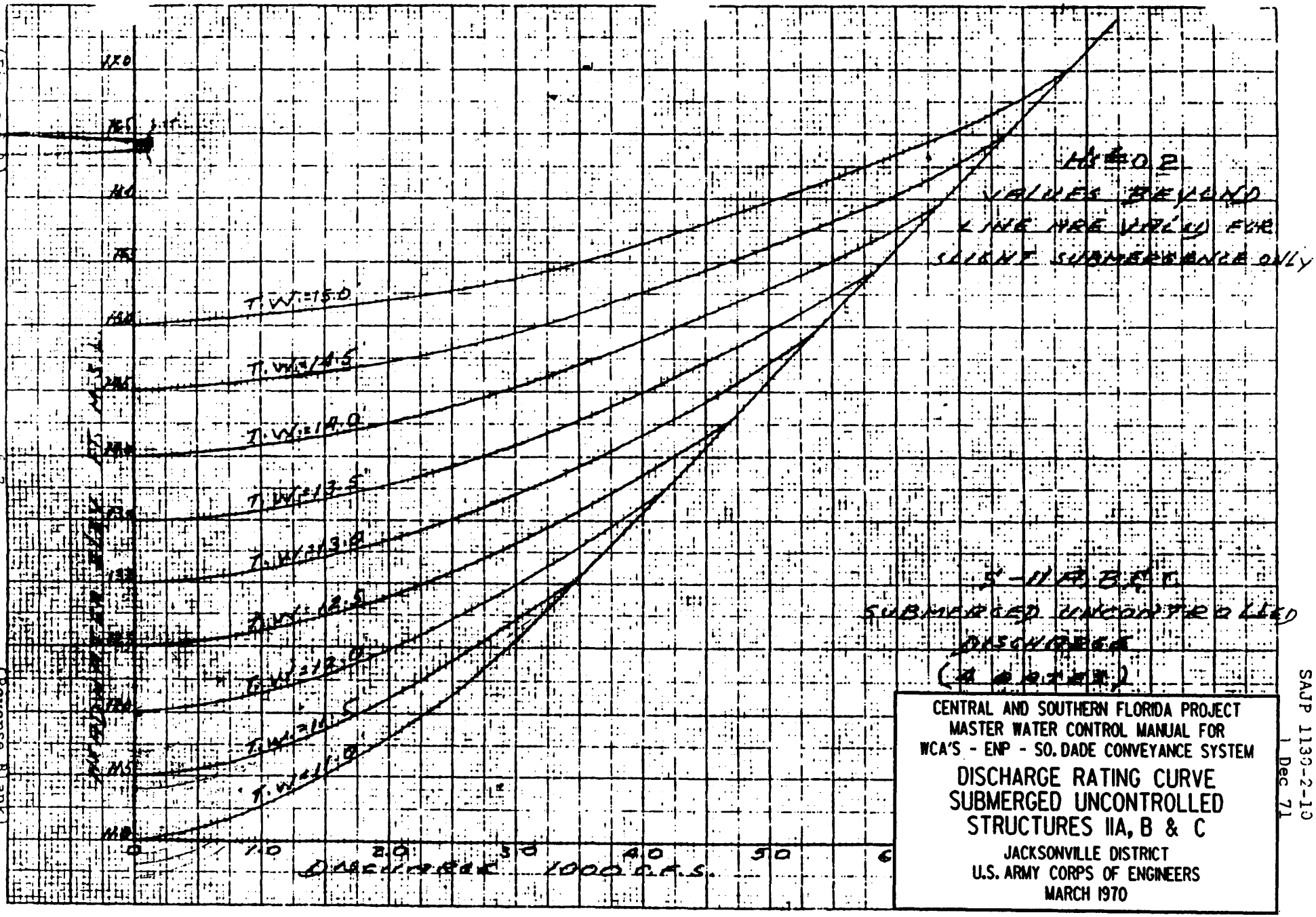
Summary of Hydraulic Design

Location	L-38
Design Conditions	
Total Discharge of 3 S-11 Spillways (cfs)	17,200
Type	Submerged Uncontrolled
Headwater Elevation (ft.)	
Maximum	15.4
Minimum	12.0
Tailwater Elevation (ft.)	
Maximum	13.6
Minimum	8.0
SPF Condition	
Total Discharge of 3 S-11 Spillways (cfs)	17,200
Type	Submerged Uncontrolled
Headwater Elevation (ft.)	15.4
Tailwater Elevation (ft.)	13.6
Optimum Conditions	
Headwater Elevation (ft.)	12.0 to 14.5
Tailwater Elevation (ft.)	9.5 to 11.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	7.5
Net Length (ft.)	100.0
Gates	
Type of Gate	Vertical lift
Number	4
Width x Height (ft.)	25.8 x 9.0
Top of Gates Elev. (full closed)	16.5
Bottom of Gates Elev. (full open)	18.0
Control	manual
Stilling Basin	
Apron Elevation (ft.)	6.0
Apron Length, approx. (ft.)	30.0
End Sill Elevation (ft.)	7.5
Training Wall Minimum Elevation (ft.)	13.0



(Figure 6-2)

(Reverse Blank)



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(Figure p-1)

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STRUCTURE 12A (S-12A)

Location. S-12A is located in Levee 29 (U.S. Highway 41), Section 2, on the south perimeter of WCA No. 3A, about 42.1 miles west of Miami, Florida.

Description. Structure 12A is one of four spillways which make up Structure 12. S-12A is a reinforced concrete, gated, six-bay spillway, with a trapezoidal weir having a crest elevation of 0.8 feet. The 25 ft. wide x 10.2 ft. high, mechanically operated, vertical-lift gates are installed on the crest of the weir. A steel-sheet-pile cutoff is provided under the downstream edge of the structure and under the downstream training walls. The superstructure consists of a highway bridge, a gate operating platform, and a service walkway, all constructed of reinforced concrete. For dewatering, the aluminum posts and timber stop logs for S-11 and the needle beam and timber needles provided for S-10 may be used.

Purpose. S-12A, B, C, and D provide the principal means of discharge from WCA No. 3A and are also a principal source of gravity flow into Shark River Slough (Everglades National Park). The S-12's serve to maintain an optimum water elevation in Water Conservation Area No. 3A. At this writing, the S-12's and S-333 share (on a percentage basis) the responsibility to deliver water to ENP under the Experimental Program of Water Deliveries to Everglades National Park. The experimental plan is discussed in detail in Chapter VII, paragraph 7-03, of this manual.

Normal Regulation. The water surface elevation of Water Conservation Area No. 3A has been regulated according to a 9.5 - 10.5 ft. regulation schedule, as shown in this manual and as a part of the Experimental Plan of Water Deliveries to ENP. Under the current regulation schedule, the stage peaks at 10.5 to coincide with the end of the normal rainy season (November 1), remains at 10.5 feet through December 30, and then gradually declines to 9.5 feet by June 1 before beginning a gradual return to the peak stage.

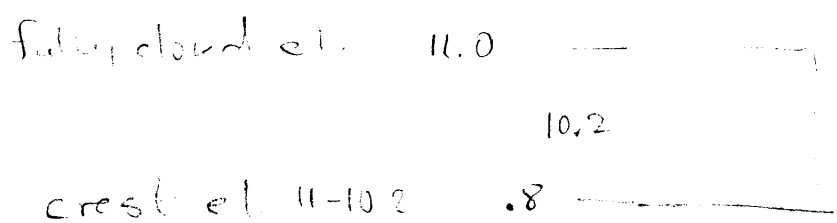
The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-12's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 8.0 ft., NGVD. As a practical consideration, the S-12 spillway gate settings should be kept within 1 foot of each other.

Flood Control. The S-12's were sized to pass the Standard Project Flood (SPF). The spillways provide a means of

controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The peak SPF stage in WCA No. 3A is about 14.4 ft. with a total storage of about 2.7 million acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-12's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

Low Flow Regulation. The S-12's have no minimum low flow discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts a minimum elevation in the borrow canals of 7.5 ft., NGVD should be observed. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 3A.

Constraints. Water releases from S-12A should not be made when the water stage in WCA No. 3 is 7.5 ft., NGVD or below.



STRUCTURE 12A (S-12A)

Summary of Hydraulic Design

Location	L-29
Total Drainage Area for S-12's (sq. miles)	3,070
Design Conditions	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
SPF Condition	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
Critical Static Condition (no flow)	
Headwater Elevation (ft.)	10.5
Tailwater Elevation (ft.)	5.0
Optimum Conditions	
Headwater Elevation (ft.)	9.5 - 10.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	7.5
Crest	
Shape	Trapezoidal
Elevation (ft.)	0.8
Net Length (ft.)	150.0
Gates	
Type of Gate	vertical lift
Number	6
Width x Height (ft.)	25.0 x 10.2
Low Steel Elevation (ft.) (fully open position)	13.4
Top of Gates Elevation (ft.) (fully closed position)	11.0
Top of Gates Elevation (ft.) (fully open position)	23.6
Stilling Basin	
Apron Elevation (ft.)	-0.2
Apron Length (ft.)	20.0
End Sill Elevation (ft.)	0.8
Training Wall Angle to flow (degrees)	45.0
Highway Bridge Low Elevation (ft.)	14.5
Service Walkway Elevation (ft.)	16.0
Operating Platform Elevation (ft.)	29.5
Dewatering Capabilities	Yes

RT 12.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 05-SEP-88 15:10 ECP RATING NO 12.0

25454308049110 1 TAMIAMI CANAL BELOW S-12-A, NR MIAMI, FL TYPE LINEAR

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

RATING TO BE USED STARTING AT: 03/01/85 (0015) COMP BY ..... DATE .....

REMARKS: TAILWATER RATING - GATES OUT OF THE WATER CKD. BY ..... DATE .....

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
7.10						.000*	.004	.008	.012	.016	
7.20	.020*	.068	.115	.164	.212	.260	.308	.356	.404	.452	.480
7.30	.500*	1.05	1.60	2.15	2.70	3.25	3.80	4.35	4.90	5.45	5.50
7.40	6.00*	6.70	7.40	8.10	8.30	9.50	10.2	10.9	11.6	12.3	7.0
7.50	13.0*	13.7	14.4	15.1	15.8	16.5	17.2	17.9	18.6	19.3	7.0
7.60	20.0*	20.7	21.8	22.7	23.6	24.5	25.4	26.3	27.2	28.1	9.0
7.70	29.0*	29.9	30.8	31.7	32.6	33.5	34.4	35.3	36.2	37.1	9.0
7.80	38.0*	38.9	39.8	40.7	41.6	42.5	43.4	44.3	45.2	46.1	9.0
7.90	47.0*	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	10.0
8.00	57.0*	58.1	59.2	60.3	61.4	62.5	63.6	64.7	65.8	66.9	11.0
8.10	68.0*	69.1	70.2	71.3	72.4	73.5	74.6	75.7	76.8	77.9	11.0
8.20	79.0*	80.3	81.6	82.9	84.2	85.5	86.8	88.1	89.4	90.7	13.0
8.30	92.0*	93.3	94.6	95.9	97.2	98.5	99.8	101.1	102.4	103.7	13.0
8.40	105.0*	106.7	108.4	110.1	111.8	113.5	115.2	116.9	118.6	120.3	17.0
8.50	122.0*	123.9	125.8	127.7	129.6	131.5	133.4	135.3	137.2	139.1	19.0
8.60	141.0*	143.6	145.2	148.8	151.4	154.0	156.6	159.2	161.8	164.4	26.0
8.70	167.0*	170.3	173.6	176.9	180.2	183.5	186.8	190.1	193.4	196.7	33.0
8.80	200.0*	203.5	207.0	210.5	214.0	217.5	221.0	224.5	228.0	231.5	35.0
8.90	235.0*	238.6	242.2	245.8	249.4	253.0	256.6	260.2	263.8	267.4	36.0
9.00	271.0*	274.6	278.2	281.8	285.4	289.0	292.6	296.2	299.8	303.4	36.0
9.10	307.0	310.6	314.2	317.8	321.4	325.0	328.6	332.2	335.8	339.4	36.0
9.20	343.0	346.6	350.2	353.8	357.4	361.0	364.6	368.2	371.8	375.4	36.0
9.30	379.0	382.6	386.2	389.8	393.4	397.0	400.6	404.2	407.8	411.4	36.0
9.40	415.0	418.6	422.2	425.8	429.4	433.0	436.6	440.2	443.8	447.4	36.0
9.50	451.0	454.6	458.2	461.8	465.4	469.0	472.6	476.2	479.8	483.4	36.0
9.60	487.0	490.6	494.2	497.8	501.4	505.0	508.6	512.2	515.8	519.4	36.0
9.70	523.0	526.6	530.2	533.8	537.4	541.0	544.6	548.2	551.8	555.4	36.0
9.80	559.0	562.6	566.2	569.8	573.4	577.0	580.6	584.2	587.8	591.4	36.0
9.90	595.0	598.6	602.2	605.8	609.4	613.0	616.6	620.2	623.8	627.4	36.0
10.00	631.0*										

S-12A ~~Rat~~ Tailwater Rating

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
TAILWATER RATING - GATES OUT OF WATER
STRUCTURE 12A

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

PT 15.7 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE P DATE: 07-SEP-88 07:46 ECP RATING

25454302049110O 10B S-12-A ABOVE TYPE LOG [OFFSET=(0.00, 0.00)]

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

RATING TO BE USED STARTING AT: 02/01/88 (0015) COMP BY ..... DATE .....

REMARKS: HEAD VS DISCHARGE FOR 1 GATE OPEN 1 FT CKD. BY ..... DATE .....

HEAD ~~GAGE HT~~ (FEET)

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
0.00			25.4*	36.5	37.6	42.0	45.0*	48.3	50.3	52.2	
0.10	54.0*	56.3	57.5	60.5	62.5	64.4	66.2	68.0	69.7	71.4	19.0
0.20	73.5*	74.5	76.2	77.7	79.5	80.7	82.1	83.5	84.3	86.2	14.5
0.30	87.5*	88.5	90.2	91.6	92.5	93.7	94.9	96.0	97.2	98.3	11.9
0.40	99.4	100.5	101.6	102.7	103.7	104.7	105.5	106.3	107.8	103.8	10.4
0.50	109.8	110.7	111.7	112.5	113.5	114.5	115.4	116.3	117.2	118.1	9.2
0.60	119.0	119.9*	120.7	121.5	122.4	123.3	124.1	124.9	125.7	126.5	8.3
0.70	127.3	128.1	128.7	129.7	130.5	131.2	132.0	132.8	133.5	134.3	7.7
0.80	135.0*	135.7	136.4	137.1	137.7	138.4	139.1	139.7	140.4	141.1	6.7
0.90	141.7	142.4	143.0	143.6	144.5	144.9	145.5	146.2	146.8	147.4	6.3
1.00	148.0*	148.7	149.3	150.0	150.6	151.3	151.9	152.6	153.2	153.8	6.5
1.10	154.5	155.1	155.7	156.3	157.0	157.6	158.2	158.8	159.4	160.0	6.1
1.20	160.6	161.2	161.8	162.4	163.0	163.6	164.2	164.8	165.3	165.9	5.9
1.30	166.5	167.1	167.6	168.2	168.8	169.3	169.9	170.5	171.0	171.6	5.6
1.40	172.1	172.7	173.2	173.8	174.3	174.9	175.4	175.9	176.5	177.0	5.4
1.50	177.5	178.1	178.6	179.1	179.6	180.2	180.7	181.2	181.7	182.2	5.3
1.60	182.8	183.3	183.8	184.3	184.8	185.3	185.8	186.3	186.8	187.3	5.0
1.70	187.8	188.3	188.8	189.3	189.8	190.3	190.7	191.2	191.7	192.2	4.9
1.80	192.7	193.2	193.6	194.1	194.6	195.1	195.5	196.0	196.5	196.9	4.7
1.90	197.4	197.9	198.3	198.8	199.3	199.7	200.2	200.6	201.1	201.5	4.6
2.00	202.0*	202.4	202.9	203.3	203.7	204.1	204.5	205.0	205.4	205.8	4.2
2.10	206.2	206.7	207.1	207.5	207.9	208.3	208.7	209.1	209.5	209.9	4.2
2.20	210.4	210.8	211.2	211.6	212.0	212.4	212.8	213.2	213.6	214.0	4.0
2.30	214.4	214.8	215.2	215.5	215.9	216.3	216.7	217.1	217.5	217.9	3.9
2.40	218.3	218.7	219.1	219.4	219.8	220.2	220.6	221.0	221.3	221.7	3.3
2.50	222.1	222.5	222.9	223.2	223.6	224.0	224.4	224.7	225.1	225.5	3.7
2.60	225.8	226.2	226.6	226.9	227.3	227.7	228.0	228.4	228.8	229.1	3.7
2.70	229.5	229.8	230.2	230.5	230.9	231.3	231.6	232.0	232.4	232.7	3.6
2.80	233.1	233.4	233.8	234.1	234.5	234.8	235.2	235.5	235.9	236.2	3.5
2.90	236.6	236.9	237.2	237.6	237.9	238.3	238.6	239.0	239.3	239.7	3.4
3.00	240.0*	240.3	240.7	241.0	241.4	241.7	242.1	242.4	242.8	243.1	3.5
3.10	243.4	243.8	244.1	244.5	244.8	245.2	245.5	245.9	246.2	246.5	3.4
3.20	246.9	247.2	247.5	247.9	248.2	248.6	248.9	249.2	249.6	249.9	3.3
3.30	250.2	250.6	250.9	251.2	251.6	251.9	252.2	252.5	252.9	253.2	3.3
3.40	253.5	253.8	254.2	254.5	254.8	255.1	255.5	255.8	256.1	256.4	3.2
3.50	256.7	257.1	257.4	257.7	258.0	258.3	258.7	259.0	259.3	259.6	3.2
3.60	260.0	260.3	260.6	260.9	261.2	261.5	261.8	262.1	262.4	262.7	3.2
3.70	263.1	263.4	263.7	264.0	264.3	264.6	264.9	265.2	265.5	265.8	3.0
3.80	266.1	266.4	266.7	267.1	267.4	267.7	268.0	268.3	268.6	268.9	3.1

S-12A Partial Gate Opening

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
PARTIAL GATE OPENING
STRUCTURE 12A

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

-T 15.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 07-SEP-88 07:46 ECP RATING NO 15.0

25434[illegible]049110[illegible] 103 S-12-A ABOVE TYPE LOG [OFFSET=(0.00, 0.00)]

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										
3.90	269.2	269.5	269.8	270.1	270.4	270.7	271.0	271.3	271.6	271.9	3.0
4.00	272.2	272.5	272.8	273.1	273.4	273.7	274.0	274.3	274.6	274.8	2.9
4.10	275.1	275.4	275.7	276.0	276.3	276.6	276.8	277.2	277.5	277.3	3.0
4.20	278.1	278.3	278.6	278.9	279.2	279.5	279.8	280.1	280.4	280.6	2.8
4.30	280.9	281.2	281.5	281.8	282.1	282.4	282.6	282.9	283.2	283.5	2.9
4.40	283.8	284.1	284.3	284.6	284.9	285.2	285.5	285.7	286.0	286.3	2.8
4.50	286.6	286.9	287.1	287.4	287.7	288.0	288.2	288.5	288.8	289.1	2.7
4.60	289.3	289.6	289.8	290.1	290.4	290.7	291.0	291.3	291.5	291.8	2.8
4.70	292.1	292.3	292.6	292.9	293.2	293.4	293.7	294.0	294.2	294.5	2.7
4.80	294.8	295.0	295.3	295.5	295.8	296.1	296.4	296.6	296.9	297.2	2.6
4.90	297.4	297.7	297.9	298.2	298.4	298.6	298.9	299.3	299.6	299.8	2.7
5.00	300.1	300.4	300.6	300.9	301.1	301.4	301.7	301.9	302.2	302.4	2.6
5.10	302.7	302.9	303.2	303.4	303.7	304.0	304.3	304.5	304.8	305.0	2.6
5.20	305.3	305.5	305.8	306.0	306.3	306.6	306.8	307.1	307.3	307.6	2.5
5.30	307.8	308.1	308.3	308.6	308.8	309.1	309.4	309.6	309.9	310.1	2.6
5.40	310.4	310.6	310.9	311.1	311.4	311.6	311.9	312.1	312.4	312.6	2.5
5.50	312.9	313.1	313.4	313.6	313.9	314.1	314.4	314.6	314.8	315.1	2.4
5.60	315.3	315.5	315.8	316.1	316.3	316.6	316.8	317.1	317.3	317.5	2.5
5.70	317.8	318.0	318.3	318.5	318.8	319.0	319.2	319.5	319.7	320.0	2.4
5.80	320.2	320.4	320.7	320.9	321.2	321.4	321.7	321.9	322.1	322.4	2.4
5.90	322.6	322.9	323.1	323.3	323.6	323.8	324.1	324.3	324.5	324.8	2.4
6.00	325.0*										

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
(continued)

DISCHARGE RATING TABLE
PARTIAL GATE OPENING
STRUCTURE 12A

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

STRUCTURE 12B (S-12B)

Location. S-12B is located in Levee 29 (U.S. Highway 41), Section 2, on the south perimeter of WCA No. 3A, about 38.9 miles west of Miami, Florida.

Description. Structure 12B is one of four spillways which make up Structure 12. S-12B is a reinforced concrete, gated, six-bay spillway, with a trapezoidal weir having a crest elevation of 0.8 feet. The 25 ft. wide x 10.2 ft. high, mechanically operated, vertical-lift gates are installed on the crest of the weir. A steel-sheet-pile cutoff is provided under the downstream edge of the structure and under the downstream training walls. The superstructure consists of a highway bridge, a gate operating platform, and a service walkway, all constructed of reinforced concrete. For dewatering, the aluminum posts and timber stop logs for S-11 and the needle beam and timber needles provided for S-10 may be used.

Purpose. S-12A, B, C, and D provide the principal means of discharge from WCA No. 3A and are also a principal source of gravity flow into Shark River Slough (Everglades National Park). The S-12's serve to maintain an optimum water elevation in Water Conservation Area No. 3A. At this writing, the S-12's and S-333 share (on a percentage basis) the responsibility to deliver water to ENP under the Experimental Program of Water Deliveries to Everglades National Park. The experimental plan is discussed in detail in Chapter VII, paragraph 7-03, of this manual.

Normal Regulation. The water surface elevation of Water Conservation Area No. 3A has been regulated according to a 9.5 - 10.5 ft. regulation schedule, as shown in this manual and as a part of the Experimental Plan of Water Deliveries to ENP. Under the current regulation schedule, the stage peaks at 10.5 to coincide with the end of the normal rainy season (November 1), remains at 10.5 feet through December 30, and then gradually declines to 9.5 feet by June 1 before beginning a gradual return to the peak stage.

The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-12's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 8.0 ft., NGVD. As a practical consideration, the S-12 spillway gate settings should be kept within 1 foot of each other.

Flood Control. The S-12's were sized to pass the Standard Project Flood (SPF). The spillways provide a means of

controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The peak SPF stage in WCA No. 3A is about 14.4 ft. with a total storage of about 2.7 million acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-12's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

Low Flow Regulation. The S-12's have no minimum low flow discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts a minimum elevation in the borrow canals of 7.5 ft., NGVD should be observed. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 3A.

Constraints. Water releases from S-12B should not be made when the water stage in WCA No. 3 is 7.5 ft., NGVD or below.

STRUCTURE 12B (S-12B)

Summary of Hydraulic Design

Location	L-29
Total Drainage Area for S-12's (sq. miles)	3,070
Design Conditions	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
SPF Condition	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
Critical Static Condition (no flow)	
Headwater Elevation (ft.)	10.5
Tailwater Elevation (ft.)	5.0
Optimum Conditions	
Headwater Elevation (ft.)	9.5 - 10.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	7.5
Crest	
Shape	Trapezoidal
Elevation (ft.)	0.8
Net Length (ft.)	150.0
Gates	
Type of Gate	vertical lift
Number	6
Width x Height (ft.)	25.0 x 10.2
Low Steel Elevation (ft.) (fully open position)	13.4
Top of Gates Elevation (ft.) (fully closed position)	11.0
Top of Gates Elevation (ft.) (fully open position)	23.6
Stilling Basin	
Apron Elevation (ft.)	-0.2
Apron Length (ft.)	20.0
End Sill Elevation (ft.)	0.8
Training Wall Angle to flow (degrees)	45.0
Highway Bridge Low Elevation (ft.)	14.5
Service Walkway Elevation (ft.)	16.0
Operating Platform Elevation (ft.)	29.5
Dewatering Capabilities	Yes

RT 13.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 06-SEP-88 15:08 ECP RATING NO 13.0

02289019 TAMIAMI CANAL BELOW S-12-B, NEAR MIAMI, FLA. TYPE LINEAR

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

RATING TO BE USED STARTING AT: 03/01/85 (0015) COMP BY ..... DATE .....

REMARKS: TAILWATER RATING - GATES OUT OF THE WATER CKD. BY ..... DATE .....

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
7.20						.000*	.200	.400	.600	.800	
7.30	1.00*	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	2.00
7.40	3.00*	3.40	3.80	4.20	4.60	5.00	5.40	5.80	6.20	6.60	4.00
7.50	7.00*	7.40	7.80	8.20	8.60	9.00	9.40	9.80	10.2	10.6	4.0
7.60	11.0*	11.4	11.8	12.2	12.6	13.0	13.4	13.8	14.2	14.6	4.0
7.70	15.0*	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	5.0
7.80	20.0*	20.7	21.4	22.1	22.8	23.5	24.2	24.9	25.6	26.3	7.0
7.90	27.0*	27.7	28.4	29.1	29.8	30.5	31.2	31.9	32.6	33.3	7.0
8.00	34.0*	34.8	35.6	36.7	37.6	38.5	39.4	40.3	41.2	42.1	9.0
8.10	43.0*	44.1	45.2	46.3	47.4	48.5	49.6	50.7	51.8	52.9	11.0
8.20	54.0*	55.3	56.6	57.9	59.2	60.5	61.8	63.1	64.4	65.7	13.0
8.30	67.0*	68.3	69.6	70.9	72.2	73.5	74.8	76.1	77.4	78.7	13.0
8.40	80.0*	81.6	83.2	84.8	86.4	88.0	89.6	91.2	92.8	94.4	16.0
8.50	95.0*	97.7	99.4	101.1	102.8	104.5	106.2	107.9	109.6	111.3	17.0
8.60	113.0*	115.0	117.0	119.0	121.0	123.0	125.0	127.0	129.0	131.0	20.0
8.70	133.0*	135.4	137.8	140.2	142.6	145.0	147.4	149.8	152.2	154.6	24.0
8.80	157.0*	159.6	162.2	164.8	167.4	170.0	172.6	175.2	177.8	180.4	26.0
8.90	183.0*	185.7	188.4	191.1	193.8	196.5	199.2	201.9	204.6	207.3	27.0
9.00	210.0*	213.0	216.0	219.0	222.0	225.0	228.0	231.0	234.0	237.0	30.0
9.10	240.0*	243.0	246.0	249.0	252.0	255.0	258.0	261.0	264.0	267.0	30.0
9.20	270.0*	273.0	276.0	279.0	282.0	285.0	288.0	291.0	294.0	297.0	30.0
9.30	300.0*	303.4	306.8	310.2	313.6	317.0	320.4	323.8	327.2	330.6	34.0
9.40	334.0*	337.4	340.8	344.2	347.6	351.0	354.4	357.8	361.2	364.6	34.0
9.50	368.0*	371.4	374.8	378.2	381.6	385.0	388.4	391.8	395.2	398.6	34.0
9.60	402.0*	405.5	409.0	412.5	416.0	419.5	423.0	426.5	430.0	433.5	35.0
9.70	437.0*	440.7	444.4	448.1	451.8	455.5	459.2	462.9	466.6	470.3	37.0
9.80	474.0*	477.7	481.4	485.1	488.8	492.5	496.2	499.9	503.6	507.3	37.0
9.90	511.0*	514.7	518.4	522.1	525.8	529.5	533.2	536.9	540.6	544.3	37.0
10.00	548.0*	551.7	555.4	559.1	562.8	566.5	570.2	573.9	577.6	581.3	37.0
10.10	585.0*										

S-12B Tailwater Rating

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
TAILWATER RATING - GATES OUT OF WATER
STRUCTURE 12B

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINI
SEPTEMBER 1988

AT 17.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 07-SEP-88 07:47 ECP RATING NO 17.0

02284001 TAMIAMI CANAL ABOVE S-12-B, NEAR MIAMI, FLA. TYPE LOG (OFFSET=(0.00, 0.00))

BASED ON ..... DISCHARGE MEASUREMENTS, NGS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

COMP BY ..... DATE .....

CKD. BY ..... DATE .....

RATING TO BE USED STARTING AT: 02/01/85 (2015)

REMARKS: HEAD VS DISCHARGE FOR 1 GATE OPEN 1 FT

HEAD (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
			DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)								
0.00			21.7*	28.4*	30.9*	34.2	37.3	40.0*	42.8	45.5*	
0.10	47.3*	49.9	52.3	54.1	56.1	58.1	60.0	61.8	63.6	65.3	19.5
0.20	67.0*	68.8	70.2	71.5	73.3	74.6	76.3	77.7	79.1	80.5	14.9
0.30	81.8*	83.4	84.4	86.3	87.6	88.4	89.7	90.9	92.1	93.3	12.6
0.40	94.5*	95.7	96.4	98.1	99.3	100.4	101.5	102.7	103.8	104.9	11.5
0.50	106.0*	107.0	108.0	108.9	109.9	110.8	111.3	112.7	113.6	114.5	9.4
0.60	115.4	116.3	117.3	118.1	119.0	119.8	120.6	121.5	122.3	123.2	8.6
0.70	124.0	124.9*	125.7	126.5	127.4	128.2	129.0	129.8	130.7	131.5	8.3
0.80	132.3	133.1	133.8	134.6	135.4	136.2	137.0	137.7	138.5	139.2	7.7
0.90	140.0*	140.8	141.5	142.3	143.2	144.0	144.8	145.6	146.4	147.2	8.0
1.00	148.0*	148.7	149.4	150.2	150.9	151.6	152.3	153.0	153.7	154.4	7.1
1.10	155.1	155.8	156.5	157.2	157.9	158.5	159.2	159.9	160.5	161.2	6.8
1.20	161.9	162.5	163.2	163.8	164.5	165.1	165.8	166.4	167.1	167.7	6.4
1.30	168.3	168.9	169.5	170.2	170.8	171.5	172.1	172.7	173.4	174.0	6.3
1.40	174.6	175.2	175.8	176.4	177.0	177.6	178.2	178.8	179.4	180.0	6.0
1.50	180.6	181.2	181.8	182.4	182.9	183.5	184.1	184.7	185.3	185.8	5.8
1.60	186.4	187.0	187.5	188.1	188.7	189.3	189.8	190.4	190.9	191.5	5.6
1.70	192.0	192.6	193.2	193.7	194.3	194.8	195.3	195.9	196.4	197.0	5.5
1.80	197.5	198.1	198.6	199.1	199.7	200.2	200.7	201.2	201.3	202.3	5.3
1.90	202.8	203.4	203.9	204.4	204.9	205.4	205.9	206.5	207.0	207.5	5.2
2.00	208.0*	208.5	209.0	209.5	210.0	210.4	210.9	211.4	211.9	212.4	4.9
2.10	212.9	213.4	213.9	214.3	214.8	215.2	215.7	216.2	216.7	217.1	4.7
2.20	217.6	218.1	218.5	219.0	219.5	219.9	220.4	220.8	221.3	221.8	4.6
2.30	222.2	222.7	223.1	223.6	224.0	224.5	224.9	225.4	225.8	226.3	4.5
2.40	226.7	227.2	227.6	228.1	228.5	229.0	229.4	229.9	230.3	230.7	4.5
2.50	231.2	231.6	232.0	232.5	232.9	233.3	233.8	234.2	234.6	235.1	4.3
2.60	235.5	235.9	236.4	236.8	237.2	237.6	238.1	238.5	238.9	239.3	4.2
2.70	239.7	240.1	240.5	241.0	241.4	241.8	242.2	242.7	243.1	243.5	4.2
2.80	243.9	244.3	244.7	245.1	245.5	246.0	246.4	246.8	247.2	247.6	4.1
2.90	248.0	248.4	248.8	249.2	249.6	250.0	250.4	250.8	251.2	251.6	4.0
3.00	252.0*										

S-12B Partial Gate Opening

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
PARTIAL GATE OPENING
STRUCTURE 12B

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

STRUCTURE 12C (S-12C)

Location. S-12C is located in Levee 29 (U.S. Highway 41), Section 2, on the south perimeter of WCA No. 3A, about 36.3 miles west of Miami, Florida.

Description. Structure 12C is one of four spillways which make up Structure 12. S-12C is a reinforced concrete, gated, six-bay spillway, with a trapezoidal weir having a crest elevation of 0.8 feet. The 25 ft. wide x 10.2 ft. high, mechanically operated, vertical-lift gates are installed on the crest of the weir. A steel-sheet-pile cutoff is provided under the downstream edge of the structure and under the downstream training walls. The superstructure consists of a highway bridge, a gate operating platform, and a service walkway, all constructed of reinforced concrete. For dewatering, the aluminum posts and timber stop logs for S-11 and the needle beam and timber needles provided for S-10 may be used.

Purpose. S-12A, B, C, and D provide the principal means of discharge from WCA No. 3A and are also a principal source of gravity flow into Shark River Slough (Everglades National Park). The S-12's serve to maintain an optimum water elevation in Water Conservation Area No. 3A. At this writing, the S-12's and S-333 share (on a percentage basis) the responsibility to deliver water to ENP under the Experimental Program of Water Deliveries to Everglades National Park. The experimental plan is discussed in detail in Chapter VII, paragraph 7-03, of this manual.

Normal Regulation. The water surface elevation of Water Conservation Area No. 3A has been regulated according to a 9.5 - 10.5 ft. regulation schedule, as shown in this manual and as a part of the Experimental Plan of Water Deliveries to ENP. Under the current regulation schedule, the stage peaks at 10.5 to coincide with the end of the normal rainy season (November 1), remains at 10.5 feet through December 30, and then gradually declines to 9.5 feet by June 1 before beginning a gradual return to the peak stage.

The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-12's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 8.0 ft., NGVD. As a practical consideration, the S-12 spillway gate settings should be kept within 1 foot of each other.

Flood Control. The S-12's were sized to pass the Standard Project Flood (SPF). The spillways provide a means of

controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The peak SPF stage in WCA No. 3A is about 14.4 ft. with a total storage of about 2.7 million acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-12's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

Low Flow Regulation. The S-12's have no minimum low flow discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts a minimum elevation in the borrow canals of 7.5 ft., NGVD should be observed. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 3A.

Constraints. Water releases from S-12C should not be made when the water stage in WCA No. 3 is 7.5 ft., NGVD or below.

STRUCTURE 12C (S-12C)

Summary of Hydraulic Design

Location	L-29
Total Drainage Area for S-12's (sq. miles)	3,070
Design Conditions	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
SPF Condition	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
Critical Static Condition (no flow)	
Headwater Elevation (ft.)	10.5
Tailwater Elevation (ft.)	5.0
Optimum Conditions	
Headwater Elevation (ft.)	9.5 - 10.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	7.5
Crest	
Shape	Trapezoidal
Elevation (ft.)	0.8
Net Length (ft.)	150.0
Gates	
Type of Gate	vertical lift
Number	6
Width x Height (ft.)	25.0 x 10.2
Low Steel Elevation (ft.) (fully open position)	13.4
Top of Gates Elevation (ft.) (fully closed position)	11.0
Top of Gates Elevation (ft.) (fully open position)	23.6
Stilling Basin	
Apron Elevation (ft.)	-0.2
Apron Length (ft.)	20.0
End Sill Elevation (ft.)	0.8
Training Wall Angle to flow (degrees)	45.0
Highway Bridge Low Elevation (ft.)	14.5
Service Walkway Elevation (ft.)	16.0
Operating Platform Elevation (ft.)	29.5
Dewatering Capabilities	Yes

PT 14.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 06-SEP-86 15:09 ECP RATING NO 14.0

02289041 TAMIAMI CANAL BELOW S-12-C, NEAR MIAMI, FLA TYPE LINEAR

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

RATING TO BE USED STARTING AT: 03/01/85 (0015) COMP BY ..... DATE .....

REMARKS: TAILWATER RATING - GATES OUT OF WATER CKD. BY ..... DATE .....

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
7.00	.000*	.100	.200	.300	.400	.500	.600	.700	.800	.900	1.00
7.10	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	1.00
7.20	2.00*	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.80	2.00
7.30	4.00*	4.40	4.80	5.20	5.60	6.00	6.40	6.80	7.20	7.60	4.00
7.40	8.00*	8.50	9.00	9.50	10.0	10.5	11.0	11.5	12.0	12.5	5.0
7.50	13.0*	13.3	14.6	15.4	16.2	17.0	17.8	18.6	19.4	20.2	8.0
7.60	21.0*	21.9	22.8	23.7	24.6	25.5	26.4	27.3	28.2	29.1	9.0
7.70	30.0*	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	10.0
7.80	40.0*	41.2	42.4	43.6	44.8	46.0	47.2	48.4	49.6	50.8	12.0
7.90	52.0*	53.3	54.6	55.9	57.2	58.5	59.8	61.1	62.4	63.7	13.0
8.00	65.0*	66.5	68.0	69.5	71.0	72.5	74.0	75.5	77.0	78.5	15.0
8.10	80.0*	81.7	83.4	85.1	86.8	88.5	90.2	91.9	93.6	95.3	17.0
8.20	97.0*	98.8	100.6	102.4	104.2	106.0	107.8	109.6	111.4	113.2	18.0
8.30	115.0*	117.0	119.0	121.0	123.0	125.0	127.0	129.0	131.0	133.0	20.0
8.40	135.0*	137.3	139.6	141.9	144.2	146.5	148.8	151.1	153.4	155.7	23.0
8.50	158.0*	160.6	163.2	165.8	168.4	171.0	173.6	176.2	178.8	181.4	26.0
8.60	184.0*	186.9	189.8	192.7	195.6	198.5	201.4	204.3	207.2	210.1	29.0
8.70	213.0*	216.2	219.4	222.6	225.8	229.0	232.2	235.4	238.6	241.8	32.0
8.80	245.0*	248.9	252.8	256.7	260.6	264.5	268.4	272.3	276.2	280.1	39.0
8.90	284.0*	288.4	292.8	297.2	301.6	306.0	310.4	314.8	319.2	323.6	44.0
9.00	328.0*	332.7	337.4	342.1	346.8	351.5	356.2	360.9	365.6	370.3	47.0
9.10	375.0*	379.9	384.8	389.7	394.6	399.5	404.4	409.3	414.2	419.1	49.0
9.20	424.0*	429.1	434.2	439.3	444.4	449.5	454.6	459.7	464.8	469.9	51.0
9.30	475.0*	480.5	486.0	491.5	497.0	502.5	508.0	513.5	519.0	524.5	55.0
9.40	530.0*	535.7	541.4	547.1	552.8	558.5	564.2	569.9	575.6	581.3	57.0
9.50	587.0*	592.8	598.6	604.4	610.2	616.0	621.8	627.6	633.4	639.2	58.0
9.60	645.0*	651.0	657.0	663.0	669.0	675.0	681.0	687.0	693.0	699.0	60.0
9.70	705.0*	711.0	717.0	723.0	729.0	735.0	741.0	747.0	753.0	759.0	60.0
9.80	765.0*	771.0	777.0	783.0	789.0	795.0	801.0	807.0	813.0	819.0	60.0
9.90	825.0*	831.0	837.0	843.0	849.0	855.0	861.0	867.0	873.0	879.0	60.0
10.00	885.0*										

S-12C Tailwater Rating

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
TAILWATER RATING - GATES OUT OF WATER
STRUCTURE 12C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

PT 1.. UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 07-SEP-86 07:47 ECP RATING NO 13.0

02289040 TAMIAMI C OUTLETS LOCA TO 40 MI BND NR MIAMI, FL TYPE LOG [OFFSET=(0.00, 0.00)]

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AVG ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

COMP BY ..... DATE .....
CKD. BY ..... DATE .....

HEAD

RATING TO BE USED STARTING AT: 04/01/86 (0015)
REMARKS: HEAD VS DISCHARGE FOR 4 GATE OPEN 1 FT

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
			DISCHARGE IN CUBIC FEET PER SECOND				(EXPANDED PRECISION)				
0.00			19.0*	26.0*	30.8	30.8*	34.4	37.3*	40.1	42.3	
0.10	44.4*	46.7	48.9	51.0	53.0	55.0	56.9	58.7	60.5	62.3	19.6
0.20	64.0*	65.7	67.3	68.9	70.5	72.1	73.6	75.1	76.5	78.0	15.4
0.30	79.4	80.8	82.2	83.5	84.8	86.2	87.5	88.7	90.0	91.3	13.1
0.40	92.5*	93.7	94.8	96.0	97.2	98.3	99.4	100.5	101.6	102.7	11.3
0.50	103.8	104.8	105.8	106.8	108.0	109.0	110.0	111.0	112.0	113.0	10.2
0.60	114.0	115.0*	116.0	117.0	118.0	119.0	120.0	120.9	121.9	122.9	9.8
0.70	123.8	124.7	125.7	126.6	127.6	128.5	129.4	130.3	131.2	132.1	9.2
0.80	133.0*	133.9	134.8	135.7	136.5	137.4	138.3	139.2	140.0	140.9	8.7
0.90	141.7	142.5	143.4	144.2	145.1	145.9	146.7	147.6	148.4	149.2	8.3
1.00	150.0*	150.8	151.6	152.4	153.2	153.9	154.7	155.5	156.3	157.0	7.8
1.10	157.8	158.5	159.3	160.1	160.8	161.6	162.3	163.1	163.8	164.6	7.5
1.20	165.3	166.0	166.8	167.5	168.2	168.9	169.7	170.4	171.1	171.8	7.2
1.30	172.5	173.2	173.9	174.6	175.3	176.0	176.7	177.4	178.1	178.8	6.9
1.40	179.4	180.1	180.8	181.5	182.2	182.8	183.5	184.2	184.8	185.5	6.8
1.50	186.2	186.8	187.5	188.1	188.8	189.4	190.1	190.7	191.4	192.0	6.5
1.60	192.7	193.3	194.0	194.6	195.2	195.9	196.5	197.1	197.8	198.4	6.3
1.70	199.0	199.6	200.2	200.8	201.5	202.1	202.7	203.3	203.9	204.5	6.2
1.80	205.2	205.8	206.4	207.0	207.6	208.2	208.8	209.4	210.0	210.6	6.0
1.90	211.2	211.7	212.3	212.9	213.5	214.1	214.7	215.3	215.8	216.4	5.8
2.00	217.0*										

S-12C Partial Gate Opening

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
PARTIAL GATE OPENING
STRUCTURE 12C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

STRUCTURE 12D (S-12D)

Location. S-12D is located in Levee 29 (U.S. Highway 41), Section 2, on the south perimeter of WCA No. 3A, about 33.5 miles west of Miami, Florida.

Description. Structure 12D is one of four spillways which make up Structure 12. S-12D is a reinforced concrete, gated, six-bay spillway, with a trapezoidal weir having a crest elevation of 0.8 feet. The 25 ft. wide x 10.2 ft. high, mechanically operated, vertical-lift gates are installed on the crest of the weir. A steel-sheet-pile cutoff is provided under the downstream edge of the structure and under the downstream training walls. The superstructure consists of a highway bridge, a gate operating platform, and a service walkway, all constructed of reinforced concrete. For dewatering, the aluminum posts and timber stop logs for S-11 and the needle beam and timber needles provided for S-10 may be used.

Purpose. S-12A, B, C, and D provide the principal means of discharge from WCA No. 3A and are also a principal source of gravity flow into Shark River Slough (Everglades National Park). The S-12's serve to maintain an optimum water elevation in Water Conservation Area No. 3A. At this writing, the S-12's and S-333 share (on a percentage basis) the responsibility to deliver water to ENP under the Experimental Program of Water Deliveries to Everglades National Park. The experimental plan is discussed in detail in Chapter VII, paragraph 7-03, of this manual.

Normal Regulation. The water surface elevation of Water Conservation Area No. 3A has been regulated according to a 9.5 - 10.5 ft. regulation schedule, as shown in this manual and as a part of the Experimental Plan of Water Deliveries to ENP. Under the current regulation schedule, the stage peaks at 10.5 to coincide with the end of the normal rainy season (November 1), remains at 10.5 feet through December 30, and then gradually declines to 9.5 feet by June 1 before beginning a gradual return to the peak stage.

The spillway gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. The S-12's generally are operated under highly submerged flow conditions. Before large releases are made, the spillway gates should be opened gradually to allow the tailwater stages to rise above 8.0 ft., NGVD. As a practical consideration, the S-12 spillway gate settings should be kept within 1 foot of each other.

Flood Control. The S-12's were sized to pass the Standard Project Flood (SPF). The spillways provide a means of

controlling and transporting the flow from the WCA to the tailwater for all flood discharges up to the Spillway Design Flood (SDF). The peak SPF stage in WCA No. 3A is about 14.4 ft. with a total storage of about 2.7 million acre-feet. When a hurricane or tropical storm alert is initiated, Corps of Engineers personnel from the South Florida Operations Office will inspect the S-12's to make sure they are operating properly. The Water Management and Meteorology Section in the Jacksonville District Office will provide the desired gate settings to the South Florida Operations Office personnel to be used during the alert period.

Low Flow Regulation. The S-12's have no minimum low flow discharge other than that covered under the ENP Interim Water Delivery Schedule. During droughts a minimum elevation in the borrow canals of 7.5 ft., NGVD should be observed. Below this elevation no further releases should be permitted from the area unless a supply of water from another storage area is transferred to WCA No. 3A.

Constraints. Water releases from S-12D should not be made when the water stage in WCA No. 3 is 7.5 ft., NGVD or below.

STRUCTURE 12D (S-12D)

Summary of Hydraulic Design

Location	L-29
Total Drainage Area for S-12's (sq. miles)	3,070
Design Conditions	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
SPF Condition	
Total Discharge for 4 spillways (cfs)	32,000
Type	uncontrolled submerged
Headwater Elevation (ft.)	12.4
Tailwater Elevation (ft.)	11.9
Critical Static Condition (no flow)	
Headwater Elevation (ft.)	10.5
Tailwater Elevation (ft.)	5.0
Optimum Conditions	
Headwater Elevation (ft.)	9.5 - 10.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	7.5
Crest	
Shape	Trapezoidal
Elevation (ft.)	0.8
Net Length (ft.)	150.0
Gates	
Type of Gate	vertical lift
Number	6
Width x Height (ft.)	25.0 x 10.2
Low Steel Elevation (ft.) (fully open position)	13.4
Top of Gates Elevation (ft.) (fully closed position)	11.0
Top of Gates Elevation (ft.) (fully open position)	23.6
Stilling Basin	
Apron Elevation (ft.)	-0.2
Apron Length (ft.)	20.0
End Sill Elevation (ft.)	0.8
Training Wall Angle to flow (degrees)	45.0
Highway Bridge Low Elevation (ft.)	14.5
Service Walkway Elevation (ft.)	16.0
Operating Platform Elevation (ft.)	29.5
Dewatering Capabilities	Yes

PT 15.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE PROCESS DATE: 06-SEP-88 15:11 ECP RATING NO 15.0

2545430804054 01 TAMIAMI CANAL BELOW S-12-D, NR MIAMI, FL TYPE LINEAR

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

RATING TO BE USED STARTING AT: 03/01/85 (0015) COMP BY ..... DATE .....

REMARKS: TAILWATER RATING - GATES OUT OF WATER CKD. BY ..... DATE .....

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
7.00	.000*	.730	1.40	2.10	2.30	3.50	4.20	4.90	5.60	6.30	7.00
7.10	7.00*	7.70	8.40	9.10	9.30	10.5	11.2	11.9	12.6	13.3	7.0
7.20	14.0*	14.7	15.4	16.4	17.2	18.0	18.8	19.6	20.4	21.2	8.0
7.30	22.0*	22.8	23.6	24.4	25.2	26.0	26.8	27.6	28.4	29.2	8.0
7.40	30.0*	30.9	31.8	32.7	33.6	34.5	35.4	36.3	37.2	38.1	9.0
7.50	39.0*	40.1	41.2	42.3	43.4	44.5	45.6	46.7	47.8	48.9	11.0
7.60	50.0*	51.1	52.2	53.3	54.4	55.5	56.6	57.7	58.8	59.9	11.0
7.70	61.0*	62.2	63.4	64.6	65.8	67.0	68.2	69.4	70.6	71.8	12.0
7.80	73.0*	74.3	75.6	76.9	78.2	79.5	80.8	82.1	83.4	84.7	13.0
7.90	86.0*	87.4	88.8	90.2	91.6	93.0	94.4	95.8	97.2	98.6	14.0
8.00	100.0*	101.6	103.2	104.8	106.4	108.0	109.6	111.2	112.8	114.4	16.0
8.10	116.0*	117.6	119.2	121.4	123.2	125.0	126.8	128.6	130.4	132.2	18.0
8.20	134.0*	136.0	138.0	140.0	142.0	144.0	146.0	148.0	150.0	152.0	20.0
8.30	154.0*	156.1	158.2	160.3	162.4	164.5	166.6	168.7	170.8	172.9	21.0
8.40	175.0*	177.7	180.4	183.1	185.8	188.5	191.2	193.9	196.6	199.3	27.0
8.50	202.0*	205.0	208.0	211.0	214.0	217.0	220.0	223.0	226.0	229.0	30.0
8.60	232.0*	235.3	238.6	241.9	245.2	248.5	251.8	255.1	258.4	261.7	33.0
8.70	265.0*	268.5	272.0	275.5	279.0	282.5	286.0	289.5	293.0	296.5	35.0
8.80	300.0*	303.7	307.4	311.1	314.8	318.5	322.2	325.9	329.6	333.3	37.0
8.90	337.0*	340.5	344.0	347.5	351.0	354.5	358.0	361.5	365.0	368.5	35.0
9.00	372.0*	375.1	378.3	411.4	424.6	437.7	450.3	464.0	477.1	490.3	131.4
9.10	503.4	516.5	529.7	542.8	556.0	569.1	582.2	595.4	608.5	621.7	131.4
9.20	634.8	647.9	661.1	674.2	687.4	700.5	713.6	726.8	739.9	753.1	131.4
9.30	766.2	779.3	792.5	805.6	818.8	831.9	845.0	858.2	871.3	884.5	131.4
9.40	897.6	910.7	923.8	937.0	950.2	963.3	976.4	989.6	1003	1016	131
9.50	1029	1042	1055	1068	1082	1095	1108	1121	1134	1147	131
9.60	1160	1174	1187	1200	1213	1226	1239	1252	1266	1279	132
9.70	1292	1305	1318	1331	1344	1358	1371	1384	1397	1410	131
9.80	1423	1436	1449	1463	1476	1489	1502	1515	1523	1541	132
9.90	1555	1568	1581	1594	1607	1620	1633	1647	1660	1673	131
10.00	1686	1699	1712	1725	1739	1752	1765	1778	1791	1804	131
10.10	1817	1831	1844	1857	1870	1883	1896	1909	1923	1936	132
10.20	1949	1962	1975	1988	2001	2015	2028	2041	2054	2067	131
10.30	2080	2093	2106	2120	2133	2146	2159	2172	2185	2198	132
10.40	2212	2225	2238	2251	2264	2277	2290	2304	2317	2330	131
10.50	2343	2356	2369	2382	2396	2409	2422	2435	2448	2461	131
10.60	2474	2488	2501	2514	2527	2540	2553	2566	2580	2593	132
10.70	2606	2619	2632	2645	2658	2672	2685	2698	2711	2724	131
10.80	2737	2750	2763	2777	2790	2803	2816	2829	2842	2855	132

S-12D Tailwater Rating

CENTRAL AND SOUTHERN FLORIDA PROJECT
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DISCHARGE RATING TABLE
TAILWATER RATING - GATES OUT OF WATER
STRUCTURE 12D

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

RT 15. UNITED STATES DEPARTMENT OF INTERIOR - GEOL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE P. 35 DATE: 06-SEP-88 15:11 ECP RATING 00.0

254543080405401 TAMIAMI CANAL BELOW S-12-D, NR MIAMI, FL TYPE LINEAR

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
	DISCHARGE IN CUBIC FEET PER SECOND						(EXPANDED PRECISION)				
10.90	2869	2882	2895	2903	2921	2934	2947	2961	2974	2987	131
11.00	3000*										

Jim
looks like
S12A 500
S12B 500
S12C 800
S12D 1000
Gate open Pal.

Let's
discuss.
Susan &
Tracy

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
(Continued)

DISCHARGE RATING TABLE
TAILWATER RATING - GATES OUT OF WATER
STRUCTURE 12D

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

-T 19.0 UNITED STATES DEPARTMENT OF INTERIOR - GEOL. SURVEY - WATER RESOURCES DIVISION

XPANDED RATING TABLE PROCESS DATE: 07-SEP-88 07:48 ECP RATING NO 19.0

0645430083400 10a S-12-D ABOVE TYPE LOG [OFFSET=(0.00, 0.00)]

BASED ON ..... DISCHARGE MEASUREMENTS, NOS ....., AND ....., AND IS ..... WELL DEFINED BETWEEN ..... AND ..... CFS

COMP BY ..... DATE .....

CKD. BY ..... DATE .....

Head

RATING TO BE USED STARTING AT: 08/01/88 (0015)

REMARKS: HEAD vs DISCHARGE FOR 1 GATE OPEN 1 FT

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH GH
			DISCHARGE IN CUBIC FEET PER SECOND				(EXPANDED PRECISION)				
0.00				24.0*	29.5*	36.1	35.4*	38.4	41.2*	43.4	
0.10	46.3*	47.7	51.0	53.3	55.4	57.5	59.5	61.4	63.3	65.2	20.7
0.20	67.0*	68.5	70.5	72.5	73.8	75.5	77.1	78.6	80.2	81.7	16.2
0.30	83.2	84.7	86.1	87.5	88.9	90.3	91.7	93.0	94.4	95.7	13.8
0.40	97.0*	98.3	99.5	100.8	102.0	103.2	104.4	105.6	106.7	107.9	12.1
0.50	109.1	110.2	111.2	112.4	113.5	114.6	115.7	116.8	117.9	118.9	10.9
0.60	120.0*	121.1	122.1	123.2	124.2	125.3	126.3	127.3	128.3	129.3	10.3
0.70	130.2	131.2	132.2	133.2	134.2	135.2	136.2	137.2	138.1	139.1	9.7
0.80	140.0*	140.9	141.9	142.8	143.8	144.7	145.6	146.5	147.4	148.3	9.2
0.90	149.2	150.1	151.0	151.9	152.8	153.7	154.5	155.4	156.3	157.1	8.8
1.00	158.0*	158.8	159.6	160.5	161.3	162.1	162.9	163.7	164.5	165.3	8.1
1.10	166.1	166.9	167.6	168.4	169.2	170.0	170.7	171.5	172.3	173.0	7.7
1.20	173.8	174.5	175.3	176.1	176.8	177.5	178.3	179.0	179.8	180.5	7.4
1.30	181.2	182.0	182.7	183.4	184.1	184.8	185.6	186.3	187.0	187.7	7.2
1.40	188.4	189.1	189.8	190.5	191.2	191.9	192.6	193.3	193.9	194.6	6.9
1.50	195.3	196.0	196.7	197.3	198.0	198.7	199.3	200.0	200.7	201.3	6.7
1.60	202.0	202.7	203.3	204.0	204.6	205.3	205.9	206.5	207.2	207.9	6.5
1.70	208.5	209.2	209.8	210.4	211.1	211.7	212.3	213.0	213.6	214.2	6.3
1.80	214.8	215.5	216.1	216.7	217.3	217.9	218.5	219.2	219.8	220.4	6.2
1.90	221.0	221.6	222.2	222.8	223.4	224.0	224.6	225.2	225.8	226.4	6.0
2.00	227.0*										

S-12D Partial Gate Opening

CENTRAL AND SOUTHERN FLORIDA PROJECT
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WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING TABLE
PARTIAL GATE OPENING
STRUCTURE 12D

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1988

STRUCTURE 12E (S-12E)

Location. Control Structure 12E is located in Section 2 of Levee 29 where L-67A intersects L-29. The structure is in Dade County about 33 miles west of Miami, Florida.

Description. S-12E, as built, was a reinforced concrete, gated, four barrel box culvert. The structure had manually controlled vertical-lift gates which could be operated from an operating platform. However, the structure is no longer in service.

Purpose. The culvert was originally built to be the regulatory outlet for WCA No. 3B but is no longer in service. S-12E would have discharged from the L-29 borrow canal (through the Tamiami Canal) to the Everglades National Park via the L-67 Extension borrow canal.

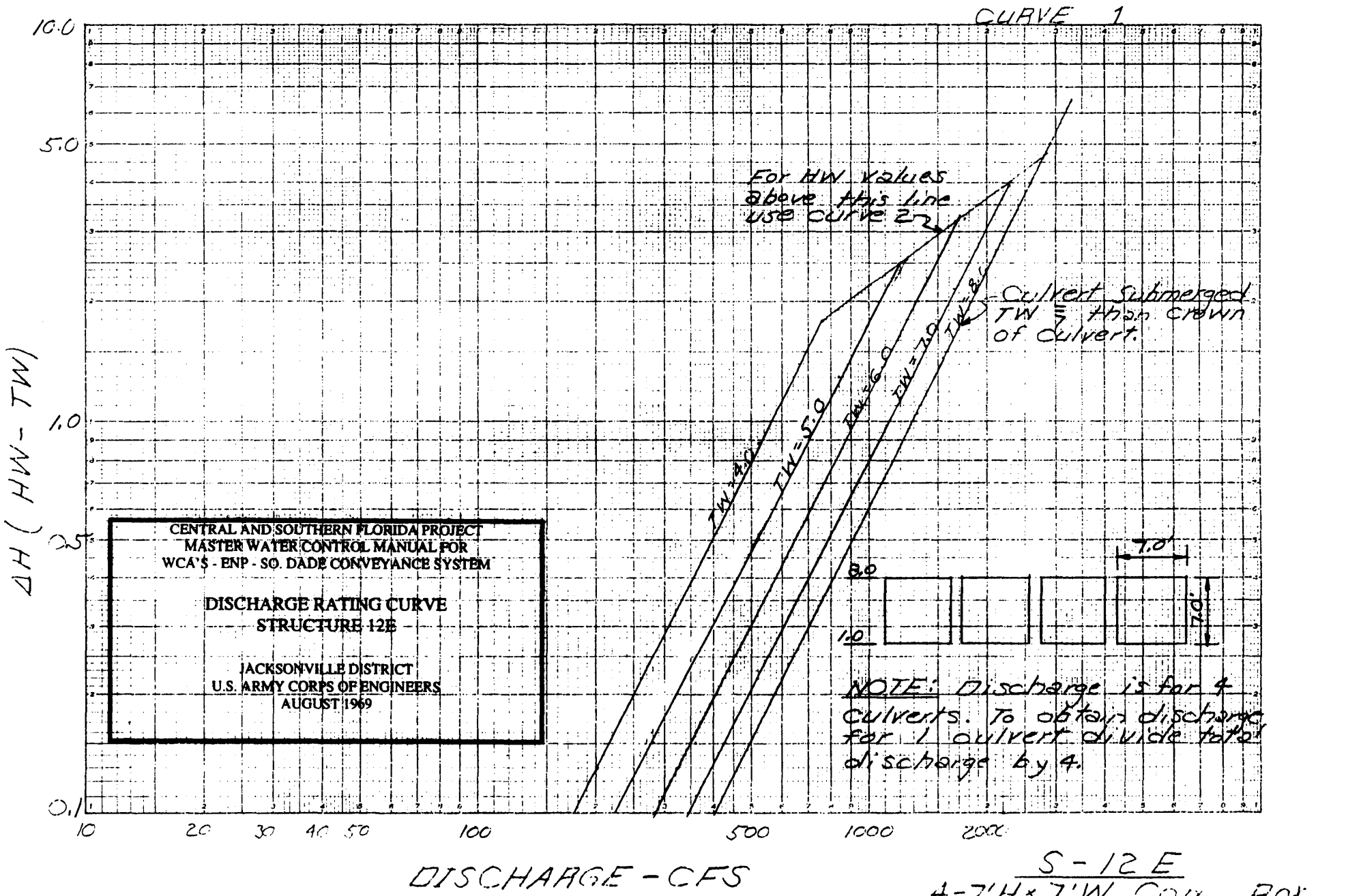
Normal Regulation. S-12E never functioned as intended due to tailwater conditions which were higher than designed. The construction of the ENP-South Dade Conveyance System has made S-12E a non-functional structure. However, under normal regulation the gates would have remained closed until water levels in WCA No. 3B were above a desirable elevation. Under design conditions, the four-barrel box culvert would have discharged 700 cfs into the Everglades National Park.

Note: S-12E never functioned as intended due to tailwater conditions which were higher than designed. The construction of the ENP-South Dade Conveyance System has made S-12E a non-functional structure. The gates have been removed and the structure has been abandoned.

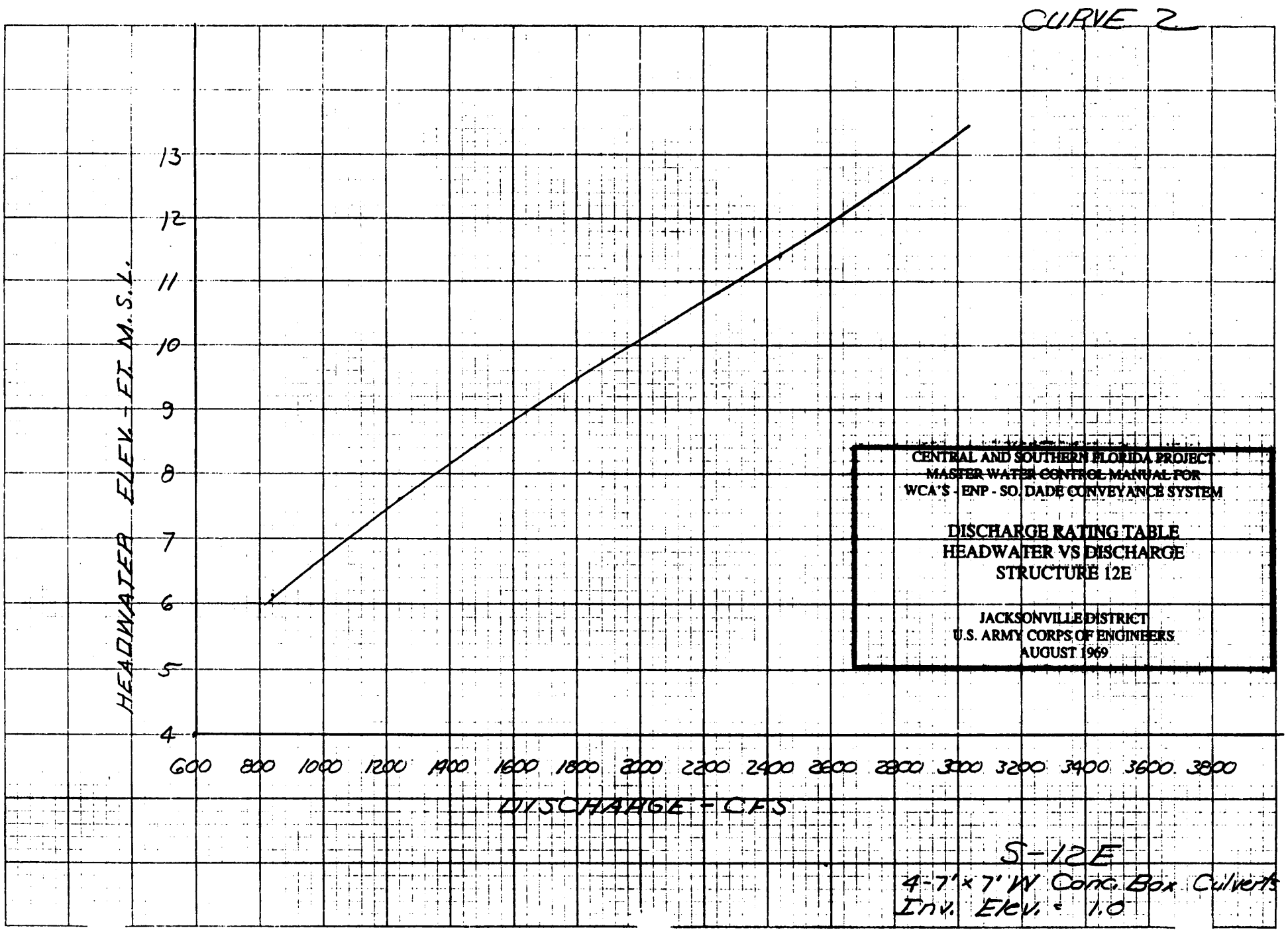
STRUCTURE S-12E

Summary of Hydraulic Design Data
(Culvert)

Location	L-29
Station	577+29
Design Conditions	
Discharge (cfs)	700
Type	controlled submerged
Headwater Elevation (ft.)	8.5
Tailwater Elevation (ft.)	8.0
Maximum Water Elevation (ft.)	
Headwater Elevation	10.0
Tailwater Elevation	12.0
Minimum Elevation (ft.)	
Headwater Elevation	7.0
Tailwater Elevation	5.0
Culvert	
Type	concrete box
Number of Barrels	4
Invert Elevation ~~(ft.)~~	1.0
Gates	
Number	4
Type of Control	manual slide gates
Size (ft.)	7.0 x 7.0
Wingwalls	
Type	T-type
Operating Platform Elevation (ft.)	18.0
Dewatering Capabilities	None



S - 12 E
4-7'H × 7'W Conc. Box Culverts - Inv. Elev. = 1.0


CURVE 2
HEADWATER ELEV. - FT. M.S.L.
13
12
11
10
9
8
7
6
5
4
600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400 3600 3800
DISCHARGE - CFS
CENTRAL AND SOUTHERN FLORIDA PROJECT
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WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING TABLE
HEADWATER VS DISCHARGE
STRUCTURE 12E
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1969
S-12E
4-7' x 7' W Conc. Box Culverts
Inv. Elev. = 1.0

STRUCTURE 12F (S-12F)

Note: This structure is inoperative and has not been operated since 1960's. COE Jacksonville District has received approval to remove the structure and to place backfill to maintain the function of the access road. Data is included for informational purposes only.

Location. Structure 12F is located in the Tamiami Canal approximately midway between S-12C and S-12D. The culverts pass under Access Road No. 1, which goes between the old Tamiami Trail on the south and the new U.S. Highway 41 on the north.

Description. S-12F consists of three 72-inch diameter corrugated metal pipe culverts each 81 feet long, and one 48-inch diameter corrugated metal pipe 78 feet long. The culverts are equipped with stoplog risers.

Purpose. S-12F maintains desirable water levels in the old Tamiami Canal west of S-12F, preventing overdrainage of this stretch of the canal during low-flow periods.

Normal Operation. None. S-12F in not operational.

STRUCTURE S-12F

Summary of Hydraulic Design Data

Location	Old Tamiami Canal
Design Conditions	
Discharge (cfs)	700
Type	controlled submerged
Headwater Elevation (ft.)	8.5
Tailwater Elevation (ft.)	8.0
Culvert	
Type	CMP
Number of Barrels	3 72-inch, 1 48-inch
Invert Elevation (ft.)	2.0
Gates	
Number	4
Type	stoplog risers
Size (ft.)	7.0 X 7.0

Note: Structure 12F is not operational.

STRUCTURE 14 (S-14)

Location. Structure 14 is located in Section 2 of Levee 29 west of the S-12's. This structure is parallel to and north of Tamiami Canal, in Dade County, Florida.

Description. S-14 is a reinforced concrete, gated, two-barrel box culvert. The structure has manually controlled vertical-lift gates which can be operated from an operating platform.

Purpose. The culvert provides gravity drainage from the lower reaches of Levee 28 borrow pit, via the Levee 29, Section 2, borrow pit, through the Tamiami Trail into the Everglades National Park.

Regulation. S-14's gates are normally closed. This structure acts as a plug for water into S-12. The structure is manually operated only under flood conditions. The gates of the structure are opened whenever the headwater elevation reaches 7.0 ft., NGVD. Under design conditions, the two-barrel box culvert will discharge 500 cfs into the Everglades National Park.

Note: S-14 is not operational. S-14 never functioned as intended due to tailwater conditions which were higher than designed.

STRUCTURE S-14

Summary of Hydraulic Design Data

Location	L-29
Design Conditions	
Discharge	500
Type	controlled submerged
Headwater Elevation (ft.)	7.0
Tailwater Elevation (ft.)	6.0
Maximum Water Elevation (ft.)	
Headwater Elevation	10.0
Tailwater Elevation	12.0
Minimum Elevation (ft.)	
Headwater Elevation	7.0
Tailwater Elevation	5.0
Culvert	
Type	concrete box
Number of Barrels	2
Invert Elevation (ft.)	0.0
Gates	
Number	2
Type	manual slide gates
Size (ft.)	7.0 x 7.0
Wingwalls	
Type	T-type
Operating Platform Elevation (ft.)	17.0
Dewatering Capabilities	None

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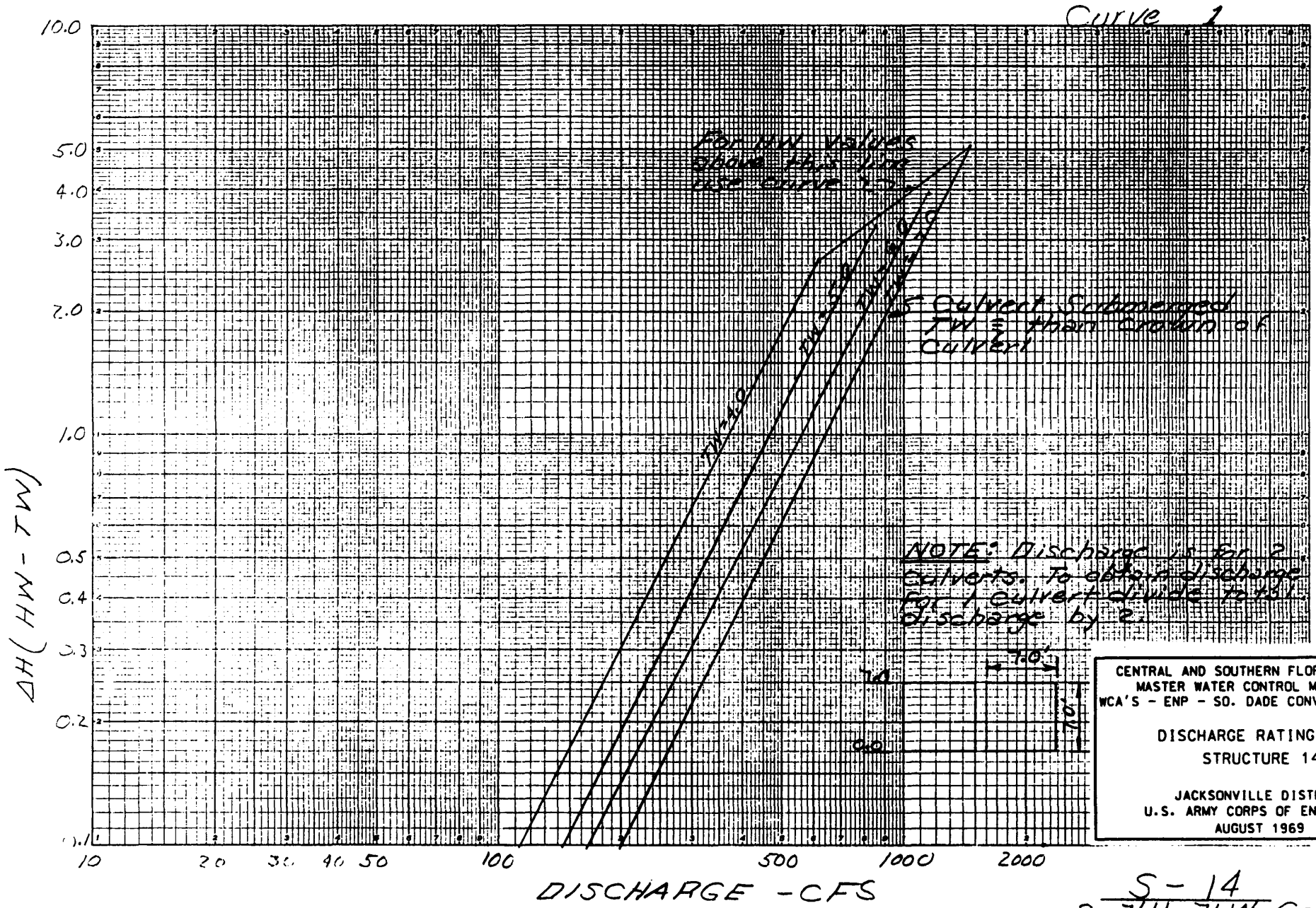

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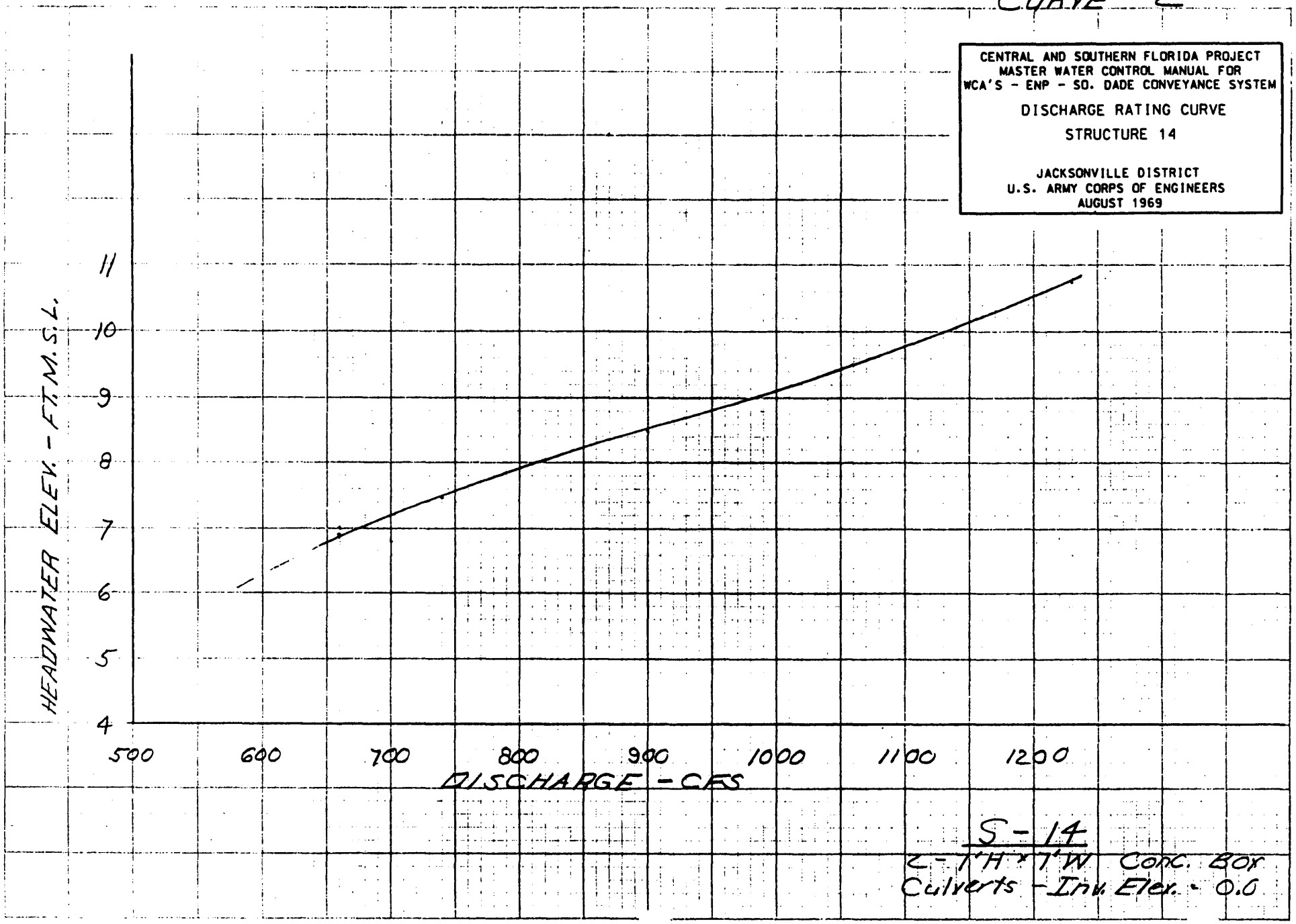
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 14

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1969

S - 14
2 - 7'H × 7'W Conc. Box
Culverts - Inv. El. = 0.0

CURVE 2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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING CURVE
STRUCTURE 14
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1969
HEADWATER ELEV. - FT. M.S.L.
11
10
9
8
7
6
5
4
500
600
700
800
900
1000
1100
1200
DISCHARGE - CFS
S-14
2-1'H x 1'W Conc. Box
Culverts - Inv. Elev. - 0.0

8/69

STRUCTURE 18 (S-18)

Note: This is an inoperative spillway. Data is included for informational purposes only. A description is also included in Volume 5, East Coast Canals Water Control Manual.

Location. S-18 is located about 9 miles south of Homestead, Florida approximately 2500 feet west of Highway 1. It was constructed as an outlet for Canal 109. However, except for partial clearing, drilling and blasting, C-109 was not constructed, at the request of the State of Florida.

Description. Control structure S-18 is a one bay, U-shaped gated spillway. It has a trapezoidal weir and an automatically controlled vertical-lift gate. The structure has an operating platform at elevation 26.0 ft. and a 20 ft. wide service bridge at elevation 8.0 on the downstream side of the gate. Riprap is provided upstream and downstream to protect against erosion.

Purpose. S-18 would have provided water control and salinity control to prevent salt water intrusion along Canal 109. It would have been able to discharge up to 750 cfs under standard project flood conditions.

Normal Operation. None. S-18 is not operational.

STRUCTURE 18 (S-18)

Summary of Hydraulic Design

Location	C-109
Drainage Area (sq. miles)	7.3
Design Conditions	
Discharge (cfs)	440
Headwater Elevation (ft.)	2.3
Tailwater Elevation (ft.)	2.1
SPF Condition	
Discharge (cfs)	750
Headwater Elevation (ft.)	3.9
Tailwater Elevation (ft.)	3.5
Crest	
Shape	Trapezoidal
Elevation (ft.)	-5.9
Net Length (ft.)	20.0
Gates	
Type of Gate	vertical lift
Number	1
Width x Height (ft.)	20.0 x 9.9
Clearance Elevation (ft.)	3.4
Overflow Slot Elevation (ft.)	1.0 - 2.5
Apron	
Elevation (ft.)	-7.9
Length (ft.)	20.0
End sill elevation (ft.)	-6.9

Note: Structure 18 is not operational.

STRUCTURE 18C (S-18C)

Location. Structure 18C is located in Section 1 of Canal 111.

Description. S-18C is a two bay, U-shaped, gated spillway with a trapezoidal weir and vertical-lift gates. The gate hydraulic operating system operates both gates simultaneously according to headwater level criteria.

Purpose. The structure maintains optimum water control stages upstream in Canal 111. It passes the design flood (40 percent of the SPF) without exceeding upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels. S-18C assists in preventing saline intrusion into C-111. It also makes discharges to the eastern panhandle of the Everglades National Park.

Normal Regulation. The automatic controls operate both gates simultaneously to maintain an optimum headwater elevation between 2.0 ft. and 2.6 ft., NGVD. The automatic controls function as follows: When the headwater rises to 2.6 ft., the gates will open at six inches per minute. When the headwater drops to 2.3 ft., the gates remain stationary until the headwater again reaches 2.6 ft. or drops to 2.0 ft. at which time the gates will begin to close at the rate of six inches per minute. The gates continue to close until they are fully closed or until the headwater again reaches 2.0 when they once more remain stationary until reactivated by the rising or falling headwater.

Flood Control Regulation. When the headwater reaches 2.6 ft., NGVD, the gates will open to continuously pass the design discharge of 2,100 cfs or up to the amount as will reach the structure.

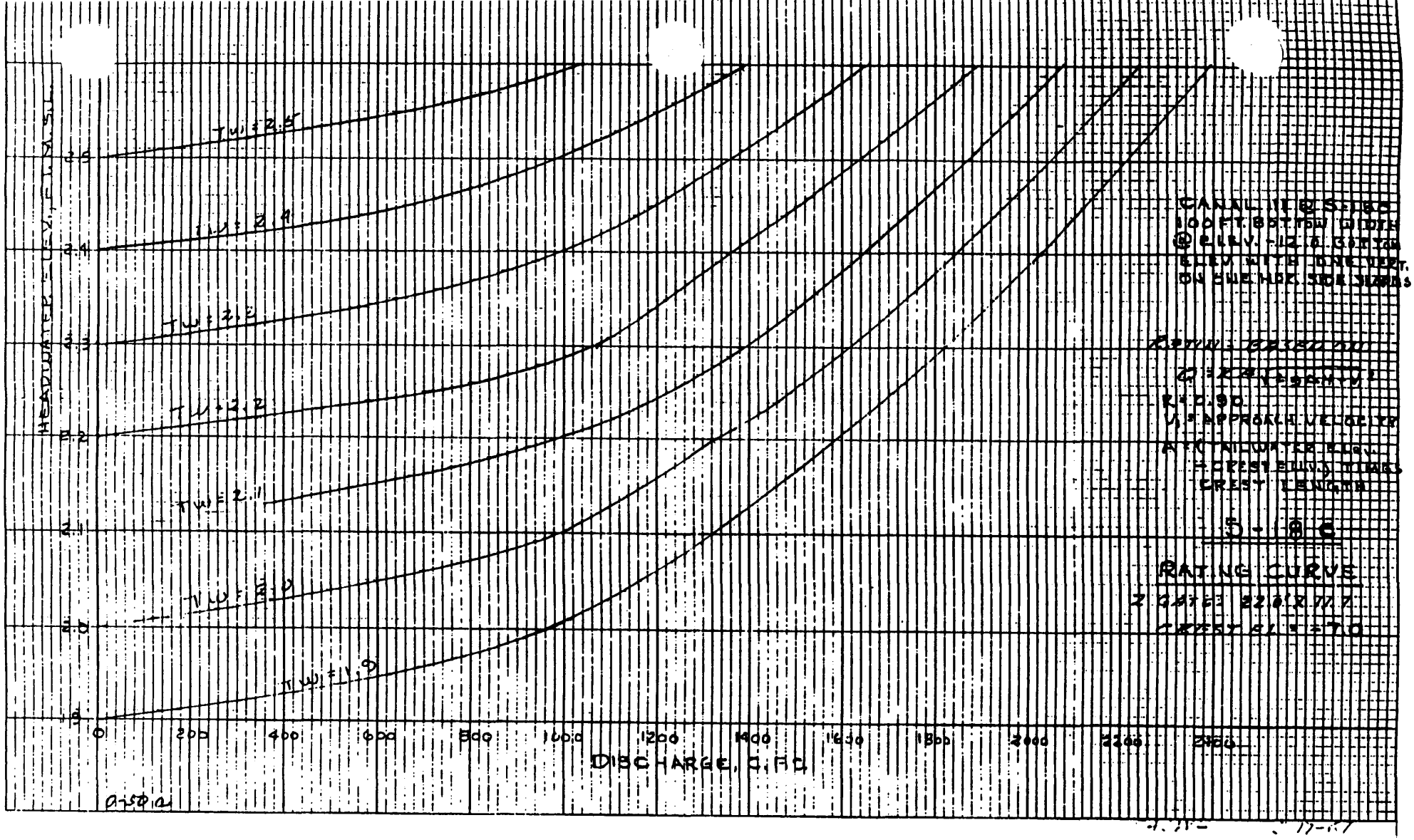
Park Releases. The gates at S-18C will be remotely controlled to maintain the structure's optimum headwater elevation while making monthly water releases to the Everglades National Park as follows:

January	1,540 AF	July	510 AF
February	630 AF	August	860 AF
March	290 AF	September	2,690 AF
April	110 AF	October	4,630 AF
May	110 AF	November	4,060 AF
June	340 AF	December	2,230 AF

STRUCTURE 18C (S-18C)

Summary of Hydraulic Design

Location	C-111
Drainage Area (sq. miles)	34.1
Design Conditions	
Discharge (cfs)	2,100
Type	uncontrolled submerged
Headwater Elevation (ft.)	2.6
Tailwater Elevation (ft.)	2.1
SPF Condition	
Discharge (cfs)	3,200
Type	uncontrolled submerged
Headwater Elevation (ft.)	3.8
Tailwater Elevation (ft.)	2.8
Optimum Conditions (ft.)	
Headwater Elevation	2.0
Tailwater Elevation	1.4
Minimum Estimated Headwater Elevation (ft.)	1.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-7.0
Net Length (ft.)	44.0
Gates	
Type of Gate	vertical lift gates
Number	2
Width x Height (ft.)	22.0 x 11.0
Clearance Elevation (ft.)	4.8
Overflow Slots Elevation (ft.)	1.0 to 2.5
Apron	
Elevation (ft.)	-8.0
Length (ft.)	20.0
End sill elevation (ft.)	-7.0
Operating Platform Elevation (ft.)	27.0
Service Bridge Elevation (ft.)	8.0
Dewatering Capabilities	Yes



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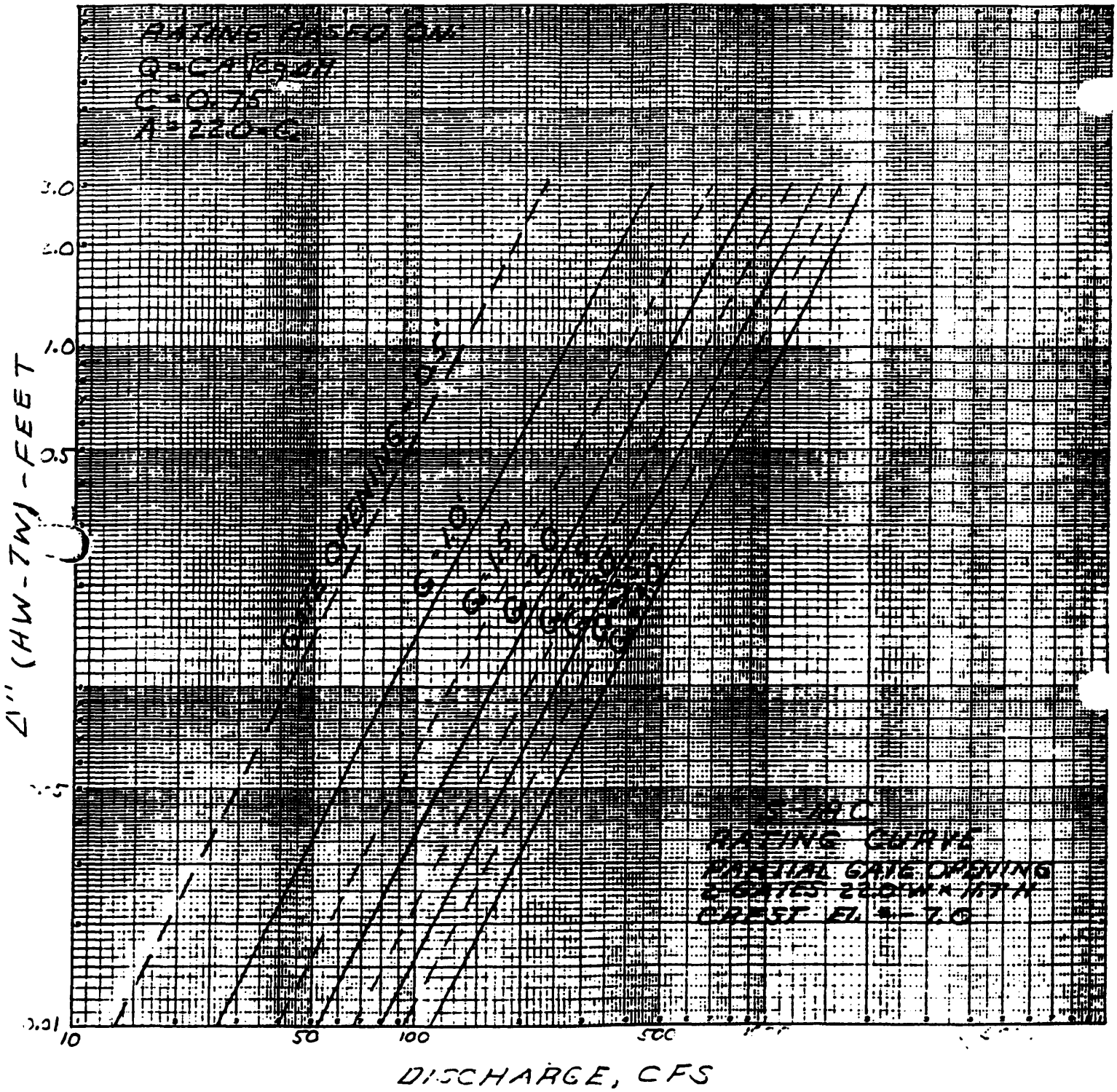
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 18C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OCTOBER 1967



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WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
PARTIAL GATE OPENING
STRUCTURE 18C

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OCTOBER 1967

STRUCTURE 24 (S-24)

Location. S-24 is located 635 ft. east of L-31N and under U.S. Highway 41 at the northern end of the L-31N borrow canal. It is at the junction of Tamiami Canal and Levee 30.

Description. S-24 is a single barrel, 54-inch corrugated metal culvert with slide gate control in the north or upstream end. The structure's concrete headwalls provide erosion control and the culvert's crown elevation of 4.5 ft. insures maximum efficiency.

Purpose. Structure 24 drains water from the area between the Dade-Broward levee and Levee 30 into the L-31N borrow canal.

Normal Regulation. The structure is operated to make flood releases when downstream conditions will not be aggravated, generally when the stage at the junction of C-4 and C-2 is less than 4.0 ft., NGVD.

STRUCTURE 24 (S-24)

Summary of Hydraulic Design

Location	L-30
Design Conditions	
Discharge (cfs)	unknown
Headwater Elevation (ft.)	unknown
Tailwater Elevation (ft.)	unknown
Culvert	
Type	CMP
Number of Barrels	1
Size (dia., inches)	54
Net Length (ft.)	81
Invert Elevation (ft.)	-0.4
Gate	
Type of Control	Slide
Number	1
Size (dia., inches)	54

STRUCTURE 24A (S-24A)

Location. S-24A is in Levee 31N about 3 1/2 miles south of S-24.

Description. S-24A is a gated, two barrel, 54-inch, corrugated metal pipe culvert with manually operated slide gates mounted on the upstream end of the culvert. The crown of the culvert is at elevation 5.5 ft, for maximum efficiency.

Purpose. The structure permits drainage of the area between L-31 and Krome Avenue.

Normal Regulation. This structure operates solely for flood control.

Flood Control Regulation. The gates remain closed when the tailwater elevation, on the west side of the structure, exceeds the headwater elevation, on the east side of the structure. The gates are opened when the headwater elevation exceeds the tailwater elevation.

STRUCTURE 24A (S-24A)

Summary of Hydraulic Design

Location	L-31N
Design Conditions	
Discharge (cfs)	unknown
Headwater Elevation (ft.)	unknown
Tailwater Elevation (ft.)	unknown
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	54
Net Length (ft.)	86
Invert Elevation (ft.)	1.0
Gates	
Type of Control	manual slide gate
Number	2

STRUCTURE 31 (S-31)

Location. Structure 31 is located where Levee 30 crosses the Miami Canal, about 15 miles west of Miami.

Description. S-31 is a three barrel, 84-inch corrugated metal pipe culvert with slide gates. The structure also has a timber operating platform.

Purpose. This structure controls water levels in WCA No. 3B. However, this structure along with S-151 can also permit water releases from WCA No. 3A to the East Coast during dry periods or when seepage is inadequate. Also in combination with S-151, it can discharge excess water from WCA No. 3A when channel capacity is available in the Miami Canal.

Normal Regulation. Releases may be made, as necessary, to supply downstream water requirements to maintain an optimum stage of 2.5 feet at S-26 in C-6 and 1.85 feet at S-27 in C-7. Under design conditions, the culvert will discharge a total of 700 cfs. The structure can make low water releases to maintain minimum desirable stages in the developed area east of L-30.

Flood Control Regulation. The gates of S-31 may be opened prior to hurricane season, when the stage in WCA No. 3A (measured as the average of gages 63, 64, and 65) is in Zone A of the regulation schedule. The gates may also need to be operated so the tailwater remains below 4.0 feet.

Constraints. To preclude fish kills in C-304, the combined discharge of S-337 and S-31 shall be equal to or less than the discharge of S-151. In addition, S-151 shall be opened the day before S-337 and/or S-31 are opened, and S-151 shall remain open until the day after S-337 and/or S-31 are closed.

Currently, regulatory releases from WCA No. 3B can only be made on a secondary basis through S-31 to the East Coast.

Design criteria for structure stability make it imperative that the head not exceed 10.0 feet.

STRUCTURE 31 (S-31)

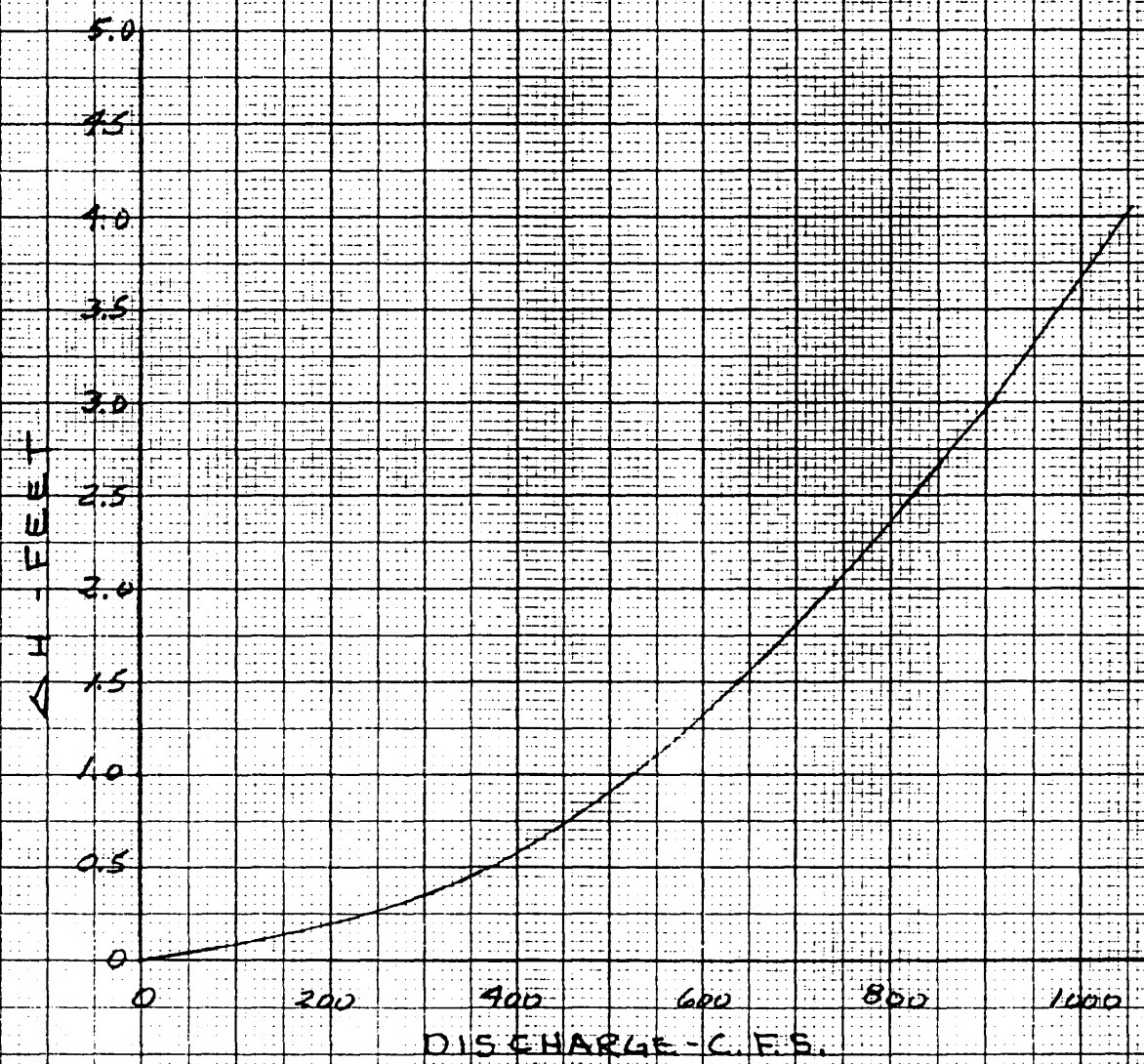
Summary of Hydraulic Design Data (Culvert)

Location	L-30
Design Conditions	
Discharge (cfs)	700
Type	controlled submerged
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	4.0
Maximum Head (ft.)	10.00
Culvert	
Type	CMP
Number of Barrels	3
Size (inches)	84
Invert Elevation (ft.)	-3.0
Length (ft.)	172
Gates	
Number	3
Type of Control	manual slide gate

S-31

RATINGS BASED ON:

1. THREE 84" C.M.P.'S, 172' LONG WITH INVERTS AT ELEV. ~3.0± FT. M.S.L.
2. ALL GATES OPEN, PIPES FLOWING FULL
3. n = 0.024 AND ENTRANCE PLUS EXIT LOSS = $1.78 \frac{V^2}{2g}$



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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 31

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1966

K&E 10 X 10 TO 1/2 INCH 46 1323
KEUFFEL & ESSER CO.

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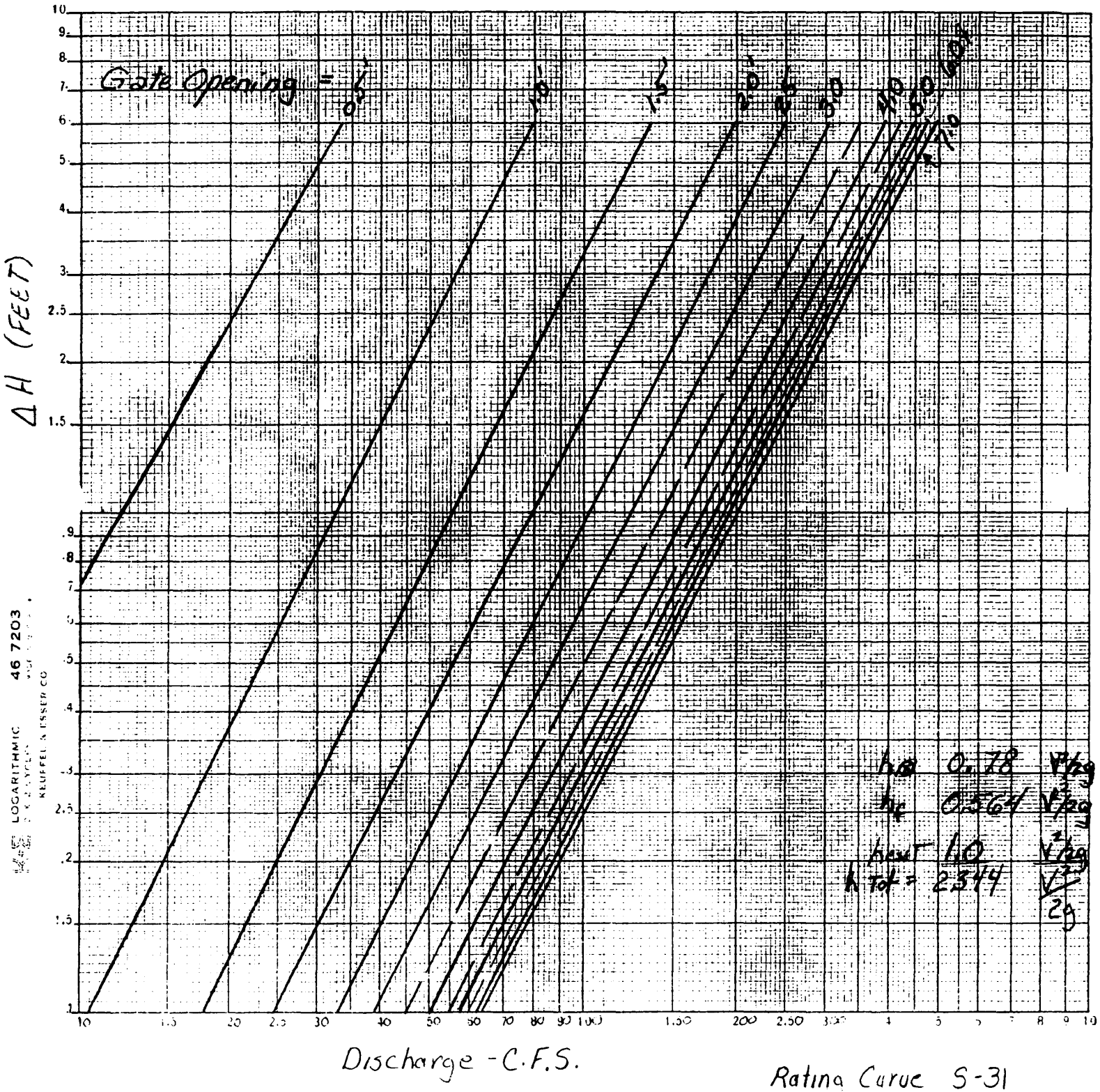
DISCHARGE RATING CURVE
STRUCTURE 31

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994



Rating Curve S-31
Curves are for 1-84" pipe discharge
71'-0" Long
Total C.F.S. = Discharge x 3.0

STRUCTURE 32 (S-32)

Location. This structure connects the Miami Canal and the borrow pit of Levee 33. S-32 is located in a county road adjacent to the Miami Canal.

Description. S-32 is a gated, two barrel, 72-inch, corrugated metal pipe culvert with manually operated slide gates on the upstream end of the culvert. The reinforced concrete headwall supports the control gates.

Purpose. S-32, together with S-30 and S-9XS, controls drainage of the area between Levees 33 and 37, and U.S. Highway 27. The structure allows water to be stored in the area and released during periods of flow deficiency. This storage reduces the seepage under Levees 33 and 37 from WCA No. 3B.

Flood Control Regulation. Gates should be closed when S-32 releases might aggravate downstream flood conditions. When the headwater stage at S-32 exceeds 6.0 feet, and releases will not aggravate downstream conditions, the gates should be opened. The water level which will bypass the structure is 11.5 ft.

Low Flow Regulation. Releases should be made, as necessary, subject to water availability, to meet downstream water needs. Releases should be made based on the stage requirements at S-29.

STRUCTURE 32 (S-32)

Summary of Hydraulic Design

Location	L-33
Design Conditions	
Discharge (cfs)	unknown
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	unknown
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Invert Elevation (ft.)	-2.0
Net Length (ft.)	40
Gates	
Type of Control	Manual slide gate
Number	2
Size (dia., inches)	72

STRUCTURE 32A (S-32A)

Location. S-32A is located at the north end of Levee 30 in the Dade-Broward Dike about 19 miles northwest of Miami, Florida.

Description. S-32A is a gated, single barrel, 54-inch diameter, corrugated metal pipe culvert. The manually operated, 54-inch square, slide gate is on the upstream side (south end) of the culvert.

Purpose. This structure, along with S-335, controls water stored in the Levee 30 borrow canal to prevent seepage under Levee 30 from WCA No. 3B, and maintains head for the southward discharge of water at S-335.

Regulation. The gates should be open when the headwater stage at S-32A or S-335 exceeds 6.0 feet, and the releases will not aggravate downstream conditions. The tailwater will fluctuate depending on conditions in the Miami Canal, east of S-31. Under low water conditions, S-32A should remain closed to maintain adequate stages in the L-30 borrow canal to help the southward delivery of water.

Constraints. Water will bypass the structure at elevation 11.5 ft.

STRUCTURE 32A (S-32A)

Summary of Hydraulic Design

Location	L-30
Design Conditions	
Discharge (cfs)	80
Headwater Elevation (ft.)	5.2
Tailwater Elevation (ft.)	4.0
Optimum Conditions	
Headwater Elevation (ft)	6.0
Tailwater Elevation (ft.)	2.5
Culvert	
Type	CMP
Number of Barrels	1
Size (dia., inches)	54
Net Length (ft.)	102
Invert Elevation (ft.)	-2.0
Gates	
Type of Control	manual slide gate
Number	1
Size (width x height, inches)	54 x 54

STRUCTURE 34 (S-34)

Location. S-34 is located in North New River Canal under Levee L-37, about 20 miles west of Ft. Lauderdale, Florida at Andytown.

Description. S-34 is a double barrel, 72-inch corrugated metal pipe culvert with manual slide gates.

Purpose. Structure 34 permits water releases from WCA No. 2 to meet water supply needs along the North New River Canal during dry periods. It may also discharge excess water from WCA No. 2A and/or 2B when capacity is available in the North New River Canal and when the water is not needed in WCA No. 3.

Normal Regulation. When operations are not required by flood conditions, S-34 may release water to supply downstream water requirements and to maintain an optimum stage at Sewell's Lock, between elevation 3.5 ft. and 4.5 ft.

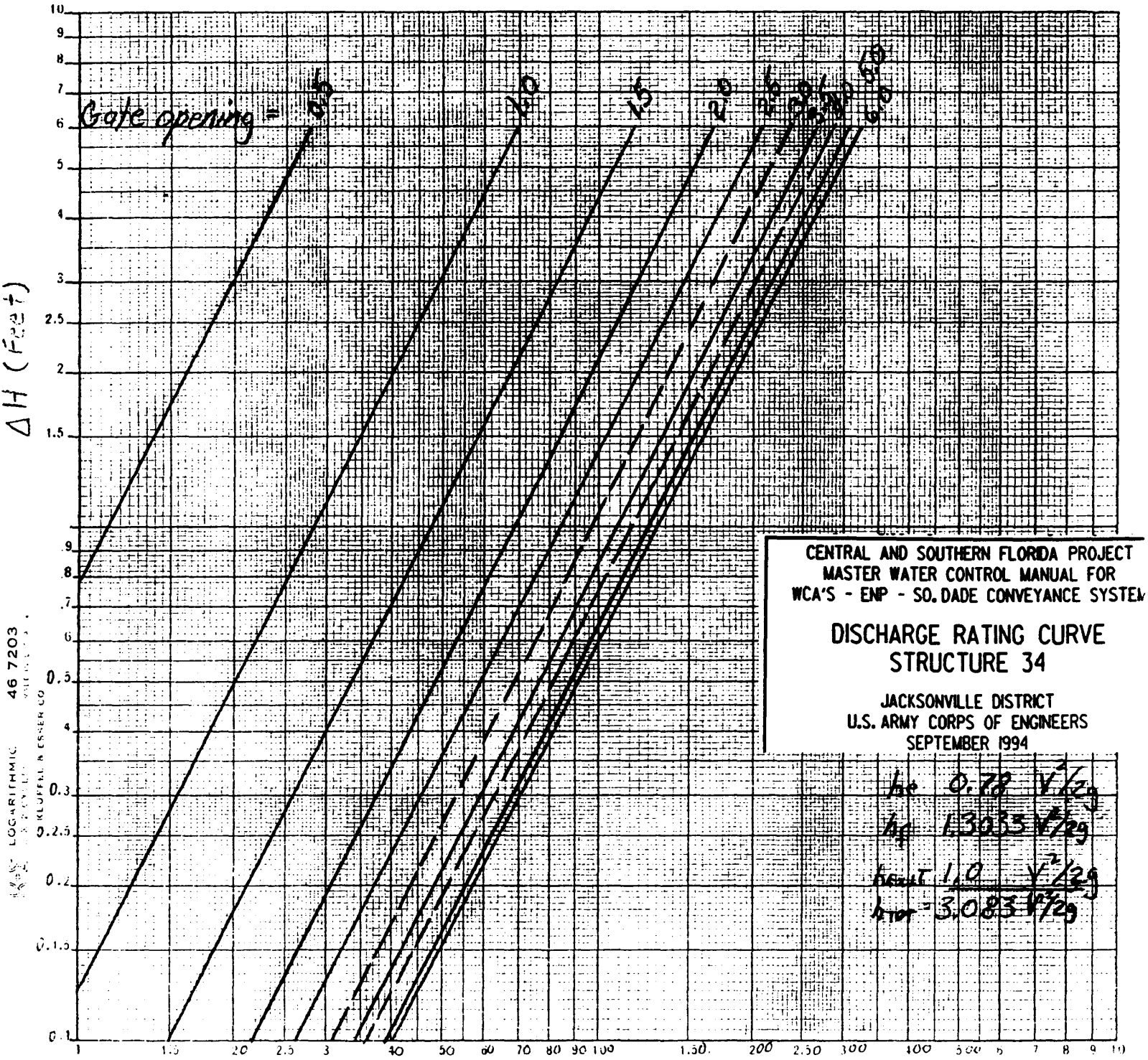
Flood Control Regulation. The gates should be open whenever damage stages would not be exceeded below the structure and excess water in North New River Canal and WCA No. 2 is increasing the flood potential in the agricultural area south of Lake Okeechobee. Excess water should be released from WCA No. 2 prior to the hurricane season.

The gates of S-34 should be open whenever excess storage is present in WCA No. 2A and/or WCA No. 2B before hurricane season, which is when the stage in WCA No. 2A is in Zone A of the regulation schedule, as measured at gage 112. The gates may be opened if the excess water in WCA No. 2A is not needed in WCA No. 3 and/or the tailwater elevation will not exceed 6.0 ft.

STRUCTURE 34 (S-34)

Summary of Hydraulic Design Data (Culvert)

Location	L-37/L-33
Design Conditions	
Discharge (cfs)	350
Headwater	7.7
Tailwater Elevation (ft.)	6.0
Culvert	
Type	CMP
Number of Barrels	2
Size (Inches & Type)	72
Net Length (ft.)	133.5
Invert Elevation (ft.)	-3.0 to -4.0
Gates	
Number	2
Type of Control	Manual slide gates
Size (dia. inches)	72



Rating Curve
S-34

Curves are for 1-pipe discharge
1-72" C.M.P. - 133.5' Long
Total C.F.S = Discharge x 2.0

STRUCTURE 38 (S-38)

Location. Structure 38 is located in the southeast corner of WCA No. 2A in L-36, where L-36, Canal 14, and the L-35B borrow canal intersect. The structure is about 15 miles northwest of Ft. Lauderdale, Florida.

Description. S-38 is a gated, two barrel, 72-inch diameter, corrugated metal pipe culvert with concrete headwalls, wingwalls, and aprons. It has manually operated slide gates, a timber walkway, and concrete operating platform.

Purpose. S-38 permits water releases from WCA No. 2A to meet water supply needs in the area served by Canals 13 and 14 during the dry season. It may also discharge excess water from WCA No. 2A when capacity is available in Canals 13 and 14 and when the water is not needed in WCA No. 3.

Normal Regulation. When not operating under flood conditions, S-38 may operate to support optimum water control conditions downstream by providing a stage of 6.8 ft. at S-37 and 5.0 ft at S-36.

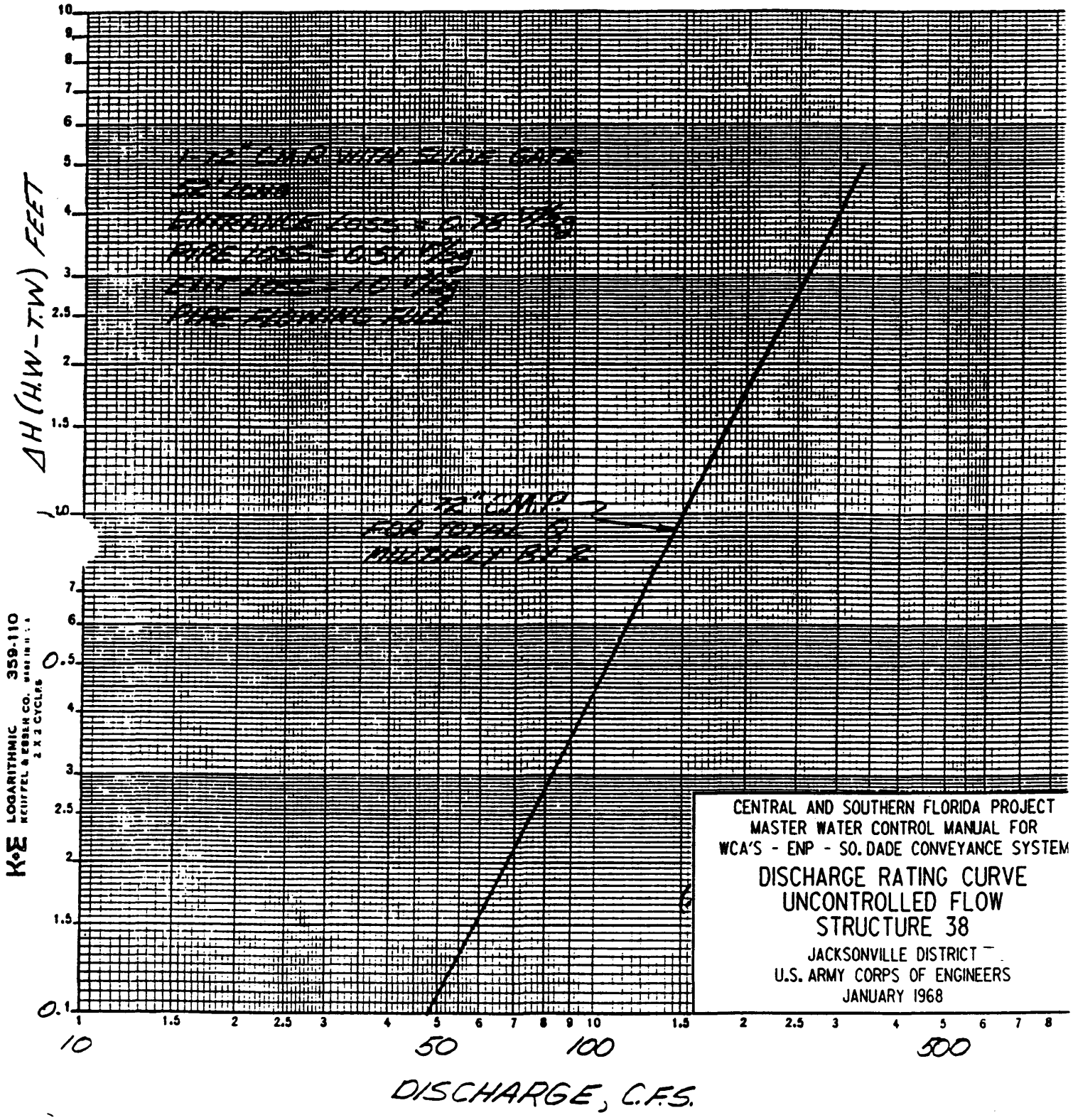
Flood Control Regulation. Discharges may be made from S-38 if the water is not needed in WCA No. 3 and WCA No. 2A has excess water. When the WCA No. 2A stage is in Zone A and Structure 11 is at maximum capacity, the U.S. Army Corps of Engineers may request maximum practicable releases from S-38.

Constraints. Discharge from S-38 should not cause the tailwater to exceed 8.2 ft.

STRUCTURE 38 (S-38)

Summary of Hydraulic Design

Location	L-36
Design Conditions	
Discharge (cfs)	500
Headwater Elevation (ft.)	13.0
Tailwater Elevation (ft.)	10.0
SPF Condition	
Discharge (cfs)	600
Headwater Elevation (ft.)	14.5
Optimum Conditions	
Headwater Elevation (ft.)	11.0-11.5
Tailwater Elevation (ft.)	6.5
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	52
Invert Elevation (ft.)	
Headwater	3.0
Tailwater	2.0
Gates	
Type of Control	manual slide gate
Number	2
Size (dia., inches)	72



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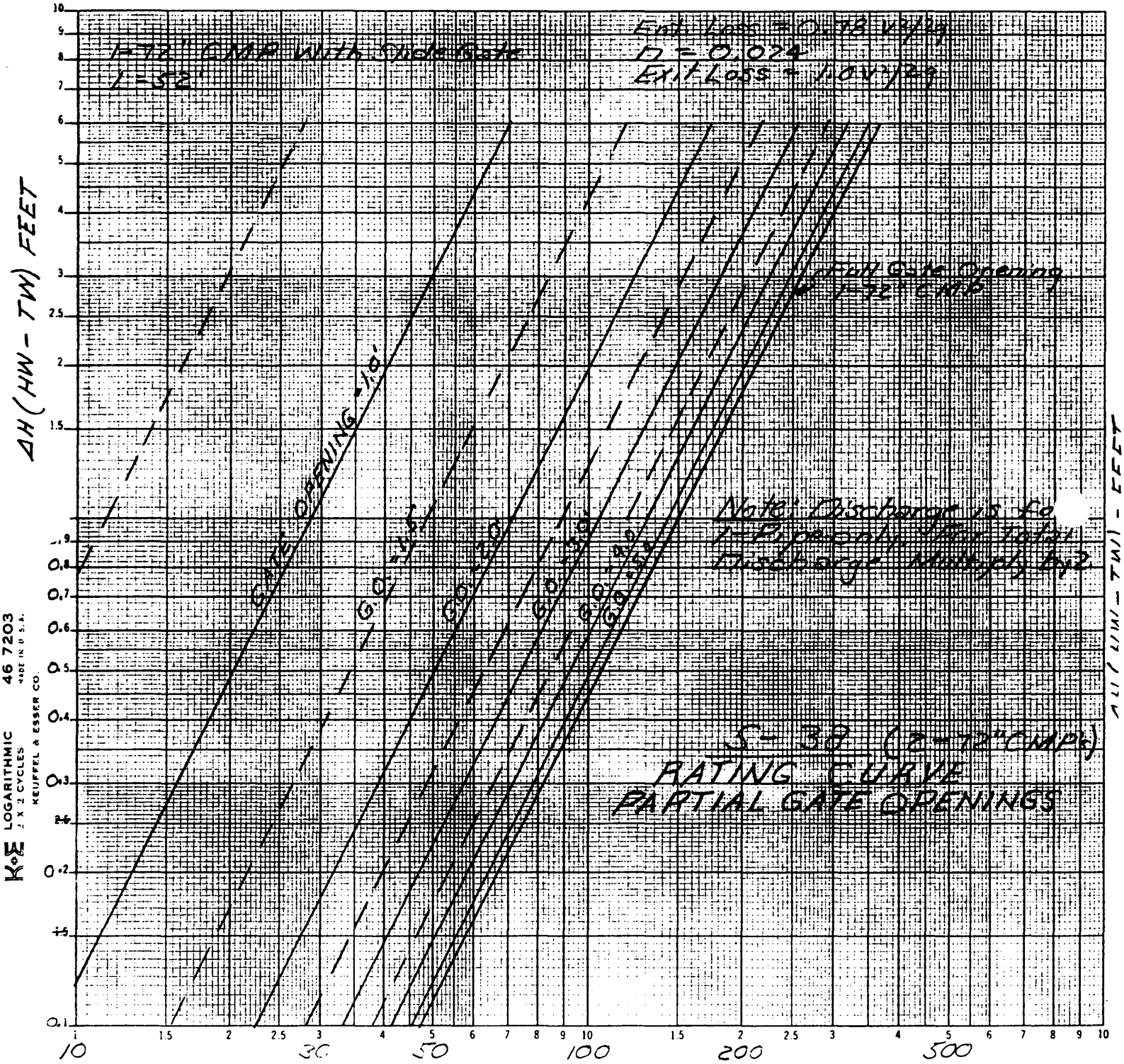
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
UNCONTROLLED FLOW
STRUCTURE 38

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 1968



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MASTER WATER CONTROL MANUAL FOR
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DISCHARGE RATING CURVE
PARTIAL GATE OPENING
STRUCTURE 38

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NOVEMBER 1969

STRUCTURE 38A (S-38A)

Location. Structure 38A is located in the L-36 borrow canal on the east perimeter on WCA No. 2, just north of C-14 and about 13 miles west of Pompano Beach, Florida.

Description. S-38A is a double-barreled, 60-inch diameter, corrugated metal pipe culvert. Control is effected by flashboards in a CMP riser pipe on the upstream or north end of the structure.

Purpose. This structure along with S-38B controls the seepage rate from WCA No. 2A and discharge from the North Springs Improvement District Pump Station at S-38B by regulating the water level in the south half of the L-36 borrow canal.

Regulation. This structure is manually operated to maintain the optimum upstream water level of 7.65 feet, NGVD, insofar as possible. When the North Springs Improvement District discharges, sufficient boards are removed to hold a maximum headwater stage at 9.0 feet, NGVD.

Constraints. Water elevation of 14.37 feet, NGVD, will bypass structure.

STRUCTURE 38A (S-38A)

Summary of Hydraulic Design

Location	
L-36	
Design Conditions	
Discharge (cfs)	190
Headwater Elevation (ft.)	9.0
Tailwater Elevation (ft.)	8.0
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	60
Length (ft.), each	70
Invert Elevation (ft.)	2.0
Service Bridge Elevation (ft.)	12.77
Riser Pipe Top Elevation (ft.)	12.37
Size (dia., inches)	84
Stop Logs	
Number per barrel	8
Size	2" x 10" x 6'10"
Top of Board Elevation (ft.)	12.77
Elevation of Control Weir (ft.)	
All boards removed	2.0
All boards in place	8.5

STRUCTURE 38B (S-38B)

Location. S-38B is located in the L-36 borrow canal about midway between S-38 and S-39 and about 13 1/2 miles southwest of Boca Raton, Florida.

Description. S-38B is a gated, single barrel, 66-inch, corrugated metal pipe culvert. The manually operated, 72-inch square, slide gate is on the upstream side, north end of the culvert.

Purpose. S-38B, with S-38A, controls the seepage rate from WCA No. 2A by regulating the water level in the south half of the Levee 36 borrow canal.

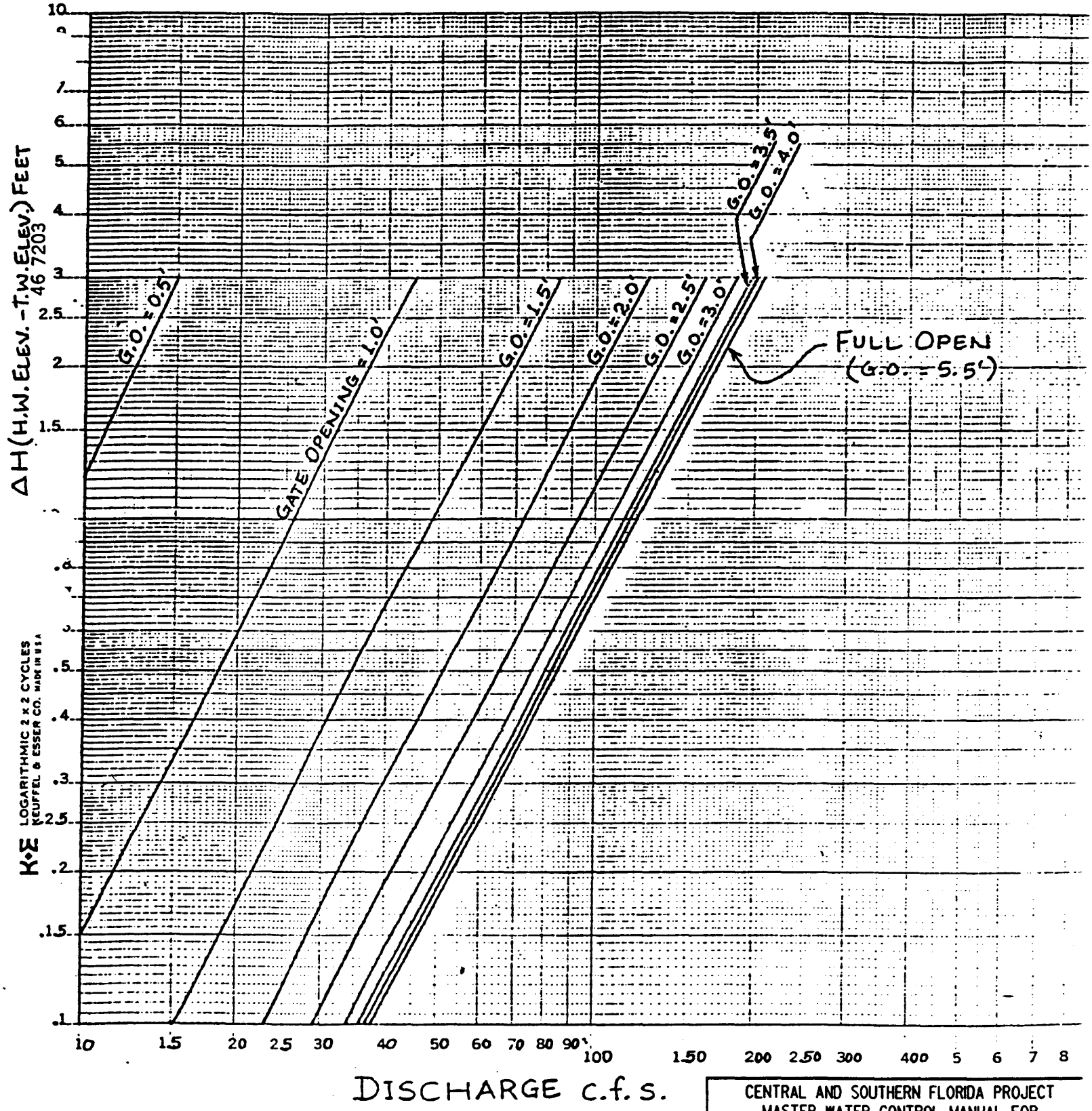
Normal Regulation. S-38B is manually operated to maintain an optimum water surface of 7.65 ft. in the southern portion of the L-36 borrow canal in so far as possible.

Constraints. Water will bypass the structure at a stage of 15.0 ft.

STRUCTURE 38B (S-38B)

Summary of Hydraulic Design

Location	L-36
Design Conditions	
Discharge (cfs)	unknown
Headwater Elevation (ft.)	9.0
Tailwater Elevation (ft.)	7.65
Optimum Conditions	
Headwater Elevation (ft.)	9.0
Tailwater Elevation (ft.)	7.65
Culvert	
Type	CMP
Number of Barrels	1
Size (dia., inches)	66
Net Length (ft.)	72
Invert Elevation (ft.)	0.0
Gates	
Type of Control	manual slide gate
Number	1
Size (width x height, inches)	72



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 38B

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1981

A-S38B-3

STRUCTURE 39 (S-39)

Location. S-39 is located in WCA No. 1, where L-40 crosses the Hillsboro Canal, about 13 miles west of Boca Raton, Florida.

Description. Structure S-39 is a single-bay reinforced concrete spillway. The flow is controlled by a top sealing tainter gate, which can be operated remotely by computer or manually on site.

Purpose. The primary purpose of S-39 is to release water from WCA No. 1 to supply water needs along the Hillsboro Canal during dry periods. It may also discharge excess water from WCA No. 1 when there is available capacity in the Hillsboro Canal and when the water is not needed in WCA No. 2 or WCA No.3.

Normal Regulation. Releases are made, as necessary, to supply downstream water requirements, so as to maintain an optimum stage of 7.7 ft. at Deerfield Lock. Water releases should not be made from S-39 if the elevation of gage 1-8C is 11.0 ft. or lower.

Flood Control Regulation. The gate of this structure is usually closed. However, it may be opened whenever WCA No. 1 is above the regulation schedule and the excess water is not needed in WCA No. 2 or WCA No. 3.

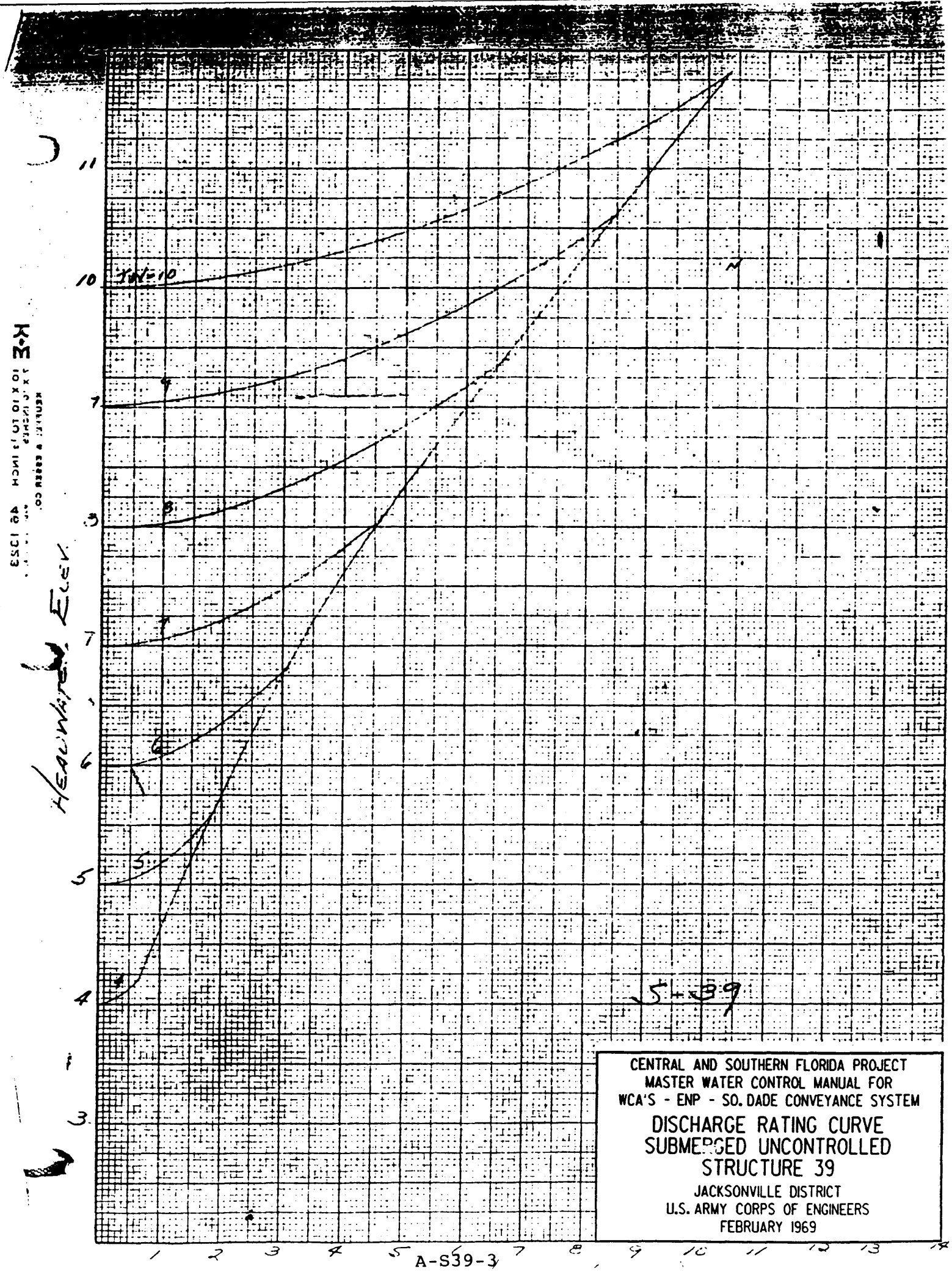
The structure's gate shall be closed whenever releases would aggravate flood conditions downstream. The gate shall be opened whenever damage stages will not be exceeded below the structure and excess water in the WCA No. 1 is increasing the flood potential in the agricultural area south of Lake Okeechobee.

Constraints. Water releases should not be made from S-39 if the elevation of gage 1-8C is 11.0 ft. or lower. Releases should not cause the tailwater to rise above 9.0 ft.

STRUCTURE 39 (S-39)

Summary of Hydraulic Design

Location	L-40
Design Conditions	
Discharge (cfs)	800
Type	uncontrolled submerged
Headwater Elevation (ft.)	11.0
Tailwater Elevation (ft.)	9.0
SPF Condition	
Discharge (cfs)	800
Type	controlled submerged
Headwater Elevation (ft.)	18.4
Tailwater Elevation (ft.)	10.6
Optimum Conditions	
Headwater Elevation (ft.)	14.0-17.0
Tailwater Elevation (ft.)	7.7
Crest	
Shape	rounded
Elevation (ft.)	2.5
Net Length (ft.)	15.0
Gates	
Type of Gate	Tainter
Number	1
Width x Height (ft.)	16.0 x 9.2
Clearance Elevation (ft.)	10.5
Apron	
Elevation (ft.)	-3.5
Length (ft.)	30.0
Service Bridge Elevation (ft.)	24.0



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED UNCONTROLLED
STRUCTURE 39

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1969

STRUCTURE 39A (S-39A)

Location. S-39A is located in the L-36 borrow canal at its junction with the Hillsboro Canal, and about 13 miles west of Boca Raton, Florida.

Description. S-39A is a triple-barrel, 72-inch, corrugated metal pipe culvert. Control is effected by flashboards mounted on a steel frame erected on the upstream or south end of the structure.

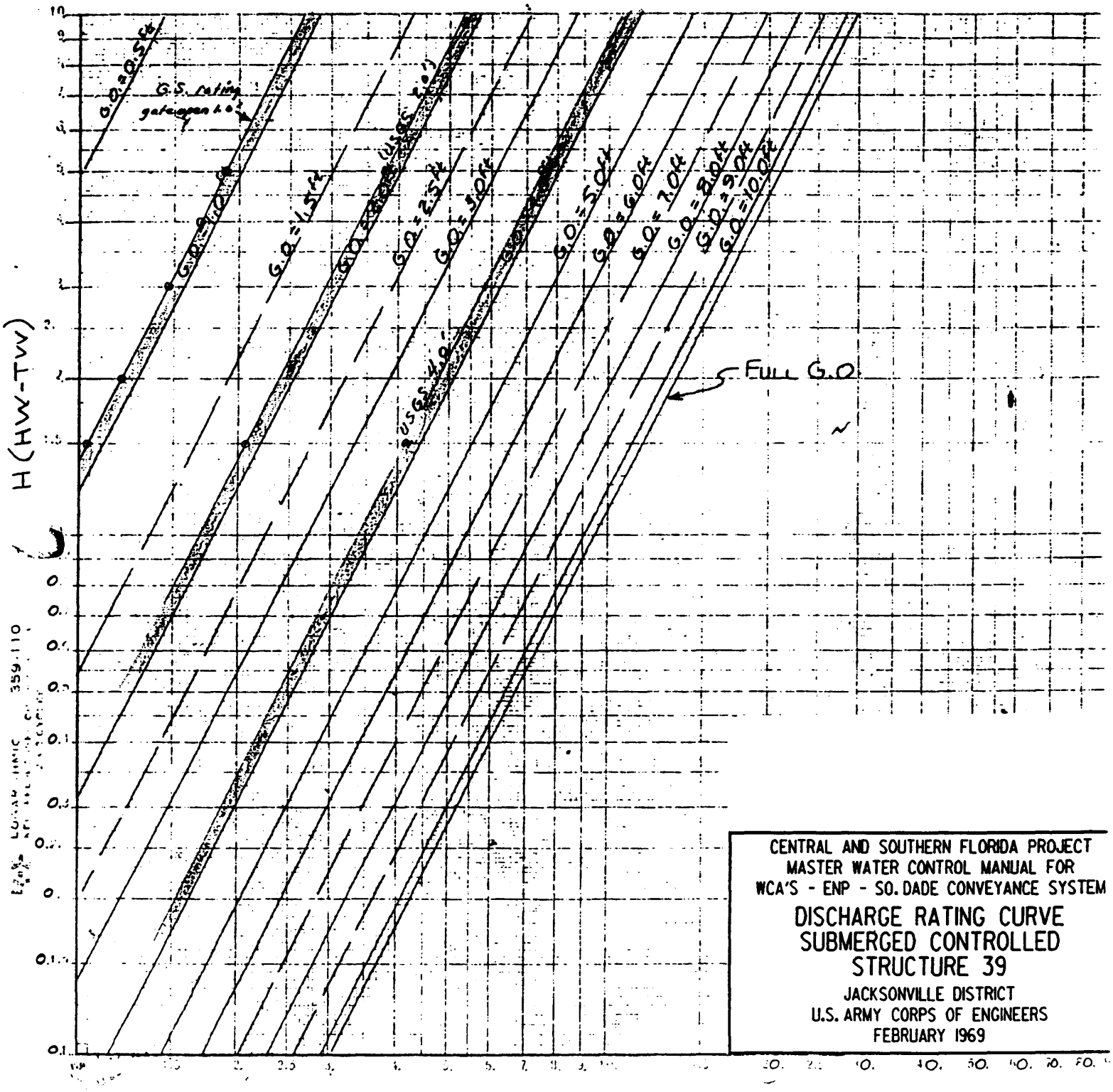
Purpose. S-39A, with S-38B, controls the seepage rate from WCA No. 2A by regulating the water level in the north half of the L-36 borrow canal.

Regulation. S-39A is manually operated to maintain an optimum water surface elevation of 7.0 to 7.5 ft., NGVD, in the northern portion of the L-36 borrow canal. Normally, this structure is opened.

STRUCTURE 39A (S-39A)

Summary of Hydraulic Design

Location	L-36
Design Conditions	
Discharge (cfs)	unknown
Optimum Conditions	
Headwater Elevation (ft.)	7.0 - 7.5
Culvert	
Type	CMP
Number of Barrels	3
Size (dia., inches)	72
Length, each, (ft.)	54
Flow line Elevation (ft.)	3.2
Gates	
Type of Control	manual - flashboards
Number	3
Size (width x height, inches)	72



DISCHARGE (100 CFS)

STRUCTURE 124 (S-124)

Location. S-124 is located in the L-35A borrow canal immediately north of North New River Canal. It is a divide structure between the C-13 and North New River Basins.

Description. S-124 is a gated, five barrel, 72-inch corrugated metal pipe culvert with manual slide gates attached to the pipes.

Purpose. This structure works together with S-125, S-38C and S-36 to maintain an optimum water elevation in the C-13 Basin east of WCA No. 2 and to maintain a sufficient stage in the L-35A borrow canal to limit seepage from WCA No. 2B. S-124 releases excess water from the C-13 Basin so the water may be pumped into WCA No. 3, or discharged to tidewater when capacity is available in North New River Canal.

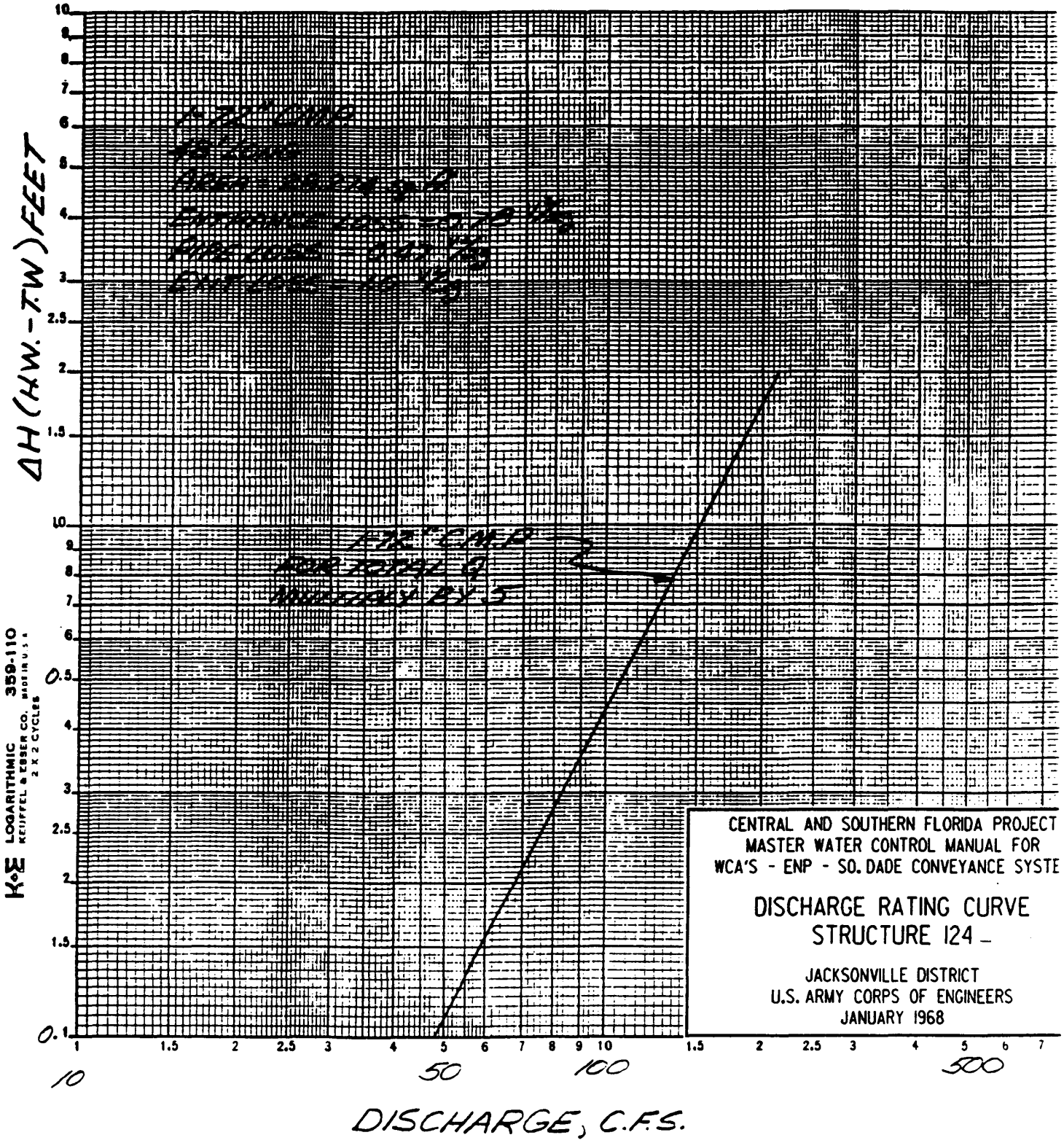
Normal Regulation. S-124 is operated manually according to water levels in the C-13 Basin, and pumping operations in the North New River Canal.

Low Flow Regulation. The gates on the five 72-inch barrels should be operated to support an optimum headwater elevation of 6.0 ft. and to continuously pass the design discharge, 550 cfs, or up to the amount that can reach the structure.

STRUCTURE 124 (S-124)

Summary of Hydraulic Design

Location	L-35A
Design Conditions	
Discharge (cfs)	550
Type	uncontrolled submerged
Headwater Elevation (ft.)	6.5
Tailwater Elevation (ft.)	6.0
Optimum Conditions	
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	5.5
Culvert	
Type	CMP
Number of Barrels	5
Size (diam., inches)	72
Net Length (ft.)	48.0
Invert Elevation (ft.)	-1.0
Gates	
Type of Control	manual slide gate
Number	5
Size (width x height, inches)	72


ΔH (H.W. - T.W.) FEET
DISCHARGE, C.F.S.
10
50
100
500
K+E LOGARITHMIC 359-110
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 X 2 CYCLES
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTE
DISCHARGE RATING CURVE
STRUCTURE 124
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 1968

A-S124-3

STRUCTURE 140 (S-140)

Location. Structure 140 is in L-28 approximately 42 miles south of Clewiston on the east edge of the Seminole Indian Reservation.

Description. S-140 is a pumping station with a gated, gravity spillway. The spillway section is a 16 ft. wide trapezoidal-type spillway with a wheeled vertical lift gate. The spillway was sized to pass 300 cfs at a headwater elevation of 10.5 feet and a head loss of 0.2 feet. S-140 has three axial-flow type vertical-shaft pumps each having a nominal rating of 435 cfs at a 4.1 foot static head.

Purpose. S-140 is used to maintain the L-28 borrow canal level below 10.5 ft. unless gravity flow into WCA No. 3A is possible at an adequate rate. This structure can remove excess drainage water from the drainage area into WCA No. 3, at a rate of 7/16 inch per day. The station serves a 110 square mile drainage area north and east of the interceptor canal and west of L-28.

Regulation. The pumping station should maintain an optimum water control elevation of 10.5 ft in the Levee 28 borrow canal. The pumps should be started and stopped slowly, one pump at a time, to avoid high velocities and surges in the approach canal. The water surface should not be drawn down below elevation 7.5 ft. at the pump intake. If during pumping, the water surface on the intake bay falls below elevation 7.5 ft. all pumps operating should be reduced to not less than the minimum speed as shown on the Operation Chart. If necessary, shut down one or more units until intake pool is re-established above 7.5 ft. No operation should be attempted at heads in excess of 5.2 feet nor should engine speeds be increased above 1200 rpm. During extended periods of operation, pump speed may be decreased in order to improve operating efficiency and fuel economy, although such operation will simultaneously result in a decrease in capacity. The Operation Chart defines the entire recommended range over which pumping can be accomplished. During certain periods, stages in the conservation area will be low enough to permit sufficient gravity discharge through the spillway.

Constraints. The main pumping units at Station 140 are free from severe or harmful criticals through the speed range zero to 1200 rpm. However, there are minor criticals at 646 rpm and 841 rpm and these speeds should be avoided in the starting up and slowing down phases.

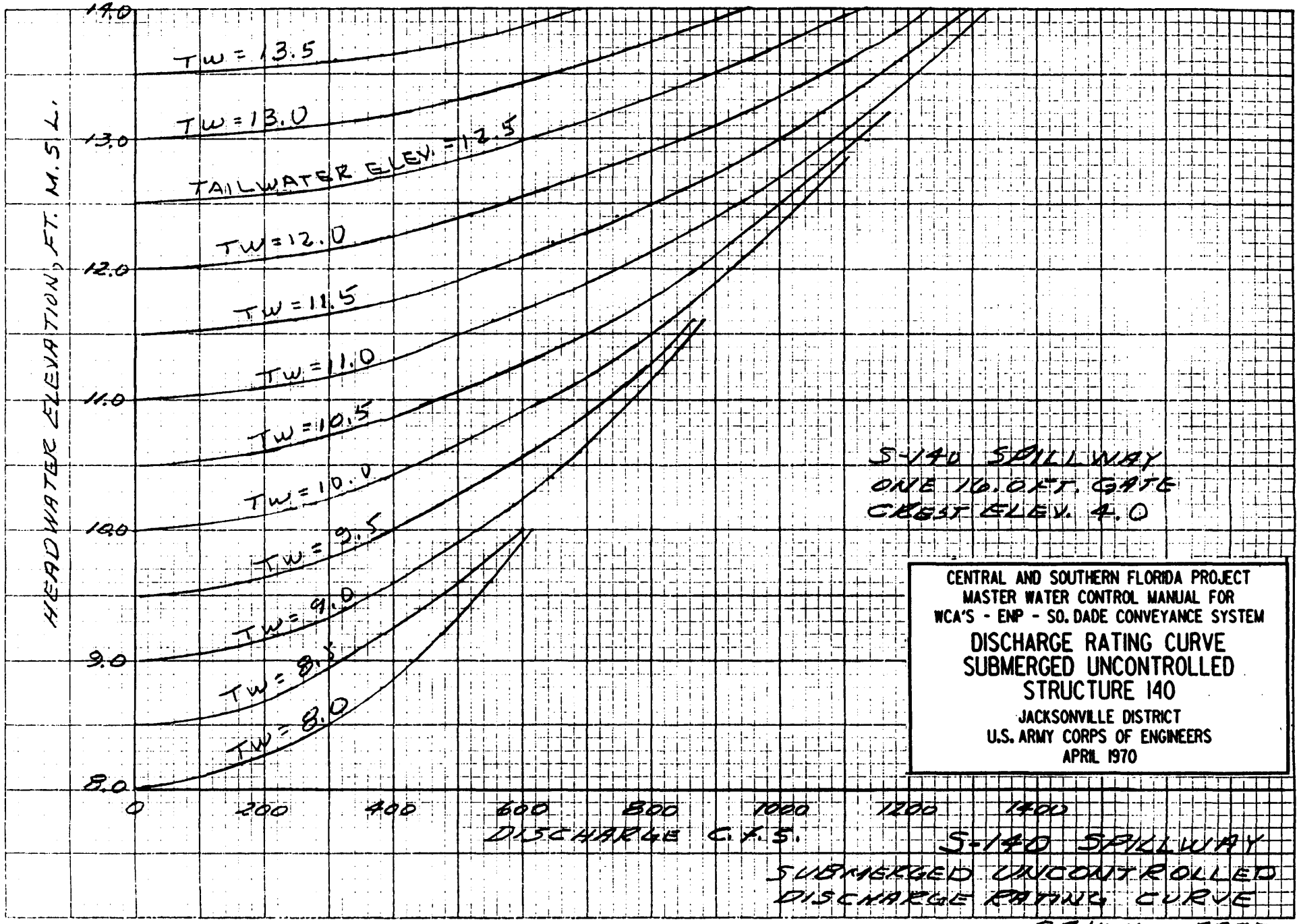
The water level which will bypass the structure is 19.0 ft.

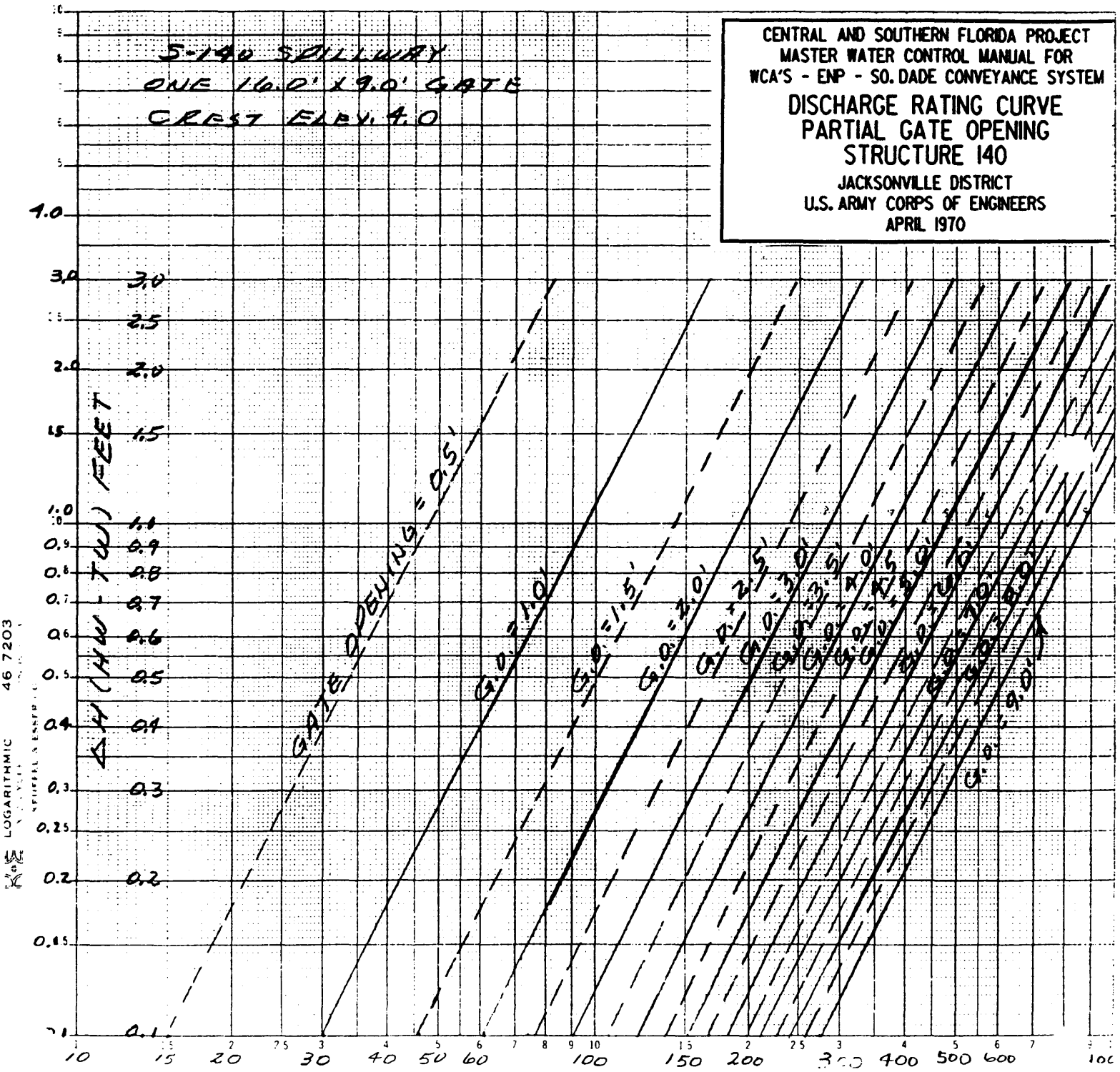
STRUCTURE 140 (S-140)

Summary of Hydraulic Design

Location	L-28
Drainage Area (sq. miles)	110
Pumping Station	
Design Conditions	
Discharge (cfs)	1,300
Headwater Elevation (ft.)	10.5
Tailwater Elevation (ft.)	14.6
Intake Water Surface Elevation (ft.)	
Start Pumps	10.5
Normal Drawdown	9.5
Minimum	7.5
Pumps	
Type	vertical propeller
Number & Size (inches)	3 @ 110
Design Rating (cfs)	435
Impeller Speed (rpm)	81.6
Engine Horsepower (ea)	320
Engine Speed (rpm)	1,200
Gates (per bay)	
Number	1
Location	downstream end
Type	vert. lift flapgates
Size (width x height, ft.)	23.25 x 7.9
Gravity Spillway	
Design Conditions	
Discharge (cfs)	300
Headwater Elevation (ft.)	10.5
Tailwater Elevation (ft.)	10.3
Crest	
Type	Trapezoidal
Elevation (ft.)	4.0
Length (ft.)	16.0
Invert Elevation (ft.)	3.0
Gate Sill Elevation (ft.)	4.0
Gates	
Type of Control	Vertical lift
Number	1
Size (width x height, ft.)	16.0 x 9.0

K+E 5 x 5 TO ½ INCH 46 0863
KEUFFEL & ESSER CO.



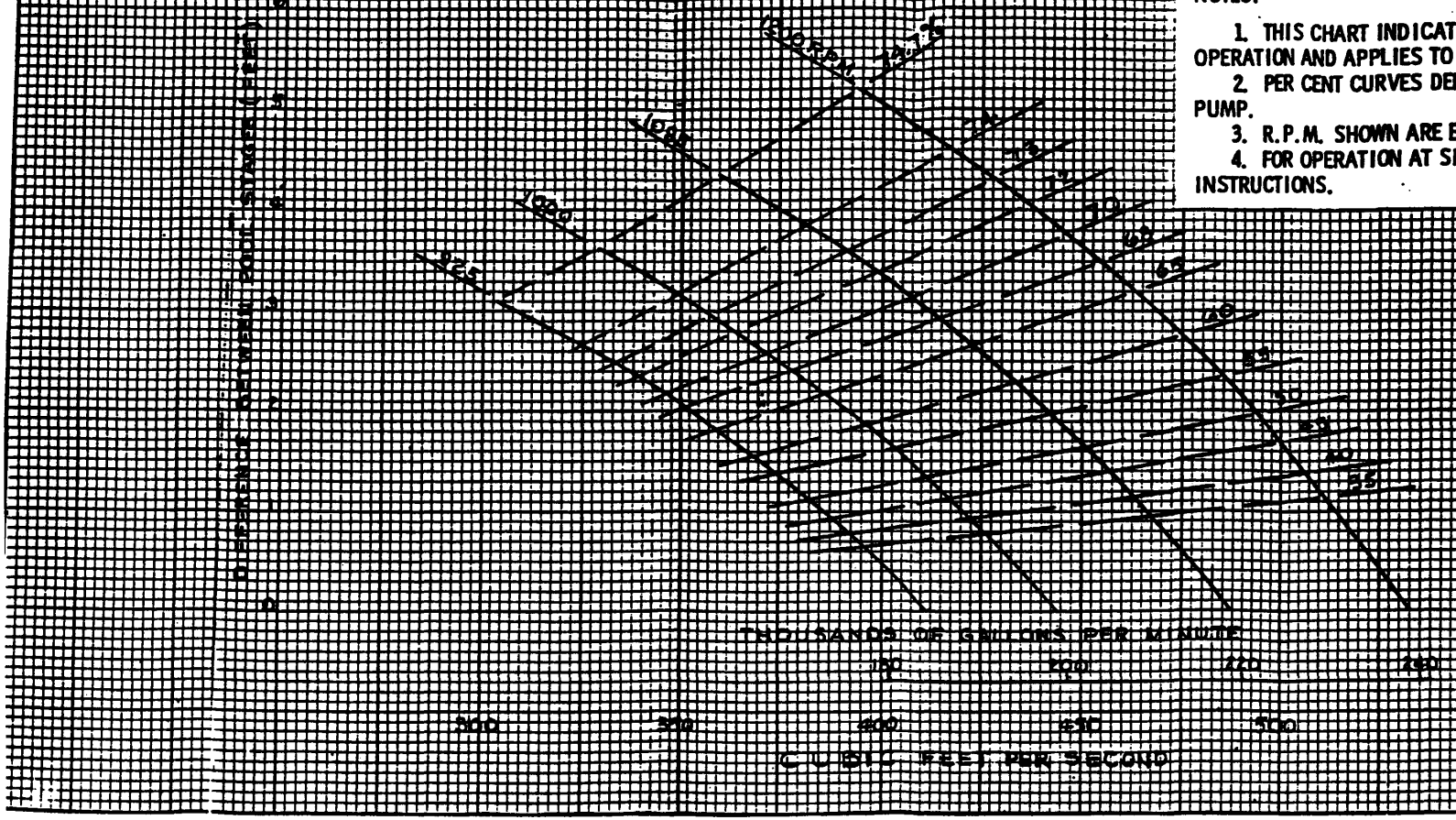


S-140 SPILLWAY

RATING CURVE FOR
PARTIAL GATE OPENING

SAJWA APR. 70

OPERATION CHART FOR PUMPIN' TATION 140



NOTES:

1. THIS CHART INDICATES RECOMMENDED LIMITS FOR CONTINUC OPERATION AND APPLIES TO EACH OF THREE (3) MAIN PUMPS.
2. PER CENT CURVES DENOTE POOL-TO-POOL EFFICIENCY OF THE PUMP.
3. R.P.M. SHOWN ARE ENGINE SPEEDS.
4. FOR OPERATION AT SPEEDS OTHER THAN SHOWN, SEE OPERATI INSTRUCTIONS.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYST

OPERATION CHART
PUMP STATION 140

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994

STRUCTURE 141 (S-141)

Location. S-141 is in Levee 38E at the southwest corner of Water Conservation Area No. 2B, about 20 miles west of Ft. Lauderdale, Florida.

Description. S-141 is a six-bay steel sheet pile spillway with a weir crest length of 30 feet. The structure has timber flashboards and a timber operating platform. The flashboards sit on a concrete sill which also serves as a cap for the sheet pile weir.

Purpose. Regulatory discharges from WCA No. 2B are made via S-141. This spillway structure controls the water level in WCA No. 2B, and permits releases from the area to the North New River Canal when capacity is available.

Normal Regulation. When S-141 is not operating under flood conditions and when water is available with releases from S-142 and S-143, then S-141 may be manually operated to support an optimum elevation range of 3.5 to 4.5 at Sewell's Lock.

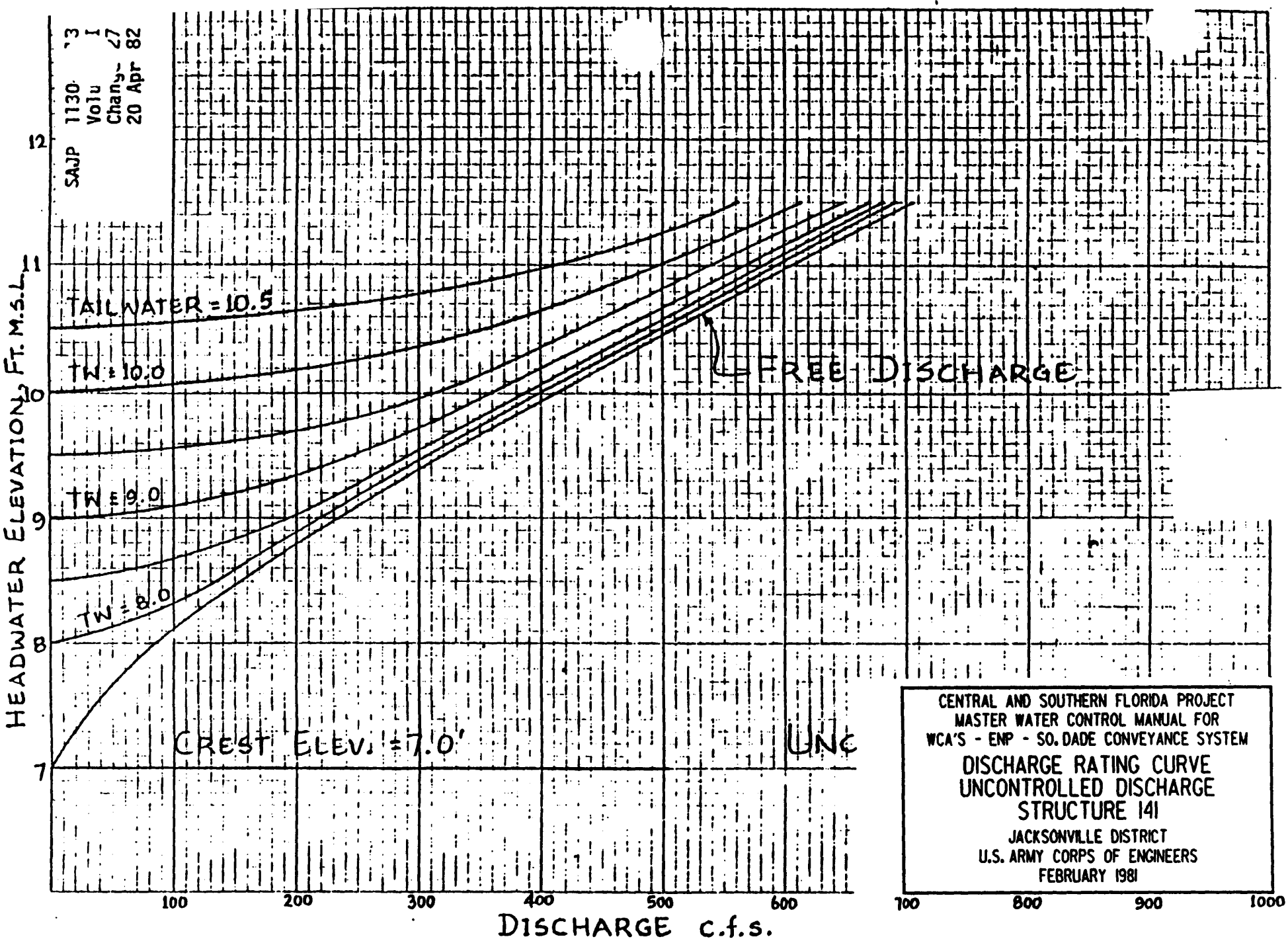
Flood Control Regulation. Whenever WCA No. 2B exceeds 11.0 ft., S-141 will be operated for flood releases through S-34 if canal capacity is available. A regulation schedule is not used for WCA No. 2B due to high rates of seepage from the area.

Constraints. Discharges should not cause S-34's tailwater to exceed 6.0 ft.

STRUCTURE 141 (S-141)

Summary of Hydraulic Design

Location	L-38E
Design Conditions	
Discharge (cfs)	435
Type	controlled submerged
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	8.0
Optimum Conditions	
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	8.0
Crest	
Shape	weir
Elevation (ft.)	7.0
Length	30.0
Gates	
Type	Timber flashboards
Number of Bays	6
Concrete Cap Elevation (ft.)	7.0



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
UNCONTROLLED DISCHARGE
STRUCTURE 141

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1981

STRUCTURE 142 (S-142)

Location. S-142 is in WCA No. 3A, between the North New River Canal and WCA No. 3A., about 350 feet west of U.S. Highway 27. It is about 20 miles west of Ft. Lauderdale, Florida.

Description. S-142 is a gated, two barrel, 72-inch, corrugated metal pipe culvert with concrete headwalls. It has standard manual slide gates, a timber walkway, and a concrete operating platform.

Purpose. S-142 releases water from WCA No. 3A for water supply and other water needs along the North New River Canal through control structure S-34. It can also make regulatory releases from WCA No. 3A.

Normal Regulation. When S-142 is not operating under flood conditions and when water is available, releases are made in conjunction with S-141 and S-143, and S-142 may be manually operated to support an optimum elevation range of 3.5 ft. to 4.5 ft. at Sewell's Lock.

Flood Control Regulation. S-142 may be operated to make regulatory releases from WCA No. 3A.

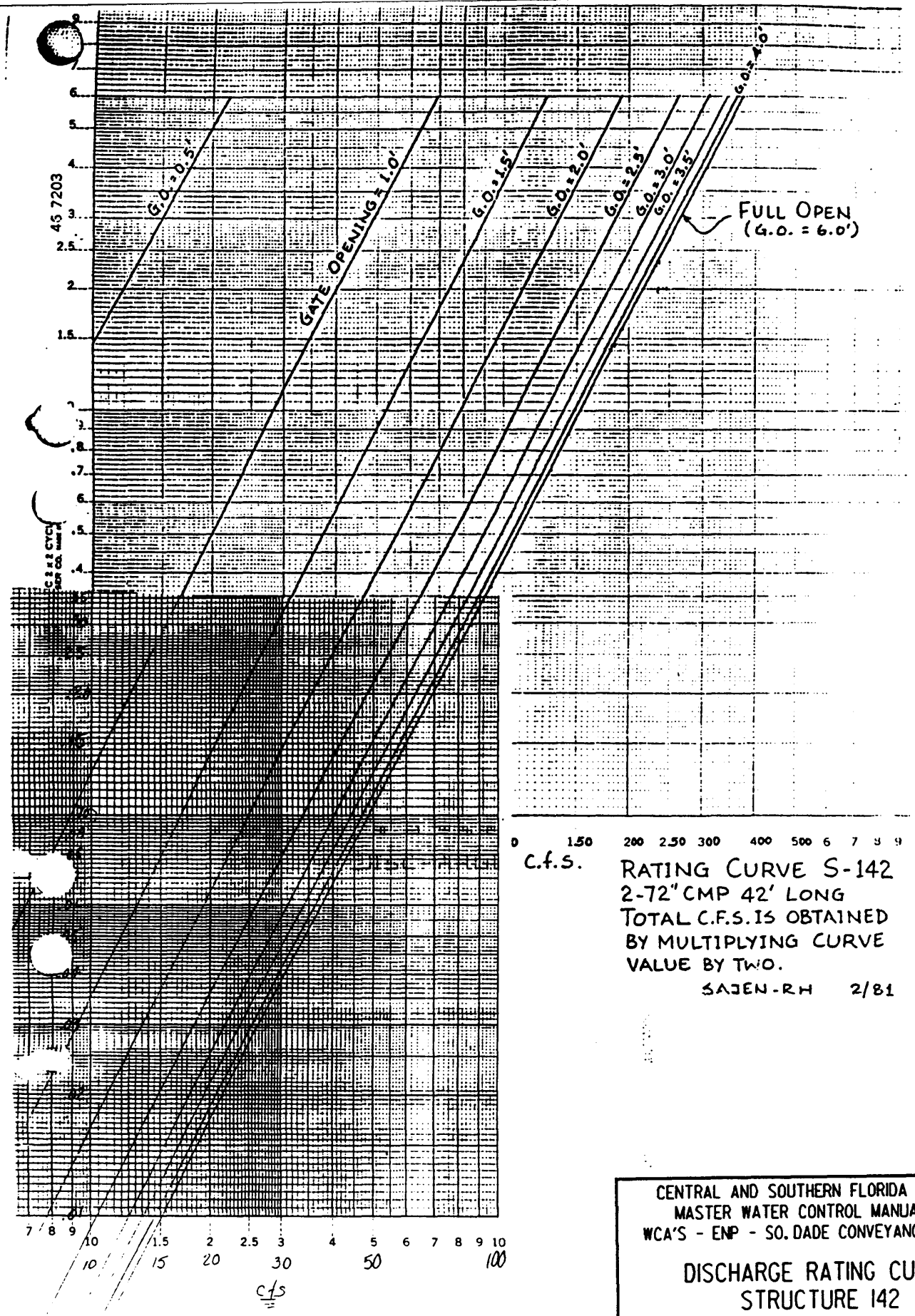
Low Flow Regulation. When there is insufficient water available in the WCA's, water is transferred from Lake Okeechobee through the WCA's to meet the needs of the East Coast and ENP. SFWMD can make water supply releases to the East Coast from the WCA's through S-142 and other structures.

Constraints. Discharges should not cause S-34's tailwater to exceed 6.0 ft.

STRUCTURE 142 (S-142)

Summary of Hydraulic Design

Location	L-38W
Design Conditions	
Discharge (cfs)	430
Type	controlled submerged
Headwater Elevation (ft.)	11.0
Tailwater Elevation (ft.)	9.0
Optimum Conditions	
Headwater Elevation (ft.)	11.0
Tailwater Elevation (ft.)	9.0
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	42
Invert Elevation (ft.)	2.0
Gates	
Type of Control	manual slide gate
Number	2
Size (width x height, inches)	72x72



RATING CURVE S-142
2-72" CMP 42' LONG
TOTAL C.F.S. IS OBTAINED
BY MULTIPLYING CURVE
VALUE BY TWO.

SAJEN-RH 2/81

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
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DISCHARGE RATING CURVE
STRUCTURE 142

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1981

A-S142-3

STRUCTURE 143 (S-143)

Location. S-143 is located in Water Conservation Area No. 2A at the juncture of Levee 35B and the North New River Canal, about 215 feet south of Control Structure 11A.

Description. S-143 is a gated, two barrel, 72-inch, corrugated metal pipe culvert with concrete headwalls, wingwalls, and aprons. It has standard manually operated slide gates, a timber walkway, and a concrete operating platform. Timber flashboards are used to facilitate the dewatering of the gate side of the structure if needed.

Purpose. S-143 releases water from WCA No. 2A to maintain desirable water levels, and to supply irrigation and other water needs along the North New River Canal through control structure S-34. The structure will also permit small flood releases when the capacity of North New River Canal is not required to remove local runoff.

Normal Regulation. When S-143 is not operating under flood conditions and when water is available with releases from S-141 and S-142, then S-143 may be manually operated to support an optimum elevation range of 3.5 to 4.5 feet at Sewell's Lock.

Flood Control Regulation. Prior to the hurricane season, discharges may be made from S-143 whenever WCA No. 2A has excess water. This is when the stage in WCA No. 2A is in "Area A" of the regulation schedule (measured at gage 112). Discharges can be made through S-143 if doing so doesn't cause the tailwater elevation to exceed 10.0 ft.

When the WCA No. 2A stage is in Zone A and Structure 11 is at maximum capacity, the U. S. Army Corps of Engineers may request maximum practicable releases from S-143 as long as doing so will not cause damages downstream.

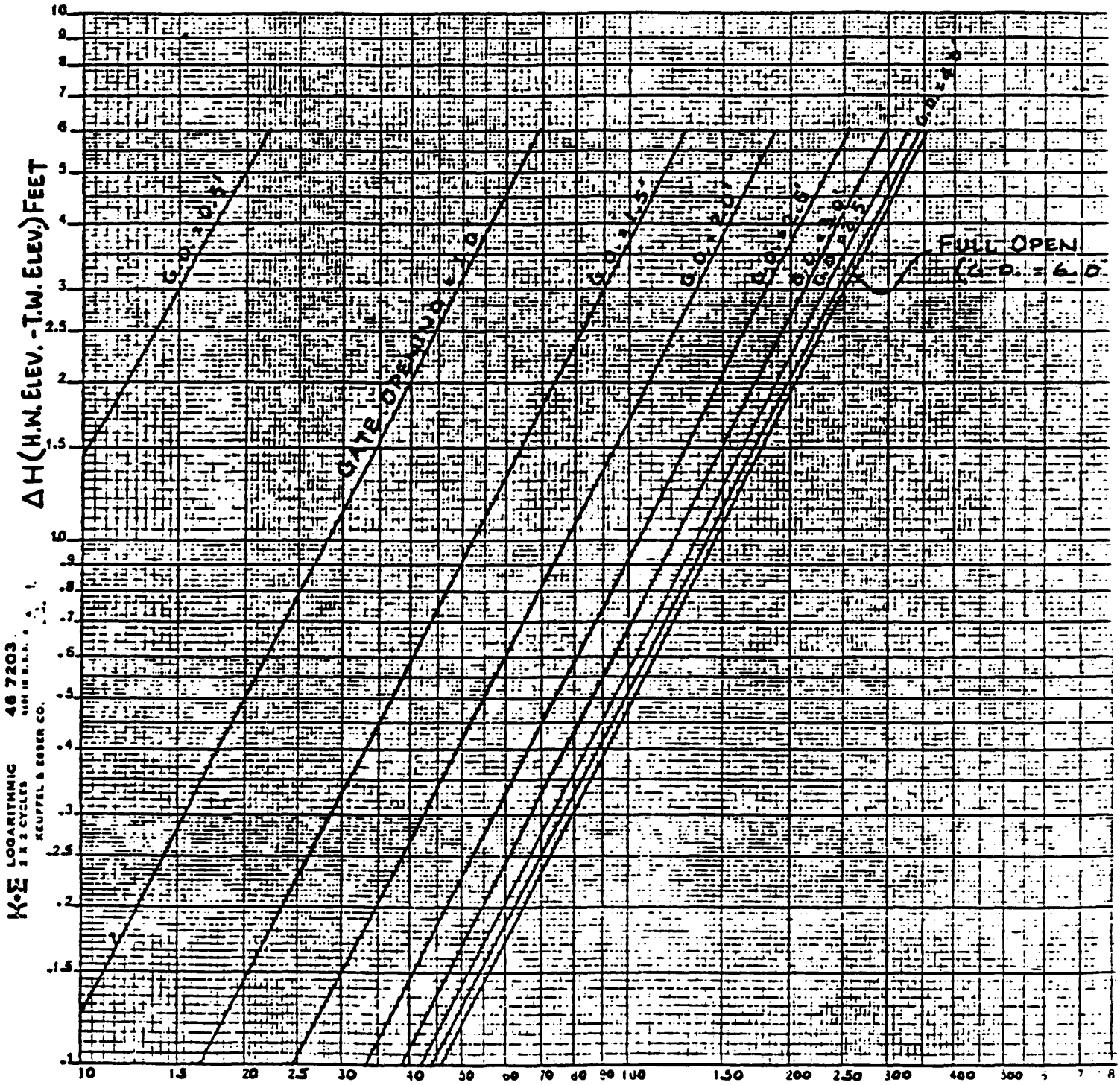
Low Flow Regulation. When there is insufficient water available in the WCA's, water is transferred from Lake Okeechobee through the WCA's to meet the needs of the East Coast and ENP. SFWMD can make water supply releases to the East Coast from the WCA's through S-143 and other structures.

Constraints. Discharges from S-143 shouldn't cause the tailwater to exceed 10.0 ft. during flood conditions or when water is not needed in WCA No. 3.

STRUCTURE 143 (S-143)

Summary of Hydraulic Design

Location	L-35B
Design Conditions	
Discharge (cfs)	500
Type	controlled submerged
Headwater Elevation (ft.)	13.0
Tailwater Elevation (ft.)	10.0
Critical Design Conditions	
Headwater Elevation (ft.)	14.5
Tailwater Elevation (ft.), approx.	8.0
Minimum Tailwater, no flow @S-34	6.0
Culvert	
Number	1
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	70
Invert Elevation (ft.)	2.0
Gates	
Type of Control	manual slide gate
Number	2
Size (dia., inches)	72



DISCHARGE c.f.s.

A-S143-3

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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 143

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
FEBURARY 1981

STRUCTURE 144 (S-144)

Location. S-144 is located in Levee 35B, an interior levee of WCA No. 2 which separates WCA No. 2A from WCA No. 2B.

Description. S-144 is a one barrel, 72-inch, corrugated metal pipe culvert with a standard manual slide gate. The structure has a timber operating platform. S-144 was replaced with a new structure in 1991.

Purpose. S-144 together with S-145 and S-146, releases water from WCA No. 2A into WCA No. 2B to regulate water levels in WCA No. 2A. South Florida Water Management District operates S-144 with prior concurrence of the U.S. Army Corps of Engineers, Jacksonville District.

Normal Regulation. The gate at S-144 is usually closed. The structure is used with S-145 and S-146 to provide water to WCA No. 2B. S-144 also serves to remove excess water from WCA No. 2A.

Flood Control Regulation. This structure can be operated to maintain stages in WCA No. 2A according to the regulation schedule. When the WCA No. 2A stage is in Zone A, S-144 may release up to the maximum discharge of 210 cfs. Releases to WCA No. 2B from S-144 should stop if WCA No. 2B stage (measured at gage 99) exceeds 11.0 ft.

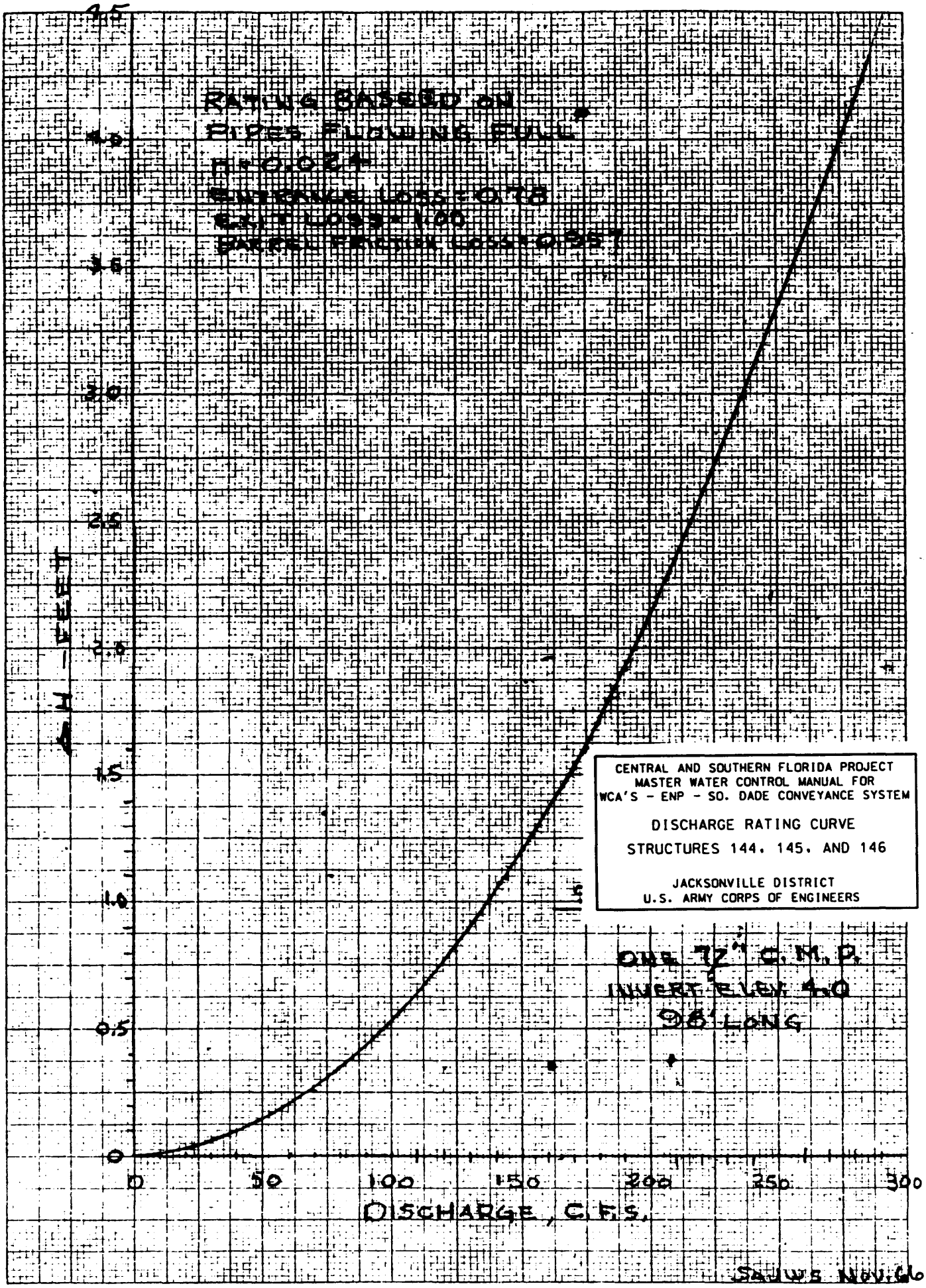
Low Flow Regulation. When WCA No. 2A is below the regulation schedule, releases may be made from S-144 when benefits from releases are greater than benefits from the storage in and the demands on WCA No. 2A. In Zone B only releases for water supply are made.

Constraints. Discharges from S-144 should be discontinued if the stage in WCA No. 2B stage (as measured at gage 99) exceeds 11.0 ft.

STRUCTURE 144 (S-144)

Summary of Hydraulic Design

Location	L-35B
Design Conditions	
Discharge (cfs)	210
Type	controlled submerged
Headwater Elevation (ft.)	12.0
Tailwater Elevation (ft.)	10.0
Critical Design Conditions	
Headwater Elevation (ft.)	14.5
Tailwater Elevation (ft.), approx.	10.5
Minimum Tailwater, no flow	8.5
Culvert	
Type	CMP
Number of Barrels	1
Size (dia., inches)	72
Net Length (ft.)	98
Invert Elevation (ft.)	4.0
Gates	
Type of Control	Manual slide gate
Number	1
Size (dia. inches)	72



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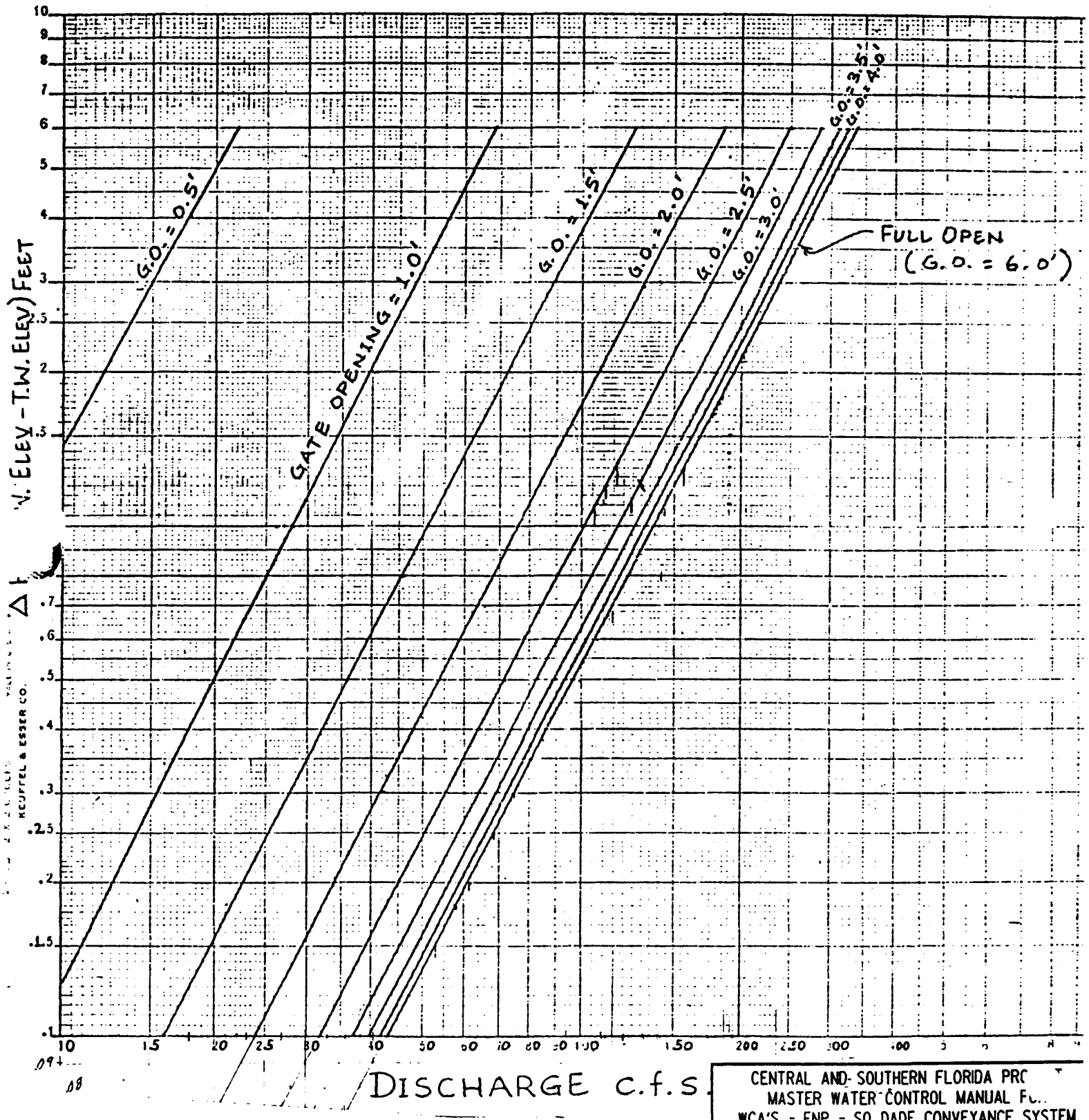
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE

STRUCTURES 144, 145, AND 146

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS



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CENTRAL AND SOUTHERN FLORIDA PRC
MASTER WATER CONTROL MANUAL F...
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 144

JACKSONVILLE DISTRICT

STRUCTURE 145 (S-145)

Location. S-145 is located in Levee 35B, an interior levee of WCA No. 2 which separates WCA No. 2A from WCA No. 2B.

Description. S-145 is a one barrel, 72-inch, corrugated metal pipe culvert with a standard manual slide gate. The structure has a timber operating platform. The structure was replaced with a new structure in 1991.

Purpose. S-145 releases water from WCA No. 2A into WCA No. 2B to regulate water levels. South Florida Water Management District operates S-145 with prior concurrence of the U.S. Army Corps of Engineers, Jacksonville District.

Normal Regulation. The gate at S-145 is usually closed. The structure is used with S-144 and S-146 to provide water to WCA No. 2B. S-145 also serves to remove excess water from WCA No. 2A.

Flood Control Regulation. This structure can be operated to maintain stages in WCA No. 2A according to the regulation schedule. When the WCA No. 2A stage is in Zone A, S-145 may release up to the maximum discharge of 210 cfs. Releases to WCA No. 2B from S-145 should stop if the WCA No. 2B stage (measured at gage 99) exceeds 11.0 ft.

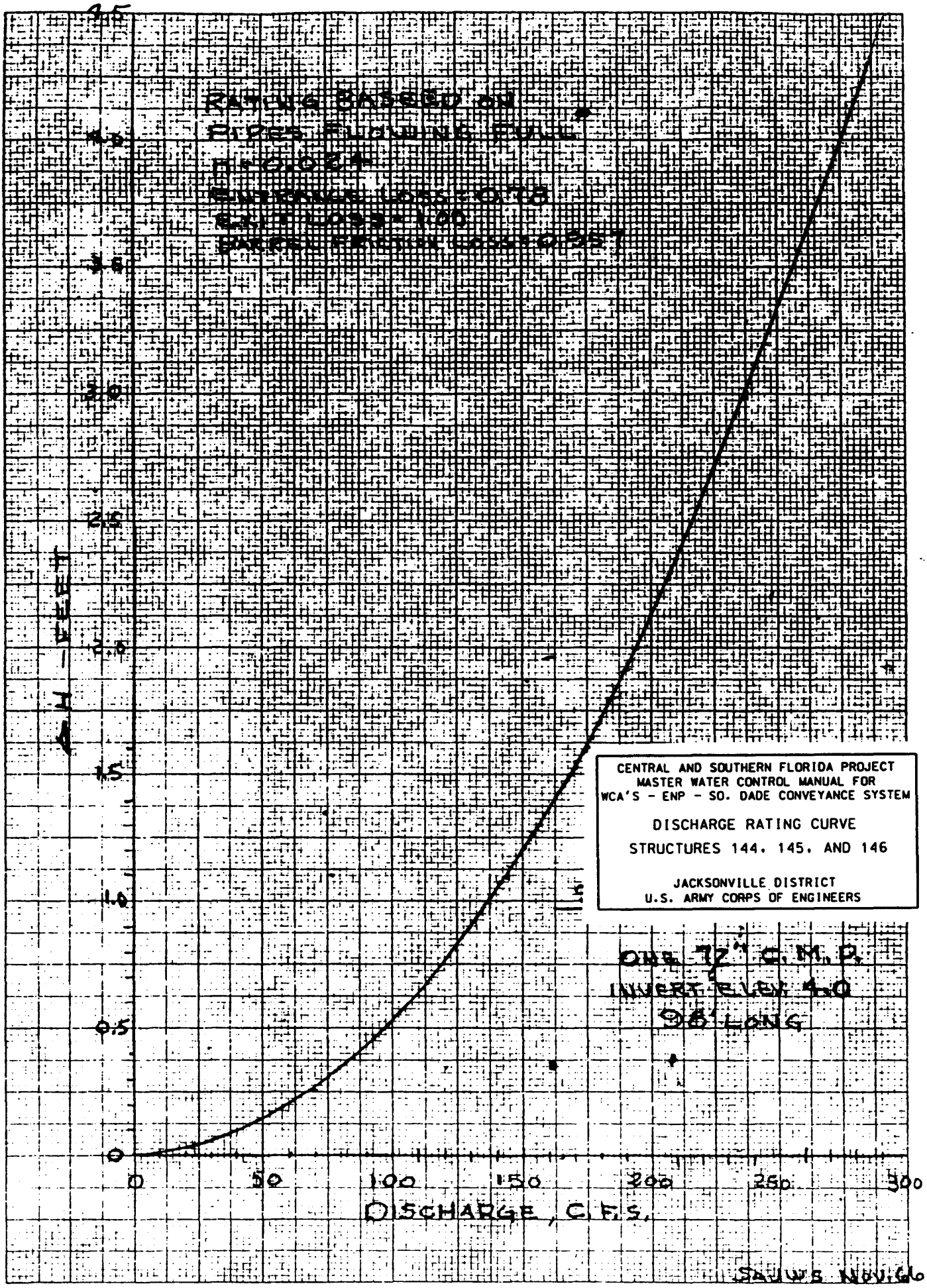
Low Flow Regulation. When WCA No. 2A is below the regulation schedule, releases may be made from S-145 when benefits from releases are greater than benefits from the storage in and the demands on WCA No. 2A. In Zone B only releases for water supply are made.

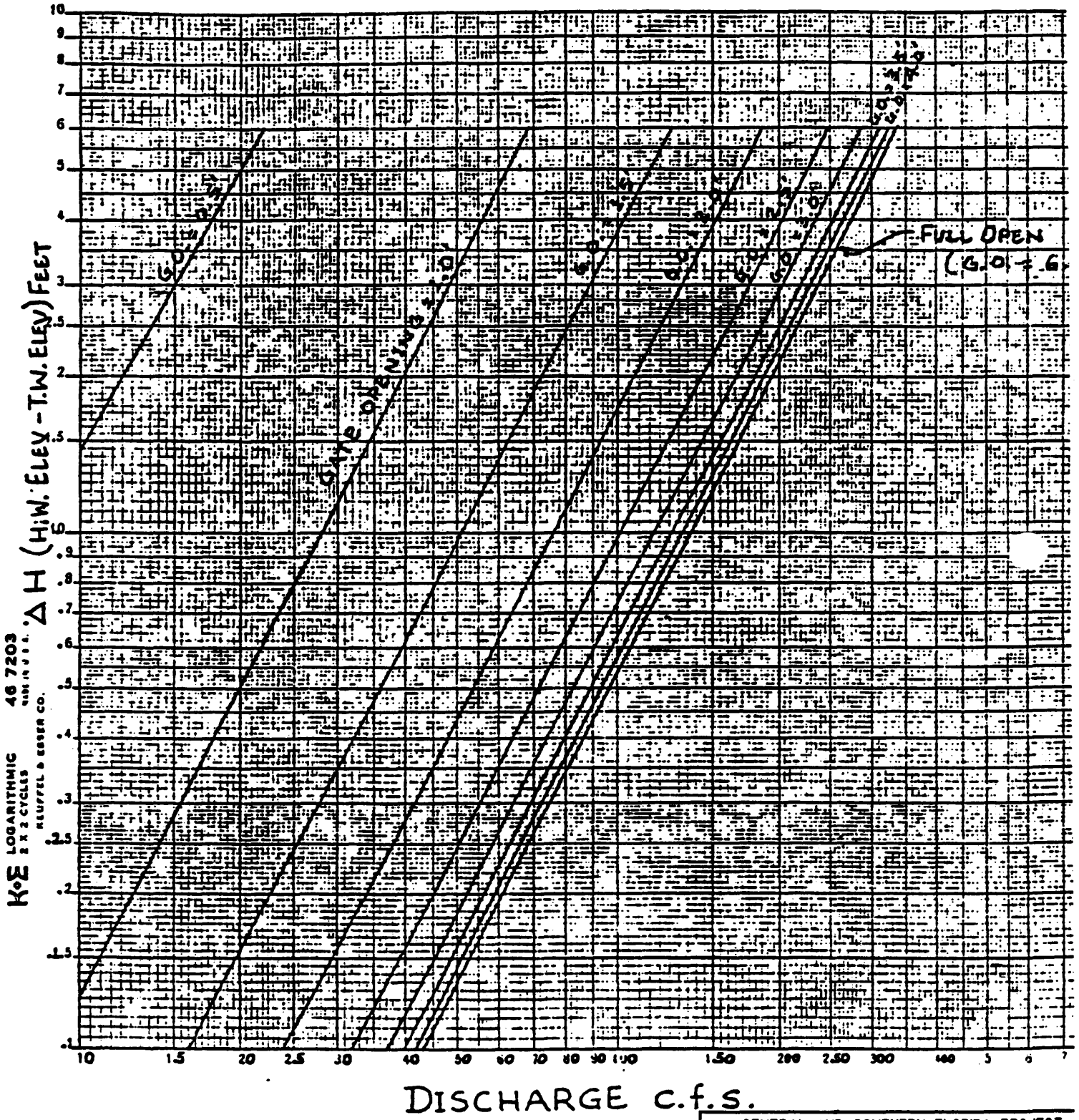
Constraints. Discharges from S-145 should be stopped when the WCA No. 2B stage (measured at gage 99) exceeds 11.0 ft.

STRUCTURE 145 (S-145)

Summary of Hydraulic Design

Location	L-35B
Design Conditions	
Discharge (cfs)	210
Type	controlled submerged
Headwater Elevation (ft.)	12.0
Tailwater Elevation (ft.)	10.0
Critical Design Conditions	
Headwater Elevation (ft.)	14.5
Tailwater Elevation (ft.), approx.	10.5
Minimum Tailwater, no flow	8.5
Culvert	
Type	CMP
Number of Barrels	1
Size (dia., inches)	72
Net Length (ft.)	98
Invert Elevation (ft.)	4.0
Gates	
Type of Control	manual slide gate
Number	1
Size (dia. inches)	72

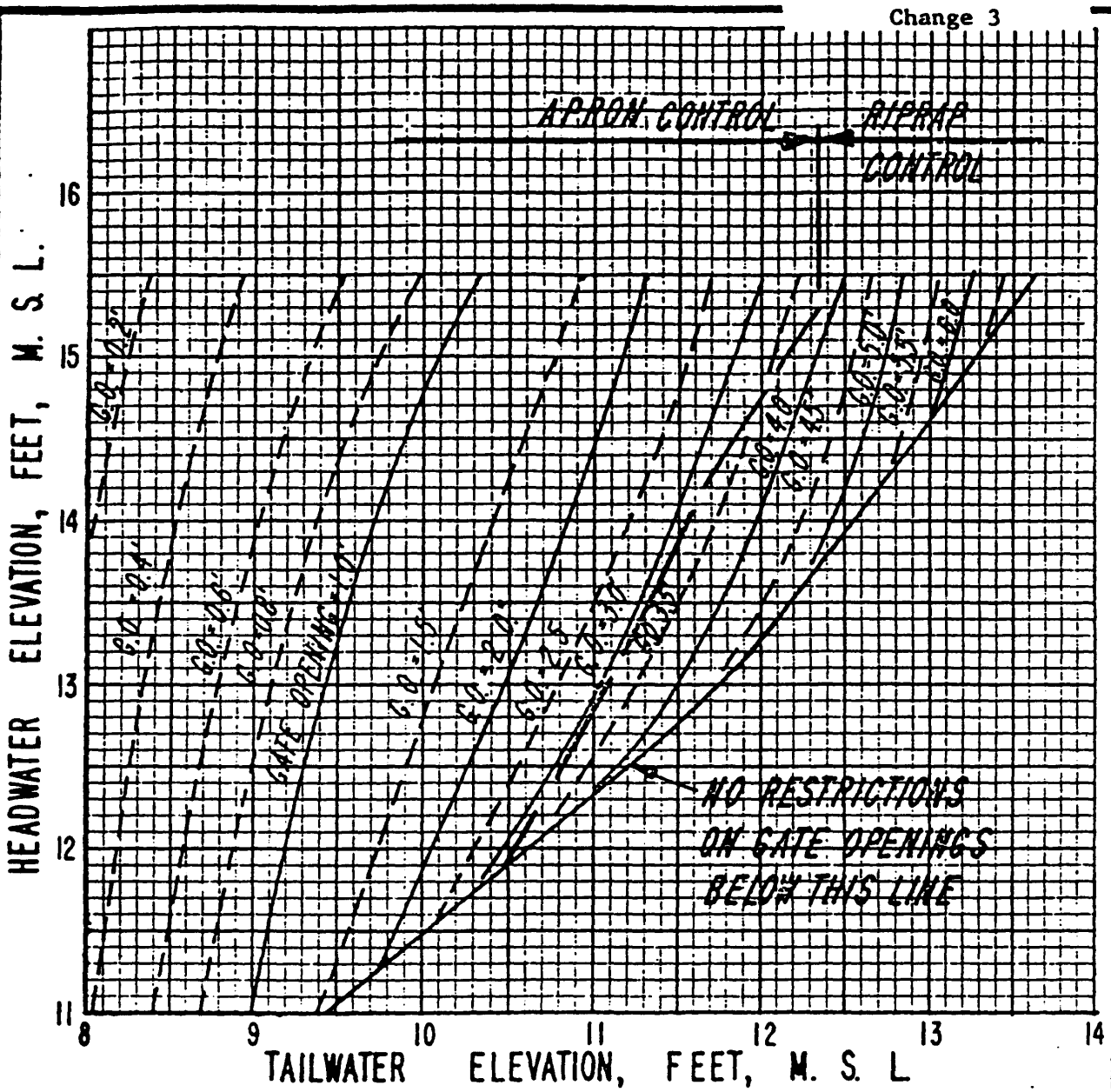

RATING BASED ON
PIPES FLOWING FULL
n=0.024
ENTRANCE LOSS=0.78
EXIT LOSS=1.00
PARTIAL FRICTION LOSS=0.95
H - FEET
DISCHARGE, C.F.S.
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
50
100
150
200
250
300
ONE 72" C.M.P.
INVERT ELEV. 4.0
98' LONG
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING CURVE
STRUCTURES 144, 145, AND 146
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SAJWS NOV.66



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 145 AND 146

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS



NOTE:

SPILLWAY GATES TO BE OPENED UNIFORMLY.

EXAMPLE:

H.W. = 14.0 T.W. = 12.0
GATE OPENING SHOULD NOT EXCEED 4 FEET.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

MAXIMUM ALLOWABLE GATE OPENING
STRUCTURE II

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MAY 1972

STRUCTURE 146 (S-146)

Location. S-146 is located in Levee 35B, an interior levee of WCA No. 2 which separates WCA No. 2A from WCA No. 2B.

Description. S-146 is a single barrel, 72-inch, corrugated metal pipe culvert with a standard manual slide gate. The structure has a timber operating platform. S-146 was replaced by a new structure in 1991.

Purpose. S-146 releases water from WCA No. 2A into WCA No. 2B to regulate water levels. South Florida Water Management District operates S-146 with prior concurrence of the U.S. Army Corps of Engineers, Jacksonville District.

Normal Regulation. The gate at S-146 is usually closed. The structure is used with S-144 and S-145 to provide water to WCA No. 2B. S-146 also serves to remove excess water from WCA No. 2A.

Flood Control Regulation. This structure can be operated to maintain stages in WCA No. 2A according to the regulation schedule. When the WCA No. 2A stage is in Zone A, S-146 may release up to the maximum discharge of 210 cfs. Releases to WCA No. 2B from S-145 should stop if the WCA No. 2B stage (measured at gage 99) exceeds 11.0 feet.

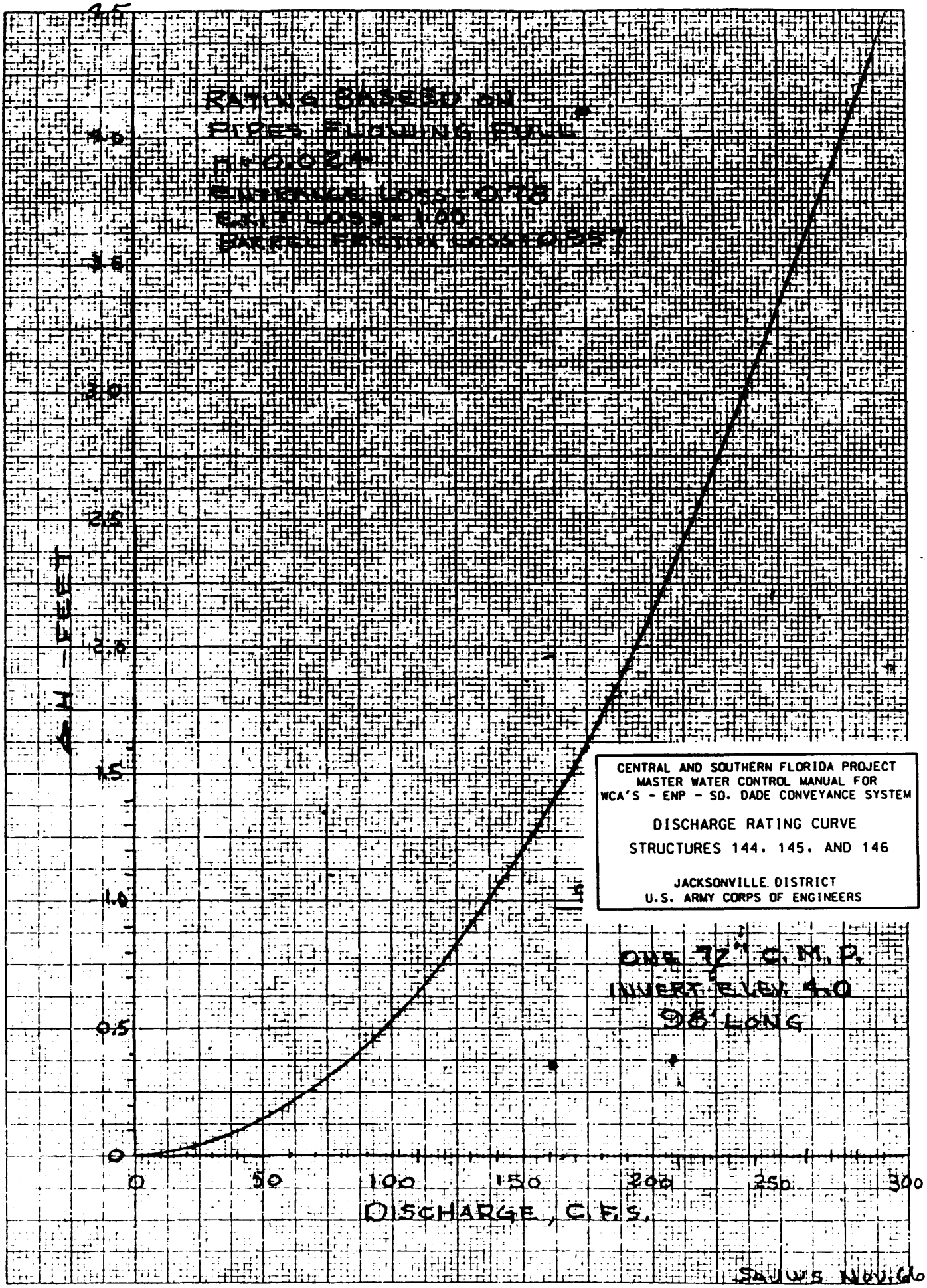
Low Flow Regulation. When WCA No. 2A is below the regulation schedule, releases may be made from S-146 when benefits from releases are greater than benefits from the storage in and the demands on WCA No.2A. In Zone B only releases for water supply are made.

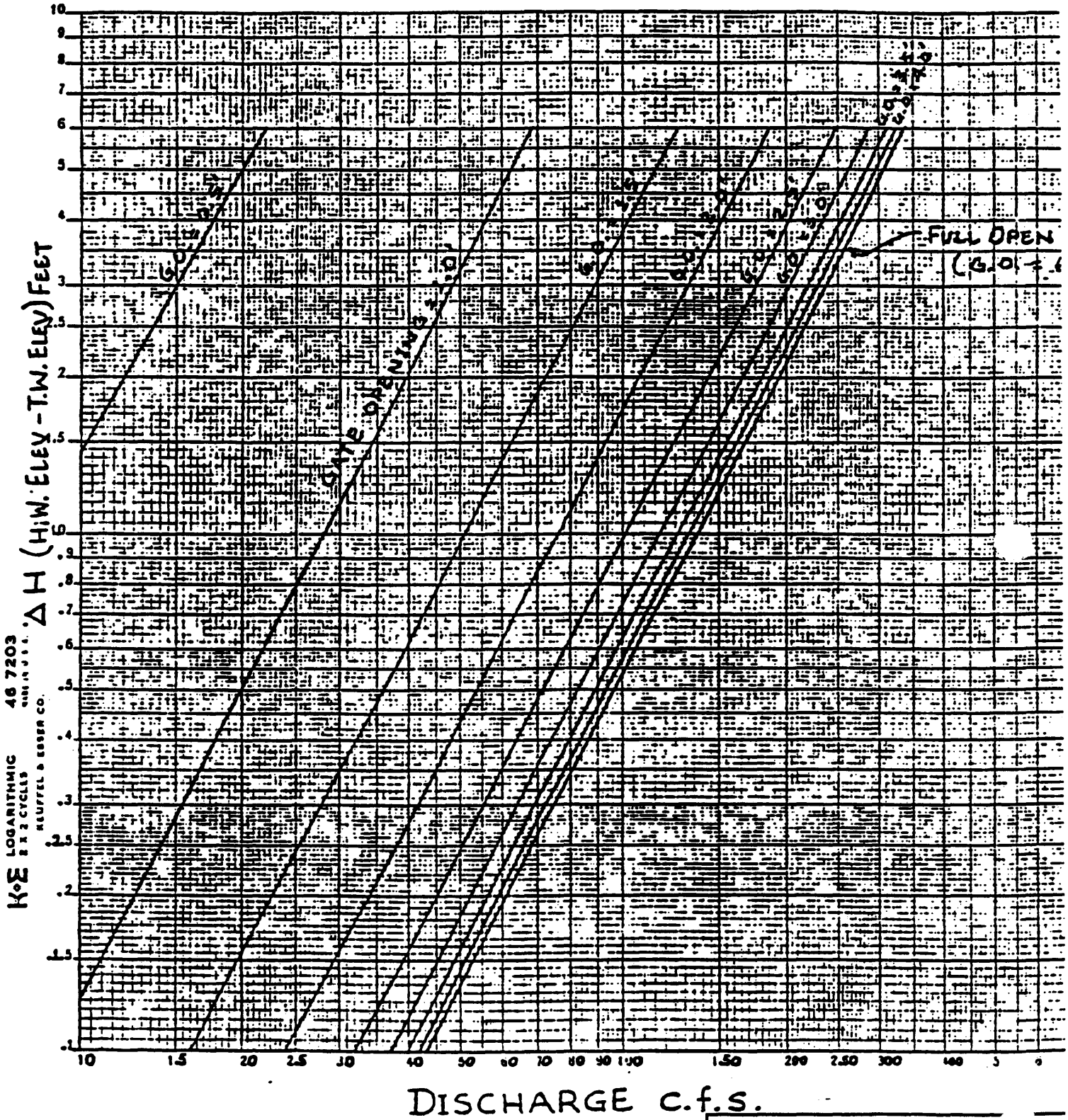
Constraints. Releases through S-146 should be stopped when the WCA No. 2B stage (measured at gage 99) exceeds 11.0 feet.

STRUCTURE 146 (S-146)

Summary of Hydraulic Design

Location	L-35B
Design Conditions	
Discharge (cfs)	210
Type	controlled submerged
Headwater Elevation (ft.)	12.0
Tailwater Elevation (ft.)	10.0
Critical Design Conditions	
Headwater Elevation (ft.)	14.5
Tailwater Elevation (ft.), approx.	10.5
Minimum Tailwater (ft.), no flow	8.5
Culvert	
Type	CMP
Number of Barrels	1
Size (dia., inches)	72
Net Length (ft.)	98
Invert Elevation (ft.)	4.0
Gates	
Type of Control	manual slide gate
Number	1
Size (dia. inches)	72

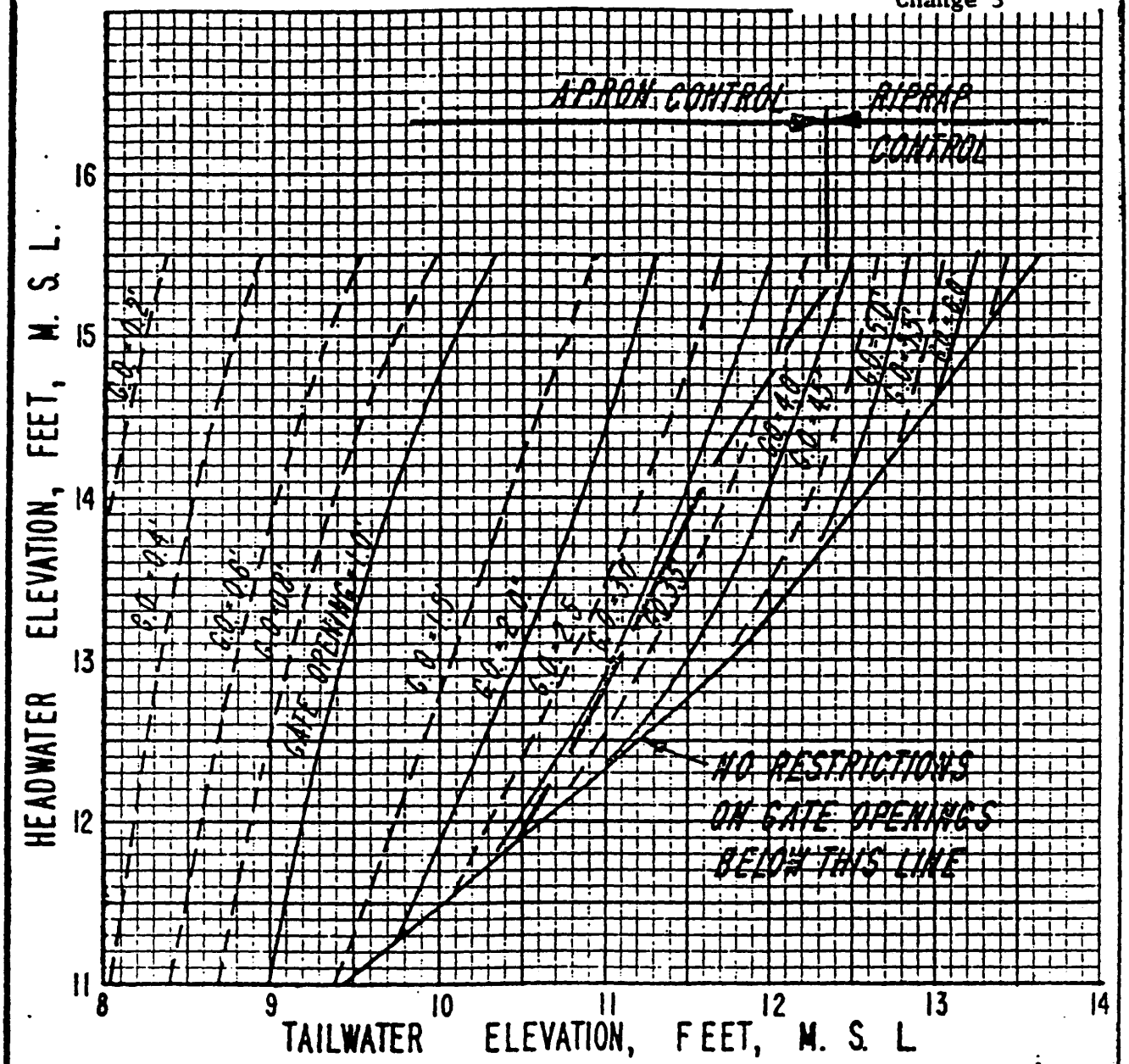

RATING BASED ON
PIPES FLOWING FULL
n=0.024
ENTRANCE LOSS=0.75
EXIT LOSS=1.00
PARTIAL FRICTION LOSS=0.257
ΔH - FEET
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0
50
100
150
200
250
300
DISCHARGE, C.F.S.
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING CURVE
STRUCTURES 144, 145, AND 146
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
ONE 72" C.M.P.
INVERT ELEV. 4.0
98' LONG
SAJWS NOV.66



CENTRAL AND SOUTHERN FLORIDA
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYST

DISCHARGE RATING CURVE
STRUCTURE 145 AND 146

JACKSONVILLE DISTRICT



NOTE:

SPILLWAY GATES TO BE OPENED UNIFORMLY.

EXAMPLE:

H.W. = 14.0 T.W. = 12.0

GATE OPENING SHOULD NOT EXCEED 4 FEET.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

MAXIMUM ALLOWABLE GATE OPENING
STRUCTURE II

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MAY 1972

A-S146-5

STRUCTURE 150 (S-150)

Location. Structure 150 is located in Levee 5 at the North New River Canal. It is on the north perimeter of Water Conservation Area No. 3A, 950 ft. west of U.S. Highway 27, and about 24 miles south of South Bay.

Description. S-150 is a five barrel, 84-inch corrugated metal pipe culvert structure with manually operated slide gates. The structure also has a timber operating platform.

Purpose. S-150 provides gravity flow from Lake Okeechobee and the agricultural area to the south into WCA No. 3A, as needed, helping to maintain water levels in WCA No. 3A.

Normal Regulation. S-150 may be used to supplement the discharge of S-8 into WCA No. 3A, when the headwater elevation exceeds the tailwater elevation and when this discharge will not interfere with the discharge of S-7 into WCA No. 2A.

Flood Control Regulation. S-150 may be manually operated to remove excess water from the agricultural area or Lake Okeechobee when WCA No. 3A stages are low and the water is not needed to fill available storage in WCA No. 2A. The 5 gated culverts will pass up to 1000 cfs.

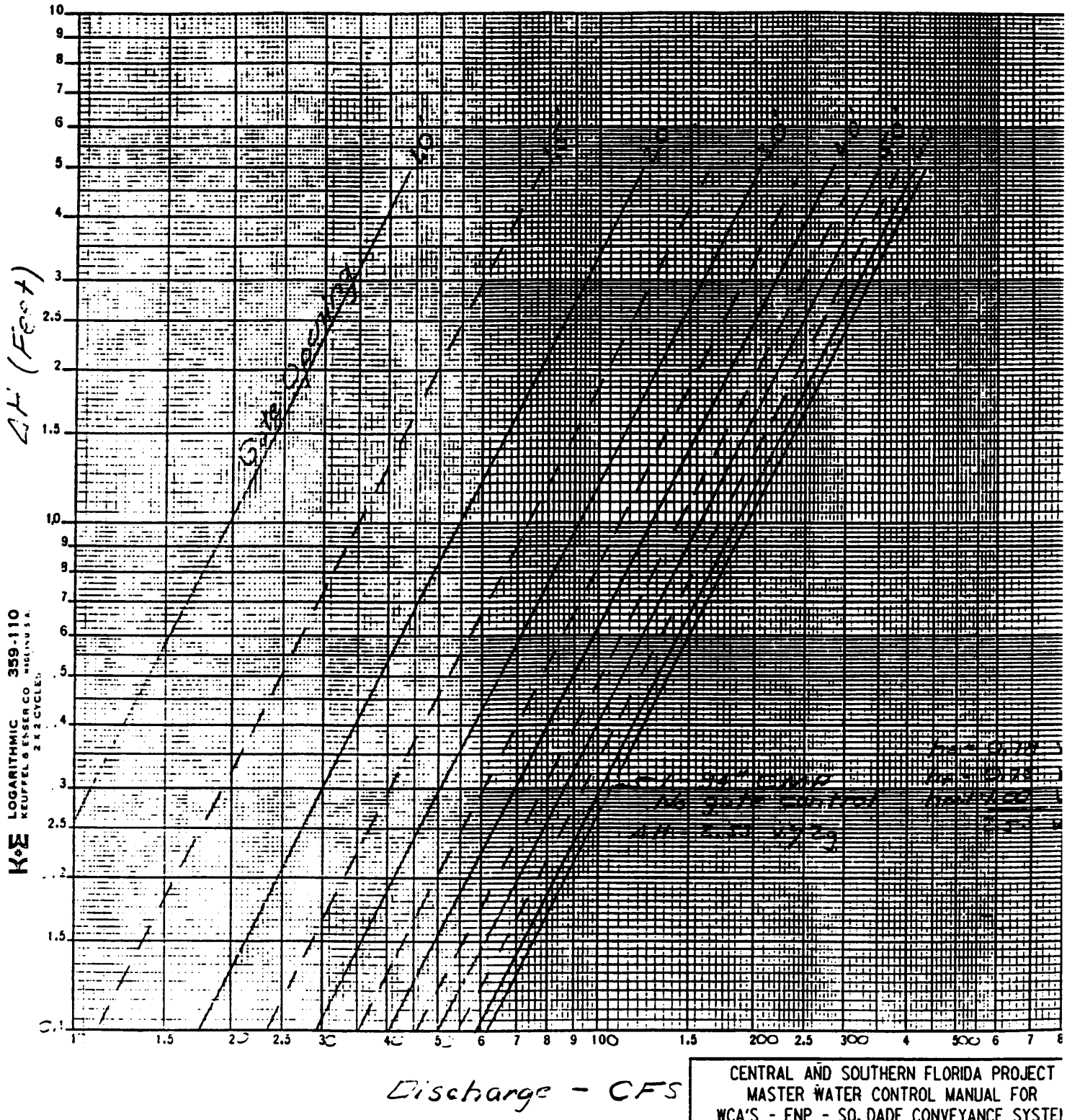
Low Water Regulation. Instead of pumping, S-150 may be used when possible to transfer up to 1,000 cfs by gravity from Lake Okeechobee to meet demands on WCA No. 3A under existing interim or future agreements.

Constraints. Gates may be opened when the water is not needed to meet the regulation schedule of WCA No. 2A, WCA No. 3A is below the regulation schedule and water is available in the North New River Canal.

STRUCTURE 150 (S-150)

Summary of Hydraulic Design Data

Location	L-5
Design Conditions	
Discharge (cfs)	1,000
Type	Controlled submerged
Headwater Elevation (ft.)	11.0
Tailwater Elevation (ft.)	10.0
Maximum Headwater Elevation (ft.)	13.0
Maximum Head	10.0
Culvert	
Type	CMP
Number of Barrels	5
Size (inches)	84
Net Length (ft.)	92
Invert Elevation (ft.)	3.0
Gates	
Number	5
Type of Control	Manual slide gate
Size (dia. inches)	84
Instrumentation	
Headwater Recorder and Staff Gage	No
Tailwater Recorder and Staff Gage	Yes
Gate Position Recorders	No
Operating Platform	
Type	Timber
Elevation (ft.)	19.0

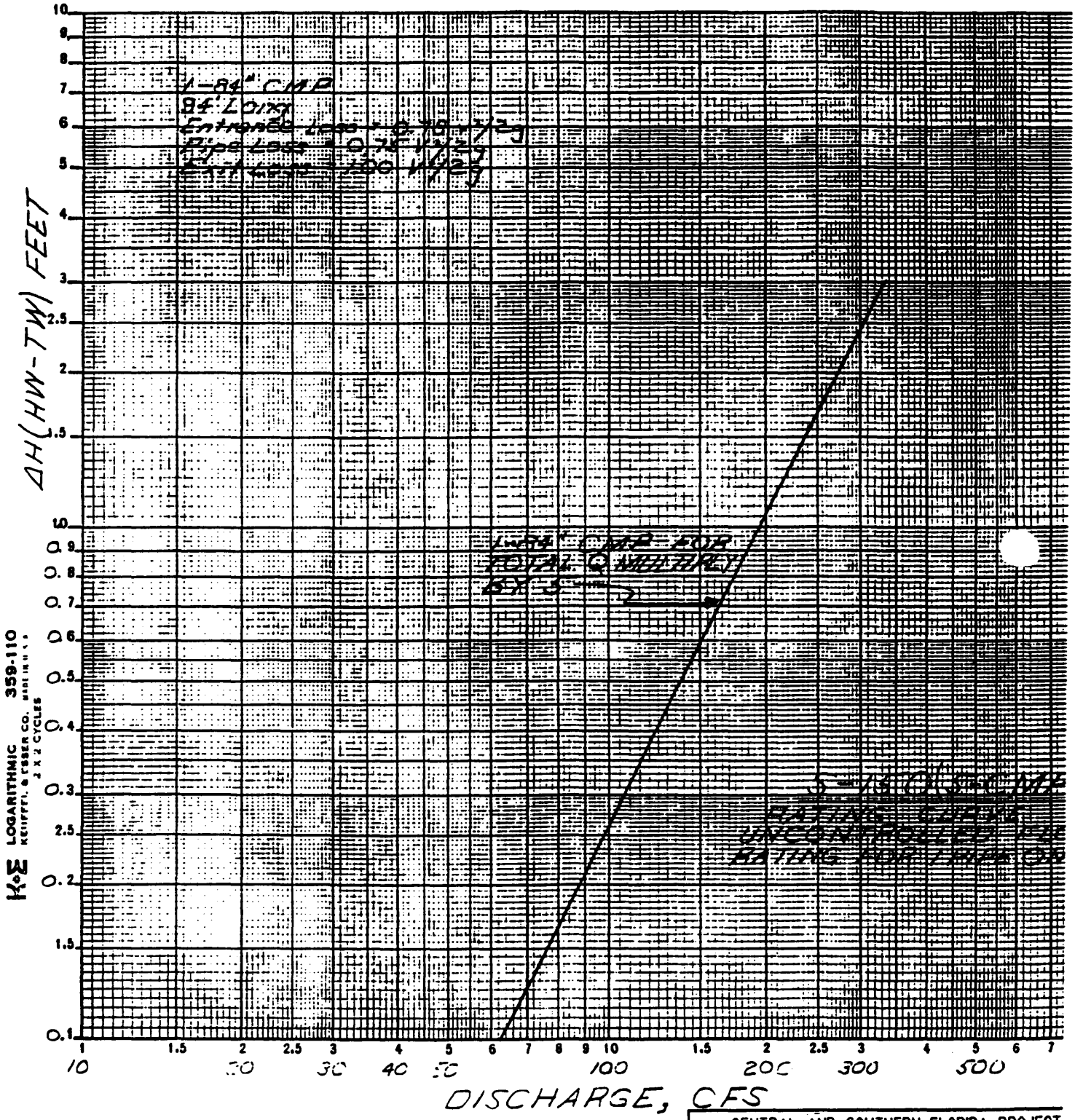


A-S150-3

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 150

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
UNCONTROLLED FLOW
STRUCTURE 150

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 151 (S-151)

Location. S-151 is located in Levee 67A in the Miami Canal. It is about 5.7 miles southwest of Pumping Station 9 and about 6.2 miles west of U.S. Highway 27.

Description. S-151 is a gated, six barrel, 84-inch corrugated metal pipe culvert. It was originally built as a 3 barrel cmp culvert and was later modified by adding 3 barrels adjacent to the existing structure. The structure has a timber operating platform and manual slide gates.

Purpose. S-151 permits releases from WCA No. 3A to supply water needs to South Dade County and along the Miami Canal (C-6), C-7 and C-8 during the dry season. It can also be used to make releases from Water Conservation Area No. 3A to maintain water levels in WCA No. 3B. S-151 also provides capacity for water releases through S-31 to the east coast.

Normal Regulation. The gates of S-151 may be manually operated to release water, as necessary, to fulfill downstream water requirements in Dade County and to maintain the necessary water levels in WCA No. 3B.

Flood Control Regulation. When requested by the Corps of Engineers, S-151 may be used to increase flexibility in making regulatory releases from WCA No. 3A. Four gaps in the southwest berm and disposal mounds along C-304 will allow water discharged through S-151 to overflow into WCA No. 3B when canal stages exceed 8.3 feet.

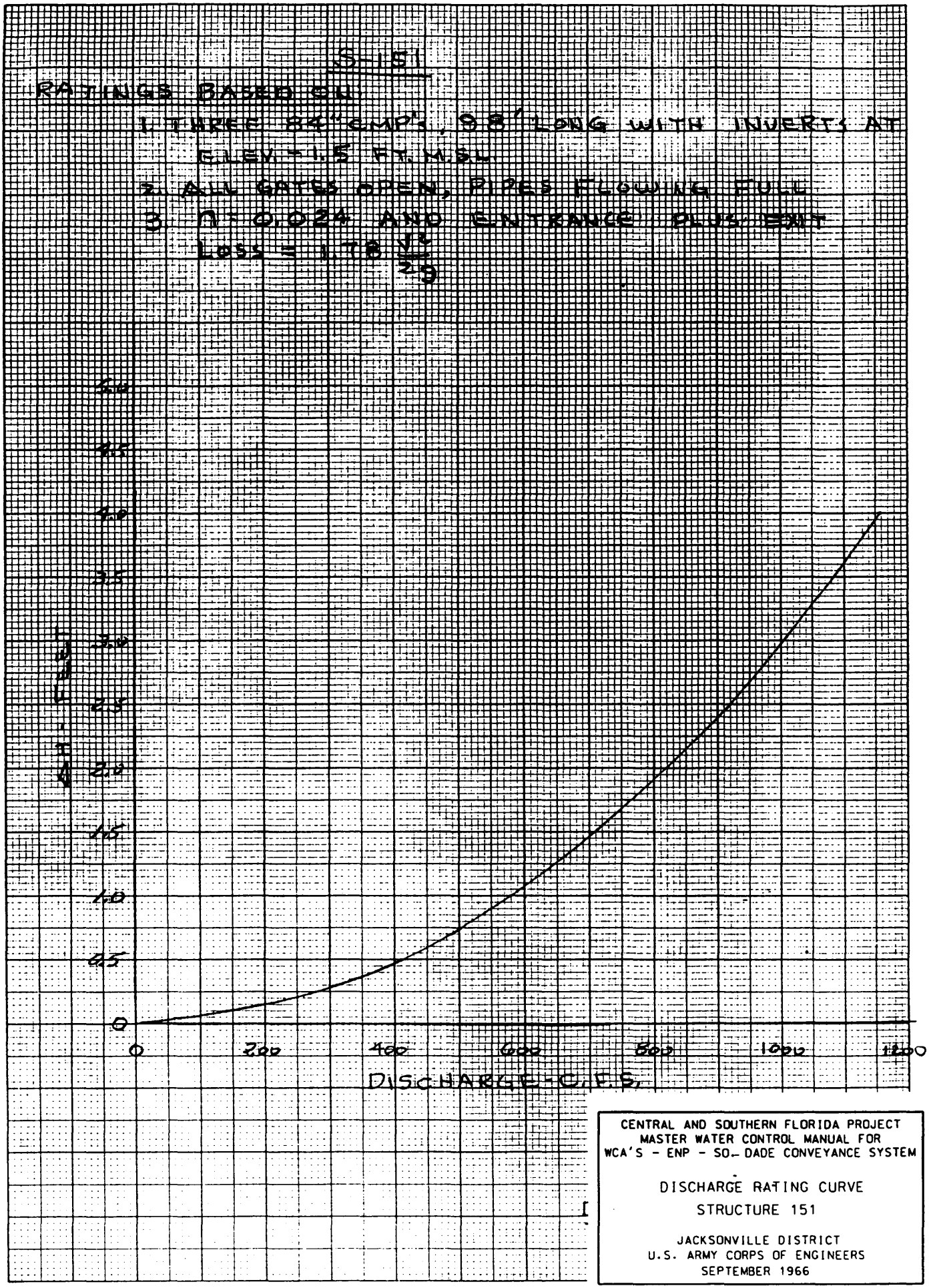
Low Water Regulation. Whenever S-151 is not required for regulatory or water supply releases, the headwater and tailwater may fluctuate in response to water conditions in WCA No. 3A and 3B. The structure's design discharge capacity is 1,105 cfs, 500 cfs of which could be subsequently released at S-31 and the remaining 605 cfs could be released at S-337, with a headwater elevation of 7.5 feet, and a tailwater elevation of 6.4 feet.

Constraints. S-151's tailwater elevation shall not exceed 10.0 feet.

STRUCTURE 151 (S-151)

Summary of Hydraulic Design Data (Culvert) (4&2)

Location	L-67A
Design Conditions	
Discharge (cfs)	1,105
Type	Controlled submerged
Headwater Elevation (ft.)	7.5
Tailwater Elevation (ft.)	6.4
Culvert	
Type	CMP
Number of Barrels	6
Size (dia., inches)	84
Net Length (ft.)	98
Invert Elevation (ft.)	-1.5
Gate	
Number	6
Size (dia., inches)	84
Type of Control	Manual slide gate
Operating Platform	
Type	Timber
Elevation (ft.)	17.0

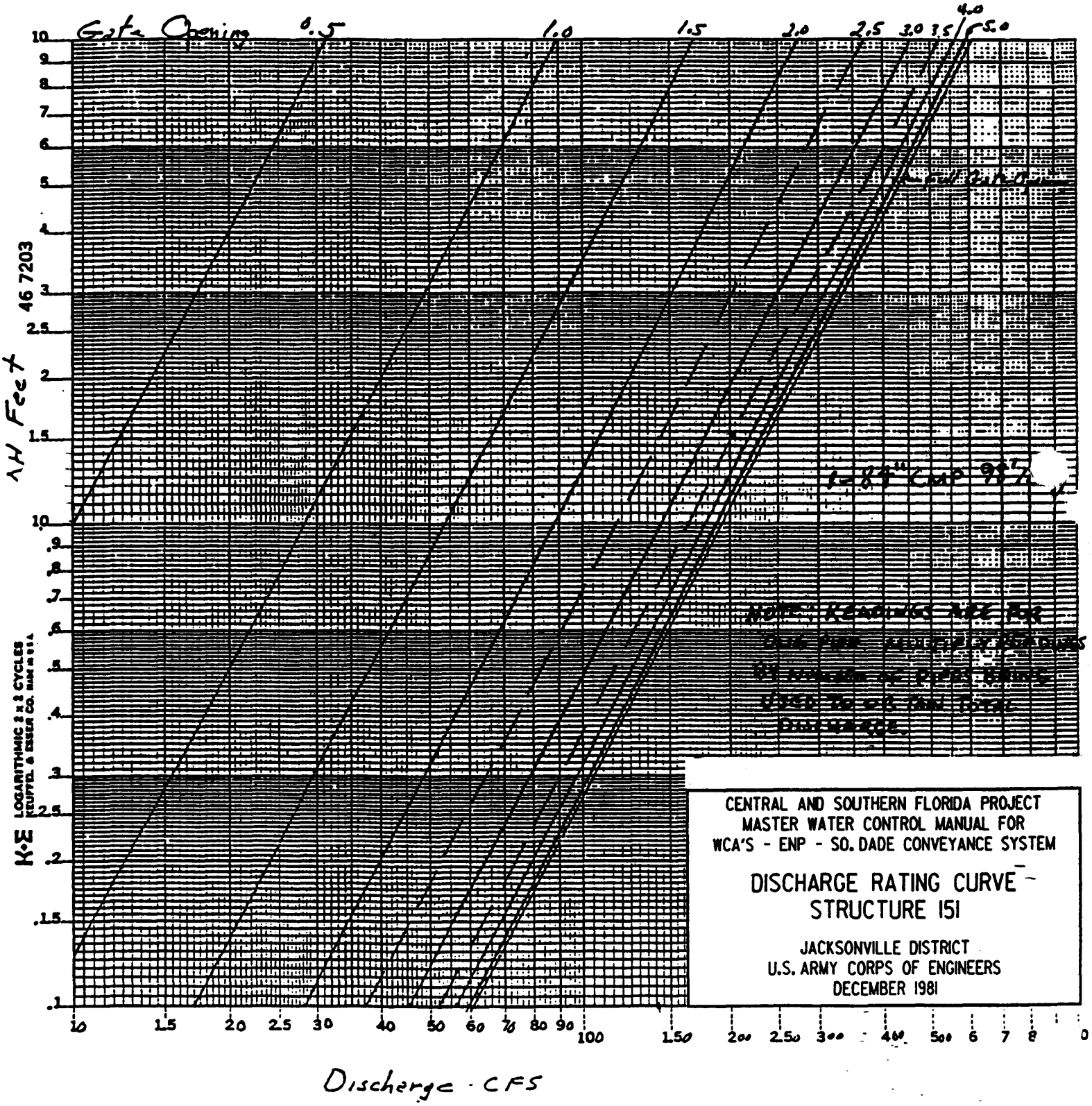


CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 151

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1966

K+E 10 X 10 TO ½ INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE -
STRUCTURE 151

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
DECEMBER 1981

STRUCTURE 173 (S-173)

Location. Structure 173 is located in the Levee 31 North borrow canal adjacent to the east boundary of the Everglades National Park about 9.0 miles northwest of Homestead, Florida.

Description. S-173 is a single-barreled, 72-inch reinforced concrete pipe culvert with a manually operated sluice gate on a reinforced concrete head structure at the northeast end of the structure.

Purpose. S-173 is used in conjunction with pump station S-331 to pass water to the south so as to protect areas to the west of L-31N

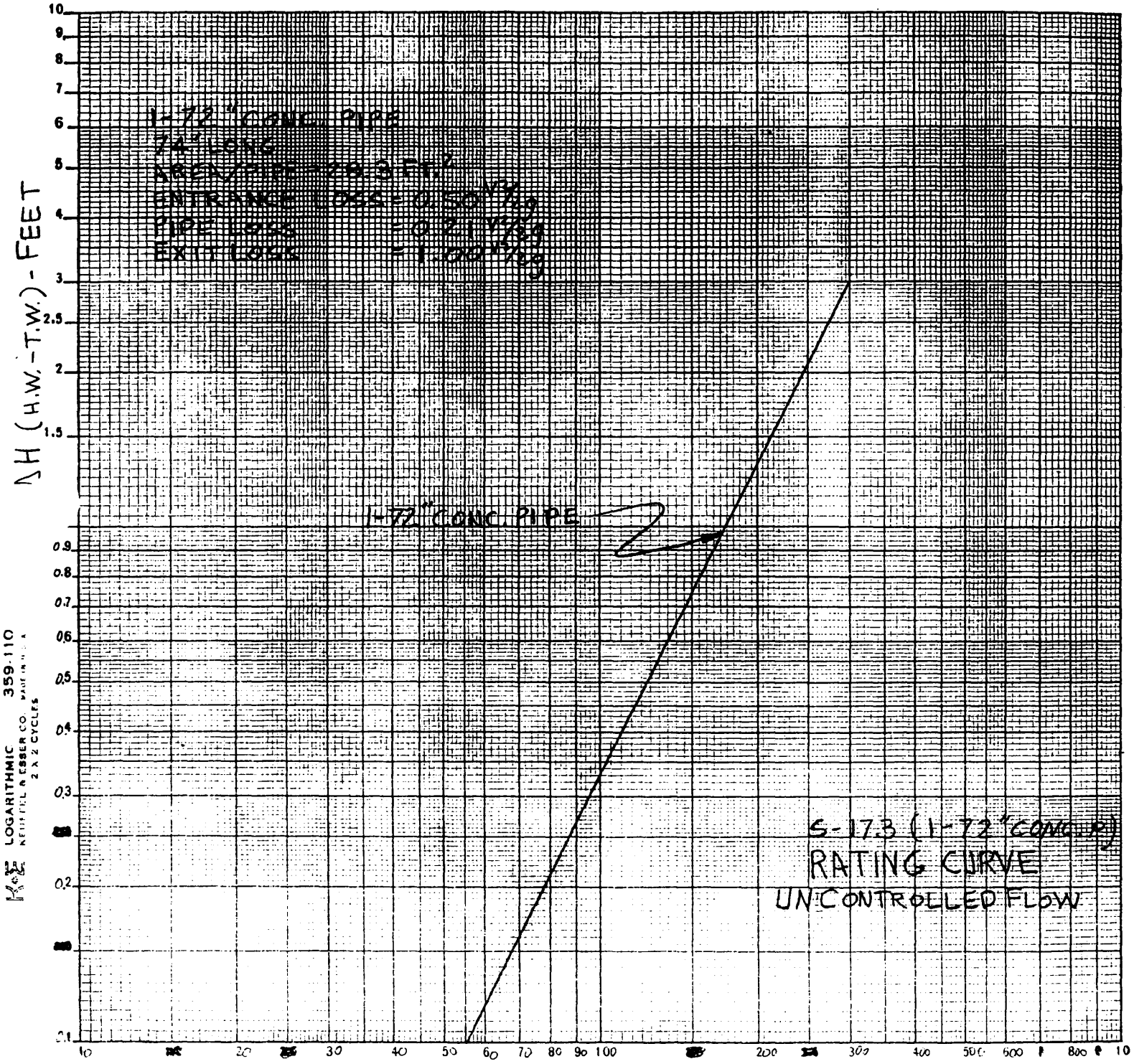
Regulation. This structure is operated in either the water supply or flood control mode in conjunction with S-331 which is regulated according to an agreement between the U. S. Army Corps of Engineers, the Everglades National Park and the South Florida Water Management District. The agreement is part of the experimental water delivery program as authorized by PL 91-282.

See structure description and operation for structure S-331, appendix A, pages A-S331-1,2, and 3.

STRUCTURE 173 (S-173)

Summary of Hydraulic Design

Location	L-31N
Design Conditions	
Discharge (cfs)	100
Type	controlled submerged
Headwater Elevation (ft.)	5.0
Tailwater Elevation (ft.)	4.5
Culvert	
Type	RCP
Number of Barrels	1
Size (dia., inches)	72
Net Length (ft.)	70
Invert Elevation (ft.)	-2.5
Gates	
Type of Control	sluice gate
Number	1
Size (dia., inches)	72



S-173

A-S173-3

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
UNCONTROLLED FLOW
STRUCTURE 173

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 174 (S-174)

Location. S-174 is located in the northern end of the L-31(W) borrow canal, approximately 5 miles west of Homestead.

Description. Structure 174 is a 1-bay, reinforced concrete, U-shaped spillway with an automatically controlled vertical-lift gate. The gate has two manual slide gates, over one and one-half-feet-high, which provide overflow and water control above elevation 4.5 ft, NGVD to minimize vertical-lift gate movement. The structure has an operating platform and a service bridge. S-174 has sheet-pile wingwalls protected by riprap on the side slopes of the canal.

Purpose. Prior to construction of S-332B, S-332C, and S-332D; this structure, together with S-176, maintained a desirable water control stage upstream in the L-31(N) borrow canal. It passed the design flood (40 percent of the SPF) without exceeding the upstream flood design stage, and restricted downstream flood stages and discharge velocities to non-damaging levels. It also passed the required flows (up to 500 cfs) to Taylor Slough in ENP. It now no longer performs its original purpose.

Regulation. Closed.

STRUCTURE 174 (S-174)

Summary of Hydraulic Design

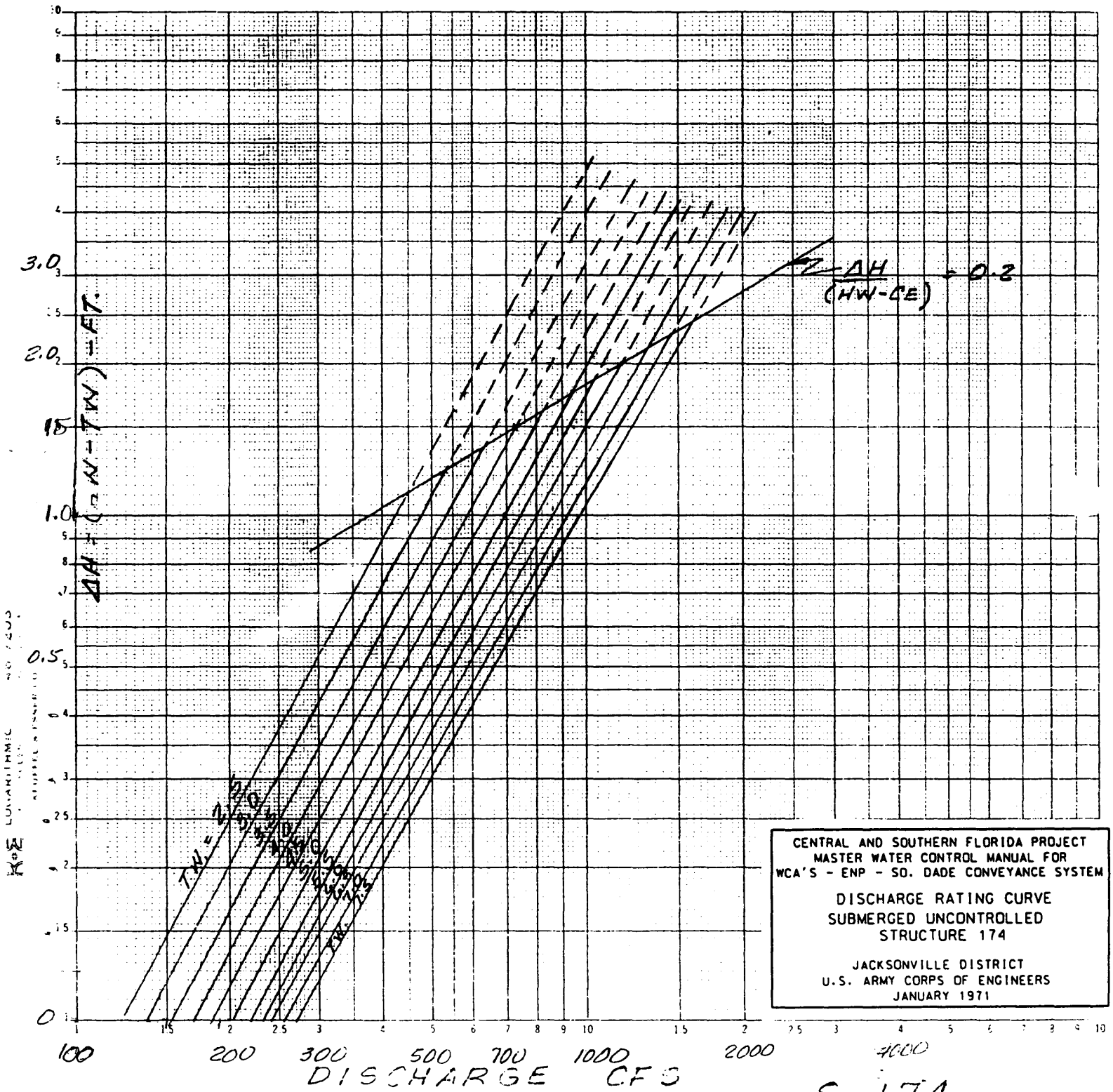
Location	L-31(W)
Design Conditions	
Discharge (cfs)	500
Type	Uncontrol submerged
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	5.5
S.P.F. Condition	
Discharge (cfs)	850
Type	Uncontrol submerged
Headwater Elevation (ft.), est.	7.5
Tailwater Elevation (ft.), est.	6.5
Optimum Conditions	
Headwater Elevation (ft.)	5.3
Tailwater Elevation (ft.)	4.3
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	3.0
Tailwater Elevation (ft.)	2.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-1.5
Net Length (ft.)	16.0
Gates	
Number	1
Type of Control	Automatic vert. lift
Width x Height (ft.)	16.0 x 8.0
Elevation of low steel in fully open position	10.7
Top of gates in the closed position	6.5
Overflow slot elevation (ft.)	4.5 to 6.0
Canal Section	
Upstream Bottom Width (ft.)	20.0
Upstream Bottom Elevation (ft.)	-12.0
Upstream Side Slopes	1 on 1
Downstream Bottom Width (ft.)	20
Downstream Bottom Elevation (ft.)	-12.0
Downstream Side Slopes	1 on 1
Protection Elevation (ft.)	11.0
Apron	
Elevation (ft.)	-3.5
Length (ft.)	20.0
End sill elevation (ft.)	-2.5
Service Bridge Elevation (ft.)	11.0
Operating Platform Elevation (ft.)	27.0
Dewatering Facilities	Yes

RATING BASED ON:

$Q = KA\sqrt{2g\Delta H + V^2}$

$K = 0.1 \times \Delta H + 0.725$

V = Approach Velocity



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED UNCONTROLLED
STRUCTURE 174

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 1971

S-174

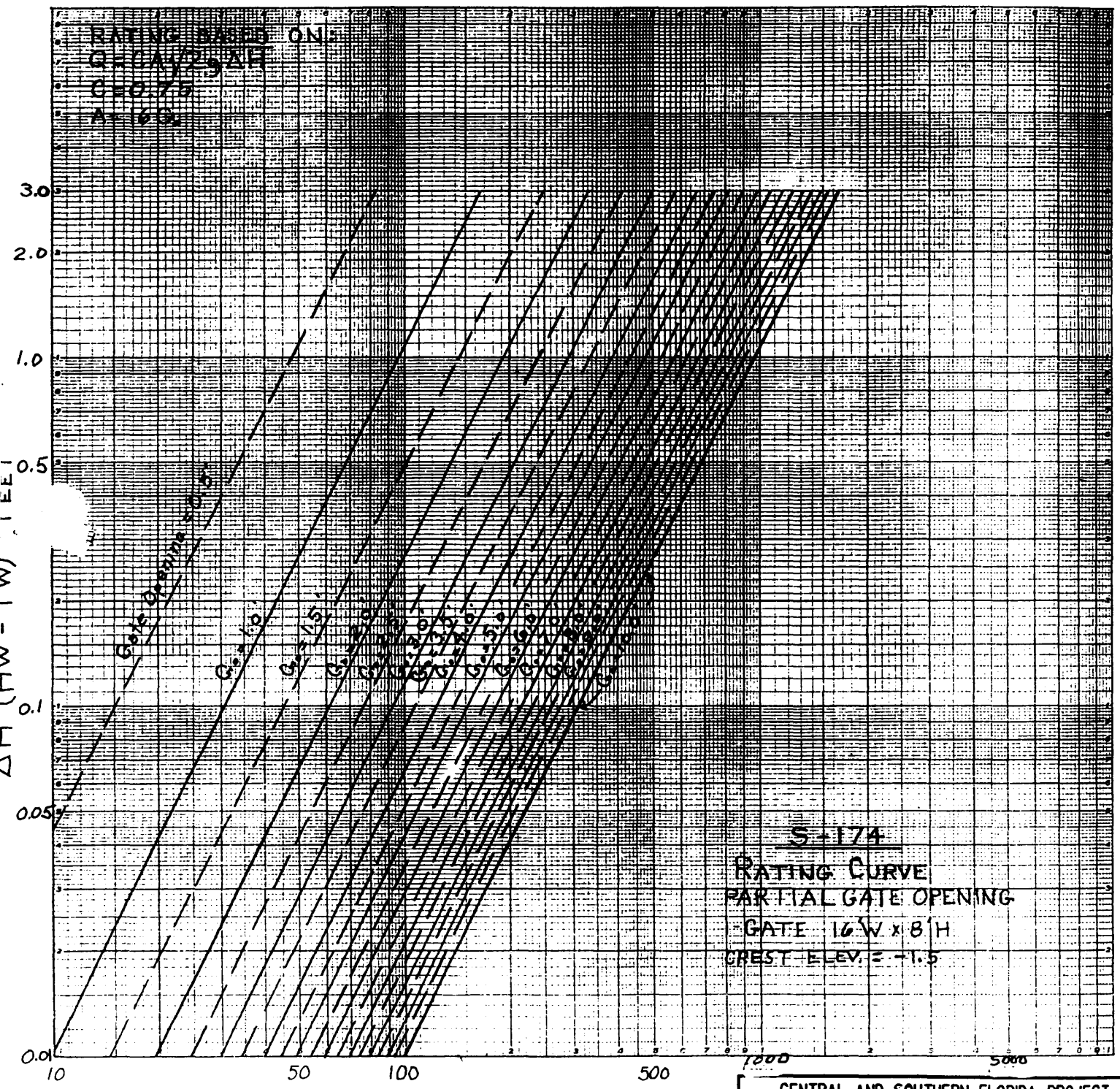
RATING CURVE

SUB. UNCONTROLLED FLOW

1 GATE 16'W x 8'H CREST EL. -1.5

A-S174-4

Partial Gate Opening



A-S174-5

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
PARTIAL GATE OPENING
STRUCTURE 174

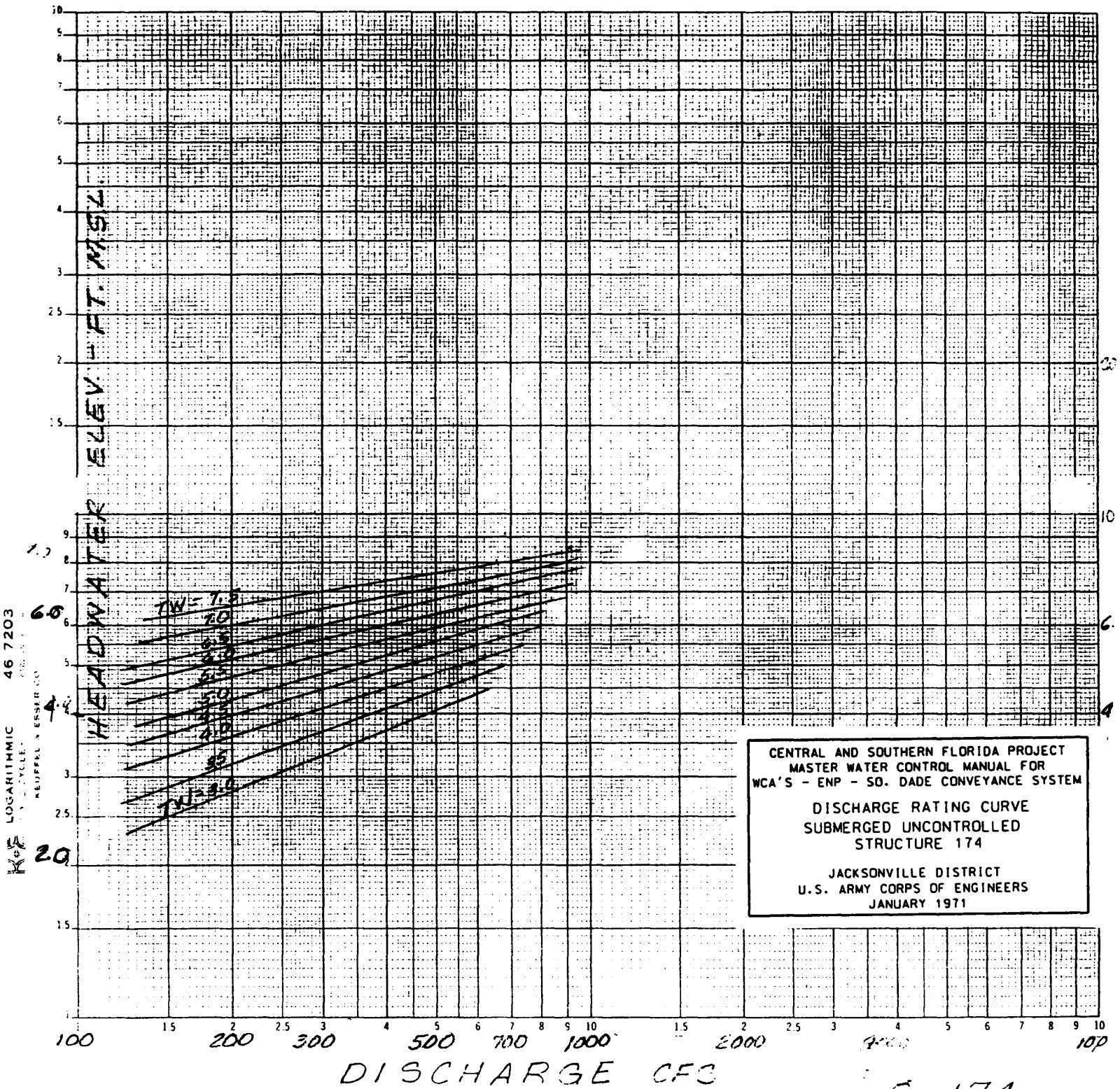
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

RATING BASED ON:

$Q = KA\sqrt{2g\,\Delta H + V^2}$

$K = 0.1 \times \Delta H + 0.725$

V. = Approach Velocity



S-174

RATING CURVE

SUBMERGED UNCONTROLLED FLOW

1-GATE 10'W x 5'H

SILL ELEV. = -1.5

A-S174-6

STRUCTURE 175 (S-175)

Location. Structure 175 is located in the Levee 31 West borrow canal adjacent to the east boundary of the ENP approximately one and one-quarter miles north of S.R. 27.

Description. S-175 is a gated, three barrel, 84-inch CMP culvert with reinforced concrete headwalls and manually-operated slide gates.

Purpose. Prior to removal of L-31(W) near S-332, this structure maintained optimum upstream water control stages in the L-31(W) borrow canal. It passed the design flood (40 percent of the SPF) without exceeding the upstream flood design stage, and restricted downstream flood stages and channel velocities to non-damaging levels. S-175 also prevents salt water intrusion into the canal. S-175 is no longer operated for flood control purposes.

Regulation. Closed.

STRUCTURE 175 (S-175)

Summary of Hydraulic Design

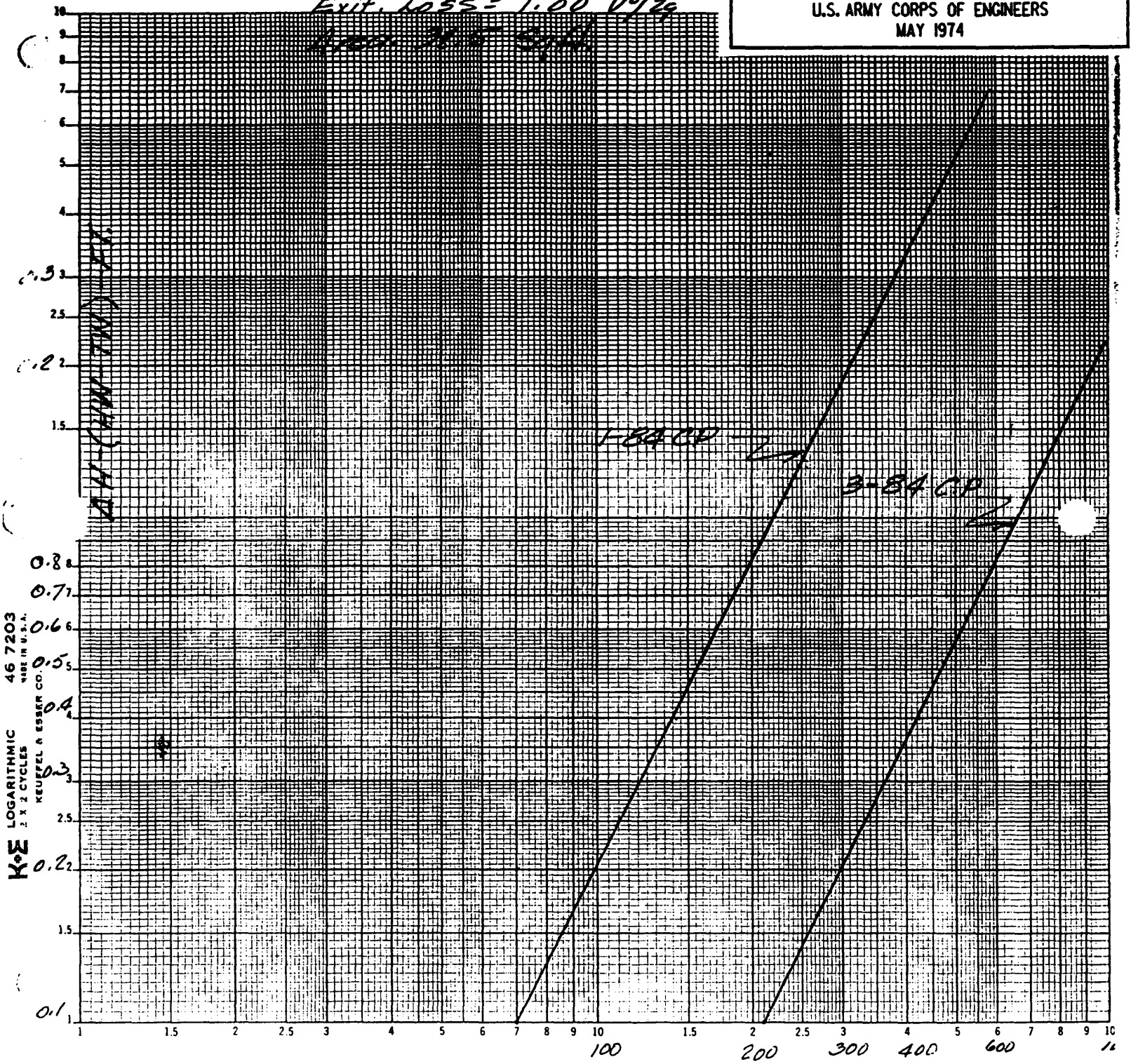
Location	L-31W
Design Conditions	
Discharge (cfs)	500
Type	controlled submerged
Headwater Elevation (ft.)	5.0
Tailwater Elevation (ft.)	4.5
S.P.F. Condition	
Discharge (cfs)	500
Type	submerged
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	5.5
Optimum Conditions	
Headwater Elevation (ft.)	4.5
Minimum Water Surface Conditions	
Headwater Elevation (ft.)	2.0
Tailwater Elevation (ft.)	-1.0
Culvert	
Type	RCP
Number of Barrels	3
Size (dia., inches)	84
Net Length (ft.)	56
Invert Elevation (ft.)	-5.0
Gates	
Type of Control	manual sluice gate
Number	3
Size (dia., inches)	84

RATING CURVE CIV.
84" Conc. Pipe
L-66'
Invert Elev. -3.5
n = 0.012
Ent. Loss = 0.78 $V^2/2g$
Exit. Loss = 1.00 $V^2/2g$
Tailw. 38.5 Stat.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 175

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MAY 1974



A-S175-4

S-175
RATING CURVE
1-84" C.P. & 3-84" C.P.
INVERT EL. -3.5

STRUCTURE 176 (S-176)

Location. S-176 is located on Canal 111 about 5 miles west of Homestead, Florida.

Description. Structure 176 is a reinforced concrete, one bay, U-shaped spillway with automatically controlled vertical-lift gate and manually operated slide gates. The gate hydraulic operating system operates the gate according to headwater level criteria. The structure has an operating platform and a service bridge. S-176 has sheet-pile wingwalls protected by riprap on the side slopes of the canal.

Purpose. This structure, together with S-174, maintains a desirable water control stage upstream in L-31N borrow canal. It passes the design flood (40 percent of the SPF) without exceeding the upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels. During low-flow periods, S-176 can pass sufficient discharges to maintain stages downstream.

Regulation. S-176, together with S-174, is regulated according to an agreement between the U. S. Army Corps of Engineers, the Everglades National Park and the South Florida Water Management District. The agreement is part of the experimental water delivery program as authorized by PL 91-282.

The terms of this agreement require that the operation will be as follows:

Wet Season Criteria
S-176 will remain closed unless the headwater stage exceeds 5.0 ft.. Under normal conditions, S-176 will begin closing when the headwater stage drops to 4.85 ft., and be fully closed when the headwater stage drops to 4.75 ft.. During flood conditions, S-176 will begin closing when the headwater stage reaches 4.8 ft., and be fully closed when the headwater stage reaches 4.6 ft..

Normal Dry Season Criteria
Dry season criteria will go into effect following the cessation of wet season rainfall, and L-31W borrow canal stages have receded naturally to 3.5 ft. S-176 will normally remain closed. Supplemental water supply deliveries can be made to the Eastern Panhandle basin and Florida Bay, if adequate water is available. If S-176 headwater stage exceeds 5.0 ft., the structure will be operated according to the dry season flood control criteria.

Dry Season Flood Control Criteria
S-176 will remain closed unless the headwater stage exceeds 5.0 ft.. S-176 will begin closing when the headwater stage drops to 4.8 ft. and be fully closed when the headwater stage reaches 4.6 ft..

Transition from the Dry Season into the Wet Season
Beginning at 0800 on June 1st, the wet season operating criteria would go into effect.

Transition from the Wet Season into the Dry Season
The goal of the transition is to reach elevation 3.5 ft. on December 1st as measured at the S-175 HW.

S-176 shall normally remain closed. If the S-176 HW is greater than or equal to 5.0 ft., then S-176 shall be operated according to the dry season flood control criteria.

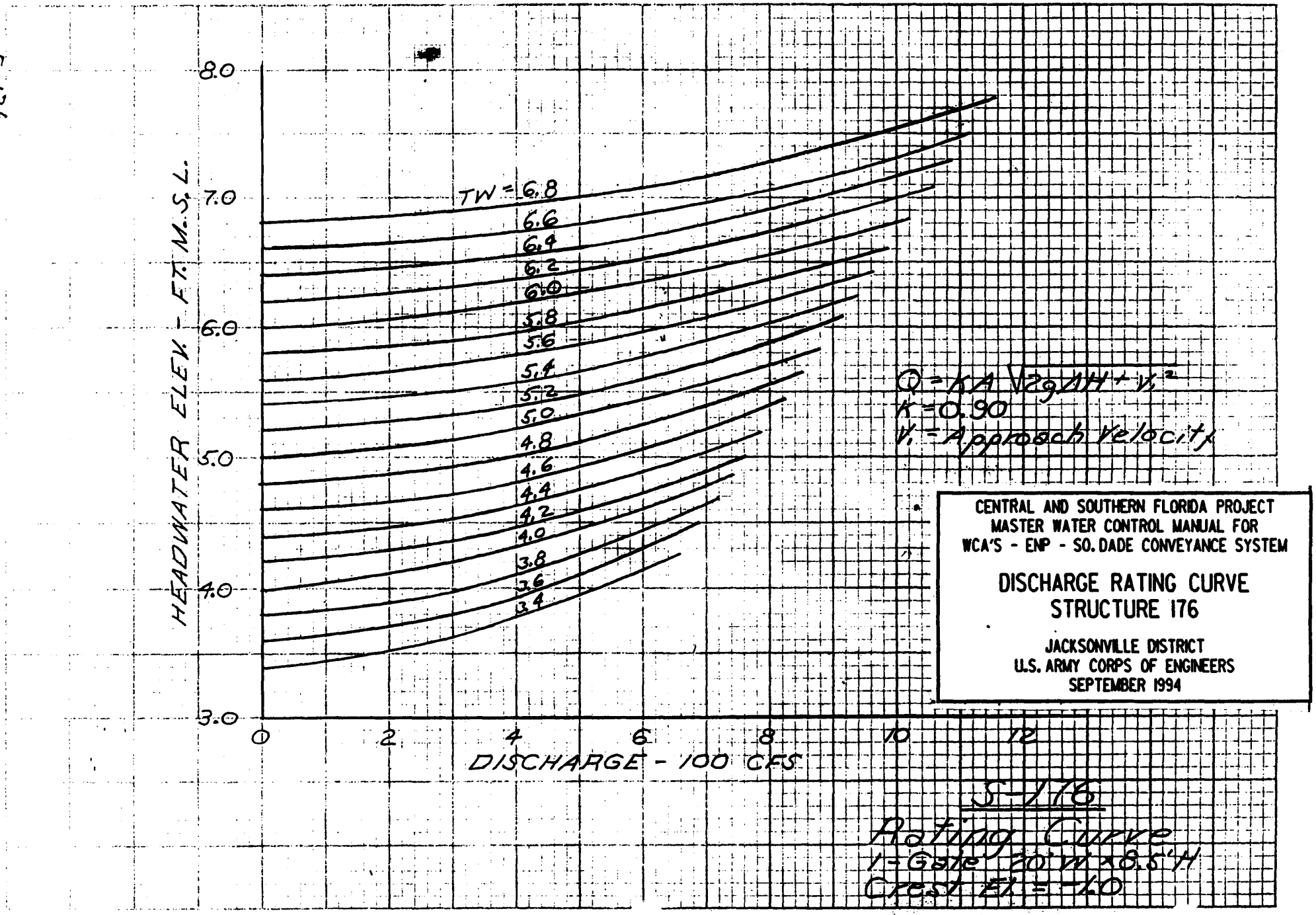
Low Flow Regulation. The main gate has two manual slide gates, over 1.5-foot-high, which provide overflow and water control above elevation 4.5 ft. to minimize vertical-lift gate movement.

Constraints: Design criteria for the structure require that the hydrostatic head not exceed 6.5 ft.

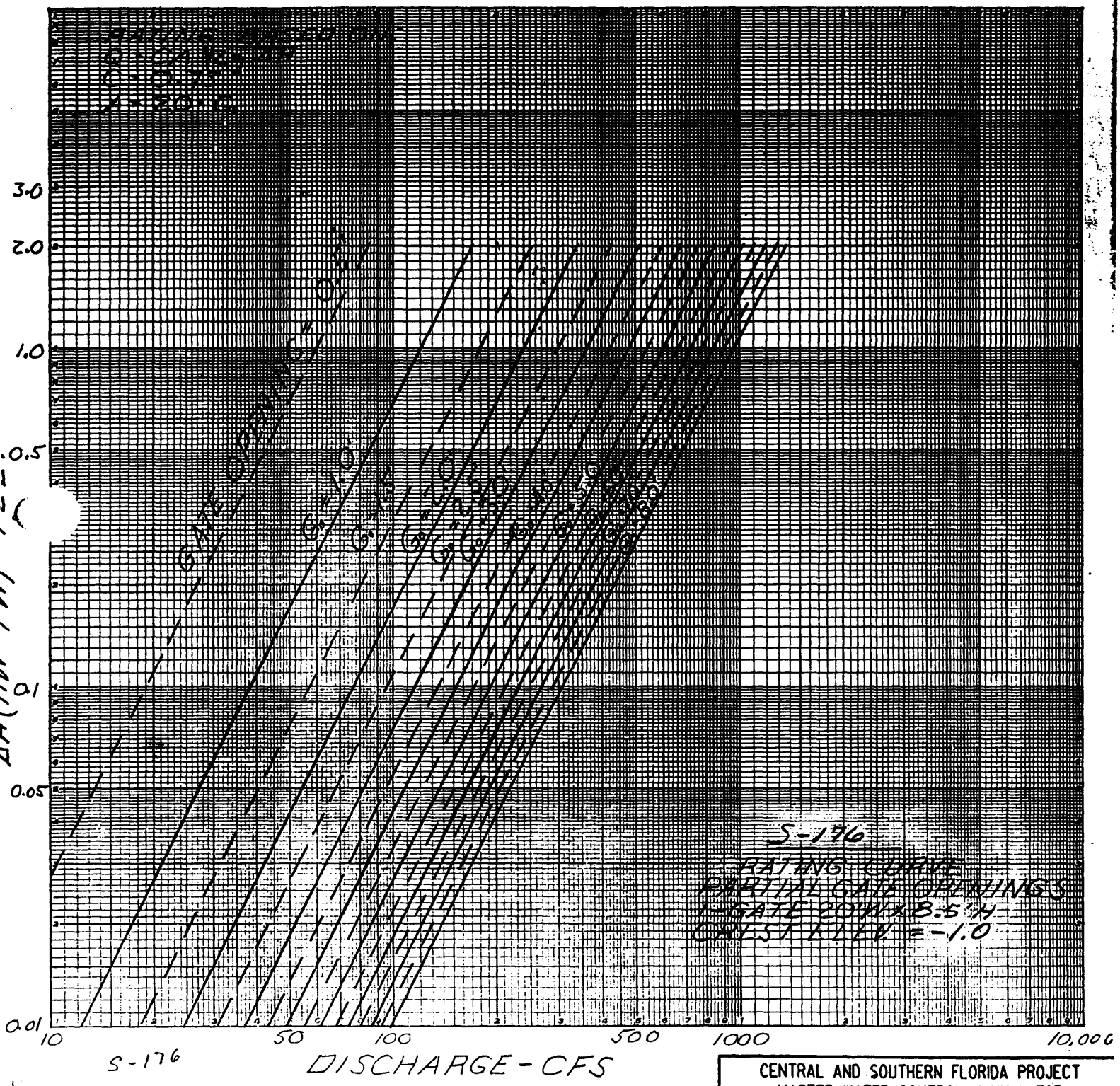
STRUCTURE 176 (S-176)

Summary of Hydraulic Design

Location	Canal 111
Design Conditions	
Discharge (cfs)	630
Type	Uncontrolled submerged
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	5.5
Maximum Head	6.5
S.P.F. Condition	
Discharge (cfs)	1,100
Type	Uncontrolled submerged
Headwater Elevation (ft.), est.	7.5
Tailwater Elevation (ft.), est.	6.3
Optimum Conditions	
Headwater Elevation (ft.)	5.5
Tailwater Elevation (ft.)	4.5
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	3.0
Tailwater Elevation (ft.)	2.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-1.0
Net Length (ft.)	20.0
Gates	
Number	1
Type of Control	Automatic vertical lift
Width x Height (ft.)	20.0 x 8.5
Elevation of low steel in fully open position	9.0
Top of gates in the closed position (ft.)	7.5
Overflow slot elevation (ft.)	5.5 to 7.0
Apron	
Elevation (ft.)	-2.0
Length (ft.)	20.0
End sill elevation (ft.)	-1.0
Service Bridge Elevation (ft.)	11.0
Operating Platform Elevation (ft.)	27.5
Dewatering Facilities	Yes


HEADWATER ELEV. - FT. M.S.L.
8.0
7.0
6.0
5.0
4.0
3.0
0
2
4
6
8
10
12
DISCHARGE - 100 CFS
TW = 6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
Q = KA √(2gΔH + V₁²)
K = 0.90
V₁ = Approach Velocity
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING CURVE
STRUCTURE 176
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994
S-176
Rating Curve
1-Gate 20'W x 8.5'H
Crest El = -1.0

S-176



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
PARTIAL GATE OPENING
STRUCTURE 176

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994

A-S176-5

STRUCTURE 177 (S-177)

Location. S-177 is located in Canal 111, 300 feet south of State Road 27.

Description. Structure 177 is a reinforced concrete, one bay, U-shaped spillway with an automatically controlled vertical-lift gate and auxiliary manually-operated slide gates. The gate hydraulic operating system operates the gate according to headwater level criteria. S-177 has an operating platform, a service bridge, and sheet-pile wingwalls protected by riprap on the side slopes of the canal. The structure has dewatering capabilities.

Purpose. This structure maintains optimum water levels upstream in Canal 111. It passes the design flood (40 percent of the SPF) without exceeding the upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels. During low-flow periods, S-177 can maintain desirable water control conditions upstream in Canal 111.

Regulation. S-177 is normally operated to maintain the optimum headwater elevation when sufficient water is available.

The gate hydraulic operating system operates the gate according to headwater level criteria. When the headwater elevation rises 4.2 ft. the gate will begin to open at six inches per minute; when the headwater elevation rises or fall to 3.9 ft. the gate will become stationary; and when the headwater elevation falls to 3.6 ft. the gate will begin to close at six inches per minute.

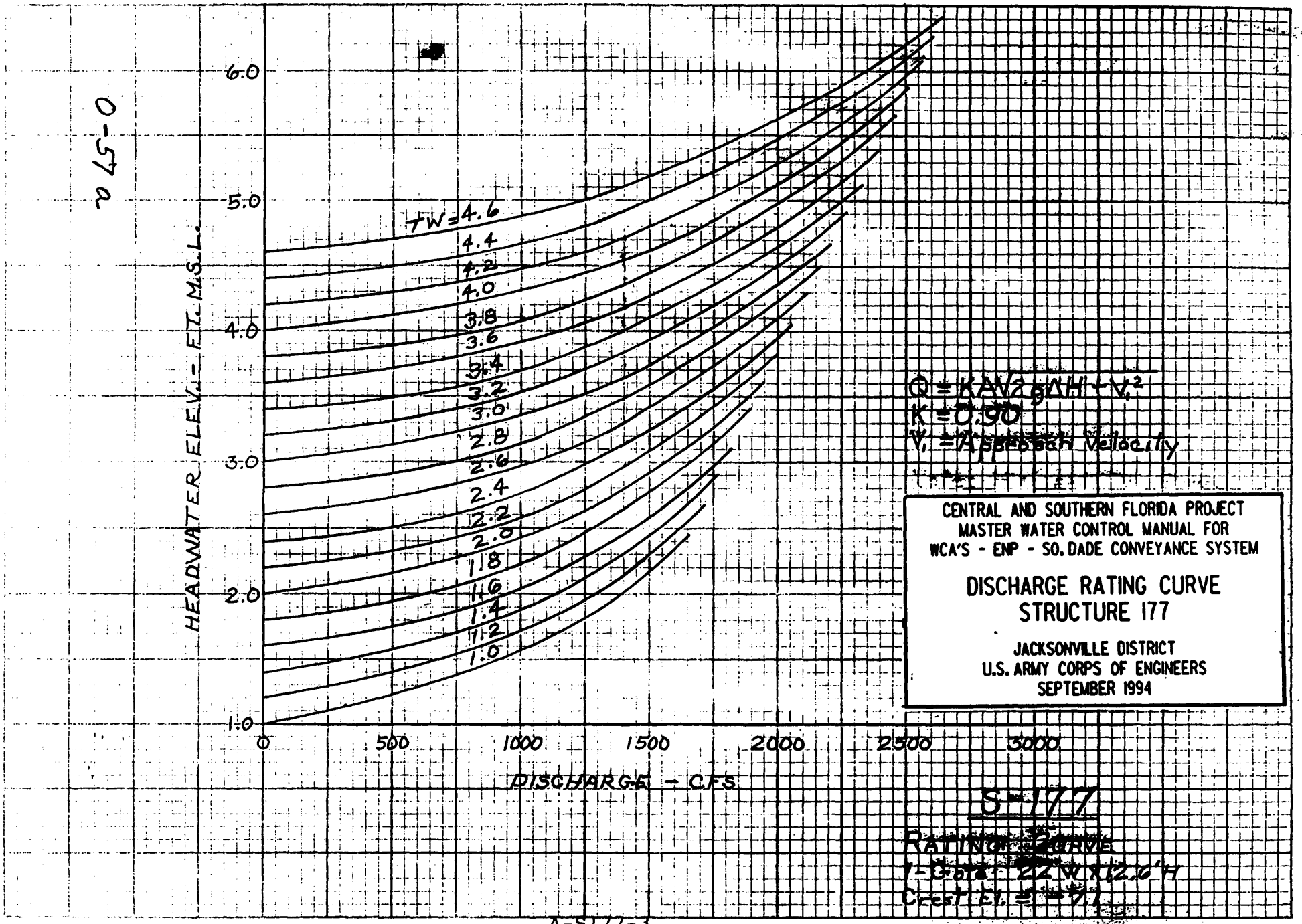
Flood Regulation. S-177 discharges the design flood (40 percent of the SPF) without exceeding the upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels.

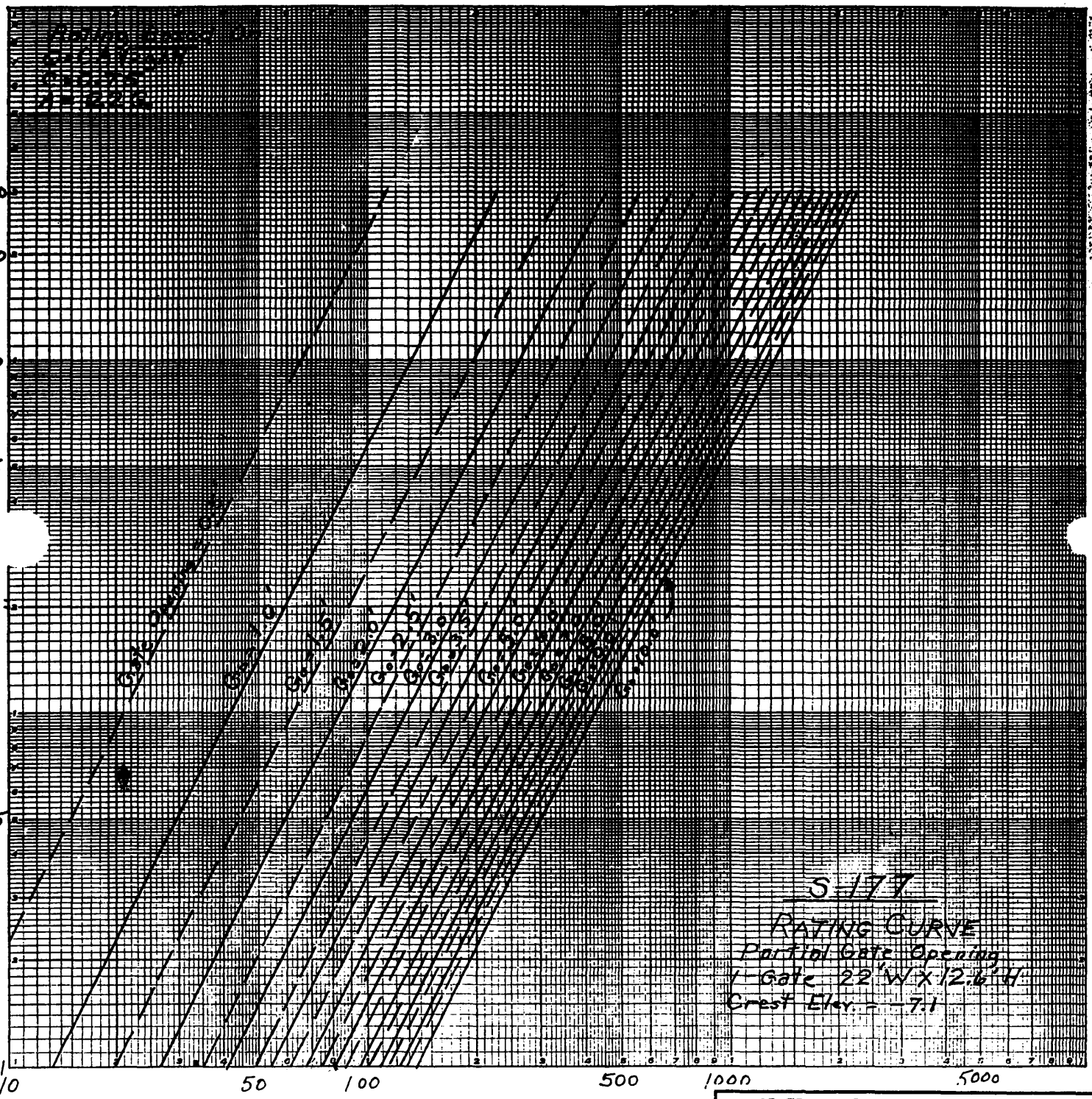
Low Flow Regulation. During low-flow periods, S-177 can maintain desirable water control conditions upstream in Canal 111.

STRUCTURE 177 (S-177)

Summary of Hydraulic Design

Location	Canal 111
Design Conditions	
Discharge (cfs)	1,400
Type	uncontrolled submerged
Headwater Elevation (ft.)	4.3
Tailwater Elevation (ft.)	3.7
S.P.F. Condition	
Discharge (cfs)	2,900
Type	uncontrolled submerged
Headwater Elevation (ft.), est.	6.0
Tailwater Elevation (ft.), est.	4.3
Optimum Conditions	
Headwater Elevation (ft.)	4.5
Tailwater Elevation (ft.)	2.0
Crest	
Shape	trapezoidal
Elevation (ft.)	-7.1
Net Length	22.0
Gates	
Number	1
Type of Control	automatic vertical lift
Width x Height (ft.)	22.8 x 12.6
Clearance elevation	6.9
Top of gates in the closed position	5.5
Overflow slot elevation	3.5 to 5.0
Protection Elevation (ft.)	9.0
Apron	
Elevation (ft.)	-8.0
Length (ft.)	20.0
End sill elevation (ft.)	-7.0
Service Bridge Elevation (ft.)	9.0
Operating Platform Elevation (ft.)	29.0
Dewatering Facilities	Yes


HEADWATER ELEV. - FT. M.S.L.
6.0
5.0
4.0
3.0
2.0
1.0
0
500
1000
1500
2000
2500
3000
DISCHARGE - CFS
TW=4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
Q = KA√2gΔH - V₁²
K = 0.90
V₁ = Approach Velocity
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
DISCHARGE RATING CURVE
STRUCTURE 177
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994
S-177
RATING CURVE
Crest El. = 9.1



DISCHARGE, C.F.S.

0-57b

A-S177-4

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE S.

DISCHARGE RATING CURVE
PARTIAL GATE OPENING
STRUCTURE 177

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994

STRUCTURE 178 (S-178)

Location. S-178 is located in Canal 111E, about 110 feet upstream of State Road 27.

Description. S-178 is a single barreled concrete box culvert with a reinforced concrete overflow intake box. The structure has two standard, manually operated slide gates which are mounted on the headwall. The operating platform is on the upstream end of the intake box.

Purpose. This structure maintains optimum water control stages upstream in Canal 111E, passes the design flood (40% of the SPF) without exceeding upstream flood design stages, and restricts downstream flood stages and channel velocities to non-damaging levels.

Normal Regulation. S-178 is operated to maintain an upstream water surface elevation of 4.5 feet.

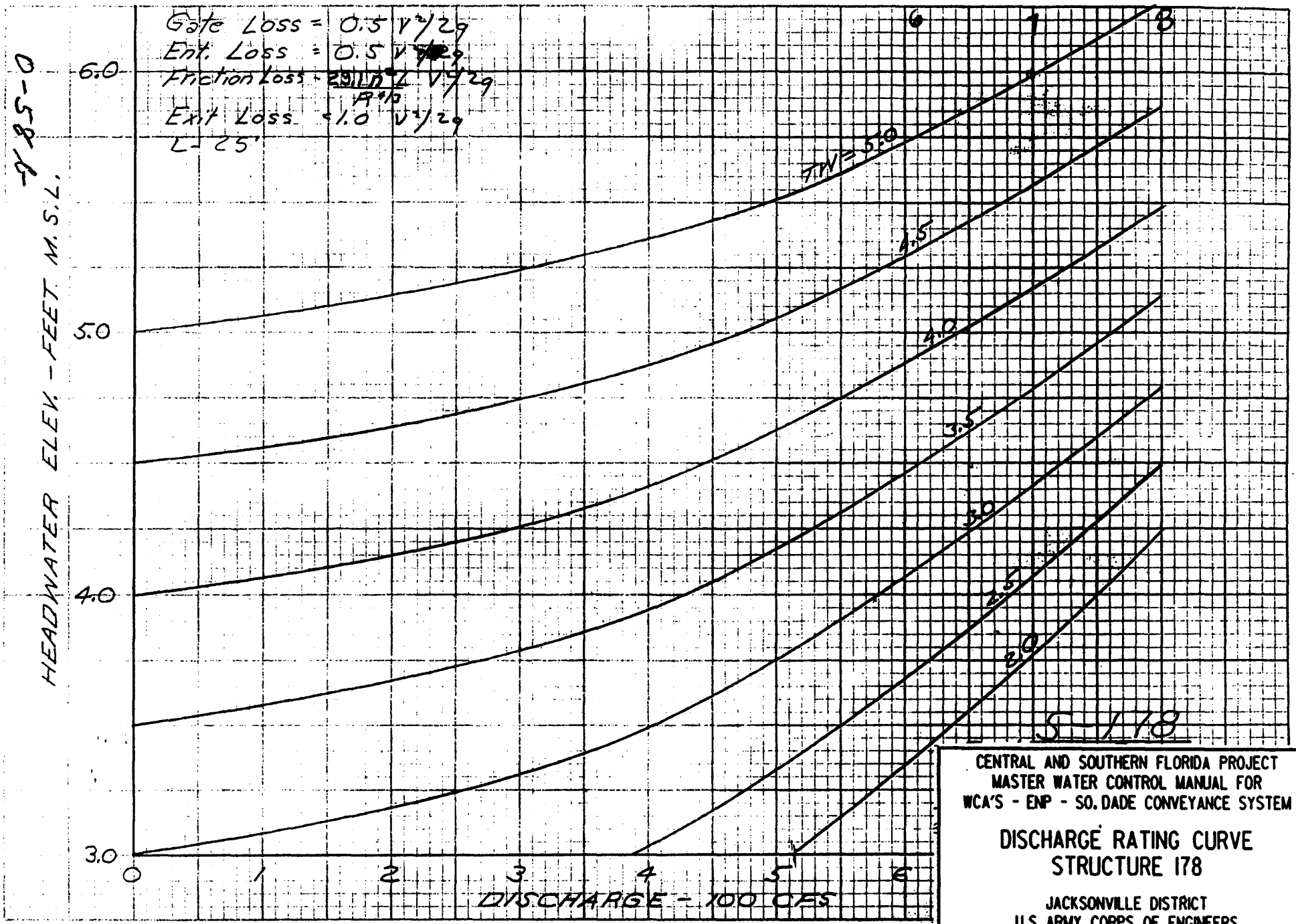
Flood Control Regulation. The gates should be manually operated to maintain an optimum headwater elevation of 4.5 feet and to continuously pass the design discharge of 510 cfs or up to the amount which will reach the structure.

Constraints. Headwater elevations above 5.0 feet will overflow the top of the structure uncontrolled.

STRUCTURE 178 (S-178)

Summary of Hydraulic Design

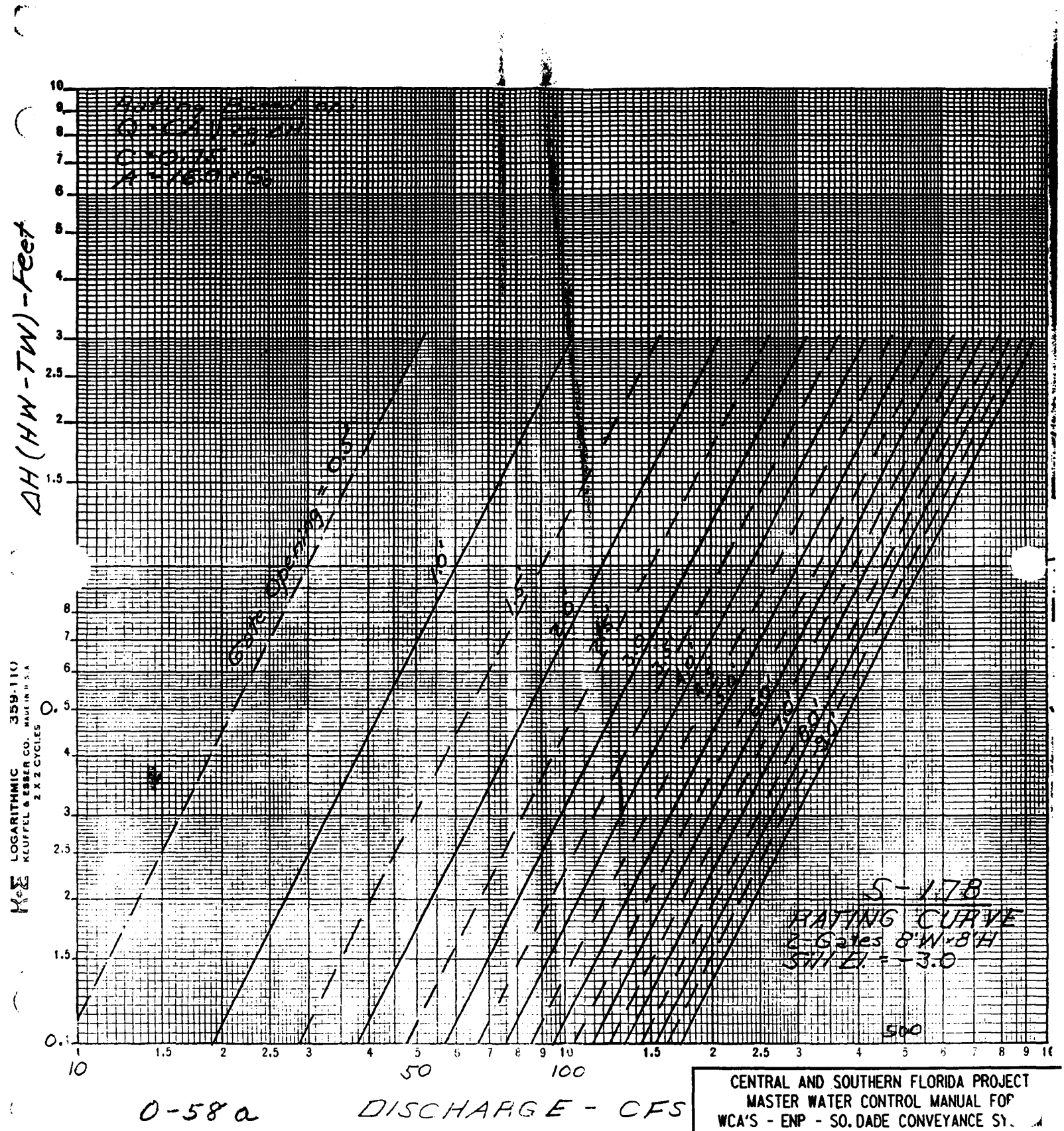
Location	C-111E
Design Conditions	
Discharge (cfs)	510
Type	controlled submerged
Headwater Elevation (ft.)	4.6
Tailwater Elevation (ft.)	3.9
S.P.F. Condition	
Discharge (cfs)	510
Headwater Elevation (ft.)	5.5
Tailwater Elevation (ft.)	5.0
Optimum Conditions	
Headwater Elevation (ft.)	5.0
Tailwater Elevation (ft.)	2.0
Minimum Water Surface Condition	
Headwater Elevation (ft.)	2.0
Tailwater Elevation (ft.)	1.0
Culvert	
Type	concrete box
Number of Barrels	1
Width x Height (ft.)	10.0 x 12.0
Net Length (ft.)	25
Invert Elevation (ft.)	-7.0
Gates	
Type of Control	manual sluice gates
Number	2
Width x Height (ft.)	8 x 8



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 178

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994



0-58a

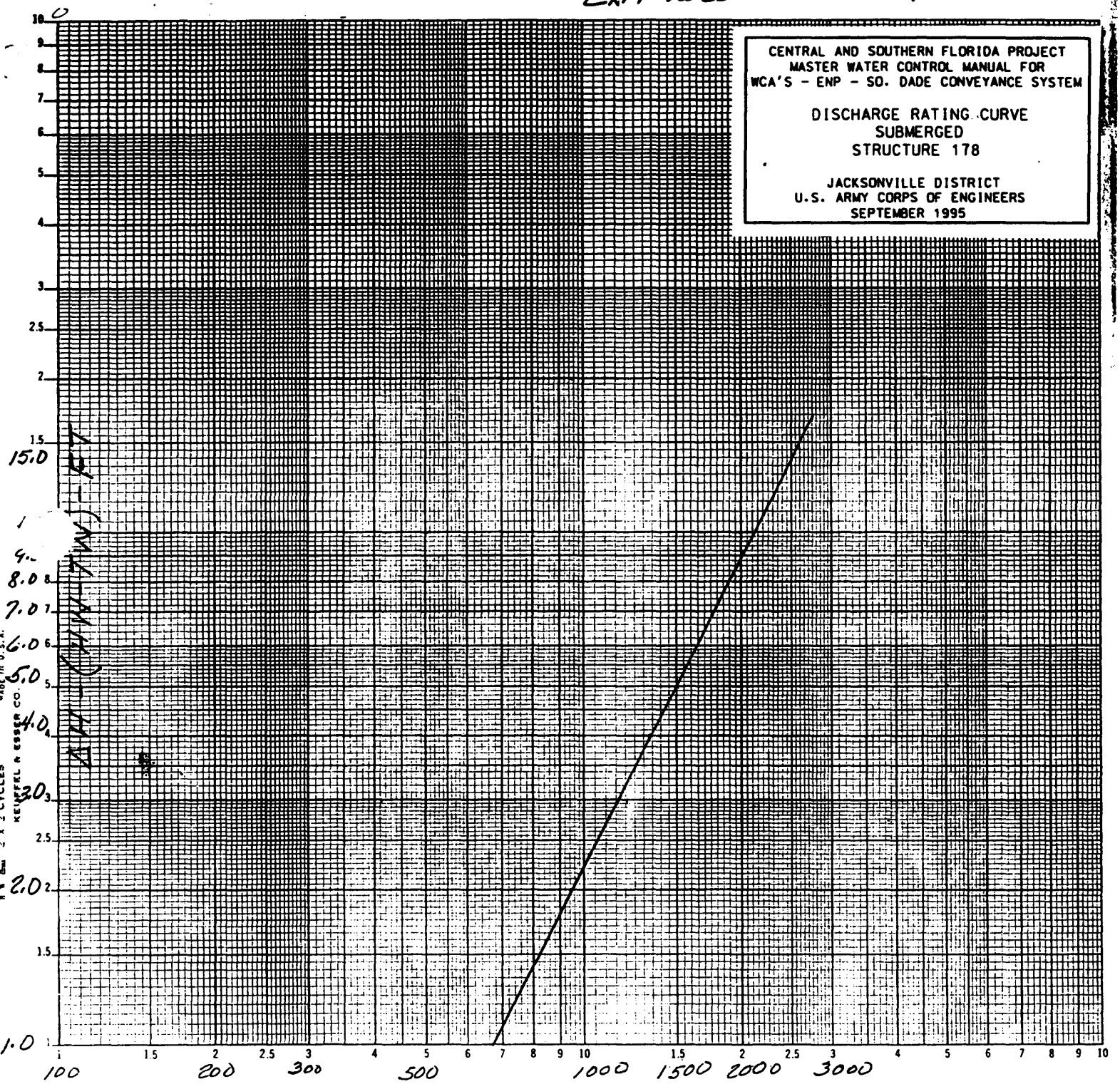
A-S178-4

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SY.

DISCHARGE RATING CURVE
PARTIAL GATE OPENING
STRUCTURE 178

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994

RATING CURVE ON
CONC. BOX. CULVERT 10'W x 12'H
L-25'
GATE LOSS = 0.5 $V^2/2g$
ENT. LOSS = 0.5 $V^2/2g$
Frict. LOSS = .02 $V^2/2g$
EXIT LOSS = 1.0 $V^2/2g$



S-178
RATING CURVE
CONC. BOX CULVERT 10W x 12H
INVERT EL. -7.0
SUBMERGED FLOW

STRUCTURE 190 (S-190)

Location. S-190 is located in the L-28 Interceptor Canal about one-half mile south of the junction of the West and North Feeder Canals.

Description. Structure 190 is a reinforced concrete, U-shaped, gated, two -bay spillway with an ogee-weir with automatically controlled vertical-lift gates. The structure has an operating platform and a service bridge.

Purpose. This structure maintains optimum upstream water control stages in the North and West Feeder Canals and prevents overdrainage of these canals.

Regulation. This structure will be operated on either a low or a high setting, through automatic controls as follows:

During the normal condition, the low setting is used. When the headwater elevation rises to 14.8 ft., NGVD, the gates will open at six inches per minute but the maximum gate opening will be limited to the amounts shown on the "Limiting Gate Opening" curve. When the headwater elevation rises or falls to 14.5 ft., NGVD, the gates will become stationary. When the headwater elevation fall to 14.2 ft., NGVD, the gates will close at six inches per minute.

During the dry condition, the high setting is used. When the headwater elevation rises to 15.8 ft., NGVD, the gates will open at six inches per minute. When the headwater elevations rises or fall to 15.5 ft., NGVD, the gates will become stationary. When the headwater elevation fall to 15.2 ft., NGVD, the gates will close at six inches per minute.

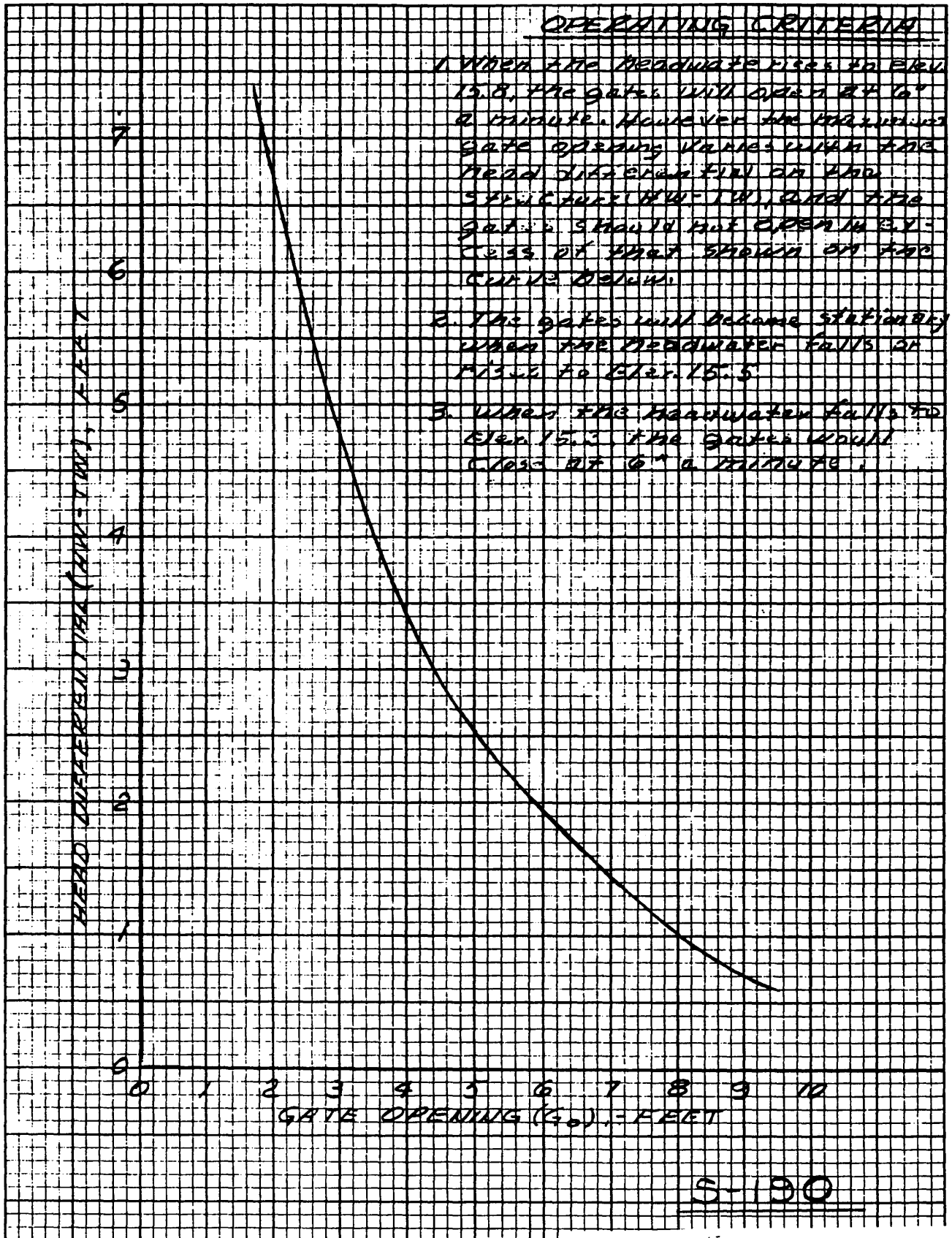
During low water periods, releases will be made to meet downstream irrigation requirements even though necessary releases will violate the optimum headwater criteria.

Constraints: To meet structural and stability requirements, the maximum allowable hydrostatic head on the structure should not be allowed to exceed 7.5 ft., NGVD, with a headwater elevation of 15.5 ft., NGVD, and a tailwater elevation of 8.0 ft., NGVD.

STRUCTURE 190 (S-190)

Summary of Hydraulic Design

Location	L-28
Design Conditions	
Discharge (cfs)	2,960
Type	Uncontrol submerged
Headwater Elevation (ft.)	16.6
Tailwater Elevation (ft.)	16.1
Optimum Conditions	
Headwater Elevation (ft.)	15.5
Tailwater Elevation (ft.)	10.0
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	8.0
Tailwater Elevation (ft.)	8.0
Crest	
Shape	Ogee
Elevation (ft.)	3.5
Net Length (ft.)	48.0
Gates	
Number	2
Type of Control	Automatic vert. lift
Width x Height (ft.)	24.0 x 12.0
Bottom Elevation, (ft.), fully open position	18.4
Top Elevation, (ft.), closed position	15.5
Clearance Elevation (ft.)	17.6
Protection Elevation (ft.)	20.4
Apron	
Elevation (ft.)	-0.1
Length (ft.)	30.0
End sill elevation (ft.)	1.0
Service Bridge Elevation (ft.)	20.5
Operating Platform Elevation (ft.)	20.5



S-190

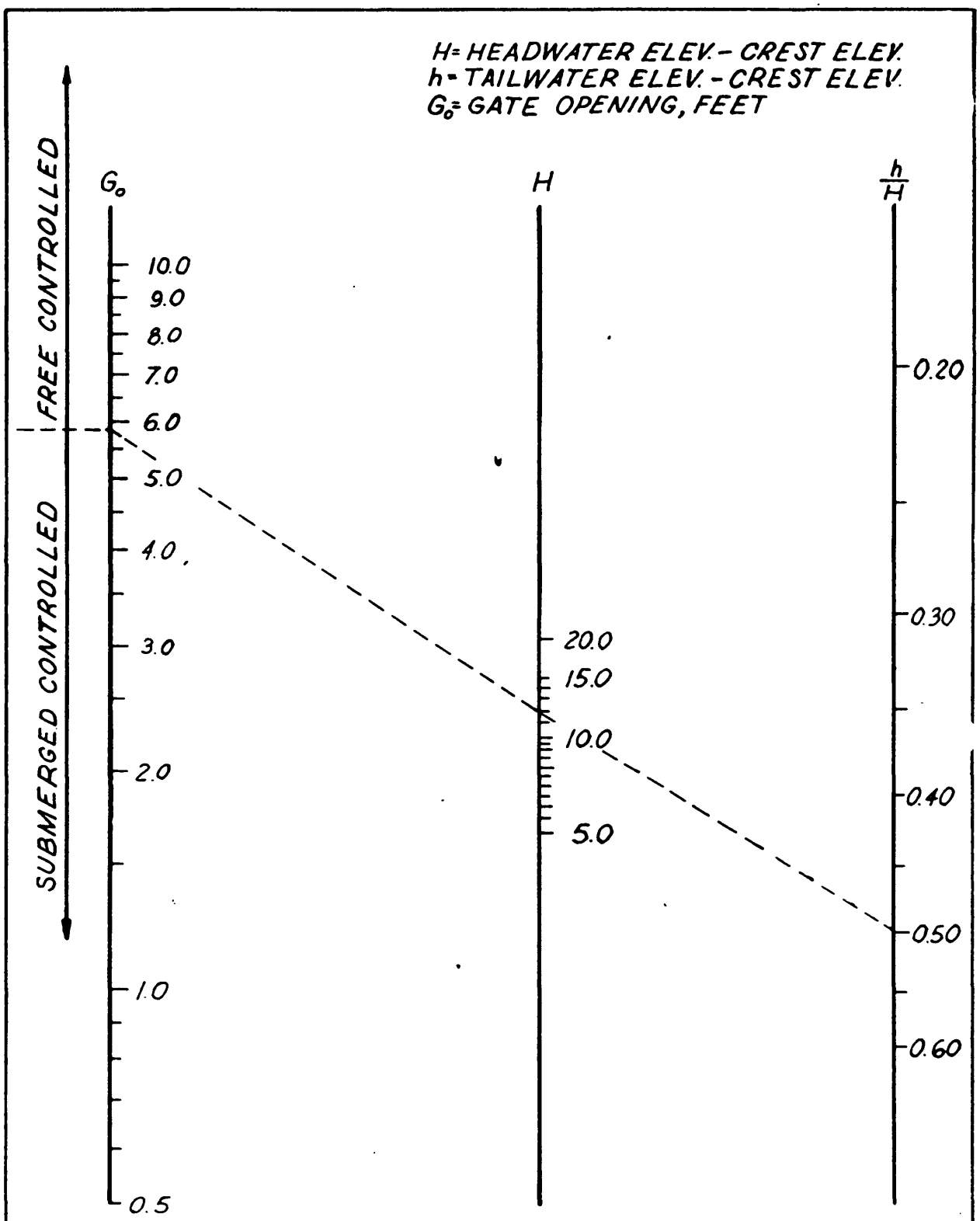
A-S190-3

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
LIMITING GATE OPENING
STRUCTURE 190

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OCTOBER 1968

K+E 5 X 5 TO ½ INCH 46 0863
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



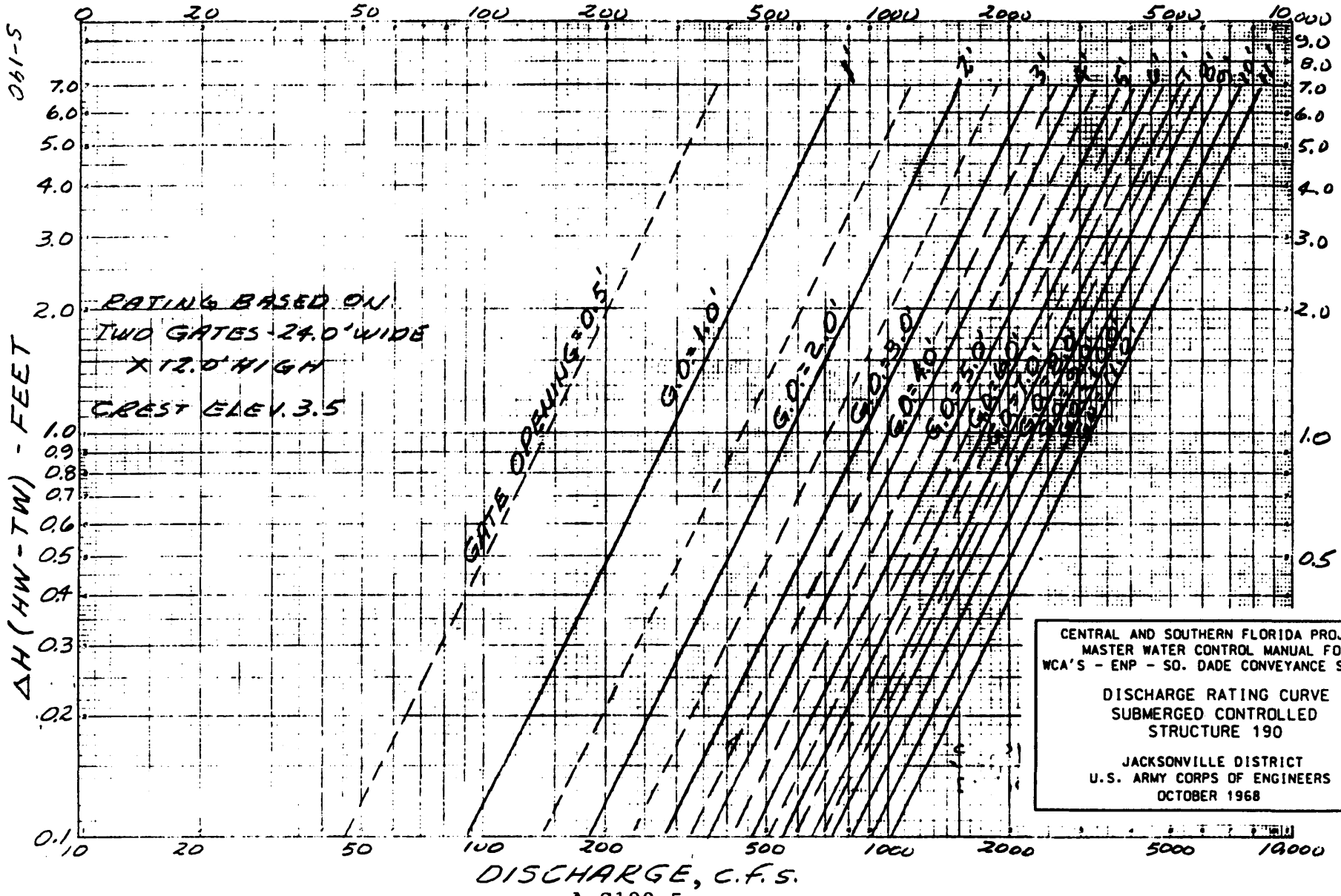
EXAMPLE:
H= 12.0'
h= 6.0
h/H 0.5
$G_o > 5.8$ FREE CONTROLLED
$G_o < 5.8$ SUBMERGED CONTROLLED

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

CONTROLLED FLOW NOMOGRAPH
STRUCTURE 190

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OCTOBER 1968

S-190

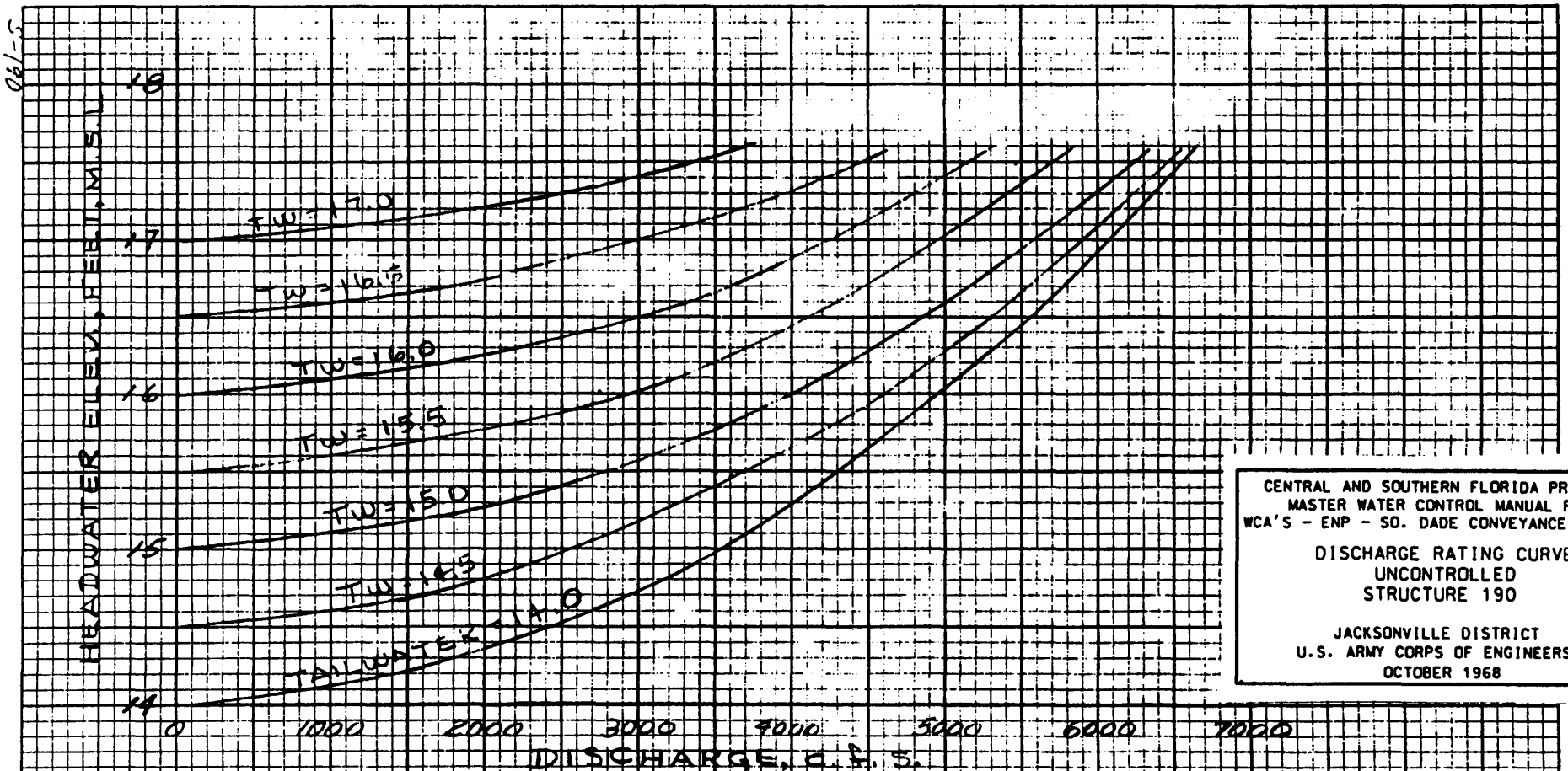


CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE 190

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OCTOBER 1968

K+E 5 x 5 TO ½ INCH 46 0863
7 x 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
UNCONTROLLED
STRUCTURE 190

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OCTOBER 1968

RATING BASED ON:
TWO GATES 24.0' WIDE X 12.0' HIGH
CREST ELEV. 3.5

S-190

UNCONTROLLED DISCHARGE
RATING CURVES

SAJWH OCT.68

STRUCTURE 194 (S-194)

Location. S-194 is located in Canal 102 at Krome Avenue, about 7 miles north of Homestead, Florida.

Description. S-194 is a double-barreled reinforced concrete pipe culvert with standard manual slide gates, a reinforced concrete intake headwall and an operating platform on the upstream side.

Purpose. S-194 acts as a drainage divide structure and a control structure for stages in C-102. It allows limited runoff to the east when capacity is available and provides a supplemental supply during dry periods.

Normal Regulation. S-194 is manually operated to supplement water to eastern Dade County from WCA No. 3 when the headwater stage at S-165 drops below 4.0 feet. The optimum headwater at S-194 is 6.5 feet and the optimum tailwater is 6.0 feet.

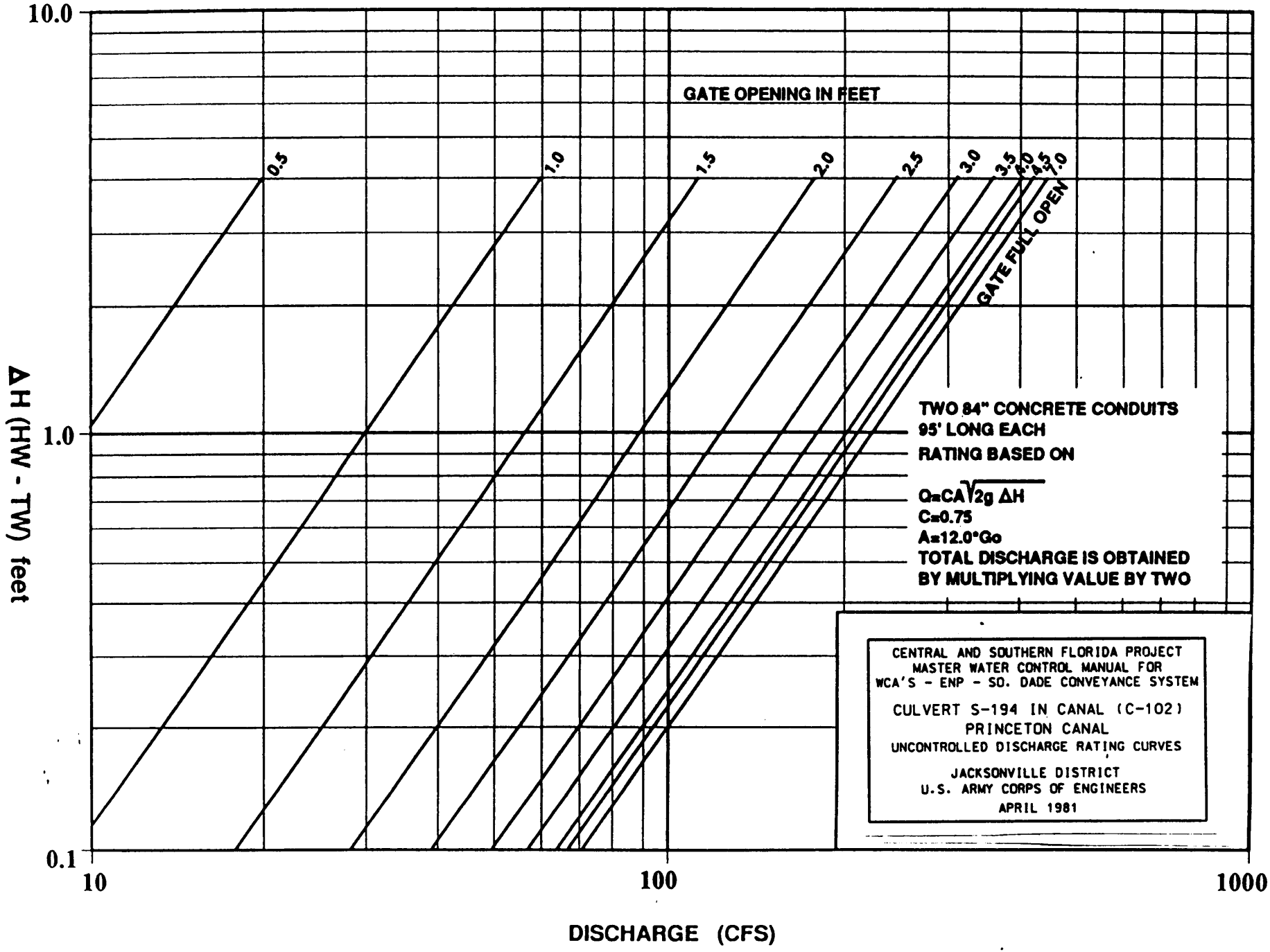
Flood Control Regulation. S-194 is used to pass flood waters to the west when flood conditions will not be created to the south and east in the C-102 basin. The discharge should be limited so as not to cause damaging velocities or stages downstream. The design headwater and tailwater is 6.5 ft. and 5.5 ft., respectively. The design discharge is 200 cfs.

Low Flow Regulation. During low flow conditions the design headwater is 3.9 feet, the design tailwater is 3.7 feet, and the design discharge is 190 cfs. To prevent saltwater intrusion, discharges should be made through S-194 for minimum releases at the eastward structures.

STRUCTURE 194 (S-194)

Summary of Hydraulic Design

Location	C-102
Design Conditions	
Discharge (cfs)	190
Type	Uncontrolled submerged
Headwater Elevation (ft.)	3.9
Tailwater Elevation (ft.)	3.7
Low-Flow Condition	
Discharge (cfs)	190
Headwater Elevation (ft.)	3.9
Tailwater Elevation (ft.)	3.7
S.P.F. Condition	
Discharge (cfs)	200
Headwater Elevation (ft.)	6.5
Tailwater Elevation (ft.)	5.5
Optimum Conditions	
Headwater Elevation (ft.)	5.5
Tailwater Elevation (ft.)	5.5
Culvert	
Type	RCP
Number of Barrels	2
Size (dia., in.)	84
Net Length (ft.)	190
Invert Elevation (ft.)	
Upstream	-2.5
Downstream	-3.5
Gates	
Type of Control	Manual slide gate
Number	2
Size (width x height, in.)	84 x 84


10.0
1.0
0.1
10
100
1000
ΔH (HW - TW) feet
DISCHARGE (CFS)
GATE OPENING IN FEET
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
7.0
GATE FULL OPEN
TWO 84" CONCRETE CONDUITS
95' LONG EACH
RATING BASED ON
Q=CA√2g ΔH
C=0.75
A=12.0*Go
TOTAL DISCHARGE IS OBTAINED
BY MULTIPLYING VALUE BY TWO
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
CULVERT S-194 IN CANAL (C-102)
PRINCETON CANAL
UNCONTROLLED DISCHARGE RATING CURVES
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
APRIL 1981

A-S194-3

STRUCTURE 196 (S-196)

Location. S-196 is located in C-103 about 350 feet upstream from Richards Roads.

Description. Structure 196 is a one-barrel, 84-inch concrete pipe culvert with a reinforced concrete headwall and an operating platform upstream. S-196 has a manually operated slide gate.

Purpose. S-196 is a drainage divide structure and a control for stages in western C-103. It allows limited runoff to the east when capacity is available. It also provides supplemental water supply when needed and when water is available.

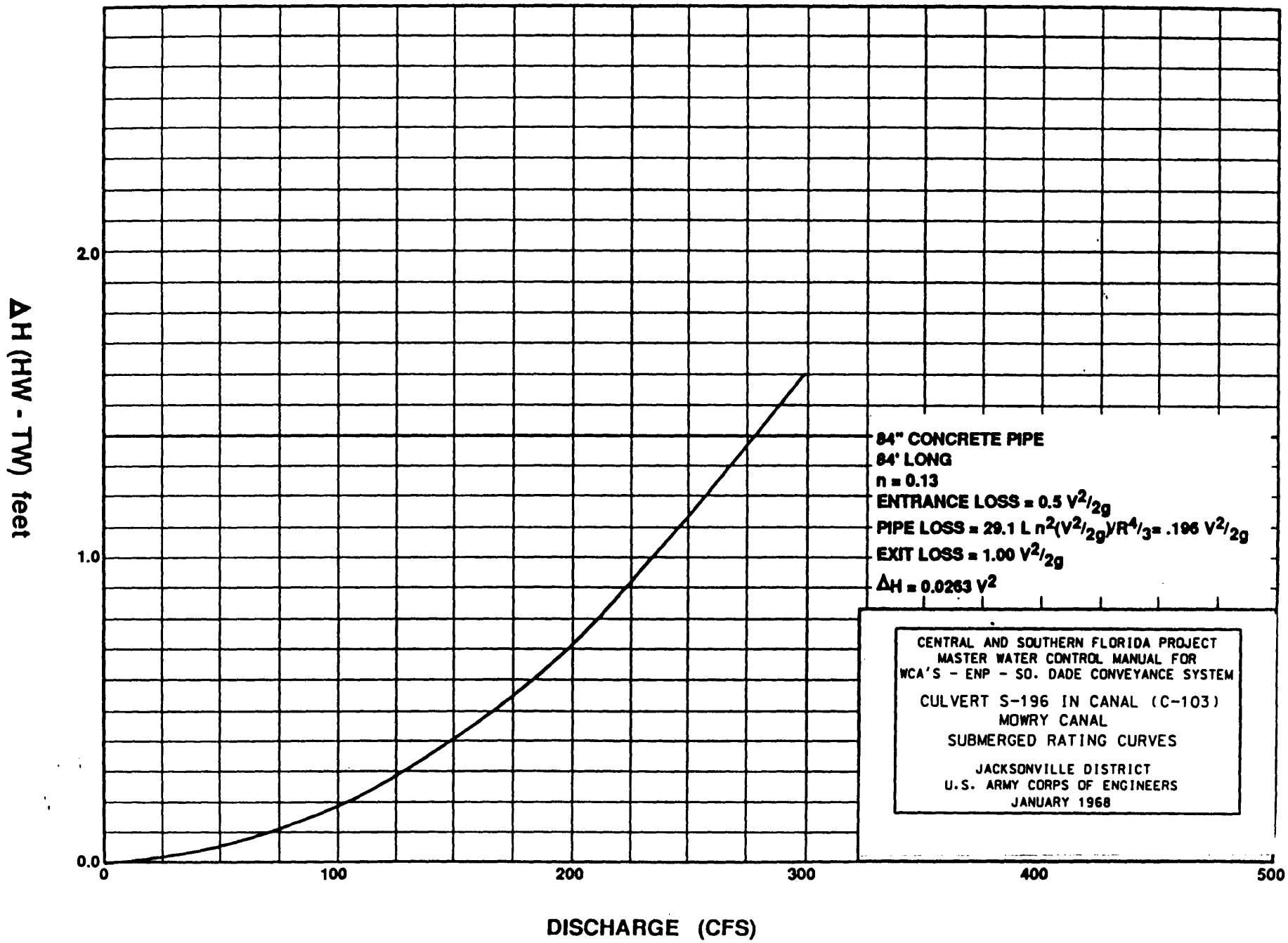
Normal Regulation. S-196 is manually operated to maintain an optimum headwater elevation of 5.5 feet and an optimum tailwater elevation of 5.5 feet.

Flood Control Regulation. S-196 should be manually operated to maintain a headwater elevation of 6.5 feet. The structure should continuously pass the design discharge (40% of the SPF), 200 cfs, or up to the amount that will reach the structure.

STRUCTURE 196 (S-196)

Summary of Hydraulic Design

Location	C-103
Design Conditions	
Discharge (cfs)	200
Type	Uncontrolled submerged
Headwater Elevation (ft.)	6.5
Tailwater Elevation (ft.)	5.5
Optimum Conditions	
Headwater Elevation (ft.)	5.5
Tailwater Elevation (ft.)	5.5
Culvert	
Type	Concrete pipe
Number of Barrels	1
Size (inches)	84
Net Length (ft.)	58
Invert Elevation (ft.)	
Upstream	-2.5
Downstream	-3.5
Gates	
Type of Control	Manual slide gate
Number	1
Size (inches)	84 x 84
Canal Section	
Upstream Bottom Width (ft.)	10.0
Upstream Bottom Elevation (ft.)	-3.5
Downstream Bottom Width (ft.)	10.0
Downstream Bottom Elevation (ft.)	-5.0
Side Slopes (vert. on hor.)	1 on 1
Operating Platform Elevation (ft.)	15.5
Dewatering Capabilities	No


84" CONCRETE PIPE
84' LONG
n = 0.13
ENTRANCE LOSS = 0.5 $V^2/2g$
PIPE LOSS = 29.1 L $n^2(V^2/2g)/R^{4/3}$ = .196 $V^2/2g$
EXIT LOSS = 1.00 $V^2/2g$
$\Delta H = 0.0263\ V^2$
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
CULVERT S-196 IN CANAL (C-103)
MOWRY CANAL
SUBMERGED RATING CURVES
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 1968
ΔH (HW - TW) feet
2.0
1.0
0.0
0
100
200
300
400
500
DISCHARGE (CFS)

A-S196-3

STRUCTURE 197 (S-197)

Location. S-197 is located in Canal 111 near the mouth of the canal. The structure is about 3 miles from Manatee Bay and 750 feet east of U.S. Highway 1.

Description. Structure 197 was originally built as a gated, three barrel, 84-inch, corrugated metal pipe culvert with an invert elevation of minus 8.0 feet. It originally had three manually operated slide gates attached to the upstream ends of the pipes. In 1990, ten additional culverts were built with two metal slide gates at the face of each riser. The gates can be operated from the timber operating platform.

Purpose. S-197 maintains optimum water control stages in Canal 111 and prevents saltwater intrusion during high tides.

Normal Regulation. Normally S-197 is closed and diverts discharge from S-18C overland to the panhandle of the Everglades National Park.

Flood Control Regulation. During flood conditions, S-197 should be operated as shown below.

Open Culverts: Opening of S-197 culverts should begin when water levels exceed specified levels at the referenced structure:

1) S-177 HW > 4.10 feet after gates have been opened full* or S-18C HW > 2.8 feet; open 3 culverts

2) S-177 HW > 4.2 feet for 24 hours or S-18C > 3.10 feet; open 7 culverts

3) S-177 HW > 4.3 feet or S-18C HW > 3.3 feet; open 13 culverts

* Due to discharge capacity of S-177, headwater stages upstream of the structure may decline abruptly once the structure is opened. Culverts at S-197 will remain closed until S-177 has been completely opened. This lag time will allow the canal levels to equalize and provide an opportunity for flood waters to first discharge through the C-111 gaps. After S-177 gates have been fully opened and canal stage level continues to exceed the flood control criteria, culverts at S-197 will be opened according to the criteria above.

Close Culverts: Closing of the culverts at S-197 should begin after the following conditions have been met:

1. When headwater canal stage (stage upstream of the structure) at S-176 has declined below 5.2 feet, NGVD and

headwater stage at S-177 has declined below 4.2 feet, NGVD. Stage levels above 5.2 feet and 4.2 feet, respectively, at these structures trigger mandatory flood control releases. A declining trend in water levels below this stage would indicate the peak of the storm event has passed.

2. Position of the storm has moved away from the basin.

3. Once conditions 1 and 2 above have been met, only the number of S-197 culverts required to match the residual discharge volume flowing through S-176 will be open. This will prevent unnecessary over-drainage of the panhandle region by restricting the amount discharged through S-197 to equal the amount of inflow from the upper basin. All culverts will be closed once the S-177 headwater stage declines below 4.1 feet, NGVD and the above conditions are satisfied.

Constraints. Due to structural and stability requirements, the hydrostatic head should not exceed 0.8 feet with a headwater of 1.4 feet and a tailwater of 0.6 feet. The water level which will by-pass the structure is 5 feet.

STRUCTURE 197 (S-197)

Summary of Hydraulic Design

Location	C-111
Design Conditions	
Discharge (cfs)	2400
Type	Uncontrolled submerged
Headwater Elevation (ft.)	1.4
Tailwater Elevation (ft.)	0.6
Culvert	
Type	CMP
Number of Barrels	13
Size (inches)	84
Net Length (ft.)	66
Invert Elevation (ft.)	-8.0
Gates (Original)	
Type of Control	Manual sluice gate
Number	3
Width x Height (inches)	84x84
Gates (Additional)	
Type of Control	Manual sluice gate
Number	20
Width x Height (feet)	4 X 12

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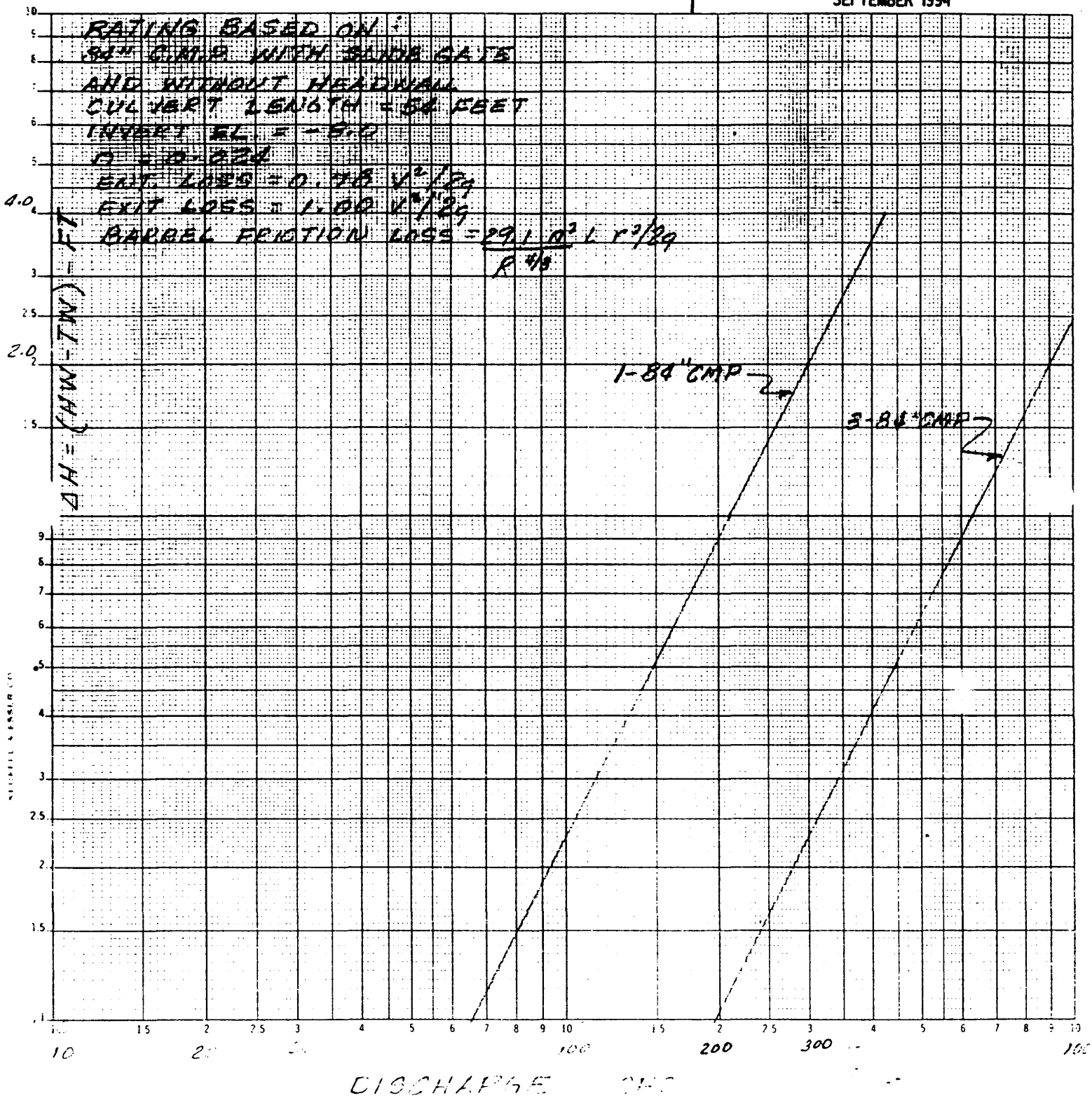
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 197

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994



DISCHARGE

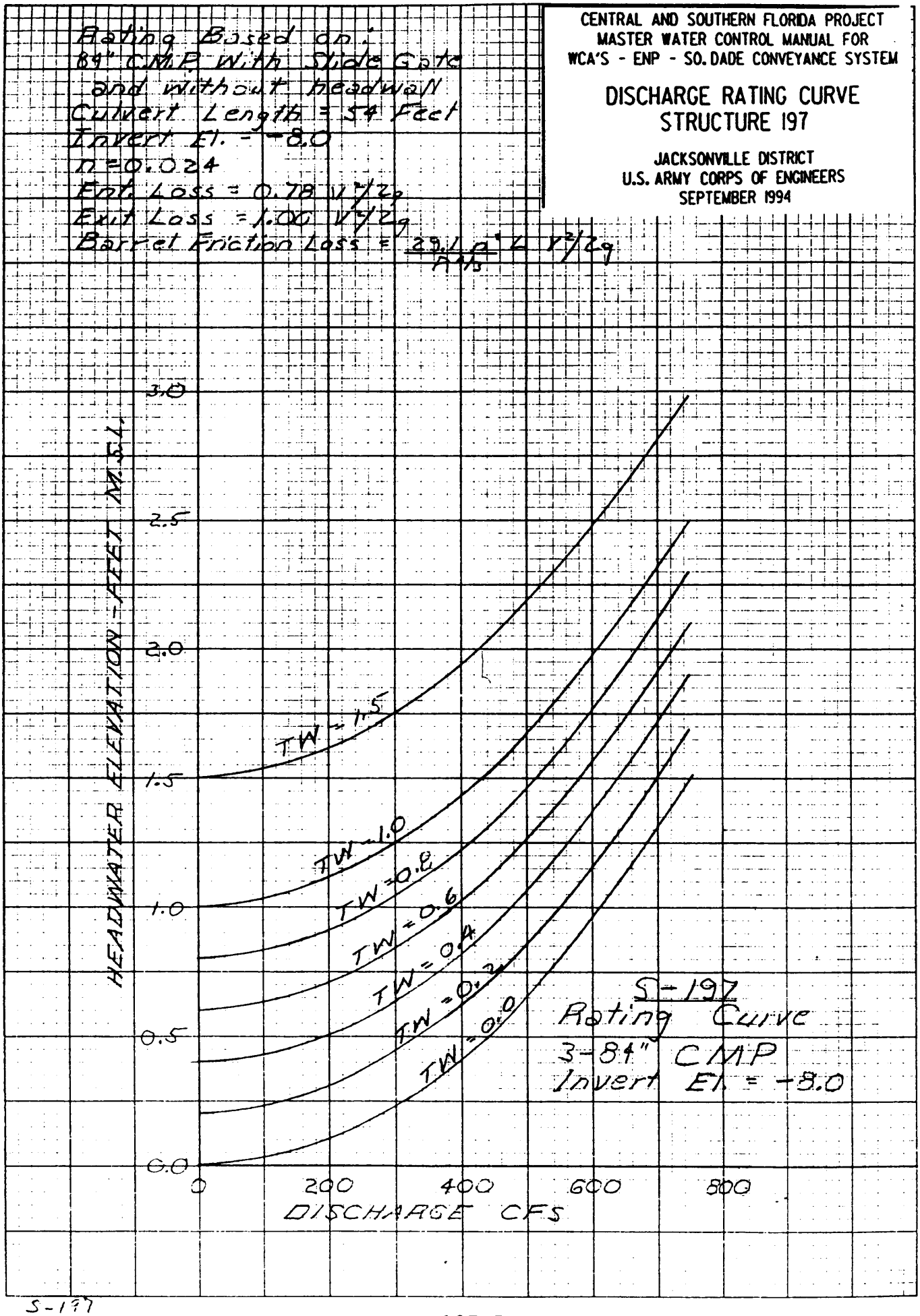
S-197

RATING CURVES
1-84" CMP & 3-84" CMP

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 197

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1994



S-197

STRUCTURE 199 (S-199)

Note: This is an inoperative spillway and included for informational purposes only. It is also included in Volume 5, East Coast Canals Water Control Manual.

Location. S-199 is located about 9 miles south of Homestead, Florida at Canal 110.

Description. Control structure S-199 is a one bay, U-shaped spillway, with a trapezoidal weir and an automatically controlled vertical lift gate. The structure also has a service bridge, steel-sheet-pile wingwalls, and a concrete block control house. Riprap is provided upstream and downstream to protect against erosion.

Purpose. S-199 would have maintained optimum water control stages in C-110 and passed up to 1100 cfs during flood conditions. S-199 would also have provided the necessary salinity control to prevent salt water intrusion along the canal.

Normal Regulation. None.

Flood Control Regulation. None.

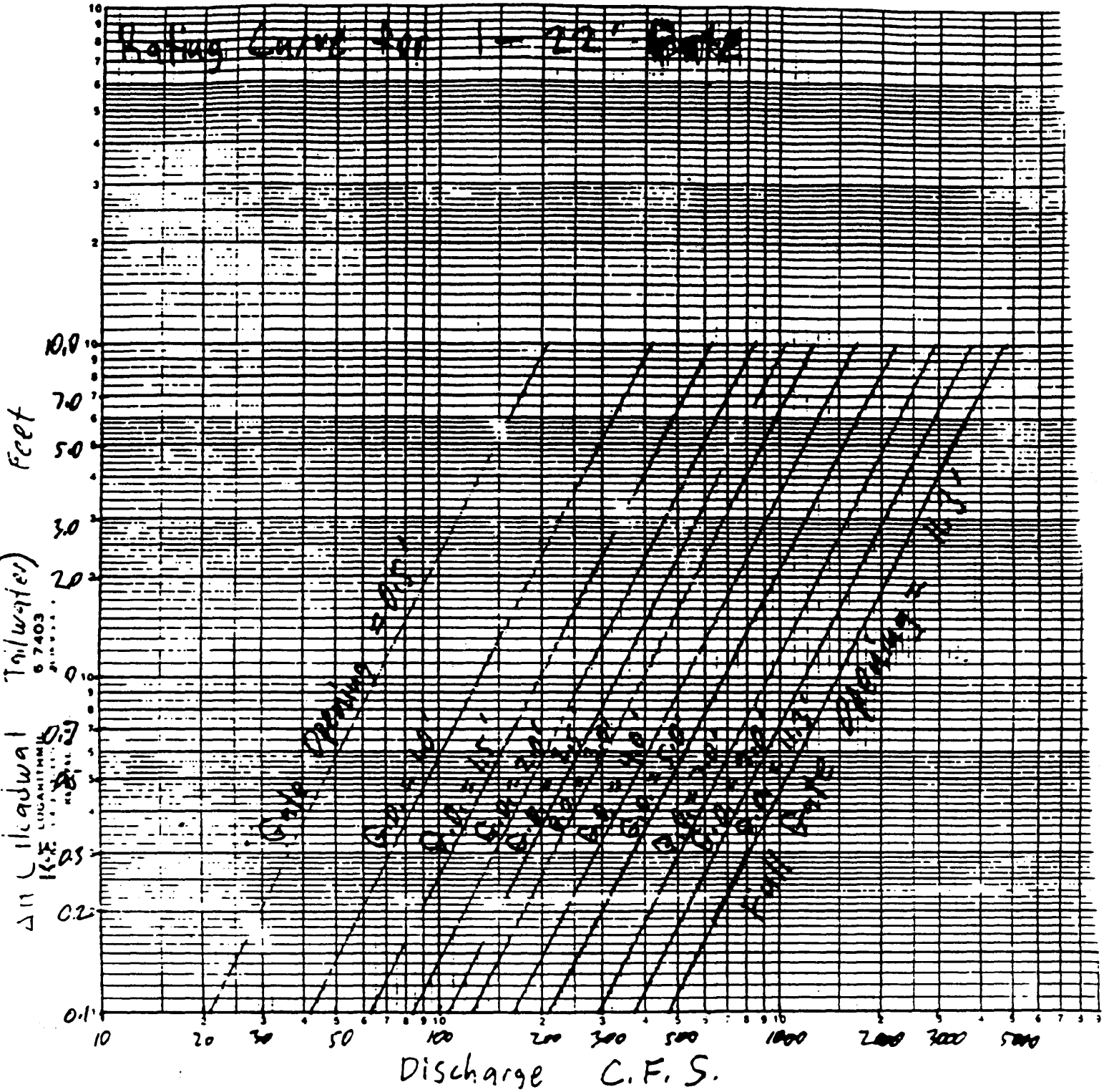
Note: Construction of C-110 was completed south of S-199 with the exception of a 50 ft. plug immediately north of the junction with C-111. No canal excavation was done from S-199 north to 424th Street.

STRUCTURE 199 (S-199)

Summary of Hydraulic Design

Location	C-110
Design Conditions	
Discharge (cfs)	690
Headwater Elevation (ft.)	2.8
Tailwater Elevation (ft.)	2.6
Maximum Head	3.9
S.P.F. Condition	
Discharge (cfs)	1100
Headwater Elevation (ft.)	3.9
Tailwater Elevation (ft.)	3.5
Optimum Conditions	
Headwater Elevation (ft.)	1.7
Tailwater Elevation (ft.)	0.9
Hurricane Conditions	
Maximum Tide Elevation (ft.), est.	7.0
Maximum Reverse Head	4.2
Minimum Water Surface Condition, estimated	
Headwater Elevation (ft.)	1.0
Tailwater Elevation (ft.)	-2.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-7.3
Net Length (ft.)	22.0
Gates	
Type of Gate	Vertical lift with slide gates
Number	1
Width x Height (ft.)	22.0 x 11.3
Clearance Elevation (ft.)	4.9
Overflow Slot Elevation (ft.)	1.0 - 2.5

S-199



Submerged Controlled

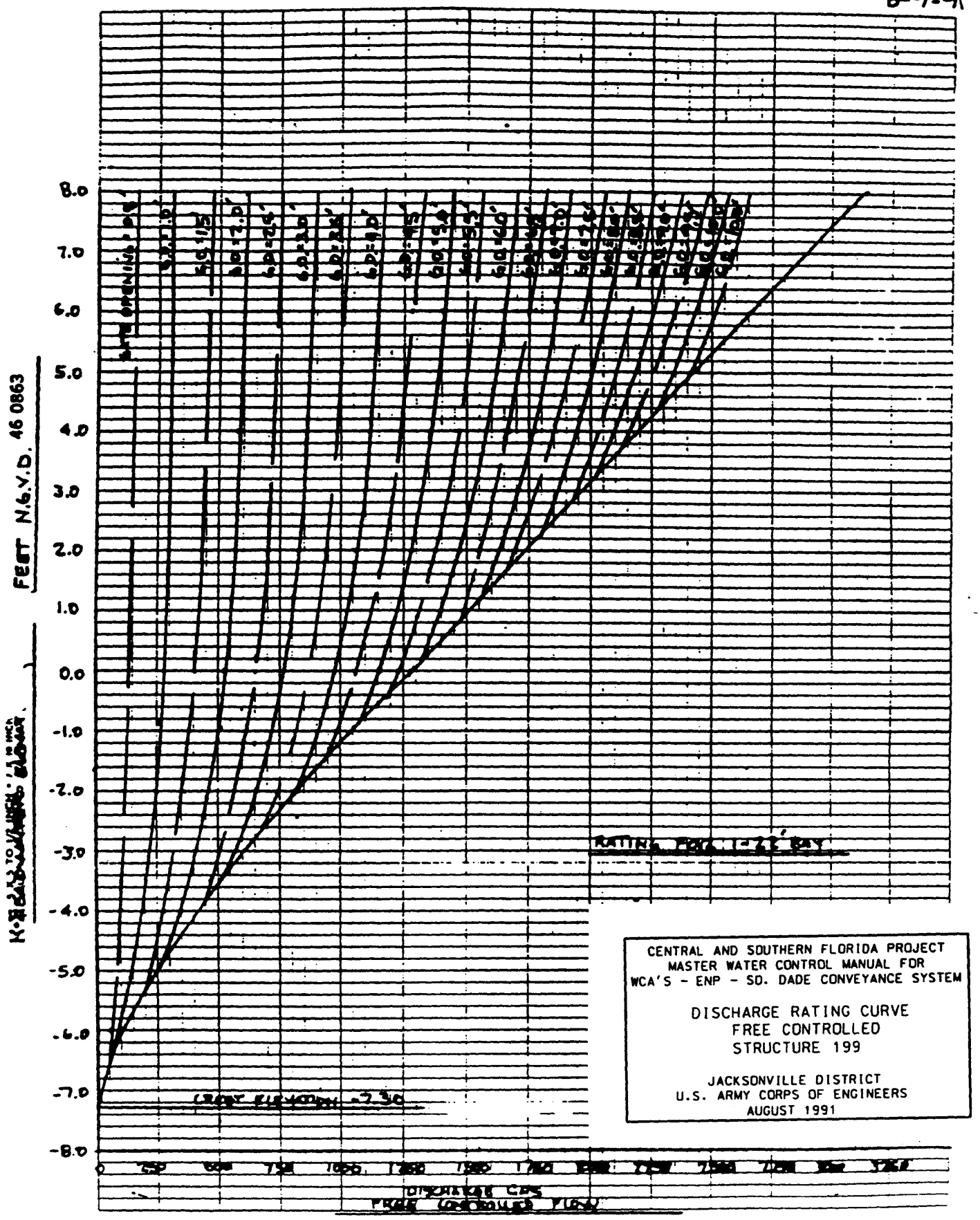
A-S199-3

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED
STRUCTURE 199

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JULY 1991

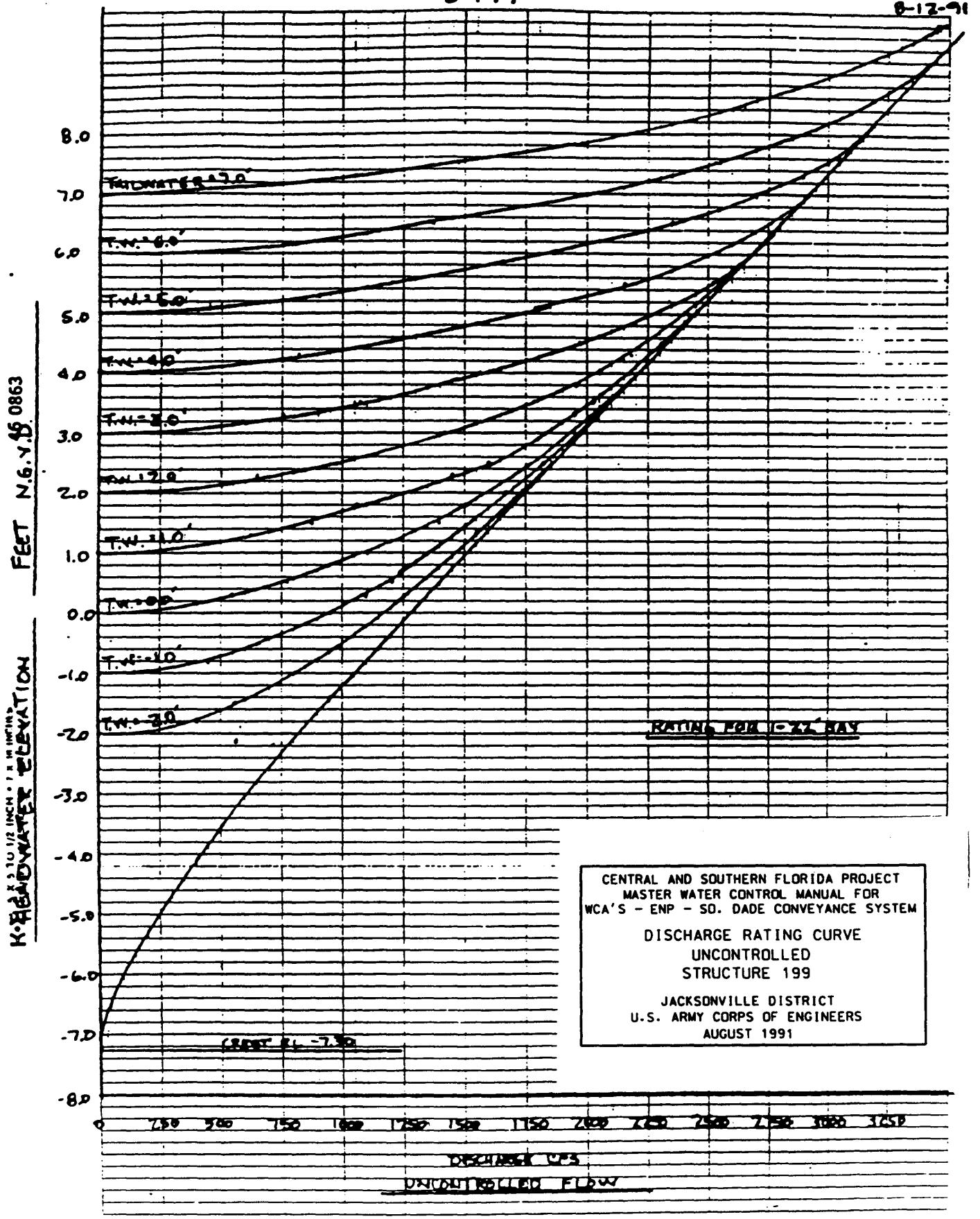
8-9-91



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
FREE CONTROLLED
STRUCTURE 199

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1991



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
UNCONTROLLED
STRUCTURE 199

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1991

STRUCTURE 331 (S-331)

Location. Structure 331 is located in the L-31N borrow canal about 9 miles north of Homestead, Florida.

Description. S-331, a three unit pumping plant with an adjacent CMP gated culvert (S-173). Each unit rates 387 cfs for a 3.0 foot static head and is driven by a 250 horsepower diesel engine.

Purpose. This structure's original purpose was to function as a component of the South Dade Conveyance System to deliver supplementary water supply to South Dade County and to provide a continuous supply to the Everglades National Park at Taylor Slough and the Panhandle. This purpose was augmented by an Agreement dated July 11, 1985. With the new agreement, S-331 serves to control the level in L-31N north of S-331 as a function of the water levels in the Rocky Glades residential area.

Normal Regulation. The discharge of S-331 is accomplished by syphoning through the pumps by using the adjacent culvert (S-173), or by pumping. In the water supply mode, discharge through the structure is performed when the stage at any downstream, inland structure drops more than 1.5 ft. below optimum. Optimum and critical levels of these structures are as follows:

CANAL	STRUCTURE	OPTIMUM STAGE (ft.)	CRITICAL STAGE (ft.)
L-31(N)	S-174/176	5.5	4.0
C-111	S-177	4.5	3.0
L-31(W)	S-332	4.5	3.0
	S-175	4.5	3.0
C-103	S-196	5.5	4.0
	S-167	5.5	4.0
	S-179	3.5	2.0
C-102	S-194	5.5	4.0
	S-165	5.5	4.0

Flood Regulation. S-331 is regulated according to an agreement between the U. S. Army Corps of Engineers, the Everglades National Park and the South Florida Water Management District.

The agreement is part of the experimental water delivery program as authorized by PL 91-282. S-331 discharges in response to the stage at a groundwater monitoring well known as Angel. If the stage at Angel is below 6.0 feet, discharge through S-331 should maintain an average headwater stage of 5.0 feet. If the stage at Angel's well exceeds 6.0 feet, S-331's discharge should maintain an average headwater stage of 4.5 feet until Angel drops to 5.7 feet, whereupon the headwater at S-331 may be allowed to rise to 5.0 feet. During any of these operations, the discharge from S-331 will be limited so as not to cause downstream structures to exceed their design stages as follows:

CANAL	STRUCTURE	HEADWATER DESIGN STAGE (FT.)
L-31(N)	S-174	6.0
	S-176	6.0
C-111	S-177	4.3
	S-18C	3.3
L-31(W)	S-175	5.0

<u>L-31(N) borrow canal north of S-331</u>
If the level at Angel's well is between 5.5 and 6.0 feet, the average daily water level upstream of S-331 should be maintained at or below 5.0 feet, if permitted by downstream conditions. If the level at Angel's well is above 6.0 feet, the average daily water level upstream of S-331 should be maintained at or below 4.5 feet, until the water level at Angel's well recedes below 5.7 feet, if permitted by downstream conditions.

<u>L-31(N) borrow canal south of S-331</u>
Between June 1 and October 31, the L-31(N) canal between S-331 and S-176 will be managed to maintain a daily average stage of approximately 4.3 feet, upstream of S-176.

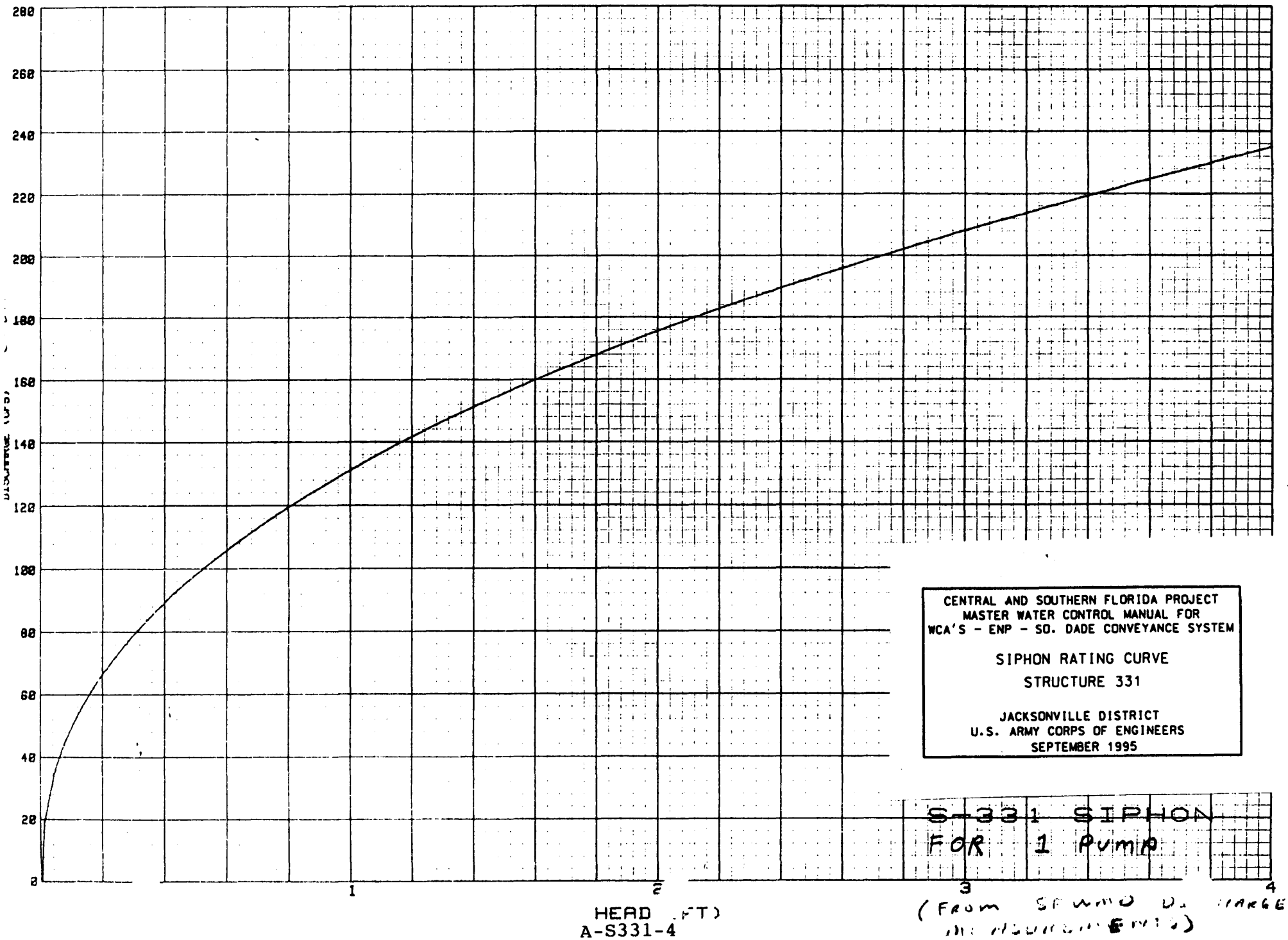
Between November 1 and May 31, the L-31(N) Canal between S-331 and S-176 will be managed to maintain a daily stage of approximately 4.8 feet, upstream of S-176.

<u>Constraints</u>. Discharges through S-331 can be made if the S-331 tailwater stage is below 6.0 ft. and the S-176 headwater stage is below 5.5 feet. If either of those water levels of S-331 and S-176 were exceeded, discharges at S-331 should be terminated until the S-176 headwater stage recedes to 5.0 feet. If heavy rainfall is expected, S-331 discharges should be terminated when the S-176 headwater stage is between 5.0 and 5.5 feet.

STRUCTURE 331 (S-331)

Summary of Hydraulic Design

Location	L-31(N)
Pump Design	
Discharge Rate (cfs)	1,160
Headwater Elevation (ft.)	3.0
Tailwater Elevation (ft.)	6.0
Gravity Design (S-173)	
Discharge Rate (cfs)	100
Type	controlled submerged
Headwater Elevation (ft.)	5.0
Tailwater Elevation (ft.)	4.5
Design Heads Elevation (ft.)	
Normal	1.5
Discharge Water Surface Elevation (ft.)	
Normal pumping	6.0
Minimum non-pumping	3.5
Intake Water Surface Elevation (ft.)	
Start Pumps	3.0 to 5.0
Normal Drawdown	3.0
Minimum non-pumping	3.5
Pumps	
Type	Vertical axial flow
Number & Size (inches)	3 @ 96
Design Rating (cfs)	387
Impeller Speed (rpm)	100
Engine Horsepower (ea)	250
Engine Speed (rpm)	1,800


280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
HEAD (FT)
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
SIPHON RATING CURVE
STRUCTURE 331
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1995
S-331 SIPHON
FOR 1 PUMP

A-S331-4

STRUCTURE 332 (S-332)

Location. Structure 332 is located on the west side of the L-31W borrow canal at the head of Taylor Slough in the Everglades National Park (ENP) about 6 miles west of Homestead, Florida.

Description. S-332 is an electric motor-driven pumping station with a variable pump arrangement. The upstream wingwalls are steel sheet pile walls capped with steel channels. The downstream wingwalls are reinforced concrete inverted "T" walls. The concrete apron and end sill are on the downstream side of the structure. A service bridge over the pumping station provides access for service vehicles.

Purpose. The purpose of S-332 is to function as a component of the conveyance canal system to ENP and South Dade County. The system is designed to provide supplemental water supply from WCA No. 3A to satisfy the peak dry season demands of ENP and South Dade County agricultural users during a 1-in-10 year drought.

Regulation. S-332, together with S-174, S-176, and S-177, is regulated according to an agreement between the U. S. Army Corps of Engineers, the Everglades National Park and the South Florida Water Management District. The agreement is part of the experimental water delivery program as authorized by PL 91-282.

The terms of this agreement require that the operation will be as follows:

Wet Season Criteria
S-332 and the auxiliary pumps will be operated as needed to maintain S-176 and S-175 at their optimum levels (5.0 ft and 4.5 ft., respectively).

Normal Dry Season Criteria
Dry season criteria will go into effect following the cessation of wet season rainfall, and L-31W borrow canal stages have receded naturally to 3.5 ft. When water supply deliveries are being mad, S-332 and the auxiliary pumps will be operated to keep the S-174 tailwater stage from exceeding 3.7 ft, and concurrently S-175 headwater equal to 3.5 ft.. S-174 and S-332 will be operated to meet the minimum delivery criteria when S-175 headwater stage drops below 3.0 ft.. This stage-based approach is intended to approximately balance inflows and outflows, while maintaining the L-31W average stage at or near 3.5 ft..

Dry Season Flood Control Criteria
S-332 and the auxiliary pumps may be operated up to their maximum capacity, to maintain the S-175 headwater stage at or below 3.5 ft..

Transition from the Dry Season into the Wet Season
Beginning at 0800 on June 1st, the wet season operating criteria would go into effect. From June 1 until June 15, pumping at S-332 shall not exceed 165 cfs.

Transition from the Wet Season into the Dry Season
The goal of the transition is to reach elevation 3.5 ft. on December 1st as measured at the S-175 HW.

S-332 and the temporary pumps shall be operated to allow a smooth recession of stages in the L-31W borrow canal.

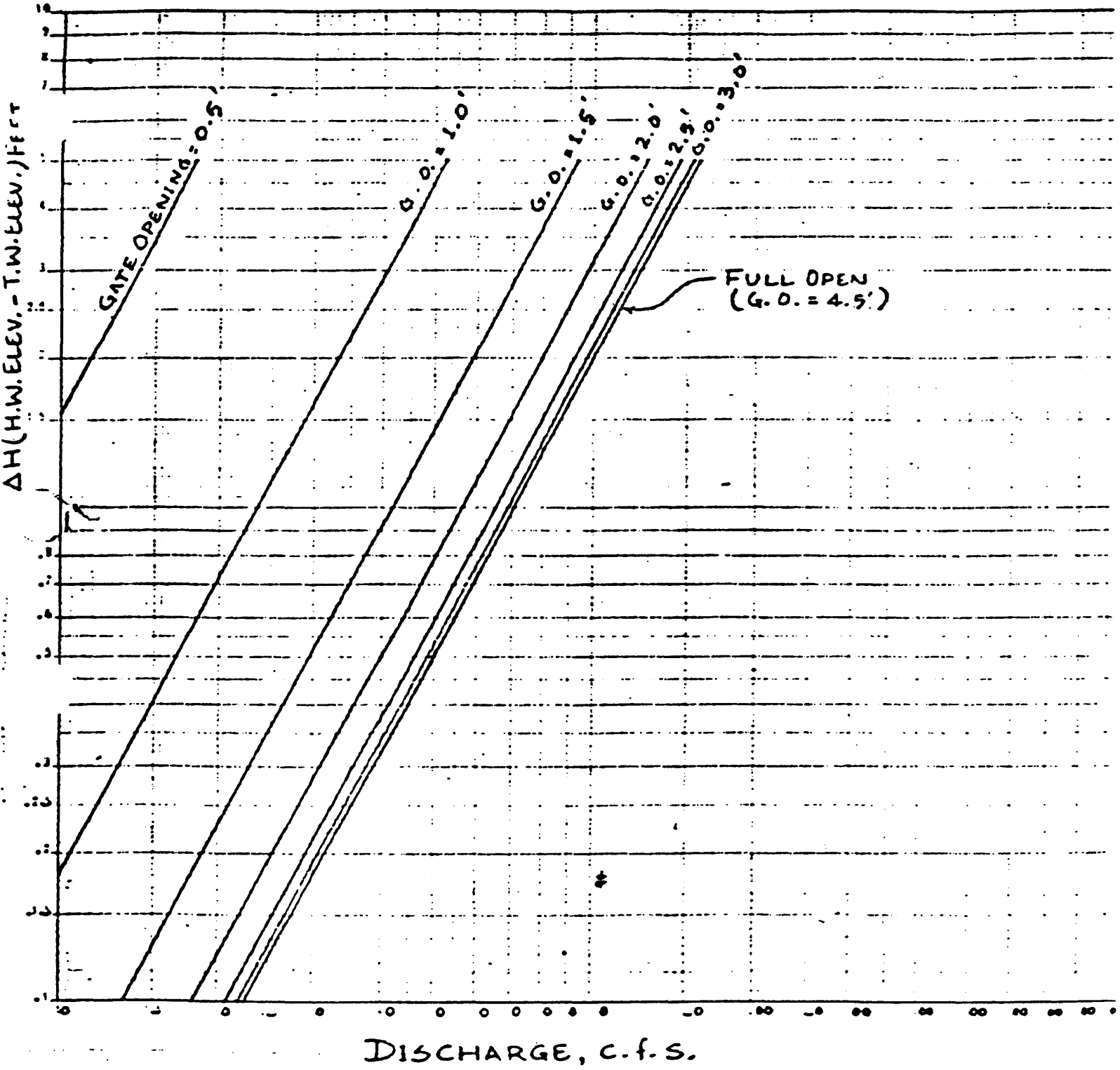
Low Flow Regulation. The main gate has two manual slide gates, over 1.5-foot-high, which provide overflow and water control above elevation 4.5 ft. to minimize vertical-lift gate movement.

Constraints. The pumps are designed to operate between headwater stages of 2.0 and 5.0 feet. If the headwater stage drops to 2.0 feet, the sump float causes the power to the motor to be cut off.

STRUCTURE 332 (S-332)

Summary of Hydraulic Design

Location	L-31W
Design Conditions	
Discharge (cfs)	165
Headwater Elevation (ft.)	3.0
Tailwater Elevation (ft.)	Below 5.8
Intake Water Surface Elevation (ft.)	
Maximum pumping	4.5
Maximum non-pumping	5.0
Start pumping	3.0 to 4.5
Normal drawdown pumping	3.0
Minimum non-pumping	3.0
Discharge Water Surface Elevation (ft.)	
Maximum pumping	4.5
Normal pumping	6 in. above ground
Minimum pumping	Natural ground
Minimum non-pumping	Natural ground
Pumps	
Type	Vertical axial flow
Number & Size (inches)	2 @ 30
Number & Size (inches)	1 @ 24
Number & Size (inches)	1 @ 20
Number & Size (inches)	1 @ 14
Number & Size (inches)	1 @ 10
Invert Elevation (ft.)	5.75
Gates	
Type of Control	Flapgates
Number	6



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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

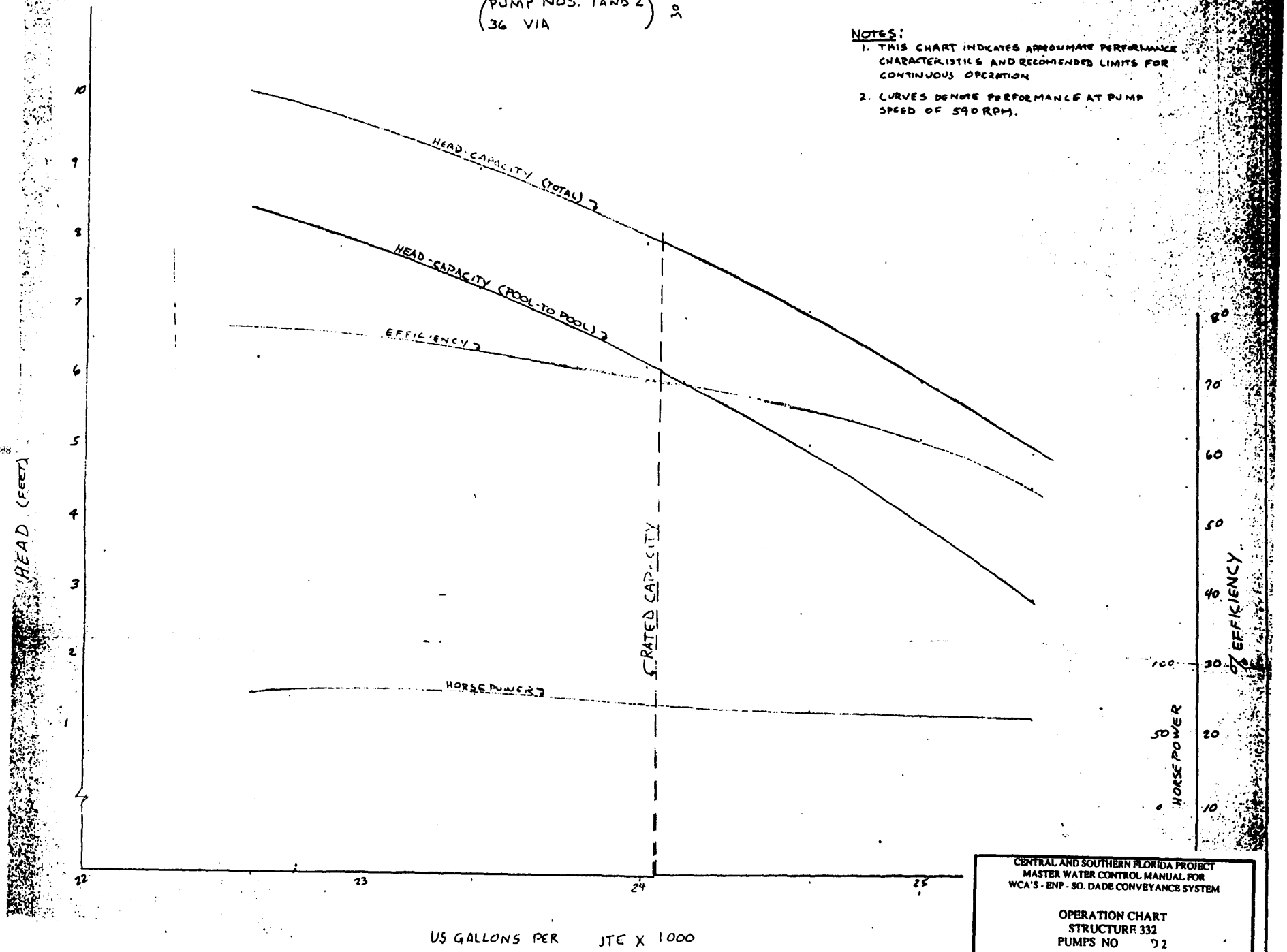
DISCHARGE RATING CURVE
STRUCTURE 32A

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
APRIL 1981

OPERATIOI ART
FOR
PUMPING STH -N 332
(PUMP NOS. 1 AND 2)
(36 VIA)

S -32
f

NOTES:
1. THIS CHART INDICATES APPROXIMATE PERFORMANCE CHARACTERISTICS AND RECOMENDED LIMITS FOR CONTINUOUS OPERATION
2. CURVES DENOTE PERFORMANCE AT PUMP SPEED OF 590 RPM.



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WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATION CHART
STRUCTURE 332
PUMPS NO 1 2

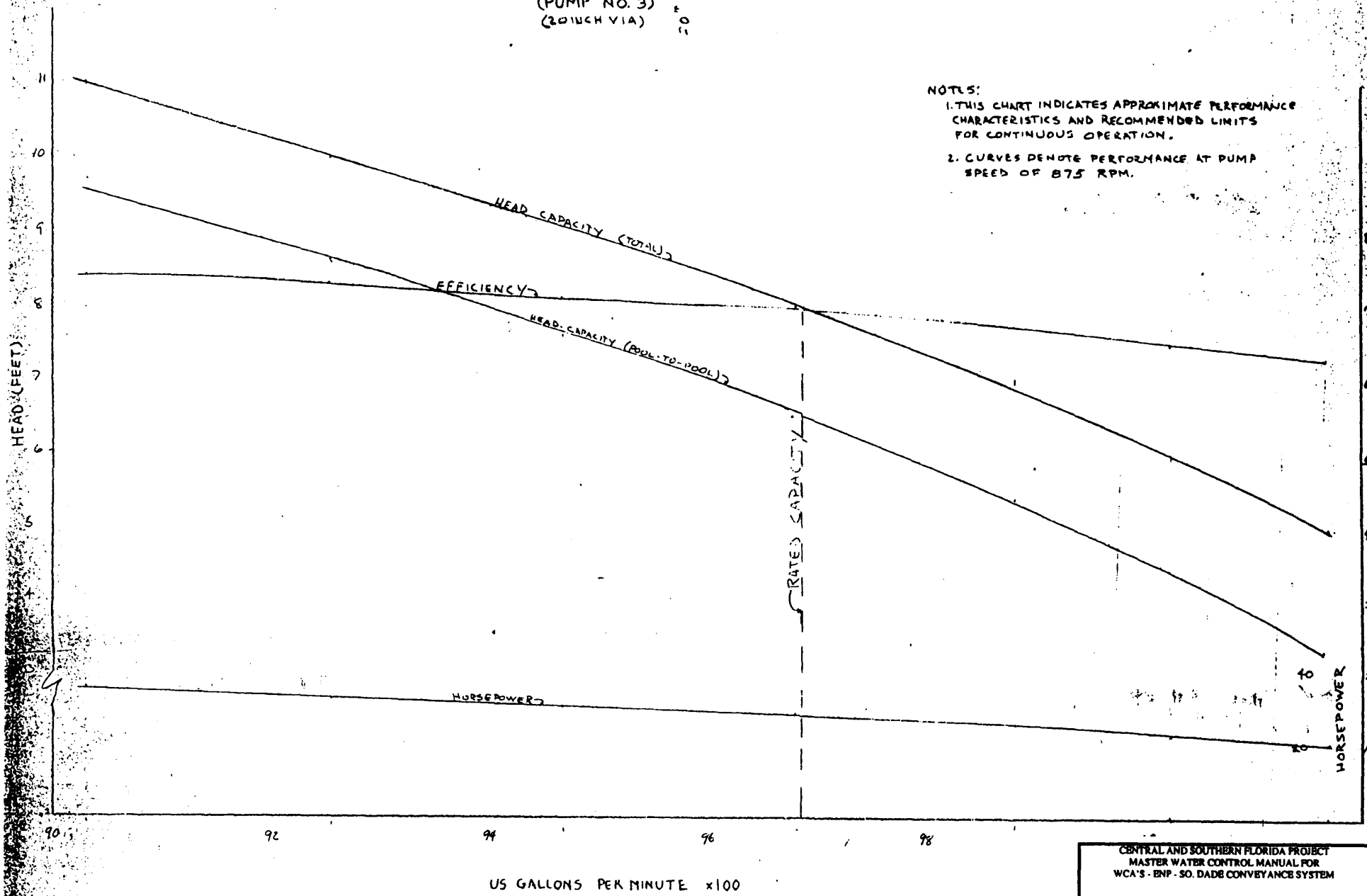
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

A-S332-4

5-3
Pump #3

OPERATION CHART
PUMPING STATION 332

(PUMP NO. 3)
(20 INCH VIA)



A-S332-5

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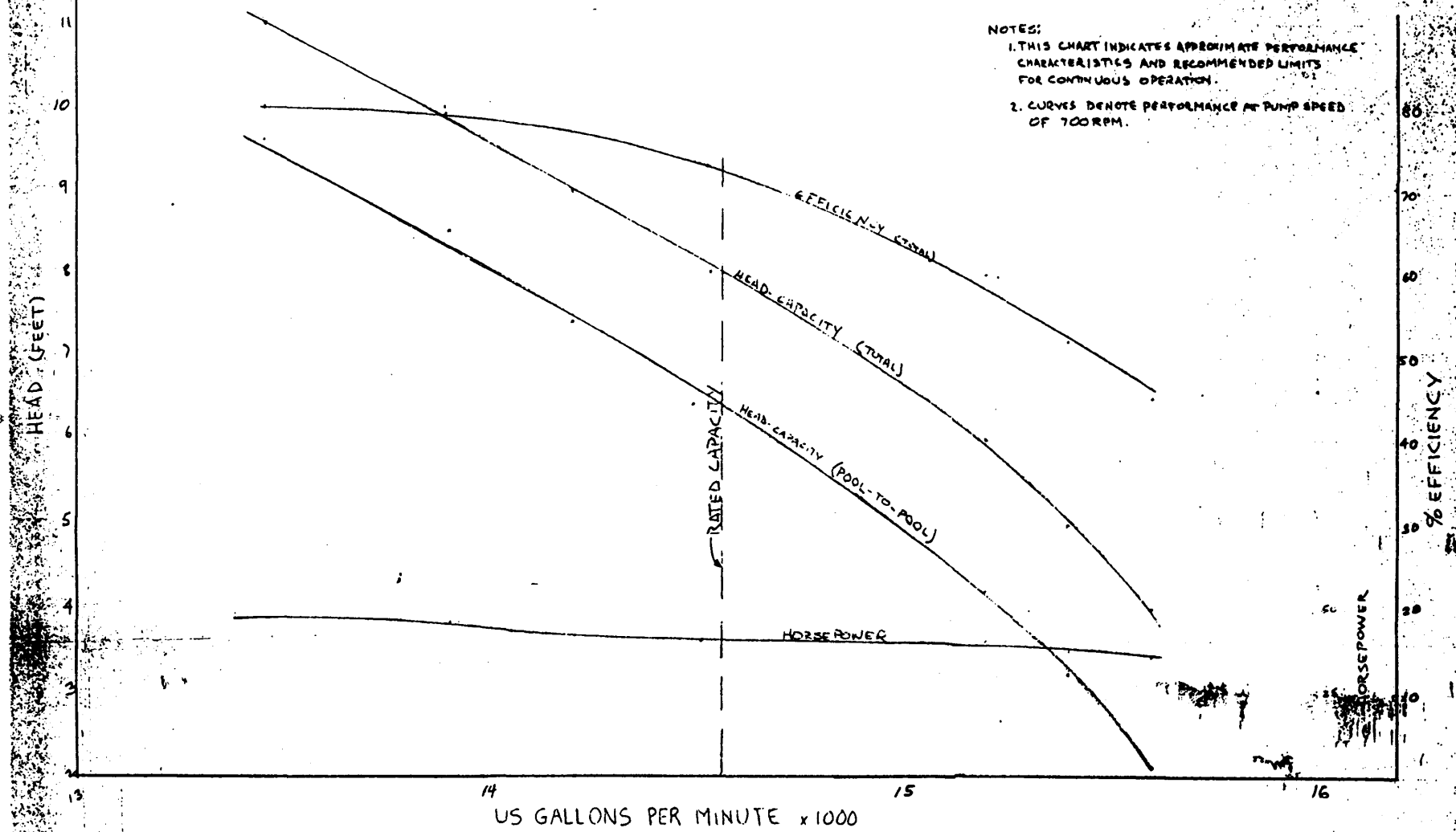
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATION CHART
STRUCTURE 332
PUMP NO. 3

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

S 2
pump-4

OPERATION CHART
PUMPING STATION 332
(PUMP NO. 4)
(24 INCH VIA)



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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATION CHART
STRUCTURE 332
PUMP NO. 4

JACKSONVILLE DISTR
U.S. ARMY CORPS OF ENG

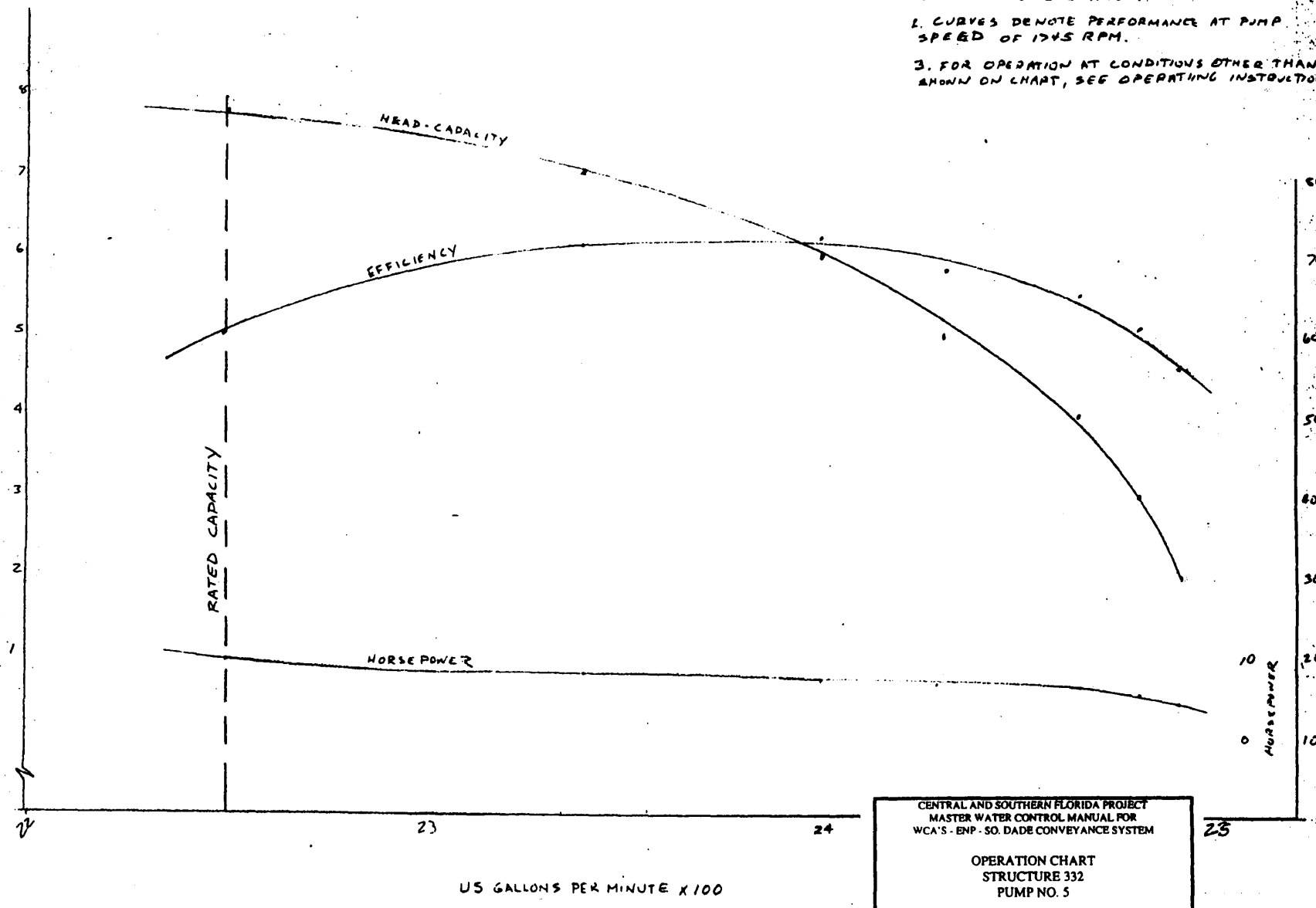
OPERI I CHART

PUMPING STATION S32
(PUMP NO. 5) 10"

S-332 Rating Curves
Pump #5

NOTES:

1. THIS CHART INDICATES APPROXIMATE PERFORMANCE CHARACTERISTICS AND RECOMMENDED LIMITS FOR CONTINUOUS OPERATION.
2. CURVES DENOTE PERFORMANCE AT PUMP SPEED OF 1745 RPM.
3. FOR OPERATION AT CONDITIONS OTHER THAN SHOWN ON CHART, SEE OPERATING INSTRUCTIONS.



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MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATION CHART
STRUCTURE 332
PUMP NO. 5

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

A-S332-7

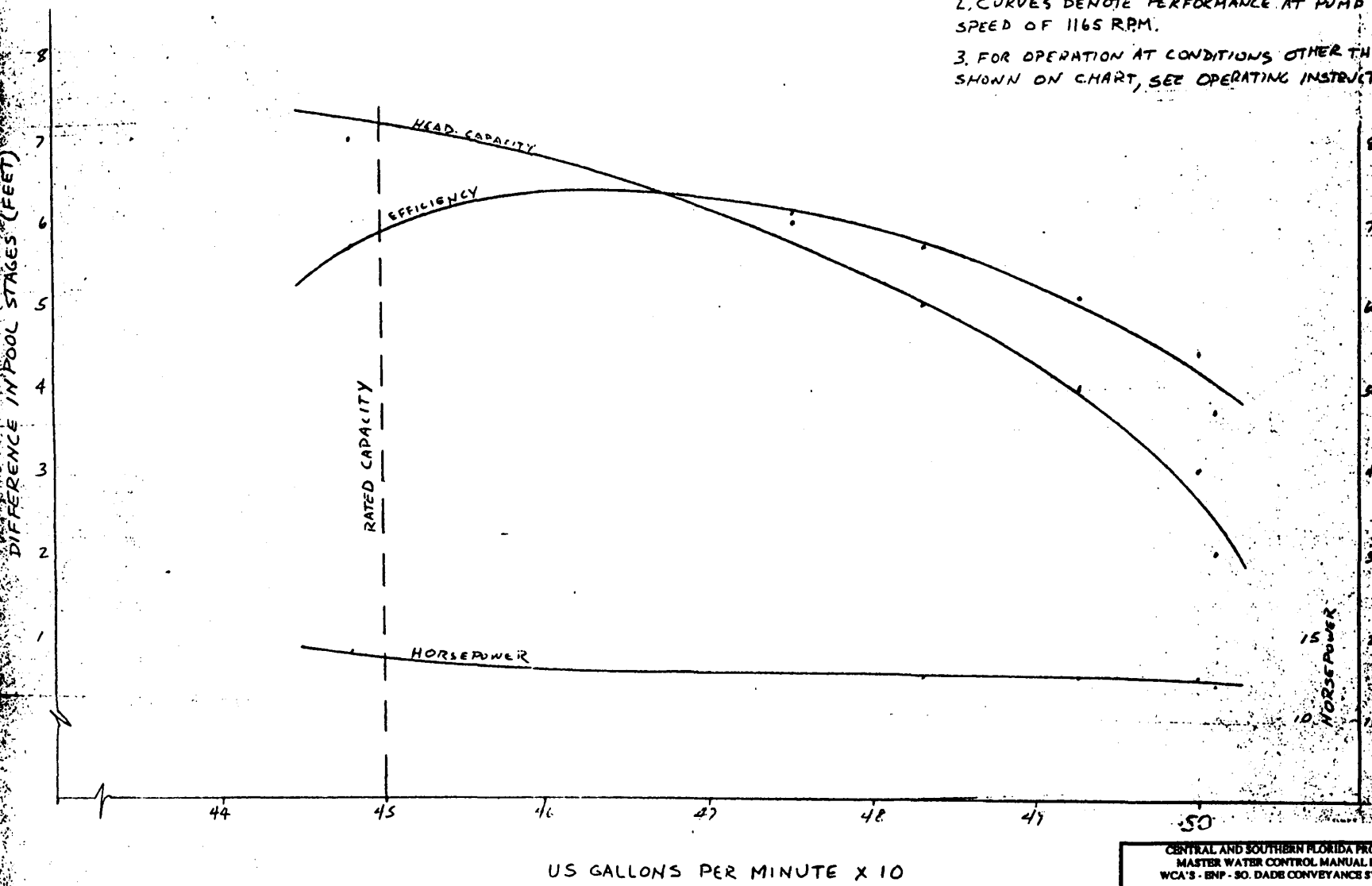
OPERA N CHART

PUMPING STATION 332
(PUMP NO. 6) 14

S - 332 pump #6

NOTES:

1. THIS CHART INDICATES APPROXIMATE PERFORMANCE CHARACTERISTICS AND RECOMMENDED LIMITS FOR CONTINUOUS OPERATION.
2. CURVES DENOTE PERFORMANCE AT PUMP SPEED OF 1165 R.P.M.
3. FOR OPERATION AT CONDITIONS OTHER THAN SHOWN ON CHART, SEE OPERATING INSTRUCTIONS



CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATION CHART
STRUCTUI
PUMP N.

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

STRUCTURE 332DX1 (S-332DX1)

Location. Structure 322DX1 is located approximately 28 miles southwest of Miami, approximately 6 miles west of Krome Avenue, and approximately 5.5 miles north of State Road 9336 (Ingraham Highway), in Levee 31W, west of the S-332D pump station.

Description. S-332DX1 is a 4 Barrel corrugated aluminum pipe (CAP) structure. The barrels are 174 feet long and are gated with vertical lift gates in the middle of the barrel along the alignment of the L-31(W) levee. The structure is designed to pass a combined total of 250 cfs. Flow can pass either way through the structure. Forward flow is defined as the flow passing from the Frog Pond High Head Cell (HCC) to the C-111 Southern Detention Area (SDA). Reverse flow would have flow flowing from the SDA to the HHC.

Purpose. The purpose of S-332DX1 is to improve the ability of the C-111 SDA to create a hydraulic ridge by allowing water conveyance to the north from the Frog Pond HHC into the C-111 SDA. This assists in improving ENP hydrology in accordance with the 2006 Interim Operating Plan (IOP).

Operation. Flow can potentially occur in both directions (North or South) through the S-332DX1 with the notable limitation that water levels in the SDA must be higher than the crest elevation of the weir that separates the FPHHC from the rest of the Frog Pond Detention Area to flow further south. Only flow from South to North through S-332DX1 may be allowed under normal conditions.

DISCHARGE CHARACTERISTICS

Design Discharge Rate (combined):	250 cfs

DESCRIPTION OF STRUCTURE

Optimal Design Head	
Design HW	8.50 ft (HHC)
Design TW	8.00 ft (SDA)
Maximum Stages	
Max HW (forward)	8.60 ft (HHC)
Max TW	10.00 ft (SDA)
Minimum Stages	
Min HW	4.50 ft (HHC)
Min TW	4.50 ft (SDA)
Gate Seating Head*	
Max HW	10.00 ft
Min TW	0.67 ft
Unseating Head	
Min HW	10.00 ft
Max TW	0.67 ft

Culvert Data

Material	Corrugated Aluminum
No. in Set	4
Diameter	60 in
Length	173 ft
Invert--HW	1.00 ft
Invert--TW	1.00 ft
Nat Grade	6 ft
Nat Wat Table**	4.5 to 6.0 ft

Gate Data

Gate Type	Vertical Slide
Top-of-Gate Ht	9.00 ft
Protection Elev	9.00 ft

HYDRAULIC AND HYDROLOGIC MEASUREMENTS

Stilling wells and staff gages located at upstream and downstream of structure.

STRUCTURE 333 (S-333)

Location. S-333 is located in the L-29 borrow canal where L-29 and L-67 cross. The structure is north of U. S. Highway 41 and about 30 miles west of Miami.

Description. S-333 is a single-bay gated spillway. It is a reinforced concrete U-shaped, trapezoidal weir-type structure. The manual vertical-lift gate has 4 auxiliary gates, each measuring 6.0 feet wide x 2.5 feet high, with a crest elevation of 8.5 feet. S-333 has a 23'8" wide service bridge, an operating platform, steel sheet pile wingwalls, and a control house.

Purpose. S-333 functions principally to make water deliveries from WCA No. 3A to south and eastern Dade County and to the Shark River and Taylor Slough areas of the ENP. It is also used to make regulatory releases from WCA No. 3A.

S-333 helps to maintain desirable stages in the L-29 borrow canal and provides a means of discharging water from WCA No. 3A into the L-29 Borrow Canal, from which it is diverted into either the L-31N Borrow Canal or C-4. S-333 functions as a component of the conveyance system which supplies water from WCA No. 3A to south Dade County and ENP. Under drought conditions, the conveyance system provides supplemental water to satisfy peak month demands for municipal, industrial, and agricultural water supply; for seepage and dilution; and for cyclical discharges to ENP.

Regulation. The headwater fluctuates with stages in WCA No. 3A. Under normal conditions S-333's gate should remain closed to allow the uninterrupted southward seepage from WCA No. 3B.

When S-333 makes water deliveries to south or east Dade County, it may operate alone or with S-337. The total delivery amount should support the appropriate stages at S-331, S-25B, and S-22; while maintaining a 5.0 foot to 6.0 foot headwater at S-334.

When S-333 is used in conjunction with S-12 to make regulatory releases to the Everglades National Park at Shark River Slough, the structure will be operated in accordance with an agreement between the U. S. Army Corps of Engineers, the Everglades National Park and the South Florida Water Management District. The agreement is part of the experimental water delivery program as authorized by PL 91-282.

(1) S-333 discharges would be limited to avoid causing the downstream water levels to exceed 7.5 ft., NGVD.

(2) When water levels at G-3273 have been above 6.8 ft.,NGVD for 24 hours, S-333 will be closed.

(3) S-333 will be closed until the water level at G-3273 has stopped rising and is below 6.8 ft., NGVD if the following conditions occur:

(a) The water level at G-3273 has been above 6.5 ft.,

NGVD for 48 hours; and

(b) The water level at G-3273 has risen in the last 24 hours at a rate that would cause it to exceed 6.8 ft., NGVD, within the next 24 hours.

(4) If the headwater stage at S-176 exceeds 5.0 ft., NGVD for more than 24 hours or the S-331 headwater stage exceeds its target level for more than 24 hours, discharges at S-333 will be reduced, if necessary, to avoid causing water levels in the L-29 borrow canal from exceeding for 24 hours.

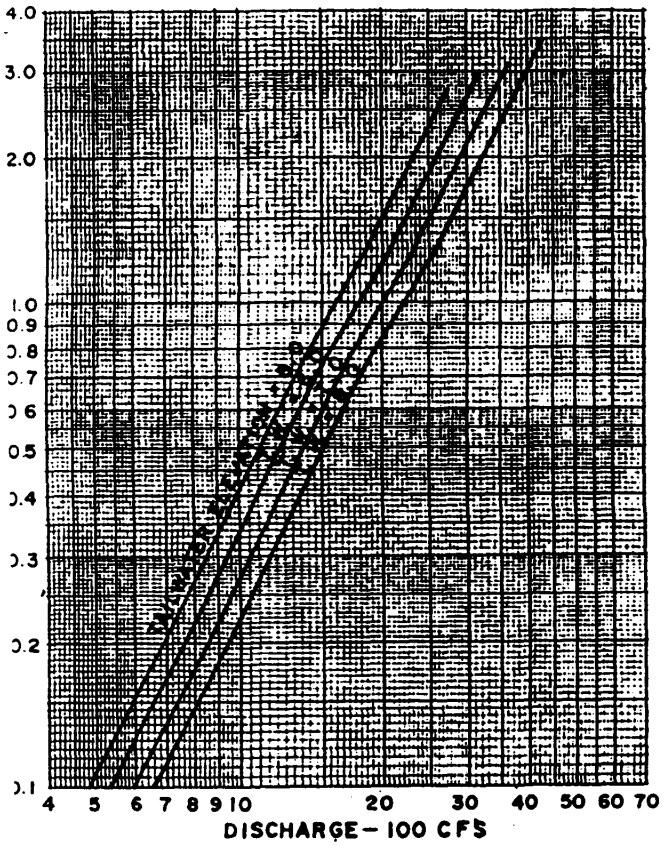
Low Flow Regulation. The structure's optimum tailwater is 5.0 feet during drought conditions. When there is insufficient water available in the WCA's, water is transferred from Lake Okeechobee through the WCA's to meet the needs of the East Coast and ENP. SFWMD can make water supply releases to the East Coast from the WCA's through S-333 and other structures. The tailwater may be raised to 7.0 feet, to expedite water delivery southward. Under design conditions (HW = 7.5 feet; TW = 7.0 feet), the spillway can discharge 1,350 cfs with the gate fully opened.

Major Constraints. To prevent impacts to privately owned lands, a number of constraints have been placed on the use of S-333 to deliver water to Northeast Shark River Slough. These constraints are listed in Table 7-1 on pages T7-1 thru T7-3. To protect the structure's stability the head should not exceed 5.0 feet.

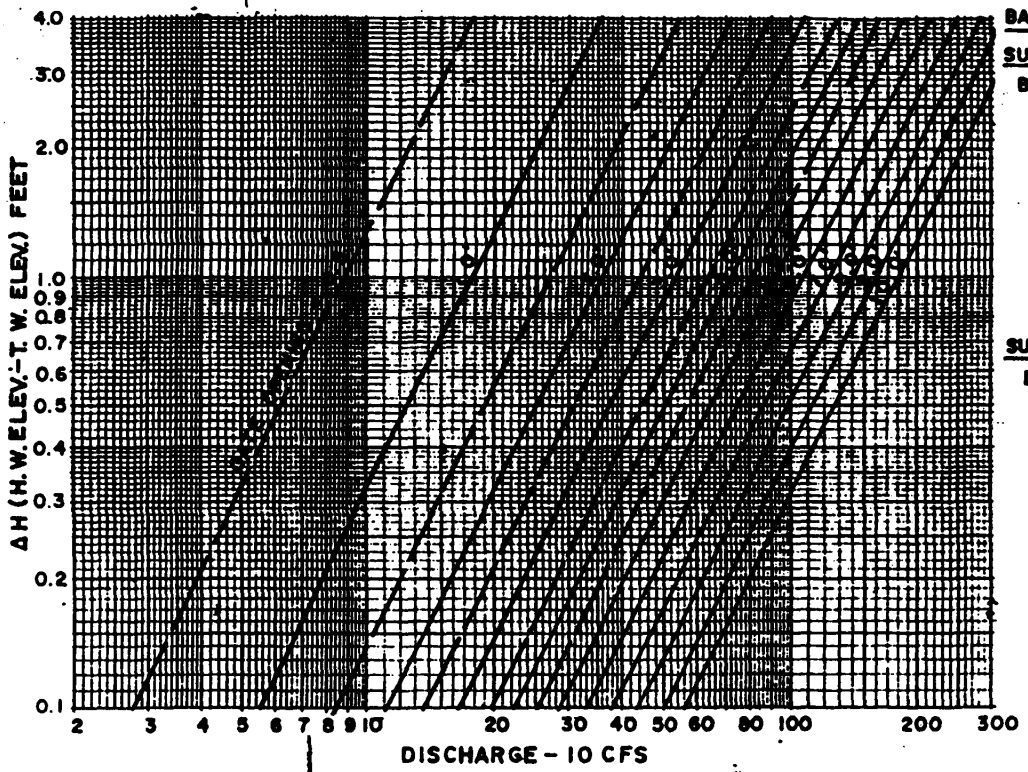
STRUCTURE 333 (S-333)

Summary of Hydraulic Design

Location	L-29
Design Conditions	
Discharge (cfs)	1,350
Type	Uncontrolled submerged
Headwater Elevation (ft.)	7.5
Tailwater Elevation (ft.)	7.0
Maximum Head (ft.)	5.0
Optimum Conditions	
Headwater Elevation (ft.)	9.5 to 10.5
Tailwater Elevation (ft.)	5.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-3.1
Net Length	29
Gates	
Type of Gate	Manual vertical lift
Number	1
Width x Height (ft.)	29 x 14.6
Low Steel Elevation (ft.) (fully open position)	8.5
Top of Gates Elevation (ft.) (fully closed position)	11.5
Overflow Slot Elevation (ft.)	8.5 to 11.0
Channel Section	
Upstream Bottom Width (ft.)	35.0
Upstream Bottom Elevation (ft.)	-10.0
Upstream Side Slopes	1v on 2h
Downstream Bottom Width (ft.)	35.0
Downstream Bottom Elevation (ft.)	-10.0
Downstream Side Slopes	1 on 2
Canal Riprap	
Upstream Length (ft.)	20
Upstream Protection Elevation (ft.)	10.5
Downstream Riprap Length (ft., min.)	20.0
Downstream Protection Elevation (ft.)	10.0
Stilling Basin	
Apron Elevation (ft.)	-6.0
Apron Length (ft.)	20.0
End Sill Elevation (ft.)	-5.0
Training Wall Elevation (ft.)	7.0



SUBMERGED UNCONTROLLED FLOW



SUBMERGED CONTROLLED FLOW

BASIS FOR DISCHARGE RATING CURVES

SUBMERGED UNCONTROLLED FLOW

BASED ON DAUBUISSON'S FORMULA

$Q = KA\sqrt{2g\Delta H + V_1^2}$

$K = 0.85$ WHEN $\Delta H \geq 1.0'$

$K = 0.80$ WHEN $\Delta H < 1.0'$

$A = (\text{TW ELEV.} - \text{CREST ELEV.}) \times 29.0'$

V = APPROACH VELOCITY

SUBMERGED CONTROLLED FLOW

BASED ON ORIFICE FORMULA

$Q = CA\sqrt{2g\Delta H}$

$C = 0.75$

A = GATE OPENING X 29.0'

S-333

ONE 29.0' WIDE X 14.6' HIGH GATE
CREST ELEVATION = – 3.1

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 333

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1974

STRUCTURE 334 (S-334)

Location. S-334 is located in the east end of L-29, in section 3 of the borrow canal, near L-30.

Description. S-334 is a single-bay gated spillway. It is a reinforced concrete, U-shaped, trapezoidal weir structure. The manual vertical-lift gate is equipped with hand-operated slide gates (6.0 ft. wide x 2.0 ft. high, each) which minimize the use of the vertical-lift gate. S-334 has a 23'8" wide service bridge, an operating platform, steel sheet pile wingwalls, and a control house.

Purpose. S-334 functions principally to make supplemental water deliveries to south and east Dade County. It also makes regulation releases from WCA No. 3A.

S-334 helps maintain desirable stages in the L-29 and L-31N borrow canals and regulates discharges to the L-31N borrow canal from the L-29 borrow canal. The spillway functions as a component of the conveyance system which supplies water from WCA No. 3A to south Dade County and ENP. Under drought conditions, the conveyance system provides supplemental water to satisfy peak month demands for municipal, industrial, and agricultural water supply; for seepage and dilution; and for cyclical discharges to ENP.

Normal Regulation. The structure's optimum headwater is between 5.0 and 6.5 feet, and the optimum tailwater is 5.0 feet. Under normal conditions, this structure should remain closed to allow stages in the C-29 borrow canal to fluctuate in response to seepage from WCA No. 3B.

Flood Control Regulation. The water level which will bypass the structure is 14.0 feet.

Low Flow Regulation. When discharges are needed for water supply, the S-334 headwater can be raised to as high as 6.5 ft., by increasing discharges at S-333. This will facilitate the southward delivery of water. S-134 may operate with S-333 to support the optimum level of 6.0 ft. in the L-29 borrow canal or to maintain a maximum stage of 7.2 ft. at the L-29-1 culvert. Under design conditions (HW = 5.0 ft., and TW = 4.7 ft.), S-334 can discharge 1,230 cfs with the gate fully opened under low water conditions.

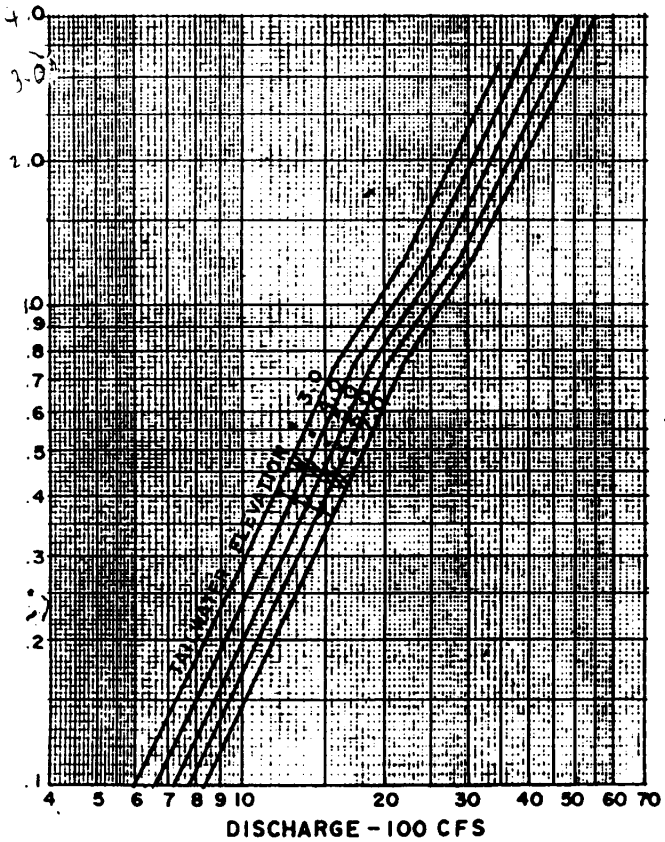
Constraints. S-334 does not have a breastwall. The top of the gate in the closed position is only at elevation 7.7 ft. In addition, the US 41 crossing through L-31N is only at elevation 10.6 ft. The design criteria for S-334 make it necessary for the hydrostatic head not to exceed 3.3 feet.

STRUCTURE 334 (S-334)

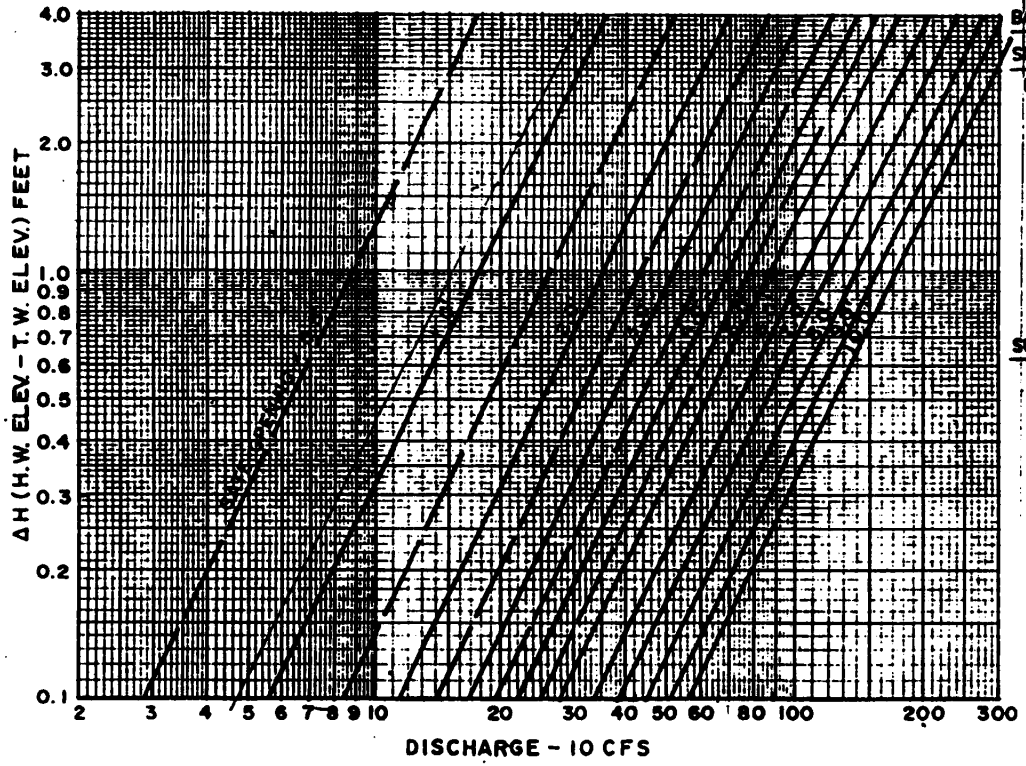
Summary of Hydraulic Design

Location	L-29
Design Conditions	
Discharge (cfs)	1,230
Type	Uncontrolled submerged
Headwater Elevation (ft.)	5.0
Tailwater Elevation (ft.)	4.7
Maximum Head (ft.)	3.3
Optimum Conditions	
Headwater Elevation (ft.)	5.0 to 6.0
Tailwater Elevation (ft.)	5.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-6.9
Net Length (ft.)	29
Gates	
Type of Gate	Elect. hydraulic lift
Number	1
Width x Height (ft.)	29 x 14.6
Low Steel Elevation (ft.) (fully open position)	6.2
Top of Gates Elevation (ft.) (fully closed position)	7.7
~~Overflow Slot Elevation (ft.)~~	4.7 to 7.2

New gate does not have slot gates



SUBMERGED UNCONTROLLED FLOW



SUBMERGED CONTROLLED FLOW

BASIS FOR DISCHARGE RATING CURVES

SUBMERGED UNCONTROLLED FLOW

BASED ON DAUBUISSON'S FORMULA

$Q = KA\sqrt{2g\Delta H + V_1^2}$

$K = 0.85$ WHEN $\Delta H \geq 1.0'$

$K = 0.80$ WHEN $\Delta H < 1.0'$

$A = (\text{TW ELEV.} - \text{CREST ELEV.}) \times 29.0'$

V_1 = APPROACH VELOCITY

SUBMERGED CONTROLLED FLOW

BASED ON ORIFICE FORMULA

$Q = CA\sqrt{2g\Delta H}$

$C = 0.75$

A = GATE OPENING X 29.0'

S-334 14.6?

ONE 29.0' WIDE X 12.9' HIGH GATE

CREST ELEVATION = -6.9

A-S334-3

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 334

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1974

STRUCTURE 335 (S-335)

Location. S-335 is located in the south end of the L-30 borrow canal, upstream of U.S. Highway 41 and west of State Highway 27.

Description. S-335 is a single-bay gated spillway. It is a reinforced concrete U-shaped, trapezoidal weir-type structure. The manual vertical-lift gate is equipped with three hand-operated slide gates (6.0 feet wide x 1.5 feet high, each) which minimize the use of the vertical-lift gate. S-335 has a service bridge, operating platform, steel sheet pile wingwalls, and a control house.

Purpose. S-335 functions primarily to make supplemental water deliveries to south and east Dade County. S-335 maintains water control in the L-30 and L-31N borrow canals and regulates discharges from the L-30 borrow canal to the L-31N borrow canal.

S-335 helps maintain desirable stages in the L-30 and L-31N borrow canals and regulates discharges to the L-31N borrow canal
L-30 from the L-29 borrow canal. The spillway functions as a component of the ENP/South Dade conveyance system which supplies water from WCA No. 3A. Under drought conditions, the conveyance system provides supplemental water to satisfy peak month demands for municipal, industrial, and agricultural water supply; for seepage and dilution; and for cyclical discharges to ENP.

Normal Regulation. This structure is operated with S-32A to maintain the optimum level of 6.0 feet in the L-30 borrow canal.

Flood Control Regulation. During high flows, S-335 should be operated to maintain optimum water levels. The gate will be opened when the headwater stage exceeds 6.0 feet and only when releases will not create hazardous conditions downstream. The water level which will bypass the structure is 11.5 feet.

Low Flow Regulation. Releases may be started from S-335, S-334 or both when the canal stage between S-335 and S-331 recedes to 3.5 feet or when the headwater stage at S-25B or S-22 falls below 2.8 feet. Once these releases begin then the headwater at S-335 and S-331 should be held between 5.0 feet and 6.0 feet, and 3.0 feet and 3.5 feet, respectively.

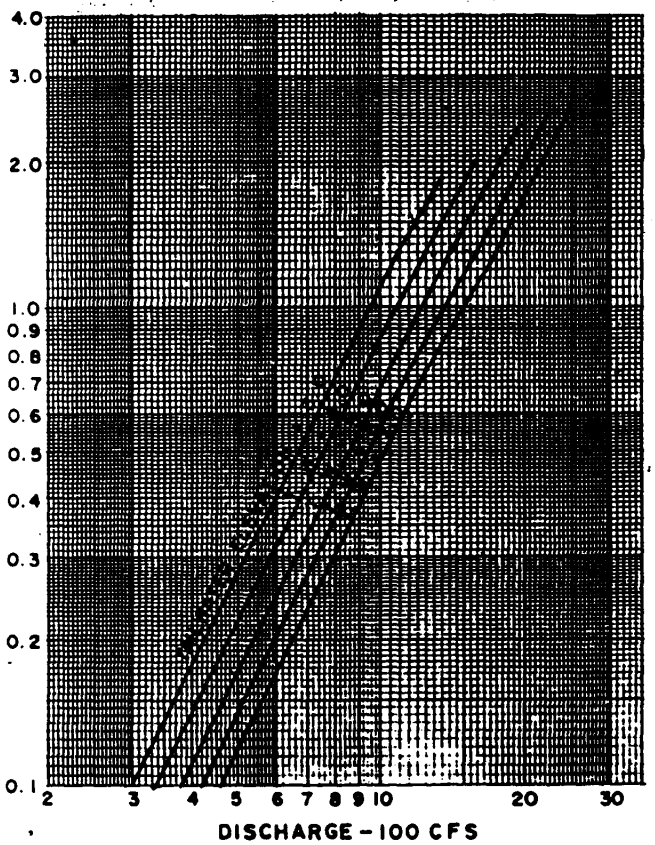
When water is needed in the L-31N borrow canal, S-335 can discharge additional water. The headwater can be raised to 6.0 feet to facilitate the water southward. Under design conditions (HW = 5.0 feet and TW= 4.8 feet for drought conditions), S-335 may discharge 525 cfs with the gate fully open.

Constraints. To protect the stability of the structure, the head across the structure should not exceed 3.2 feet.

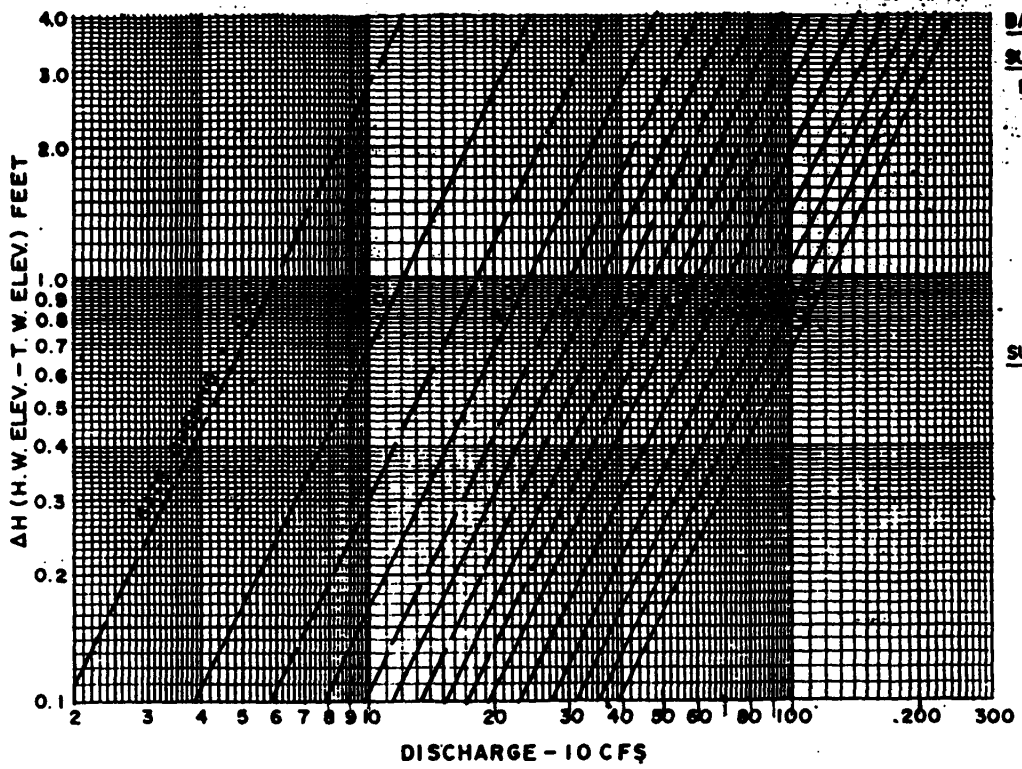
STRUCTURE 335 (S-335)

Summary of Hydraulic Design

Location	L-30
Design Conditions	
Discharge (cfs)	525
Type	Uncontrolled submerged
Headwater Elevation (ft.)	5.0
Tailwater Elevation (ft.)	4.8
Maximum Head (ft.)	3.2
Optimum Conditions	
Headwater Elevation (ft.)	5.0-6.0
Tailwater Elevation (ft.)	5.0
Crest	
Shape	Trapezoidal
Elevation (ft.)	-4.2
Net Length (ft.)	20
Gates	
Type of Gate	Vertical lift
Number	1
Width x Height (ft.)	20 x 11.2
Low Steel Elevation (ft.) (fully open position)	6.0
Top of Gates Elevation (ft.) (fully closed position)	7.0
Overflow Slot Elevation (ft.)	5.0 to 6.5
Service Bridge Elevation (ft.)	11.5
Protection Elevation (ft.)	11.5
Operating Platform Elevation (ft.)	30.5
Dewatering Capabilities	Yes



SUBMERGED UNCONTROLLED FLOW



SUBMERGED CONTROLLED FLOW

BASIS FOR DISCHARGE RATING CURVES

SUBMERGED UNCONTROLLED FLOW

BASED ON DAUBUISSON'S FORMULA

$Q = KA\sqrt{2g\Delta H + V_1^2}$

$K = 0.85$ WHEN $\Delta H \geq 1.0'$

$K = 0.80$ WHEN $\Delta H < 1.0'$

$A = (\text{TW ELEV.} - \text{CREST ELEV.}) \times 20.0'$

V_1 = APPROACH VELOCITY

SUBMERGED CONTROLLED FLOW

BASED ON ORIFICE FORMULA

$Q = CA\sqrt{2g\Delta H}$

$C = 0.75$

A = GATE OPENING X 20.0'

S-335

ONE 20.0' WIDE X 11.2' HIGH GATE

CREST ELEVATION = -4.2

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
STRUCTURE 335

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1974

STRUCTURE 336 (S-336)

Location. Structure 336 is located in the Tamiami Canal (C-4), where the L-30 and L-31N borrow canals intersect.

Description. S-336 is a gated, three barrel, 54-inch, corrugated metal pipe culvert. It has standard manually operated slide gates, reinforced concrete intake headwalls, an operating platform, and a walkway on the upstream side.

Purpose. This structure permits supplemental deliveries from WCA No. 3 to help fulfill water needs in eastern Dade Co. via the L-30 or L-29 canals. It also can be used to discharge excess water from WCA No. 3A when capacity is available in the Tamiami Canal.

S-336 regulates eastward flows in C-4 and southward flows in the L-31N borrow canal. Releases to C-4 help support optimum headwater stages at east coast structures to establish an adequate fresh water head against saltwater intrusion during low flow periods. Flows diverted southward via the L-31(N) borrow canal supply water for the conveyance system which supplements flows in south Dade County and ENP. Under drought conditions, the conveyance system provides supplemental water to satisfy peak monthly demands for municipal, industrial, and agricultural water supply, for seepage and dilution; and for cyclical discharges to ENP.

Normal Regulation. This structure normally remains closed.

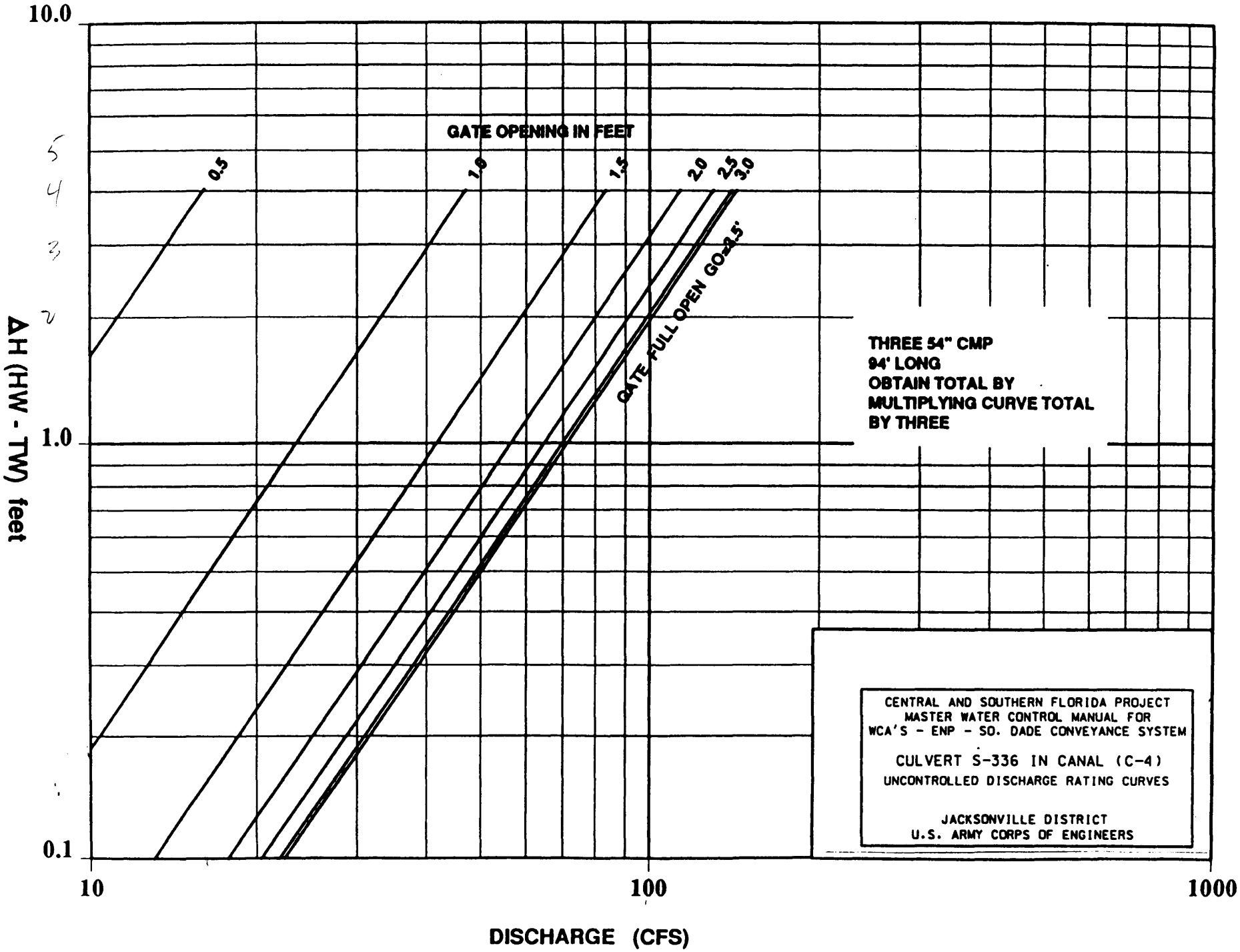
Flood Control Regulation. S-336 is not designed to provide primary flood control but can provide secondary flood releases after flood stages in C-4 and C-2 have peaked and as long as the stage at T-5 is less than 4.0 feet.

Low Flow Regulation. S-336 may supplement water deliveries to East Dade County when the headwater at S-25(B) or S-22 falls below 2.8 feet. Under design conditions (HW =4.7 feet and TW = 4.2 feet) the structure can discharge 145 cfs.

STRUCTURE 336 (S-336)

Summary of Hydraulic Design

Location	C-4
Design Conditions	
Discharge (cfs)	145
Type	Controlled submerged
Headwater Elevation (ft.)	4.7
Tailwater Elevation (ft.)	4.2
Optimum Headwater Elevation (ft.)	5.0
Culvert	
Type	CMP
Number of Barrels	3
Size (dia., inches)	54
Net Length (ft.)	85
Invert Elevation (ft.)	-1.8
Gates	
Type of Control	Manual vertical slide gate
Number	3
Size (Width x height, inches)	54 x 54
Protection Grade Elevation (ft.)	11.0
Operating Platform Elevation (ft.)	10.0
Dewatering Capabilities	No


10.0
1.0
0.1
10
100
1000
ΔH (HW - TW) feet
DISCHARGE (CFS)
GATE OPENING IN FEET
0.5
1.0
1.5
2.0
2.5
3.0
GATE FULL OPEN GO=2.5'
THREE 54" CMP
94' LONG
OBTAIN TOTAL BY
MULTIPLYING CURVE TOTAL
BY THREE
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
CULVERT S-336 IN CANAL (C-4)
UNCONTROLLED DISCHARGE RATING CURVES
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

A-S336-3

STRUCTURE 337 (S-337)

Location. Structure 337 is located in Levee 30 where L-30 crosses the Miami Canal.

Description. S-337 is a gated, six barrel, 84-inch, corrugated metal pipe culvert with manually operated, standard slide gates. There is a timber operating platform on the upstream side.

Purpose. S-337 regulates discharges from WCA No. 3A into the L-30 borrow canal. Discharges from the structure provide supplemental water to the conveyance system which provides water supply for south Dade County and the Everglades National Park. Under drought conditions, the conveyance system provides water to satisfy peak monthly water demands.

S-337, along with S-31 and S-151, permits water releases from WCA No. 3 to eastern and southern Dade County. S-337 can also be used to discharge excess water from WCA No. 3B when downstream capacity is available.

When insufficient water is available in the WCA's, water is transferred from Lake Okeechobee through the WCA's to meet the needs of the East Coast and ENP. SFWMD can make water supply releases to the East Coast from the WCA's through S-337, and other structures.

Currently, regulatory releases from WCA No. 3B can only be made on a secondary basis through S-31 or S-337 to the East Coast.

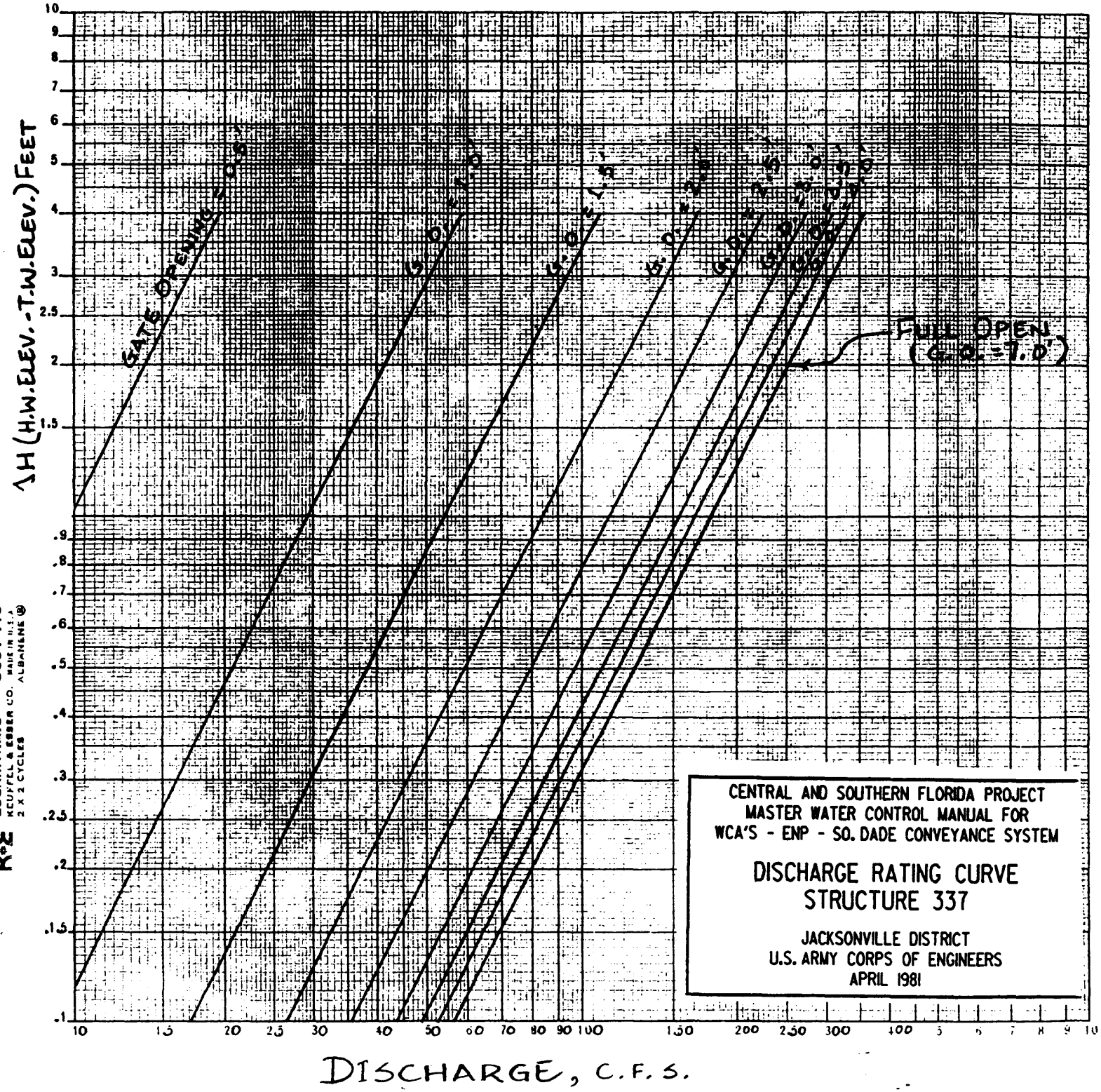
Normal Regulation. S-337 supports an optimum water level in the L-30 borrow canal of 6.0 feet between S-337 and S-335.

Low Flow Regulation. When S-337 makes supplemental releases from WCA No. 3 via the L-30 Canal it should do so together with S-333. The total delivery amount should support the appropriate stages at S-331, S-25B and S-22 while maintaining a headwater between 5.0 feet and 6.0 feet at S-335 and below 6.0 feet at S-32B.

STRUCTURE 337 (S-337)

Summary of Hydraulic Design

Location	L-30
Design Conditions	
Discharge (cfs)	605
Type	Controlled submerged
Headwater Elevation (ft.)	5.5
Tailwater Elevation (ft.)	5.2
Optimum Tailwater Elevation (ft.)	6.0
Culvert	
Type	CMP
Number of Barrels	6
Size (dia., inches)	84
Net Length (ft.)	164
Invert Elevation (ft.)	
Headwater	-3.0
Tailwater	-4.0
Gates	
Type of Control	Manual slide gate
Number	6
Size (width x height, inches)	84 x 84
Protection Grade Elevation (ft.)	X
Operating Platform Elevation (ft.)	15.0
Dewatering Capabilities	No



A-S337-3

RATING CURVE, S-337
6-84" CMP, 152 FT. LONG
TOTAL C.F.S. IS OBTAINED
BY MULTIPLYING CURVE VALUE
BY SIX.

STRUCTURE 338 (S-338)

Location. Structure 338 is located in Canal C-1, just west of State Highway 27.

Description. S-338 is a gated, double-barreled, 84-inch, corrugated metal pipe culvert with a reinforced concrete headwall and operating platform on the upstream side. The structure has manually operated, standard slide gates and stone protection on the embankment side slopes.

Purpose. S-338 supplies water to the C-1 area to maintain adequate canal stages, to prevent saltwater intrusion at east coast structures, to provide water to the root zone of growing plants, and to permit groundwater withdrawals for water supply. S-338 also provides flood control releases from the area between Krome Avenue and L-31N and north of S-331.

Normal Regulation. This structure is normally closed except during flood events when the gates are opened fully.

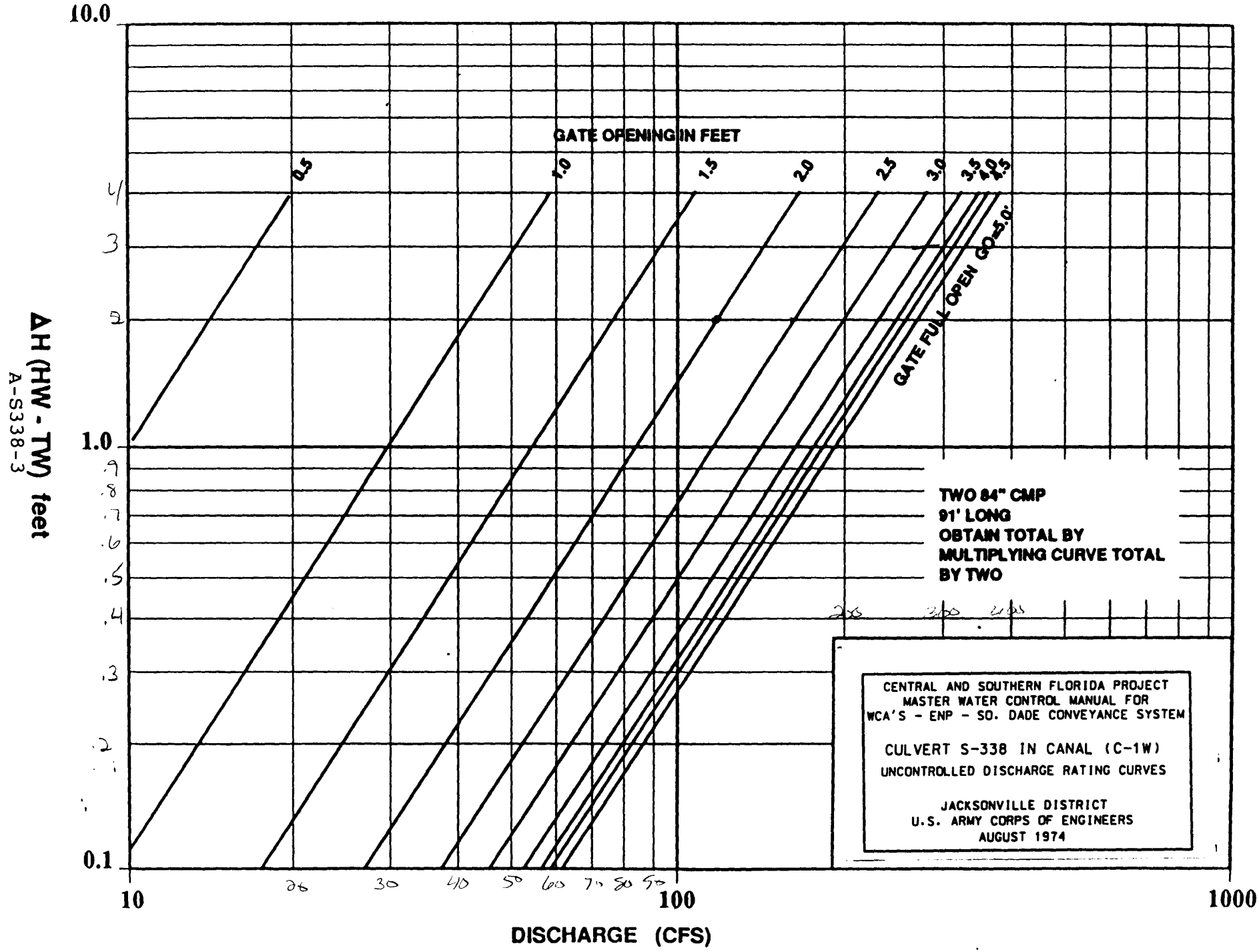
Flood Regulation. During floods, this structure is usually open but the discharge is limited to the design capacity which is 40% of the SPF.

Low Flow Regulation. During drought periods, S-338 should discharge into C-1 to provide for irrigation, ground-water recharge and the maintenance of an adequate head to prevent saltwater intrusion.

STRUCTURE 338 (S-338)

Summary of Hydraulic Design

Location	C-1
Design Conditions	
Discharge (cfs)	170
Type	Uncontrolled submerged
Headwater Elevation (ft.)	6.1
Tailwater Elevation (ft.)	5.91
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	84
Net Length (ft.)	85
Invert Elevation (ft.)	-4.5
Gates	
Type of Control	Manual slide gate
Number	2
Size (width x height, inches)	84 x 84
Protection Grade Elevation (ft.)	8.0
Operating Platform Elevation (ft.)	11.0
Dewatering Capabilities	No


GATE OPENING IN FEET
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
GATE FULL OPEN GO=5.0'
TWO 84" CMP
91' LONG
OBTAIN TOTAL BY
MULTIPLYING CURVE TOTAL
BY TWO
CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM
CULVERT S-338 IN CANAL (C-1W)
UNCONTROLLED DISCHARGE RATING CURVES
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
AUGUST 1974
10.0
1.0
0.1
10
100
1000
DISCHARGE (CFS)
ΔH (HW - TW) feet

A-S338-3

STRUCTURE 339 (S-339)

Location. Structure 339 is located in C-123 of WCA No. 3A, approximately six miles north of Everglades Parkway (Alligator Alley) in Broward County, Florida.

Description. S-339 is a vertical sheet pile barrier wall across C-123 with three 12.0 foot x 12.0 foot cast iron slide gates on the face of the wall. The gate openings will be submerged at all times.

Purpose. This structure prevents overdrainage of the northern portion of WCA No. 3A by forcing flows, from C-123 out into the marsh. It also helps to transfer water to the Everglades National Park, metropolitan Miami, and the South Dade County areas.

Normal Regulation. S-339 remains closed most of the time. When necessary, the gates are opened fully in accordance with the operation schedule. This schedule is governed primarily by the stage at gage 62 (Deer Gage). The operation is also governed by the pumping at S-8, water deliveries to Dade County and Everglades National Park and the gate opening at S-340. The optimum headwater elevation is 11.0 feet. If necessary, the optimum headwater stage can be altered by closing or opening additional gaps in the spoil mounds on either side of C-123.

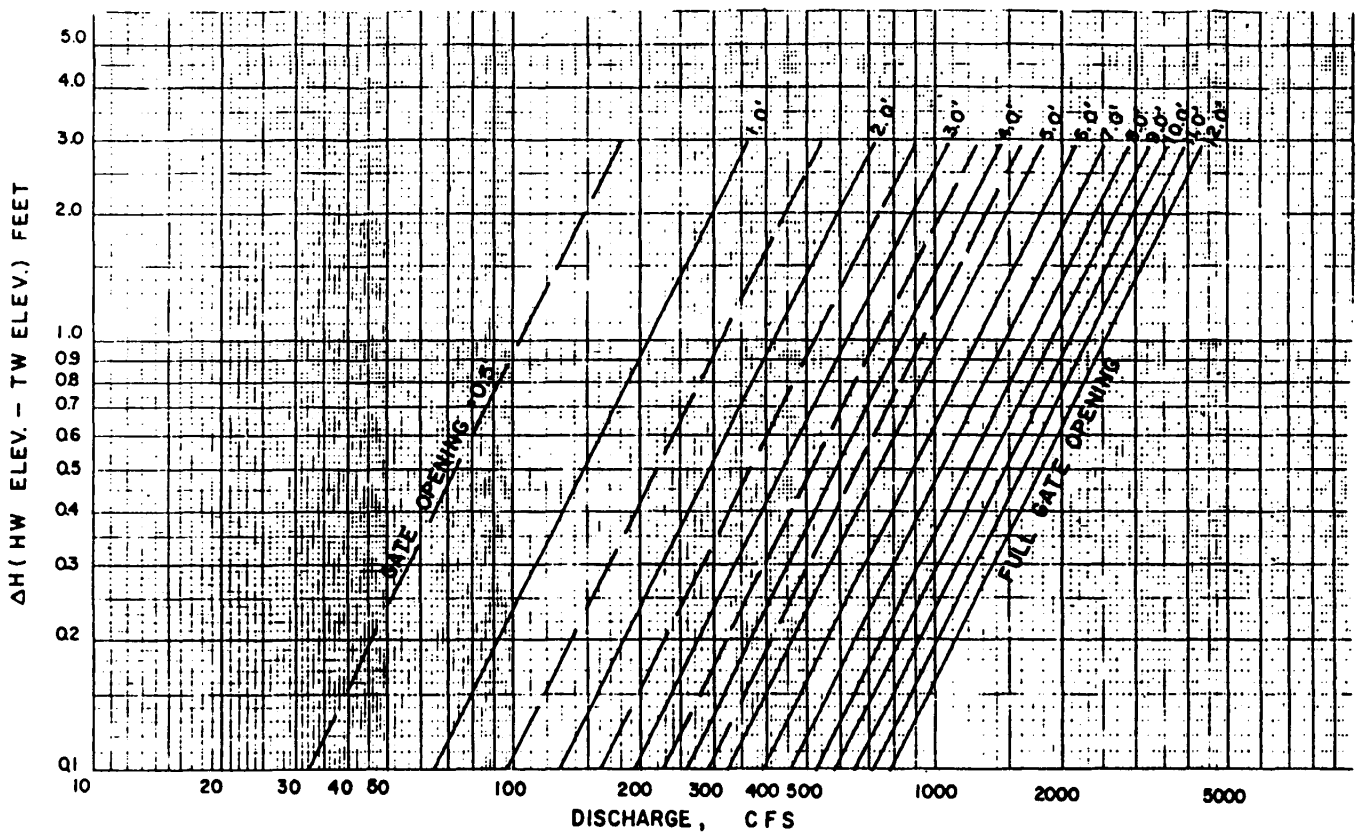
Flood Regulation. Under design conditions, S-339 will pass 1,100 cfs with a headwater stage of 10.4 ft., and a tailwater stage of 10.2 ft. The structure should be opened as shown on the operations schedule to lower excessively high stages in the northern portion of WCA No. 3A and to help with the removal of water pumped into the area at Pumping Station 8. The stage at gage 62 should be used in conjunction with the operations schedule. However, using gage 62 as a basis for operation is not intended to imply stage control in this area. The correct gate setting for a selected discharge can be determined using the discharge rating curve.

Low Flow Regulation. S-339 should be opened when necessary to transfer water from S-8 to Everglades National Park or Dade County.

STRUCTURE 339 (S-339)

Summary of Hydraulic Design

Location	C-123
Design Conditions	
Discharge (cfs)	1,100
Type	Uncontrolled submerged
Headwater Elevation (ft.)	10.4
Tailwater Elevation (ft.)	10.2
Optimum Conditions	
Headwater Elevation (ft.)	11.0
Tailwater Elevation (ft.)	9.3
Minimum Tailwater Elevation (ft.)	7.0
Gates	
Type of Control	Manual slide gate
Number	3
Size (width x height, ft.)	12 x 12
End Sill Elevation (ft.)	-2.8
Protection Grade Elevation (ft.)	15.0
Operating Platform Elevation (ft.)	26.0
Dewatering Capabilities	No



SUBMERGED CONTROLLED FLOW

RATING SHOWN IS FOR THREE 12.
FEET WIDE GATES. DIVIDE BY
THREE TO OBTAIN DISCHARGE
FOR ONE GATE.

0-145b

BASIS FOR DISCHARGE RATING CURVES

SUBMERGED CONTROLLED FLOW

BASED ON THE ORIFICE FOR FORMULA

$$Q = CA\sqrt{2g\Delta H}$$

C = 0.75

A = GATE OPENING X 36'

S-339 AND S-340

THREE 12.0' WIDE X 12.0' HIGH SLIDE GATES

SILL ELEVATION:

S-339 = -2.8 FEET M.S.L.

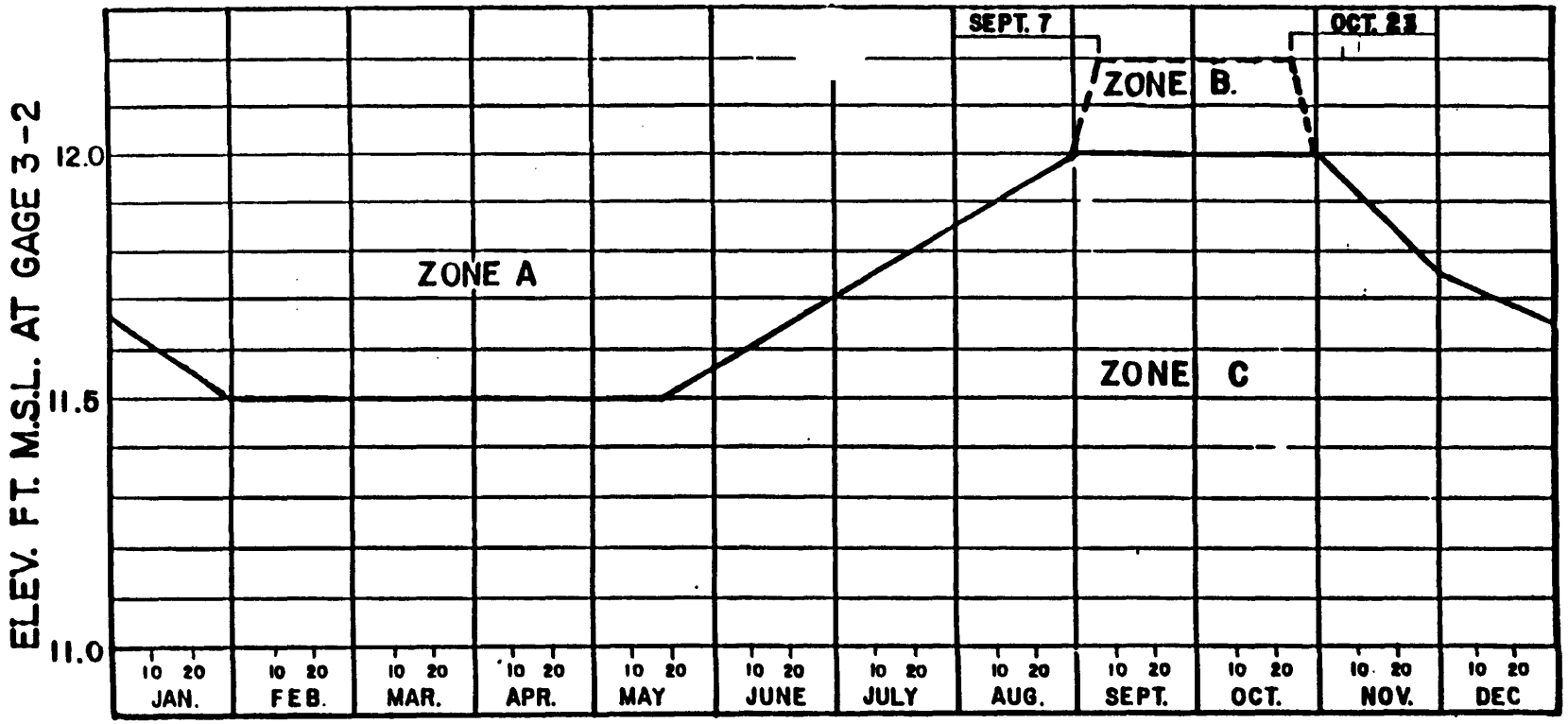
S-340 = -4.3 FEET M.S.L.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED FLOW
STRUCTURE 339 & 340

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1977

Change
20 Aug



STRUCTURE OPERATION

ZONE	S-340	S-339
A	*OPEN AFTER 7 DAYS IN ZONE	OPEN IF S-8 PUMPING OF 15,000 ACRE FT. OR MORE EXPECTED NEXT 14 DAYS AND S-340 OPEN.
B	OPEN AFTER 30 TO 14 DAYS AS * THE ELEVATION VARIES FROM 12.0 TO 12.2 RESPECTFULLY.	
C	CLOSE AFTER .25 FT BELOW SCHEDULE UNLESS TRANSFERING WATER FROM S-8 TO DADE COUNTY OR E.N.P.	

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATIONS SCHEDULE
CANAL 123 STRUCTURE 339 AND 340

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1977

STRUCTURE 340 (S-340)

Location. Structure 340 is located in C-123 of WCA No. 3A, approximately three miles south of Everglades Parkway (Alligator Alley) in Broward County, Florida.

Description. S-340 is a vertical sheet pile barrier wall across C-123 with three 12.0 foot x 12.0 foot cast iron slide gates on the face of the wall. The gate openings are submerged at all times.

Purpose. This structure prevents overdrainage of the northern portion of WCA No. 3A by forcing flows, from C-123 out into the marsh. It also helps to transfer water to the Everglades National Park, metropolitan Miami, and the South Dade County areas.

Normal Regulation. S-340 remains closed most of the time. When necessary, the gates are fully opened in accordance with the operation schedule. This schedule is governed primarily by the stage at Gage 62 (Deer Gage). The operation is also governed by the pumping at S-8, water deliveries to Dade County and Everglades National Park. The optimum headwater elevation is 9.0 feet. If necessary, the optimum headwater stage can be altered by closing or opening additional gaps in the spoil mounds on either side of C-123.

Flood Regulation. Under design conditions, S-340 will pass 1,100 cfs with a headwater stage of 8.9 ft., and a tailwater stage of 8.7 ft. The structure should be opened as shown on the operations schedule to lower excessively high stages in the northern portion of WCA No. 3A and to help with the removal of water pumped into the area at Pumping Station 8. The stage at Gage 62 should be used in conjunction with the operations schedule. However, using Gage 62 as a basis for operation is not intended to imply stage control in this area. The correct gate setting for a selected discharge can be determined using the discharge rating curve.

Low Flow Regulation. S-340 should be opened when necessary to transfer water from S-8 to Everglades National Park or Dade County.

Constraints. To insure the structure's stability, gates should be opened when the head approaches 2.3 feet.

STRUCTURE 340 (S-340)

Summary of Hydraulic Design

Location	C-123
Design Conditions	
Discharge (cfs)	1,100
Type	Uncontrolled submerged
Headwater Elevation (ft.)	8.9
Tailwater Elevation (ft.)	8.7
Optimum Conditions	
Headwater Elevation (ft.)	9.3
Tailwater Elevation (ft.)	8.5
Minimum Tailwater Elevation (ft.)	7.0
Gates	
Type of Control	Manual Slide gate
Number	3
Size (width x height, ft.)	12 x 12
End Sill Elevation (ft.)	-4.3
Protection Grade Elevation (ft.)	13.5
Operating Platform Elevation (ft.)	24.5
Dewatering Capabilities	No

BASIS FOR DISCHARGE RATING CURVES

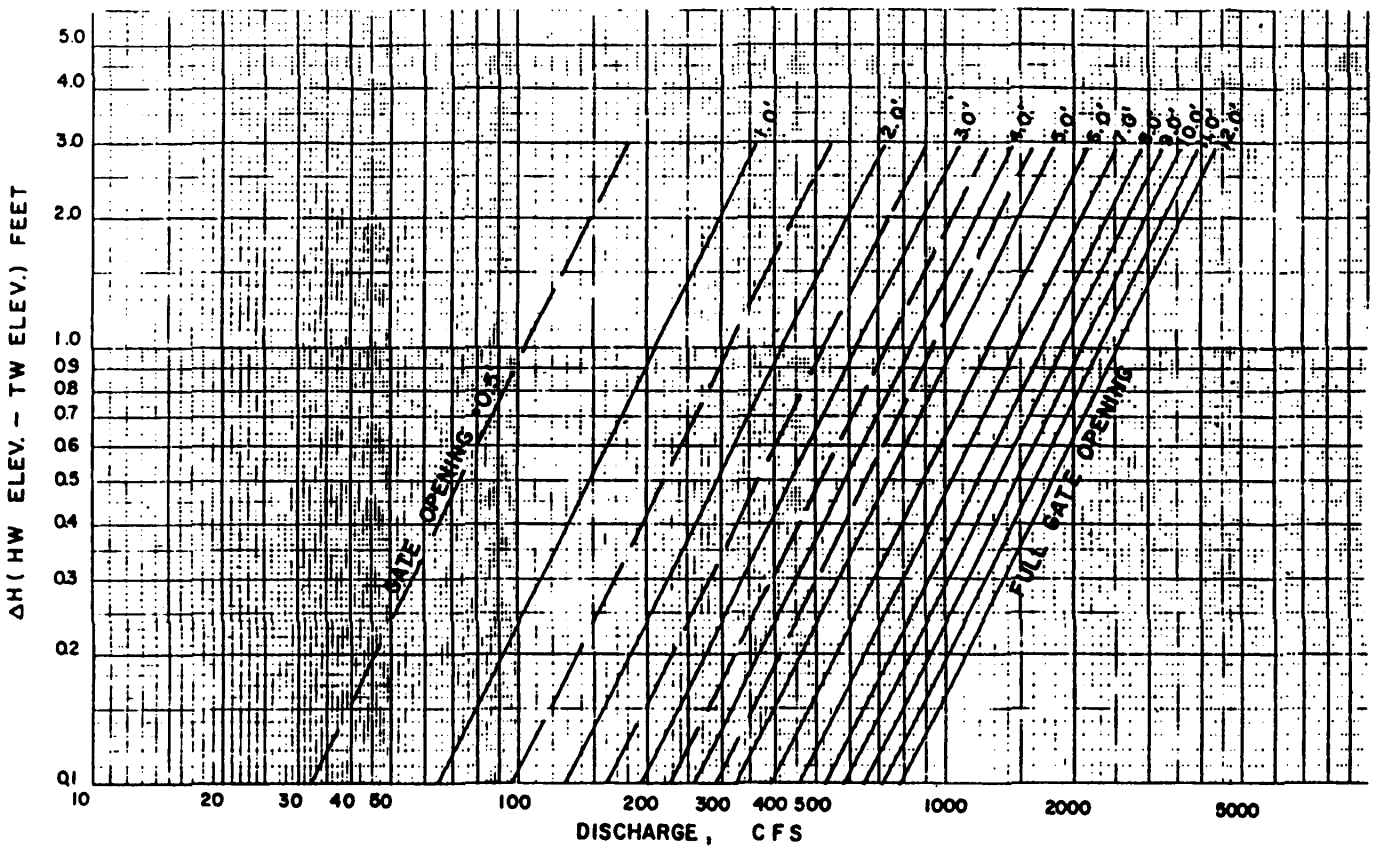
SUBMERGED CONTROLLED FLOW

BASED ON THE ORIFICE FOR FORMULA

$Q = CA\sqrt{2g\Delta H}$

C = 0.75

A = GATE OPENING X 36'



SUBMERGED CONTROLLED FLOW

S-339 AND S-340

THREE 12.0' WIDE X 12.0' HIGH SLIDE GATES

SILL ELEVATION:

S-339 = -2.8 FEET M.S.L.

S-340 = -4.3 FEET M.S.L.

RATING SHOWN IS FOR THREE 12.0 FEET WIDE GATES. DIVIDE BY THREE TO OBTAIN DISCHARGE FOR ONE GATE.

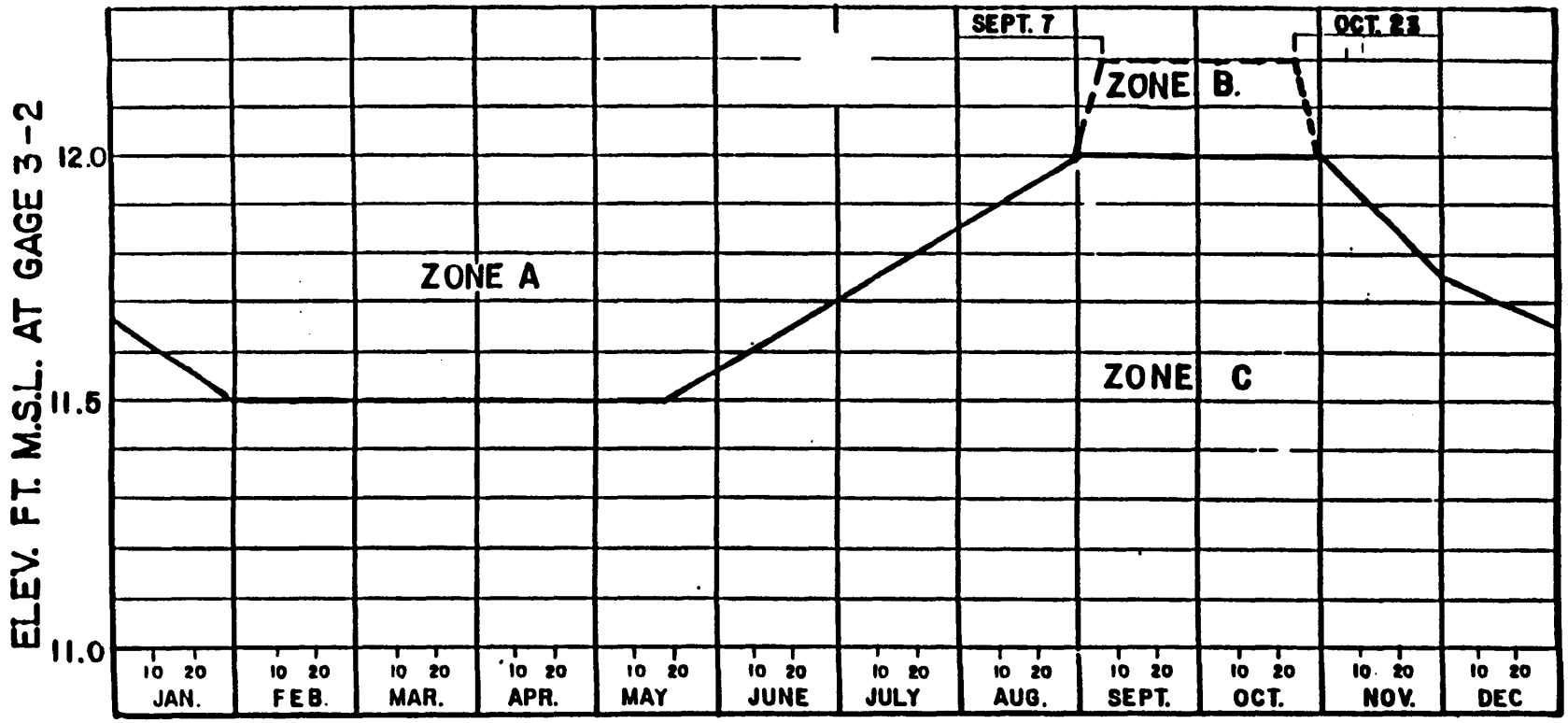
0-145b

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

DISCHARGE RATING CURVE
SUBMERGED CONTROLLED FLOW
STRUCTURE 339 & 340

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1977

Change
20 Aug



STRUCTURE OPERATION

ZONE	S-340	S-339
A	*OPEN AFTER 7 DAYS IN ZONE	OPEN IF S-8 PUMPING OF 15,000 ACRE FT. OR MORE EXPECTED NEXT 14 DAYS AND S-340 OPEN.
B	OPEN AFTER 30 TO 14 DAYS AS * THE ELEVATION VARIES FROM 12.0 TO 12.2 RESPECTFULLY.	
C	CLOSE AFTER .25 FT BELOW SCHEDULE UNLESS TRANSFERING WATER FROM S-8 TO DADE COUNTY OR E.N.P.	

CENTRAL AND SOUTHERN FLORIDA PROJECT
MASTER WATER CONTROL MANUAL FOR
WCA'S - ENP - SO. DADE CONVEYANCE SYSTEM

OPERATIONS SCHEDULE
CANAL 123 STRUCTURE 339 AND 340

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
SEPTEMBER 1977

STRUCTURE 343A (S-343A)

Location. Structure 343A is located near the junction of L-28 and L-29 about 35 miles west of Miami on U.S. 41.

Description. S-343A is a gated, three barrel, 72-inch, corrugated metal pipe culvert with manually operated, standard slide gates. There is a timber operating platform on the upstream side.

Purpose. S-343A permits discharge from WCA No. 3A during periods of excessively high stages.

Regulation. S-343A's gates are normally closed. The gates of the structure are opened when WCA 3A water levels are above schedule.

Constraints. The combined discharge of 343A and 343B shall be limited to the capacity under the bridges on U.S. 41 which is 400 cfs. In addition, the Loop Road 1 gage should not exceed an elevation of 8.5 ft.

STRUCTURE 343A (S-343A)

Summary of Hydraulic Design

Location	
L-29	
Design Conditions	
Discharge (cfs)	195
Type	Controlled
submerged	
Headwater Elevation (ft.)	9.5
Tailwater Elevation (ft.)	9.3
Culvert	
Type	CMP
Number of Barrels	3
Size (dia., inches)	72
Net Length (ft.)	82
Invert Elevation (ft.)	0.0
Gates	
Type of Control	Manual slide gate
Number	3
Size (width x height, inches)	72 x 72
Protection Grade Elevation (ft.)	17.5
Operating Platform Elevation (ft.)	17.5
Dewatering Capabilities	No
Discharge capacity per culvert:	$145(H)^{1/2}$ cfs

STRUCTURE 343B (S-343B)

Location. Structure 343B is located near the junction of L-28 and L-29 about 35 miles west of Miami on U.S. 41.

Description. S-343B is a gated, three barrel, 72-inch, corrugated metal pipe culvert with manually operated, standard slide gates. There is a timber operating platform on the upstream side.

Purpose. S-343B permits discharge from WCA No. 3A during periods of excessively high stages.

Regulation. S-343B's gates are normally closed. The gates of the structure are opened when WCA 3A water levels are above schedule.

Constraints. The combined discharge of 343A and 343B shall be limited to the capacity under the bridges on U.S. 41 which is 400 cfs. In addition, the Loop Road 1 gage should not exceed an elevation of 8.5 ft.

STRUCTURE 343B (S-343B)

Summary of Hydraulic Design

Location	L-29
Design Conditions	
Discharge (cfs)	195
Type	Controlled submerged
Headwater Elevation (ft.)	9.5
Tailwater Elevation (ft.)	9.3
Culvert	
Type	CMP
Number of Barrels	3
Size (dia., inches)	72
Net Length (ft.)	82
Invert Elevation (ft.)	0.0
Gates	
Type of Control	Manual slide gate
Number	3
Size (width x height, inches)	72 x 72
Protection Grade Elevation (ft.)	17.5
Operating Platform Elevation (ft.)	17.5
Dewatering Capabilities	No
Discharge capacity per culvert:	$145(H)^{1/2}$ cfs

STRUCTURE 344 (S-344)

Location. Structure 344 is located in L-28 about 9 miles north of U.S. 41.

Description. S-344 is a gated, two barrel, 72-inch, corrugated metal pipe culvert with manually operated, standard slide gates. There is a timber operating platform on the upstream side.

Purpose. S-344 permits discharge from WCA No. 3A during periods of excessively high stages and extends the hydroperiod in the Big Cypress National Preserve during dry periods.

Regulation. S-344's gates are normally closed. The gates of the structure are opened when WCA 3A water levels are above schedule.

Constraints. The Loop Road 1 gauge should not exceed an elevation of 8.5 ft.

STRUCTURE 344 (S-344)

Summary of Hydraulic Design

Location	L-28
Design Conditions	
Discharge (cfs)	135
Type	Controlled submerged
Headwater Elevation (ft.)	9.9
Tailwater Elevation (ft.)	9.7
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	78
Invert Elevation (ft.)	1.0
Gates	
Type of Control	Manual slide gate
Number	2
Size (width x height, inches)	72 x 72
Protection Grade Elevation (ft.)	17.5
Operating Platform Elevation (ft.)	17.5
Dewatering Capabilities	No
Discharge capacity per culvert:	$150(H)^{1/2}$ cfs

STRUCTURES 345A, B, and C (S-345A, B, and C)

NOTE: These are proposed structures.

Location. Structures 345A, B, and C are located in Levee 67A.

Description. Proposed structures consist of 3 gated culverts having design criterias and size. Each proposed structure S-345A, S-345B, and S-345C, consist of three 72-inch corrugated metal or concrete pipes with manually operated slide gates. A timber walkway and platform will be included to provide for access to the gate hoists.

Purpose. The proposed gated culvert structures will enable discharges from WCA No. 3A into WCA No. 3B. The culvert structures will provide an alternative means of discharging regulatory releases from WCA No. 3A and assist in restoring WCA No. 3B as a hydrologic component of the Everglades.

PROPOSED STRUCTURES 345A,B, and C (S-345A, B, and C)

Summary of Hydraulic Design

Location	L-67A
Design Conditions	
Discharge (cfs)	500
Headwater Elevation (ft.)	9.4
Tailwater Elevation (ft.)	7.9
S.P.F. Condition	
Discharge (cfs)	590
Headwater Elevation (ft.)	14.6
Tailwater Elevation (ft.)	12.6
Culvert	
Type	CMP
Number of Barrels	3
Size (dia., inches)	72
Net Length (ft.)	85
Invert Elevation (ft.)	0.0
Gates	
Type of Control	Slide gate
Number	3
Size (inches)	72

STRUCTURE 346 (S-346)

Location. Structure 346 is located in the borrow canal of the L-67 Extension just south of U.S. Highway 41/Tamiami Trail.

Description. S-346 is a double-barreled, 72 inch, corrugated metal pipe culvert with riser pipes. Control is affected by stop logs in risers in each culvert.

Purpose. S-346 increases the proportion of overland flow with respect to canal flow from the S12D discharge into the Everglades National Park (ENP). S-346 can be open to increase the capacity of S-12D.

Regulation. It is operated in conjunction with the S-12 structures. Normally, this structure can be open when S-12D is open and is closed when all S-12 structures are closed.

Structure 346
Hydraulic Design Data

Location	
L-67 Extension	
Design Conditions	
Discharge (cfs)	165
Type	Controlled Submerged
Headwater Elevation (ft.)	6.2
Tailwater Elevation (ft.)	6.0
Culvert	
Type	Corrugated Metal Pipe
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	
Invert Elevation (ft.)	0.0
Gates	
Type of Control	Stop Logs in Risers
Number	2
Size (dia., inches)	96
Protection Grade Elevation (ft.)	12.0
Operating Platform Elevation (ft.)	12.0
Dewatering Capabilities	No
Discharge capacity per culvert (with all boards removed):	184(H)^(1/2) cfs

Note: All elevations are in feet NGVD 1929 unless otherwise stated. Revised April 2012

STRUCTURE 346 (S-346)

Summary of Hydraulic Design

Location	L-67 Ext.
Design Conditions	
Discharge (cfs)	165
Type	Controlled submerged
Headwater Elevation (ft.)	6.2
Tailwater Elevation (ft.)	6.0
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	
Invert Elevation (ft.)	0.0
Gates	
Type of Control	Stop logs in risers
Number	2
Size (dia., inches)	96
Protection Grade Elevation (ft.)	12.0
Operating Platform Elevation (ft.)	12.0
Dewatering Capabilities	No
Discharge capacity per culvert (with all boards removed):	$184(H)^{1/2}$ cfs

STRUCTURE 347 (S-347)

Location. Structure 347 is located in the borrow canal of the L-67 Extension about 2.5 miles south of U.S. 41.

Description. S-347 is a double-barreled, 72-inch, corrugated metal pipe culvert with riser pipes. Control is effected by stop logs in risers in each culvert.

Purpose. S-347 increases the proportion of overland flow with respect to canal flow from the S-12D discharge into the Everglades National Park (ENP).

Regulation. S-347's gates are normally closed. It is opened only during unusually dry conditions when the minimum deliveries to the ENP cannot otherwise be made. It is operated in conjunction with S-346 and S-12D.

STRUCTURE 347 (S-347)

Summary of Hydraulic Design

Location	L-67 Ext.
Design Conditions	
Discharge (cfs)	165
Type	Controlled submerged
Headwater Elevation (ft.)	6.0
Tailwater Elevation (ft.)	5.8
Culvert	
Type	CMP
Number of Barrels	2
Size (dia., inches)	72
Net Length (ft.)	
Invert Elevation (ft.)	0.5
Gates	
Type of Control	Stop logs in risers
Number	2
Size (dia., inches)	96
Protection Grade Elevation (ft.)	10.5
Operating Platform Elevation (ft.)	10.5
Dewatering Capabilities	No
Discharge capacity per culvert (with all boards removed):	$184(H)^{1/2}$ cfs

STRUCTURE 355A (S-355A)

Location. S-355A is located in levee 29 (L-29), north of both the L-29 borrow canal and US Highway 41 (Tamiami Trail).

Description. S-355A is a single bay, reinforced concrete ogee weir spillway with vertical lift slide gate controls.

Purpose. S-355A was designed to provide control of water levels in WCA-3B by discharging water from WCA-3B to Northeast Shark River Slough via the L-29 borrow canal. Florida Department of Transportation (FDOT) culverts under Tamiami Trail between S-333 and S-334 allow L-29 water to be conveyed from the L-29 borrow canal to Northeast Shark River Slough. Future Tamiami Trail bridge segments are planned (Tamiami Trail Bridge Modification Project) to replace culverts and improve conveyance under Tamiami Trail.

Operation. S-355A will be opened only when southerly flow from WCA-3B to the L-29 Borrow Canal is possible. S-355A will be closed when there is a threat of reverse flow (from the L-29 Borrow Canal to WCA-3B) through the structure. S-355A is operated to maintain water levels in WCA-3B at desirable levels and/or to convey inflows from WCA-3A to the L-29 Borrow Canal. If the FDOT has no roadway subbase concerns, S-355A will be closed when the S-333 tailwater is above 9.0 feet, NGVD. However, when FDOT has roadbase concerns, S-355A will be closed when the S-333 tailwater is above 7.5 feet, NGVD. However, upon completion of the Tamiami Trail Bridge Modification Project these concerns may no longer exist.

Structure 355A

Hydraulic Design Data

Location	Levee 29
Design Conditions	
Gate/Stilling Basin Design	
Discharge (cfs)	1000
Headwater Elevation (ft.)	9.2
Tailwater Elevation (ft.)	8.9
S.P.F. Condition	
Discharge (cfs)	1000
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	9.7
Crest	
Shape	Ogee
Elevation	1.8
Design Head (Hd)(ft.)	7.4
Net Length (ft.)	8.9
Gates	
Number	2
Width x Height (ft.)	20x8.4
Clearance Elevation	10.2
Instrumentation	
Headwater recorder & staff gage	30-feet upstream
Tailwater recorder & staff gage	30-feet downstream
Gate position recorders	at structure
Stilling Basin	
Elevation	0.0
Length	20
Endsill Elevation	0.75
Baffle Block Elevation	1.0
Rows of Baffle Blocks	1
Training Wall Elevation	8.9
Channel Section	
Upstream Bottom Width (ft.)	60
Upstream Bottom Width Elevation	0.0
Upstream Side Slopes	1 on 3
Downstream Bottom Width (ft.)	Existing
Upstream Bottom Width Elevation	Existing
Upstream Side Slopes	Existing
Upstream Riprap	
Length (ft.)	10.0
Protection Elevation	12.0
Downstream Riprap	
Length (ft.)	10.0
Protection Elevation	11.0

Note: All elevations are in feet NGVD 1929 unless otherwise stated. Revised April 2012

STRUCTURE 355B (S-355B)

Location. S-355B is located in levee 29 (L-29), north of both the L-29 borrow canal and US Highway 41 (Tamiami Trail).

Description. S-355B is a single bay, reinforced concrete ogee weir spillway with vertical lift slide gate controls.

Purpose. S-355B was designed to provide control of water levels in WCA-3B by discharging water from WCA-3B to Northeast Shark River Slough via the L-29 borrow canal. Florida Department of Transportation (FDOT) culverts under Tamiami Trail between S-333 and S-334 allow L-29 water to be conveyed from the L-29 borrow canal to Northeast Shark River Slough. Future Tamiami Trail bridge segments are planned (Tamiami Trail Bridge Modification Project) to replace culverts and improve conveyance under Tamiami Trail.

Operation. S-355B will be opened only when southerly flow from WCA-3B to the L-29 Borrow Canal is possible. S-355B will be closed when there is a threat of reverse flow (from the L-29 Borrow Canal to WCA-3B) through the structure. S-355B is operated to maintain water levels in WCA-3B at desirable levels and/or to convey inflows from WCA-3A to the L-29 Borrow Canal. If the FDOT has no roadway subbase concerns, S-355B will be closed when the S-333 tailwater is above 9.0 feet, NGVD. However, when FDOT has roadbase concerns, S-355B will be closed when the S-333 tailwater is above 7.5 feet, NGVD. However, upon completion of the Tamiami Trail Bridge Modification Project these concerns may no longer exist.

Structure 355B

Hydraulic Design Data

Location	Levee 29
Design Conditions	
Gate/Stilling Basin Design	
Discharge (cfs)	1000
Headwater Elevation (ft.)	9.2
Tailwater Elevation (ft.)	8.9
S.P.F. Condition	
Discharge (cfs)	1000
Headwater Elevation (ft.)	10.0
Tailwater Elevation (ft.)	9.7
Crest	
Shape	Ogee
Elevation	1.8
Design Head (Hd)(ft.)	7.4
Net Length (ft.)	8.9
Gates	
Number	2
Width x Height (ft.)	20x8.4
Clearance Elevation	10.2
Instrumentation	
Headwater recorder & staff gage	30-feet upstream
Tailwater recorder & staff gage	30-feet downstream
Gate position recorders	at structure
Stilling Basin	
Elevation	0.0
Length	20
Endsill Elevation	0.75
Baffle Block Elevation	1.0
Rows of Baffle Blocks	1
Training Wall Elevation	8.9
Channel Section	
Upstream Bottom Width (ft.)	60
Upstream Bottom Width Elevation	0.0
Upstream Side Slopes	1 on 3
Downstream Bottom Width (ft.)	Existing
Upstream Bottom Width Elevation	Existing
Upstream Side Slopes	Existing
Upstream Riprap	
Length (ft.)	10.0
Protection Elevation	12.0
Downstream Riprap	
Length (ft.)	10.0
Protection Elevation	11.0

Note: All elevations are in feet NGVD 1929 unless otherwise stated.

Revised April 2012

STRUCTURE 357 (S-357)

Location. The S-357 pump station is located approximately 20 miles southwest of Miami, approximately 3 miles west of Krome Avenue, and approximately 300 feet south of SW 168th Street (Richmond Drive) between SW 205th and SW 206th Avenues.

Description. The S-357 pump station has a capacity of 575 cubic feet per second (cfs), consisting of 4 diesel driven pumps (125 cfs each) and one electric driven pump (75 cfs). The four diesel driven vertical axial flow pumps have a discharge capacity of 56,100 gallons per min (125 cfs) against a total head corresponding to a static head of 15.5 feet, and are capable of constant speed operation from a static head of 15.5 feet down to and including a static head of 6.0 feet with water surface in intake sump ranging from elevation 0.0 feet to elevation 9.5 feet. The electric motor driven pump has a discharge capacity of 33,665 gallons per min (75 cfs) against total head corresponding to a static head of 14.5 feet, and are capable of constant speed operation from a static head of 14.5 feet down to and including a static head of 5 feet with water surface in intake sump ranging from elevation 0.0 feet to elevation 9.5 feet.

The station occupies a footprint approximately 50 feet by 100 feet in plan with an operating finish floor elevation of 18.5 feet and upstream service bridge elevation of 10.0 feet. The seepage canal transitions from a bottom width of 30 feet at elevation of negative 8.5 feet approximately 175 feet upstream of the pump station to a bottom width of 65 feet at elevation negative 12.0 at the beginning of the upstream apron. The S-357 pump station discharges into a settling pond with a concrete apron at elevation 1.0 foot. From the settling pond the flow will transition back to natural grade where the water will flow via an approximately 320 feet wide above ground flow-way to the Detention Cell (DC). Following completion of the C-111 Northern Detention Area (NDA) construction, discharges from the DC into the NDA will be allowed.

Purpose. S-357 will maintain water stages within the interior seepage canal to provide for flood damage reduction (flood mitigation) in the 8.5 SMA and to preserve hydroperiods within the Everglades. The seepage canal and S-357 are designed to work together to maintain water levels within the area interior of the outer perimeter levee. The objective is to control the water level in the seepage collection canal to maintain the groundwater levels within the area interior of the perimeter levee at the same levels as existed prior to the implementation of the MWD project.

Operation. Prior to the completion of the C-111 NDA, the 8.5 SMA pump station and general area will be operated as follows:

The S-357 pump station will turn on when the stilling well water level reaches elevation 6.2 feet. The pump will turn off when the stilling well water level is lower than elevation 5.7 feet. The pump station will pump as required to maintain this upstream canal stage and prevent surface water discharge from the DC. The pumping discharge rate will be reduced or shutdown completely to prevent an overflow event during these interim operations.

DISCHARGE CHARACTERISTICS

Design Discharge Rate (combined):	575 cfs

DESCRIPTION OF STRUCTURE

Number of Pumps:	5
Motor Size:	
1-75-cfs electric pumps:	75 hp
4-125-cfs diesel pumps:	500 hp
Intake Water Surface Elevations	
Maximum Pumping	9.5 ft
Maximum Non-Pumping	7.0 ft
Normal Pumping	5.0 ft to 6.5 ft
Start Pumping	6.2 ft
Normal Drawdown Pumping	5.7 ft
Minimum Pumping	0.0 ft
Minimum Non-Pumping	0.0 ft
Discharge Water Surface Elevations	
Maximum Pumping	11.0 ft
Normal Pumping	6.0 ft to 9.0 ft
Minimum Pumping	5.0 ft
Minimum Non-Pumping	5.0 ft
Channels & Approaches	
Channel Bottom Width	30 ft
Side Slopes	1V:1H 1V:3H above Miami Oolite (Near surface)
Intake Channel Invert	-8.5 ft
Discharge Pond Invert	1.0 ft

POWER SOURCE

Prime Movers	Commercial electricity Commercial Diesel

STATION POWER

Normal	Commercial electricity
Emergency Electrical	generator backup

HYDRAULIC AND HYDROLOGIC MEASUREMENTS

Stilling wells and staff gages located at upstream and downstream of structure.

ACCESS: Access to S-357 pump station is to the south, off of Richmond Drive.

DRAFT

SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX B

DROUGHT CONTINGENCY PLAN

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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Table B-1 (Continued)

C&SF Authorized Project Purposes 1/

Purposes of Operation:

Flood Control
Navigation
Water Supply
Preservation of Fish and Wildlife
Drainage and Water Control
Recreation
Prevention of Saltwater Intrusion
Water Quality Control
Environmental Protection
Water Supply to Everglades National Park
Preservation of Everglades National Park
Groundwater Recharge

Notes:

1/ Agricultural and Conservation Areas, Kissimmee River Basin and Related Areas, Upper St. Johns River Basin and Related Areas, Lake Okeechobee and Outlets, Coastal Areas South of St. Lucie Canal,

2/ Kissimmee River Basin Section 1135 modifications.

3/ This was also called Water Conservation in H.D. 80-643. See discussion of water supply in H.D. 85-186.

4/ As amended by PL 95-632, PL 96-159, and PL 97-304.

PL 71-520 authorized the Project for the Caloosahatchee River and Lake Okeechobee Drainage Areas. PL 80-858 modified and expanded the Project for the Caloosahatchee River and Lake Okeechobee Drainage Areas to include the first phase of the C & SF Project as recommended in H.D. 80-643. PL 83-780 authorized the remainder of the Comprehensive Plan found in H.D. 80-643. Completed work under the Project for Caloosahatchee River and Lake Okeechobee Drainage Areas that did not pertain to navigation have been maintained as a part of the C&SF Project since July 1950 (1950 Annual Report-Chief of Engineers). The navigation project since then has been known as the Okeechobee Waterway.

CENTRAL AND SOUTHERN FLORIDA PROJECT
FOR FLOOD CONTROL AND OTHER PURPOSES

SYSTEM OPERATING MANUAL

WATER CONSERVATION AREAS – EVERGLADES NATIONAL PARK AND ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX B

DROUGHT CONTINGENCY PLAN

DEPART OF THE ARMY
CORPS OF ENGINEERS, JACKSONVILLE DISTRICT
JACKSONVILLE, FLORIDA

APPENDIX B

Contents

1 Purpose 3
2 References 3
3 Introduction 3
4 Background 3
5 Summary of Existing Water Control Plan 3
6 Definition of Drought 4
7 Drought Management Plan 4
7.1 Management Principles 4
7.2 Actions 4

Exhibit A -Chapter 40E-21 -"Water Shortage Plan" published by SFWMD

1 PURPOSE

This appendix is written to (1) provide a platform from which to make decisions to implement water conservation measures during droughts, (2) review the operational flexibility of the Water Conservation Areas - Everglades National Park and ENP South Dade Conveyance Canals Water Control Plan in a drought, and (3) address the potential problems associated with an extreme drought.

2 REFERENCES

1. ER 1110-2-1941. -"Drought Contingency Plans"
2. ER 1110-2-240 -"Water Control Management"
3. EM 1110-2-3600 -"Management of Water Control Systems"
4. Water Control Plan for Water Conservation Areas and South Dade Conveyance System -Chapter VII
5. Chapter 40E-2J. -"Water Shortage Plan" published by SFWMD (Exhibit A)

3 INTRODUCTION

A severe drought in the Water Conservation Areas develops over a fairly long period of time and has a typical duration of 6 to 12 months. Adequate time will be available to plan specific details of drought operation. Therefore, this plan is an outline of water management measures and coordination actions to be considered when a severe drought occurs. Details of particular water management measures and the timing of their application will be determined as the drought progresses.

4 BACKGROUND

In 1949, the Central and Southern Florida Flood Control District (C&SFFCD) was established and became the local sponsor for the project works of the Central and Southern Florida Project for flood control and other purposes. In 1972, the C&SFFCD was renamed the South Florida Water Management District (SFWMD). As a government agency, the SFWMD has established rules and regulations that establish priorities and define procedures for restricting water use during conditions of water shortage. The "Water Shortage Plan" published by the South Florida Water Management District is an exhibit to this plan.

5 SUMMARY OF EXISTING WATER CONTROL PLAN

The authorized purposes of the Comprehensive Central and Southern Florida Project for Flood Control are flood control, navigation, environmental enhancement, water supply, groundwater recharge, and prevention of salinity intrusion. A complete listing of project purposes is found in Table B-1. Under normal conditions water is released from Water Conservation Areas to maintain desired water levels in WCA's, Everglades National Park and the South Dade Conveyance System. The volume of water released is limited only by the capacity of the outlet structures. The water control plan for Water Conservation Areas is written to provide for these purposes. Regulation flexibility is very limited under

existing authority. When the elevations in the project areas are below their optimum, the project will be operated to meet water supply, environmental enhancement, and prevention of salinity intrusion.

6 DEFINITION OF DROUGHT

Droughts generally are considered to have three components -duration, magnitude (average water deficiency), and severity (cumulative water deficiency). Dry periods occur randomly during any time period. There is no major indicator to distinguish "normal" dry periods from severe droughts. Conditions may vary slightly depending on the time of year, length of time that water elevations remain below optimum levels, and the water supply and water quality requirements. The SFWMD uses the following definitions:

40E-21.051. Definitions

1. "Water shortage" means that situation within all or part of the District when insufficient water is available to meet the present and anticipated needs of the users, or when conditions are such as to require temporary reduction in total use within a particular area to protect water resources from serious harm. A water shortage usually occurs due to drought.
2. “Water shortage emergency" means that situation when the powers which can be exercised under Part II of Chapter 40E-21 are not sufficient to protect the public health, safety, or welfare, or the health of animals, fish or aquatic life, or a public water supply, or commercial, industrial, agricultural, recreational or other reasonable uses.

7 DROUGHT MANAGEMENT PLAN

7.1 MANAGEMENT PRINCIPLES

Water conservation is the most efficient and practical option to obtain additional supplies of water using the same sources. It should be the option of primary consideration provided it does not create environmental, health, or other negative effects. If it does, it could be more effective to control or mitigate those effects before going to other options.

7.2 ACTIONS

If the SFWMD determines there is an increased likelihood that there will be an insufficient amount of water to meet the estimated anticipated user demands within a source class or to protect the water resource from serious harm, the following actions may be initiated by the
SFWMD and the Jacksonville District of the Corps of Engineers. The actions include but are not limited to:

1. Initiation of appropriate the SFWMD Water Shortage Plan and "General Water Use Restrictions" as established in Chapter 40E-21.271 by the SFWMD. (These rules are an exhibit to this plan). SFWMD's Water Shortage Plan provides specific guidelines for water restrictions which are based on the type of use and

severity of the drought. Included within the plan are water use reductions which range from 15% to as much as 60% of estimated need.

Note: Water deliveries to Everglades National Park are not reduced except by physical limitations imposed by the drought. Water deliveries to the ENP are computed using the Tamiami Trail Flow Formula equation which accounts for floods and droughts.

2. Enforcement of the water use restrictions by the SFWMD.
3. Public press releases shall be made on an "as-need" basis through the Public Affairs Office (PAO) of the Jacksonville District. These statements shall provide the public with a full explanation of drought operations and expected conditions in an effort to reduce inquiries from recreation and concerned interests. Similarly, the SFWMD will make press releases notifying the public of water use restrictions.
4. Drought situation reports for the Central and Southern Florida Project and other projects within the Jacksonville District shall be prepared by the Water Management and Meteorology section of the Jacksonville District. This report shall provide detailed information on current and forecast situations for informational purposes of District and South Atlantic Division (SAD) elements. The report will include general descriptions of the drought and climatic conditions, current Palmer Indices, rainfall summaries, stages and storages for the projects, and current water use restrictions.
5. Temporarily relax State standards for water quality requirements in the Lake and the Water Conservation Areas to permit the continued operation of agricultural pumps, and conserve remaining water in storage.
6. Should water quality or all water supply storage become depleted, potential alternatives include but are not limited to:
    a. Emergency reallocation of water from other parts of the Central and Southern Florida project.
    b. Declaration by the State of Florida of a water emergency. After a water emergency has been declared, emergency diversions to meet the needs of human consumption, necessary sanitation, and public safety can be made.

SELECTED FEDERAL EMERGENCY AUTHORITIES PROVIDING DROUGHT ASSISTANCE

The responsibility for providing an adequate supply of water to inhabitants of any area is basically non-Federal. Corps assistance to provide emergency water supplies will only be considered when non-Federal interests have exhausted reasonable means for securing necessary water supplies, including assistance and support from other Federal agencies.

Assistance may be available from the Corps through PL 84-99 as amended by PL 95-51. Before Corps assistance is considered under PL 95-51, the applicability of other Federal authorities should be evaluated. If these programs cannot provide the needed assistance, then maximum coordination should be made with appropriate agencies in implementing

Corps assistance. The applicability of programs administered by the following Federal agencies, as a minimum, will be determined prior to consideration of Corps assistance.

1. Small Business Administration (SBA).
2. Farmers Home Administration (FmHA).
3. Economic Development Administration (EDA).

Corps Authority for Drought Assistance.

The Corps authority for Drought Assistance is contained in Chapter 6, "Emergency Water Supplies and Drought Assistance" of Engineering Regulation (ER) 500-1-1 Natural Disaster Procedures (1983). Under this authority, the Chief of Engineers, acting for the Secretary of the Army, can construct wells and transport water to farmers, ranchers, and political subdivisions within areas he determines to be drought-distressed.

Table B-1

C&SF Authorized Project Purposes 1/

Purpose	Authorizing Law
1. Flood Control	PL 71-520, PL 80-858, PL 87-874, and PL 90-843
2. Navigation	PL 71-520, and PL 80-858
3. Agricultural Water Supply 3/	PL 80-858 and PL 90-483
4. Municipal and Industrial Water Supply 3/	PL 80-858, PL 90-483, and PL 87-874
5. Preservation of Fish and Wildlife	PL 80-858, PL 85-624, PL 90-843, and PL 93-205 4/
6. Drainage and Water Control	PL 80-858, PL 87-874, and PL 90-483
7. Preservation of Everglades National Park	PL 90-483 PL 101-229
8. Water Supply to Everglades National Park	PL 80-858, PL 90-483, PL 91-282, PL 98-181, PL 99-190, PL 101-229, and PL 100-676
9. Recreation	PL 90-483 PL 78-534, PL 87-874, and PL 89-72
10. Water Quality Control	PL 90-483, PL 92-500, and PL 95-217
11. Prevention of Saltwater Intrusion	PL 80-858, PL 90-483, and PL 87-874
12. Environmental Protection	PL 101-640, PL 91-190, PL 99-662, 2/

13. Groundwater Recharge	and PL 100-676 2/ PL 80-858 and PL 87-874

Table B-1 (Continued)

C&SF Authorized Project Purposes 1/

Purposes of Operation:

Flood Control Navigation
Water Supply
Preservation of Fish and Wildlife
Drainage and Water Control
Recreation
Prevention of Saltwater Intrusion
Water Quality Control
Environmental Protection
Water Supply to Everglades National Park
Preservation of Everglades National Park
Groundwater Recharge

Notes:

1/ Agricultural and Conservation Areas, Kissimmee River Basin and Related Areas, upper St. Johns River Basin and Related Areas, Lake Okeechobee and outlets, Coastal Areas South of St. Lucie Canal,

2/ Kissimmee River Basin Section 1135 modifications.

3/ This was also called Water Conservation in H.D. 80-643. See discussion of water supply in H.D. 85-186.

4/ As amended by PL 95-632, PL 96-159, and PL 97-304.

PL 71-520 authorized the Project for the Caloosahatchee River and Lake Okeechobee Drainage Areas. PL 80-858 modified and expanded the Project for the Caloosahatchee River and Lake Okeechobee Drainage Areas to include the first phase of the C&SF Project as recommended in H.D. 80-643. PL 83-780 authorized the remainder of the Comprehensive Plan found in H.D. 80-643. Completed work under the Project for Caloosahatchee River and Lake Okeechobee Drainage Areas that did not pertain to navigation have been maintained as a part of the C&SF Project since July 1950 (1950 Annual Report-Chief of Engineers). The navigation project since then has been known as the Okeechobee Waterway.

EXHIBIT A

Chapter 40E-21 - "Water Shortage Plan"

Rules of the South Florida Water Management District

WATER SHORTAGE PLAN
CHAPTER 40E-21, F.A.C.

Effective November 19, 2007

The 2007 SFWMD Water Shortage Plan can be found at:
https://www.sfwmd.gov/sites/default/files/documents/40e-21_0.pdf

DRAFT

SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX C

AGREEMENTS WITH NON-FEDERAL SPONSORS

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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Central and Southern Florida Flood Control District

RESOLUTION NO. 224

ASSUMPTION OF RESPONSIBILITY FOR COMPLIANCE WITH CONDITIONS OF LOCAL COOPERATION WITH FEDERAL GOVERNMENT UNDER FEDERAL AUTHORIZATION ENACTED BY 83rd CONGRESS, 2nd SESSION

WHEREAS, on the first day of August 1949 the Governing Board of Central and Southern Florida Flood Control District in regular meeting duly assembled at West Palm Beach, Florida, adopted a resolution, dated August 1, 1949 and numbered 12, whereby the said Board on behalf of the Central and Southern Florida Flood Control District agreed to and did assume full responsibility for compliance with the specific requirements of local cooperation set forth in House Document No. 643, Eightieth Congress, Second Session, and in detail in the second paragraph of said resolution; and,

WHEREAS the Flood Control Act of 1954, Public Law No. 780, of the Eighty-third Congress, Second Session, adopted and authorized modification and expansion of the comprehensive plan for Flood Control and other purposes in Central and Southern Florida authorized by the Flood Control Act of June 30, 1948, and amendments thereto, to include the entire comprehensive plan of improvement as recommended by the Report of the Chief of Engineers in House Document No. 643, Eightieth Congress, with such modifications thereof as the Congress may thereafter authorize; Provided that the conditions of local cooperation for the authorized first phase approved by the said Flood Control Act of June 30, 1948, shall apply to that authorized first phase, but for all work over and beyond that previous authorization such conditions shall apply on an interim basis only until they shall be modified as deemed appropriate by the Congress, based on recommendations to be submitted at the earliest practicable date by the Chief of Engineers through the Bureau of the Budget to the Congress: Provided further, That whatever conditions of local cooperation are established by Congress as a result of such recommendations shall be retroactive to any units of the comprehensive plan authorized in the Flood Control Act of September 1, 1954, which may be started prior to establishment of the exact conditions of local cooperation; and,

WHEREAS, the Central and Southern Florida Flood Control District has informally indicated its willingness and intention to assume responsibility for the compliance with conditions of local cooperation for the comprehensive plan for flood control and other purposes in Central and Southern Florida set forth in the Flood Control Act of 1954, Public Law No. 780 of the Eighty-third Congress, Second Session:

NOW, THEREFORE, BE IT RESOLVED by the Governing Board of Central and Southern Florida Flood Control District, in regular meeting duly assembled on the 15th day of September, 1954, at West Palm Beach, Florida, that the Governing Board of Central and Southern Florida Flood Control District by this Resolution agrees to and hereby assumes full responsibility for compliance with the aforementioned requirements of local cooperation which are set forth in detail in the Flood Control Act of 1954, Public Law No. 780, Title Two, Eight-third Congress, Second Session, under the heading CENTRAL AND SOUTHERN FLORIDA in Section 203 thereof, and specifically including compliance with whatever conditions of local cooperation are established by Congress to apply retroactively to any units of the comprehensive plan authorized by the said Flood Control Act of 1954 which may be started prior to establishment of the exact conditions of local cooperation applicable to units of the comprehensive plan authorized by the said Flood Control Act of 1954.

PASSED and ADOPTED, at West Palm Beach, Florida, this the 15th day of September, A. D., 1954.

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, BY ITS GOVERNING BOARD

(Corporate Seal)

BY /s/F. Elgin Bayless
Chairman

ATTEST:

/s/ W. Turner Wallis
Secretary

STATE OF FLORIDA)
)
COUNTY OF PALM BEACH)

C E R T I F I C A T E

I, W. TURNER WALLIS, Secretary of the Governing Board of Central and Southern Florida Flood Control District, do hereby certify that the foregoing is a true and correct copy of Resolution No. 224 duly adopted by the Governing Board of said District on the 15th day of September A.D. 1954.

I FURTHER CERTIFY that said Resolution has not been revoked, modified or changed in any way and is at the date of this certificate in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Governing Board this 18th day of October, A. D. 1954.

/s/ W. Turner Wallis
W. Turner Wallis, Secretary of
the Governing Board aforesaid

(typed: 3 June 59)

#383

SAKRG

3 - JUN 1959

Mr. D. G. Click
Chairman
Central and Southern Florida
Flood Control District
901 Evernia Street
West Palm Beach, Florida

Re: Local Assurances
(Arch Creek, Florida) (C + S F)

Dear Mr. Click:

Receipt is acknowledged of certified copies of Resolution No. 383, adopted by the Governing Board of Central and Southern Florida Flood Control District on 9 April 1959, providing the assurances of local cooperation in connection with Arch Creek Flood Control Project as required by Congress.

Your assurances are hereby accepted; however, it should be understood that the giving of acceptable assurances does not in itself, alone, satisfy the requirements of local cooperation as such requirements can be met by actual performance only.

Your cooperation with the Government in connection with this project is appreciated.

Sincerely yours,

PAUL D. TROXLER
Colonel, Corps of Engineers
District Engineer

Mr.Fryer:pg
SPOONER

Cy furnished:
Chief, Eng. Div. w/cy Assur.
Chief, Operations Div.
w/cy Assur.

4

Central and Southern Florida Flood Control District

RESOLUTION NO. 383

ASSURANCE TO THE CORPS OF ENGINEERS, U. S. ARMY OF LOCAL COOPERATION FOR THE CONSTRUCTION OF ARCH CREEK AND ITS CONTROL STRUCTURE, DADE COUNTY, FLORIDA

WHEREAS, Section 205 of Public Law 858, 80th Congress, as amended, and including the amendment set forth in Public Law 685, 84th Congress, 2d Session, authorizes the Secretary of the Army to construct certain small flood control projects not specifically authorized by Congress, which come within the provisions of Section I of the Flood Control Act of June 22, 1936; and

WHEREAS, Arch Creek and its control structure in Dade County, Florida has been authorized by the Secretary of the Army for improvement and construction; and

WHEREAS, prior to commencement of construction, under the above authorization, it is necessary for local interests to agree to cooperate in connection with this project.

NOW THEREFORE BE IT RESOLVED by the Governing Board of Central and Southern Florida Flood Control District that as the representative of local interests it does agree to the following cooperation with the United States for Arch Creek, Dade County, Florida: (a) to furnish without cost to the United States all necessary lands, easements and rights of way, when and as required; (b) assume the cost of all relocations and alterations incident to construction of the proposed improvements; (c) hold and save the United States free from damages that may result from construction, operation, and maintenance of the improvements; (d) operate and maintain the works after completion in accordance with regulations prescribed by the Secretary of the Army.

PASSED AND ADOPTED, this the 9th day of April, A. D., 1959.

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, BY ITS GOVERNING BOARD

By /s/ D. G. Click
Chairman

(Corporate Seal)

ATTEST:

/s/ G. E. Dail, Jr.
Secretary

STATE OF FLORIDA)
)
COUNTY OF PALM BEACH)

C E R T I F I C A T E

I, G. E. DAIL, JR., Secretary of the Governing Board of CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, do hereby certify that the foregoing is a true and correct copy of Resolution No. 383 , duly adopted by the Governing Board of said District on the 9th day of April, A. D., 1959

I FURTHER CERTIFY that said Resolution has not been revoked, modified or changed in any way and is at the date of this Certificate in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Governing Board, this the 1st day of June, A. D., 1959

G. E. Dail Jr.
G. E. DAIL, JR., Secretary of
the Governing Board aforesaid

(Corporate Seal)

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT

RESOLUTION NO. 511

ASSUMPTION OF RESPONSIBILITY FOR COMPLIANCE WITH CONDITIONS OF LOCAL COOPERATION WITH FEDERAL GOVERNMENT UNDER FEDERAL AUTHORIZATION ENACTED BY 87th CONGRESS, 2d SESSION, RELATING TO SENATE DOCUMENT 146 (WEST PALM BEACH CANAL, FLORIDA)

WHEREAS, on the 1st day of August 1949, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 12 agreeing to and assuming full responsibility for compliance with the specific requirements of local cooperation set forth in House Document No. 643, 80th Congress, 2d Session; and

WHEREAS, on the 15th day of September 1954, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 224 agreeing to and assuming full responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1954, Public Law 780, Title II, 83rd Congress, 2d Session, under the heading, Central and Southern Florida in Section 203 thereof; and

WHEREAS, on the 9th day of October 1959, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 393 agreeing to and assuming responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1958, Public Law 85-500, 85th Congress, 2d Session, as recommended by House Document No. 186, 85th Congress, 2d Session; and

WHEREAS, the Flood Control Act of 1962, Public Law 87-874, 87th Congress, 2d Session, adopted and authorized modifications to be comprehensive plan for flood control in Central and Southern Florida as recommended by Senate Document No. 146, 87th Congress, 2d Session, with respect to the West Palm Beach Canal and which provides for the acceptance by non-Federal interests of certain requirements of local cooperation.

NOW THEREFORE BE IT RESOLVED, by the Governing Board of the Central and Southern Florida Flood Control District that it does agree to and hereby assumes responsibility for compliance with the requirements of local cooperation as set forth in Senate Document No. 146, 87th Congress, 2d Session, West Palm Beach Canal, Florida, in that it will:

1. Contribute in cash 12.6 per cent of the contract price plus supervision and administration thereof for all items of work to be provided by the Corps of Engineers, an amount presently estimated at $444,000, to be paid in a lump sum prior to start of construction, or in installments prior to start of pertinent work items in accordance with construction schedules as required by the Chief of Engineers, the final allocation of cost to be made after the actual costs have been determined;
2. Construct and maintain at no cost to the Federal Government the lateral drainage facilities needed to realize the benefits potential made available by the proposed improvements to the West Palm Beach Canal;
3. Provide without cost to the United States all lands, easements, and rights of way necessary for construction of the project;
4. Assume the cost of construction of all new highway bridges and of all relocations or alterations of existing bridges, roads, utilities, or other improvements, except railroad bridges and approaches;
5. Hold and save the United States free from damages due to the construction works;
6. Prevent encroachment on the flood-carrying capacity of the improved channel; and
7. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

PASSED and ADOPTED, this the 5th day of April, A.D. 1963.

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, BY ITS GOVERNING BOARD

By Riley S. Miles
Chairman

(Corporate Seal)

ATTEST:

/s/ G. E. Dail, Jr.
Secretary

STATE OF FLORIDA)
COUNTY OF PALM BEACH)

C E R T I F I C A T E

I, G. E. DAIL, JR., Secretary of the Governing Board of CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, do hereby certify that the foregoing is a true and correct copy of Resolution No. 511 , duly adopted by the Governing Board of said District on the 5th day of April, A. D., 19 63.

I FURTHER CERTIFY that said Resolution has not been revoked, modified or changed in any way and is at the date of this Certificate in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Governing Board, this the 16th day of April, A. D., 19 64.

G. E. DAIL, JR., Secretary of the
Governing Board aforesaid

(Corporate Seal)

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT

RESOLUTION NO. 512

ASSUMPTION OF RESPONSIBILITY FOR COMPLIANCE WITH CONDITIONS OF LOCAL COOPERATION WITH FEDERAL GOVERNMENT UNDER FEDERAL AUTHORIZATION ENACTED BY 87th CONGRESS, 2d SESSION, RELATING TO SENATE DOCUMENT 138 (SOUTH DADE COUNTY, FLORIDA)

WHEREAS, on the 1st day of August 1949, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 12 agreeing to and assuming full responsibility for compliance with the specific requirements of local cooperation set forth in House Document No. 643, 80th Congress, 2d Session; and

WHEREAS, on the 15th day of September 1954, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 224 agreeing to and assuming full responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1954, Public Law 780, Title II, 83rd Congress, 2d Session, under the heading, Central and Southern Florida in Section 203 thereof; and

WHEREAS, on the 9th day of October 1959, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 398 agreeing to and assuming responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1958, Public Law 85-500, 85th Congress, 2d Session, as recommended by House Document No. 186, 85th Congress, 2d Session; and

WHEREAS, the Flood Control Act of 1962, Public Law 87-874, 87th Congress, 2d Session, adopted and authorized modifications to the comprehensive plan for flood control in Central and Southern Florida as recommended by Senate Document No. 138, 87th Congress, 2d Session, with respect to South Dade County and which provides for the acceptance by non-Federal interests of certain requirements of local cooperation.

NOW THEREFORE BE IT RESOLVED, by the Governing Board of the Central and Southern Florida Flood Control District that it does agree to and hereby assumes responsibility for compliance with the requirements of local cooperation as set forth in Senate Document No. 138, 87th Congress, 2d Session, South Dade County, in that it will:

1. Contribute in cash 19.2 per cent of the sum of the contract price and the costs of supervision and administration thereof for all items of

work to be provided by the Corps of Engineers; this amount is presently estimated at $2,953,000, to be paid either in a lump sum prior to start of construction, or in installments prior to start of pertinent work items in accordance with construction schedules as required by the Chief of Engineers, the final contribution to be determined after actual costs are known;

2. Construct and maintain at no cost to the Federal Government the lateral drainage facilities needed to realize the benefits potential made available by the proposed improvements;

3. Provide without cost to the United States all lands, easements, and rights of way necessary for construction of the project;

4. Assume the cost of construction of all new highway bridges and of all relocations and alterations of existing bridges, roads, utilities, and other improvements, except railroad bridges and approaches;

5. Hold and save the United States free from damages due to construction works;

6. Prevent encroachment on the flood-carrying capacity of the improved channels;

7. Operate and maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

8. At least annually, inform interests affected that the Project will provide no protection from ocean surges.

PASSED and ADOPTED, this the 5th day of April, A. D. 1963.

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, BY ITS GOVERNING BOARD

(Corporate Seal)

By Riley S. Miles
Chairman

ATTEST:

/s/ G. E. Dail, Jr.
Secretary

STATE OF FLORIDA)
)
COUNTY OF PALM BEACH)

C E R T I F I C A T E

I, G. E. DAIL, JR., Secretary of the Governing Board of CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, do hereby certify that the foregoing is a true and correct copy of Resolution No. 512 , duly adopted by the Governing Board of said District on the 5th day of April, A. D., 19 63.

I FURTHER CERTIFY that said Resolution has not been revoked, modified or changed in any way and is at the date of this Certificate in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Governing Board, this the 16th day of April, A. D., 19 64.

G. E. DAIL, JR., Secretary of the
Governing Board aforesaid

(Corporate Seal)

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT

RESOLUTION NO. 514

ASSUMPTION OF RESPONSIBILITY FOR COMPLIANCE WITH CONDITIONS OF LOCAL COOPERATION WITH FEDERAL GOVERNMENT UNDER FEDERAL AUTHORIZATION ENACTED BY 87th CONGRESS, 2d SESSION, RELATING TO SENATE DOCUMENT 123 (CUTLER DRAIN AREA, FLORIDA)

WHEREAS, on the 1st day of August 1949, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 12 agreeing to and assuming full responsibility for compliance with the specific requirements of local cooperation set forth in House Document No. 643, 80th Congress, 2d Session; and

WHEREAS, on the 15th day of September 1954, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 224 agreeing to and assuming full responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1954, Public Law 780, Title II, 83rd Congress, 2d Session, under the heading, Central and Southern Florida in Section 203 thereof; and

WHEREAS, on the 9th day of October 1959, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 398 agreeing to and assuming responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1958, Public Law 85-500, 85th Congress, 2d Session, as recommended by House Document No. 186, 85th Congress, 2d Session; and

WHEREAS, the Flood Control Act of 1962, Public Law 87-874, 87th Congress, 2d Session, adopted and authorized modifications to the comprehensive plan for flood control in Central and Southern Florida as recommended by Senate Document No. 123, 87th Congress, 2d Session, with respect to the Cutler Drain Area and which provides for the acceptance by non-Federal interests of certain requirements of local cooperation.

NOW THEREFORE BE IT RESOLVED, by the Governing Board of the Central and Southern Florida Flood Control District that it does agree to and hereby assumes responsibility for compliance with the requirements of local cooperation as set forth in Senate Document No. 123, 87th Congress, 2d Session, Cutler Drain Area, Florida, in that it will:

1. Construct and maintain at no cost to the Federal Government the lateral drainage facilities needed to realize the benefits potentially made available by the proposed improvements in the Cutler Drain area;
2. Provide without cost to the United States all lands, easements, and rights of way necessary for construction of the project;
3. Assume the cost of construction of all new highway bridges and of all relocations and alterations of existing bridges, roads, utilities, and other improvements, except railroad bridges and approaches;
4. Hold and save the United States free from damages due to the construction works;
5. Prevent encroachments on the flood-carrying capacity of the improved channels; and
6. Maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army.

PASSED and ADOPTED, this the 5th day of April, A.D. 1963.

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, BY ITS GOVERNING BOARD

(Corporate Seal)

By Riley S. Miles
Chairman

ATTEST:

/s/ G. E. Dail, Jr.
Secretary

STATE OF FLORIDA)
)
COUNTY OF PALM BEACH)

C E R T I F I C A T E

I, G. E. DAIL, JR., Secretary of the Governing Board of CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, do hereby certify that the foregoing is a true and correct copy of Resolution No. 514 , duly adopted by the Governing Board of said District on the 5th day of April, A. D., 19 63.

I FURTHER CERTIFY that said Resolution has not been revoked, modified or changed in any way and is at the date of this Certificate in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Governing Board, this the 16th day of April, A. D., 19 64.

G. E. DAIL, JR., Secretary of the
Governing Board aforesaid

(Corporate Seal)

Central and Southern Florida Flood Control District

RESOLUTION NO. 744

ASSUMPTION OF RESPONSIBILITY FOR COMPLIANCE WITH CONDITIONS OF LOCAL COOPERATION WITH FEDERAL GOVERNMENT UNDER FEDERAL AUTHORIZATION ENACTED BY 89th CONGRESS, 1st SESSION, RELATING TO SENATE DOCUMENT NO. 20, SOUTHWEST DADE COUNTY

WHEREAS, on the 1st day of August 1949, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 12 agreeing to and assuming full responsibility for compliance with the specific requirements of local cooperation set forth in House Document No. 643, 80th Congress, 2nd Session; and

WHEREAS, on the 15th day of September 1954, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 224 agreeing to and assuming full responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1954, Public Law 780, Title II, 83rd Congress, 2nd Session, under the heading, Central and Southern Florida in Section 203 thereof; and

WHEREAS, on the 9th day of October 1959, the Governing Board of the Central and Southern Florida Flood Control District adopted its Resolution No. 398 agreeing to and assuming responsibility for compliance with the requirements of local cooperation set forth in the Flood Control Act of 1958, Public Law 85-500, 85th Congress, 2nd Session, as recommended by House Document No. 186, 85th Congress, 2nd Session; and

WHEREAS, the Flood Control Act of 1965, Public Law 89-298, 89th Congress, 1st Session, adopted and authorized modifications to the comprehensive plan for flood control in Central and Southern Florida as recommended by Senate Document No. 20, 89th Congress, 1st Session, with respect to Southwest Dade County, Dade County, Florida, and which provides for the acceptance by non-Federal interests of certain requirements of local cooperation.

NOW THEREFORE BE IT RESOLVED, by the Governing Board of the Central and Southern Florida Flood Control District that it does agree to and hereby assumes responsibility for compliance with the requirements of local cooperation as set forth in Senate Document No. 20, 89th Congress, 1st Session, Southwest Dade County, in that it will:

1. Contribute in cash 46 percent of the sum of the contract price and the costs of supervision and administration thereof for each part of the primary work to be provided by the Corps of Engineers, an amount presently estimated at $3,663,000 to be paid either in a lump sum prior to start of construction, or in installments prior to start of pertinent work items in accordance with construction schedules as required by the Chief of Engineers, the final contribution to be determined after actual costs are known;

2. Construct and maintain the associated works needed to realize the benefits made available by the work to be provided by the United States;

3. Provide without cost to the United States all lands, easements, and rights of way necessary for construction of the project;

4. Provide without cost to the United States all necessary alterations or replacements of bridges, roads, miscellaneous utilities, and other existing improvements;

5. Hold and save the United States free from damages due to the construction works;

6 Prevent encroachment on the flood-removal capacity of the improvements; and

7 Operate and maintain the works after completion in accordance with regulations prescribed by the Secretary of the Army

PASSED and ADOPTED, this the 9th day of June, A.D., 1967.

CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, BY ITS GOVERNING BOARD

By /s/ Riley S. Miles
Chairman

(Corporate Seal)

ATTEST:

/s/ G. E. Dail, Jr.
Secretary

STATE OF FLORIDA)
)
COUNTY OF PALM BEACH)

C E R T I F I C A T E

I, G. E. DAIL, JR., Secretary of the Governing Board of CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, do hereby certify that the foregoing is a true and correct copy of Resolution No. 744 , duly adopted by the Governing Board of said District on the 9th day of June A. D., 1967 .

I FURTHER CERTIFY that said Resolution has not been revoked, modified or changed in any way and is at the date of this Certificate in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Governing Board, this the 12th day of June A. D., 1967.

G. E. DAIL, JR., Secretary of the
Governing Board Aforesaid

(Corporate Seal)

PROJECT COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE SEMINOLE TRIBE OF FLORIDA
FOR CONSTRUCTION OF THE
BIG CYPRESS SEMINOLE INDIAN RESERVATION WATER CONSERVATION PLAN
CRITICAL RESTORATION PROJECT

THIS AGREEMENT is entered into this 7th day of January, 2000, by and between the DEPARTMENT OF THE ARMY (hereinafter the "Government"), represented by the Assistant Secretary of the Army (Civil Works), and the SEMINOLE TRIBE OF FLORIDA (hereinafter the "Non-Federal Sponsor"), represented by the Chairman of its Tribal Council.

WITNESSETH, THAT:

WHEREAS, construction of the Big Cypress Seminole Indian Reservation Water Conservation Plan Project (hereinafter the "Project", as defined in Article I.A. of this Agreement) at Hendry County, Florida is authorized by Section 528(b)(3) of the Water Resources Development Act of 1996, Public Law 104-303, as amended;

WHEREAS, the Government and the Non-Federal Sponsor desire to enter into a Project Cooperation Agreement for construction of the Project;

WHEREAS, Section 528(e) of the Water Resources Development Act of 1996, Public Law 104-303, as amended, specifies the cost-sharing requirements applicable to the Project;

WHEREAS, Section 221 of the Flood Control Act of 1970, Public Law 91-611, as amended, provides that the Secretary of the Army shall not commence construction of any water resources project, or separable element thereof, until each Non-Federal Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

WHEREAS, Section 208(b) of the Water Resources Development Act of 1999, Public Law 106-53, provides that the Secretary of the Army (Civil Works) may afford credit or provide reimbursement to the Non-Federal Sponsor for certain costs that have been incurred or may be incurred in connection with the Project;

WHEREAS, the Non-Federal Sponsor has performed certain work and proposes to perform certain work (hereinafter referred to as the "Section 208 Work") which is a part of the Project;

WHEREAS, Section 102 of the Energy and Water Development Appropriations Act, 2000, Public Law 106-60, provides that credits and reimbursements afforded under certain general authorities and under project specific authority, such as Section 528 of the Water Resources Development Act of 1996, as amended, shall not exceed $10,000,000 per project in each fiscal year, nor shall they exceed $50,000,000 for all applicable projects in each fiscal year; and

WHEREAS, the Government and Non-Federal Sponsor have the full authority and capability to perform as hereinafter set forth and intend to cooperate in cost-sharing and financing of the construction of the Project in accordance with the terms of this Agreement.

NOW, THEREFORE, the Government and the Non-Federal Sponsor agree as follows:

ARTICLE I - DEFINITIONS AND GENERAL PROVISIONS

For purposes of this Agreement:

A. The term "Project" shall mean infrastructure improvements for the construction of water control, management and treatment facilities in Basins 1, 2, 3 and 4, which compose the western portion of the Big Cypress Seminole Indian Reservation (hereinafter referred to as the "Reservation") and planning, design and construction of conveyance canals on the eastern portion of the Reservation, as well as required planning and design activities, land acquisition, operational and best management practice plans for the basins and reservoirs as generally described in the Seminole Tribe Big Cypress Reservation Water Conservation Plan Letter Report, dated March, 1998 and approved by the Chief, Planning Division, Directorate of Civil Works on June 24, 1998 (hereinafter referred to as the "Letter Report").

B. The term "total project costs" shall mean all costs incurred by the Non-Federal Sponsor and the Government in accordance with the terms of this Agreement directly related to construction of the Project. Subject to the provisions of this Agreement, the term shall include only those costs incurred by the Non-Federal Sponsor and the Government after approval of the Letter Report. Total project costs shall include, but are not necessarily limited to: continuing planning and engineering costs; advanced engineering and design costs; preconstruction engineering and design costs; engineering and design costs during construction; the costs of investigations to identify the existence and extent of hazardous substances in accordance with Article XV.A. of this Agreement; costs of historic preservation activities in accordance with Articles XVII.A. and XVII.C. of this Agreement; actual construction costs, including costs incurred for the Section 208 Work as defined in paragraph K. of this Article for which the Government affords credit in accordance with Article II.D.2. of this Agreement to the extent that they do not

duplicate costs otherwise included in this paragraph; supervision and administration costs; costs of participation in the Project Coordination Team in accordance with Article V of this Agreement; costs of contract dispute settlements or awards; the value of lands, easements, rights-of-way, relocations, and suitable borrow and dredged or excavated material disposal areas for which the Government affords credit in accordance with Article IV of this Agreement; and costs of audit in accordance with Article X of this Agreement. The term does not include any costs for operation, maintenance, repair, replacement, or rehabilitation; any costs due to betterments; or any costs of dispute resolution under Article VII of this Agreement.

C. The term "financial obligation for construction" shall mean a financial obligation of the Government, other than an obligation pertaining to the provision of lands, easements, rights-of-way, relocations, and borrow and dredged or excavated material disposal areas, that results or would result in a cost that is or would be included in total project costs.

D. The term "Non-Federal Sponsor's proportionate share" shall mean the ratio of the Non-Federal Sponsor's total cash contribution required in accordance with Article II.D. of this Agreement to total financial obligations for construction, as projected by the Government.

E. The term "period of construction" shall mean the time from the date the Government first notifies the Non-Federal Sponsor in writing, in accordance with Article VI.B. of this Agreement, of the scheduled date for issuance of the solicitation for the first construction contract to the date that the U.S. Army Engineer for the Jacksonville District (hereinafter the "District Engineer") notifies the Non-Federal Sponsor in writing of the Government's determination that construction of the Project is complete in accordance with Article II.C. of this Agreement.

F. The term "highway" shall mean any public highway, roadway, street, or way, including any bridge thereof.

G. The term "relocation" shall mean providing a functionally equivalent facility to the owner of an existing utility, cemetery, highway or other public facility, or railroad when such action is authorized in accordance with applicable legal principles of just compensation or as otherwise provided in the authorizing legislation for the Project or any report referenced therein. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, or replacement and attendant removal of the affected facility or part thereof.

H. The term "fiscal year" shall mean one fiscal year of the Government. The Government fiscal year begins on October 1 and ends on September 30.

I. The term "functional portion of the Project" shall mean a portion of the Project that is suitable for tender to the Non-Federal Sponsor to operate and maintain in advance

of completion of the entire Project. For a portion of the Project to be suitable for tender, the District Engineer must notify the Non-Federal Sponsor in writing of the Government's determination that the portion of the Project is complete and can function independently and for a useful purpose, although the balance of the Project is not complete.

J. The term "betterment" shall mean a change in the design and construction of an element of the Project resulting from the application of standards that the Government determines exceed those that the Government would otherwise apply for accomplishing the design and construction of that element.

K. The term "Section 208 Work" means Project work commencing after approval of the Letter Report and for which the Government will give credit pursuant to Section 208 of Public Law 106-53 and includes but is not limited to the design and construction of distribution canals in the eastern basin of the Reservation to transport internal and external surface water to the proposed storage cells in that basin and ultimately to the Feeder Canal system. Both east and west channels will be sized to carry a combined flow of 190 cfs. Widths and depths of 75 feet and 6 feet, respectively, are proposed for these channels. These channels will both be approximately 21,000 feet long distributing surface water from east to west traversing both the existing E-1 and E-2 ditches. An eastern distribution canal is approximately 23,000 feet long, connecting future water resources from the L-4 Canal (via a 190 cfs pump station that will be constructed by the South Florida Water Management District) and intersecting the E-1 and E-2 ditches and certain work as described in Attachment "A". Attachment "A" may be amended by mutual agreement between the Non-Federal Sponsor and the District Engineer, as required.

ARTICLE II - OBLIGATIONS OF THE GOVERNMENT AND THE NON-FEDERAL SPONSOR

A. The Government and the Non-Federal Sponsor acknowledge that the Project is being pursued as a Critical Restoration Project. The Department of the Army agrees that, consistent with the authority provided in Section 528(b)(3) of Public Law 104-303, as amended, and the rules that govern Executive Branch budget requests, it will exert its best efforts to obtain the appropriations to pay for the Federal share of the cost of constructing the Project. The Government, subject to receiving funds appropriated by the Congress and using those funds and funds provided by the Non-Federal Sponsor, shall expeditiously construct the Project applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations and policies. The Government and the Non-Federal Sponsor acknowledge at the time of signing this Agreement, the Congress has not provided sufficient funding necessary to complete the Project, and that, therefore, it is necessary to closely consult on all Project expenditures to ensure that amounts to be expended for Project work including project design, land acquisition and construction do not exceed the amount of Federal appropriations that are available for Project costs. The Government and the Non-Federal Sponsor agree that no Project work will ensue unless both parties agree in writing that such work can be initiated within available Federal

appropriations. As Federal appropriations are made available for the Project, the Government shall proceed with implementation of the Project on an incremental basis after consulting with the Non-Federal Sponsor pursuant to Article V.C. of this Agreement. The Government shall then, consistent with the amount of appropriations so provided, initiate engineering and design of the Project, afford credit to the Non-Federal Sponsor in accordance with this Agreement, and construct the Project. Where the Non-Federal Sponsor proposes to perform Section 208 Work under this Agreement, the Government shall authorize the initiation of such Section 208 Work consistent with the amount of available appropriations and other limitations set forth in this Agreement, after consultation with the Non-Federal Sponsor pursuant to Article V.C. of this Agreement.

1. The Government shall afford the Non-Federal Sponsor the opportunity to review and comment on the solicitations for all contracts, including relevant plans and specifications, prior to the Government's issuance of such solicitations. The Government shall not issue the solicitation for the first construction contract until the Non-Federal Sponsor has confirmed in writing its willingness to proceed with the Project. To the extent possible, the Government shall afford the Non-Federal Sponsor the opportunity to review and comment on all contract modifications, including change orders, prior to the issuance to the contractor of a Notice to Proceed. In any instance where providing the Non-Federal Sponsor with notification of a contract modification or change order is not possible prior to issuance of the Notice to Proceed, the Government shall provide such notification in writing at the earliest date possible. To the extent possible, the Government also shall afford the Non-Federal Sponsor the opportunity to review and comment on all contract claims prior to resolution thereof. The Government shall consider in good faith the comments of the Non-Federal Sponsor, but the contents of solicitations, award of contracts, execution of contract modifications, issuance of change orders, resolution of contract claims, and performance of all work on the Project, with the exception of the Section 208 Work, whether the work is performed under contract or by Government personnel, shall be exclusively within the control of the Government.

2. Throughout the period of construction, the District Engineer shall furnish the Non-Federal Sponsor with a copy of the Government's Written Notice of Acceptance of Completed Work for each contract for the Project.

3. For future Section 208 Work , the Government shall be afforded an opportunity to review and comment on the solicitations for all contracts, including relevant plans and specifications, prior to the Non-Federal Sponsor's issuance of such solicitations. No construction shall commence under this Agreement until the designs, detailed plans and specifications, and arrangements for prosecution of the Section 208 Work have been approved in writing by the District Engineer, or his representative. All bids received and proposed provisions of any contract shall be subject to review by the Government prior to contract award. In addition, all proposed changes in approved designs, plans, and specifications also must be reviewed and approved by the District Engineer or his representative in writing in advance of the related construction where practicable. To the extent possible, the Non-Federal Sponsor also shall afford the

Government the opportunity to review and comment on all contract claims prior to resolution thereof. The Non-Federal Sponsor shall consider in good faith the comments of the Government made as a result of its review, but the contents of solicitations, award of contracts, execution of contract modifications, issuance of change orders, resolution of contract claims, and performance of all Section 208 Work shall be exclusively within the control of the Non-Federal Sponsor. However, the failure of the Non-Federal Sponsor to comply with direction received from the District Engineer, with respect to the Section 208 Work, may result in the costs associated with such work being determined ineligible for credit towards the Non-Federal Sponsor's share of total project costs.

4. Notwithstanding paragraph A.1. of this Article, if, upon the award of any contract for construction of the Project, cumulative financial obligations for the Project would exceed $50,000,000.00, the Government and the Non-Federal Sponsor agree to defer award of that contract and all subsequent contracts for construction of the Project until such time as the Government and the Non-Federal Sponsor agree to proceed with further contract awards for the Project, but in no event shall the award of contracts be deferred for more than three years. Notwithstanding this general provision for deferral of contract awards, the Government, after consultation with the Non-Federal Sponsor, may award a contract or contracts after the Assistant Secretary of the Army (Civil Works) makes a written determination that the award of such contract or contracts must proceed in order to comply with law or to protect life or property from imminent and substantial harm.

5. To the extent provided in applicable Federal laws and regulations, including procurement regulations, preferences and opportunities for training and employment in connection with the administration of this Agreement shall be given to tribal members of the Non-Federal Sponsor and preferences in the award of sub-contracts shall be given to Seminole Indian organizations and Seminole Indian owned economic enterprises.

B. The Non-Federal Sponsor may request the Government to accomplish betterments. Such requests shall be in writing and shall describe the betterments requested to be accomplished. If the Government in its sole discretion elects to accomplish the requested betterments or any portion thereof, it shall so notify the Non-Federal Sponsor in a writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The Non-Federal Sponsor shall be solely responsible for all costs due to the requested betterments and shall pay all such costs in accordance with Article VI.C. of this Agreement.

C. When the District Engineer determines that the entire Project is complete or that a portion of the Project has become a functional portion of the Project, the District Engineer shall so notify the Non-Federal Sponsor in writing and furnish the Non-Federal Sponsor with an Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (hereinafter the "OMRR&R Manual") and with copies of all of the Government's

Written Notices of Acceptance of Completed Work for all contracts for the Project or the functional portion of the Project that have not been provided previously. Upon such notification, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project or the functional portion of the Project in accordance with Article VIII of this Agreement.

D. The Non-Federal Sponsor shall contribute 50 percent of total project costs in accordance with the provisions of this paragraph.

1. In accordance with Article III of this Agreement, the Non-Federal Sponsor shall provide all lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Government determines the Non-Federal Sponsor must provide for the construction, operation, and maintenance of the Project, and shall perform or ensure performance of all relocations that the Government determines to be necessary for the construction, operation, and maintenance of the Project.

2. As authorized by Section 208 of Public Law 106-53, the Government may afford credit for the Section 208 Work. The affording of such credit shall be subject to a technical review by the Government to verify that the credited work was accomplished in a satisfactory manner and in accordance with the limitations contained in this Agreement. To afford any such credit, the Government, as further specified in Article VI.B. of this Agreement, shall apply the actual amount of credit toward the cash contribution required by paragraph D.3. of this Article. The actual amount of credit shall not exceed the Non-Federal Sponsor's actual costs attributable to the Section 208 Work. The actual amount of credit shall be subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. If the actual amount of credit exceeds the cash contribution required by paragraph D.3. of this Article, the Government, subject to the availability of funds, shall, on behalf of the Non-Federal Sponsor, provide Project lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas, or perform Project relocations, equal in value to such excess credit amount. As an alternative, and in its sole discretion, the Government may, subject to the availability of funds, reimburse the Non-Federal Sponsor in an amount equal to such excess credit amount.

3. If the Government projects that the value of the Non-Federal Sponsor's contributions under paragraphs D.1. and D.2. of this Article and Articles IV, V, X, XV.A., and XVII of this Agreement will be less than 50 percent of total project costs, the Non-Federal Sponsor shall provide an additional cash contribution, in accordance with Article VI.B. of this Agreement, in the amount necessary to make the Non-Federal Sponsor's total contribution equal to 50 percent of total project costs.

4. If the Government determines that the value of the Non-Federal Sponsor's contributions provided under paragraphs D.1. and D.2. of this Article and Articles IV, V, X, XV.A., and XVII of this Agreement has exceeded 50 percent of total

project costs, the Government, subject to the availability of funds, shall reimburse the Non-Federal Sponsor for any such value in excess of 50 percent of total project costs. After such a determination, the Government, in its sole discretion, may provide any remaining Project lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas and perform any remaining Project relocations on behalf of the Non-Federal Sponsor.

E. The Non-Federal Sponsor may request the Government to provide lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or perform relocations on behalf of the Non-Federal Sponsor. Such requests shall be in writing and shall describe the services requested to be performed. If in its sole discretion the Government elects to perform the requested services or any portion thereof, it shall so notify the Non-Federal Sponsor in a writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The Non-Federal Sponsor shall be solely responsible for all costs of the requested services and shall pay all such costs in accordance with Article VI.C. of this Agreement. Notwithstanding the provision of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or performance of relocations by the Government, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of cleanup and response in accordance with Article XV.C. of this Agreement.

F. The Government shall perform a final accounting in accordance with Article VI.D. of this Agreement to determine the contributions provided by the Non-Federal Sponsor in accordance with paragraphs B., D., and E. of this Article and Articles IV, V, X, XV.A., and XVII of this Agreement and to determine whether the Non-Federal Sponsor has met its obligations under paragraphs B., D., and E. of this Article.

G. In addition to any other limitations contained in this Agreement, the affording of credit and the amount of credit is subject to the following additional limitations.

1. Any reimbursement for the Section 208 Work performed by the Non-Federal Sponsor shall be dependent upon the appropriation of funds applicable thereto or funds available therefor.

2. No credit shall be given or reimbursement made unless and until the District Engineer has certified that the Section 208 Work subject to credit or reimbursement pursuant to this Agreement has been performed in accordance with this Agreement.

3. The amount of credit or reimbursement for which the Non-Federal Sponsor may be eligible pursuant to this Agreement is not subject to interest charges, nor is it subject to adjustment to reflect changes in price levels between the time the Section 208 Work is completed and the time that the credit or reimbursement is afforded.

4. The Non-Federal Sponsor shall obtain all applicable Federal, State and Tribal permits required for the performance of the Section 208 Work and for operation, maintenance, repair, rehabilitation and replacement of the Section 208 Work.

5. Any contract awarded by the Non-Federal Sponsor for the Section 208 Work under this Agreement shall include provisions consistent with all applicable Federal laws and regulations including preferences and opportunities for training and employment in connection with the administration of this Agreement for tribal members of the Non-Federal Sponsor and preferences in the award of sub-contracts shall be given to Seminole Indian organizations and Seminole Indian owned economic enterprises.

6. Subject to the limitations above and an audit in accordance with Article X of this Agreement, the Government may afford credit for Section 208 Work performed by or to be performed on behalf of the Non-Federal Sponsor by the firms of AMS Engineering & Environmental, Inc.; Ardaman & Associates, Inc.; Gerald T. Benock; Lewis, Longman & Walker, P.A.; Lodge Environmental Consulting, Inc.; The Phoenix Environmental Group, Inc.; and Wilkison & Associates, Inc.. This provision does not preclude the Non-Federal Sponsor from selecting other contractors in accordance with applicable procurement procedures.

7. The Non-Federal Sponsor shall not perform any construction work until all National Environmental Policy Act of 1969 (NEPA) requirements are satisfied and the Non-Federal Sponsor obtains all required Federal and Tribal permits and South Florida Water Management District (SFWMD) work plan approval in accordance with the Water Rights Compact among the Seminole Tribe of Florida, the State of Florida and the South Florida Water Management District pursuant to the Seminole Indian Land Claims Settlement Act of 1987, Public Law 100-228.

8. The amount of credit or reimbursement that may be afforded the Non-Federal Sponsor for the Section 208 Work shall be subject to the applicable limitations contained in Section 102 of the Energy and Water Appropriations Act, 2000, Public Law 106-60.

H. The Non-Federal Sponsor shall not use Federal funds to meet the Non-Federal Sponsor's share of total project costs under this Agreement unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

ARTICLE III - LANDS, RELOCATIONS, DISPOSAL AREAS, AND PUBLIC LAW 91-646 COMPLIANCE

A. The Government, after consultation with the Non-Federal Sponsor, shall determine the lands, easements, and rights-of-way required for the construction,

operation, and maintenance of the Project, including those required for relocations, borrow materials, and dredged or excavated material disposal. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions, including maps as appropriate, of the lands, easements, and rights-of-way that the Government determines the Non-Federal Sponsor must provide, in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with acquisition of such lands, easements, and rights-of-way. Prior to the end of the period of construction, the Non-Federal Sponsor shall acquire all lands, easements, and rights-of-way set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each construction contract, the Non-Federal Sponsor shall provide the Government with authorization for entry to all lands, easements, and rights-of-way the Government determines the Non-Federal Sponsor must provide for that contract. For so long as the Project remains authorized, the Non-Federal Sponsor shall ensure that lands, easements, and rights-of-way that the Government determines to be required for the operation and maintenance of the Project and that were provided by the Non-Federal Sponsor are retained in public ownership for uses compatible with the authorized purposes of the Project.

B. The Government, after consultation with the Non-Federal Sponsor, shall determine the improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the construction, operation, and maintenance of the Project. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and de-watering pumps and pipes. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions of such improvements in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with construction of such improvements. Prior to the end of the period of construction, the Non-Federal Sponsor shall provide all improvements set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the Non-Federal Sponsor shall prepare plans and specifications for all improvements the Government determines to be required for the proper disposal of dredged or excavated material under that contract, submit such plans and specifications to the Government for approval, and provide such improvements in accordance with the approved plans and specifications.

C. The Government, after consultation with the Non-Federal Sponsor, shall determine the relocations necessary for the construction, operation, and maintenance of the Project, including those necessary to enable the removal of borrow materials and the proper disposal of dredged or excavated material. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions, including maps as appropriate, of such relocations in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with such relocations. Prior to the end of the period of construction, the Non-Federal Sponsor shall perform or ensure the performance of all

relocations as set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the Non-Federal Sponsor shall prepare or ensure the preparation of plans and specifications for, and perform or ensure the performance of, all relocations the Government determines to be necessary for that contract.

D. The Non-Federal Sponsor in a timely manner shall provide the Government with such documents as are sufficient to enable the Government to determine the value of any contribution provided pursuant to paragraphs A., B., or C. of this Article. Upon receipt of such documents the Government, in accordance with Article IV of this Agreement and in a timely manner, shall determine the value of such contribution, include such value in total project costs, and afford credit for such value toward the Non-Federal Sponsor's share of total project costs.

E. The Non-Federal Sponsor shall comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 C.F.R. Part 24, in acquiring lands, easements, and rights-of-way required for the construction, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and shall inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - CREDIT FOR VALUE OF LANDS, RELOCATIONS, AND DISPOSAL AREAS

A. The Non-Federal Sponsor shall receive credit toward its share of total project costs for the value of the lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Non-Federal Sponsor must provide pursuant to Article III of this Agreement, and for the value of the relocations that the Non-Federal Sponsor must perform or for which it must ensure performance pursuant to Article III of this Agreement. However, the Non-Federal Sponsor shall not receive credit for the value of any lands, easements, rights-of-way, relocations, or borrow and dredged or excavated material disposal areas that have been provided previously as an item of cooperation for another Federal project. The Non-Federal Sponsor also shall not receive credit for the value of lands, easements, rights-of-way, relocations, or borrow and dredged or excavated material disposal areas to the extent that such items are provided using Federal funds unless the Federal granting agency verifies in writing that such credit is expressly authorized by statute.

B. For the sole purpose of affording credit in accordance with this Agreement, the value of lands, easements, and rights-of-way, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, shall be the fair market

value of the real property interests, plus certain incidental costs of acquiring those interests, as determined in accordance with the provisions of this paragraph.

1. Date of Valuation. The fair market value of lands, easements, or rights-of-way owned or controlled by the Non-Federal Sponsor on the effective date of this Agreement shall be the fair market value of such real property interests as of the date the Non-Federal Sponsor provides the Government with authorization for entry thereto. The fair market value of lands, easements, or rights-of-way acquired by the Non-Federal Sponsor after the effective date of this Agreement shall be the fair market value of such real property interests at the time the interests are acquired.

2. General Valuation Procedure. Except as provided in paragraph B.3. of this Article, the fair market value of lands, easements, or rights-of-way shall be determined in accordance with paragraph B.2.a. of this Article, unless thereafter a different amount is determined to represent fair market value in accordance with paragraph B.2.b. of this Article.

a. The Non-Federal Sponsor shall obtain, for each real property interest, an appraisal that is prepared by a qualified appraiser who is acceptable to the Non-Federal Sponsor and the Government. The appraisal must be prepared in accordance with the applicable rules of just compensation, as specified by the Government. The fair market value shall be the amount set forth in the Non-Federal Sponsor's appraisal, if such appraisal is approved by the Government. In the event the Government does not approve the Non-Federal Sponsor's appraisal, the Non-Federal Sponsor may obtain ~~a~~ second appraisal, and the fair market value shall be the amount set forth in the Non-Federal Sponsor's second appraisal, if such appraisal is approved by the Government. In the event the Government does not approve the Non-Federal Sponsor's second appraisal, or the Non-Federal Sponsor chooses not to obtain a second appraisal, the Government shall obtain an appraisal, and the fair market value shall be the amount set forth in the Government's appraisal, if such appraisal is approved by the Non-Federal Sponsor. In the event the Non-Federal Sponsor does not approve the Government's appraisal, the Government, after consultation with the Non-Federal Sponsor, shall consider the Government's and the Non-Federal Sponsor's appraisals and determine an amount based thereon, which shall be deemed to be the fair market value.

b. Where the amount paid or proposed to be paid by the Non-Federal Sponsor for the real property interest exceeds the amount determined pursuant to paragraph B.2.a. of this Article, the Government, at the request of the Non-Federal Sponsor, shall consider all factors relevant to determining fair market value and, in its sole discretion, after consultation with the Non-Federal Sponsor, may approve in writing an amount greater than the amount determined pursuant to paragraph B.2.a. of this Article, but not to exceed the amount actually paid or proposed to be paid. If the Government approves such an amount, the fair market value shall be the lesser of the approved amount or the amount paid by the Non-Federal Sponsor, but no less than the amount determined pursuant to paragraph B.2.a. of this Article.

3. Eminent Domain Valuation Procedure. For lands, easements, or rights-of-way acquired by eminent domain proceedings instituted after the effective date of this Agreement, the Non-Federal Sponsor shall, prior to instituting such proceedings, submit to the Government notification in writing of its intent to institute such proceedings and an appraisal of the specific real property interests to be acquired in such proceedings. The Government shall have 60 days after receipt of such a notice and appraisal within which to review the appraisal, if not previously approved by the Government in writing.

a. If the Government previously has approved the appraisal in writing, or if the Government provides written approval of, or takes no action on, the appraisal within such 60-day period, the Non-Federal Sponsor shall use the amount set forth in such appraisal as the estimate of just compensation for the purpose of instituting the eminent domain proceeding.

b. If the Government provides written disapproval of the appraisal, including the reasons for disapproval, within such 60-day period, the Government and the Non-Federal Sponsor shall consult in good faith to promptly resolve the issues or areas of disagreement that are identified in the Government's written disapproval. If, after such good faith consultation, the Government and the Non-Federal Sponsor agree as to an appropriate amount, then the Non-Federal Sponsor shall use that amount as the estimate of just compensation for the purpose of instituting the eminent domain proceeding. If, after such good faith consultation, the Government and the Non-Federal Sponsor cannot agree as to an appropriate amount, then the Non-Federal Sponsor may use the amount set forth in its appraisal as the estimate of just compensation for the purpose of instituting the eminent domain proceeding.

c. For lands, easements, or rights-of-way acquired by eminent domain proceedings instituted in accordance with sub-paragraph B.3. of this Article, fair market value shall be either the amount of the court award for the real property interests taken, to the extent the Government determined such interests are required for the construction, operation, and maintenance of the Project, or the amount of any stipulated settlement or portion thereof that the Government approves in writing.

4. Incidental Costs. For lands, easements, or rights-of-way acquired by the Non-Federal Sponsor after the approval of the Letter Report, the value of the interest shall include the documented incidental costs of acquiring the interest, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such incidental costs shall include, but not necessarily be limited to, closing and title costs, appraisal costs, survey costs, Non-Federal Sponsor's attorney's fees and costs, plat maps, and mapping costs, landowner's attorney fees and costs required to be paid under Florida Law, as well as the actual amounts expended for payment of any Public Law 91-646 relocation assistance benefits provided in accordance with Article III.E. of this Agreement.

C. After consultation with the Non-Federal Sponsor, the Government shall determine the value of relocations in accordance with the provisions of this paragraph.

1. For a relocation other than a highway, the value shall be only that portion of relocation costs that the Government determines is necessary to provide a functionally equivalent facility, reduced by depreciation, as applicable, and by the salvage value of any removed items.

2. For a relocation of a highway, the value shall be only that portion of relocation costs that would be necessary to accomplish the relocation in accordance with the design standard that the State of Florida would apply under similar conditions of geography and traffic load, reduced by the salvage value of any removed items.

3. Relocation costs shall include, but not necessarily be limited to, actual costs of performing the relocation; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with performance of the relocation, but shall not include any costs due to betterments, as determined by the Government, nor any additional cost of using new material when suitable used material is available. Relocation costs shall be subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

D. The value of the improvements made to lands, easements, and rights-of-way for the proper disposal of dredged or excavated material shall be the costs of the improvements, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such costs shall include, but not necessarily be limited to, actual costs of providing the improvements; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with providing the improvements, but shall not include any costs due to betterments, as determined by the Government.

ARTICLE V - PROJECT COORDINATION TEAM

A. To provide for consistent and effective communication, the Non-Federal Sponsor and the Government, not later than 30 days after the effective date of this Agreement, shall appoint named senior representatives to a Project Coordination Team. Thereafter, the Project Coordination Team shall meet regularly until the end of the period of construction. The Government's Project Manager and a counterpart named by the Non-Federal Sponsor shall co-chair the Project Coordination Team.

B. The Government's Project Manager and the Non-Federal Sponsor's counterpart shall keep the Project Coordination Team informed of the progress of construction and of significant pending issues and actions, and shall seek the views of the Project Coordination Team on matters that the Project Coordination Team generally oversees.

C. Until the end of the period of construction, the Project Coordination Team shall generally oversee the Project, including consulting on issues related to design; plans and specifications; scheduling; real property and relocation requirements; real property acquisition; contract awards and modifications; the Section 208 Work; contract costs; the Government's cost projections; final inspection of the entire Project or functional portions of the Project; preparation of the proposed OMRR&R Manual; anticipated requirements and needed capabilities for performance of operation, maintenance, repair, replacement, and rehabilitation of the Project; and other related matters. The goal of this consultation, among other things, shall be to ensure, to the maximum extent practicable, that the Government and the Non-Federal Sponsor agree on the precise work that is to be performed under this Agreement and the scheduling of that work. This oversight shall be consistent with a project management plan developed by the Government after consultation with the Non-Federal Sponsor.

D. The Project Coordination Team may make recommendations that it deems warranted to the District Engineer on matters that the Project Coordination Team generally oversees, including suggestions to avoid potential sources of dispute. The Government in good faith shall consider the recommendations of the Project Coordination Team. The Government, having the legal authority and responsibility for construction of the Project, has the discretion to accept, reject, or modify the Project Coordination Team's recommendations.

E. The costs of participation in the Project Coordination Team shall be included in total project costs and shall be cost shared in accordance with the provisions of this Agreement.

ARTICLE VI - METHOD OF PAYMENT

A. The Government shall maintain current records of contributions provided by the parties and current projections of total project costs, current projections of each party's share of total project costs and costs due to betterments. By March 31 of each year and at least quarterly thereafter, the Government shall provide the Non-Federal Sponsor with a report setting forth all contributions provided to date and the current projections of total project costs, of total costs due to betterments, of the components of total project costs, of each party's share of total project costs, of the Non-Federal Sponsor's total cash contributions required in accordance with Articles II.B., II.D., and II.E. of this Agreement, of the Non-Federal Sponsor's proportionate share, and of the funds the Government projects to be required from the Non-Federal Sponsor for the upcoming fiscal year. On the effective date of this Agreement, total project costs are projected to be $49,332,000, and the Non-Federal Sponsor's cash contribution required under Article II.D. of this Agreement is projected to be $17,149,000. The amount of credit for the Section 208 Work to be afforded against the Non-Federal Sponsor's required contribution towards total project costs in accordance with Article II.D.2. of this

Agreement is projected to be $3,774,000. Such amounts are estimates subject to adjustment by the Government and are not to be construed as the total financial responsibilities of the Government and the Non-Federal Sponsor.

B. The Non-Federal Sponsor shall provide the cash contribution required under Article II.D.3. of this Agreement in accordance with the provisions of this paragraph. For the purposes of budget planning, the Government shall notify the Non-Federal Sponsor by March 15 of each year of the estimated funds that will be required from the Non-Federal Sponsor to meet the Non-Federal Sponsor's share of total Project costs for the upcoming fiscal year.

1. Not less than 60 calendar days prior to the scheduled date for issuance of the solicitation for the first construction contract, the Government shall notify the Non-Federal Sponsor in writing of such scheduled date and the funds the Government, after consideration of any credit afforded pursuant to Article II.D. of this Agreement, determines to be required from the Non-Federal Sponsor to meet the Non-Federal Sponsor's proportionate share of projected financial obligations for construction through the first fiscal year of construction, including the Non-Federal Sponsor's proportionate share of financial obligations for construction incurred prior to the commencement of the period of construction. Not later than such scheduled date, the Non-Federal Sponsor shall provide the Government with the full amount of the required funds by delivering a check payable to "FAO, USAED, Jacksonville District" to the District Engineer or verify to the satisfaction of the Government that the Non-Federal Sponsor has deposited the required funds in an escrow or other account acceptable to the Government, with interest accruing to the Non-Federal Sponsor, or present the Government with an irrevocable letter of credit acceptable to the Government for the required funds, or provide an Electronic Funds Transfer in accordance with procedures established by the Government.

2. For the second and subsequent fiscal years of construction, the Government shall notify the Non-Federal Sponsor in writing, no later than 120 calendar days prior to the beginning of that fiscal year, of the funds the Government, after consideration of any credit afforded pursuant to Article II.D. of this Agreement, determines to be required from the Non-Federal Sponsor to meet the Non-Federal Sponsor's proportionate share of projected financial obligations for construction for that fiscal year. No later than 30 calendar days following the beginning of the fiscal year, the Non-Federal Sponsor shall make the full amount of the required funds for that fiscal year available to the Government through any of the funding mechanisms specified in paragraph B.1. of this Article.

3. The Government shall draw from the funds provided by the Non-Federal Sponsor such sums as the Government deems necessary to cover: (a) the Non-Federal Sponsor's proportionate share of financial obligations for construction incurred prior to the commencement of the period of construction; and (b) the Non-Federal Sponsor's proportionate share of financial obligations for construction as they are incurred during the period of construction.

4. If at any time during the period of construction the Government, after consideration of any credit afforded pursuant to Article II.D. of this Agreement, determines that additional funds will be needed from the Non-Federal Sponsor to cover the Non-Federal Sponsor's proportionate share of projected financial obligations for construction for the current fiscal year, the Government shall notify the Non-Federal Sponsor in writing of the additional funds required, and the Non-Federal Sponsor, no later than 60 calendar days from receipt of such notice, shall make the additional required funds available through any of the payment mechanisms specified in paragraph B.1. of this Article.

C. In advance of the Government incurring any financial obligation associated with additional work under Articles II.B. or II.E. of this Agreement, the Non-Federal Sponsor shall provide the Government with the full amount of the funds required to pay for such additional work through any of the payment mechanisms specified in paragraph B.1. of this Article. The Government shall draw from the funds provided by the Non-Federal Sponsor such sums as the Government deems necessary to cover the Government's financial obligations for such additional work as they are incurred. In the event the Government determines that the Non-Federal Sponsor must provide additional funds to meet its cash contribution, the Government shall notify the Non-Federal Sponsor in writing of the additional funds required. Within 45 calendar days thereafter, the Non-Federal Sponsor shall provide the Government with the full amount of the additional required funds through any of the payment mechanisms specified in paragraph B.1. of this Article.

D. Upon completion of the Project or termination of this Agreement, and upon resolution of all relevant claims and appeals, the Government shall conduct a final accounting and furnish the Non-Federal Sponsor with the results of the final accounting. The final accounting shall determine total project costs, each party's contribution provided thereto, and each party's required share thereof. The final accounting also shall determine costs due to betterments and the Non-Federal Sponsor's cash contribution provided pursuant to Article II.D.3. of this Agreement. The Non-Federal Sponsor may request that the Government perform an interim accounting upon completion of each functional portion of the Project.

1. In the event the interim or final accounting shows that the total contribution provided by the Non-Federal Sponsor is less than its required share of total project costs plus costs due to any betterments provided in accordance with Article II.B. as well as credits associated with the Section 208 Work provided in accordance with Article II.D. of this Agreement, the Non-Federal Sponsor shall, no later than 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet the Non-Federal Sponsor's required share of total project costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement by delivering a check payable to "FAO, USAED, Jacksonville District" to the

District Engineer or provide an Electronic Funds Transfer in accordance with procedures established by the Government.

2. In the event the interim or final accounting shows that the total contribution provided by the Non-Federal Sponsor exceeds its required share of total project costs plus costs due to any betterments provided in accordance with Article II.B. as well as credits associated with the Section 208 Work provided in accordance with Article II.D. of this Agreement, the Government shall, subject to the availability of funds, refund the excess to the Non-Federal Sponsor no later than 90 calendar days after the final accounting is complete. In the event existing funds are not available to refund the excess to the Non-Federal Sponsor, the Government shall seek such appropriations as are necessary to make the refund.

ARTICLE VII - DISPUTE RESOLUTION

As a condition precedent to a party bringing any suit for breach of this Agreement, that party must first notify the other party in writing of the nature of the purported breach and seek in good faith to resolve the dispute through negotiation. If the parties cannot resolve the dispute through negotiation, they may agree to a mutually acceptable method of non-binding alternative dispute resolution with a qualified third party acceptable to both parties. The parties shall each pay 50 percent of any costs for the services provided by such a third party as such costs are incurred. The existence of a dispute shall not excuse the parties from performance pursuant to this Agreement.

ARTICLE VIII - OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

A. Upon notification in accordance with Article II.C. of this Agreement and for so long as the Project remains authorized, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project or the functional portion of the Project, at no cost to the Government, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal, Tribal and State laws as provided in Article XI of this Agreement and specific directions prescribed by the Government in the OMRR&R Manual and any subsequent amendments thereto.

B. The Non-Federal Sponsor hereby gives the Government a right to enter, at reasonable times and in a reasonable manner subject to reasonable written notice, upon property that the Non-Federal Sponsor owns or controls for access to the Project for the purpose of inspection and, if necessary in the event of Non-Federal Sponsor's failure to perform as described below, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. If an inspection shows that the Non-Federal Sponsor for any reason is failing to perform its obligations under this Agreement, the Government shall send a written notice describing the non-performance to the Non-

Federal Sponsor. If, after 30 calendar days from receipt of notice, the Non-Federal Sponsor continues to fail to perform, then the Government shall have the right to enter, at reasonable times and in a reasonable manner subject to reasonable written notice, upon property that the Non-Federal Sponsor owns or controls for access to the Project for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Government shall operate to relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to ensure faithful performance pursuant to this Agreement.

ARTICLE IX - INDEMNIFICATION

The Non-Federal Sponsor shall hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project, including the Section 208 Work, and any Project-related betterments, except for damages due to the fault or negligence of the Government or its contractors. The Non-Federal Sponsor does not waive any defense it may have against third parties by providing the indemnification contemplated in this Article.

ARTICLE X - MAINTENANCE OF RECORDS AND AUDIT

A. Not later than 60 calendar days after the effective date of this Agreement, the Government and the Non-Federal Sponsor shall develop procedures for keeping books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement. These procedures shall incorporate, and apply as appropriate, the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 C.F.R. Section 33.20. The Government and the Non-Federal Sponsor shall maintain such books, records, documents, and other evidence in accordance with these procedures and for a minimum of three years after the period of construction and resolution of all relevant claims arising therefrom. To the extent permitted under applicable Federal laws and regulations, the Government and the Non-Federal Sponsor shall each allow the other to inspect such books, documents, records, and other evidence.

B. For purposes of this Project, pursuant to 32 C.F.R. Section 33.26, the Non-Federal Sponsor agrees to comply with the Single Audit Act of 1984, 31 U.S.C. Sections 7501-7507, as implemented by Office of Management and Budget (OMB) Circular No. A-133 and Department of Defense Directive 7600.10. Upon request of the Non-Federal Sponsor and to the extent permitted under applicable Federal laws and regulations, the Government shall provide to the Non-Federal Sponsor and independent auditors any information necessary to enable an audit of the Non-Federal Sponsor's activities under this Agreement. The costs of any Non-Federal Sponsor audits performed in accordance

with this paragraph shall be allocated in accordance with the provisions of OMB Circulars A-87 and A-133, and such costs as are allocated to the Project shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

C. In accordance with 31 U.S.C. Section 7503, the Government may conduct audits in addition to any audit that the Non-Federal Sponsor agrees to conduct under the Single Audit Act. Any such Government audits shall be conducted in accordance with Government Auditing Standards and the cost principles in OMB Circular No. A-87 and other applicable cost principles and regulations. The costs of Government audits performed in accordance with this paragraph shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

ARTICLE XI – FEDERAL, TRIBAL, AND STATE LAWS

In the exercise of their respective rights and obligations under this Agreement, the Non-Federal Sponsor and the Government agree to comply with all applicable Federal, Tribal, and State laws and regulations.

ARTICLE XII - RELATIONSHIP OF PARTIES

A. In the exercise of their respective rights and obligations under this Agreement, the Government and the Non-Federal Sponsor each act in an independent capacity, and neither is to be considered the officer, agent, or employee of the other.

B. In the exercise of its rights and obligations under this Agreement, neither party shall provide, without the consent of the other party, any contractor with a release that waives or purports to waive any rights such other party may have to seek relief or redress against such contractor either pursuant to any cause of action that such other party may have or for violation of any law.

ARTICLE XIII - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, nor any resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XIV - TERMINATION OR SUSPENSION

A. If at any time the Non-Federal Sponsor fails to fulfill its obligations under Articles II.B., II.D., II.E., VI, or XVII.C. of this Agreement, the Assistant Secretary of the Army (Civil Works) shall terminate this Agreement or suspend future performance under

this Agreement unless he determines that continuation of work on the Project is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with the Project.

B. If the Government fails to receive annual appropriations in amounts sufficient to meet Project expenditures for the then-current or upcoming fiscal year, the Government shall so notify the Non-Federal Sponsor in writing, and 60 calendar days thereafter either party may elect without penalty to terminate this Agreement or to suspend future performance under this Agreement. In the event that either party elects to suspend future performance under this Agreement pursuant to this paragraph, such suspension shall remain in effect until such time as the Government receives sufficient appropriations or until either the Government or the Non-Federal Sponsor elects to terminate this Agreement.

C. In the event that either party elects to terminate this Agreement pursuant to this Article or Article XV of this Agreement, both parties shall conclude their activities relating to the Project and proceed to a final accounting in accordance with Article VI.D. of this Agreement.

D. Any termination of this Agreement or suspension of future performance under this Agreement in accordance with this Article or Article XV of this Agreement shall not relieve the parties of liability for any obligation previously incurred. Any delinquent payment owed by the Non-Federal Sponsor shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent rate of the 13-week Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3-month period if the period of delinquency exceeds 3 months.

ARTICLE XV - HAZARDOUS SUBSTANCES

A. After execution of this Agreement and upon direction by the District Engineer, the Non-Federal Sponsor shall perform, or cause to be performed, any investigations for hazardous substances that the Government or the Non-Federal Sponsor determines to be necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (hereinafter "CERCLA"), 42 U.S.C. Sections 9601-9675, that may exist in, on, or under lands, easements, and rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the construction, operation, and maintenance of the Project. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the District Engineer provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction. All actual costs incurred by the Non-Federal Sponsor for such investigations for hazardous substances shall be included in total project costs and

cost shared in accordance with the provisions of this Agreement, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

B. In the event it is discovered through any investigation for hazardous substances or other means that hazardous substances regulated under CERCLA exist in, on, or under any lands, easements, or rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the construction, operation, and maintenance of the Project, the Non-Federal Sponsor and the Government shall provide prompt written notice to each other, and the Non-Federal Sponsor shall not proceed with the acquisition of the real property interests until both parties agree that the Non-Federal Sponsor should proceed.

C. The Government and the Non-Federal Sponsor shall determine whether to initiate construction of the Project, or, if already in construction, whether to continue with work on the Project, suspend future performance under this Agreement, or terminate this Agreement for the convenience of the Government, in any case where hazardous substances regulated under CERCLA are found to exist in, on, or under any lands, easements, or rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the construction, operation, and maintenance of the Project. Should the Government and the Non-Federal Sponsor determine to initiate or continue with construction after considering any liability that may arise under CERCLA, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of clean-up and response, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination. Such costs shall not be considered a part of total project costs. In the event the Non-Federal Sponsor fails to provide any funds necessary to pay for clean up and response costs or to otherwise discharge the Non-Federal Sponsor's responsibilities under this paragraph upon direction by the Government, the Government may, in its sole discretion, either terminate this Agreement for the convenience of the Government, suspend future performance under this Agreement, or continue work on the Project.

D. The Non-Federal Sponsor and the Government shall consult with each other in accordance with Article V of this Agreement in an effort to ensure that responsible parties bear any necessary clean up and response costs as defined in CERCLA. Any decision made pursuant to paragraph C. of this Article shall not relieve any third party from any liability that may arise under CERCLA.

E. As between the Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the Project for purposes of CERCLA liability. To the maximum extent practicable, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the Project in a manner that will not cause liability to arise under CERCLA.

ARTICLE XVI - NOTICES

A. Any notice, request, demand, or other communication required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and either delivered personally or mailed by first-class, registered, or certified mail, as follows:

If to the Non-Federal Sponsor:

Director of Water Resources Management Dept.
Seminole Tribe of Florida
Hollywood, Florida 33024
(954) 967-3402
Fax No. (954) 967-3489

If to the Government:

Deputy District Engineer for Programs and Project Management
U.S. Army Engineer District
Jacksonville District
P.O. Box 4970
Jacksonville, Florida 32232-0019
(904) 232-2586
Fax No. (904) 232- 1213

B. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

C. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at the earlier of such time as it is actually received or seven calendar days after it is mailed.

ARTICLE XVII - HISTORIC PRESERVATION

A. The costs of identification, survey and evaluation of historic properties shall be included in total project costs and cost shared in accordance with the provisions of this Agreement.

B. As specified in Section 7(a) of Public Law 93-291 (16 U.S.C. Section 469c(a)), the costs of mitigation and data recovery activities associated with historic preservation shall be borne entirely by the Government and shall not be included in total project costs, up to the statutory limit of one percent of the total amount authorized to be appropriated for the Project.

C. The Government shall not incur costs for mitigation and data recovery that exceed the statutory one percent limit specified in paragraph B. of this Article unless and until the Assistant Secretary of the Army (Civil Works) has waived that limit in accordance with Section 208(3) of Public Law 96-515 (16 U.S.C. Section 469c-2(3)). Any costs of mitigation and data recovery that exceed the one percent limit shall be included in total project costs.

ARTICLE XVIII - PROGRAM EXPENDITURE LIMITATION

The Government's cost sharing participation in the Project is subject to a current Critical Project Restoration Program Federal expenditure limitation of 75 million dollars and a maximum Federal contribution of 25 million dollars for any single project under Section 528(b)(3)(C)(i) of the Water Resources Development Act of 1996 (Public Law 104-303), as amended. Expenditures under this Agreement and other agreements executed for Critical Restoration Projects will be cumulatively limited to this expenditure limitation or as it may be amended. Notwithstanding any other provision of this Agreement, the Non-Federal Sponsor shall be responsible for all costs on this Project that exceed 25 million dollars or that exceed the program expenditure limitation of 75 million dollars.

ARTICLE XIX – CREDIT OR REIMBURSEMENT UNDER SECTION 208 OF PUBLIC LAW 106-53

Pursuant to Section 208(b) of the Water Resources Development Act of 1999, Public Law 106-53, the Government may provide credit or reimburse the Non-Federal Sponsor for the reasonable costs for any Project work that has been performed or will be performed in connection with the Project based upon the following criteria: 1) the Government determines that the work performed by the Non-Federal Sponsor will substantially expedite completion of the Project, and 2) further determines that the work is necessary for the Project. The amount of such credit or reimbursement shall be determined by the Government based upon an audit in accordance with Article X.C. of this Agreement to determine that such costs are allowable, reasonable, and allocable to the Project.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the Assistant Secretary of the Army (Civil Works).

DEPARTMENT OF THE ARMY

BY: _____
JOSEPH W. WESTPHAL
Assistant Secretary of the Army
(Civil Works)

DATE: January 7, 2000

SEMINOLE TRIBE OF FLORIDA

BY: _____
JAMES E. BILLIE
Chairman of its
Tribal Council, Seminole Tribe

DATE: January 7, 2000

CERTIFICATE OF AUTHORITY

I, Jim Shore, do hereby certify that I am the principal legal officer of the Seminole Tribe of Florida, that the Seminole Tribe of Florida is a legally constituted public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the Seminole Tribe of Florida in connection with the Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project, and that, pursuant to its Constitution the Seminole Tribe of Florida has the authority and legal capability to pay damages, if necessary, in the event of the failure to perform, as required by Section 221 of Public Law 91-611 (42 U.S.C. Section 1962d-5b), and that the person who has executed this Agreement on behalf of the Seminole Tribe of Florida has acted within his authority pursuant to the Constitution and By-Laws of the Seminole Tribe of Florida.

IN WITNESS WHEREOF, I have made and executed this certification this 7th day of January, 2000.

Jim Shore
General Counsel
Seminole Tribe of Florida

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file any required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

DATE: 1/4/2000

James E. Billie
Chairman of its
Tribal Council
Seminole Tribe of Florida

ATTACHMENT A

Scope of Work for Feasibility Effort
Big Cypress Reservation Critical Project
Seminole Tribe of Florida

Item Description				Tribe Est.	COE Est.	Total $	C/T
A.	Verify that engineering and water quality assumptions used in the original master plan are valid.						
	1.	Review new information that may be available through on-going research projects related to the Everglades project.					
		a.	Revisit STA design concepts for relevance to this project. Incorporate COE Restudy Team comments.	$4,000	$6,300	$10,300	T/C
		b.	Consider any newer data that may have been developed related to water quality treatment in a natural wetland system.	$3,000	$0	$3,000	T
		c.	Review ENR data related to treatment capacity of wetland systems.	$3,000	$0	$3,000	T
	2.	Recalculate WRA sizes if warranted from above review. If newer information shows a ___ percent change (same as COE contingency % for project--25 ?) through a reduction in land needed, then newer information will be used to resize the WRAs. If this threshold percentage is not reached, then existing WRA assumptions will be maintained.		$3,000	$0	$3,000	T
	3.	Obtain concurrence on any proposed changes. **(Project Management Team-PMT review meeting)**		$5,000	$5,800	$10,800	T/C

B.	Using new digital aerials and FLUCCS GIS coverage, transfer and adjust plan feature boundaries (i.e. reservoirs dikes, ditches, structure locations, etc.). Based on new field knowledge and 404 Permit requirements.					
	1.	Produce a working layout of the system as transferred from the original plan to the new rectified photographic maps.	$4,000	$500	$4,500	T
	2.	Incorporate existing soils information through a digital database and determine if layout adjustments are necessary based on this preliminary data.	$3,000	$3,000	$6,000	T/C
	3.	Make major decisions on sizes and locations of storage cells.	$3,000	$13,800	$16,800	T/C
	4.	Revise the layout through coordinated team review session(s) to consider new environmental and regulatory issues.	$5,000	$1,920	$6,920	T/C
	5.	Produce revised layout. Provide limited documentation of assumptions.	$3,000	$3,200	$6,200	T/C
C.	Obtain concurrence on revised layout.					
	1.	Provide sign-off on layout revisions from COE & Tribe.	$2,000	$4,270	$6,270	T/C
	2.	Provide Real Estate O.K. from Tribe with documentation provided to COE. **This excludes formal boundary survey of the planned facilities.**	$3,000	$0	$3,000	T
D.	Run preliminary engineering calculations to confirm size and configuration of proposed WRAs, storage areas, ditches and canals.					
	1.	Obtain concurrence from Tribe and COE on basic hydrologic and hydraulic parameters to be evaluated and the types of models to use.				
		a. Site or office visit needed to confirm selections. (PMT review meeting)	$8,000	$6,250	$14,250	T/C
	2.	Run storm event model				
		a. SE Model preparation	$11,000	$0	$11,000	T
		b. run 1-in-10 year storm event plus 25-year and 100-year events	$4,000	$0	$4,000	T
		c. verify capacity of WRA borrow canal for drainage flows	$4,000	$0	$4,000	T
	3.	Check conveyance capacity under maximum irrigation flows.	$2,000	$0	$2,000	T

E.	Review data and identify critical deficiencies and collect limited data for completing feasibility analysis.					
	1.	Core boring(s) are needed at most proposed structure locations.	$0	$51,480	$51,480	C
	2.	Topographic data is needed at all proposed structure locations.	$0	$60,000	$60,000	C
	3.	Soil borings are needed along proposed main canal alignment to determine depth to rock and permeability capacity. Permeability data collection envisioned.	$0	$50,000	$50,000	C
	4.	Referencing digitized soils information and proposed dike locations, soil borings will be needed along dike alignments.				
		a. Soil borings will be needed along Irrigation Cell dike alignment. Limited soil borings may be needed from interior of proposed cell locations.	$0	$300,000	$300,000	C
		b. Limited soil borings will be needed along WRA dike alignment.	$0	$100,000	$100,000	C
	5.	Identify borrow and spoil staging areas.	$2,000	$8,240	$10,240	T/C
	6.	Collect limited topographic data in strategically selected wetlands within proposed WRA sites.	$15,000	$3,000	$18,000	T/C
	7.	Obtain field survey data				
		a. Obtain topographic data from within contributing watersheds (fields outside WRA and Irrigation Cell boundaries)	$38,000	$0	$38,000	T
		b. Obtain cross-section and elevation data along major dike/canal alignments. Locate wells and other important physical features that could impede future construction efforts.	$0	$280,480	$280,480	C
F.	Modify design and recalculate engineering parameters using new data.					
	1.	Run storm event model to predict performance under the following scenarios:				
		a. Adjust model inputs	$4,000	$0	$4,000	T
		b. 25-year, 100-year events and the SPF event ???	$4,000	$0	$4,000	T
	2.	Check conveyance capacity under maximum irrigation flows.	$2,000	$0	$2,000	T
	3.	Compare post-development system against original 1994 system with regard to storm event behavior/capability.	$10,000	$0	$10,000	T
G.	Identify design and performance parameters and develop					

	tables and plates for report.					
	1.	Set control elevations, channel sizes, culverts sizes, etc.	$4,000	$13,000	$17,000	T/C
	2.	Develop drawings (tables & plates) depicting final plan elements and critical design parameters.	$7,000	$0	$7,000	T
H.	Tribe sends preliminary findings to COE (90% review)					
	1.	COE provides comments to Tribe on reviewed **drawings**	$0	$17,240	$17,240	C
	2.	Meeting to agree on proposed changes. (PMT review meeting)	$5,000	$5,400	$10,400	T/C
I.	Prepare final feasibility documents and submit for review.					
	1.	Re-estimate cost of project.	$2,500	$2,000	$4,500	C/T
	2.	Develop estimated project O&MRRR costs. (Operation & Maintenance, Replacement, Repair and Rehabilitation). - use 50 year life cycle - include replacement cost - include annual/bi-annual inspections with the COE.	$5,000	$1,000	$6,000	T/C
	3.	Prepare feasibility document.	$15,000	$0	$15,000	T/C
	4.	Tribal review and revisions before submitting to COE	$5,000	$0	$5,000	T
J.	Review and comment from Tribe and COE (100%--PMT review meeting) **and final revisions.**		$8,000	$6,240	$14,240	T/C
			$196,500	$943,120	$1,139,620	

AMENDMENT NO. 1
TO
PROJECT COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE SEMINOLE TRIBE OF FLORIDA
FOR CONSTRUCTION OF THE
BIG CYPRESS SEMINOLE INDIAN RESERVATION WATER CONSERVATION PLAN
CRITICAL RESTORATION PROJECT

The Amendment No. 1 is entered into this the 11th day of May, 2007 by and between the DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government"), represented by the District Engineer, U.S. Army Corps of Engineers, Jacksonville District, and the SEMINOLE TRIBE OF FLORIDA (hereinafter the "Non-Federal Sponsor"), represented by the Chairman of its Tribal Council.

WHEREAS, the parties entered into a Project Cooperation Agreement (hereinafter referred to as "PCA") on January 7, 2000 providing for the construction of the Big Cypress Seminole Indian Reservation Water Conservation Plan Project. (hereinafter referred to as "Project");

WHEREAS, the Water Resources Development Act of 2000 provided for a change in the cost sharing for the operation, maintenance, repair, replacement and rehabilitation responsibility of the Non-Federal Sponsor for the Project from 100 percent Non-Federal and 0 percent Federal to 50 percent Non-Federal and 50 percent Federal;

WHEREAS, the parties desire to implement the new operation, maintenance, repair, replacement and rehabilitation authority for the Project as provided by Congress, and it is necessary to amend the existing PCA to so provide;

WHEREAS, the parties also need to address the application of federal labor standards for work to be performed by contractors or subcontractors of the Non-Federal Sponsor;

WHEREAS, Section 6012 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005, (Public Law 109-13) was passed by Congress and provided as follows:

> Section 6012. Section 528(b)(3) of the Water Resources Development Act of 1996 (110 Stat. 3769; 113 Stat. 286) is amended by adding the following:

The Seminole Tribe of Florida shall receive a mitigation credit for 50 percent of the net wetland benefits derived within the footprint of the Big Cypress Seminole Reservation

Water Conservation Plan Project. Such credit may be used to meet the mitigation requirements of Section 404 of the Clean Water Act as they may apply to future projects proposed by the Seminole Tribe of Florida.

And it is necessary to document and implement the authority provided by Section 6012 of Public Law 109-13);

NOW, THEREFORE, the parties do hereby agree as follows:

1. Article I- Definitions, there is added the following definition:

"L. The term "operation, maintenance, repair, replacement, and rehabilitation costs" (hereinafter referred to as "OMRR&R") shall mean those costs incurred by the Non-Federal Sponsor and the Government directly related to performing the OMRR&R on the Project as described and required in the Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual ("OMRR&R Manual").

2. Article 1V.C. is amended by adding a new paragraph 4 as follows:

Crediting for relocations performed by the Non-Federal Sponsor's contractors or subcontractors within the Project boundaries is subject to satisfactory compliance with applicable federal labor laws covering non-Federal construction, including, but not limited to applicable Federal labor standards in U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 USC 276a et seq.) the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c). Crediting may be withheld, in whole or in part, as a result of the failure of the Non-Federal Sponsor's contractors or subcontractors to comply with its obligations under these laws. However, in recognition of Tribal Sovereignty, if relocation is performed by employees of the Non-Federal Sponsor, without contractors or subcontractors, compliance with applicable federal labor laws governing non-Federal construction will not be required as a condition of relocation credit.

3. Article V.C. of the PCA is amended to read as follows:

C. Until the end of the period of construction, the Project Coordination Team shall generally oversee the Project, including consulting on issues related to design; plans and specifications; scheduling; real property and relocations requirements; real property acquisition; contract awards and modifications; the Section 208 Work; contract costs; the application of and compliance with the Davis-Bacon Act, Contract Work Hours and Safety Standards Act and the Copeland Anti-Kickback Act for relocations, the Section 208 Work and OMRR&R work by the Non-Federal Sponsor; the Government's cost projections, final inspection of the entire Project or functional portions of the Project; preparation of the proposed OMRR&R Manual; anticipated requirements and needed capabilities for performance of operation, maintenance, repair, replacement, and rehabilitation of the Project; and other related matters. The goal of this consultation,

among other things, shall be to ensure, to the maximum extent practicable, that the Government and the Non-Federal Sponsor agree on the precise work that is to be performed under this Agreement and the scheduling of that work. This oversight shall be consistent with a project management plan developed by the Government after consultation with the Non-Federal Sponsor.

4. Article VIII of the PCA is amended to read as follows:

A. Upon notification in accordance with Article 1I.C of this Agreement, and for so long as the Project remains authorized, the Non-Federal sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project, or the functional portions of the Project, in a manner compatible with the Project's authorized purposes, and in accordance with applicable Federal, Tribal, and State laws as provided in Article XI of this Agreement, and specific directions prescribed by the Government in the OMRR&R Manual and any subsequent amendments thereto. The Government shall provide the Non-Federal Sponsor with payment for 50% of the operation, maintenance, repair, replacement and rehabilitation costs for so long as the Project remains authorized in accordance with Article XX.

5. Article XI- Federal, Tribal, and State Laws is amended to read as follows:

In the exercise of their respective rights and obligations under this Agreement, the Non-Federal Sponsor and the Government agree to comply with all applicable Federal, Tribal, and State laws and regulations. To the extent that relocations, Section 208 work or OMRR&R is performed by contractors or subcontractors of the Non-Federal Sponsor and not by employees of the Non-Federal Sponsor, such contractors or subcontractors are required to comply with all applicable Federal labor requirements including, but not limited to 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis Bacon Act (formerly 40 U.S.C. 276a et seq.) the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c).

6. Article XX - COST SHARING FOR OPERATION, MAINTENANCE, REPAIR, REPLACEMENT AND REHABILITATION is added as follows:

a. In accordance with Title VI, Section 601 (c)(4) of the Water Resources Development Act of 2000, the Government shall provide the Non-Federal Sponsor with payment for 50 percent of the OMRR&R activities subject to the procedures and requirements outlined below for so long as the project remains authorized.

b. The Government and the Non-Federal Sponsor shall consult with each other in accordance with Article V of this Agreement in an effort to ensure timely accomplishment of the cost-shared OMRR&R activities.

c. The Government, in consultation with the Non-Federal Sponsor, shall develop a five-year plan to identify proposed future fiscal year funding requirements for cost-shared

OMRR&R activities. The five-year plan will be updated every year based on actual cost-shared OMRR&R activities accomplished. The Government shall use the five-year plan for development of future fiscal year budget requests.

d. To aid in the development of annual scopes of work relating to the five year plan, the Government shall notify the Non-Federal Sponsor in writing, no later than 90 calendar days prior to the end of the then current fiscal year, of the amount of anticipated funding for accomplishment of the cost-shared OMRR&R activities for the next fiscal year. The Government, working jointly with the Non-Federal Sponsor, shall develop a preliminary scope of work, including an estimate of costs, for accomplishment of scheduled cost-shared OMRR&R activities based on the anticipated appropriations for the upcoming fiscal year. The Government and the Non-Federal sponsor shall confer on the preliminary scope of work and estimate of costs.

e. No later than 30 calendar days following receipt of appropriations for that fiscal year, the Government shall notify the Non-Federal Sponsor of the actual funds available for accomplishment of cost-shared OMRR&R activities. The Government, working jointly with the Non-Federal Sponsor, shall develop a final scope of work, including an estimate of costs, for accomplishment of cost-shared OMRR&R activities. The Government and the Non-Federal sponsor shall confer on the final scope of work and estimate of costs for such cost-shared OMRR&R activities to be accomplished for that fiscal year.

f. The Non-Federal Sponsor, in contracting for the performance of any cost-shared OMRR&R activity under this Agreement, shall include provisions consistent with all applicable Federal laws and regulations.

g. The Non-Federal Sponsor shall not issue a solicitation for any contract for cost-shared OMRR&R activities until the Government has approved the relevant plans and specifications for such OMRR&R activities. Such written approval shall be provided no later than 45 days after the Government receives such plans and specifications.

h. The Non-Federal Sponsor shall not award a contract, execute a contract modification, issue a change order, or resolve a contract claim without the prior written approval of the Government. Such written approval shall be provided no later than 45 days after the Government receives notice from the Non-Federal Sponsor that it intends to award a contract, execute a contract modification, issue a change order, or resolve a contract claim.

i. The Government shall inspect all cost-shared OMRR&R activities accomplished by the Non-Federal Sponsor under this Agreement to ensure that such work is accomplished in accordance with the approved final scopes of work, designs, and plans and specifications. If in the Government's judgment, the cost-shared OMRR&R activities do not conform to the final scopes of the Non-Federal Sponsor's designs or plans and specifications, the Government shall notify the Non-Federal sponsor in writing, setting

forth with specifity the nonconformity. The Non-Federal sponsor will then have a reasonable time to cure the nonconformity to the satisfaction of the Government.

j. Subject to the availability of funds, the Government shall make quarterly payments to the Non-Federal Sponsor for its share of cost-shared OMRR&R activity costs. Not later than 90 days after the completion of the cost-shared OMRR&R activities performed within each quarter, the Non-Federal Sponsor shall provide the Government with such documents as are sufficient to enable the Government to conduct an accounting of the cost-shared OMRR&R activities performed that quarter to determine the estimated amount of payment. The Government shall conduct an annual audit for the cost-shared OMRR&R activities performed during each fiscal year, to determine final costs eligible for payment, subject to an audit in accordance with Article X of this Agreement to determine reasonableness, allocability, and allowability of costs. After the annual audit, and review and comment by the Non-Federal Sponsor, any adjustments in quarterly payments to reflect the results of the audit will be made in the next quarterly payment by the Government, subject to the availability of funds.

k. No portion of the quarterly payment shall be made for any cost-shared OMRR&R activities which do not in the judgment of the Government, conform to approved plans and specifications, contract modifications, or change orders approved pursuant to Sections (g) and (h) above, and the OMRR&R manual.

1. The amount of payment is not subject to interest charges, nor is it subject to adjustment to reflect changes in price levels between the time the cost-shared OMRR&R activities are completed and the time that payments are made.

m. Payment for OMRR&R activities performed by the Non-Federal Sponsor's contractors or subcontractors is subject to satisfactory compliance with applicable federal labor laws covering non-Federal construction, including, but not limited to the Davis-Bacon Act (40 USC 276a et seq), the Contract Work Hours and Safety Standards Act (40 USC 327 et seq) and the Copeland Anti-Kickback Act (40 USC 276c). Payment for OMRR&R activities may be withheld, in whole or in part, as a result of the failure of the Non-Federal Sponsor's contractors or subcontractors to comply with their obligations under these laws. However, in recognition of Tribal sovereignty, if OMRR&R activities are performed by employees of the Non-Federal Sponsor, and not by contractors or subcontractors, compliance with federal labor laws covering non-Federal construction will not be required as a condition for payment for OMRR&R activities.

7. The following Article is added to the Agreement:

ARTICLE XXI - PREPARTION OF MITIGATION CREDIT REPORT

The Government in cooperation with the Non-Federal Sponsor shall prepare a report identifying the net wetland benefits derived within the footprint of the Big Cypress Seminole Reservation Water Conservation Plan Project. This report, once approved by

the Government, shall be the basis of the mitigation credit provided for by Section 6012 of Public Law 109-13.

8. All other provisions of the Agreement remain in full force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this Amendment No. 1, which shall become effective upon the date it is signed by the District Engineer.

DEPARTMENT OF THE ARMY

By: _____
Paul L. Grosskruger
Colonel, U.S. Army
District Engineer

Date: 3/11/07

SEMINOLE TRIBE OF FLORIDA

By: _____
Mitchell Cypress
Chairman of its Tribal Council
Seminole Tribe of Florida

Date: 3/30/2007

CERTIFICATE OF AUTHORITY

I, Jim Shore, do hereby certify that I am the principal legal officer of the Seminole Tribe of Florida, that the Seminole Tribe of Florida is a legally constituted public body with full authority and legal capability to perform the terms of this Amendment to the Project Cooperation Agreement between the Department of the Army and the Seminole Tribe of Florida for the Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project and to pay damages, if necessary, in the event of the failure to perform, in accordance with Section 221 of Public Law 91-611, and that the person who has executed this Amendment on behalf of the Seminole Tribe of Florida has acted within his statutory capacity.

IN WITNESS WHEREOF, I have made and executed this certification this 30th day of March 2007.

Jim Shore
General Counsel
Seminole Tribe of Florida

CERTIFICATION OF LEGAL REVIEW

This is to certify that the draft Amendment to the Project Cooperation Agreement for construction of the Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project has been reviewed by Office of Counsel, USAED, Jacksonville, and is legally sufficient.

Assistant District Counsel

CERTIFICATION REGARDING LOBBYING

While the Seminole Tribe of Florida does not agree that it is required by law to execute this certification pursuant to 31 USC 1352, nevertheless the Seminole Tribe of Florida voluntarily and without qualification does agree to and be bound by the execution of this certification.

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress , an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction. Any person who fails to file the required certification shall be subject to a penalty of not less than $10,000 and not more than $100,000 for each such failure.

Mitchell Cypress
As Its Chairman of Tribal Council

Date: 5/4/2007

Exhibit A

AMENDMENT NO. 2
TO
PROJECT COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE SEMINOLE TRIBE OF FLORIDA
FOR CONSTRUCTION OF THE
BIG CYPRESS SEMINOLE INDIAN RESERVATION WATER CONSERVATION PLAN
CRITICAL RESTORATION PROJECT

This Amendment No. 2 is entered into this the ~~22~~ 7th day of ~~February~~ March 2011, by and between the DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government"), represented by the U.S. Army Engineer, Jacksonville District, and the SEMINOLE TRIBE OF FLORIDA (hereinafter the "Non-Federal Sponsor"), represented by the Chairman of its Tribal Council.

WHEREAS, the parties entered into a Project Cooperation Agreement on January 7, 2000 and Amendment No. 1 on May 11, 2007 (hereinafter collectively referred to as "Amended PCA") providing for the construction of the Big Cypress Seminole Indian Reservation Water Conservation Plan Project, (hereinafter referred to as "Project");

WHEREAS, Section 6006 of the Water Resources Development Act of 2007 increased the amount authorized to be appropriated to the Department of the Army to pay the Federal share of costs of carrying out Critical Restoration Projects pursuant to Section 528 of the Water Resources Development Act of 1996, as amended from $75,000,000 to $95,000,000 and increased the Federal share of costs of carrying out the Project from $25,000,000 to $30,000,000;

WHEREAS, the parties desire to further amend the Amended PCA to implement the increased limits.

NOW, THEREFORE, the parties do hereby agree as follows:

1. Article II.A.4 is deleted in its entirety and replaced as follows:

"4. Notwithstanding paragraph A.1. of this Article, if, upon the award of any contract for construction of the Project, cumulative financial obligations for the Project would exceed $60,000,000, the Government and the Non-Federal Sponsor agree to defer award of that contract and all subsequent contracts for construction of the Project until such time as the Government and the Non-Federal Sponsor agree to proceed with further contract awards for the Project, but in no event shall the award of contracts be deferred for more than three years. Notwithstanding this general provision for deferral of contract awards, the Government, after consultation with the Non-Federal Sponsor, may

award a contract or contracts after the Assistant Secretary of the Army (Civil Works) makes a written determination that the award of such contract or contracts must proceed in order to comply with law or to protect life or property from imminent and substantial harm."

2. Article VI.A is deleted in its entirety and replaced as follows:

"A. The Government shall maintain current records of contributions provided by the parties and current projections of total project costs, current projections of each party's share of total project costs and costs due to betterments. By March 31 of each year and at least quarterly thereafter, the Government shall provide the Non-Federal Sponsor with a report setting forth all contributions provided to date and the current projections of total project costs, of total costs due to betterments, of the components of total project costs, of each party's share of total project costs, of the Non-Federal Sponsor's total cash contributions required in accordance with Articles II.B., II.D., and II.E. of this Agreement, of the Non-Federal Sponsor's proportionate share, and of the funds the Government projects to be required from the Non-Federal Sponsor for the upcoming fiscal year. On the effective date of Amendment No. 2 of this Agreement, the total project costs are projected to be $60,000,000, and the Non-Federal Sponsor's cash contribution required under Article II.D. of this Agreement is projected to be $12,380,000. The amount of credit for the Section 208 Work to be afforded against the Non-Federal Sponsor's required contribution towards total project costs in accordance with Article II.D.2. of this Agreement is projected to be $10,120,000. Such amounts are estimates subject to adjustment by the Government, after consultation with the Non-Federal Sponsor, and are not to be construed as the total financial responsibilities of the Government and the Non-Federal Sponsor."

3. Article XVIII, Program Expenditure Limitation, is deleted in its entirety and replaced as follows:

"The Government's cost sharing participation in the Project is subject to a Critical Project Restoration Program Federal expenditure limitation of 95 million dollars and a maximum Federal contribution of 30 million dollars for this Project under Section 528(b)(3)(C) of the Water Resources Development Act of 1996 (Public Law 104-303), as amended. Expenditures under this Agreement and other agreements executed for Critical Restoration Projects will be cumulatively limited to this expenditure limitation or as it may be amended. Notwithstanding any other provision of this Agreement, the Non-Federal Sponsor shall be responsible for all costs on this Project that exceed the Federal expenditure limit of 30 million dollars or that exceed the Federal program expenditure limitation of 95 million dollars."

4. All other provisions of the Amended PCA remain in full force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this Amendment No. 2, which shall become effective upon the date it is signed by the U.S. Army Engineer, Jacksonville District.

DEPARTMENT OF THE ARMY

Alfred A. Pantano, Jr.
Colonel, U.S. Army
District Commander

Date: 07 March 2011

SEMINOLE TRIBE OF FLORIDA

Mitchell Cypress
Chairman of its Tribal Council
Seminole Tribe of Florida

Date: 2/24/11

CERTIFICATE OF AUTHORITY

I, Jim Shore, do hereby certify that I am the principal legal officer of the Seminole Tribe of Florida, that the Seminole Tribe of Florida is a legally constituted public body with full authority and legal capability to perform the terms of this Amendment No. 2 to the Project Cooperation Agreement between the Department of the Army and the Seminole Tribe of Florida for the Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project and to pay damages, if necessary, in the event of the failure to perform, in accordance with Section 221 of Public Law 91-611, and that the person who has executed this Amendment on behalf of the Seminole Tribe of Florida has acted within his statutory capacity.

IN WITNESS WHEREOF, I have made and executed this certification this 2nd day of March 2011.

Jim Shore
General Counsel
Seminole Tribe of Florida

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

DATE: 2/24/11

Mitchell Cypress
Chairman of its Tribal Council
Seminole Tribe of Florida

AMENDMENT NO. 3
TO
PROJECT COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE SEMINOLE TRIBE OF FLORIDA
FOR CONSTRUCTION OF THE
BIG CYPRESS SEMINOLE INDIAN RESERVATION WATER CONSERVATION PLAN
CRITICAL RESTORATION PROJECT

This AMENDMENT NO. 3 is entered into this 20th day of August, 2018, by and between the DEPARTMENT OF THE ARMY (hereinafter the "Government"), represented by the U.S. Army Commander, Jacksonville District (hereinafter the "District Commander"), and the SEMINOLE TRIBE OF FLORIDA (hereinafter the "Non-Federal Sponsor"), represented by the Chairman of its Tribal Council.

WITNESSETH, THAT:

WHEREAS, the Government and the Non-Federal Sponsor entered into a Project Cooperation Agreement on January 7, 2000 (hereinafter the "Agreement") for the construction of the Big Cypress Seminole Indian Reservation Water Conservation Plan Project (hereinafter the "Project");

WHEREAS, on May 11, 2007, the Government and the Non-Federal Sponsor entered into Amendment No. 1 to the Agreement to implement the new operation, maintenance, repair, replacement and rehabilitation authority for the Project; address the application of Federal labor standards for work to be performed by contractors or subcontractors of the Non-Federal Sponsor; and implement the authority allowing the Seminole Tribe of Florida to apply a certain mitigation credit to mitigation requirements of Section 404 of the Clean Water Act;

WHEREAS, on March 7, 2011, the Government and the Non-Federal Sponsor entered into Amendment No. 2 to the Agreement to implement the increased Federal share of costs of carrying out the Project;

WHEREAS, on July 8, 2015, the Jacksonville District Commander approved an Engineering Documentation Report which removed the Basin 3 lands and associated construction features from the Project; and

WHEREAS, the Government and the Non-Federal Sponsor desire to further amend the Agreement to remove the Basin 3 lands and affiliated features from the Project.

NOW, THEREFORE, the Government and the Non-Federal Sponsor agree to further amend the Agreement as follows:

1. Article I.A. of the Agreement is amended by striking the current paragraph and replacing with the following:

"A. The term "Project" shall mean infrastructure improvements for the construction of water control, management and treatment facilities in Basins 1, 2 and 4, which are located within the western portion of the Big Cypress Seminole Indian Reservation (hereinafter the "Reservation") and planning, design, and construction of conveyance canals on the eastern portion of the Reservation, as well as planning and design activities, land acquisition, and operational and best management practice plans for the basins and reservoirs as generally described in the Seminole Tribe Big Cypress Reservation Water Conservation Plan Letter Report, dated March 1998 and approved by the Chief, Planning Division, Directorate of Civil Works on June 24, 1998 (hereinafter the "Letter Report"), as amended by the Engineering Documentation Report, dated June 2015 and approved by the Jacksonville District Commander on July 8, 2015.

2. Article VI.A. of the Agreement is amended by striking it in its entirety and replacing with the following:

"A. The Government shall maintain current records of contributions provided by the Government and the Non-Federal Sponsor and current projections of total project costs, current projections of each party's share of total project costs and costs due to betterments. By March 31 of each year and at least quarterly thereafter, the Government shall provide the Non-Federal Sponsor with a report setting forth all contributions provided to date and the current projections of total project costs, total costs due to betterments, the components of total project costs, each party's share of total project costs, the Non-Federal Sponsor's total cash contributions required in accordance with Articles II.B., II.D., and II.E. of this Agreement, the Non-Federal Sponsor's proportionate share, and the funds the Government projects to be required from the Non-Federal Sponsor for the upcoming fiscal year. On the effective date of Amendment No. 3 to this Agreement, total project costs are projected to be $62,886,000, and the Non-Federal Sponsor's cash contribution required under Article II.D. of this Agreement is projected to be $ 16,491,000. The amount of credit for the Section 208 Work to be afforded against the Non-Federal Sponsor's required contribution towards total project costs in accordance with Article II.D.2. of this Agreement is projected to be $10,119,000. Such amounts are estimates subject to adjustment by the Government, after consultation with the Non-Federal Sponsor, and are not to be construed as the total financial responsibilities of the Government and the Non-Federal Sponsor."

3. The title of Article XXI is amended by replacing "PREPARTION" with "PREPARATION".

4. All other terms and conditions of the Agreement, as amended, remain in full force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this Amendment No. 3, which shall become effective upon the date it is signed by the District Commander.

DEPARTMENT OF THE ARMY

Jason A. Kirk, P.E.
Colonel, U.S. Army
District Commander

Date: 20 AUG 2018

SEMINOLE TRIBE OF FLORIDA

Marcellus W. Osceola, Jr.
Chairman of its Tribal Council
Seminole Tribe of Florida

Date: 7/31/18

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Marcellus W. Osceola, Jr.
Chairman of its Tribal Council
Seminole Tribe of Florida

DATE: 7/31/18

CERTIFICATE OF AUTHORITY

I, Jim Shore, do hereby certify that I am the principal legal officer of the Seminole Tribe of Florida, that the Seminole Tribe of Florida is a legally constituted public body with full authority and legal capability to perform the terms of this Amendment No. 3 to the Agreement between the Department of the Army and the Seminole Tribe of Florida in connection with the Big Cypress Seminole Indian Reservation Water Conservation Plan Project, and to pay damages, if necessary, in the event of the failure to perform in accordance with the terms of this Amendment No. 3 to the Agreement, as required by Section 221 of the Flood Control Act of 1970, as amended (42 U.S.C. Section 1962d-5b), and that the person who executed the Amendment No. 3 on behalf of the Seminole Tribe of Florida acted within his statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this 13th day of August 2018.

Jim Shore
General Counsel
Seminole Tribe of Florida

DRAFT

SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX D

CODE OF FEDERAL REGULATIONS

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS, EVERGLADES NATIONAL PARK, AND ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX D1

CODE OF FEDERAL REGULATIONS TITLE 33, SECTION 208.10

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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CODE OF FEDERAL REGULATIONS
TITLE 33--NAVIGATION AND NAVIGABLE WATERS
CHAPTER II--CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY
PART 208--FLOOD CONTROL REGULATIONS

s 208.10 Local flood protection works; maintenance and operation of structures and facilities.

(a) General.

(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of the Army, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the Department of the Army or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his

approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The Department of the Army will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under this part.

(b) Levees.

(1) Maintenance. The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) Operation. During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of leave exist which may be

overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) Flood walls.

(1) Maintenance. Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found

necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) Operation. Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) Drainage structures.

(1) Maintenance. Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Where drainage structures are provided with stop log or other emergency closures, the condition of the equipment and its housing shall be inspected regularly and a trial installation of the emergency closure shall be made at least once each year. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) Operation. Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as

necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition.

(e) Closure structures.

(1) Maintenance. Closure structures for traffic openings shall be inspected by the Superintendent every 90 days to be certain that:

(i) No parts are missing;

(ii) Metal parts are adequately covered with paint;

(iii) All movable parts are in satisfactory working order;

(iv) Proper closure can be made promptly when necessary;

(v) Sufficient materials are on hand for the erection of sand bag closures and that the location of such materials will be readily accessible in times of emergency.

Tools and parts shall not be removed for other use. Trial erections of one or more closure structures shall be made once each year, alternating the structures chosen so that each gate will be erected at least once in each 3-year period. Trial erection of all closure structures shall be made whenever a change is made in key operating personnel. Where railroad operation makes trial erection of a closure structure infeasible, rigorous inspection and drill of operating personnel may be substituted therefor. Trial erection of sand bag closures is not required. Closure materials will be carefully checked prior to and following flood periods, and damaged or missing parts shall be repaired or replaced immediately.

(2) Operation. Erection of each movable closure shall be started in sufficient time to permit completion before flood waters reach the top of the structure sill. Information regarding the proper method of erecting each individual closure structure, together with an estimate of the time required by an experienced crew to complete its erection will be given in the Operation and Maintenance Manual which will be furnished local interests upon completion of the project. Closure structures will be inspected frequently during flood periods to ascertain that no undue leakage is occurring and that drains provided to care for ordinary leakage are functioning properly. Boats or

floating plant shall not be allowed to tie up to closure structures or to discharge passengers or cargo over them.

(f) Pumping plants.

(1) Maintenance. Pumping plants shall be inspected by the Superintendent at intervals not to exceed 30 days during flood seasons and 90 days during off-flood seasons to insure that all equipment is in order for instant use. At regular intervals, proper measures shall be taken to provide for cleaning plant, buildings, and equipment, repainting as necessary, and lubricating all machinery. Adequate supplies of lubricants for all types of machines, fuel for gasoline or diesel powered equipment, and flash lights or lanterns for emergency lighting shall be kept on hand at all times. Telephone service shall be maintained at pumping plants. All equipment, including switch gear, transformers, motors, pumps, valves, and gates shall be trial operated and checked at least once every 90 days. Megger tests of all insulation shall be made whenever wiring has been subjected to undue dampness and otherwise at intervals not to exceed one year. A record shall be kept showing the results of such tests. Wiring disclosed to be in an unsatisfactory condition by such tests shall be brought to a satisfactory condition or shall be promptly replaced. Diesel and gasoline engines shall be started at such intervals and allowed to run for such length of time as may be necessary to insure their serviceability in times of emergency. Only skilled electricians and mechanics shall be employed on tests and repairs. Operating personnel for the plant shall be present during tests. Any equipment removed from the station for repair or replacement shall be returned or replaced as soon as practicable and shall be trial operated after reinstallation. Repairs requiring removal of equipment from the plant shall be made during off-flood seasons insofar as practicable.

(2) Operation. Competent operators shall be on duty at pumping plants whenever it appears that necessity for pump operation is imminent. The operator shall thoroughly inspect, trial operate, and place in readiness all plant equipment. The operator shall be familiar with the equipment manufacturers' instructions and drawings and with the "Operating Instructions" for each station. The equipment shall be operated in accordance with the above-mentioned "Operating Instructions" and care shall be exercised that proper lubrication is being supplied all equipment, and that no overheating, undue vibration or noise is occurring. Immediately upon final recession of flood waters, the pumping station shall be thoroughly cleaned, pump house sumps flushed, and equipment thoroughly inspected, oiled and greased. A record or log of pumping plant operation shall be kept for each station, a copy of which shall be furnished the District Engineer following each flood.

(g) Channels and floodways.

(1) Maintenance. Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds, and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections and deflection dikes and walls are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary.

(2) Operation. Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

(h) Miscellaneous facilities.

(1) Maintenance. Miscellaneous structures and

facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. Areas used for ponding in connection with pumping plants or for temporary storage of interior run-off during flood periods shall not be allowed to become filled with silt, debris, or dumped material. The Superintendent shall take proper steps to prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) Operation. Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor.

(Authority: Sec. 3, 49 Stat. 1571, as amended; 33 U.S.C. 701c)
[9 FR 9999, Aug. 17, 1944; 9 FR 10203, Aug. 22, 1944]

PART 208--FLOOD CONTROL REGULATIONS

Authority: Sec. 7, 58 Stat. 890; 33 U.S.C. 709, unless otherwise noted.

DRAFT

SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX D2

CODE OF FEDERAL REGULATIONS
TITLE 33, SECTION 208.11

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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structures affecting the navigable capacity of any navigable waters of the United States, prior to issuance of a license by the Commission as follows:

The Commission is hereby authorized and empowered to issue licenses to citizens * * * for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission, and utilization of power across, along, from or in any of the streams or other bodies of water over which Congress has jurisdiction * * * *Provided further*, That no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of the Army.

(B) Sections 10(a) and 10(c) of the Federal Power Act specify conditions of project licenses including the following:

(1) *Section 10(a)*. "That the project adopted * * * shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of waterpower development, and for other beneficial public uses * * *."

(2) *Section 10(c)*. "That the licensee shall * * * so maintain and operate said works as not to impair navigation, and shall conform to such rules and regulations as the Commission may from time to time prescribe for the protection of life, health, and property * * *."

(C) Section 18 of the Federal Power Act directs the operation of any navigation facilities built under the provision of that Act, be controlled by rules and regulations prescribed by the Secretary of the Army as follows:

The operation of any navigation facilities which may be constructed as part of or in connection with any dam or diversion structure built under the provisions of this Act, whether at the expense of a licensee hereunder or of the United States, shall at all times be controlled by such reasonable rules and regulations in the interest of navigation; including the control of the pool caused by such dam or diversion structure as may be made from time to time by the Secretary of the Army, * * *.

(ii) Federal Power Commission Order No. 540 issued October 31, 1975, and published November 7, 1975 (40 FR 51998), amending § 2.9 of the Commission's General Policy and Interpretations prescribed Standardized Conditions (Forms) for Inclusion in Preliminary Permits and Licenses Issued Under part I of the Federal Power Act. As an example, Article 12 of Standard Form L-3, titled: "Terms and Conditions of License for Constructed Major Projects Affecting Navigable Waters of the United States," sets forth the Commission's interpretation of appropriate sections of the Act, which deal with navigation aspects and attendant responsibilities of the Secretary of the Army in licensing actions as follows:

The United States specifically retains and safeguards the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, * * * and the Licensee shall release water from the project reservoir at such rate * * * as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

(c) *Scope and terminology*. This regulation applies to Federal authorized flood control and/or navigation storage projects, and to non-Federal projects which require the Secretary of the Army to prescribe regulations as a condition of the license, permit or legislation, during the planning, design and construction phases, and throughout the life of the project. In compliance with the authority cited above, this regulation defines certain activities and responsibilities concerning water control management throughout the Nation in the interest of flood control and navigation. In carrying out the conditions of this regulation, the owner and/or operating

agency will comply with applicable provisions of Pub. L. 85-624, the Fish and Wildlife Coordination Act of 1958, and Pub. L. 92-500, the Federal Water Pollution Control Act Amendments of 1972. This regulation does not apply to local flood protection works governed by § 208.10, or to navigation facilities and associated structures which are otherwise covered by part 207 (Navigation Regulations) of title 33 of the code. Small reservoirs, containing less than 12,500 acre-feet of flood control or navigation storage, may be excluded from this regulation and covered under § 208.10, unless specifically required by law or conditions of the license or permit.

(1) The terms "reservoir" and "project" as used herein include all water resource impoundment projects constructed or modified, including natural lakes, that are subject to this regulation.

(2) The term "project owner" refers to the entity responsible for maintenance, physical operation, and safety of the project, and for carrying out the water control plan in the interest of flood control and/or navigation as prescribed by the Corps of Engineers. Special arrangements may be made by the project owner for "operating agencies" to perform these tasks.

(3) The term "letter of understanding" as used herein includes statements which consummate this regulation for any given project and define the general provisions or conditions of the local sponsor, or owner, cooperation agreed to in the authorizing legislative document, and the requirements for compliance with section 7 of the 1944 Flood Control Act, the Federal Power Act or other special congressional act. This information will be specified in the water control plan and manual. The letter of understanding will be signed by a duly authorized representative of the Chief of Engineers and the project owner. A "field working agreement" may be substituted for a letter of understanding, provided that the specified minimum requirements of the latter, as stated above, are met.

(4) The term "water control agreement" refers to a compilation of water control criteria, guidelines, diagrams, release schedules, rule curves and specifications that basically govern the use of reservoir storage space allocated for flood control or navigation and/or release functions of a water control project for these purposes. In general, they indicate controlling or limiting rates of discharge and storage space required for flood control and/or navigation, based on the runoff potential during various seasons of the year.

(5) For the purpose of this regulation, the term "water control plan" is limited to the plan of regulation for a water resources project in the interest of flood control and/or navigation. The water control plan must conform with proposed allocations of storage capacity and downstream conditions or other requirements to meet all functional objectives of the particular project, acting separately or in combination with other projects in a system.

(6) The term "real-time" denotes the processing of current information or data in a sufficiently timely manner to influence a physicial response in the system being monitered and controlled. As used herein the term connotes * * * the analyses for and execution of water control decisions for both minor and major flood events and for navigation, based on prevailing hydrometeorological and other conditions and constraints, to achieve efficient management of water resource systems.

(d) *Procedures*—(1) *Conditions during project formulation.* During the planning and design phases, the project owner should consult with the Corps of Engineers regarding the quantity and value of space to reserve in the reservoir for flood control and/or navigation purposes, and for utilization of the space, and other requirements of the license, permit or conditions of the law. Relevant matters that bear upon flood control and navigation accomplishment include: Runoff potential, reservoir discharge capability, downstream channel characteristics, hydrometeorological data collection, flood hazard, flood damage charateristics, real estate acquisition for flowage requirements (fee and easement), and resources required to carry out the water control plan.

Advice may also be sought on determination of and regulation for the probable maximum or other design flood under consideration by the project owner to establish the quantity of surcharge storage space, and freeboard elevation of top of dam or embankment for safety of the project.

(2) *Corps of Engineers involvement.* If the project owner is responsible for real-time implemenetation of the water control plan, consultation and assistance will be provided by the Corps of Engineers when appropriate and to the extent possible. During any emergency that affects flood control and/or navigation, the Corps of Engineers may temporarily prescribe regulation of flood control or navigation storage space on a day-to-day (real-time) basis without request of the project owner. Appropriate consideration will be given for other authorized project functions. Upon refusal of the project owner to comply with regulations prescribed by the Corps of Engineers, a letter will be sent to the project owner by the Chief of Engineers or his duly authorized representative describing the reason for the regulations prescribed, events that have transpired, and notification that the project owner is in violation of the Code of Federal Regulations. Should an impasse arise, in that the project owner or the designated operating entity persists in noncompliance with regulations prescribed by the Corps of Engineers, measures may be taken to assure compliance.

(3) *Corps of Engineers implementation of real-time water control decisions.* The Corps of Engineers may prescribe the continuing regulation of flood control storage space for any project subject to this regulation on a day-to-day (real-time) basis. When this is the case, consultation and assistance from the project owner to the extent possible will be expected. Special requests by the project owner, or appropriate operating entity, are preferred before the Corps of Engineers offers advice on real-time regulation during surcharge storage utilization.

(4) *Water control plan and manual.* Prior to project completion, water control managers from the Corps of Engineers will visit the project and the area served by the project to become familiar with the water control facilities, and to insure sound formulation of the water control plan. The formal plan of regulation for flood control and/or navigation, referred to herein as the water control plan, will be developed and documented in a water control manual prepared by the Corps of Engineers. Development of the manual will be coordinated with the project owner to obtain the necessary pertinent information, and to insure compatibility with other project purposes and with surcharge regulation. Major topics in the manual will include: Authorization and description of the project, hydrometeorology, data collection and communication networks, hydrologic forecasting, the water control plan, and water resource management functions, including responsibilities and coordination for water control decisionmaking. Special instructions to the dam tender or reservoir manager on data collection, reporting to higher Federal authority, and on procedures to be followed in the event of a communication outage under emergency conditions, will be prepared as an exhibit in the manual. Other exhibits will include copies of this regulation, letters of understanding consummating this regulation, and the water control agreements. After approval by the Chief of Engineers or his duly authorized representative, the manual will be furnished the project owner.

(5) *Water control agreement.* (i) A water control diagram (graphical) will be prepared by the Corps of Engineers for each project having variable space reservation for flood control and/or navigation during the year; e.g., variable seasonal storage, joint-use space, or other rule curve designation. Reservoir inflow parameters will be included on the diagrams when appropriate. Concise notes will be included on the diagrams prescribing the use of storage space in terms of release schedules, runoff, nondamaging or other controlling flow rates downstream of the damsite, and other major factors as appropriate. A water control release schedule will be prepared in tabular form for projects that do not have variable space reservation for flood

control and/or navigation. The water control diagram or release schedule will be signed by a duly authorized representative of the Chief of Engineers, the project owner, and the designated operating agency, and will be used as the basis for carrying out this regulation. Each diagram or schedule will contain a reference to this regulation.

(ii) When deemed necessary by the Corps of Engineers, information given on the water control diagram or release schedule will be supplemented by appropriate text to assure mutual understanding on certain details or other important aspects of the water control plan not covered in this regulation, on the water control diagram or in the release schedule. This material will include clarification of any aspects that might otherwise result in unsatisfactory project performance in the interest of flood contol and/or navigation. Supplementation of the agreement will be necessary for each project where the Corps of Engineers exercises the discretionary authority to prescribe the flood control regulation on a day-to-day (real-time) basis. The agreement will include delegation of the responsibility. The document should also cite, as appropriate, section 7 of the 1944 Flood Control Act, the Federal Power Act and/or other congressional legislation authorizing construction an/or directing operation of the project.

(iii) All flood control regulations published in the FEDERAL REGISTER under this section (part 208) of the code prior to the date of this publication which are listed in § 208.11(e) are hereby superseded.

(iv) Nothing in this regulation prohibits the promulgation of specific regulations for a project in compliance with the authorizing acts, when agreement on acceptable regulations cannot be reached between the Corps of Engineers and the owner.

(6) *Hydrometeorological instrumentation.* The project owner will provide instrumentation in the vicinity of the damsite and will provide communication equipment necessary to record and transmit hydrometeorological and reservoir data to all appropriate Federal authorities on a real-time basis unless there are extenuating circumstances or are otherwise provided for as a condition of the license or permit. For those projects where the owner retains responsibility for real-time implementation of the water control plan, the owner will also provide or arrange for the measurement and reporting of hydrometeorological parameters required within and adjacent to the watershed and downstream of the damsite, sufficient to regulate the project for flood control and/or navigation in an efficient manner. When data collection stations outside the immediate vicinity of the damsite are required, and funds for installation, observation, and maintenance are not available from other sources, the Corps of Engineers may agree to share the costs for such stations with the project owner. Availability of funds and urgency of data needs are factors which will be considered in reaching decisions on cost sharing.

(7) *Project safety.* The project owner is responsible for the safety of the dam and appurtenant facilities and for regulation of the project during surcharge storage utilization. Emphasis upon the safety of the dam is especially important in the event surcharge storage is utilized, which results when the total storage space reserved for flood control is exceeded. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be utilized at the discretion of the project owner, and does not relieve the owner of the responsibility for safety of the project.

(8) *Notification of the general public.* The Corps of Engineers and other interested Federal and State agencies, and the project owner will jointly sponsor public involvement activities, as appropriate, to fully apprise the general public of the water control plan. Public meetings or other effective means of notification and involvement will be held, with the initial meeting being conducted as early as practicable but not later than the time the project first becomes operational. Notice of the initial public meeting shall be published once a week for 2 consecutive weeks in one or more newspapers of general circulation published in each county covered by the

water control plan. Such notice shall also be used when appropriate to inform the public of modifications in the water control plan. If no newspaper is published in a county, the notice shall be published in one or more newspapers of general circulation within that county. For the purposes of this section a newspaper is one qualified to publish public notices under applicable State law. Notice shall be given in the event significant problems are anticipated or experienced that will prevent carrying out the approved water control plan or in the event that an extreme water condition is expected that could produce severe damage to property or loss of life. The means for conveying this information shall be commensurate with the urgency of the situation. The water control manual will be made available for examination by the general public upon request at the appropriate office of the Corps of Engineers, project owner or designated operating agency.

(9) *Other generalized requirements for flood control and navigation.* (i) Storage space in the reservoirs allocated for flood control and navigation purposes shall be kept available for those purposes in accordance with the water control agreement, and the plan of regulation in the water control manual.

(ii) Any water impounded in the flood control space defined by the water control agreement shall be evacuated as rapidly as can be safely accomplished without causing downstream flows to exceed the controlling rates; i.e., releases from reservoirs shall be restricted insofar as practicable to quantities which, in conjunction with uncontrolled runoff downstream of the dam, will not cause water levels to exceed the controlling stages currently in force. Although conflicts may arise with other purposes, such as hydropower, the plan or regulation may require releases to be completely curtailed in the interest of flood control or safety of the project.

(iii) Nothing in the plan of regulation for flood control shall be construed to require or allow dangerously rapid changes in magnitudes of releases. Releases will be made in a manner consistent with requirements for protecting the dam and reservoir from major damage during passage of the maximum design flood for the project.

(iv) The project owner shall monitor current reservoir and hydro- meteorological conditions in and adjacent to the watershed and downstream of the damsite, as necessary. This and any other pertinent information shall be reported to the Corps of Engineers on a timely basis, in accordance with standing instructions to the damtender or other means requested by the Corps of Engineers.

(v) In all cases where the project owner retains responsibility for real-time implementation of the water control plan, he shall make current determinations of: Reservoir inflow, flood control storage utilized, and scheduled releases. He shall also determine storage space and releases required to comply with the water control plan prescribed by the Corps of Engineers. The owner shall report this information on a timely basis as requested by the Corps of Engineers.

(vi) The water control plan is subject to temporary modification by the Corps of Engineers if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest means of communication available. The action taken shall be confirmed in writing the same day to the project owner and shall include justification for the action.

(vii) The project owner may temporarily deviate from the water control plan in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Chief of Engineers, or his duly authorized representative.

(viii) Advance approval of the Chief of Engineers, or his duly authorized representative, is required prior to any

deviation from the plan of regulation prescribed or approved by the Corps of Engineers in the interest of flood control and/or navigation, except in emergency situations provided for in paragraph (d)(9)(vii) of this section. When conditions appear to warrant a prolonged deviation from the approved plan, the project owner and the Corps of Engineers will jointly investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Chief of Engineers, or his designated representatives, to fully substantiate the deviation.

(10) *Revisions.* The water control plan and all associated documents will be revised by the Corps of Engineers as necessary, to reflect changed conditions that come to bear upon flood control and navigation, e.g., reallocation of reservoir storage space due to sedimentation or transfer of storage space to a neighboring project. Revision of the water control plan, water control agreement, water control diagram, or release schedule requires approval of the Chief of Engineers or his duly authorized representative. Each such revision shall be effective upon the date specified in the approval. The original (signed document) water control agreement shall be kept on file in the respective Office the Division Engineer, Corps of Engineers, Department of the Army, located at division offices throughout the continental USA. Copies of these agreements may be obtained from the office of the project owner, or from the office of the appropriate Division Engineer, Corps of Engineers.

(11) *Federal Register.* The following information for each project subject to section 7 of the 1944 Flood Control Act and other applicable congressional acts shall be published in the FEDERAL REGISTER prior to the time the projects becomes operational and prior to any significant impoundment before project completion or * * * at such time as the responsibility for physical operation and maintenance of the Corps of Engineers owned projects is transferred to another entity:

(i) Reservoir, dam, and lake names,

(ii) Stream, county, and State corresponding to the damsite location,

(iii) The maximum current storage space in acre-feet to be reserved exclusively for flood control and/or navigation purposes, or any multiple-use space (intermingled) when flood control or navigation is one of the purposes, with corresponding elevations in feet above mean sea level, and area in acres, at the upper and lower limits of said space,

(iv) The name of the project owner, and

(v) Congressional legislation authorizing the project for Federal participation.

(e) *List of projects.* The following tables, "Pertinent Project Data—Section 208.11 Regulation," show the pertinent data for projects which are subject to this regulation.

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SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX E

STANDING INSTRUCTIONS TO STRUCTURE OPERATOR

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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APPENDIX E

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STANDING INSTRUCTIONS TO STRUCTURE OPERATOR (DAMTENDER)

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E-01. References. The following Operation and Maintenance Manuals should be consulted for specific guidance on structure operations and maintenance. This list will be updated upon the completion of the O&M Manuals as construction of project features is completed.

Central and Southern Florida Project O&M Manual

Volume I: Levees, Canals, and Bridges
Volume II: Spillways and Culverts
Volume III: Pumping Stations

E-02. General. The Water Conservation Area-Everglades National Park-South Dade Conveyance System is an integrated system of storage capabilities and structure outlet capacities. The spillway structures are operated to maintain optimum stages in Water Conservation Areas and the canals. The optimum stage essentially represents the limits of storage which guides the regulation of the project for the planned purposes. The minimum levels are set to provide sufficient flood control storage. The optimum level was derived by determining the effect of various water levels on the flood control, low water regulation, groundwater, fish and wildlife, and recreation. The maximum levels are governed by the level of minimum allowable flood damages and maximum level desirable for fish and wildlife.

E-03. Possible Flow Conditions. The project features in the Water Conservation Area-Everglades National Park-South Dade Conveyance System are designed to provide flood protection ranging from 30-percent to 100-percent of the Standard Project Flood (SPF) level without exceeding damaging levels. Spillways in the project area can have four possible flow regimes resulting from the effects of the spillway gates and tailwater effects. The flow regimes are:

a. Free Uncontrolled Flow. The spillway gates are fully opened and the discharge is unaffected by the tailwater stage.

b. Submerged Uncontrolled Flow. The spillway gates are fully opened and the discharge is reduced by tailwater conditions.

c. Free Controlled Flow. The spillway gates are partially opened and discharge is unaffected by the tailwater stage.

d. Submerged Controlled Flow. The spillway gates are partially open and the discharge is reduced by the tailwater conditions.

The spillway discharge rating curves that are being used must be applicable to the particular flow regime encountered. The spillway gates should be opened and closed gradually to provide

an even transition to the new flow regime and to minimize the hydraulic effects downstream. The tailwater stage should be allowed to build up before the next gate opening operation takes place. Some of the spillways in the Water Conservation Area-Everglades National Park-South Dade Conveyance System always have a high tailwater, therefore, no Maximum Allowable Gate Opening (MAGO) Curves are provided for these structures. Spillway gate openings should be checked to insure that the gate opening operations are non-damaging to the spillway. The gate openings should retain the hydraulic jump within the stilling basin and provide safe velocities over the riprap. These MAGO curves must not be exceeded in the "Apron Control" range to insure the safety of the structure. For large floods the MAGO curves may be exceeded in the "Riprap Control" range, however some riprap damage will likely occur.

For spillway structures with multiple gates, the spillway gates should be operated at the same gate opening. As a practical consideration the main spillway gates should not be adjusted such that the gate opening differs by more than one foot. Violation of this precaution could result in erosive action due to excessive velocities, turbulence, and return flow. The stilling basin reduces the kinetic energy of the flow entering the downstream channel. The stilling basin and downstream riprap are intended to prevent scour downstream of the spillway from undermining or otherwise threatening the integrity of the structure.

E-04. Maximum Allowable Gate Opening Curves. Some of the spillways in the Water Conservation Area-Everglades National Park-South Dade Conveyance System always have a high tailwater, therefore, no Maximum Allowable Gate Opening Curves (MAGO) are provided for these structures. The purpose of these MAGO curves are to prevent excessive discharges with low tailwater conditions. They show the allowable gate openings for specific headwater and tailwater elevations to alert the operator that there may be damage downstream of the structure if the gate openings shown on the curve are exceeded. The gate openings limits are based on either hydraulic jump conditions, excessive velocities at the end of the riprap, or excessive velocities over the end sill. If the tailwater is lower than the conjugate depth of the hydraulic jump, the jump will sweep out of the stilling basin and dissipate its energy over the riprap with the possibility of undermining the end sill and causing scour and erosion downstream. A low tailwater with high discharges could create high velocities over the end sill, and can create erosion along the canal banks and channel bottom and may disturb the riprap. The most critical condition for a particular concurrent headwater, tailwater, and discharge is selected for the control at the structure. The controlling condition varies with each structure depending on the required functions at the structure,

the capability of the structure, or the characteristic of the downstream channel.

These maximum allowable gate openings should not be exceeded during normal operations of the structure. During extreme flood conditions it might become necessary to exceed the values on the curve to avoid overtopping or washing out the tieback levees or exceeding the maximum allowable head differential for the structure. In these dangerous situations, the gates should be opened as required to lower the headwater regardless of the limits established on the maximum gate opening curves.

E-05. Normal Operating Conditions. During normal conditions the project structures shall be operated in accordance with the approved Water Control Plan (contained herein as Chapter VII), and in accordance with the structure design criteria as described in Appendix A. Optimum elevations in the manual shall be followed. Deviation from the normal regulation schedule will be permitted only under emergency conditions. Notification shall be as outlined in the Water Control Plan (Chapter VII).

E-06. Storms Procedures.

a. Corps of Engineers. The Jacksonville District, U.S. Army Corps of Engineers (CESAJ) will operate the main outlets to WCA Nos. 1, 2, and 3, during hurricane alerts as specified in the Central and Southern Florida Flood Control Project as Maintained by the Corps of Engineers, Operation & Maintenance Manual.

1. Hurricane Alert - Structures S-10A, B, C, and Structures 11A, B, and C. The Area Engineer will arrange for a two-man inspection team to make an examination of these structures when the U.S. Weather Bureau reports the existence of a hurricane that might strike the South Florida area. This examination ordinarily will be made 12 to 48 hours in advance of the time a hurricane emergency is expected to occur. Prior to making this inspection, the Area Office should contact the Water Management Section of the District Office for instructions relating to desired gate positions condition, including recording gages, with gates set in the position as directed by the District Office. The inspecting team will report to the Area Engineers' office by telephone or radio any instance of a structure not being in proper operating condition, and will be required from the Clewiston Base Station to correct the inoperative condition. The Water Management Section of the Jacksonville District Office should be notified by the Area Engineer or one of his assistants of any inability to comply with requested gate settings.

2. Hurricane Alert - Structures S-12A, B, C, and D. S-12 operations will become the responsibility of the Clewiston Area Engineer in the event of a hurricane alert. Immediately after declaration of a Hurricane Alert by the District Engineer,

the Area Engineer will contact the West Palm Beach office of the C&SFFCD and coordinate operations affecting the two agencies at this spillway. The Area Engineer will arrange for a two-man inspection team to make an examination of these structures when the U.S. Weather Bureau reports the existence of a hurricane that might strike the South Florida area. This examination ordinarily will be made 12 to 48 hours in advance of the time a hurricane emergency is expected to occur. Prior to making this inspection, the Area Office should contact the Water Management Section of the District Office for instructions relating to desired gate positions condition, including recording gages, with gates set in the position as directed by the District Office. The inspecting team will report to the Area Engineers' office by telephone or radio any instance of a structure not being in proper operating condition, and will be required from the Clewiston Base Station to correct the inoperative condition. The Water Management Section of the Jacksonville District Office should be notified by the Area Engineer or one of his assistants of any inability to comply with requested gate settings.

b. South Florida Water Management District. SFWMD is responsible for operations of the remaining project works covered in this volume for storm procedures. In addition to the referenced manuals in paragraph E-01, the South Florida Water Management District's Major Storm Procedure Manual should be consulted for specific guidance on structure operations in preparation for and duration of major storms.

E-07. Communication Outages. Upon emergency situations where communication with the Damtender is interrupted, the Damtender shall take any action deemed necessary to prevent the loss of life or property. Such actions shall be documented in writing and shall be forwarded to the Jacksonville District as soon as practicable. Upon the resumption of normal communications, the Damtender shall report the sequence of events which lead to unplanned releases and receive additional instructions from higher authority.

E-08. Deviation from Normal Regulation.

a. Emergencies. Some emergencies can be expected. The Damtender shall take the necessary action under emergency conditions immediately unless such action would create equal or worse conditions. The Jacksonville District (SAJ) will be informed as soon as practicable. A written confirmation showing the deviations and conditions shall be furnished to the Jacksonville District after the incident. SAJ will report these deviations to the South Atlantic Division Office (SAD).

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from

the normal regulation, although they are not considered emergencies. Requests for changes of release rates are generally for a few hours to a few days. Each request will be analyzed on its own merits. Approval for these minor deviations will normally be obtained from the Chief, Water Management and Meteorology Section (or his designee), Jacksonville District, by telephone, who in turn will seek approval from SAD. A written confirmation showing the deviation and conditions will be furnished to SAD by SAJ after the deviation is complete.

c. Planned Deviations. The Damtender will receive specific instructions on planned deviations. These instructions will be followed in lieu of the normal regulation schedule. Upon completion of the planned deviation, the normal regulation schedule shall resume.

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APPENDIX F

USFWS BIOLOGICAL OPINION FOR THE COMBINED OPERATIONAL PLAN (COP) PERTINENT INFORMATION

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
MAY 5, 2020

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

May 5, 2020

Andrew D. Kelly, Colonel
District Commander
U.S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207

Service Consultation Code: 04EF2000-2020-F-0283
Date Received: December 11, 2019
Project: Combined Operational Plan

Dear Colonel Kelly:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) for the proposed Combined Operational Plan (COP). The BO is in accordance with section 7 of the Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The U.S. Army Corps of Engineers (Corps) completed a Biological Assessment (BA) for the COP which was received at the Service's South Florida Ecological Services Field Office on December 11, 2019.

This enclosed BO evaluates the potential effects of the COP on the federally endangered Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) (CSSS) and its designated critical habitat, the federally endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*) (snail kite) and its designated critical habitat, and the federally threatened wood stork (*Mycteria americana*). The Service's conclusion after evaluating the COP is that its implementation will not jeopardize the continued existence of the CSSS, snail kites, or wood stork. And the COP implementation will not adversely modify designated critical habitat for the CSSS or snail kite.

This BO is based on best available science, including information provided in the Corps' BA, meetings, analysis of modeling output, published peer reviewed research, Corps' annual assessment reports, and additional information. A complete administrative record of this consultation is on file in the South Florida Ecological Services Field Office, Vero Beach, Florida.

The COP represents the first major change in system-wide water management since the authorization of the Comprehensive Everglades Restoration Plan in 2000. It is the culmination of the Modified Water Deliveries (MWD) to Everglades National Park and C-111 South Dade Conveyance System projects, which have been in various stages of planning, construction and

operation for well over two decades. The COP will serve as the operating plan for the completely built-out features of the Tamiami Trail Modification, 8.5 Square Mile Area, S-332 Detention Area, Frog Pond Detention Area, and several other projects built in previous years. It will allow unprecedented flow deliveries into Northeast Shark River Slough, which have long stymied Everglade's restoration progress. The COP lays the groundwork for future CERP projects to be planned and constructed at a faster pace.

The COP replaces the Everglades Restoration Transition Plan – 2016 (ERTP-2016) and associated water operations. The conclusion of the ERTP-2016 BO was that current water operations at that time would jeopardize the continued existence of the CSSS. In order to prevent jeopardy to the CSSS, the Corps developed a Reasonable and Prudent Alternative (RPA) to the proposed action. Included in that RPA were several actions and timelines that the Corps agreed to implement including extended closures of the S-12A/B structures, the ability to increase the L-29 canal stage to 8.5 feet, and completion of several incremental stages of MWD culminating in the completion of the COP analysis. The Corps will achieve all those actions and timelines with the implementation of COP in July-August 2020.

Thank you for your cooperation and effort in conserving federally listed species. If you have any questions regarding this BO, please contact Miles Meyer at 772-469-4281.

Sincerely yours,

Donald (Bob) Progulske
Everglades Program Supervisor
South Florida Ecological Services Office

Enclosure

cc: (w/enclosure) electronic only
Corps, Jacksonville, Florida (Angie Dunn, Andy LoSchiavo, Melissa Nasuti)
DEP, Tallahassee, Florida (Ed Smith)
EPA, Jacksonville, Florida (Cecelia Harper)
Everglades National Park, Homestead (Tylan Dean)
FWC, Tallahassee, Florida
FWC, West Palm Beach, Florida (James Erskine)
Miccosukee Tribe of Indians of Florida (Craig van der Heiden)
SFWMD, West Palm Beach (Jennifer Reynolds)

BIOLOGICAL OPINION
FOR THE
COMBINED OPERATIONAL PLAN (COP)

Service Consultation Code: 04EF2000-2020-F-0283

Submitted to:
Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

Prepared by:
U.S. Fish and Wildlife Service
South Florida Ecological Services Office
Vero Beach, Florida

May 5, 2020

Approved By: Donald (Bob) Progulske, Everglades Program Supervisor

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Acronyms and Abbreviations

Abbreviation	Definition
3AVG	3-gauge average (gauges 3A-3, 3A-4, and 3A-28 also known as sites 63, 64 and 65)
Act	Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*)
ALT	Alternative
AMMP	Adaptive Management and Monitoring Plan
AOU	American Ornithologists Union
AVM	Avian Vacuolar Myelinopathy
BA	Biological Assessment
BCNP	Big Cypress National Preserve
BO	Biological Opinion
C-111 SD	C-111 South Dade Conveyance System Project
C&SF	Central & Southern Florida
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeters
COP	Combined Operational Plan
Corps	U.S. Army Corps of Engineers
CSSS	Cape Sable Seaside Sparrow
CSOP	Combined Structural and Operational Plan
CWA	Clean Water Act
District/SFWMD	South Florida Water Management District
DPM	Decompartmentalization Physical Model
DOI	Department of the Interior
EAA	Everglades Agricultural Area
EBM	Ecological Based Management Group
ECB19RR	Existing Condition Base run for COP
EDEN	Everglades Depth Estimation Network
EHWL	Extreme High Water Line
EIS	Environmental Impact Statement
ELVeS	Everglades Landscape Vegetation Succession Model
ENP	Everglades National Park
ERTP 2010	Everglades Restoration Transition Plan, Phase 1
ERTP 2016	Everglades Restoration Transition Plan, 2016 Biological Opinion
ET	Ecological Target
FDACS	Florida Department of Agriculture and Consumer Affairs
FDOT	Florida Department of Transportation

Abbreviation	Definition
FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
ft	feet
FONSI	Finding of No Significant Impact
FWC	Florida Fish and Wildlife Conservation Commission
GDM	General Design Memorandum
GRR	General Re-evaluation Report
GSE	Ground Surface Elevation
IDS	Integrated Delivery Schedule
IOP	Interim Operational Plan
ISOP	Interim Structural and Operational Plan
ITS	Incidental Take Statement
KCOL	Kissimmee Chain of Lakes
kg	kilograms
km	kilometer
lbs	pounds
m	meter
MANLAA	May Affect, Not Likely to Adversely Affect
µg	micro gram
MHHW	Mean Higher High Water
MIN	Annual Minimum Stage
MSTS	Multi-Species Transition Strategy
MWD	Modified Water Deliveries to Everglades National Park
NASA	National Aeronautics and Space Administration
NDA	North Detention Area
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NESRS	Northeast Shark River Slough
NRC	National Research Council
PAL	Planning Aid Letter
PCE	Primary Constituent Element
PM	Performance Measure
POR	Period of Record
PSC	Periodic Scientist Calls
PVA	Population Viability Analysis
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measure
SDAS	South Detention Area
SDCS	South Dade Conveyance System
SFWMM	South Florida Water Management Model

Abbreviation	Definition
SEI	Sustainable Ecosystems Institute
SEIS	Supplemental Environmental Impact Statement
Service	U.S. Fish and Wildlife Service
SLR	Sea Level Rise
SMA	8.5 Square Mile Area
SRS	Shark River Slough
STA(s)	Stormwater Treatment Area(s)
TTFF	Tamiami Trail Flow Formula
USC	United States Code
USGS	U.S. Geological Survey
WCA(s)	Water Conservation Area(s)
WCP	Water Control Plan
WSRS	Western Shark River Slough
WY	Water Year

Executive Summary

The Combined Operational Plan (COP) represents the first major change in system-wide water management since the authorization of the Comprehensive Everglades Restoration Plan (CERP) in 2000. It is the culmination of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) and C-111 South Dade Conveyance System (C-111 SD) projects which have been in various stages of planning, construction and operation for well over two decades. The COP will serve as the operating plan for the completely built-out features of the Tamiami Trail Modification, 8.5 Square Mile Area (8.5 SMA), S-332 Detention Area, Frog Pond Detention Area and several other projects built in previous years. It will allow unprecedented flow deliveries into Northeast Shark River Slough (NESRS) which have long stymied Everglade's restoration progress. The COP is expected to be the water operations plan for this area for the next 7 years.

The COP replaces the 2016 Everglades Restoration Transition Plan (ERTP-2016) and associated water operations. The conclusion of the ERTP-2016 Biological Opinion was that current water operations at that time would jeopardize the continued existence of the CSSS. In order to prevent jeopardy to the CSSS the Corps, in consultation with the Service, developed a Reasonable and Prudent Alternative (RPA) to the proposed action. Included in that RPA were several actions and timelines that the Corps agreed to implement including extended closures of the S-12A/B structures, the ability to increase the L-29 canal stage to 8.5 feet, and completion of several incremental stages of Modified Waters Delivery culminating in the completion of the COP analysis. The Corps will achieve all those actions and timelines with the implementation of COP in August 2020. The COP includes many of the monitoring requirements and performance targets from ERTP.

An increase in flows to NESRS of over 229,000 acre-feet per year are expected to not only begin the restoration of degraded slough habitat within ENP but also restore the hydrology in the shorter hydroperiod marl prairies on the banks of the major sloughs. These are unique habitats within ENP and used by many plant and animal species, in addition to the federally endangered Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) (CSSS), the federally endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*), and the federally threatened wood stork (*Mycteria americana*). Prolonged ponding in Southern Water Conservation Area 3A (WCA-3A), which has degraded ridge and slough habitat, damaged tree islands, and affected suitability of nesting habitat for snail kites, will also be improved. The COP will improve the system's ability to handle emergency high water conditions in WCA-3A and allow an increased volume of discharge south from Lake Okeechobee. The COP carefully considered the hydrology of upstream areas in northern WCA-3A and is not expected to significantly exacerbate drying conditions in these areas while we wait for future Central Everglades Planning Project (CEPP) components to restore this area. The COP lays the groundwork for future CERP projects to be planned and constructed at a faster pace.

The U.S. Army Corps of Engineers (Corps) has determined that the proposed action, COP Alternative Q+ (ALT Q+), "may affect" the federally endangered CSSS and its designated

critical habitat, the federally endangered Everglade snail kite,and its designated critical habitat, and the federally threatened wood stork.

It should be noted that ALT Q+ was not specifically modeled by the Corps but performs similarly to Alternative Q (ALT Q) which was modeled. Therefore, the results from ALT Q are used for analysis purposes throughout this document.

This Biological Opinion provides an evaluation of the potential effects of the COP on the federally endangered Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) (CSSS) and its designated critical habitat, the federally endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*) (snail kite) and its designated critical habitat , and the federally threatened wood stork (*Mycteria americana*). The Services' conclusion after evaluating the COP is that its implementation will not jeopardize the continued existence of the CSSS, snail kites, or wood stork and the COP implementation will not adversely modify designated critical habitat for the CSSS or snail kite.

Consultation History

Previous Consultations

This project and related components have an extensive consultation history going back to the mid-1980s. A complete history of the previous consultations can be found in the ERTP 2016 BO. The ERTP BO resulted in a jeopardy determination for water operations affects to the CSSS. The Corps, in consultation with the Service, developed a Reasonable and Prudent Alternative to avoid jeopardy.

Consultation History for Combined Operational Plan (COP)

The 2016 Everglades Restoration Transition Plan (ERTP 2016) Biological Opinion (BO) was issued on July 22, 2016. As part of that BO, the Corps committed to expediting the COP review and implementing the project by the end of calendar year 2019.

On September 22, 2017, The Corps provided correspondence to the Service indicating that they were beginning preparation of the National Environmental Policy Act (NEPA) assessment for the COP. This correspondence requested comments from the agencies, tribes, and interested parties. Scoping comments were accepted through October 21, 2017.

On September 26, 2017, the Corps requested a list of federally listed threatened and endangered species within the action area.

By letter dated October 24, 2017, the Corps requested written confirmation of concurrence on the use of a single environmental baseline for purposes of the Endangered Species Act consultation. This single environmental baseline was developed for purposes of alternative evaluation which represented the conditions in place at the expected time of the COP implementation in 2019.

On October 31, 2017, the Service provided the list of species to the Corps.

The Service provided a Planning Aid Letter (PAL) on November 13, 2017, requesting consideration of the addition of the following items to the Corps' Existing Condition Base: (1) structure S-333N expansion expedited by the South Florida Water Management District (SFWMD) and considered under the Central Everglades Planning Project (CEPP) (Corps 2014); (2) MWD Increment 2 (operational changes required under the July 2016 Everglades Restoration Transition Plan (ERTP 2016) Biological Opinion (BO)) (Corps 2018); and (3) relaxation of the G-3273 Constraint. The Service also commented on and concurred with the Corps use of performance metrics and ecological planning tools to evaluate the effects of the COP.

On November 27, 2017, the Service provided an updated species list via email which included recently listed species.

On August 10, 2018, the Service received a letter from the Corps requesting that the Biological Opinion (Service 2016) for the Environmental Restoration Transition Plan (ERTP) be amended to reflect a change in the completion date of the Combined Operational Plan (COP) project.

On September 7, 2018, the Service provided an acknowledgement letter to the Corps stating that the 2016 ERTP BO would be revised to reflect the new COP completion date of May 25, 2020.

On August 24, 2018, Service staff attended a workshop to review and comment on draft alternatives for COP which were drafted by the "lead" agencies consisting of the Corps, SFWMD and ENP. It was noted at this meeting that though the Service was not invited to the previous design charrettes the Corps decided it was best to retain the sparrow protections as a constraint and include them in the COP alternatives.

On September 30, 2019, the Service received a letter from the Corps requesting that the Biological Opinion (BO) (Service 2016) for the Everglades Restoration Transition Plan (ERTP) be amended again to reflect a change in the implementation date of the Combined Operational Plan (COP).

By letter dated October 9, 2019, the Service acknowledged the Corps' request to move the COP completion date out to August 2020 for the Record of Decision to be signed.

On December 11, 2019, the Service received the Corps' Biological Assessment (BA) for the COP. The Corps' BA determined that the proposed project "may affect, but is not likely adversely affect" (MANLAA) the following species: Florida panther (*Puma concolor coryi*), Florida manatee (*trichechus manatus latiostris*), Florida bonneted bat (*Eumops floridanus*), American alligator (*Alligator mississippiensis*), American crocodile (*Crocodylus acutus*) and Eastern indigo snake (*Drymarchon corais couperi*). The Corps also determined that the project "may affect, but not likely adversely affect" (MANLAA) the following: manatee critical habitat, American crocodile critical habitat, Bartram's hairstreak butterfly critical habitat, and Florida

leafwing critical habitat. The Corps determined that the project "may affect" the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) and its designated critical habitat, the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) and its designated critical habitat, and the wood stork (*Mycteria americana*). The Corps requested to enter into formal consultation for these species and critical habitats. The BA also included "no effect" determinations for several species.

On January 17, 2020, the Service replied to the Corps with a letter with recommendations to reconsider the "effects determinations" for several species addressed in the BA.

On February 14, 2020, the Corps responded to the Service's January 17, 2020, correspondence with an amendment to their BA. This BA amendment changed effects determinations from "no effect" to "may affect, not likely to adversely affect" determinations for the following species: Bartram's hairstreak butterfly (*Strymon acis bartrami*), Florida leafwing butterfly (*Anaea troglodyte floridalis*), Garber's spurge (*Chamaesyce garberi*), Small's milkpea (*Galactia smallii*), Tiny polygala (*Polygala smallii*), Blodgett's silverbush (*Argythamnia blodgettii*), Everglades bully (*Sideroxylonreclinatum spp. austrofloridense*), Florida pineland crabgrass (*Digitaria paucifloria*), Florida prairie-clover (*Dalea carthagenesis floridana*) and Pineland sandmat (*Chaemaesyce deltoidea pinetorium*).

On March 16, 2020, the Service provided a concurrence letter regarding the Corps' "May Affect, Not Likely to Adversely Affect" species determinations.

On March 16, 2020, the Draft BO was provided to the Corps by email for comments. The Corps provided their comments by email on March 23, 2020.

By email dated March 19, 2020, the draft BO was provided to the Miccosukee Tribe of Indians of Florida for their review. The Service requested comments be provided by March 31, 2020. As of the signing of this BO no comments have been received from the Miccosukee Tribe.

On April 22, 2020, the Service provided a revised draft BO to the Corps by email for review. The Corps provided their comments by email on April 23, 2020.

On April 30, 2020, the Service provided a draft final version of the BO for the Corps to review. The Corps provided their comments on May 1, 2020.

A complete administrative record of this consultation is on file in the Service's South Florida Ecological Services Field Office located in Vero Beach, Florida.

BIOLOGICAL OPINION

A Biological Opinion (BO) is the document required under the Endangered Species Act (Act) that states the opinion of the Service as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of

designated critical habitat (50 CFR §402.02). This BO addresses the effects resulting from the Corps' proposed action of the Combined Operational Plan (COP) to the Cape Sable seaside sparrow (CSSS) and its critical habitat, Everglade snail kite and its critical habitat, and the wood stork. "*Jeopardize the continued existence of*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species (50 CFR §402.02).

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat "as a whole" for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

This BO is based on best available science, including information provided in the Corps' Biological Assessment, meetings, analysis of modeling output, published peer reviewed research, Corps' annual assessment reports, and additional information. A complete administrative record of this consultation is on file in the South Florida Ecological Services Office, Vero Beach, Florida.

1.0 DESCRIPTION OF THE PROPOSED ACTION – COMBINED OPERATIONAL PLAN (COP)

The Corps' Biological Assessment (BA) dated December 11, 2019, for the Combined Operational Plan (COP) describes the Proposed Action as an integrated water operational plan which includes two modifications of the Central & Southern Florida (C&SF) Project. These modifications are the Modified Water Deliveries (MWD) to Everglades National Park (ENP) and the C-111 South Dade Conveyance (C-111 SD) Projects. The COP is the final iteration of operational plans for the foundational projects which precede the Comprehensive Everglades Restoration Plan (CERP) and includes infrastructure that has been put in place since the ERTP 2016 Biological Opinion was issued. The purpose of the COP is to define the water management operations for the WCA-3A and WCA-3B outlets, structures in the L-31N and C-111 basins constructed as part of the C&SF Project, and the recently constructed components of the MWD and C-111 SD Projects. The COP will balance ecological restoration objectives of the MWD and C-111 SD completed infrastructure by redistributing the existing WCA-3A and ENP water budget while remaining consistent with the original purposes of the C&SF Project to provide flood control; water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation.

The Corps' proposed action is called Alternative Q+ (ALT Q+) for planning purposes. While this alternative was not specifically modeled during the planning process, it performs similarly to Alternative Q (ALT Q) which was modeled. Therefore, results from ALT Q are used as a

surrogate for analyses within this document. ALT Q+ and ALT Q may be used interchangeably within this document.

Additionally, CSSS-Ax, which is mentioned throughout the analysis contained in this document, was originally described in the ERTP 2016 BO (Service 2016). CSSS-Ax includes expansion areas to the northeast and southeast of the original CSSS-A polygon which was delineated as part of the proposed critical habitat designation in 2007. CSSS-A is not designated critical habitat for CSSS. The expansion areas were delineated based on hydrologic models which indicate that marl prairie conditions may improve in these areas under ERTP and COP operations. It should be noted that analyses within this document refer to CSSS-Ax which is the original CSSS-A plus the expansion areas (roughly 82,000 acres).

According to the Corps' Integrated Delivery Schedule (IDS), the COP water management activities will be continuous over either: (1) the 7-year period identified in the IDS; (2) until construction of new CEPP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay; or (3) if new information becomes available through implementation of the COP Water Control Plan and/or the COP Adaptive Management and Monitoring Program (AMMP) that would necessitate a need to modify water management operations. Therefore, the expected reasonable duration of the COP operations is 7 years.

The Corps' BA (Corps 2019a) lists the COP goals and objectives as follows:

1. Improve water deliveries (timing, location, volume) into ENP and take steps to restore natural hydrologic conditions in ENP given current C&SF infrastructure and features expected to be completed by the time of implementation, to the extent practicable by

    a. Changing schedule of water deliveries so that it fluctuates in consonance with local meteorological conditions, including providing for long term and annual variation in ecosystem conditions in the Everglades (Timing) (P.L. 101-229, Section 101b);

    b. Restoring NESRS as a functioning component of the Everglades hydrologic system (Location) (P.L. 101-229, Section 101b); and

    c. Adjusting the magnitude of water discharged to ENP to minimize effects of too much or too little water (Volume) (1992 MWD GDM, Section 44).

2. Maximize progress toward restoring historic hydrologic conditions in the Taylor Slough, Rocky Glades, and eastern Panhandle of ENP.

3. Protect the intrinsic ecological values associated with WCA-3A and ENP.

4. Minimize the damaging freshwater flows to Manatee Bay/Barnes Sound through the S-197 structure and increase flows through Taylor Slough and coastal creeks (1994 C-111 GRR, Section 5.2).

5. Include consideration of cultural values and tribal interests and concerns within WCA-3A and ENP.

The COP defines operations for the constructed features of the MWD and C-111 SD Projects. A detailed description of the proposed action is found under Section 1.3 Proposed Actions for the COP. Minor changes to the current WCA-3A regulation schedule (removal of Zone E1) are being proposed under the COP and no changes to associated infrastructure are proposed at this time; however, the Corps' proposed action does contain several features that are anticipated to improve hydrologic conditions for the Cape Sable seaside sparrow and other endangered species. Among the proposed features which will have the biggest effects on hydrology in the region are the Tamiami Trail Flow Formula, increased stages in the L-29 borrow canal and a fully functional detention area along the eastern boundary of ENP. The Corps should continue to search for and employ operational flexibilities within the current regulation schedule to maximize benefits for all natural resources within the Greater Everglades. The Corps has agreed to continue working with the U.S. Fish and Wildlife Service (Service) and the South Florida Water Management District (SFWMD) to optimize operation of the C-111 South Dade Conveyance System (SDCS) and detention areas for the conservation of listed species.

1.1 Conservation Measures

As part of the proposed action, the Corps has committed to implementing the following conservation measures, which are essentially the Terms and Conditions from the ERTP 2016 Biological Opinion. These measures are listed below as they appear in the Corps' Biological Assessment (Corps 2019a). Conservation Measures are included as part of the proposed action to monitor and minimize affects to listed species.

1. Species and habitat monitoring currently being conducted in compliance with the ERTP 2016 BO (Service 2016) will continue to identify population trends for the CSSS, snail kite, wood stork and the vegetation characteristic of their habitats.

2. Under the COP, the Corps will continue to implement the Periodic Scientist Calls (PSC) to provide real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process.

3. The COP Adaptive Management and Monitoring Plan (AMMP) includes the following: (1) Part 1 Adaptive Management and Ecological Monitoring Plan; (2) Part 2 Water Quality Monitoring Plan; (3) Part 3 Hydrometerological Monitoring Plan, and (4) Part 4 Cultural Resources Monitoring Plan. The COP AMMP identifies the monitoring information needed to inform the COP implementation and to document progress towards meeting the project goals and objectives.

4. The Corps will continue to evaluate how water management operations within the flexibility available to water managers under the water control plan, may be conducted to maximize beneficial effects for the CSSS.

5. The Corps will continue to utilize best available methods to monitor and estimate the spatial and temporal extent of hydrologic conditions (water above or below ground surface) relative to the CSSS habitat targets (*i.e.,* dry nesting days and annual discontinuous hydroperiod).

6. The Corps will continue to implement provisions of the ERTP 2016 BO which require the Corps to provide a report to the Service on the results of this monitoring at least twice annually to evaluate progress toward meeting the performance targets (Service 2016). Bi-annual reports will evaluate nesting season conditions and include information such as the operations that occurred and their effectiveness, and the spatial and temporal extent of hydrologic conditions within each CSSS subpopulation (Service 2016).

7. The Corps will continue discussions with the Service in the event of operational modifications of the COP if such modifications are proposed to occur in the future. The Corps will track implementation of the COP and communicate the status of all actions to the Service as appropriate through regular interagency discussions (*i.e.,* COP PSC, COP AMMP Meetings). ESA consultation will be revisited as needed. If any effects to listed species associated with the COP are revealed that were not previously considered in this BA, the Corps will reinitiate ESA consultation as appropriate.

1.2 COP Background and Context

Water management and flood control in south Florida is accomplished through an extensive network of canals, levees, pumping stations, and control structures constructed as part of the C&SF Project, including three WCAs. The WCAs store excess water coming from the Everglades Agricultural Area (EAA), other parts of the east coast region, and Lake Okeechobee flood discharges. The WCAs are designed to prevent Everglades' floodwaters from inundating the east coast urban areas, provide a water supply for those same areas and ENP, recharge aquifers, reduce seepage, and protect against saltwater intrusion in coastal well-fields.

The regulation schedules for the WCAs and other facilities contain seasonal and monthly guidelines for acceptable water level ranges at many monitoring stations throughout numerous projects and watersheds. The regulation schedules generally prescribe low stages at the beginning of the wet season (late spring) and high stages at the end of the wet season (late fall). These regulation schedules must accommodate various, often apparently conflicting, water management purposes. Although the seasonal distribution of rainfall determines overall water availability in the system, the regulation schedules modify the timing, duration, and magnitude of extreme water levels (both low and high) that would otherwise occur.

The last decade of hydrologic management in the Everglades have been primarily under the Everglades Restoration Transition Plan (ERTP) except for the MWD Incremental Testing Phases 1, 1.1, 1.2 and 2 which made relatively minor incremental changes between 2016 and 2020. The largest difference from these testing phases was the movement of water east into NESRS similarly to how COP will manage these flows. These operations were disrupted by emergency management actions for high water events in 2017 and again in 2018. Analysis of these events showed the tremendous amount of water that could be moved eastward and into NESRS. These testing phases became the building blocks for COP. The initial Biological Opinion for ERTP was signed on November 17, 2010 (Service 2010a). The proposed action authorized by the ERTP 2010 BO was the continuation of the Interim Operational Plan (IOP) and the operations of the IOP structures and impoundments in the C&SF Project for up to 1 year until the ERTP Record of Decision (ROD) could be signed. The continuation of the IOP included the operations of the Modified Water Deliveries (MWD) and C-111 structural features and impoundments of the C&SF Project as described in the Service's 2006 IOP Biological Opinion (Service 2006a). The ERTP operations replaced the IOP after the ROD for ERTP was signed on October 19, 2012.

The purpose of ERTP was to define water operations for the constructed features of the MWD and C-111 projects until those projects were fully completed and the currently proposed action called the Combined Operational Plan (COP) could be planned and implemented. The ERTP actions included modifications of the IOP and the operations of the IOP structures and impoundments in the C&SF Project under the 2002 IOP Alt-7R plan, including operational flexibilities and were intended to improve or maintain hydrological conditions to benefit multiple listed species and other resource values in the project area. The IOP, a Reasonable and Prudent Alternative (RPA) under the Service's 1999 Biological Opinion, was developed to avoid jeopardy to the CSSS while meeting other needs and constraints of the region, including restoration of sheetflow to ENP and maintenance of flood control in adjacent urban areas. ERTP represented a transition between the IOP and implementation of the MWD, C-111, and CERP project features. COP is the proposed operational plan that will include the MWD, C-111 and CERP features.

Completion of these project features is believed necessary to provide suitable conditions for the recovery of multiple listed species including the CSSS, Everglade snail kite, and wood stork within the project area (Sustainable Ecosystems Institute [SEI] 2003, 2007a, 2007b; National Research Council [NRC] 2008, 2010). Under the ERTP 2016 projected timeline, the Record of Decision for the revised water control plan, COP, was scheduled for completion in 2020. Many other components of Everglades CERP restoration such as those included in the most recent CEPP South are not scheduled to be completed until 2027. Considering the still declining status of the CSSS, the timing of future CERP and other associated projects (*e.g.*, CEPP South, Decompartmentalization, water storage, C-111 Spreader Canal phase 2, etc.) and the uncertainty of their completion dates gives reason for continued concern.

The overall CSSS population was low at the inception of IOP but was considered stable by researchers through 2009 at approximately 3,000 sparrows (Basier et al. 2008; Boulton et al.

2009; Cassey et al. 2007; Slater et al. 2009; Virzi et al. 2009). However, in five of the last nine years (2011, 2013, 2014, 2016 and 2019) the population estimates have been below 3,000 sparrows, with the lowest estimates from 2016 when the population was estimated at only 2,416 birds followed closely by preliminary estimates for 2019 which estimated the population at 2,688 and 2014 which had 2,720. The populations did increase in 2017 and 2018 with an estimated population of 3,280 and 3,184 sparrows respectively, however, as mentioned above, 2019 numbers fell below 3,000 again. Overall, the intrinsic rate of increase for the CSSS has been negative in 10 of the last 14 years. Recent investigations have expressed concern about the future viability of the population and habitat conditions (Virzi and Davis 2013; Slater et al. 2014).

Since around 1992, prolonged high water in WCA-3A has persisted, likely contributing to degradation of tree islands and marsh habitat (Zweig and Kitchens 2008). In addition, the Everglade snail kite range-wide estimated population declined from a high of approximately 3,500 kites in 1999 to an estimated low of approximately 662 kites in 2009 (Cattau et al. 2009). During this time, the snail kite population essentially declined by half from 2000 to 2002 and again from 2006 to 2008, at least in part, due to two severe regional droughts and a tropical storm (Cattau et al. 2009). By 2012, the population estimate had increased to 1,218 birds (Cattau et al. 2012). In 2015, the population estimate was significantly higher (2,127 birds [95 percent CI = 2,000-2,338]) primarily due to stable fledging rates in Lake Okeechobee, an increase in fledging in the Everglades and STAs, and a large amount of successful nesting in a new area (Mary A. Mitigation Bank in Brevard County) (Fletcher et al. 2016). As shown in Figure 15, in 2016, the population estimate slightly decreased to approximately 2,100 birds. But, in 2017 the estimate rose to approximately 2,600 birds. The 2018 population estimate slightly decreased to 2,347 birds. The 2019 population is currently being calculated (Fletcher et al. 2019).

Given the resource concerns at the time, the objective of ERTP 2016, which essentially extended ERTP for four more years, was to utilize operational flexibility in order to improve conditions for the Everglade snail kite, maintain nesting and habitat requirements for the CSSS, and enhance wood stork and native habitats. The ERTP 2016 was expected to provide these water management flexibilities by emphasizing an east-to-west distribution of water, explore preemptive releases of water, and keep the implementation of the COP on schedule, while maintaining the C&SF Project purposes (flood control and water supply). Around the same time ERTP 2016 was being finalized the Corps began implementing a series of operational tests called the MWD Incremental Field Tests. Increment 1 was implemented prior to completion of ERTP 2016 but was later revised during increments 1.1 and 1.2 to include expanded closure periods for the S-12A, S-12B, S-343A, S-343B, and S-344 structures as required by the RPA in the ERTP 2016 BO. Increment 2 maintained the required closure periods for these structures and analyzed a set of alternatives to address the mandated RPA of the ERTP 2016 BO to raise the maximum operating limit in the L-29 Canal up to a maximum of 8.5 feet NGVD, subject to identified constraints. As mentioned previously, these field tests were interrupted by the high water years of 2017 and 2018 but the results were very promising in that it was demonstrated that increased amounts of water could be delivered to NESRS. The benefit of these actions to sparrows in CSSS-Ax was less evident since sparrows and their habitat respond at longer time frames than

the few years these tests were conducted. For more detail regarding the Incremental Field Tests see the Corps' draft EIS for the COP.

The 2010 ERTP was intended to cover operations until full implementation of the Combined Operational Plan (COP) in 2013. However, the prerequisite projects (MWD and C-111) required to implement the COP were not yet completed. Since the completion of the ERTP 2016 BO, the Corps has kept the planning of the COP generally on schedule and the ROD is expected to be signed in August 2020. This date was extended on two separate occasions and since staying on schedule was a part of the Service's ERTP 2016 RPA (Service 2016), the Service followed up with correspondence on July 13, 2018, and October 9, 2019 to acknowledge the delays. The COP is expected to be in place for (1) the 7-year period identified in the Integrated Delivery Schedule (IDS); (2) until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay; or (3) if new information becomes available through implementation of the COP Water Control Plan and/or the COP Adaptive Management and Monitoring Program (AMMP) that would necessitate a need to modify water management operations.

1.3 Proposed Actions for the COP

The Action currently proposed in the Corps' BA is the Combined Operational Plan which defines operations for the constructed features of the Modified Water Deliveries (MWD) and C-111 Projects. Under the COP, the Corps and SFWMD will begin to restore historic flows to Northeast Shark River and Taylor Sloughs in ENP by adjusting proportionate flow volumes across Tamiami Trail to what they were originally, 30 percent on the west side and 70 percent on the east side. Two features of the COP will allow this to happen and are discussed in more detail below. One is structural modifications to the east side of Tamiami Trail (U.S. Hwy 41) that will allow stages in the L-29 borrow canal to increase to 8.5 feet NGVD, subject to identified constraints. The Florida Department of Transportation currently restricts the amount of time that water levels can be at 8.5 NGVD due to roadbed integrity concerns. The final phase of the Tamiami Trail Next Steps project, when completed, should eliminate the need for these restrictions by raising the roadbed. The second is an operational feature called the Tamiami Trail Flow Formula (TTFF) which will replace the current rainfall plan which dictates the amount and timing for flows through the S-333 structure to the eastern side of Tamiami Trail.

Under the COP, all the previously sought flexibility in system operations (*e.g.*, prioritizing S-12 flow from east to west and early or delayed open/close of S-12A, S-12B, S-343A and S-343B) will become inherent in the project. The COP will promote more suitable discontinuous hydroperiods within CSSS habitat by reducing flows to CSSS-Ax and provide an increase in flows into parts of the eastern subpopulations that are overly dry due to drainage by neighboring canals. The Corps should continue to explore the use of operational flexibility to improve the timing of flow deliveries throughout the system. The TTFF will incorporate previous operational flexibility such as preemptive releases. The Adaptive Management and Monitoring Plan (AMMP) is intended be able to capture areas where additional operational flexibility can be incorporated into the COP. This flexibility will assist in maintaining target stages within

WCA-3A and allow for further flexibility in discharges through the S-12 and S-333 structures. The elements of the proposed action are discussed in more detail in the following sections.

1.3.1 Tamiami Trail Flow Formula

Since before the implementation of ERTP in 2010, water releases through the S-333 and S-12 structures which are part of the WCA-3A Regulation Schedule, were determined by the 1985 WCA-3A Rainfall Plan (Corps 2019a). This Rainfall Based Water Management Plan consisted of a rainfall-based delivery formula that specified the amount of water to be delivered to ENP in weekly volumes through the S-333 and S-12 structures. The COP will replace this formula with the Tamiami Trail Flow Formula (TTFF) which is designed to provide more natural deliveries of water. The 2020 WCA-3A Regulation Schedule has two zones; Zone A and Zone B along with an Extreme High Water Line (EHWL). Zone A is above Zone B and delineated by a seasonally varying line that ranges from a maximum of 10.5 feet NGVD (November 1) to a minimum of 9.5 feet NGVD. In Zone A, maximum releases at S-333, S-333N, S-12D, S-12C, S-12B, S-12A, S-343A, S-343B, S-344, and S-151 are subject to the applicable closure periods and downstream constraints and the FDEP permit in the case of S-333N. In Zone B, the WCA-3A release targets are computed by the TTFF for S-333, S-12D, S-12C, S-12B, S-12A (listed in priority order) to prioritize releases to Northeast Shark River Slough (NESRS) first and Western Shark River Slough (WSRS) second.

The TTFF represents a more robust "rainfall plan" and is geared more towards enhanced ecosystem and landscape performance while also recognizing constraints such as flood protection, water supply and other C&SF Project requirements. It improves upon the old rainfall plan by achieving flow deliveries that mimic natural processes, moderates flow rates and more evenly distributes flow across the entire slough. The TTFF uses an existing network of stage gauges, potential evapotranspiration, and rainfall gauges in WCA-3A and ENP to guide real-time operations to convey water from WCA-3A across Tamiami Trail to ENP to meet ecological, flood protection, and water supply needs in WCA-3A and ENP. The TTFF uses multiple stage stations for the start of the current week and the previous week's flow in a linear approximation formula to compute a flow target for the coming week. Some of the variables used in the equation include:

- the spatial average of observed stages (feet NGVD) at WCA-3A gauges A-3 (Site 63), A-4 (Site 64) and A3-28 (Site 65) for the start of the current week
- the observed stage (feet NGVD) at ENP gauge NESRS2 for the start of the current week
- the daily average of observed releases (sum of S-12C, S-12D, S-333, S-333N, S-12A, and S-12B flows) for the previous week
- the areal average for the total weekly rainfall (inches) for the entire WCA-3A and Mullet Slough for current week
- the total weekly potential evapotranspiration (inches) at the 3AS3WX gauge location, and
- the Zone A regulation stage (ft, NGVD) value for the beginning of the current week

The TTFF may need to be adjusted once implemented under the COP so the Adaptive Management and Monitoring Plan (AMMP) features two management uncertainties to be closely monitored (Uncertainty ID #12a and #12b). For more detailed information about the TTFF refer to Appendix H of the Corps Environmental Impact Statement (EIS) for the COP.

1.3.2 S-12, S-343, S-344, S-346 Structures/Shark Valley Tram Road Culvert Plugs

Seasonal closures of the S-12A/B, S-343A/B, and S-344 structures were retained in the ERTP 2016. Based on sensitivity runs, the seasonal closures of the S-344 structure will be removed under the COP. S-344 has a design discharge capacity of 135 cfs and releases water west from WCA-3A to the L-28 canal along the Big Cypress National Preserve. It is opened when the WCA-3A regulations schedule is in Zone A and closed when in Zone B. It will no longer be subject to seasonal closures for protection of the CSSS. All the other structures listed above will be operated similarly to ERTP 2016.

In 2010, the ERTP removed the seasonal closures of S-12C and to compensate for its removal, inflatable culvert plugs were installed along the Shark Valley Tram Road within ENP. These culvert plugs were intended to help prevent the westward flow of water from S-12C under the Shark Valley Tram Road and help to maintain shorter hydroperiods within the western marl prairies where CSSS-Ax is located. These plugs were not durable enough in this application and were later replaced by more permanent sandbags. Removal of the S-12C seasonal closure was recommended during the transition to Everglades restoration to better achieve the objective of managing water levels within WCA-3A for the protection of multiple species and their habitats while also providing additional outlet capacity to address high water concerns within WCA-3A especially during periods when the S-333 outlet structure was constrained due to the G-3273 constraint.

Hydrologic modeling for the COP indicates that S-12C discharges will be reduced to 93,100 ac/ft per year on average from 142,000 ac/ft in the ECB19RR (a reduction of 49,800 ac/ft per year). The G-3273 constraint has been removed with the completion of the 8.5 SMA flood protection features. The modeling also shows that hydroperiods will be improved in the northeastern portions of CSSS-Ax under the COP. Given these developments and in consideration of road maintenance and structural integrity of the Tram Road, the Service does not see the need to continue this culvert plug operation. Standard hydrologic monitoring of annual discontinuous hydroperiod in CSSS-Ax will continue. The expectation from COP modeling, as assessed in this document, is that hydroperiods in this area could be shortened by up to 30 days. If this does not occur or the hydroperiod increases after four years of COP operations, then the Corps in conjunction with ENP and the Service should seek to investigate all sources of flow into this area to determine the cause.

1.3.3 Tamiami Trail Modifications and L-29 Stage

To date, the Modified Water Deliveries Project's Tamiami Trail: Next Steps Modification project has constructed two bridges (2.6 mile western and 1.0 mile eastern) and raised the low

spots in the 10-mile stretch of Tamiami Trail (U.S. Hwy 41) from the L-67 Extension east to the L-31 N levee. The final phase of the project which will further raise the roadbed and install box culverts is slated for completion in 2023. These modifications, along with the completion of the 8.5 SMA protection features, have allowed the removal of the G-3273 constraint (6.7 feet NGVD to protect the 8.5 SMA). However, the 8.5 SMA flood mitigation constraint may continue to limit raising L-29 Canal stages above 8.5 feet NGVD under specific conditions. The major remaining constraint to raising the L-29 Canal stage above 8.5 feet NGVD is the FDOT's constraint on roadbed integrity. The L-29 canal can be maintained up to 8.5 feet NGVD for up to 90 cumulative days per water year (May 1 through 30 April), with the opportunity to increase the duration based on written FDOT approval. The number of either cumulative or consecutive days will be measured when L-29 stages exceed 8.3 feet NGVD. L-29 stages at 8.5 feet NGVD for longer than 90 days will need FDOT written approval. Once the final phase of Tamiami Trail is completed, water managers will be able to maintain L-29 stages at 8.5 feet NGVD for longer durations and possibly go higher.

1.3.4 S-332B, S-332C and S-332D Operations

The S-332B and S-332C structures are expected to be upgraded to permanent pumping stations. Design of the permanent pump stations is anticipated to begin within the next year. When S-332B is completed it will consist of four 125 cfs diesel units (maximum operational capacity of 575 cfs) and two 75 cfs electric back-up units. It will be able to pump into the Southern and Northern Detention Areas. During the CSSS nesting season (written as February 15 through July 31 in the Corps' Water Control Plan) the operating range will be a headwater stage of 4.0 to 4.8 feet NGVD. Once the S-332C is completed it will consist of four 125 cfs diesel pumps (maximum operational capacity of 575 cfs) and two 75 cfs electric back-up pumps. This pumping station will discharge into the Southern Detention Area and will have seasonal variations in operational criteria with operating range of 4.0 to 4.8 feet NGVD during the sparrow nesting season.

Based on modeling sensitivity run analysis the Service further reduced its previously maintained protections for the CSSS by altering the pumping restrictions at the S-332D structure. This pumping station has four 125 cfs diesel pumps and one 75 cfs pump for a total capacity of 575 cfs. It has calendar-based flow restrictions for protection of the CSSS as follows:

- 500 cfs (July 15 to December 31)
- 325 cfs (January 1 to January 31)
- 250 cfs without the use of S-332DX1 or 375 cfs with S-332DX1 discharge of 125 cfs (February 1 to July 14)

As it has in the past, the Service requests the Corps and other State, Local and Tribal partners work closely to monitor and adaptively manage the entire detention area from the 8.5 SMA south to the Frog Pond, to ensure it is being used efficiently to meet the goals and objectives of the COP. The order of S-332B, S-332C and S-332D pumping should be prioritized, in real-time, based on coordination with the Service, SFWMD, ENP and other partners. Local rainfall

patterns, antecedent conditions, operations and other parameters should be discussed at the weekly multi-species meetings and at the Periodic Scientist Calls to determine pumping prioritization. For more detail on the evolution of S-332 detention area operations and their relation to the Frog Pond detention area see the ERTP 2016 Biological Opinion (Service 2016).

1.3.5 Periodic Scientist Calls

The purpose of the Periodic Scientist Calls (PSC) are for the Corps to gather input regarding ecological, hydrological, and meteorological conditions from various governmental and Tribal agencies to make future water management decisions. The monitoring and reporting of ecological, hydrological, and meteorological conditions were critical to achieving the ERTP objective of managing WCA-3A water levels and water releases for the protection of multiple endangered species and their sensitive habitats. The PSC occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP. The PSC focus on both the status of individual species (*e.g.*, Everglade snail kite nesting status) and the status of a suite of species and habitat conditions to allow for adaptive management of the system based upon the needs of multiple species and their habitats. Under the COP, the Corps will continue to implement the PSC.

1.3.6 Multi-Species Transition Strategy

Another interagency group created as a result of the ERTP 2010 planning process, which included the Multi-Species Transition Strategy, is the Ecosystem Based Management Group (EBM). This group consists of staff from the Corps, ENP, FDACS, FWC, Service, SFWMD and others who meet weekly during the dry season transition and seasonally three times annually. Discussion topics usually include climate conditions and weather forecasts, current water management conditions, pertinent species reports and typically culminates in a set of recommendations for water managers to consider in the coming weeks. The focus of the EBM group is currently on the WCAs, more specifically on WCA-3A. The Service suggests these meetings become a permanent fixture in the COP. The scope of the group would need to expand to include areas like ENP and Florida Bay. Additionally, there would need to be timely input mechanisms for the groups' recommendations to both Corps and SFWMD water managers so that they could be implemented if necessary.

1.3.7 Operational Flexibility

Examples of operational flexibility, such as preemptive releases, were proposed by the Corps during ERTP 2016 and were used to create storage within WCA-3A when large adjustments to inflow into WCA-3A or large regional rainfall events were forecast. It is unclear how many times these type of releases were used. The more efficient TTFF may reduce the need for these types of releases. The Corps should continue to explore the use of operational flexibility to improve the timing of flow deliveries throughout the system. The Adaptive Management and Monitoring Plan (AMMP) is intended be able to capture areas where additional operational flexibility can be incorporated into the COP. This flexibility will assist in maintaining target

stages within WCA-3A and allow for further flexibility in discharges through the S-12 and S-333 structures.

1.3.8 Temporary Emergency Deviations During 2017

The Corps initiated a Temporary Emergency Deviation to Alleviate High Water Levels in WCA-3A during June 2017. The intent of this deviation was to address high water concerns related to a series of early wet season storms that occurred during the month of June 2017. These rainfall events caused hydrologic conditions within the C&SF Project to change rapidly from very dry conditions to very wet conditions within South Florida, with the WCAs and EAA accumulating most of the rainfall. The Corps' BA for the temporary deviations, dated July 2017, outlined four major components of the deviation which included (1) opening of the S-12A, S-12B, S-343A, S-343B and S-344 structures prior to the official opening date of July 15, 2017; (2) opening of S-152 structure of the Decompartmentalization Physical Model (DPM) to discharge water from WCA-3A and WCA-3B; (3) increasing discharges at S-332D from 250 cfs to 500 cfs to increase discharge from WCA-3A to the South Dade Conveyance System via S-333 to S-334, if needed; and (4) increasing discharge at S-197 from 400 cfs to 2,400 cfs to accommodate additional flows from WCA-3A to South Dade via S-334. They anticipated these actions would continue until the WCA-3A 3-gauge average (3AVG) (gauges 3A-3, 3A-4 and 3A-28 also known as sites 63, 64 and 65) fell below Zone A of the regulation schedule.

By letter dated June 27, 2017, the Service responded to the Corps' request for emergency consultation and the associated deviations outlined in Corps letters dated June 22, 2017; June 26, 2017; and email dated June 26, 2017. Our recommendation to the Corps was to proceed with all the emergency deviations and actions described in the BA and other correspondence; however, we requested that to the extent practical, that early release of water through the S-12A and S-12B structures be minimized. CSSS were actively nesting immediately downstream of these structures and allowing those nests to succeed would benefit the species. The Service concurred with the Corps' determinations that the emergency actions may affect, but would not adversely affect the wood stork and snail kite but we did not concur with the same determination for the sparrow because there was documented nesting in CSSS-A. However, the Service determined that the emergency actions would not result in jeopardy to the CSSS because their population had slightly increased and the minimum target of 90 dry nesting days had been met in all subpopulations.

The S-343A and B opened on June 28 and the S-12A and B structures were opened on June 29, 2017. CSSS-Ax was displaying 6.5 percent (roughly 5,340 acres) dry with mean water depth of 22.8 cm (8.97 inches) at the time the structures opened. This small dry area was near the upper and lower meadow study plots where ground researchers had identified active nesting. Water depths increased throughout the next two weeks until July 14 when no available dry habitat remained. Field crews confirmed 4 active nests in CSSS-Ax after visits on June 23, 27 and 30. On July 6, the three nests observed on June 27 had failed due to unknown predators. One new juvenile was banded on that trip. On July 11, no nests were seen, and breeding activity had subsided.

On September 10, around 3 pm EDT, Hurricane Irma made landfall near Marco Island as a category-3 storm with 115 mph winds. While it was not a direct hit to CSSS-Ax, strong winds and rains resulted in a maximum stage of 8.29 feet NGVD (water depth of 2.3 feet) at NP-205 which is believed to have negatively impacted sparrows (Virzi and Tafoya 2020). The Service had planned to mobilize crews during the non-nesting season to assess impacts to sparrows in the area but was unable to secure funding to do so. The estimated population size in CSSS-Ax, based on the helicopter surveys, was reported as 16 birds in 2017, 32 in 2018 and 0 in 2019.

1.4 Action Area

For consultation purposes, the Action Area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The COP defines operations for the constructed features of the MWD and C-111 Projects. The major project components of the MWD and C-111 Projects are shown in Figure 1 (Figures referenced in this BO are included at the end of the document in section 12). The Action Area for the COP encompasses approximately 2,374,782 acres (See Figure 2).

The primary areas in which these projects directly affect water flows and levels are (listed in north-south order):

- Water Conservation Areas (WCAs) 3A and 3B;
- Western and Eastern Shark River Slough (SRS);
- 8.5 Square Mile Area (8.5 SMA) and Rocky Glades;
- Private and public lands served by the South Dade Conveyance System (SDCS); and
- Taylor Slough.

The dominant project features addressed in the COP are the massive wetland expanses of WCA-3A and increased flow from it into Northeast Shark River Slough in Everglades National Park. The management of WCA-3A affects adjacent areas hydrologically both upstream and downstream but primarily to the south. Effects of WCA-3A management can be felt as far north as Lake Okeechobee and WCAs 1 and 2. Likewise, the COP may affect Big Cypress National Preserve, Biscayne Bay, and Florida Bay through its modification of freshwater flow in south Florida. The Action Area spans: (a) the entire range of the CSSS; (b) the range of the Everglade snail kite south of and including Lake Okeechobee; and (c) all wood stork nesting colonies within 18.6 miles of WCA-3 or Everglades National Park (ENP) that have been active during the past 10 years (Figure 2).

The Action Area is comprised of a series of hydrologically interconnected wetlands that include some of the largest remaining expanses of Everglades marshes and many man-made features, including canals, levees, and artificial impoundments. Water movement through this system is managed with a variety of water control structures and pumps. The man-made infrastructure

influences large volumes of water received via rainfall, which varies seasonally and annually, and which establishes the general hydrologic regime for wetlands in southern Florida.

Historically, the entire Action Area was known as the Everglades; a mosaic of sloughs, tree islands, long-hydroperiod marshes, shorter-hydroperiod marl prairies, sawgrass marshes, and coastal mangrove fringe habitats. Much of this land has been converted to urban development; active agriculture composed of fruit tree groves, row and field crops, and plant nurseries; and abandoned agricultural areas that a variety of native and invasive plant species have colonized. It is estimated that less than half of the historic Everglades remains (Corps 1999).

2.0 CAPE SABLE SEASIDE SPARROW

2.1 Status of the Species

This section summarizes the effects of all past human and natural activities or events that have led to the current status of the CSSS and are relevant to formulating the biological opinion about the proposed action.

2.1.1 Legal Status

The CSSS was one of the first species listed on March 11, 1967, under the Endangered Species Preservation Act of 1967 (32 FR 4001). The subspecies' limited distribution and small population size, along with threats to its habitat, resulted in its listing under the Endangered Species Preservation Act in 1967. Protection for the sparrow was continued under the Endangered Species Conservation Act of 1969. The sparrow and all the other species listed under the Endangered Species Conservation Act of 1969 were also listed as endangered under the Act of 1973.

2.2 Species Description

The Cape Sable seaside sparrow (CSSS) is one of eight extant subspecies of seaside sparrow in North America. Its distribution is limited to the short-hydroperiod wetlands, or marl prairies, located at the southern end of the greater Everglades ecosystem, on the southern tip of mainland Florida. The CSSS is a medium-sized bird, 5.1 to 5.5 inches in length (Werner 1975). Unlike most other subspecies of seaside sparrow, which occupy primarily brackish tidal systems (Post and Greenlaw 1994), this sparrow currently occurs primarily in the short-hydroperiod wet prairies, also referred to as marl prairies. The sparrow is generally sedentary, secretive, and non-migratory, although sparrows are known to disperse between subpopulations (Lockwood et al. 2008; Virzi et al. 2009).

From its initial discovery in the cordgrass (*Spartina* spp.) marshes on Cape Sable in 1918 (Howell 1919), followed by reports in what is now Everglades City (Nicholson 1928) as well as Ochopee (Anderson 1942), CSSS have experienced hurricanes, fires, and habitat transitions.

These historic populations have since been extirpated, but in 1972, sparrows were discovered near Taylor Slough (Ogden 1972). Subsequent investigation revealed that a sparrow had been reported in this area in 1958, but the observation was never verified (Werner 1975; Pimm et al. 2002). Werner conducted helicopter surveys in 1974 and 1975 to characterize the distribution and abundance of sparrows in this region. These initial surveys revealed that sparrows were widely distributed and abundant (Werner 1975). A subsequent 1981 survey (Kushlan and Bass 1983) delineated the six subpopulations that are currently monitored.

2.3 Life History

2.3.1 Breeding and Nesting Behaviors

CSSS are thought to be generally monogamous (Post and Greenlaw 1994), with a single female occurring within a male's breeding territory. However, there are indications that sparrows may be polygamous under some circumstances, such as within small populations; it is unknown whether the sparrows are simultaneously or sequentially polygamous (Lockwood et al. 2006).

During the breeding season, typically considered March 1 through July 15, but which can extend through August, male sparrows establish and defend territories that are variable in size, ranging from 0.7 to 16.8 acres (Werner 1975), with reported average sizes ranging from 2.2 to 8.9 acres (Werner and Woolfenden 1983; Pimm et al. 2002). Throughout the breeding season, the majority of a sparrow pair's activities occur within this territory, including breeding, feeding, and sheltering. Within an area of suitable habitat, territories do not appear to be tightly packed (Werner 1975), and there are gaps between defended boundaries of adjacent males. Even when sparrows occur at high densities, small areas usually remain between adjacent territories, though some territories do appear to overlap (Cassey et al. 2007). Therefore, some gaps that appear to be suitable habitat may remain unclaimed by territorial sparrows (Werner 1975). It is likely that sparrows venture into these "unclaimed areas" during the breeding season. In many cases, areas that appear to be suitable for sparrow occupancy may not be suitable during certain environmental conditions and this may cause sparrow territories to appear to be widely separated from neighboring territories (Cassey et al. 2007).

Outside of the breeding season (August to February), sparrows generally remain sedentary in the general vicinity of their breeding territories but expand the area that they use compared to the breeding season territory (Dean and Morrison 2001). The average non-breeding season home range is approximately 42 acres, with a range of 14.1 to 137.1 acres (Dean and Morrison 2001). Some individuals make exploratory movements away from the area of their territories and may occasionally relocate their territories and home ranges before resuming a sedentary movement pattern (Dean and Morrison 2001).

Sparrows generally begin nesting in early March (Lockwood et al. 2001), but may begin territorial behavior, courtship, and nest-building in late February (Werner and Woolfenden 1983; Lockwood et al. 1997). This timing coincides with the dry season, and most areas within the marl prairies are either dry or only shallowly inundated at the beginning of the breeding season.

During the dry portion of the breeding season (March to May), sparrows build nests above the ground, but relatively low in the vegetation (6.7 to 7.1 inches) (Werner 1975; Lockwood et al. 2001). Nests are woven into clumps of dense vegetation and are well-concealed (Werner 1975; Post and Greenlaw 1994). Nest cups are consistently concealed from above (Post and Greenlaw 1994), either through construction of a domed cover or through modifying vegetation in the vicinity (Werner 1975; Post and Greenlaw 1994). During the wet portion of the sparrow breeding season (June to August), sparrows build their nests higher in the vegetation than during dry periods, an average of 8.3 inches above the ground surface (Lockwood et al. 2001). Wet-season nests probably occur in taller prairie grass vegetation than during the dry season because there must be sufficient height and density of vegetation remaining above the nest to cover and conceal nests.

Pimm et al. (2002) suggest that nesting will not be initiated if water levels are at a depth greater than 4 inches during the breeding season. For many years, rising water levels resulting from the onset of summer rains were thought to end the breeding season (Werner 1975). While these statements are generally true, the sparrows may respond to changes in hydrologic conditions as long as water levels are not prohibitively high. Large rainfall events early in the wet season may cause some nest failure and sparrows generally cease breeding when water levels rise above the mean height of the nests above the ground (Lockwood et al. 1997; Basier et al. 2008; Cade and Dong 2008). However, if water levels subsequently drop, sparrows may again initiate breeding activity. The initiation of molt, which usually occurs in early September, is probably the best indicator of the true end of the breeding season.

CSSS lay three to four eggs per clutch (Werner 1978, Pimm et al. 2002) with a hatching rate ranging between 0.66 and 1.00 (Boulton et al. 2009). The sparrow nesting cycle, from nest construction to independence of young, lasts between 30 and 45 days (Werner 1975; Lockwood et al. 2001; Pimm et al. 2002), and sparrows may re-nest following both successful and failed nesting attempts (Werner 1975; Post and Greenlaw 1994; Lockwood et al. 2001). A three-clutch breeding season necessitates an uninterrupted period of 90 to 120 days of maximally favorable conditions (Lockwood et al. 2001; Elderd and Nott, 2008). Both parents rear and feed the young birds and may do so for an additional 10 to 20 days after the young fledge (Woolfenden 1956, 1968; Trost 1968). Sparrows are incapable of flight until they are about 17 days old; when approached, flightless fledglings will freeze on a perch until the threat is less than approximately 3 ft away, and then run along the ground (Werner 1975; Lockwood et al. 1997).

Because of the long breeding season in southern Florida (March – August), optimal conditions may allow sparrows to nest several times within a year, and they may be capable of successfully fledging two to four clutches. Few sparrows probably reach this level of success (Lockwood et al. 2001) since second and third nesting attempts may occur during the early portion of the wet season. Nests initiated later in the season usually occur over water and result in reduced success rates.

Nest success rates vary among years, and range from 12 to 60 percent, depending upon time within the breeding season (Lockwood et al. 2001; Baiser et al. 2008; Boulton et al. 2009; Slater

et al. 2014). Substantially higher nest success rates occur within the early portion of the breeding season (prior to June 1) followed by a decline in success as the breeding season progresses to a low of about 20 percent after June 1. Nest predation is the primary documented cause of nest failure (Pimm et al. 2002; Baiser et al. 2008; Boulton et al. 2009; Virzi et al. 2009; Slater et al. 2014), accounting for more than 75 percent of all nest failures (Lockwood et al. 1997; Baiser et al. 2008). A complete array of nest predators has not been determined, however, raccoons (*Procyon lotor*), rice rats (*Oryzomys palustris*), and snakes, including exotic pythons may be the predominant predators (Lockwood et al. 1997; Post and Greenlaw 2000; Dean and Morrison 2001). It is also possible that as exotic tegus continue to expand their range, they may become a significant predator for CSSS (Mazzotti 2015). As water levels begin to rise above ground surface with the onset of the summer rains in May to June, nest predation rates also rise. Nests that are active after June 1, when water levels are above ground, are more than twice as likely to fail as nests during drier periods (Lockwood et al. 2001; Baiser et al. 2008; Cade and Dong 2008). This effect appears to be the result of both increased likelihood of nests being flooded and an increased likelihood of predation (Lockwood et al. 1997, 2001; Pimm et al. 2002).

CSSS are generally short-lived, with an average individual annual survival rate of 66 percent (Lockwood et al. 2001). The average lifespan is probably 2 to 3 years. Consequently, a sparrow population requires favorable breeding conditions in most years to be self-sustaining and cannot persist under poor conditions for extended periods (Lockwood et al. 1997, 2001; Pimm et al. 2002).

2.3.2 Feeding Behavior

While detailed information about the diet of CSSS is not known, invertebrates comprise most of their diet, though sparrows may also consume seeds when they are available (Werner 1975; Post and Greenlaw 1994). Howell (1932) identified the contents of 15 sparrow stomachs and primarily found remains of insects and spiders, as well as amphipods, mollusks, and plant matter. Primary prey items that are fed to nestlings during the breeding season include grasshoppers (*Orthoptera*), moths and butterflies (*Lepidoptera*), dragonflies (*Odonata*), and other common large insects (Post and Greenlaw 1994; Stevenson and Anderson 1994; Lockwood et al. 1997; Pimm et al. 2002). Adult sparrows probably consume the same species during the nesting season. Sparrows may consume different proportions of different species over time and among sites, suggesting that they are dietary generalists (Pimm et al. 2002). During the non- breeding season, preliminary information from evaluation of fecal collections suggests that a variety of small invertebrates, including weevils and small mollusks are regularly consumed (Dean and Morrison 2001). Evidence of seed consumption was only present in 4 percent of samples (Dean and Morrison 2001). These non-breeding season samples may not be representative of the foods most frequently consumed during that season and may only represent a portion of the items ingested.

While the sparrow appears to be a dietary generalist, an important characteristic of sparrow habitat is its ability to support a diverse array of insect fauna. In addition, these food items must be available to sparrows both during periods when there is dry ground and during extended

periods of inundation. The specific foraging substrates used are unknown, but they probably vary throughout the year in response to hydrologic conditions.

2.4 Habitat

CSSS subpopulations require large patches of contiguous open habitat. The minimum area required to support a population has not been specifically determined, but the smallest area that has remained occupied by sparrows for an extended period is about 4,000 acres. Individuals are area-sensitive and generally avoid the edges where other habitat types meet the marl prairies. They will only occupy small patches (less than 100 acres) of marl prairie vegetation when they occur within large, expansive areas and are not close to forested boundaries (Dean and Morrison 2001). Large expanses of deep water or wooded habitat may act as barriers to long-range movements (Dean and Morrison 2001). Once sparrows establish a breeding territory, they exhibit high site fidelity, and each individual sparrow may only occupy a small area for most of its life (Warner 1975). Although sparrows are generally sedentary, research has revealed occasional movement between subpopulations east of SRS (Lockwood et al. 2008; Virzi et al. 2009). However, sparrow dispersal probability declines greatly over longer distances and thus the likelihood of sparrows immigrating from other subpopulations decreases as distances increase (Gilroy et al. 2012). CSSS most consistently occur and are most abundant near the center of the patch of habitat in which they occur.

CSSS occur mostly within the short-hydroperiod freshwater marl prairies of the southern Everglades that flank the deeper Shark River and Taylor Sloughs. The most commonly associated vegetation species in occupied freshwater habitat is muhly grass (*Muhlenbergia filipes*) (Werner 1975; Kushlan and Bass 1983; Werner and Woolfenden 1983; Post and Greenlaw 1994; Stevenson and Anderson 1994), but CSSS also occur in freshwater marl prairies where *Muhlenbergia* is absent (Ross et al. 2006). Other dominant species that occur in these prairies include sawgrass (*Cladium jamaicense*), south Florida bluestem (*Schizachyrium rhizomatum*), black-topped sedge (*Schoenus nigricans*), and beak rushes (*Rhynchospora* spp.) (Werner and Woolfenden 1983; Ross et al. 2006).

CSSS occupy these marl prairie communities year-round during all life stages. During the dry season, usually coinciding with the late winter and early spring (November to May), sparrows traverse the ground surface beneath the grasses, and only occasionally perch on the vegetation. During the wet season (June to October), the ground surface is inundated, with peak water depths occasionally exceeding 2 ft (Nott et al. 1998). Sparrows travel within the grasses, perching low in the vegetation, hopping among the bases of dense grass clumps, walking over matted grass litter, and flying more frequently than during the dry season, but generally remain inconspicuous (Dean and Morrison 2001).

Hydrologic conditions have significant direct and indirect effects on sparrows. First, water depth or depth of inundation within sparrow habitat is directly related to the sparrow's ability to move, forage, nest, find shelter, and avoid predators and harsh environmental conditions. Average annual rainfall in the Everglades is approximately 56 inches per year (ENP 2005), with the

majority of this falling within the wet season months (June-October), which coincides with the latter half of the sparrow nesting season. This rainfall drives hydrologic characteristics in the marl prairies; however, throughout southern Florida, water management actions also influence hydrologic conditions. The operation of a system of canals, levees, pumps, and other water management structures affects much of the remaining marl prairies (Johnson et al. 1988; Van Lent and Johnson 1993; Pimm et al. 2002).

At water depths greater than 2 ft above ground surface, the majority of the vegetation in sparrow habitat is completely inundated, leaving sparrows with limited refugia. Conditions such as these may result in significant impacts to sparrow survival, and if they occur during the breeding season, can cause loss of sparrow nests (Nott et al. 1998; Pimm and Bass 2002). Even more moderate water levels, in the range of 6 inches above ground surface, may inundate enough habitat that sparrows cannot find shelter and are restricted in their movements. These water levels, when they occur during the breeding season, result in increased rates of nest failure (Lockwood et al. 1997; Baiser et al. 2008). While topographical variation within the remaining Everglades is relatively small, differences in elevation as little as 1 ft are associated with substantial differences in habitat characteristics.

The composition and structure/density of plant communities in the Everglades are strongly influenced by the rise and fall of annual water levels, which is measured as the number of days of inundation per year, or annual hydroperiod. Water quality has the potential to influence vegetation communities in sparrow habitat, but the literature summarized below highlights the more dominant role of hydroperiod and fire. Hydroperiods that range from 60 to 270 days support the full variety of vegetation conditions that are generally suitable for sparrows (Ross et al. 2006), though the vegetation composition and structure may vary significantly. Persistent increases in hydroperiod may alter vegetation communities from marl prairies or mixed prairies to sawgrass-dominated communities resembling sawgrass marshes (Nott et al. 1998). Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 60 to 180 days in most years is optimal for the plant species that support sparrow nesting and otherwise maintain sparrow habitat (Olmsted and Loope 1984; Kushlan et al. 1982; Kushlan 1990; Wetzel 2001; Ross et al. 2006, Sah et al. 2013).

Average hydroperiods that extend much beyond 240 days per year are associated with sawgrass marsh communities (Ross et al. 2006, Sah et al 2013) which are unlikely to support sparrows in the long term. Conversely, areas that are frequently subjected to short hydroperiods generally have higher fire frequency (Lockwood et al. 2003; Ross et al. 2006) and are readily invaded by woody shrubs and trees (Werner 1975; Davis et al. 2005). Both an increased incidence of fire and an increased density and occurrence of woody shrubs reduce the suitability of an area as sparrow habitat.

Small tree islands and individual trees and shrubs occur throughout the areas occupied by the sparrows, but at a very low density. Sparrows do not appear to require woody vegetation for any aspect of their normal behavior, and generally avoid areas where shrubs and trees are either

dense or evenly distributed. However, the small tree islands and scattered shrubs and trees may serve as refugia during extreme environmental conditions and may serve as escape cover when fleeing from potential predators (Dean and Morrison 2001). Because of their general aversion to dense trees and woody vegetation, encroachment of trees and shrubs quickly degrades potential sparrow habitat. However, a heterogeneous arrangement of different vegetation conditions provides habitat for sparrows under variable environmental conditions. A complex relationship between hydrologic conditions, fire history, and soil depth determine the specific vegetation communities at a particular site, and variation in these characteristics may result in a complex mosaic of vegetation (Taylor 1983; Ross et al. 2006). Kushlan and Bass (1983) conclude that a combination of hydroperiod and periodic fire events is critical in the maintenance of suitable mixed marl prairie communities for the sparrow. CSSS are generally not found in communities dominated by dense sawgrass, cattail (*Typha* spp.) monocultures, long-hydroperiod wetlands with tall, dense vegetative cover, spike rush (*Eleocharis cellulosa*) marshes and sites supporting woody vegetation (Werner 1975, Bass and Kushlan 1982). Sparrows also avoid sites with permanent year-round water cover (Curnutt and Pimm 1993).

Sparrows do not regularly occupy burned areas for 2 to 3 years following fires (Pimm et al. 2002; Lockwood et al. 2005), though they can re-occupy areas after only 1-year post-fire under some conditions (Taylor 1983; Werner and Woolfenden 1983). This is probably because of the sparrow's dependence on a level of structural complexity in the vegetation, which is absent after a fire, to provide cover, support nests, and allow individuals to move through the habitat during wet periods. Fire is common within the areas occupied by sparrows, and nearly all areas where sparrows currently occur have been burned within the past 10 to 20 years (Lockwood et al. 2003; LaPuma et al. 2007; Sah et al. 2013). A combination of naturally ignited and human-ignited (both prescribed and arson/accidental ignition) fires have resulted in different fire frequencies in different portions of the sparrow's range. Most of the species of vegetation that occur within sparrow habitat are fire-adapted and respond quickly following fire (Snyder 2003). Several of the dominant grass species, including *Muhlenbergia*, also flower following fires during the growing season (Main and Barry 2002). Under normal conditions, fires do not kill the individual plants that make up the dominant species in sparrow habitat, and fires remove only the aboveground growth and leaf litter (Snyder and Schaeffer 2004). Many of the dominant grasses may grow more than 15 inches after only a few weeks (Steward and Ornes 1975; Snyder 2003). For this reason, the species composition and even the general structural characteristics of the vegetation may be nearly indistinguishable from unburned areas only 2 to 3 years after burning (Lockwood et al. 2005).

The interaction of fire and flooding strongly influence the suitability of habitat for sparrows. In the most extreme case, vegetation that burns and is subsequently flooded within 1 to 3 weeks, either because of a natural rainfall event or water management operations, may not recover for up to 10 or more years (Ross 2006). If water levels overtop sprouting grasses after a fire, the grasses may die, resulting in an absence of vegetation. Recovery of vegetation from these circumstances is via seed germination, which requires a longer time than recovery via vegetative growth and may result in a different plant species community (composition and structure) than was present prior to the fire. Under more suitable conditions, vegetation may recover more

quickly following fire when water levels are near the soil surface, providing ample water for the plants to grow, without changing the plant community species composition.

2.5 Population Dynamics

2.5.1 Population Size and Variability

The use of helicopters to facilitate larger spatial-scale surveys for the sparrow was first accomplished in 1974 (Werner 1975). The first comprehensive, range-wide sparrow population survey was conducted in 1981 but was not repeated until 1992. Since that time, surveys have been conducted annually including twice in 1999 and 2000 (Pimm et al. 2002). The number of survey locations has changed through time, from a high of over 850 sites in 1992 to a low of 250 sites in 1995 (Cassey et al. 2007). The results of these annual helicopter surveys are used to estimate the CSSS population. An assumption of the annual population estimate calculations based on the range wide helicopter surveys (Pimm et al. 2002) is that every male detected calling also accounts for one female in the population (*i.e.,* they are paired), resulting in a sex ratio of 50:50. To estimate the total number of sparrows from the number observed on helicopter point counts, a correction factor is needed. Bass and Kushlan (1982), used a value of 15.87 (rounding it to 16) based on the range at which they could detect the sparrow's song (detection distance of a singing sparrow [200 m] resulting in a census coverage of 12.6 ha at each site visited), and on the assumption that each singing male was accompanied by one female ([100 ha/km^2 ÷ 12.6] x 2).

Over the period that range wide helicopter surveys have been performed, there have been substantial demographic changes in most of the six subpopulations (Table 1) (Tables referenced in this BO are included at the end of the document in section 11). The 1981 and 1992 sparrow surveys provided a baseline of the distribution and abundance of sparrows at that time, though there is no information available about how the populations may have changed during the intervening 11 years. In 1981, there were an estimated 6,656 sparrows distributed across six subpopulations, with the majority (86 percent) of the sparrows occurring within subpopulations A, B, and E. By comparison, the last complete CSSS population survey for all the subpopulations (2019) resulted in an estimate of 2,688 sparrows, with most birds occurring within subpopulation B (57 percent) and subpopulation E (33 percent). Survey results for 2019 indicate a drop in the estimated population of sparrows, from 3,184 in 2018 to 2,688 in 2019. To better understand the variability in the annual population estimates, the total number of birds has fluctuated between a high of 6,576 in 1992 to a low of 2,416 in 1994 and 2016 (Table 1). Several subpopulations were not surveyed during 1994.

Subpopulation A inhabits the marl prairies west of SRS in ENP and eastern Big Cypress National Preserve (BCNP), (Figure 3). In 1981 and 1992, subpopulation A supported over 40 percent (2,600 sparrows) of the total CSSS population (Table 1). Subpopulation A experienced the most dramatic population decline observed, dropping from more than 2,600 birds in 1992 to 432 birds in 1993 a decrease of 84 percent (Curnutt et al. 1998, Pimm et al. 2002). It is likely that Hurricane Andrew, in August 1992, caused mortality within most subpopulations but details suggest that Andrew was not the major cause of the overall population

decline (Curnutt et al. 1998, Nott et al. 1998). Andrew was followed by several wet years and high discharges of water through water control structures which caused several years of poor conditions for the CSSS, reducing its ability to recover from the impact of the hurricane (Curnutt et al. 1998, ENP 2005, Nott et al. 1998). The sharp decline in sparrow subpopulation A corresponds to a change from four drier than average years prior to 1992 to four wetter than average years between 1993 and 1996 when only limited breeding was possible and vegetation changes were documented (Nott et al. 1998, Jenkins et al., 2003). Lockwood et al. (2001) demonstrated that after experiencing three years of poor breeding conditions in quick succession, CSSS populations will decline sharply. Subpopulation A has subsequently remained at a low level, ranging from a high of 448 sparrows in 2000 to a low of 16 sparrows in 2017.

The most recent population estimate for CSSS-A was 0 sparrows in 2019. While male sparrows were not heard singing during the helicopter surveys, 3 adults and 2 fledglings were observed by researchers during one of their intensive demographic monitoring trips to this subpopulation. Prior to 2019, Subpopulation A accounted for only 6 percent of the total CSSS population. The continued low population numbers in subpopulation A are a major concern due to this subpopulation historically providing over 40 percent of the total population. Researchers have previously hypothesized that subpopulation A could be approaching a minimum threshold necessary to promote settlement of breeding sparrows and that local recruitment and dispersal rates alone will likely be insufficient to enable this sparrow subpopulation to persist (Virzi and Davis 2013, Slater et al. 2014). This seems more likely to be the case as we await survey results for the 2020 nesting season. Additional management measures including prescribed fire and translocation of sparrows from other subpopulations may be needed to ensure recovery of this critical subpopulation and are being considered by the Service at this time.

Subpopulation B, inhabiting the marl prairies southeast of SRS near the center of ENP, has remained relatively stable over time. When first surveyed in 1981, subpopulation B contained an estimated 2,352 sparrows (35 percent of the total population). Subpopulation B remains one of the most abundant subpopulations, with the estimated population size from 1981 to 2019 ranging from 1,536 to 3,184 sparrows (Table 1). Even though subpopulation B is the largest remaining subpopulation, a general downward trend in the estimated population has been noticed over the period of record. The subpopulation averaged 2,320 birds between 1992 and 2007. However, the average estimated population of subpopulation B since that period has been 1,958 birds. In 2019, subpopulation B recorded its lowest estimate on record 1,536 birds. Since this has been one of the most abundant subpopulations, regularly comprising 60 percent or more of the total population, this recent downturn is cause for concern and will be watched closely for a rebound in 2020.

In 1981, subpopulation C, located in the vicinity of Taylor Slough and along the eastern boundary of ENP, contained an estimated 432 sparrows (6 percent of the total population). By the 1992 survey, subpopulation C had declined nearly 90 percent, to 48 sparrows (Table 1). The population has remained very low since 1992, with two years where no sparrows were detected (1993 and 1995). There were only 48 sparrows estimated in this area in 1996 and 1997, and 80 sparrows estimated in 1998. Between 2007 and 2010, the population declined to an estimated

32 to 48 sparrows. However, since 2010, the sparrow population in subpopulation C has increased slightly and has been hovering around an estimated average of 104 sparrows (24 percent of its 1981 estimated population size).

Subpopulation D, just to the southeast of subpopulation C, supported an estimated 400 sparrows in 1981 (approximately 6 percent of the sparrow population), but declined to approximately 96 sparrows in 1993 (Table 1). High water levels likely led to the decrease in population since 1999 (Slater et al. 2009) with 32 sparrows estimated in 2000. No sparrows were identified within subpopulation D in 1995, 2002, 2003, 2004, 2006, and 2007. When birds have been detected, the number of males consistently exceeded the number of females (Virzi et al. 2011, Virzi and Davis 2012, Virzi and Davis 2013). Lockwood et al. (2008), observed that the continued population decline, since its estimate of 400 sparrows in 1981, had possibly left this subpopulation functionally extirpated. Surveys from 2008 through 2015 documented a few sparrows in this subpopulation with an estimated population range of 16 to 64 sparrows, except for 2012 when the estimate was 224 sparrows. Recent population estimates in 2018 and 2019 have indicated a significant increase in sparrows with 2018 registering 256 sparrows, the most since 1981, while 2019 estimated 176 (Virzi et al. 2018, Virzi and Tafoya 2020). Additionally, intensive ground surveys observed and banded 64 fledglings during 2019. Prior to 2018 and 2019, which saw significant increases in production, intensive ground monitoring activities in this subpopulation were indicating that the actual number of birds in this subpopulation may be far fewer than what was being estimated by the helicopter surveys. This area, like subpopulation A, has suffered from persistent high water levels that may have precluded sparrows from nesting in many of these years (Virzi at al. 2018).

Subpopulation E, north of subpopulation B and east of SRS, contained over 10 percent of the total population (approximately 672 sparrows) in 1981. Following Hurricane Andrew, subpopulation E declined by about 50 percent to 320 sparrows (Curnutt et al. 1998). However, due to the presence of suitable conditions, this subpopulation, like subpopulation B, has remained relatively stable even though it has experienced wide interannual fluctuations (Table 1). Between 2010 and 2019 the estimated population ranged from 384 to 1,200 sparrows with the most recent survey in 2019, estimating a population of 880 sparrows (T. Dean pers. comm.).

Subpopulation F, located between SRS and the western edge of the Atlantic coastal ridge along the eastern boundary of ENP, was the smallest subpopulation in 1981, containing an estimated 112 sparrows or just 2 percent of the total population. Population estimates for subpopulation F declined from 1981 to 1992, from 112 sparrows to 32 sparrows (Table 1). In several years (1993, 1995, 1999, 2000, 2007, 2008, and 2009) no birds were detected during the surveys. Only 16 sparrows were estimated for each year from 1996 to 1998, 2002, 2004, 2010, 2013, and 2014. Since 2010 the estimated population has ranged between 16 and 64 sparrows, with 16 sparrows estimated in 2019 (T. Dean pers. comm.).

Subpopulations A, C, D and F are currently the smallest in terms of number of sparrows. Since subpopulations A, B and E have consistently held sparrows over all survey years they are

considered "core" subpopulations and essential to the survival of the species. Subpopulation A has a large amount of previously occupied habitat which has the potential for restoration given the proper hydrologic regime. During the 2006-2008 nesting seasons, intensive ground surveys were conducted in subpopulations C, D, and F to better understand these small subpopulations (Lockwood et al. 2006; Boulton et al. 2009). Data collected in these surveys included territory size, fecundity, nest success and survival rates. Results indicate that the small subpopulations exhibit: 1) suppressed breeding, 2) an excess of unpaired males, 3) nest survival comparable to larger subpopulations, 4) low hatch rate, and 5) larger territory sizes than birds in the larger subpopulations. Boulton et al. (2009) concluded that the small subpopulations are demographically dynamic and subject to the negative effects of low densities (*e.g.*, allee effects). Allee effects often make it difficult 1) for breeding adults to find each other to mate, 2) to assess the condition of potential breeding habitat and 3) to ward off predators of adults and nests (Reed 1997, Etterson 2003).

Recent surveys in subpopulation D, prior to 2018 and 2019, have revealed results demonstrating the effects of small population size (Virzi and Davis 2013, Slater et al. 2014). In addition to C and D, subpopulation A was intensively surveyed beginning in 2009 (Virzi et al. 2009). Nineteen male sparrows holding territories and 15 nests were detected in CSSS-A during intensive ground surveys in 2009, and the subpopulation exhibited similar traits to the larger subpopulations such as the presence of few unmated males, and comparable clutch sizes, adult return rates, and proportion of early to late nests (Virzi et al. 2009). The subpopulation was reported as extant and functional. However, recent surveys between 2011 and 2019 found that the number of breeding pairs within subpopulation A has decreased, leading to concerns that subpopulation A could be approaching, or is already below, a minimum threshold necessary to promote settlement of breeding sparrows, perhaps due to a lack of conspecific cues (Virzi et al. 2018, Virzi and Tafoya 2020). No males were heard singing during the 2019 helicopter surveys which resulted in a population estimate of zero for the first time on record. Additionally, past low nest success rates and current low return rates raise the concern that this subpopulation may face extirpation unless the cause of the lower demographic rates can be identified and managed (Slater et al. 2014).

There have been large population declines recorded among most of the subpopulations and relatively few large population increases since 1981, especially in the smaller subpopulations and specifically CSSS-A. These population changes suggest that while declines can occur rapidly, it may take many years of favorable conditions to return a sparrow population to its previous status (Jenkins et al. 2003; Cassey et al. 2007; Lockwood et al. 2008). The continued population decline is a major concern. Since the significant decline in sparrow numbers in 1993, the overall population has varied from a low of 2,416 birds in 1994 to a high of 4,048 birds in 1997. Since 2001, the population estimates have ranged from a high of 3,584 in 2004 to a low of 2,416 in 2016. Understanding these population changes, especially in small subpopulations, is often complicated by discrepancies between population estimates based on range wide helicopter survey results and intensive ground monitoring. For example, based on intensive ground surveys in selected areas, the number of sparrows in CSSS-A dropped between 2010 and 2011, largely due to a reduction in females. Between 2010 and 2011 the number of males decreased from

24 to 16 while the number of females decreased from 19 to 6 within the study plot. The numbers dropped again between 2012 and 2014 due to a reduction in single males (Slater et al. 2014). Population estimates based on helicopter counts do not closely follow these trends. This can be partially explained by the fact that helicopter surveys only detect males and that they are conducted on a much larger range wide subpopulation level scale than intensive ground monitoring which concentrates on intensive data collection within a much smaller area, usually within optimal habitat conditions.

2.5.2 Population Stability

Current information suggests that sparrow subpopulations C, D, and F may support fewer sparrows than previously estimated, and the demographics of these subpopulations may differ from the larger subpopulations (Lockwood et al. 2006, Virzi and Davis 2013, Virzi and Tafoya 2020). Because sparrows typically experience low nest survival, low juvenile survival, and have a relatively short life span, we cannot expect sparrow recovery to be rapid (Lockwood et al. 2001). The demographic attributes of sparrows preclude them from rapid recovery particularly when consistently faced with poor conditions (*i.e.*, high water levels and frequent fires) (Lockwood et al. 2008). This affects assessment of the likelihood of the persistence of these subpopulations and the overall probability of persistence for the species.

With smaller population sizes in subpopulations C, D, and F, the relative importance of subpopulations A, B and E is increased with respect to maintaining a viable overall sparrow population. Similarly, potential contributions of the small subpopulations to maintaining the overall sparrow population and buffering it from potential catastrophic events such as widespread fire and hurricanes are reduced (Lockwood et al. 2006). Pimm et al. (2002) and Walters et al. (2000) suggested that three breeding subpopulations are necessary for the continued long-term survival of the sparrow. However, Slater et al. (2009) emphasize the need to recover all subpopulations, noting that with a vast majority of sparrows concentrated within subpopulations B and E, the species' vulnerability to stochastic events is particularly acute.

Slater et al. (2009) observed that even though the overall sparrow population has remained somewhat stable since the massive decline it experienced in the early 1990s, the population has shown minimal signs of recovery. The Sustainable Ecosystems Institute (SEI), an independent scientist review panel (2007a) also concluded:

> *"More important than trying to delineate populations, is recognizing that protecting the subspecies from catastrophic events will require maintaining sparrows over as wide an area as possible. This recognition provides a more compelling rationale for maintaining subpopulation A than the need to maintain three populations did, since subpopulation A is the only subpopulation west of SRS. It also suggests more emphasis should be placed on maintaining subpopulation D as the southeastern-most subpopulation".*

2.6 Distribution

The CSSS was first discovered in the cordgrass (*Spartina* spp.) marshes on Cape Sable in 1918 and was originally thought to be limited in distribution to Cape Sable (Howell 1919). On September 2, 1935, a severe hurricane struck the Keys and southern Florida, with the hurricane's center passing within a few miles of Cape Sable (Stimson 1956). Post-hurricane observations in the vicinity of Cape Sable suggest that water levels resulting from the storm surge rose about 8 ft above normal water levels, and the sparrow was thought to have been extirpated from the area due to habitat degradation as a result of the storm surge. Between 1935 and the 1950s, searches on Cape Sable failed to locate sparrows, however there were occasional reports of sparrows that could not be verified (Stimson 1956). Despite the fact that sparrows were again reported on Cape Sable in 1970 (Kushlan and Bass 1983; Werner and Woolfenden 1983), the habitat in the area had changed significantly from cordgrass marshes to mangroves and mud flats since the 1935 hurricane, and sparrows were considered to have been extirpated from this area since 1981 (Kushlan and Bass 1983).

In 1928, CSSS were reported to the northwest of Pinecrest, along the mainland coast of Florida, near what is today Everglades City (Nicholson 1928). The location of this mainland record was improperly reported, and the true location, Lostmans Pine Islands area approximately 5 miles southwest of Pinecrest, was not accurately reported until 1954 (Sprunt 1954). Stimson conducted extensive searches on the Florida mainland in the vicinity of the corrected 1928 sparrow observation and found sparrows to be very widespread throughout both coastal cordgrass marshes (Werner and Woolfenden 1983) and freshwater prairies along the western edge of the Everglades (Stimson 1956). However, by 1968, Stimson (1968) concluded that widespread fires in this region had severely impacted the sparrows in that area, and he expected them to be extirpated from the area as a result.

In the early 1940s, Anderson (1942) reported sparrows in the coastal cordgrass marshes near Ochopee. Subsequent searches revealed that sparrows occurred south of Ochopee along the coastal marshes landward of the mangrove zone (Stimson 1956). Werner (1975) reported that habitat occupied by sparrows in the Ochopee area was changing from cordgrass marshes to other species, and mangroves were encroaching into the area. Werner's searches in the area from 1970 through 1975 revealed a decline in the number of sparrows and the amount of habitat available in the area (Werner 1975). Sparrows were extirpated from this area by 1981 (Kushlan and Bass 1983), and there is little or no suitable habitat remaining in the area.

In 1972, CSSS were discovered near Taylor Slough (Ogden 1972). Subsequent investigation revealed that a sparrow had been reported to ENP in this area in 1958, but the observation was never verified (Werner 1975; Pimm et al. 2002). Surveys conducted by Werner in 1974 and 1975 with the use of a helicopter, sought to characterize the distribution and abundance of sparrows in this region. These initial surveys revealed that sparrows were widely distributed and abundant (Werner 1975). They occupied an area of about 21,745 to 31,629 acres, and the number of sparrows occurring within this area was estimated to range from 1,500 to 26,300 individuals (Werner 1975). Because of the magnitude of the area occupied and the

large estimates of population size, ecologists concluded that sparrows probably occurred within this area for many years. The difficulty in accessing the areas and the vastness of the areas (Kushlan and Bass 1983), as well as the secretiveness of the sparrow, all contributed to the failure to document the sparrow's occurrence in the area previously. The sparrow populations within these areas probably fluctuated over time in response to changes in habitat suitability resulting from fires and hydrologic conditions (Taylor 1983; Kushlan and Bass 1983). These fluctuations may have also contributed to the lack of sparrow detections in these areas.

The 1981 sparrow survey provided a good baseline on the distribution and abundance of sparrows at that time, and the 1992 survey results were remarkably similar, though there is no information available about how the population may have changed during the intervening years.

The overall sparrow population has declined since 1992, and there has been no evidence of significant improvements (Table 1). In addition to the decline in overall numbers, the distribution has decreased. Several of the sparrow subpopulations have contracted toward the center of the remaining habitat patches (Cassey et al. 2007).

2.7 Factors Affecting the Species

2.7.1 Hydrology

The C&SF Project is a system-wide network of canals and water-control structures. The Corps and District operate the C&SF Project to achieve a variety of local and regional objectives including flood protection, water supply, and environmental benefits. Operations of the C&SF Project affect the hydrologic conditions of nearly all the wetland systems within south Florida to some degree, including the habitat supporting the CSSS.

The most critical issue facing the sparrow today is altered hydrology in what was once the largest and most productive subpopulation, CSSS-A. Since 1992, and coincidental with Hurricane Andrew, the numbers of dry nesting days and average annual discontinuous hydroperiod in this area have been inadequate to maintain suitable habitat conditions. This altered hydrology resulted from implementation of the C&SF Project which re-routed the main flow through the Everglades from an eastern flow path within SRS to a more western one below the S-12 structures. The restoration of flow through the Everglades has been studied for decades and is a prominent part of the CERP, which has yet to be completed.

The Service's 1999 Biological Opinion required immediate emergency management actions to reduce the amount of flow through the S-12 structures onto western marl prairies. Later, in 2002, the Corps requested that the Service consider IOP as an RPA with a requirement that included a hydrologic management regime to protect sparrow breeding by reducing water deliveries in western marl prairies which were too wet and increasing water deliveries to the eastern marl prairies that had been over drained (Service 2002).

Many areas of sparrow habitat have experienced vegetation change since monitoring was initiated. These changes in vegetative composition have resulted from changes in hydrologic conditions, fire frequency, and management actions. Over drying within CSSS habitat is a result of maintaining artificially low water levels within areas of sparrow habitat, such as those that occur along the eastern boundary of ENP, increasing the potential for woody vegetation encroachment, and reducing the suitability of the habitat for sparrow occupancy. Extended hydroperiods and deep water depths occur as a result of managed water releases in combination with wet-season rainfall which can lead to the marl prairie vegetation changing to marsh species, also reducing habitat suitability.

Under IOP, hydrologic management provided reduced flows to sparrow habitat located in the western marl prairies during the breeding season. Construction and operation of several detention areas adjacent to sparrow habitat in the eastern subpopulations increased hydroperiods by an average of approximately 40 days in some over-drained habitats such as CSSS-C. Many other routine hydrologic operations that occur throughout the C&SF system have resulted in changes to hydrologic conditions in and adjacent to sparrow habitat. Pre-storm and post-storm operations, testing of hydrologic management operations, and other similar activities conducted by the Corps and District also affect hydrologic conditions within sparrow habitat, mainly through alteration of the natural timing of wetting and drying events.

In November 2019, the Corps released its report entitled, 2016 Everglades Restoration Transition Plan Biological Opinion: Evaluation of Western Flows Assessment (Corps 2019b). A draft preliminary report was summarized in the ERTP 2016 BO and can be found in Appendix C of that report (Service 2016). The current report, summarized below, contains similar hydrologic modeling analyses to those produced for the COP and utilizes nesting days, annual hydroperiod days and the marl prairie suitability index. Key points from this report include:

1. Areas within the southeastern corner of BCNP and the western marl prairies of ENP are receiving more water quantities than the historical pre-drainage condition. The source of this water is the L-28 borrow canal receiving inflows from S-344, S-343A and S-343B and shunting it south (along with BCNP basin runoff from south of the Jet Port), to the Tamiami Trail borrow canal which then discharges through Tamiami Trial bridges and Loop Road bridges into ENP near the western marl prairies. Seepage may also be occurring through and around the S-343A and S-343B structures and ending up near the western marl prairies.

2. In accordance with the ERTP 2016 BO, the Corps has provided their assessment summarizing planning efforts under WERP and potential effects to CSSS-Ax (Corps 2019a). Model results for the WERP alternatives WALT1R, WALT3R, W3RNL and ALTH were observed to better re-distribute water across the existing landscape through modifications of the L-28 Tieback and L-28 Canal relative to the WECB and WFWO model runs, with WALT3R and W3RNL better re-distributing water away from areas within southeastern BCNP and ENP's western marl prairies which are currently deemed too wet and further into the central and southern interior of BCNP.

3. The Corps concluded that, implementation of WERP would be expected to influence wetland hydroperiods causing changes in nesting and marl prairie suitability for the CSSS primarily within the western marl prairies. Those alternatives (*i.e.,* WALT3R and W3RNL) that included pump stations at the bottom of the L-29 Canal to direct water toward the interior of BCNP were more aggressive in reducing potential water depths in CSSS-Ax. Each WERP alternative slightly increased the average percentage of habitat within CSSS-Ax that experienced >90 dry nesting days over the period of record relative to the WECB (48.1 percent) and WFWO (43.1 percent). On average, CSSS-Ax experienced >90 dry nesting days 48.7, 52.1, 52.6, and 49.7 percent under WALT1R, WALT3R, W3RNL, and ALTH respectively, showing a minor beneficial effect.

4. Each WERP alternative also slightly increased the average percentage of habitat within CSSS-Ax that experienced a four-year running average discontinuous hydroperiod between 90 and 210 days over the period of record relative to the WECB (27.3 percent) and the WFWO (23.3 percent). On average, CSSS-Ax experienced a four-year running average discontinuous hydroperiod between 90 and 210 days 30.1, 33.7, 34.3 and 31.0 percent, under WALT1R, WALT3R, W3RNL and ALTH, respectively, showing a minor beneficial effect. Potential effects to the eastern marl prairies between each alternative and each baseline were not as great.

Western Water Flows are driven by the hydraulics of the L-28 Levee and L-28 Interceptor infrastructure (*i.e.,* levees, canals, and structures). When the L-28 was constructed, BCNP was privately owned. The L-28 was designed to protect those areas from flooding and impound water in WCA-3A. This infrastructure has not been substantially changed since it was installed in the 1960s, the result of which has been over-drainage of water around and away from BCNP in favor of channeling the surplus water south (into WCA-3A and the western marl prairie). The CSSS-Ax has been negatively affected as a result. Absent changes to the L-28 system, Western Water Flows will continue to pose hydro-ecological impacts to the western marl prairie and CSSS-Ax. The Service looks forward to working closely with the Corps during renewed WERP planning to ensure the western marl prairies remain suitable for sparrows.

Prior to ERTP 2016, the discontinuous hydroperiod and dry nesting window analyses were based on data that were available from gauges situated within and in the vicinity of individual subpopulations. A single water-level gauge (in the case of NP-205, R3110 or EVER4) or several gauges within or in the vicinity of a subpopulation were used to estimate water depths in one or more subpopulation areas. In 2015, several water-level gauges used to estimate water depths in CSSS habitats (MRSHOP-B1, MRSHOP-C1, MRSHOP-C2, and MRSHOP-C3 in CSSS-F and MRSHOP-D1 in CSSS-C) were discontinued following a reduction in funding. With the removal of these gauges and questions arising about the use of individual gauges to estimate hydrology over large areas, the Service worked with the USGS to develop an improved method for estimating and evaluating water depths and their spatial extent. EDEN has provided daily water-level and water-depth surfaces for the freshwater Everglades for the period 1991 to present. The Sparrow Viewer tool (http://sofia.usgs.gov/eden/csss) was developed by the USGS

in coordination with the Service, to use these surfaces to estimate and evaluate water levels, depths, and durations in CSSS habitat on a near-real-time basis. CSSS Water-Depth Maps containing daily water depths based on the EDEN water-level surfaces, water-level gauge data, and ground elevation data are generated each day. The data have the same 400 meters by 400 meters grid resolution as other EDEN data.

The animated viewer shows changes in water levels and provides calculations of the percent area that is dry along with other statistics relating to CSSS biology on a daily basis. Scientists and water managers can use the Sparrow Viewer data to spatially analyze and assess past and present impacts of hydrology on sparrow habitat and nesting success and develop management strategies for the future. Another tool developed by the USGS for use in analyzing EDEN data is the EDEN Transect Plotter tool, which facilitates the plotting of water levels from the EDEN daily water-level surfaces and ground elevations along transects located at key locations along water management features for specified periods such as the CSSS breeding season. This tool can be used to assess past events as well as providing a real time evaluation of hydrologic conditions. The tool has been used to evaluate conditions as a substitute for the MRSHOP gauges which were discontinued. The analysis contained in this document will only rely on data produced by EDEN and the Sparrow Viewer. For more detailed information on the relationship between individual gauge stations and EDEN, see ERTP 2016 biological opinion (Service 2016).

The requirement to provide suitable conditions over 40 percent of the habitat within CSSS-Ax, equating to approximately 24,000 acres, was originally established to ensure that sufficient habitat was properly maintained to support pre-1993 sparrow populations. Over time, the western CSSS-A habitat has declined in condition due to extended hydroperiods. However, the Sparrow Viewer analysis has indicated that areas to the east of CSSS-A (Figures 7 and 8) appear to provide suitable breeding season dry periods, indicating that habitat management actions may provide benefits in that area. Given the currently diminished condition of both optimal CSSS habitat and population numbers compared to historical levels, and the need to identify what improvements in habitat would be possible to facilitate its recovery, it is appropriate to extend the analysis to determine the feasibility of expanding suitable habitat beyond the original boundary of CSSS-A. For purposes of analysis throughout this document we will only be looking at the CSSS-Ax delineated area. For more detailed information on the origin of CSSS-Ax see the ERTP 2016 BO (Service 2016).

2.7.2 Dry Nesting Days

While provision of the quality and quantity of viable habitat for all phases of the CSSS life cycle is vital, conditions during the March 1 to July 15 breeding season that favor successful rearing of young, and ideally multiple broods, are essential for maintenance of healthy and sustainable sparrow populations. This has been the subject of considerable study, and development of metrics and trigger levels in an attempt to foster these conditions. This metric has evolved over time since 1999 and the target, in use since 2016, is worded as follows: To produce multiple broods each year, the CSSS requires at least 90 consecutive dry days (water below ground surface) over 40 percent of each subpopulation during the nesting season (March 1 – July 15).

1. Subpopulation A - At least 24,000 acres of suitable habitat within and adjacent to CSSS subpopulation A must have 90 consecutive dry days between March 1 and July 15 (CSSS breeding season) every year.

2. Subpopulations B through F – At least 40 percent of each designated CSSS critical habitat unit must have 90 consecutive dry days between March 1 and July 15 (CSSS breeding season) every year.

While the average nest cycle for sparrows is estimated to be 34 to 44 days (Pimm et al. 2002), a minimum of two successful nesting periods, in the majority of years is considered essential to maintain a stable and viable CSSS population (Pimm et al. 2002). A nesting window of at least 90 days provides additional time to account for delays in nest initiation due to weather conditions, possible reversals of water levels, and other factors which may delay or interrupt breeding attempts. For a more detailed version of how this metric has evolved over time see the Service's ERTP 2016 Biological Opinion (Service 2016).

With the development of the Cape Sable Seaside Sparrow Viewer (Sparrow Viewer) tool in 2016 (http://sofia.usgs.gov/eden/csss), it is possible to assess the performance of this metric across all subpopulations from 1991-2019 (Table 2). This data indicates that CSSS-Ax and CSSS-D miss the target more frequently and have more occurrences of consecutive years outside the target range. CSSS-Ax only met the target in 8 out of 29 years and averages just 25 percent of its total area achieving 90 or more consecutive dry nesting days. CSSS-D meets the target in 14 of 29 years with an average of 39.7 percent of its total area meeting the 90-day criterion. Consecutive years of not providing ideal nesting windows for sparrows increases the likelihood that multiple broods will not be achieved, and population numbers will not increase. CSSS-Ax had 13 instances where conditions were not met in two consecutive years. CSSS-D had 7 instances where this occurred. These results indicate that the current level of breeding habitat has not been sufficient to aid in the recovery of the population within CSSS-Ax and is only minimally adequate to maintain the subpopulation at a precariously low level.

By contrast, CSSS-B the largest and most consistent performing subpopulation met the target 21 of 29 years with an average of 56.4 percent of the area meeting the 90 consecutive dry day target. Only twice did CSSS-B not meet the target in consecutive years. CSSS-E which is located closer to NESRS and is not protected by the main Everglades National Park road met the target 19 of 29 years with an average of 54.3 percent of the area meeting the target. It only exhibited one instance of consecutive years missing the target.

2.7.3 Discontinuous Hydroperiod

The timing and extent of dry habitat during the Cape Sable seaside sparrow breeding season has been the subject of extensive research and analysis in an attempt to determine key periods and relationships to ensure successful breeding. However, equally if not more important, is the provision of optimal depth and duration of above ground surface water levels throughout each

year (known as the discontinuous hydroperiod). Additionally, this hydroperiod should have an optimal occurrence frequency over the long-range period of years to maintain enough suitable sparrow habitat capable of supporting a healthy sparrow population. Walters et al. (2000) observed that if water management produces long hydroperiods in CSSS habitat frequently enough to alter its vegetation, as has occurred in CSSS-AX and CSSS-D, sparrow survival and reproductive rates will be moot because the habitat will be unable to support successful reproduction regardless of how many birds might be in the area.

The discontinuous hydroperiod for the marl prairie habitat type favored by CSSS has been determined to be in the range of 90 to 210 days (Ross et al. 2003, Beerens et al. 2016). Habitat in the lower end of this range or with less than a 90-day discontinuous hydroperiod tends to be more prone to fire and has more woody vegetation encroachment. Habitat in the upper range or with more than a 210-day discontinuous hydroperiod tends to quickly convert to habitat dominated by species such as sawgrass and cattail. Research has shown that habitat degradation, whether by changes in available habitat or increases in water level, had a much larger impact on final population size and quasi-extinction risk compared to changes in demography and behavioral parameters (Elderd and Nott, 2008).

The marl prairie habitat that the CSSS requires for its survival and recovery persists under a hydrologic regime of 90 to 210 wet days (water above ground; discontinuous). In order to maintain and restore enough area of suitable marl prairie habitat for each CSSS subpopulation, water management should be implemented in a manner aimed at meeting the following:

1. Subpopulation Ax – At least 24,000 acres of suitable habitat within and adjacent to CSSS subpopulation Ax must show a 4-year running average discontinuous hydroperiod range of 90 to 210 days, with no 2 consecutive years failing to meet this target.

2. Subpopulations B through F – At least 40 percent of each designated CSSS critical habitat unit must show a 4-year running average discontinuous hydroperiod range of 90 to 210 days, with no 2 consecutive years failing to meet this target.

With the development of the Cape Sable Seaside Sparrow Viewer (Sparrow Viewer) tool in 2016 (http://sofia.usgs.gov/eden/csss/index.php), it is possible to assess the performance of this metric across all subpopulations from 1991 to 2019 (Table 3). First, with regards to the percent area meeting the target, table 3 shows the percentage of each subpopulation that falls into the 0 to 89, 90 to 210 and greater than 210-day annual hydroperiod for the period of record 1991-2019. The target hydroperiod range is between 90 and 210 days over 40 percent of each subpopulation. The metric above calls for 4-year running average hydroperiod. However, it is beneficial to look at percentages by year to see how many years in the period of record the annual target is met and the percentage of area that is too dry or too wet outside of the target.

CSSS-Ax

It is evident from table 3 that CSSS-Ax is too wet compared to the other subpopulations and has been so since 1993. This subpopulation only met the 90 to 210-day discontinuous hydroperiod target in 2 of 29 years, has the least amount of area meeting the target on average (16 percent) and has the highest percentage of area, on average, with a hydroperiod greater than 210 days (83 percent). During the period 1991-2019, CSSS-Ax only exhibited comparable conditions to the larger subpopulations in two years, 2001, when 40.6 percent of available habitat was in the optimal discontinuous hydroperiod range and 2008 when the percentage was 48.6 (Table 3). In 72 percent of the years it failed to meet the 90 to 210-day threshold over even 20 percent of the habitat.

CSSS-B

CSSS-B is presently the largest subpopulation in terms of numbers of sparrows and the second largest in area. The Sparrow Viewer analysis demonstrates that CSSS-B has been able to achieve the 90 to 210-day discontinuous hydroperiod threshold over 35 percent of its habitat. However, recently it appears that CSSS-B may have experienced a decline in habitat meeting the threshold with 38 percent of the habitat meeting the threshold between 1992 and 2008 and 28 percent meeting it between 2009 and 2019. The area experiencing greater than 210-day hydroperiod for the same time period indicates an increase of 13 points, from 25.3 to 48.2 percent, indicating that CSSS-B has become wetter. The decline from 2009 to 2019 is possibly due to wetter than average dry season conditions between 2012 and 2019 and/or the still to be determined effects of water management operations. The latter is unlikely because CSSS-B is surrounded by the Main Park Road and is not susceptible to management actions like some of the other subpopulations.

CSSS-C

CSSS-C is presently maintaining a very low population level and represents only a small portion of all delineated CSSS habitat. The eastern portion of this subpopulation has been subjected to over drainage due to adjoining canal infrastructure resulting in the invasion of non-native woody vegetation and a frequent fire return rate. The western portion of this subpopulation has remained mostly unimpacted, except for occasional fires. Since the implementation of IOP in 2002, portions of this subpopulation have been affected to varying degrees by the construction and operation of infrastructure designed to retain more water in Taylor Slough and adjoining marshlands. The Sparrow Viewer analysis (Table 3) demonstrates that between 1992 and 2008, CSSS-C had an average of 63 percent of its acreage in the optimal 90 to 210-day discontinuous hydroperiod range with 53 percent of the years achieving it over more than 60 percent of the habitat (Table 3). However, between 2009 and 2019 there has been a 13 percent decrease in the area of habitat achieving the optimal range, possibly attributable to wetter meteorological conditions during the dry season (2012 through 2019) and/or the effects of water management operations (Table 3).

CSSS-D

CSSS-D is also at a very low population level and represents only a small portion of all delineated CSSS habitat. The Sparrow Viewer analysis demonstrates that between 1992 and 2008, CSSS-D had an average of 45 percent of its acreage in the optimal 90 to 210-day discontinuous hydroperiod range (Table 3). However, the amount of habitat achieving the optimal range has decreased from 45 percent between 1992 and 2008 to just 21 percent between 2009 and 2019 (Table 3). This is possibly attributable to wetter meteorological conditions during the dry season (2012 through 2019) and/or effects of water management operations. Percentages in the 90 to 210-day discontinuous hydroperiod category have remained low since 2016 with less than 4 percent of the area meeting the target during the exceptionally wet years of 2016 and 2018. As noted earlier, despite these wet years, productivity increased significantly in 2018 and 2019. This further demonstrates the complexity of factors affecting this species and highlights the importance of maintaining interannual variability to ensure continued success.

CSSS-E

CSSS-E is presently the second largest population of CSSS. Since the early 1990s, CSSS-E has consistently been within the target discontinuous hydroperiod needed to maintain CSSS habitat and its persistence is evidence of this. The Sparrow Viewer analysis demonstrates that between 1992 and 2008, CSSS-E had an average of over 41 percent of its acreage in the optimal 90 to 210-day discontinuous hydroperiod range (Table 3). However, the amount of habitat achieving the optimal range has decreased from 41 percent between 1992 and 2008 to 29 percent between 2009 and 2019 (Table 3). This is possibly attributable to wetter meteorological conditions during the dry season (2012 through 2019) and/or the effects of water management operations.

CSSS-F

CSSS-F has maintained a very low population level and has the smallest subpopulation area. In this case it appears that the over drained state of this subpopulation is the problem, frequently resulting in a discontinuous hydroperiod of less than 90 days. This subpopulation has been subjected to over drainage due to adjoining canal infrastructure which has resulted in invasion of non-native woody vegetation, and an increased frequency of fire. The Sparrow Viewer analysis demonstrates that CSSS-F has had an average of 25 percent of its acreage in the 90 to 210-day discontinuous hydroperiod range over the period from 1992 to 2008 (Table 3). But more recently (2009-2019) there has been an increase in habitat in the optimal range. In seven of the last eleven years, conditions have improved such that this subpopulation has regularly met the discontinuous hydroperiod criteria with an average of over 52 percent of the habitat within the optimal range (Table 3), possibly as the result of wetter meteorological conditions during the dry season (2012 through 2019) and/or the construction of the Tamiami Trail Modifications 1-mile bridge completed in 2013. Additionally, in the last three years, the Corps has implemented Increments 1.1, 1.2 and 2 which have put more water into NESRS presumably increasing flows at the 1-mile bridge which sits directly north of CSSS-F.

All Subpopulations

In contrast to CSSS-Ax, the other subpopulations have a higher percentage of area falling within the 90 to 210-day window ranging from 35 percent in CSSS-B to a high of 56 percent in CSSS-C. They also meet the target in more years over the 29-year period of record, ranging from 9 in CSSS-E to a high of 20 in CSSS-C. Previous characterizations of the eastern subpopulations have been that they were too dry, however, the observed data in table 3 (1991-2019) indicates that CSSS-C is not as dry as was previously thought with an average of 29 percent of the area in the 0 to 89-day hydroperiod range. CSSS-F is perpetually too dry and records an average of 59 percent in the 0 to 89-day range. CSSS-D and E tend to be on the wetter side when outside of the target range with averages of 57 and 49 percent respectively in the greater than 211-day hydroperiod category.

Table 4 shows the one-year and four-year rolling average hydroperiod in each subpopulation from 1991-2019. The trends discussed earlier are evident in these metrics as well where CSSS-Ax has an average annual hydroperiod of 286 days. This is 76 days beyond the target (210 days) and 111 days beyond the average annual hydroperiod for CSSS-B at 175 days (Table 4). CSSS-D is the only other subpopulation to exceed the target with a long-term average of 225 days and CSSS-F averages drier than the target with an 81-day hydroperiod on average. CSSS-C reports an average of 135 days and CSSS-E, located just east of SRS, stays within the target range at 199 days. Since 2016, averages have remained steady except for the wet year of 2018 when all subpopulations except CSSS-F exceeded the target. Tracking of the four-year rolling average hydroperiods was initiated in 2016 to account for some of the annual variability in hydroperiod and because it has been estimated that there is a lag period of around 4 years for the vegetation to shift with hydrologic changes (Ross et al. 2006).

2.8 Population Dynamics

The methodology used to estimate Cape Sable seaside sparrow population levels has remained consistent since 1981 (Bass and Kushlan 1982). Analyses conducted as part of the ERTP development resulted in a population trigger level that was documented in the Service's ERTP Biological Opinion (Service 2010a) that, when exceeded, required the Corps to reinitiate consultation. This reinitiation trigger was based on an average total population estimate of 3,145 birds over the 2001 to 2009 period, and specified that if the annual estimated population fell below one standard deviation (-230) of the average total population (3,145 - 230 = 2,915 birds) reinitiation of consultation under the Act was required. During the period of 2001 to 2016, the population estimate fell below the trigger level of 2,915 birds four times (2002, 2011, 2014, and 2016) (Table 1). Since this criterion was developed as part of the ERTP BO which was issued in 2010 with operations commencing after the ROD was signed in October 2012, only the exceedance that occurred in 2014 was considered as a trigger for reinitiation. The Service and Corps did reinitiate formal consultation and though it was found that the project did not cause the population estimate to fall below the trigger level, a new Biological Opinion was produced (Service 2016). In the 2016 BO the reinitiation trigger was slightly modified by taking one half of a standard deviation from the 2007 – 2016 mean population estimate and subtracting that from

the 2016 population estimate (2,416 – 135 = 2,281). This meant that if the population estimate fell below 2,281, reinitiation should occur. This has not happened in the intervening years since the ERTP 2016 BO was submitted. The closest was in 2019 when the population estimate was 2,688.

While it is true that the currently proposed action (COP) was a part of the RPA in the previous BO and is anticipated to benefit sparrows in the long-term, it is possible that further exceedances could occur. This species is highly sensitive to hydrologic change and the transition into a completed MWD and C-111 SD Project operating plan and future transitions into CERP operations coupled with influences from other factors including weather events, El Nino, and potential sea level rise could cause fluctuations in the population estimate.

An additional indication of the declining sparrow status can be seen in the decline in annual peak levels of the estimated population in CSSS-B and the total CSSS population from 1981 to present (Figure 5). Since sparrow population numbers are cyclic, often over a period of 3 to 4 years, related to both the average life span (Service 1999; Pimm et al. 2002), weather, and hydrologic conditions, a repeating pattern of high and low years can be discerned within the data. The high years are indicative of conditions that have been favorable for sparrow reproduction and survival when the population has been able to recover from previous poor years. If, as indicated by the declining peak population numbers, those favorable conditions are not resulting in substantial population increases, it is an additional indicator that the species needs additional management actions. Of further concern is that this decline also appears to be occurring in the largest remaining healthy subpopulation CSSS-B. Since 1992, the estimated populations in CSSS-Ax, CSSS-C, CSSS-D, and CSSS-F, have trended lower and remain at extremely low levels, an indication that little to no improvement is occurring in these subpopulations.

The South Florida Multispecies Recovery Plan (Service 1999), identified one of the recovery criteria components for the Cape Sable seaside sparrow as when the 3-year running average intrinsic rate of increase (r) for the total population is equal to or greater than 0 for at least 10 years. When r is greater than 0 it indicates an increasing population, and when r is less than 0 it indicates a declining population. From 1994 to 2004, the three-year running average of r was greater than 0 in 6 years, and less than 0 in 4 years. Within the period of 2005 to 2015, the three-year running average of r was greater than 0 in 2 years, and less than 0 in 8 years (Figure 11). In the four years since the ERTP 2016 BO was submitted, the three-year running average of r was greater than 0 in 2 years and less than 0 in 2 years. This metric is significant in that the calculation of the three-year running average considers the complexity that is often introduced in trying to correlate yearly relationships. This metric provides additional evidence that population changes are connected to habitat effects which often occur over a period of years.

Pimm and Bass (2002), in their population viability analysis (PVA) of the sparrow offered the following tentative conclusions:

> *"…the Cape Sable sparrow will survive only if it has at least three healthy subpopulations. To implement this requirement, the breeding areas west of Shark River*

Slough must not be flooded in the breeding season, and water levels should be raised in the northeast of Shark River Slough to reduce the incidence of fires."

"…the population declines towards extinction within fifty years in the "plausible" scenario. It even goes to extinction in the "optimistic one". What if water were not released? The population dips below its population ceiling periodically but persists indefinitely even in the plausible scenario."

"We predict that the Cape Sable sparrow subpopulation west of Shark River Slough will decline to extinction if the pattern of managed flows over the S-12 structures for the last 20 years is repeated."

Their study concluded that during the previous 20 years sparrow population levels had failed to recover from documented declines, and if similar water management operations were continued, their PVA analysis indicated that extinction was inevitable. The Service concluded in its 2016 BO that:

"In reviewing the progress in Everglades restoration, the status of the species since this analysis, and the effects of water management changes that have been implemented to date with consideration for the sparrow, the Service can find minimal justification to refute that conclusion."

With the implementation of the currently proposed action (COP) in 2020, it is anticipated that we will significantly and permanently begin the redistribution of flows to their historic flow path and benefit sparrows, as well as other wildlife resources in the Everglades.

A biased sex ratio has been observed by researchers conducting intensive ground surveys for the CSSS (Lockwood et al. 2006; Lockwood et al. 2007; Boulton et al. 2009; Virzi and Davis 2013; Slater et al. 2014). The number of males observed in intensive ground surveys frequently exceeds the number of females observed, resulting in an increase in the sex ratio up to a maximum of 1.0 (*e.g.*, when only males are observed in the population, this type of ratio is expressed as the number of males divided by the total number of adults in the population). A male biased sex ratio is most often observed in smaller subpopulations (Slater et al. 2014) and may be a function of several factors such as habitat quality and increased female vulnerability to predation (Virzi and Davis 2013; Gruebler et al. 2009). Highly skewed adult sex ratios increase a species' risk of extinction (Dale 2001; Donald 2007) and were observed during the extinction of the Dusky seaside sparrow, when ultimately all the remaining sparrows in the wild were males (Delany et al. 1981). With this in mind, it is critical that the skewed sex ratio in small subpopulations be monitored closely to assess the range wide status of the CSSS (Slater et al. 2014) and that actions be taken to address this issue.

Since the current population estimator assumes that there is a one to one ratio of males and females in the population and that they are paired and successfully reproducing, the resulting population estimate may be overestimating the total population. Further research is currently

underway to increase the accuracy of the range wide survey methodology as well as the validity and statistical power of the current population estimate. For additional detail on biased sex ratios and their affects on the population estimator refer to the ERTP 2016 BO (Service 2016).

2.8.1 Territory Size

Another metric that has been used to evaluate the health of the CSSS population is the acres of suitable habitat available for each individual (Table 13). The larger, more stable subpopulations have fewer suitable acres per bird in the 90 to 210-day discontinuous hydroperiod range, meaning either the larger subpopulations have smaller territories covering the majority of the suitable habitat, and/or that the less stable subpopulations have a large amount of underutilized habitat. CSSS-B, the subpopulation with the largest population, had the lowest value for suitable acres per bird at 5.9 acres (2.4 ha) followed by CSSS-E, the second most populous, at 19.7 acres (7.9 ha). The number of suitable acres per bird in CSSS-Ax was substantially larger at 46 acres (18.5 ha), even though it has only averaged 9 percent of its potential acreage in the optimal target range. In 1992, the last year CSSS-Ax had a large population (2,608 birds), the average number of acres per bird in the target 90 to 210-day discontinuous hydroperiod range was 5.2 acres, comparable to CSSS-B. The smaller subpopulations, CSSS-C, CSSS-D, and CSSS-F, average 33 to 62 percent of their acreage within the target discontinuous hydroperiod range but account for very few birds which results in a high range of potentially suitable acres per bird (72 to 124 acres).

The average of the annual total number of suitable acres per bird across all subpopulations is 11.4 acres (4.60 ha), or 22.8 acres per pair. This is larger than the territory size documented in Pimm et al. 2002, of 3.0 to 11.1 acres (1.2 to 4.5 ha) based on observations of known breeding pairs. This could be a further indicator of the current underutilization of the less optimal habitat by sparrows compared to usage in more optimal habitat areas studied by Pimm.

If 40 percent of the maximum acreage in CSSS-Ax were to exhibit the target discontinuous hydroperiod, this would provide approximately 24,000 acres of suitable habitat. This optimal habitat acreage area, at a theoretical average of 11.4 acres per bird, would result in a potential estimated population for CSSS-Ax of 2,100 birds. For comparison, the estimated population in CSSS-Ax in 1981 was 2,688 birds and as late as 1992 was 2,608 birds. Based on this analysis, 24,000 acres of habitat meeting the target 90 to 210-day discontinuous hydroperiod would provide enough habitat to begin restoring the overall population of CSSS-Ax to its previous level.

2.8.2 Vegetative Community Changes

Another factor affecting sparrows is the loss of suitable habitat due to extended flooding or high water levels. Sah et al. (2007) documented a conversion of habitat type from shorter hydroperiod plant species (less-flood tolerant) to those indicative of longer hydroperiod conditions (more flood-tolerant) not preferred by sparrows, in particular, vegetation in the wet prairies along the eastern edge of CSSS-E, the central part of CSSS-A, and the southern part of

CSSS-B were indicative of wetter conditions. Based on vegetation studies within sparrow habitat, researchers concluded that the direction and magnitude of vegetation change within marl prairie depends on whether the vegetation is located along the fringes near either wetter or drier areas, and the magnitude of the hydrologic change that is influencing them (Ross et al. 2003, 2004, 2006; Sah et al. 2007, 2010, 2013; Elderd and Nott 2008). The transition from one vegetation type to another (*e.g.*, prairie to marsh) in response to hydrology may take place in as little as 3 to 4 years (Armentano et al. 2006); however, the transition from marsh back to suitable prairie may take longer (Ross et al. 2006; Sah et al. 2010; Sah et al. 2013).

Vegetation change is also influenced by the interaction of fire and hydrology. Studies by Sah et al. (2010) revealed that not only did post-fire flooding delay the vegetation recovery process, but also caused it to follow a different trajectory in terms of species composition. This could potentially impede recolonization of previously burned areas by the sparrow (Sah et al. 2010).

Vegetation studies within sparrow habitat (Ross et al. 2004) showed that sparrows occupy prairies with a hydroperiod ranging between 90 and 240 days. In sites with hydroperiods ranged between 150 and 240 days, CSSS occupancy was over 40 percent, while at shorter and longer hydroperiods occupancy was 20 percent or less (Ross et al. 2004). This Biological Opinion, like the ERTP 2016 BO, uses 210 days as the upper limit of the discontinuous hydroperiod metric for the analysis of effects. However, solely attaining this hydroperiod requirement may not be enough to promote a transition from marsh to prairie habitat, as this process likely requires a fire frequency regime in the landscape defining process (Ross et al. 2006; Sah et al. 2010).

Water management operations associated with IOP and ERTP have not resulted in an adequately shortened annual hydroperiod sufficient to maintain suitable marl prairie habitat throughout the historical expanse of subpopulation Ax. This is especially evident in the lower-elevation peripheral portions of subpopulation Ax (*e.g.*, at the P-34 gauge) where the average annual hydroperiod ranges from 235 to 320 days. The extended hydroperiods and associated habitat degradation are likely contributing to the decline of the sparrow in CSSS-Ax and suggests a source of water to the west of the S-12s which has recently been investigated (Corps 2019b). It is not precisely known where, when, or how this "additional" water reaches the P-34 gauge but it has been hypothesized that it may be coming from the infrastructure associated with the L-28 Borrow Canal, or may be the early impacts of sea level rise. Consequently, CSSS-Ax has not recovered under IOP or the subsequent ERTP, nor has it been extirpated, but the estimated population has remained extremely low compared to the level that existed in 1981 and 1992.

Recent sampling by Sah et al. (2018), as part of their long-term study of marl prairie vegetation, indicates that vegetation on the eastern side of CSSS-Ax has experienced an increase in vegetation composition consistent with longer hydroperiods. The reported trend in this location had been towards the drier side with the annual closures of the S-12 structures, however the reverse was evident from the 2016 sampling and thought to be due to high water conditions in the spring of 2016 (Sah et al. 2018). Several wetter than average years have occurred since 2016 so this trend has probably continued, however, it is anticipated that with the COP the trend will be reversed again as more flow is restored to NESRS. As anticipated, the same sampling picked

up the positive trend in the eastern marl prairies of shifting vegetation towards the wetter side. This is due in part to the the C-111 South Dade detention areas receiving water from the S-332 B and C structures. This is achieving the goal of rehydrating the eastern marl prairies located in the Rocky Glades.

2.8.3 Construction, Maintenance and Human Disturbance

Since the COP represents the next iteration of water management operations, and no construction is proposed, there will not be any direct impact due to project related construction. While direct physical disturbance to sparrow habitat and disturbance resulting from construction activities has occurred in the past, it has been limited because nearly all available sparrow habitat occurs within ENP and other conservation lands. Indirect effects of construction activities have included noise and vibration disturbance from heavy earth moving equipment and a general increase in human presence in the project area. Construction and maintenance of roads, canals, and levees near sparrow habitat have likely resulted in some localized effects to sparrows through loss or degradation of habitat or disturbance. However, maintenance and human disturbance is an ongoing issue that the Service has been attempting to address with its partner agencies. Maintenance of monitoring gauges has resulted in the destruction of habitat through the creation of paths between access points and the gauges. These paths can disrupt surface flow and may aid in spreading invasive plants or providing trails for exotic animals to access parts of the habitat.

2.8.4 Fire

Fire is a natural or human-related factor that affects marl prairies occupied by the sparrow and most sparrow habitat has burned at some point during the past 30 to 40 years. ENP, BCNP, SFWMD, and the FWC have all conducted prescribed burns within sparrow habitat on lands within their respective jurisdictions. Fire management on Department of the Interior (DOI) land (ENP and BCNP) combines fire operations, prescribed fire, and fire ecology in order to maintain fire in the natural ecosystems while considering impacts on nearby human population centers as well as threatened and endangered species habitat. The Service has consulted with ENP and BCNP on several fire management plans and has issued a biological opinion on ENP's 2015 Long-Term Fire Management Plan (NPS 2014). The Service also participates in the annual sparrow/fire symposium held at ENP by their fire management staff. In addition, these agencies and the Florida Division of Forestry conduct wildfire suppression and management within sparrow habitat.

In the short-term, fire typically renders sparrow habitat unsuitable for occupancy, because it removes the vegetation that sparrows rely upon for cover and refugia especially during the breeding season. Following fire, vegetation normally begins to regenerate rapidly and reaches pre-burn density and species composition about 2 years later. Sparrows do not regularly occupy burned areas for 2-3 years after fire (La Puma et al. 2007). ENP has conducted prescribed fires in former sparrow habitat within the western marl prairies to facilitate habitat restoration and has conducted wildfire suppression within CSSS-B, with the intent to reduce potential impacts to

sparrows and sparrow habitat. Additionally, prescribed burns have been conducted along the eastern ENP boundary to reduce the likelihood of human-ignited fires spreading into sparrow habitat near subpopulations C, E, and F. Prescribed, natural, and human-ignited fires have occurred within and in the vicinity of CSSS-D. Because fires reduce habitat suitability for up to 3 years, it can have adverse effects on sparrow populations, but also may be necessary in the long-term for the maintenance of habitat (Taylor 1983; Pimm et al. 2002; Lockwood et al. 2003, 2005; LaPuma et al. 2007).

Several fires burned within sparrow habitat during the 2008 dry season. Among these were the West Camp Fire (CSSS-Ax) and Mustang Corner Fire (CSSS-E and CSSS-F), which was the largest fire to have burned in ENP since the Ingraham Fire in 1989. Unlike previous burned areas, pre-fire vegetation data were available for these fires and Sah et al (2010) provide a preliminary evaluation of one year after the fire. Post-fire hydrology in these areas was favorable for normal recovery with a gradual increase in water depth. This is in contrast to a subset of sites burned in 2005 that were flooded within 7 to 14 days of the fires and remained significantly different from pre-burn vegetation composition even four years post fire. More recently in 2015, the Dogwood, Otter, and 10 Mile Fires burned a total of approximately 3,350 acres, and in 2014 ENP conducted the River of Grass NW prescribed burn, which covered approximately 8,750 acres. These fires were within or near CSSS-Ax habitat. The 10 Mile Fire burned occupied sparrow habitat in southwestern CSSS-Ax during 2015 and subsequently no sparrows were detected in that area during the 2016 surveys. Based on previous experience with burned areas, we would expect that conditions would be unsuitable for CSSS for the next 2 years in this area. This further increases the importance of providing hydrologically suitable areas in the northern part of CSSS-Ax which are most directly impacted by S-12 flows. Although habitat changes caused by these fires have not been monitored closely, they are part of a revised ENP fire management strategy that is structured to protect sparrows and improve sparrow habitat conditions.

Small populations are particularly at risk from a catastrophic event or series of events, such as fire or major rainfall during the breeding season. About two-thirds of the total CSSS population currently occur within subpopulation B, which has remained relatively stable. However, if a large fire or other catastrophic event were to occur in this subpopulation, there is a possibility the entire remaining CSSS population could be reduced by 60 percent or more. The Keyhole Hammock Fire was a lightning strike fire that started on August 14, 2017, in CSSS-B just east of Main Park Road. The extent of the burn was approximately 1,708 acres and covered roughly 75 percent (210 acres) of the Dogleg study plot (Virzi and Tafoya 2020). Sparrow numbers were declining prior to the fire with a total population of 34 in 2015, 16 in 2016 and 9 in 2017 but fell off sharply post-fire with only 2 reported in 2018 and 0 in 2019 (Virzi and Tafoya 2020). So far this season, a couple of singing males have been sighted in the more recovered parts of the Dogleg plot (T. Virzi pers. comm.). Most of the birds in this area pre-fire dispersed to surrounding suitable habitat as the field crews have observed color-banded birds across Main Park Road in the Alligator Hammock study plot in the first-year post-fire as well as south of the Dogleg in an area known as South Mahogany. CSSS habitat depends on periodic fire to

maintain its suitability and sparrows will likely move back into this area once the habitat is fully recovered.

2.8.5 Introduced Predators

The introduction of exotic species has been problematic in South Florida for many years. The Burmese python (*Python molurus bivittatus*) is found widely throughout South Florida and especially concentrated in ENP, Southern Glades, and the Model Lands where it is having major adverse effects on those ecosystems. Burmese pythons now number in the thousands if not tens of thousands in ENP and are known to consume a wide variety of prey (Snow et al. 2007), including small birds. There is documented overlap of Burmese python populations and sparrow subpopulations (Hart et al. 2015).

A more recent introduction, the Argentine black and white tegu (*Salvator merianae*), is also a concern. The tegu is a large omnivorous lizard which has been experiencing a population explosion in the Model Lands located to the east of ENP. Sightings of this species, as well as other tegu species, have been made within the critical habitat designated for CSSS-C and CSSS-D. As tegus outgrow their juvenile state, they begin to move towards a higher protein diet, frequently scavenging eggs from other reptiles, and even eating small birds. It is possible that as this exotic species continues to expand its range it may become a significant predator for CSSS (Mazzotti et al. 2014; Mazzotti 2015). While neither species has yet been documented depredating the CSSS, both species represent major threats as a predator, and are now an established part of the environmental baseline.

2.8.6 Climate Change

Climate change and sea level rise represent significant short- and long-term threats to the environmental baseline of CSSS and their habitat (Miller and Traxler 2018). Sea level rise has been estimated by various sources to potentially increase by as much as 12 to 48 inches by the end of the century (National Climate Assessment [NCA] 2014; Rahmstorf 2007; Pfeffer et al. 2008). Because the entire population of CSSS occurs in low lying areas in south Florida, the population may experience changes in habitat conditions or availability due to climate change and sea level rise over the next several decades (Figures 14, 15, 16).

Modeling scenarios provided by the Corps for South Florida at the +1, +2, and +3 ft above mean higher high water (MHHW) levels indicate that subpopulations A, B, and D are particularly vulnerable, even in the lower end of these scenarios. The baseline model scenario indicates that these areas may already be experiencing detrimental habitat effects due to sea level rise. Based on the Corps' model projections, a sea level rise of only 1-foot MHHW could result in a loss in area of approximately 40 percent of subpopulation Ax and 60 percent of subpopulations B and D. If sea levels were to rise 2-feet MHHW, it could result in a loss of almost 60 percent of subpopulation Ax and nearly 100 percent of subpopulations B and D. In the long term, all subpopulations could potentially experience major flooding effects, and if the CSSS is to be

saved as a species, accommodations for expanded habitat or relocation of individuals will need to be considered.

The Service will continue to monitor sea-level rise and other effects of climate change closely under the Strategic Habitat Conservation (SHC) paradigm. SHC is an adaptive, science-driven process that begins with explicit species population objectives in a framework for adjusting management strategies in response to monitoring, data, and assumption-driven research, including new data about climate change (Service 2006b).

2.8.7 Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication), portions of the Everglades have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species. Sah et al. (2013) observed; "In the Taylor Slough basin, surface water entering ENP typically has low average phosphorus content (10µg/l), (Sutula et al. 2001), *i.e.,* within the range considered to be protective of oligotrophic Everglades habitats. However, the cumulative effects of phosphorus loading in outflows from the canal (L-31N/C-111) seem to have enriched adjacent soils in Taylor Slough (Surratt et al. 2012), resulting in a change in plant species composition."

Increased production and changes in the periphyton (freshwater organisms clinging to plants and other objects projecting above the bottom sediments) result from increasing water levels, longer hydroperiods (Browder et al. 1994), or from nutrient enrichment (McCormick and O'Dell 1996). During high water events, submerged periphyton mats can become floating mats and shade out submerged macrophytes (Van Meter-Kasanof 1973). Field observations suggest that as heavy floating periphyton mats dry they can flatten and kill the aboveground portion of muhly grass and other vulnerable species. In contrast, sawgrass can penetrate this thick mat. Pimm et al. (2002), noted that an area spanning several kilometers dominated by mixed prairie was covered by such a mat after waters receded in 1996, which left few places for sparrows to nest during the following breeding season, and thereafter supported a smaller breeding population.

Implementation of the COP may affect water quality at certain times of the year in some locations. For example, the COP is designed to move more water into NESRS during the dry season when poor water quality is more prevalent. A monitoring plan has been developed for the COP which includes a water quality component. While anthropogenic effects on water quality are unlikely to be eliminated, water quality is expected to slowly improve. This is based on trends in the data indicating that Best Management Practices (BMPs) are continuing to reduce nutrient loading to the system.

2.8.8 Methylmercury

Since the late 1980s, researchers have documented mercury (Hg) contamination in the upper trophic-level biota of the Everglades with concentrations found in feather samples of longer-lived wading birds such as anhinga, ibis, and egrets (Frederick et al. 2004, Herring et al. 2009). Fish consumption advisories have been issued for the Everglades due to high Hg levels within species such as largemouth bass (*Micropterus salmoides*). In wetland systems, mercury contamination is particularly harmful as inorganic mercury under certain conditions is microbially converted to methylmercury (MeHg), which can accumulate as it moves up the food chain. Hign mercury concentrations have been hypothesized as one reason for documented declines of bird species in the Everglades. Cleckner et al. (1998) found spatial variability with higher concentrations of MeHg occurring in the southern portions of WCA-2 and WCA-3. Their studies also found that fish and hemipterans had the most MeHg and the magnitude of accumulation in biota varies seasonally and often independently of water concentration.

Monitoring of Hg levels has been conducted in birds based on blood, feather, and egg samples. Mercury concentrations can vary widely depending on the sample source material. Herring et al. (2009) found that feather growth influences blood mercury levels, and that nestlings were buffered to some degree against the adverse effects of mercury during early growth periods, because mercury is sequestered in growing feather tissues. Upon completion of feather growth, this elimination pathway is closed. Condon and Cristol (2009) found that the highest risk period for mercury intoxication in young songbirds may occur during the vulnerable period after fledging, when rapidly growing feathers no longer serve as a buffer against dietary mercury. Interestingly, Brasso et al. (2010), found that when female tree swallows lay eggs, some of the body burden of mercury was eliminated into each egg, potentially leading to declining mercury across the clutch.

Jackson et al. (2011) found up to 34 percent reduction in nesting success in Carolina wrens along the forest floodplain of two mercury contaminated rivers in Virginia. This study also reported a range of effects concentrations associated with various levels of reproductive impairment. A 10 percent reduction in nest success corresponded with 0.7 µg/g mercury in the blood, 2.4 µg/g mercury in body feathers, 3.0 µg/g mercury in tail feathers, and 0.11 µg/g mercury in eggs. This study showed that songbirds can suffer negative reproductive effects at relatively low mercury concentrations. Krabbenhoft (pers. comm. 2008), reported mercury concentrations for Cape Sable seaside sparrows in the Everglades, based on juvenile and adult feather and egg samples collected in all subpopulations, as 0.7 to 2.5 µg/g in feathers and 0.1 to 0.45 µg/g in eggs, consistent with the levels Jackson et al. (2011) observed to reduce nest success.

More recently, Virzi et al. (2018) reported preliminary results of their study measuring methylmercury concentrations in CSSS tissue samples collected from 2016-2017. Researchers collected breast feather samples, a less invasive sampling technique than drawing blood, from 128 sparrows in 5 subpopoulations A, B, C, D and E. Mainly adult males were sampled as they are more easily caught, however, female and free roaming juvenile sparrow samples were also collected. Reported methylmercury concentrations were highest in the eastern subpopulations,

where known methylmercury hotspots have previously been identified, with CSSS-C reporting a mean concentration of 8.83 mg/kg (n=29, SE=0.84) and CSSS-D reporting 10.11 mg/kg (n=5, SE=4.57). The other subpopulations, located further west in the Everglades reported lower concentrations of Hg with CSSS-A reporting a mean of 3.25 mg/kg (n=19, SE=0.46), CSSS-B 4.61 (n=58, SE=0.34) and CSSS-E 3.83 mg/kg (n=12, SE=0.85). While Virzi et al. (2018) and other researchers such as Jackson et al. (2011) conclude that these levels are high enough to cause sublethal impacts to reproductive success, it is interesting to note that the sparrow with the highest concentration of methylmercury in the study successfully fledged three young in a single nest. However, in general, those birds showing the lowest concentrations of methylmercury had the highest reproductive success (Virzi et al. 2018). It is believed that Hg levels in blood samples will provide the strongest correlation to impacts on reproductive success, so researchers are currenly planning for this study in the near future.

2.8.9 Conservation Actions by Others

The DOI (NPS, USGS and Service) developed a Memorandum of Understanding (MOU) outlining actions that are intended to benefit the CSSS (Service 2015). The MOU includes actions such as habitat management, research on population trends and estimates, improved information on genetics, and preparing for the potential need for captive breeding and translocation. Actions completed or ongoing since inception of the MOU are summarized by agency below. This list may not be complete but demonstrates progress towards completing priority actions.

Service

- Continue providing annual funding, barring any constraints, for intensive demographic monitoring.
- Working closely with USGS and ENP on model development and surveys.
- Working with researchers on draft population estimator and translocation studies.
- Coordinating with SFWMD on CSSS-D burn plan. Burn took place this year.

ENP

- Provides annual funding for helicopter range-wide surveys.
- Conducting a 5-year marl prairie vegetation study.
- ENP long term fire management plan.
- Providing funds to USGS for model development.
- Provided funding for a project to measuring fine scale microtopography throughout CSSS habitat with LIDAR.
- Continued woody vegetation control near CSSS-E.
- Funded mercury and DNA studies.
- Coordinating with SFWMD on CSSS-D burn plan.

USGS

- Maintaining the Sparrow Viewer and Sparrow Helper applications.

- Providing modeling support.
- Developing HSI criteria for CSSS habitat.
- Measuring fine scale microtopography throughout CSSS habitat with LIDAR.

The SFWMD is making progress on the removal of the old Tamiami Trail between S-12B and S-12D. Contractors have begun clearing the old Tamiami Trail roadway and removed the S-346 Bridge on March 12, 2020. Road removal will begin in earnest once Florida Power and Light relocates the overhead powerlines. Completion of this project is scheduled for January of 2022. This action is expected to protect CSSS-Ax from backwater effects caused by flows from S-12C/D. The ERTP 2010 BO evaluated replacement of the existing culvert in the old Tamiami Trail borrow canal with a plug. CEPP evaluated removal of the old Tamiami Trail roadway but did not include backfill of the adjacent canal.

Since 2016, the SFWMD has completed several habitat enhancement actions in and around CSSS-D as part of their commitments under the C-111 Spreader Canal Project. From 2015 to 2018 they treated approximately 4,200 acres for invasive woody vegetation (primarily cypress) that was encroaching into sparrow critical habitat. Between 2018 and 2019, an additional 1,200 acres surrounding the CSSS-D core nesting area underwent woody vegetation removal. In addition to these actions, the District has reduced ponded surface water in and around CSSS-D by gapping remnant roads formerly associated with the Aerojet missile facility. This is believed to have aided in the movement of water south and away from the core nesting area, however, it has not been confirmed though an analysis of available hydrologic gauge data. The District, in coordination with other State and Federal agencies, has also conducted prescribed fires in and around CSSS-D that benefit the habitat in this area.

The Service, in conjunction with its State and Federal partners, would like to consolidate what we've learned from the projects above and focus efforts on establishing suitable marl prairie habitat in areas that have either been formerly occupied by sparrows or in those areas where hydrologic modeling indicates a shift towards appropriate hydrology (*e.g.*, CSSS-Ax and areas east of CSSS-E). Much of the recent focus has been on restoring the hydrology in these areas, which remains the biggest driver in shifts in CSSS suitable habitat, however, habitat management via other means is also important. Several aspects of this approach have already been implemented by ENP, SFWMD and others (*e.g.*, woody vegetation removal, prescribed fire close to but not in core CSSS nesting areas, etc.) so the framework and tasks may vary. In general, the Service would like to see increased vegetation monitoring in these areas, if necessary, to establish a baseline and means of monitoring vegetation shifts. Once the baseline is defined, and in conjunction with existing hydrologic monitoring, mechanical means of habitat management such as prescribed fire and 'seeding' vegetation species which define optimal sparrow habitat (*i.e.,* Muhlenbergia) should be employed. Combining a more habitat-based management plan with restoration projects designed to correct unnatural shifts in hydrology could greatly improve habitat conditions in the upcoming years and thereby improve the outlook for the sparrow.

2.9 Environmental Baseline – Cape Sable Seaside Sparrow

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of listed species, their habitat (including designated critical habitat), and ecosystem within the action area. It is a "snapshot" of the species' health and critical habitat conditions in the action area at the time of the consultation and does not include the effects of the action under review.

Since the action area includes the entire range of the CSSS there is no difference between the status of the species in the action area and the status of the species. Refer to section 2.1 for details.

2.10 Summary and Analysis of Effects of the Action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

The evaluation method used to assess the effects of ERTP 2016 on the CSSS in the 2016 BO was different than that outlined in the preceding ERTP 2010 BO which was similar to the 1999 Biological Opinion on the MWD Project, the Experimental Program, and the C-111 Project and the 2002 BO on IOP. The ERTP 2016 BO used the Sparrow Viewer to provide regional and subpopulation-specific views of hydrologic conditions in close to real time. The Sparrow Viewer reduces the reliance on single gauges, such as NP-205, and displays results based on extrapolated hydrologic surfaces over the entire range of the species. One example of how this new evaluation method has improved our understanding of the effects of the project on the species can be seen by comparing the NP-205 output with the Sparrow Viewer output. It was previously believed that a stage of 6.01 ft NGVD at NP-205 would result in 40 percent of CSSS-Ax being dry. The Sparrow Viewer demonstrates that this stage only provided dry conditions over approximately 25 percent of the habitat, much less than what was expected. This BO will continue to use the Sparrow Viewer in its evaluation of hydrologic benefits and/or impacts to sparrows. RSM model runs of the various alternatives for the COP were run through the sparrow viewer utility for the first time providing consistent post-processing for observed data as well as model output.

The proposed action being evaluated in this Biological Opinion is the Combined Operational Plan (COP) which is the next iteration of operational plans for the completed MWD and C-111 SD Projects. Hydrologic conditions predicted by the model for the previous ERTP Biological Opinions were expected to maintain the CSSS population, but the species has continued to have low population numbers. The Service has reviewed the Corps' annual assessments (Corps 2016, 2017, 2018 and 2019) in analyzing the effects of the currently

proposed action. Hydrologic impacts to sparrow nesting and sparrow habitat have been documented as part of the analyses in these reports and are expected to continue with slight improvements while shifting locations of suitable habitat within the subpopulations. It is likely that some impacts will continue until proposed CERP projects are implemented and additional system-wide restoration is complete. The implementation of the COP is anticipated to decrease the frequency and intensity of previously documented impacts in northern CSSS-Ax and CSSS-F while increasing the chances of impacts in southern CSSS-Ax, CSSS-E and CSSS-D.

Managed water releases through the S-12 structures and the S-343A and B structures have a direct effect on the hydrologic condition within CSSS-Ax, which is located immediately downstream from these structures. These structures have varying effects on the hydrology in sparrow habitat which is reflected in the hydrologic modeling as well as in actual practice. As an example, the S-12A structure gates were partially opened due to high water in WCA-3A during the 2016 CSSS breeding season to prevent overtopping of the structure. The S-12A gate was opened to allow the equivalent amount of water that would have otherwise been released by overtopping in accordance with the 2012 Water Control Plan. Uncontrolled overtopping of the structure could have resulted in risk to the integrity of the structure. A noticeable increase in groundwater and surface water was detected five days later at NP-205. However, the individual effects of each structure on hydrologic conditions in the area have not been well established through field measurements. The S-12A structure is assumed to have the greatest direct influence on hydrologic conditions within sparrow subpopulation A due to its location immediately upstream of CSSS-Ax, followed by S-12B, C and D to a lesser extent.

Additionally, it is clear that construction and operation of the C&SF Project has diverted the historic flow path to the west, significantly increasing the amount of water in the vicinity of the S-12 structures and CSSS-Ax. The most significant difference between ERTP and the COP is the latter's ability to redistribute large amounts of water east into its historic flow path. This is anticipated to have beneficial effects in CSSS-Ax and drier subpopulations to the east while also impacting southern CSSS-Ax and western portions of CSSS-E. For these reasons, and because the shift of flow away from the S-12s, we have concentrated much of our evaluation on the effects of the proposed project on CSSS-Ax and CSSS-E.

2.11 Cape Sable Seaside Sparrow Evaluation Criteria

The South Florida Water Management District (SFWMD) in conjunction with Corps hydrologic modelers produced an extensive set of modeling results for an array of project alternatives using the iModel and Regional System Model (RSM). For purposes of this evaluation, consistent with the Corps Biological Assessment (Corps 2019a), performance of the preferred alternative ALT Q+ is compared to the Existing Condition Base (ECB19RR). While ALT Q+ was not independently modeled its performance is expected to be very close to the performance of ALT Q while including a few minor adjustments that were modeled in sensitivity runs. The previously described nesting and habitat criteria ware evaluated using the Sparrow Helper tool which runs the RSM model output through the same post processing routine that the Sparrow

Viewer does on observed or real time data. The Marl Prairie Habitat Suitability model produced and run by the USGS and its Joint Ecosystem Modeling lab was also used.

One issue with the ECB19RR that was identified by the Service and others after the first round of modeling, is that it contains features and operations associated with the Modified Water Deliveries (MWD) projects Increments 1.1, and 1.2, which already move half of the water east that is intended to be moved under the COP. This has the effect of masking the benefits and/or impacts of this water movement by the project alternative because it is already in the ECB19RR run. While the increments did undergo NEPA analysis they were not modeled, so the lift they provide above the ERTP existing condition is not quantifiable. Where appropriate in the following analysis we will compare the ECB19RR to 'observed' data to provide a better idea of the range of benefits or impacts which may be observed.

2.11.1 General Hydrology

The primary goal of the COP is to define an operating plan for the constructed elements of the Modified Water Deliveries to Everglades National Park project and the C-111 SD projects to enhance the delivery of water from WCA-3A into Northeast Shark River Slough. The COP utilizes both constructed features, such as the bridges and road raising in the Tamiami Trail Modifications (which allows increased stage in the L-29), as well as operational features like the Tamiami Trail Flow Formula to achieve a large part of the goal to redistribute flows eastward and restore Northeast Shark River Slough.

On average, ALT Q will move an additional 229,000 acre-feet per year (more than enough to cover Manhattan with 9 feet of water) into NESRS above that in the ECB19RR (Table 5). This includes a 142,000 acre-feet per year increase during the dry season (November to May) and an 87,000 acre-feet per year increase during the wet season (June to October) for a total flow amount crossing Transect 18 (Figure 9) of 561,000 acre-feet per year on average. This achieves about 40 percent of the restoration flows compared with flow estimates under the CERP of 1.4 million acre-feet per year. Once the rest of the Tamiami Trail is modified and water levels in the L-29 can be raised from 8.5 feet NGVD to 9.7 feet NGVD, more capacity will be available. Observed flows across this transect had averaged 105,000 acre-feet per year from 2012 to 2015. This increased to an average of 300,000 acre-feet per year during the period between 2016 and 2019 when Increments 1.1, 1.2 and 2 emergency high water actions were implemented. The ECB19RR, which includes Increments 1.1 and 1.2, estimates a similar flow volume of 332,000 acre-feet per year.

Research on flows in the pre-drainage Everglades, using the "Natural System Model" developed for CERP, showed that the eastern half of the Shark River Slough, including NESRS, had originally carried 65 percent of the Everglades flows, with only 35 percent going to the western half. Conversely, the routing under the C&SF Project put 78 percent of flows to the west, and only 22 percent through NESRS (Corps 1999). According to the modeling, the COP is expected to reverse this trend by shifting flow to the east and creating a flow distribution of 76 percent to the east and 24 percent to the west across the Tamiami Trail. The resulting flow across Transect

17 (western transect) will be a decrease of 67,000 acre-feet per year from 239,000 acre-feet per year in the ECB19RR to approximately 172,000 acre-feet for ALT Q (Table 5). Transect 17 flows will become 80,000 acre-feet per year during the dry season and 92,000 acre-feet per year during the wet season under the COP. This results in flow reductions at the S-12A structure (Table 5) from 29,800 acre-feet per year under ECB19RR to 21,400 acre-feet per year under ALT Q (reduction of 8,400 acre-feet). S-12B will see a reduction in flow of 10,000 acre-feet per year from 34,900 to 24,900 acre-feet per year under the COP.

This change in flow distribution is what the Service and other agency and Everglades scientists have been asking for since 2000. Not only will this benefit sparrows and other threatened and endangered species but all the natural resources in ENP and Florida Bay. This movement of water is expected to result in benefits to sparrows in CSSS-Ax by lengthening the duration of nesting season conditions and reducing hydroperiods that have significantly impacted the suitability of nesting habitat in this area. Similarly, it should help the drier areas in the eastern prairies like CSSS-F by making them wetter. CSSS-E, located in the middle of ENP just east of Shark Slough, will see the most impact from the COP as its western edge has been densely populated by sparrows. Close monitoring of this subpopulation will need to continue to see how the sparrows react to the changes in hydrology resulting from this project. The leading hypothesis is that habitat conditions will shift with changing hydrology and that the sparrows in CSSS-E will follow this shift in their habitat eastward to areas that will have improved hydrology resulting from the COP. The following sections will assess the model output to quantify the benefits/impacts from the movement of water outlined above. Reference the Corps Biological Assessment (Corps 2019a) and other species sections of this Biological Opinion for estimated changes in hydrology in WCA-3A, 3B and other areas north of ENP.

2.11.2 Nesting Criteria

Sparrows nest close to the ground surface with an average early season height of 6.3 inches and 8.3 inches later in the nesting season when water levels begin to rise (Lockwood et al. 2001). Water levels that rise above ground surface within occupied sparrow habitat, as a result of natural rain events or water management operations, may cause nest flooding and failure, increased predation, and a period of mating inactivity (male sparrows stop singing) which may reduce nesting success (Nott et al. 1998; Boulton et al. 2007; Baiser et al. 2008).

One important hydrologic measure of the potential for CSSS nesting success is the number of consecutive days between March 1 and July 15 (total of 137 days) that water levels are near or below ground surface. The range of dates used for the nesting season incorporates roughly 84 percent of the time between the earliest and latest recorded nests (Pimm et al. 2002) and is an indirect measure of the number of days potentially available for sparrow courtship and nesting (Van Lent et al. 1999). Pimm et al. (2002) estimates the nest cycle, including the number of days required for all the nesting stages (nesting, egg laying, incubation, and fledging), of CSSS to range from 34 to 44 days.

This metric has evolved over the years along with the science and analytical methodologies used to evaluate it. The Sparrow Viewer analysis proved that the NP-205 trigger stage of 6.01 feet NGVD was not providing 40 percent dry habitat rather it was closer to 25 percent (Service 2016). Additionally, previous research has indicated that a minimum of two successful nesting periods (at least 80 days), during the majority of years was considered essential to maintain a stable and viable CSSS population. A target for subpopulation Ax of at least 80 consecutive nesting days in all years until sparrow numbers have increased to at least 1,000 individuals has also been suggested by researchers (Walters et al. 2000; Pimm et al. 2002).

Considering the current status and past performance of CSSS reproduction, the Service has determined that nesting conditions provided previously were not sufficient to provide for increasing population numbers. In order to keep CSSS-Ax extant and to begin recovery of the species as a whole, water management actions should strive to provide nesting conditions which include at least 90 consecutive dry nesting days (equivalent to at least two, and possibly three broods) over 24,000 acres of the CSSS-Ax in every year until there are enough birds to sustain yearly population growth. The Sparrow Viewer analysis indicates that CSSS-Ax only met the target of 90 consecutive dry days over 40 percent of the habitat in 8 out of 29 years from 1991 to 2019. The reduction in nesting durations and amount of breeding habitat that have been provided throughout the period of record have not allowed the subpopulation to recover from the precariously low level which began in 1993. If these poor conditions continue, we can be expected to see further diminishment of the sparrow's numbers, reproduction, or distribution. The currently proposed action, with its shift of flow eastward into the historic flow path, is anticipated to improve hydrologic conditions in the western marl prairie and provide benefits to CSSS breeding success in CSSS-Ax.

CSSS-Ax

Performance of the nesting criteria under the COP as compared to the ECB19RR by subpopulation and for the period of record (POR) 1965 to 2005 is in the Corps' Biological Assessment (Corps 2019a). The number of years in which the target of 40 percent of the habitat experienced 90 or more dry nesting days is 20 of 41 years for the ECB19RR and 18 of 41 years for ALT Q. The average percentage of habitat across the POR that meets the target is 46.2 percent for ECB19RR and 44.2 percent for ALT Q a decrease of 2.0 percent. If either of these modelled alternatives performed similarly in the field as they do in the model, this would represent a significant benefit to areas within CSSS-Ax.

Table 6 is a partial reproduction of the Corps' table from their BA (Corps 2019a) with an additional column of years with overlapping POR from the EDEN Sparrow Viewer observed data (1991-2005). It is not standard practice to compare observed data with model data, however, in this case it is important to see the difference between modeled ECB19RR and observed existing condition because there may be more benefit from ALT Q than is visible in its comparison to the modeled ECB19RR. The average percentage of CSSS-Ax that meets the 90 continuous dry days over 40 percent of the area criteria drops to just 20.7 percent from 1991 to 2005 for the observed condition, a decline of 19.3 percent from the modeled ECB19RR during

this same time (40 percent). The benefit of ALT Q could be much higher if it were compared to the observed existing condition. This could be due to the issue discussed earlier where the modeled ECB19RR already includes a large amount of flow to the east.

CSSS-E

The number of years in which the target of 40 percent of habitat in CSSS-E experienced 90 or more continuous dry nesting days within 40 percent of the area is 27 of 41 years for the ECB19RR and 23 of 41 years for ALT Q. The average percentage of habitat meeting the requirement across the POR is 57.7 percent for ECB19RR and 50 percent for ALT Q which is a difference of -7.7 percent (Corps 2019a). While the average difference in the areal extent this metric is met across the POR is a reduction of 7.7 percent, there are 8 years when it is more than a 20 percent reduction (1966, 1967, 1969, 1986, 1992, 1996, 2000, and 2002). In four of these years the reduction causes the target to be missed. There are an additional four years with greater than 10 percent reduction in the area in which this target is met (range is 0.0 to 28.2 percent reduction). To put this into perspective, 20 percent of CSSS-E is 5,045 acres. Pimm et al. (2002) documented territory size range of 3.0 to 11.1 acres (1.2 to 4.5 ha) based on observations of known breeding pairs. A significant change in hydrology across 5,045 acres of currently occupied habitat in CSSS-E could disrupt and displace many nesting attempts.

Table 7 is a partial reproduction of the Corps' table for CSSS-E from the BA (Corps 2019a) with an additional column of years with overlapping POR from the EDEN Sparrow Viewer observed data (1991-2005). It is evident that the ECB19RR already contains a large portion of the redistributed flows eastward. The observed data shows the average area in which this target is met is 61.3 percent vs the modeled ECB19RR which shows 51.4 percent. If the observed data were used as the baseline, ALT Q would show a reduction of 17.2 percent in the area of CSSS-E where the target is met instead of the modeled 7.3 percent. This is not to say that the observed data is more accurate and should be substituted for the model base, however, it illustrates that the model may be over or underestimating the impacts/benefits of ALT Q.

CSSS-D

From the table in the Corps BA (Corps 2019a), the number of years in which the target of 40 percent of CSSS-D experienced 90 or more continuous dry nesting days over 40 percent of the area is 24 out of 41 years for the ECB19RR and 21 of 41 years for ALT Q. This is the second worst performing subpopulation at 53 percent of the years meeting target, second to CSSS-Ax which meets the target 45 percent of the time. CSSS-E meets the target in only 58 percent of years under ALT Q. Similar to CSSS-E, the average difference in the areal extent this metric is met across the POR for CSSS-D is a reduction of 7.2 percent. However, in 11 of the years the average reduction in areal extent meeting the target was 23.4 percent with a range of 14.7 - 41.9 percent; 23.4 percent of CSSS-D is equal to 2,275 acres.

In reviewing the overlapping observed data for this metric from 1991 to 2005 (Table 8) the ECB19RR run increases the average areal extent in which the target is met by 12 percent. The

ECB19RR also meets the target in more years out of the period of record. These indicate a sizeable benefit to CSSS-D but it is unclear why the performance drops again under ALT Q (a reduction of 11.9 percent). For the period 1991 to 2019 the sparrow viewer shows that this target has been met 48 percent of the time which is similar but slightly lower than the 41-year POR modeled percentage of 53 percent.

Subpopulations B, C and F meet the target 88, 90 and 73 percent of the POR respectively and ALT Q performs similarly to the ECB19RR with regards to the percentage of area meeting the target. As compared to the ECB19RR, ALT Q indicates that CSSS-C and F will experience increases in the areal extent in which the target is met in most years.

In summary, performance for this metric was as expected with a slight reduction in performance in CSSS-Ax for ALT Q versus the ECB19RR, however, both the ECB19RR and the alternative perform much better than the observed data from Sparrow Viewer from 1991 to 2019. CSSS-E exhibits moderate impacts when comparing ALT Q to ECB19RR and these may be underestimated due to the ECB19RR already containing flow eastward from Increments 1.1 and 1.2. Later, in this analysis, the marl prairie suitability index is used to determine the areal extent of benefit/impact in and around CSSS-Ax and CSSS-E. The ECB19RR performs the best for CSSS-D, however performance of the project falls off considerably to levels closer to the observed data from 1991 to 2005. The Corps, State, and other Federal partners should continue to monitor CSSS-D closely to see if the project makes conditions worse, per the modeling, or if conditions stay relatively the same.

2.11.3 Habitat Criteria

The average annual discontinuous hydroperiod required to maintain the wet prairie habitat where the CSSS currently resides is an important measure used to determine the effects of water management scenarios on the sparrow. Studies by Sah et al. (2007), confirm reports by Pimm et al. (2002), that sparrow habitat can remain suitable after experiencing hydroperiods up to 210 days, however, extended periods with annual hydroperiods of more than 210 days will shift the habitat from short hydroperiod marl prairie to wetter marsh habitat types unsuitable for sparrows. After review of the pertinent research, the target discontinuous hydroperiod for ERTP 2016 and future Biological Opinions was designated to be 90 to 210 days (Service 2016).

Consistent with past evaluations, maintaining and restoring sparrow CSSS-Ax is essential to maintaining the overall sparrow population. CSSS-Ax has the potential to contribute to improved population resiliency more than any other subpopulation because it is the most isolated and geographically separated from the other sparrow subpopulations, thereby providing the greatest protection from risks associated with local catastrophic events. Additionally, because of the amount of potential habitat available it has the potential to support large numbers of sparrows. The extirpation of CSSS-Ax would represent a significant reduction in the distribution of the CSSS and given its location and current condition, would be a challenging area in which to reestablish a self-sustaining subpopulation if it were lost. Walters et al. 2000, stated "Recolonization of Population A is most problematic because of its isolation from the other

populations by distance and barriers, especially Shark River Slough." Walters et al. 2000 goes on to conclude that, "…under the current water management strategy, near-term extinction of Populations A and D are real possibilities." As predicted in 2010, ERTP has not improved the status of this subpopulation but has kept it viable in anticipation of improved hydrologic conditions resulting from the MWD, C-111 SD and the COP.

Since 2016, the Service has been working closely with the Corps within the bounds of Increments 1, 1.1, 1.2 and 2 water management operations to provide improved hydroperiods within the marl prairies through movement of water eastward to the head waters of Shark River Slough under the Tamiami Trail Modifications 1-mile and 2.6-miles bridges. Additional inter-agency coordination has occurred during periodic scientist calls and weekly operations calls with SFWMD. ENP (2005) stated that "hydrologic processes, such as the timing, depth and distribution of water, are the primary drivers of CSSS habitat suitability and a primary resource that can be managed in Everglades restoration." It is evident that a major shift in how water flows through the Everglades is necessary to continue protection of the CSSS. The COP is anticipated to provide that shift.

The proposed implementation of the COP is expected to significantly change the hydrologic pattern provided by previous operational plans across all of sparrow habitat. With the average annual movement of 229,000 acre-feet of water to the east (in addition to the roughly 200,000 acre-feet per year from the Increments), hydroperiods in CSSS-Ax should be reduced. Analyses following in this document will determine how many acres in northern CSSS-Ax may be improved versus the acreage in the southern portion that may be negatively impacted by Shark River Slough flow moving westward toward this area. Additionally, areas in the eastern marl prairies which have been impacted by too little flow are expected to benefit. These areas include CSSS-F and the areas in between CSSS-E and C. The second largest subpopulation CSSS-E will see the most impacts from the COP where restoration of flow through Shark River Slough will cause the western edges of this subpopulation to become wetter and less suitable for sparrows. The following analysis assesses the impacts, as well as the benefits, each area is expected to experience as a result of the COP.

Modeled performance of the habitat criteria under the COP, compared to the ECB19RR, for each subpopulation during the period of record (POR) 1965 to 2005 is in the Corps' Biological Assessment (Corps 2019a). The Corps analyzed this metric as the percent of the habitat within the subpopulation (target is 40 percent) that meets a four-year running average discontinuous hydroperiod between 90 and 210 days and does not miss the target in two consecutive years.

CSSS-Ax

The observed 1-year and 4-year hydroperiods for CSSS-Ax during the period of record 1991 to 2020 is presented in Table 4. The averages for the 1-year and 4-year hydroperiods are generally within a day or two of each other so on occasion the following analyses will be looking at the 1-year hydroperiods depending on availability. The results of this metric are similar to that of the nesting metric in that CSSS-Ax only meets the target in 14 out of 41 years for the ECB19RR

and ALT Q and the average area in which the target is met is 26 percent for ECB19RR and 25 percent for ALT Q. The results of the model indicate that the target of 90 to 210 days is not met in the majority of years. The ECB19RR and ALT Q report a modeled average annual hydroperiod of 242 ± 56 and 243 ± 57 days respectively (Corps 2019a). For comparison, the observed average annual hydroperiod as reported by the Sparrow Viewer from 1991 to 2019 is significantly higher (286 ± 37) (Table 9). This could mean a reduction in 43 days on average of hydroperiod in CSSS-Ax which would significantly increase the area meeting the target of 210 days in areas with higher ground surface elevation. The marl prairie habitat suitability index analyzed later in this section will quantify the areas where this benefit may be realized.

Comparison between ECB19RR and ALT Q shows no difference, however, when the observed data for the POR 1991 to 2005 is added, there is a significant improvement in performance (Table 10). The percent area meeting the 90 to 210-day discontinuous hydroperiod target from 1991 to 2005 in the observed data is only 12 percent versus the ECB19RR's 21 percent and ALT Q's 22 percent. This represents a potential 10 percent increase in the area of CSSS-Ax that meets the target (roughly 8,215 acres). It is difficult to determine the magnitude of difference between observed data and the modeled ECB19RR, however, since the Increments have demonstrated their ability to move water east and with the COP predicting additional flow to the east, it is reasonable to assume that ecological lift in CSSS-Ax is possible. However, the reverse of this trend could also be true for the western portions CSSS-E on the eastern side of Shark Slough.

CSSS-E

Results of the habitat metric in CSSS-E as reported in the Corps BA (2019) demonstrate that the 90 to 210-day discontinuous hydroperiod target is met in 28 of 41 years for the ECB19RR but drops to 24 of 41 years in ALT Q. The average area within CSSS-E that the metric is met with ECB19RR is 44 percent for the 41-year POR. It drops to 39 percent of the area on average (a decrease of 5 percent) for ALT Q. While the POR indicates an average reduction of 5 percent, individual year differences range from +3 to -16 percent. Eleven years in the POR show an 8 to 16 percent reduction in area where the target is met. For perspective, 5 percent of CSSS-E equals 1,261 acres.

The ECB19RR and ALT Q report a modeled average annual discontinuous hydroperiod of 204 ± 64 and 217 ± 65 days respectively (Corps 2019a). This is compared to the observed average annual hydroperiod as reported by the Sparrow Viewer from 1991 to 2019 of 199 ± 53 days (Table 9). The difference between the observed data, ECB19RR and ALT Q is not as drastic in this area, however, ALT Q could increase the average hydroperiod in CSSS-E by 18 days, pushing the average outside the target range of 90 to 210 days. Additionally, Table 11 shows the side by side comparison of the observed data from Sparrow Viewer, ECB19RR and ALT Q with regards to the percentage of area within CSSS-E that meets the target. It is not common to compare observed data to model data, however, in this instance it is given to demonstrate the possible range of impacts in CSSS-E. Observed conditions from 1991 to 2005 in CSSS-E showed an average of 40 percent of the area meeting the target. During this same

period (1991-2005), the ECB19RR only met the target in 32 percent of the area and the project alternative ALT Q lowers it further to 29 percent.

CSSS-D

Results of the habitat metric in CSSS-D as reported in the Corps BA (2019a) show that the target 90 to 210-day discontinuous hydroperiod is met in 34 of 41 years for the ECB19RR but drops to only 18 of 41 years for the ALT Q. The average percentage of area meeting the target also drops from 57 percent in the ECB19RR to 37 percent in ALT Q. The difference in the percent area meeting the target for individual years range from +6 to –47 percent. Nearly half of all years in the 41-year POR show a reduction of 20 percent or more in the area meeting the target for ALT Q when compared to ECB19RR. Twenty percent of CSSS-D equals 1,945 acres. This is a concerning result for one of the smaller subpopulations that has been plagued by long hydroperiods for years.

Table 9 shows that CSSS-D has an average annual hydroperiod of 188 ± 46 days for the ECB19RR, 214 ± 50 for ALT Q, and 225 ± 46 for the observed data. This shows ECB19RR as the best performing alternative while ALT Q increases the average annual discontinuous hydroperiod to 214 days which is slightly outside the target range of 90 to 210 days, but ALT Q still performs better than the observed condition. Table 12 shows the percent area of CSSS-D that meets the 90 to 210-day hydroperiod for the ECB19RR, ALT Q and observed data from the sparrow viewer during the years 1991 to 2005. In this case the observed data and ECB19RR perform similarly with 43 and 44 percent of the area in the target window respectively, however, the performance of ALT Q falls off with only 28 percent of the area meeting the target. The model results indicate that ALT Q becomes wetter with 67 percent of the area experiencing hydroperiods ≥211 days.

CSSS-B, C, and F

Subpopulations B, C and F meet the target across 50 percent of their respective areas for ALT Q during the POR. ALT Q also performs similarly to the ECB19RR with regards to the percentage of area meeting the target in these subpopulations. CSSS-C experiences an increase of 4 percent areal extent in which the target is met under ALT Q, while CSSS-F sees a slight decline by 2 percent compared to ECB19RR. CSSS-B shows no change in areal extent the target is met between the ECB19RR and ALT Q (50 percent). This, however, is an increase from observed data in CSSS-B between 1991 and 2019 that shows the average area meeting the target was 35 percent.

Summary

In summary, the model does not show the anticipated lift ALT Q will provide as compared to the ECB19RR. This is assumed to be due to ECB19RR already including several major components of the COP which were initiated under Increments 1, 1.1, and 1.2. When compared to the observed data from the Sparrow Viewer there is potential for a significant increase in the area of

CSSS-Ax that will meet the target of 90 to 210-day average annual hydroperiod. CSSS-E exhibits moderate impacts when comparing ALT Q to ECB19RR and these may be underestimated due to the ECB19RR already containing flow eastward from Increments 1.1 and 1.2. As compared to observed data, within the overlapping period of record (1991-2005, Table 11) ALT Q could reduce the area meeting the target in CSSS-E by 11 percent. CSSS-D displays a significant reduction in years meeting the target as well as a reduction in areal extent in which the target is met. Monitoring of this subpopulation during the next several years will need to continue to make sure the hydrology is not shifted so far as to make it unsuitable for sparrows.

2.11.4 Marl Prairie Indicator

The Joint Ecosystem Modeling lab which is a part of the USGS Wetland and Aquatic Research Center produces several decision support tools that help relate hydrologic change, as predicted by models, to effects on species and habitats within the Everglades ecosystem. One of these tools, incorporated into the analysis below, is the Marl Prairie Indicator which is different than the two hydrologic metrics discussed previously. This model combines several hydrologic attributes such as maximum dry days, wet season water depth, and dry season water depth, with CSSS occupancy data to provide a more holistic visualization of how the proposed action may affect marl prairie habitat (Pearlstine et al. 2014). For more detailed information on this ecological model visit https://jem.gov/Modeling.

Figure 10 shows the results of the Marl Prairie Indicator through three maps; the habitat suitability of the ECB19RR (upper left), the habitat suitability of the project alternative ALT Q (lower left) and a map of the difference between ALT Q and ECB19RR in the lower right corner. Table 14 summarizes the acreage of differences within each subpopulation. The results of this tool generally track the changes we see from the previously analyzed hydrologic metrics in that it shows that northern CSSS-Ax is expected to exhibit slight improvements while southern CSSS-Ax, CSSS-D and CSSS-E will see moderate to high impacts.

As evidenced by the ALT Q - ECB19RR difference map, located in the bottom right of figure 10, the northern half of CSSS-Ax will see an increase of 1 to 20 percent towards meeting the marl habitat suitability target while the southern half of CSSS-Ax will see a 1 to 20 percent reduction in target met. In order to put these differences in perspective it is beneficial to look at the ALT Q map to see what the percent to target in these areas is under the project. Some of the most suitable habitat in CSSS-Ax is located in the northeast section and this area will be made slightly better.

The lower half of CSSS-Ax, where the ECB19RR and ALT Q show marginal habitat in the 30 to 40 percent category on averageis expected to experience habitat degredation. The difference map shows that about 27,480 acres (33.4 percent of total CSSS-Ax) will see a reduction in marl prairie suitability between 1 and 20 percent. This could shift this habitat out of reach for restoration in the future. Another hydrologic metric that may help explain the increase in hydrology in southern CSSS-Ax is east to west flows across transect 20 (Figure 9). Modeling

shows that this transect will see an average annual increase in flow under ALT Q, compared to ECB19RR, of 127,000-acre feet per year.

Approximately 18,402 acres or 83 percent of the total area in CSSS-E will see a decline in marl prairie habitat suitability of between 1 and 20 percent but the majority of this area will remain as suitable habitat and should remain occupied. This decline in suitability shows the general wetting trend that will occur in this subpopulation. An additional 523 acres in the northeast tip will see a reduction of 21 to 40 percent. This is currently occupied habitat with a high suitability score that could see damaging hydrologic shifts. ECB19RR and ALT Q show a large portion of the western edge of CSSS-E, adjacent to Shark River Slough, as already poor habitat. This poor-quality habitat will likely become unsuitable as a result of increased flows due to the project. It is encouraging to see that 1,557 acres of eastern CSSS-E are expected to have an increase of 1 to 20 percent in habitat suitability and the map shows additional acreage east of this, between CSSS-E and CSSS-C, which is also expected to see increased habitat suitability. Even though the model indicates improvements to habitat suitability, the area between the two subpopulations is not currently suitable for sparrows and management actions are necessary to make this area suitable. The Marl Prairie Indicator model already shows this area as 50 percent or more suitable in the ECB19RR and ALT Q maps, but it remains unoccupied indicating that there are more factors at play than what is considered in this model.

Results of this metric also for CSSS-D indicate that 9,506 acres, or 88 percent of this area, will see a decrease in percent of marl prairie suitability of 1 to 20 percent. CSSS-D also shows about 513 acres with a reduction of habitat suitability of 21 to 40 percent in the southeast corner. The southeast area is already poor quality habitat that is currently unoccupied by sparrows and will likely remain unsuitable with the COP. CSSS-D has been historically wet which has led to the core nesting area shrinking towards the highest points of the area just north and west of the center point. The model indicates that much of this area is already in the 50 – 60 percent habitat suitability range and substantial shifts towards wetter conditions could result in further losses in occupied habitat. Close monitoring and habitat maintenance in this area should continue in order to ensure it maintains the reproductive success seen in 2018-2019.

The majority of CSSS-F and CSSS-C will see slight increases in the marl prairie habitat suitability (1 to 20 percent). With the increase in flow to NESRS, as a result of the COP, the western and southwestern edges of CSSS-B outside of the main park road will see a decrease in marl prairies habitat suitability of between 1 and 20 percent. Field researchers and ENP scientists visit these areas frequently while monitoring CSSS so close observation of habitat conditions will continue in conjunction with standard hydrologic monitoring and vegetation surveys. The timing and volume of flows to NESRS, especially during the dry season will need to be monitored closely for effects to the shorter hydroperiod marl marsh on the flanks of SRS and Taylor Slough.

While it is expected that some currently suitable habitat will become wetter under the COP and future CERP projects, we must ensure through monitoring and habitat restoration actions that other portions of the sparrow's habitat simultaneously become more suitable.

2.12 Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Most of the lands in the Action Area for the CSSS are federally owned and managed. Therefore, the majority of impacts to CSSS and their habitat are anticipated to be related to future Federal actions that will require a separate consultation under the Act.

2.13 Conclusion

Research involving CSSS biology, population levels, demographics and habitat conditions have been conducted since the species was first described (Howell 1919) and more extensive research has been conducted since the first systematic population surveys in 1981. Beginning in 1993, the rapid decline in the CSSS population began to be documented, causes investigated, and its perilous status recognized.

Previous releases of water into habitat occupied by subpopulation Ax and the current inability to effectively manage water levels south of the S-12 structures have posed a significant risk to that subpopulation's continued existence. Additionally, frequent lack of sparrows within subpopulations D and F along with the increase in discontinuous hydroperiods experienced within subpopulation D since the construction of the C-111 Spreader Canal Project has resulted in an increased urgency to achieve substantial benefits for the species in order to avoid the possible near-term extinction of these subpopulations. The risk of extinction of the CSSS is substantially increased by the reduction of viable subpopulations from three to two and the decrease in distribution across the landscape.

Starting with the Service's jeopardy biological opinion in 1999, emergency actions were implemented to reduce the amount of water crossing western Tamiami Trail at the S-12 structures. In 2002, the Corps implemented its hydrologic equivalent to the Service's RPA which introduced the seasonal closures of the S-12 A/B/C, S-343 A/B and S-344 structures. The intent of these actions was to keep CSSS-A extant until MWD and components of CERP could be implemented. S-332D pumping restrictions were also incorporated during the sparrow nesting season to help protect CSSS-C. These actions have proved successful over the past 18 years while planning has progressed on CERP and the MWD and C-111 SD Projects are nearing completion through the COP. The Service is encouraged that the Corps will maintain these closures in COP (except the agreed upon removal of S-344 closure and relaxation of S-332D pumping prior to the nesting season). However, CSSS-Ax has experienced a significant decline in population as evidenced by the fact that zero birds were surveyed there during ENP's 2019 range-wide helicopter surveys for the first time since the surveys began. This is a possible indication that emergency protections enacted under the previous projects are not sufficient to prevent the extirpation of CSSS-A. The COP is anticipated to shift the paradigm for sparrows by

redistributing flows across Tamiami Trail with a majority going east into NESRS. With reduced hydroperiods in northern CSSS-Ax, increased hydroperiods in the eastern marl prairies (CSSS-C and F) and careful monitoring and adaptive management of CSSS-E and CSSS-D, the COP may move us one step closer in the process of recovery for the CSSS.

2.13.1 Summary of hydrologic metrics

Nesting window

Performance for this metric (provide at least 90 consecutive dry nesting days per year over 40 percent of each subpopulation) was as expected with a slight reduction in performance in CSSS-Ax for ALT Q versus the ECB19RR, however, both the ECB19RR and the alternative perform much better than the observed data from the Sparrow Viewer from 1991-2019. CSSS-E exhibits moderate impacts when comparing ALT Q to ECB19RR and these may be underestimated due to the ECB19RR already containing flow eastward from Increments 1.1 and 1.2. The ECB19RR performs the best for CSSS-D, however, modeled performance of the project falls off considerably to levels closer to the observed data during 1991 to 2005. The Corps, and State and other Federal partners should continue to monitor CSSS-D closely to see if the project makes conditions worse, per the modeling, or if conditions stay relatively the same. Subpopulations B, C and F meet the target 88, 90 and 73 percent of the POR respectively and ALT Q performs similarly to the ECB19RR with regards to the percentage of area meeting the target. CSSS-C and F experience increases in areal extent in which the target is met in most years under ALT Q as compared to ECB19RR.

Habitat Criteria

The model does not show the lift anticipated for ALT Q compared to the ECB19RR but when compared to the observed data from the Sparrow Viewer there is potential for a significant increase in the area of CSSS-Ax that will meet the target of 90 to 210 day average annual discontinuous hydroperiod. Similarly to the nesting criteria, CSSS-E exhibits moderate impacts when comparing ALT Q to ECB19RR and this may be underestimated due to the ECB19RR already containing flow eastward from Increments 1.1 and1.2. As compared to observed data, ALT Q could result in an 11 percent reduction in the area meeting the target. CSSS-D results in a decrease in the number of years meeting the target as well as a reduction in the areal extent in which the target is met. Monitoring of this subpopulation during the next several years will be necessary to make sure the hydrology is not shifted so far as to make it unsuitable for sparrows.

Marl Prairie Indicator

The Marl Prairie Indicator generally mirrors the hydrologic changes expected under the COP which shifts a significant amount of flow into NESRS and also increases flows to Taylor Slough especially during the dry season. The southern half of CSSS-Ax and nearly all of CSSS-E and CSSS-D will see declines in the percent to target met of between 1 and 20 percent. Some of the habitat that is shifting to a wetter regime was already poor habitat and could become completely

unsuitable for sparrows. The northern half of CSSS-Ax and areas northeast of this subpopulation and areas between CSSS-C and CSSS-E could see an increase in percent of target met between 1 and 20 percent. Most of the area outside of the currently delineated sparrow subpopulations already shows marginal habitat that could be improved with the project; however, these areas are currently unoccupied and there is considerable uncertainty as to whether they can be made suitable for sparrows to occupy without significant management actions. Work is continuing on the Marl Prairie Indicator to strengthen the relationship between changes in the index and response by sparrows through density and duration of occupancy. It is currently being interpreted as a general trend analysis to relate shifts in hydrology to potential habitat suitability changes.

Cape Sable seaside sparrows have a short life history (low annual survival and high fecundity), therefore they can be affected very quickly by anthropogenic changes that adversely affect sparrow breeding habitat. Given its short lifespan (2 to 3 years), the CSSS can experience rapid population declines over a short period of time if conditions severely limit or do not permit annual reproduction over several consecutive breeding seasons (Virzi et al. 2011).

The previous operational plans such as ISOP, IOP, and ERTP, have not been able to achieve substantial increases in desired dry days during the nesting season, improved discontinuous hydroperiod throughout the rest of the year, improved habitat conditions within the CSSS subpopulations, or reverse the decline in overall population numbers. The entire Everglades restoration community has been anticipating the implementation of the COP which is the culmination of the MWD and C-111 SD projects. This project will begin to remove major impediments to flow through the historic Everglades by restoring flow to NESRS and benefitting the entire Everglades ecosystem.

The continuing decrease in sparrow population in CSSS-Ax, with zero birds recorded there during the 2019 range-wide helicopter surveys, is a major concern. A few adults and two fledglings were observed during intensive demographic monitoring by field crews, but the outlook is troubling. The importance of recovering CSSS-Ax to a self-sustaining population can not be understated and several of the leading avian ecologists and sparrow researchers have published statements to this effect. A few are reproduced below. For a more complete list see the ERTP 2016 BO.

Walters et al. 2000, in The AOU Conservation Committee Review of the Biology, Status and Management of Cape Sable Seaside Sparrows: Final Report emphasized the following conclusions at that time relating to the status and vulnerability of CSSS subpopulations, especially CSSS-A;

> *"Continued releases of water into habitat occupied by Population A pose a significant risk to that population's continued existence. We conclude that under the current water management strategy, near-term extinction of Populations A and D are real possibilities. We further believe that retaining water in WCA-3A rather than releasing it west of Shark*

River Slough and into Taylor Slough in wet years will substantially reduce the risk of extinction of Populations A and D."

"The best available means to reduce the risk of extinction of the Cape Sable seaside sparrow is to retain and recover Population A. Population E should be monitored carefully while interim water management remains in place, because the persistence of this population also is important to the future of the sparrow."

"The risk of extinction of the total population obviously is increased by the reduction of the number of large populations from three to two." (*i.e.,* the loss of A, and persistence of B and E).

Ten years later, Slater (2009), as part of the preparation of an Emergency Management Action Plan for the Endangered Cape Sable Seaside Sparrow, observed;

"The sparrow population has shown no signs of recovery and we see little of the habitat restoration deemed necessary for their recovery. Therefore, we must emphasize that, without amending the conditions that led to the bird's initial decline, any implementation of emergency actions are prone to failure."

The Reasonable and Prudent Alternative to avoid jeopardy to the continued existence of the Cape Sable seaside sparrow described in the 2016 ERTP Biological Opinion had as its main component to finish the planning and implementation of the COP. The Service still believes, based on the best available scientific information, that this project will provide the greatest long-term benefit for all natural resources in the project area. There will be impacts to sparrow habitat on the eastern side of Shark River Slough, which were anticipated, but the Service feels that a concerted effort to monitor and adaptively manage the COP will reduce these impacts. After reviewing the current status of the CSSS, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Corps' proposed action is not likely to jeopardize the continued existence of the CSSS.

3.0 CAPE SABLE SEASIDE SPARROW CRITICAL HABITAT

3.1 Status of the Critical Habitat

This section summarizes the effects of all past human and natural activities or events that have led to the current status of designated critical habitat for the Cape Sable seaside sparrow and are relevant to formulating the biological opinion about the proposed action.

3.1.1 Critical Habitat Description and Status

Critical habitat for the CSSS was initially designated on August 11, 1977 (42 *FR* 42840). The critical habitat designation was revised on November 6, 2007 (Service 2007c; 72 FR 62736) and

the revised habitat included the following primary constituent elements (PCE), which are those physical and biological features essential for the conservation of the species:

1. Calcitic marl soils characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades. These soils support the unique vegetation community and probably many of the food items upon which sparrows depend. They also result from specific hydrologic conditions that are characteristic of the marl prairies. These soils are an integral component of sparrow habitat.

2. Herbaceous vegetation that includes greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species (when measured across an area of greater than 100 ft^2): muhly grass, Florida little bluestem, black-topped sedge, and cordgrass. These plant species are largely characteristic of areas where sparrows occur. They act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. The species identified in the PCE consistently occur in areas occupied by sparrows (Sah et al. 2007), however, many other herbaceous plant species and low-growing forbs also occur within sparrow habitat (Ross et al. 2006), and some of these may have important roles in the life history of the sparrow.

3. Contiguous open habitat. Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. This PCE provides the space for population and individual growth, and provides the open, contiguous habitat that sparrows prefer.

4. Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches longer than 30 days during the period from March 15 to June 30 more than 2 out of every 10 years.

The critical habitat designation, as amended in 2007 (Service 2007c; 72 FR 62736), designated five units as critical habitat for the CSSS. These critical habitat units represent the areas determined to be occupied at the time of listing that contain one or more of the characteristics that are essential for the conservation of the species (PCEs) and that may require special management (Figure 4). The units designated as CSSS critical habitat in the Action Area are: (Unit 1) marl prairie habitats that support sparrow subpopulation B and lie exclusively within ENP in the vicinity of the Main Park Road (State Road 9336), between SRS and Taylor Slough; (Unit 2) marl prairie habitat that supports sparrow subpopulation C within ENP along its eastern boundary in the vicinity of Taylor Slough; (Unit 3) marl prairie habitats that support sparrow subpopulation D in the state- owned and managed Southern Glades Wildlife and Environmental Area to the east of Taylor Slough and ENP; (Unit 4) marl prairie habitat that supports subpopulation E within ENP located on the eastern edge of SRS; and (Unit 5) marl prairie habitat that supports subpopulation F within ENP located just west of the S-332B pump station and detention area and L-31N canal.

Currently, critical habitat includes areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Miami-Dade, and Monroe Counties. Much of this area is within the boundaries of ENP. The designated area encompasses about 84,865 acres and includes subpopulations B through F (Figure 3). Subpopulation A is not included as part of the critical habitat. It was excluded per the Secretary's discretion as described in 50 CFR 62736.

The following descriptions summarize baseline conditions in critical habitat Units 1, through 5.

Unit 1 (Subpopulation B)

Unit 1 consists of 39,029 acres of marl prairie and lies exclusively within ENP. The unit is bounded on the south by the long hydroperiod Eleocharis-dominated wet prairie and mangrove zone just inland of Florida Bay, on the west by the sawgrass marshes and deep water slough communities of SRS, on the north by the pine rockland vegetation communities that occur within ENP on Long Pine Key, and on the east by the sawgrass marshes and deep water slough vegetation communities of Taylor Slough. There is a continuous topographical gradient across the site, from the slightly higher elevated pine rocklands north of the unit down to the lower-lying mangroves in the south. The area is bisected by the Main Park Road, which serves as the primary public access route from Homestead to Flamingo and Florida Bay. It is also bisected by the Old Ingraham Highway, which is the original historical roadway that provides alternate access to Florida Bay. Much of the western portion of this roadway was removed and restored to grade, but the eastern portions of the road, with its associated borrow canal and woody vegetation encroachment, interrupt the continuity of the prairies within the eastern portion of this unit. Besides the road, borrow canal, and woody vegetation, which are not critical habitat, the area consists of one large, contiguous expanse of marl prairie that contains all the PCEs for the sparrow.

When sparrows were first recorded in the area during the 1974 to 1975 surveys, they were abundant and widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery nearly 50 years ago. Consequently, the Service considered the unit to be occupied at the time of listing. The area is the largest contiguous patch of marl prairie east of SRS. It is currently occupied and has consistently supported the largest sparrow subpopulation ranging from an estimated 1,792 to 3,184 birds since 1992 (Pimm and Bass 2002, 2005; Pimm et al. 2002, 2007) (Table 1).

The natural characteristics of this area make it relatively immune to risk of flooding or frequent fires (Walters et al. 2000). Its location south of the higher-elevation pine rocklands provides it a degree of protection from high water levels compared to other units. Within the southern portion of the greater Everglades watershed, surface water generally flows from north to south, with most water moving through SRS, and to a lesser extent through Taylor Slough. The pinelands block the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of Unit 1 occur

on relatively high elevations and remain relatively dry. Consequently, this area is not easily flooded as a result of managed water releases or upstream events, and the high water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics.

Similarly, the area is not particularly vulnerable to fires. It is not over drained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and managed prescribed fire. The public road that traverses the area could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides human access greater than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2 (Subpopulation C)

Unit 2 consists of 8,304 acres of marl prairie habitat that lies exclusively within ENP in the vicinity of Taylor Slough, along the eastern edge of ENP. The unit consists of the prairies that flank both sides of the relatively narrow Taylor Slough. The area is bordered by the pine rocklands of Long Pine Key on the west and by isolated pine rocklands and the L-31W canal that runs along the ENP boundary to the east. It is bordered by an area of constriction in Taylor Slough that is closely flanked on both sides by forested habitats at the southern end and by the Rocky Glades, a region of thin marl soils and exposed limestone and sparse vegetation to the north. The area is bisected by the Main Park Road in the southern portion of the unit, but the remainder of the unit consists of contiguous marl prairies.

Sparrows were not discovered in the area until 1972 (Ogden 1972). At the time of discovery, sparrows were found to be widely distributed and abundant in this area (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that sparrows have occupied this locality since at least the time of initial listing on March 11, 1967. Following its discovery, the site was the location of some of the first intensive study of the sparrow's biology and its relationship to its habitat (Werner 1975).

During the mid-1970s, sparrows were abundant at this site (Werner 1975), and surveys in 1981 estimated 432 sparrows in this area (Pimm et al. 2002). Since 1981, the sparrow subpopulation at this site has declined and estimates have ranged from 0 to 1,176 sparrows between 1992 and the present (Pimm et al. 2002; Pimm and Bass 2005) (Table 1). During intensive nest surveys in 2008, Virzi et al. (2009) documented four females and five males, nine nest attempts and reported nest survival as 22.8 percent and in 2009, 9 males and 5 females were documented. No additional intensive nest surveys have been conducted in this subpopulation to date. When sparrows were abundant in this area, the habitat was in a relatively dry condition, with average annual hydroperiods between 90 and 180 days (ENP 2005).

Beginning in 1980, a pump station (S-332), installed along the eastern boundary of ENP at the approximate location of the historic slough, was operated to increase hydroperiods in the area. This resulted in extended hydroperiods within the portions of the area downstream from the pump station and vegetation changed from suitable marl prairie to unsuitable sawgrass marsh due to altered hydrology as a result of the S-332 pump station operations (ENP 2005), and sparrows ceased to occur in this area. At the same time, the northern portions of Unit 2, north of pump station S-332, continued to be over drained as a result of pump station and adjacent canal stage operations which effectively lowered the water table in the surrounding agricultural lands immediately bordering ENP (Johnson et al. 1988; ENP 2005).

In these over drained areas, frequent fires impacted the habitat and resulted in reduced sparrow numbers (Pimm et al. 2002). A large fire occurred in March 2007 when the Frog Pond fire swept through this area. Sah et al. 2010 and Virzi et al. 2009, observed that the habitat then was beginning to recover.

Unit 2 provides a contiguous expanse of habitat that is largely separated from other nearby subpopulations in an area that is uniquely influenced by hydrologic characteristics. The Taylor Slough basin is a relatively small system, and much of the headwaters of the Slough are cut off by canals, agricultural land, and development to the east of ENP. Portions of this unit near the slough have deep soil (15.7 inches) (Taylor 1983) and support resilient vegetation that responds rapidly following fire (Taylor 1983; Werner and Woolfenden 1983).

Sparrows were reported to reoccupy burned sites in this region within 1 to 2 years following fire (Werner and Woolfenden 1983). The unit contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrows use. However, the area along the eastern boundary of ENP remains heavily influenced by water management operations (ENP 2005). Portions of the area are also over drained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of SRS in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in aiding dispersal among the eastern subpopulations, acting as a ‘‘hub’’ that facilitates dispersal in the region and recolonization of local areas that are detrimentally impacted and locally extirpated.

Unit 3 (Subpopulation D)

Unit 3 consists of 10,806 acres of marl prairie vegetation in an area that lies on the eastern side of the lower portion of Taylor Slough. The majority of this area, 92 percent or 9,973 acres, is within the Southern Glades Wildlife and Environmental Area, which is jointly managed by the District and Florida Fish and Wildlife Conservation Commission (FWC). The remaining 8 percent (883 acres) occurs within the boundary of ENP. The area is bordered on the south by the long hydroperiod eleocharis vegetation and mangroves that flank Florida Bay, on the west by the sawgrass marshes and deepwater vegetation of Taylor Slough, on the east by long-hydroperiod eleocharis vegetation and over drained areas with shrub encroachment in the

vicinity of U.S. Highway 1, and on the north by agricultural lands and development in the vicinity of Homestead and Florida City.

When sparrows were discovered in this area, they were widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that the sparrows have occupied this locality since at least the time of listing. This is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is consequently unlikely to be affected by the same factors (*e.g.*, large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between SRS and Taylor Slough. This area is separated from other sparrow subpopulations by Taylor Slough and the agricultural and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape would tend to prevent potential fires from spreading from the area of sparrow subpopulations B, C, E, and F into the subpopulation D area.

Similarly, hydrologic conditions in this region are different than those that affect the other subpopulations because water levels are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban and agricultural areas to the north.

The 1981 comprehensive population survey estimated 400 sparrows within this region (Pimm et al. 2002). This was higher than any number of sparrows recorded in the area in recent years, and estimates have ranged from 0 to 256 sparrows since 1992 (Pimm et al. 2002; Pimm and Bass 2005) (Table 1).

The area contains all PCEs, but most of the area is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006). There is a small portion of the subpopulation critical habitat area that is somewhat higher (0.5 to 0.75 ft.) in elevation and, depending on current ambient water level conditions, offers a variable core habitat area utilized by sparrows. The larger scale habitat in this area is divided by several canals that are part of the C–111 basin. This canal system results in altered hydrologic conditions in the region (ENP 2005) and causes extended hydroperiods during wet periods (Pimm et al. 2002). The C-111 Spreader Canal Phase 1 Project, adjoining this critical habitat area, was constructed and became operational in 2012.

Effects of the project were analyzed and documented in the Service's Biological Opinion (Service 2009). Operational constraints that limit the amount and timing of water that can be pumped through project features that may affect the sparrow, and monitoring are ongoing in the area to determine if planned conditions for the project are being realized or if adaptive management may be required.

Unit 4 (Subpopulation E)

Unit 4, subpopulation E, consists of 22,278 acres of marl prairie habitat in an area that lies along the eastern margin of SRS. This unit occurs entirely within ENP. The area is bordered to the

south by the pine rocklands of Long Pine Key and by an area dominated by dwarf cypress trees. The sawgrass marshes and deepwater slough vegetation communities of SRS comprise the western and northern boundary of the area, and the Rocky Glades comprise the eastern boundary.

When sparrows were discovered in this area, they were relatively widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 40 years ago. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840).

This area supports one of the large, relatively stable sparrow subpopulations. It is centrally located among the areas supporting other subpopulations, and its location probably plays an important role in aiding dispersal among subpopulations, particularly movements from the eastern subpopulations (Units 1 – 5) to the only subpopulation west of SRS, subpopulation A. Since 1992, this area has consistently supported the second largest sparrow subpopulation in most years, with estimates ranging from 112 to 1,200 individuals (Pimm et al. 2002; Pimm and Bass 2005) (Table 1).

The location of this subpopulation helps to protect it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of managed water releases is generally dampened by the time their influence reaches this area. However, the proximity of this area to SRS will make the habitats and the sparrows that they support vulnerable to hydrologic effects during restoration activities that rehydrate SRS. The western portions of the area may become too deeply inundated at higher frequencies to provide good habitat for sparrows under some conditions such as what occurred during the 2016 nesting season. Large-scale hydrologic modifications, such as those proposed under the COP and future CERP, have the potential to influence habitat conditions in this area, and may require special management attention. Large-scale fires may detrimentally affect this area since there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation.

While the area is relatively distant from ENP boundaries and potential sources of human-caused fires, there is still concern that fires ignited on the eastern boundary of ENP may rapidly spread into the area. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

Unit 5 (Subpopulation F)

Unit 5, subpopulation F, consists of 4,883 acres of marl prairie that lies along the eastern boundary of ENP, and is the northernmost of the designated critical habitat units. Unit 5 is also the smallest of the five units. It is bounded on the north and west by ENP sawgrass marshes and deepwater slough vegetation communities associated with SRS, and on the east by agricultural

and residential development along the eastern boundary of ENP. Its southern boundary is defined and characterized by the sparse vegetation, shallow soils, and exposed limestone depressions and solution holes of the Rocky Glades. When sparrows were discovered in this area, they were relatively widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of initial listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 *FR* 40685 and 42 *FR* 47840).

The first comprehensive CSSS population survey conducted in 1981 resulted in an estimated population of 112 sparrows in this area, and most subsequent surveys have resulted in estimates lower than this (0 to 112), including several years (1993, 1995, 1999, 2000, 2007, 2008, 2009 and 2016), when no sparrows have been found (Pimm et al. 2002; Pimm and Bass 2005) (Table 1). Since 2010 sparrows have been found in the area, indicating that sparrows are consistently using the area, albeit at low numbers.

This area could serve to support or recolonize subpopulations C and E (Units 2 and 4). Loss of available habitat in this area would result in a reduction in the total spatial distribution of sparrows. Its position in the landscape results in a unique set of threats that differ from those in other subpopulations. Because of its proximity to urban and agricultural areas and its relative topographic location, this area has been consistently over drained in recent years and remains dry during the year for longer periods than other subpopulations (shortened hydroperiod). The relative dryness of the area may allow the site to remain suitable as habitat for sparrows under very wet conditions, when other subpopulations may become deeply inundated for long durations.

Due in large part to its relatively drier hydrologic condition and its proximity to developed areas, Unit 5 has been subjected to frequent human-caused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine, melaleuca, and Brazilian pepper have become established in local areas often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by resource management agencies to address this issue, and control of woody vegetation will continue to be necessary.

3.1.2 Factors Affecting Critical Habitat

Hydrology of the area is the most important component of the habitat. In addition to directly affecting the sparrow and its ability to forage, move within habitat, and nest, hydrologic patterns largely dictate the plant community composition, and even the fire frequency. Persistent increases in hydroperiod may quickly result in changes in vegetation communities from marl prairies or mixed prairies to sawgrass-dominated communities resembling sawgrass marshes

(Nott et al. 1998). Average hydroperiods that extend beyond 210 days per year generally result in sawgrass marsh communities (Ross et al. 2006). The interaction of fire and flooding also strongly influences the suitability of habitat for sparrows. In the most extreme case, the vegetation in areas that burn and are subsequently flooded within 1 to 3 weeks after the fire, either as a result of a natural rainfall event or human-caused hydrologic changes, may not recover for a long period, possibly 10 years or more (Ross 2006). Conversely, areas that are subjected to short hydroperiods generally have higher fire frequency than longer hydroperiod areas (Lockwood et al. 2003, Ross et al. 2006), and are readily invaded by woody shrubs and trees (Werner 1975, Davis et al. 2005). Another factor affecting critical habitat is sea level rise which represents significant short- and long-term threats to the CSSS and their habitat. Sea level rise has been estimated by various sources to potentially increase by as much as 12 to 48 inches by the end of the century (National Climate Assessment [NCA] 2014; Rahmstorf 2007; Pfeffer et al. 2008). Because the entire population of CSSS occurs in low lying areas in south Florida, the population may experience changes in habitat conditions or availability due to climate change and sea level rise over the next several decades (Figures 14, 15, 16).

Unit 1

The natural characteristics of Unit 1 (subpopulation B) make it relatively less susceptible to risk of human-induced flooding or frequent fires (Walters et al. 2000). Its location south of the high-elevation pine rocklands provides it a degree of protection from high water levels that do not occur within any other units. Within the southern portion of the greater Everglades watershed, water flows from north to south, with most water moving through SRS, and to a lesser extent through Taylor Slough. The pinelands interrupt the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of the area occur on relatively high elevations and remain comparatively dry. Consequently, this area is not as easily flooded as a result of managed water releases or upstream events, and the high water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics. However, as demonstrated by various model scenarios, changes in water management actions do result in changes to habitat conditions within this unit.

Unit 1 is also not particularly vulnerable to fires. It is not over-drained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and intensively managed prescribed fire. The public road that traverses Unit 1 could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides greater human access than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2

Unit 2 (subpopulation C) contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrow use. However, the area along the eastern boundary of ENP remains heavily influenced by hydrologic management (ENP 2005). Portions of the area are also over drained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of SRS in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in supporting dispersal among the eastern subpopulations, acting as a ''hub'' that facilitates dispersal in the region and recolonization of local areas that are detrimentally impacted.

Construction of the S-332B North and West Detention Areas and the associated pumps and operations schedule has resulted in wetter conditions and improved habitat quality in some areas and the desired water stage during the sparrow nesting window in subpopulation C critical habitat.

Unit 3

Unit 3 (subpopulation D) is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is consequently unlikely to be affected by the same factors (*e.g.*, large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between SRS and Taylor Slough. This area is separated from other sparrow subpopulations by Taylor Slough, and the area immediately north of this subpopulation consists of agriculture and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape tend to prevent fires from spreading into Unit 3.

Similarly, hydrologic conditions in Unit 3 are different than those that affect the other subpopulations because water levels are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban/agricultural areas to the north. The 1981 comprehensive population survey estimated 400 sparrows within Unit 3 (Pimm et al. 2002). This was higher than any number of sparrows recorded in the area in recent years when estimates have ranged from 0 to 256 sparrows between 1992 and the present (Pimm et al. 2002; Pimm and Bass 2005; Virzi et al. 2009).

Unit 3 currently contains all of the PCEs, but the majority of this unit is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006). The habitat in Unit 3 is divided by several canals that are part of the C–111 basin. This canal system results in relatively altered hydrologic conditions in the region (ENP 2005) and causes extended hydroperiods during wet periods (Pimm et al. 2002).

CSSS Unit 3 critical habitat was affected when canal infrastructure for the SDCS was completed in the 1980s. The SDCS was originally constructed to meet agricultural water supply needs, flood control, and mitigate saltwater intrusion as part of the overarching C&SF Project. More recently the C-111 SD project (Corps 1994) was modified by adding a series of detention areas aimed at retaining water within ENP by reducing seepage out of ENP into the C-111. In addition, in the 1960s, Aerojet-General Corporation built a plant, other infrastructure, and the Aerojet Canal, which is now within the Unit 3 critical habitat boundary, to supply the National Aeronautics and Space Administration (NASA) with solid rocket fuel components. It was closed after NASA chose liquid fuel for the Saturn V program. When the Aerojet product was not selected for the Saturn project, the land and facilities were returned to the State, and are now managed by the SFWMD and FWC as a nature preserve.

Unit 4

The central location of Unit 4 (subpopulation E) helps to prevent it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of any managed water release is generally dampened by the time their influence reaches this area. However, the proximity of this area to SRS may make the habitat and the sparrows that it supports vulnerable to hydrologic effects during wet periods. The western portions of Unit 4 may become too deeply inundated to provide good habitat for sparrows under certain conditions. Large-scale hydrologic modifications, such as those proposed under the COP, have the potential to influence habitat conditions in Unit 4, and may require special management attention (*e.g.*, attention to the timing and volumes of flows into NESRS). Large-scale fires may detrimentally affect Unit 4, and there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation. While this unit is relatively distant from ENP boundaries and potential sources of human-caused ignition, fires that are started along the eastern ENP boundary may rapidly spread into Unit 4. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

Unit 5

Because of its dryness and its proximity to developed areas, Unit 5 (subpopulation F) has been subjected to frequent human-caused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine, melaleuca, and Brazilian pepper have become established in local areas (Werner 1975), often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by resource agencies to address this issue, and control of woody vegetation will continue to be required.

All Units

Habitat changes in the CSSS critical habitat appear to be impacting the survival and recovery of the sparrow. Marl prairie requires an annual discontinuous hydroperiod of between 90 and 210 days. PCE 2 outlined in the revised critical habitat designation for the Cape Sable seaside sparrow (Service 2007c; 72 FR 62736), specifies herbaceous vegetation that includes greater than 15 percent combined cover of live and standing vegetation comprised of one or more of Muhly grass, Florida little bluestem, black topped sedge, and cordgrass. These plant species are largely characteristic of areas where sparrows occur and act as cover for foraging, nesting, and normal behavior for sparrows during a variety of conditions. In areas where the annual discontinuous hydroperiod frequently approaches or exceeds the upper threshold of 210 days the habitat transitions to more wet tolerant species such as sawgrass and cattail. In those areas where the annual discontinuous hydroperiod frequently approaches or is less than the lower 90-day threshold, the habitat shifts toward woody vegetation and there is an increased risk of fire.

Inspection of annual discontinuous hydroperiod data from Sparrow Viewer for the eastern subpopulations (Table 4), indicates that for the period 1991-2019, CSSS-B, CSSS-C and CSSS-E on average have achieved the target of 90 to 210-day hydroperiod. CSSS-D has averaged wetter than the target by 15 days. CSSS-F has averaged drier than optimal hydroperiods at 81 days leaving it prone to fire and invasive woody vegetation encroachment. The period from 2009 to 2019 reflects much wetter conditions compared to the previous 1991 to 2008 period, in terms of average discontinuous hydroperiod days (Table 15).

Beginning in 2009 through present, the average annual discontinuous hydroperiod for CSSS-C has increased by 57 days but still remains in the target discontinuous hydroperiod. CSSS-D and E increased by 48 and 36 days respectively and fall out of the target range of 90–210 days. Average annual discontinuous hydroperiod has doubled in CSSS-F for the time period 2009–2019 putting it within the target range. CSSS-B has also increased during this wetter period by 21 days on average.

From 2009 through 2016 the EVER4 gauge, previously used before the Sparrow Viewer, average discontinuous hydroperiod has been 253 days and has consistently exceeded the target 90 to 210-day discontinuous hydroperiod. New gauges (CSSS-D1, CSSS-D2, and CSSS-D3) were installed in CSSS-D by the SFWMD as part of monitoring for the C-111 Spreader Canal Phase 1 Project in 2011 (Service 2009). Two of these gauges (CSSS-D1 and CSSS-D2) are in, or near a core habitat area for this subpopulation where sparrows have routinely nested or have been observed in recent years. The average annual discontinuous hydroperiod at these two gauges between 2011 and 2015 was 136 and 182 days respectively, well within the 90 to 210-day range, indicating that hydrologic conditions are appropriate for the maintenance of suitable habitat for this core area. However, the average at these two gauges from 2016 to 2019 increased to 219 days and 262 days respectively. During the period between 2011 and 2015, the average discontinuous hydroperiod at EVER4 was 248 days which is an increase of 33 days over the average for the period of record. This demonstrates that the discontinuous hydroperiod at EVER4 has increased since the completion of the C-111 Spreader Canal Project. The third

installed gauge, CSSS-D3, was installed at a location near habitat that is only used by sparrows for breeding during dry years. This gauge location appears to be heavily influenced by the headwater stage level at the S-18C structure on the C-111 canal. Between 2011 and 2016, the average annual discontinuous hydroperiod at CSSS-D3 was 310 days. It has increased to 348 days during the period 2016-2019.

Examination of the recent 2009 to 2019 data compared to the previous (1992 to 2008) record (Table 3) indicates that there has been some loss of habitat in the optimal 90 to 210 day discontinuous hydroperiod range in subpopulations B (10 percent), C (9 percent), D (25 percent), and E (13 percent), possibly attributable to either recent wetter meteorological conditions or the construction and commencement of operations of nearby MWD/C-111 SD components. This analysis also indicates that the amount of habitat in the optimal 90 to 210-day discontinuous hydroperiod range in subpopulation F has more than doubled from 24 to 52 percent over that same time period.

It is worth reiterating here the nesting window requirement of providing at least 90 dry nesting days between March 1 and July 15. While this metric is normally a species-level attribute it is directly relatable to the annual hydroperiod in that if the nesting window is shortened, the hydroperiod will likely be increased. The percent of acreage meeting the criteria of 90 dry days within all critical habitat areas (B, C, D, E, and F) has decreased from 61 percent to 48 percent in CSSS-B, 90 percent to 65 percent in CSSS-C, 47 percent to 27 percent in CSSS-D, 61 percent to 44 percent in CSSS-E, and 93 percent to 80 percent in CSSS-F when comparing the record from 1991 to 2008 to the more recent 2009 to 2019 record, this change is possibly attributable to wetter meteorological conditions or the construction and commencement of operations of nearby MWD/C-111 SD components.

3.2 Environmental Baseline

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of listed species, their habitat (including designated critical habitat), and ecosystem within the action area. It is a "snapshot" of the species' health and critical habitat conditions in the action area at the time of the consultation and does not include the effects of the action under review.

Since the critical habitat of the CSSS is located entirely within the action there is no difference between the status of the critical habitat in the action area and the status of the critical habitat. Refer to the prior Status of the Critical Habitat section for details.

3.3 Summary and Analysis of Effects of the Action

The same hydrologic modeling used in the Effects of the Action section for the species was used to evaluate potential adverse impacts to PCEs and designated critical habitat for the Cape Sable seaside sparrow. The model was developed to simulate conditions within critical habitat for the sparrow for the baseline condition and with project operations for the 1965 through 2005 period

for each of the simulations. The PCEs for the Cape Sable seaside sparrow were described in the rule designating critical habitat (Service 2007c; 72 FR 62736) and discussed previously in this Biological Opinion. The PCEs include:

3.3.1 Calcitic marl soils

Marl soils are characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades and support the vegetation community on which sparrows depend. These soils result from specific hydrologic conditions that are characteristic of the marl prairie. Presently, soils in the marl prairie landscape within sparrow habitat vary in physical and chemical characteristics due to the variation in topography, hydrology, and vegetation (Sah et al. 2007). There currently are no methodologies upon which to evaluate the effects of project operations on soils; therefore, we rely on our hydrologic analyses that provide for marl prairies as surrogates for soils analyses.

3.3.2 Herbaceous vegetation

This PCE is characterized by greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species: muhly grass, Florida little bluestem, blacktopped sedge, and cordgrass. These plant species act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Many other herbaceous plant species also occur within sparrow habitat (Ross et al. 2006), and some of these play important roles in the life history of the sparrow (Sah et al. 2007).

Previous sections of the BO provided the Service's rationale for the 90 to 210 days discontinuous hydroperiod metric to measure effects on the plant community that provides marl prairie habitat detailed in this PCE. The average annual difference in hydrologic model simulations between the ECB19RR and ALT Q for Units 1-5 (subpopulations B, C, D, E, and F) are provided in the Corps BA (Corps 2019a). The annual differences in percent area meeting the 90 to 210-day discontinuous hydroperiod are discussed further in section 2.11.3.

Based on comparisons between ECB19RR and ALT Q for this metric, 0 acres (0.0 percent) of Unit 1 critical habitat, the largest and most populous CSSS critical habitat area, would be adversely affected by the proposed COP. The analysis indicates that Unit 2 critical habitat would experience an average annual increase of 336 acres (+4.0 percent) meeting the optimal 90 to 210-day discontinuous hydroperiod. Unit 3 critical habitat would experience an average annual decrease of 2,161 acres (-20.0 percent) meeting the optimal 90 to 210-day discontinuous hydroperiod. Unit 4 critical habitat would experience an average annual decrease of 1,114 acres (-5.0 percent) meeting the optimal 90 to 210-day discontinuous hydroperiod. Unit 5 critical habitat would experience an average annual decrease of 98 acres (-2.0 percent) meeting the optimal 90 to 210-day discontinuous hydroperiod.

In summary, the analysis of model results indicates that across all CSSS critical habitat there would be an average annual decrease of 3,037 acres (3.6 percent of the total 84,982 acres) meeting the 90 to 210-day discontinuous hydroperiod. These acres are likely to experience a

reduction in optimal vegetation communities due to changes in hydrology caused by the proposed project. However, the Service has determined that since the effects of the project as indicated by this metric will be minimal, (an average of 3.6 percent of the total critical habitat) the overall effect of the proposed project based on this PCE will not result in adverse modification of critical habitat.

3.3.3 Contiguous open habitat

Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs and trees. The constituents of this PCE are largely predicated on a combination of hydroperiod and periodic fire events. Fires prevent hardwood vegetation from invading these communities and prevent the accretion of dead plant material, both of which decrease the suitability of this habitat type for Cape Sable seaside sparrows. Implementation of the proposed action could extend or reduce hydroperiods but are expected to cause a minimal effect on the occurrence of natural fires in the area. Establishment of woody vegetation in marl prairie habitat is often complicated by a variety of factors. Insufficient hydroperiod can favor woody vegetation which prefers shorter periods of inundation. Land elevation changes, such as levees, as well as nutrient loading can also influence the presence of woody vegetation. The proposed operational changes under the COP are intended to control excessive hydroperiod changes and thereby minimize changes in woody vegetative composition. Appreciable changes in this PCE within each critical habitat area are not anticipated.

3.3.4 Hydrologic regime

In order to maintain suitable vegetative composition conducive for successful nesting, it is important that water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years. Water depths greater than 7.9 inches (20 centimeters) during the breeding period can result in elevated nest failure rates (Lockwood et al. 2001; Pimm et al. 2002). If these water depths occur for short periods during nesting season, sparrows may be able to re-nest within the same season. These depths, if they occur for sustained periods (>30 days) within sparrow nesting season, may reduce successful nesting to a level that could be insufficient to support a population if it occurs more frequently than 2 out of every 10 years. This PCE was discussed previously in the context of its importance as an indicator of hydrologic conditions that would prevent flooding sparrow nests, maintain suitable conditions for sparrows occupying these areas, and generally support the vegetation species that are essential to sparrows.

The result of the ALT Q model simulation for the 41-year period of record (1965- 2005) for critical habitat Units 1-5 indicate that this metric is exceeded (consecutive years missing target) once in Unit 1 (CSSS-B; *e.g.*, the target was exceeded in 1982 and 1983), three times in Unit 2 (CSSS-C), 10 times in Unit 3 (CSSS-D), 8 times in Unit 4 (CSSS-E) and 0 times in Unit 5 (CSSS-F). However, on average, less than 6 percent of critical habitat in individual sparrow subpopulations B, C and D will be affected by water depths greater than 7.9 inches between

March 15 and June 30. CSSS-E and F will see effects in 9.3 percent and 6.9 percent of the area on average respectively (note CSSS-F does not experience consecutive years exceeding the target but does exceed it in 6 years over the 41-year POR).

In summary the analysis based on this PCE shows that overall effects of the action as indicated by this metric, and based on model simulations, on critical habitat for all subpopulations will be insignificant and confined to areas that are not currently utilized by breeding sparrows.

3.4 Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Most of the lands included in designated critical habitat for the CSSS are federally owned and managed. Therefore, the majority of impacts to designated critical habitat are anticipated to be related to future Federal actions that will require a separate consultation under the Act.

3.5 Conclusion

Cape Sable Seaside Sparrow Designated Critical Habitat

Based on the Sparrow Viewer analysis of the observed record, the extent of critical habitat that experiences a 90 to 210-day discontinuous hydroperiod that maintains habitat conditions for all phases of the CSSS life cycle has been determined to be deficient within the boundaries of many subpopulations. In addition, a number of studies have determined that vegetation change due to wetter conditions can occur rapidly, but recovery to healthy marl prairie vegetation in critical habitat is much slower (Sah et al. 2013, Armentano et al. 2006). Hydrologic modeling for the COP indicates that across all CSSS critical habitat there would be an average annual decrease of 3,037 acres (3.6 percent of the total 84,982 acres) meeting the 90 to 210-day discontinuous hydroperiod. These acres are likely to experience a reduction in optimal vegetation communities due to changes in hydrology caused by the proposed project. However, the PCEs as described for the designated critical habitat remain present across the landscape within each critical habitat unit. Further, the COP is anticipated to redistribute flows from west to east across Tamiami Trail which should have the effect of improving hydrology west of Shark Slough, as well as, in the eastern subpopulations CSSS-F and C. There will likely be short to medium-term shifts in the location of optimal habitat within some subpopulations and perhaps even loss of some marginal to low quality habitat, however the long-term benefit of restoring the distribution, volume and timing of flows through the Everglades will provide benefit for all natural resources in the Greater Everglades.

Additionally, the Marl Prairie Indicator generally mirrors the hydrologic changes expected under the COP which shifts a significant amount of flow into NESRS and also increases flows to

Taylor Slough especially during the dry season. The southern half of CSSS-Ax and nearly all of CSSS-E and CSSS-D will see declines in the percent to target met of between 1 and 20 percent. Some of this habitat that is shifting to a wetter regime was already poor habitat and could become completely unsuitable for sparrows. The northern half of CSSS-Ax and areas northeast of this subpopulation and in between CSSS-C and CSSS-E could see an increase in percent of target met between 1 and 20 percent. Most of the area outside of the currently delineated sparrow subpopulations already shows marginal habitat that could be improved with the project, however, these areas are currently unoccupied and there is considerable uncertainty as whether they can be made suitable for sparrows to occupy.

No construction activities are proposed under the COP, since most of the structural features have already been constructed under MWD and C-111 SD projects or are proposed under future CERP projects, so there will be no direct impacts to sparrow critical habitat due to construction. Some improvements in habitat conditions within limited areas of critical habitat in sparrow subpopulations C and F are likely to occur under the COP. Based on this information, the Service has determined that the COP is not likely to destroy or adversely modify designated critical habitat for the Cape Sable seaside sparrow.

4.0 EVERGLADE SNAIL KITE

4.1 Status of the Species

This section summarizes the effects of all past human and natural activities or events that have led to the current status of the Everglade snail kite and are relevant to formulating the biological opinion about the proposed action.

4.1.1 Legal Status

The Everglade snail kite is one of three subspecies of snail kite, a wide-ranging New World raptor found primarily in lowland freshwater marshes in tropical and subtropical America from Florida, Cuba, and Mexico south to Argentina and Peru. The Everglade subspecies occurs in Florida and Cuba, including Isla de la Juventud, and northwestern Honduras, though only the Florida population is listed. The Florida population was first listed under the Endangered Species Preservation Act in 1967, and protection was continued under the Endangered Species Conservation Act of 1969. The Everglade snail kite (hereafter, snail kite), and all the other species listed under the Endangered Species Conservation Act of 1969 were the first species protected under the Act of 1973, as amended, and all of these species were given the 'endangered' status (32 FR 4001). Critical habitat for the snail kite was later designated in 1977 (50 CFR 17.95).

4.2 Species Description

The snail kite is a medium-sized raptor, with a total body length for adult birds of 14 to 15.5 inches and a wingspan of 43 to 46 inches (Sykes et al. 1995). In both sexes, the tail is

square tipped with a distinctive white base that appears as a white patch on the rump when in flight. The wings are broad, long, and paddle-shaped and are held bowed downward or cupped when in flight (Sykes et al. 1995). Adults of both sexes have red eyes and juveniles have brown eyes (Brown and Amadon 1976; Clark and Wheeler 1987). The plumage is markedly different among adult male, adult female, and juvenile birds. Adult males have a uniformly slate gray plumage, and adult female plumage is brown dorsally and pale white to cream ventrally, with dark streaking on the breast and belly (Sykes et al. 1995). Immature kites are similar in appearance to adult females, but are more cinnamon-colored, with tawny or buff-colored streaking rather than brown streaking. Females are slightly larger than males. A slender, decurved bill is an adaptation for extracting the kite's primary prey (*Pomacea* spp.) and is a distinguishing character for field identification in both adults and juveniles.

4.3 Life History

4.3.1 Breeding and Nesting Behaviors

Initiation, peak, and duration of the snail kite breeding season in Florida varies from year-to-year and are affected by water levels and climatic conditions (temperatures, precipitation). Ninety-eight percent of the nesting attempts are initiated from December through July, while 89 percent are initiated from January through June (Sykes 1987c; Beissinger 1988; Snyder et al. 1989), with the peak in nest initiation occurring from February to April (Sykes 1987c). Snail kites often re-nest following failed attempts early in the season as well as after successful attempts (Beissinger 1986; Snyder et al. 1989), with an observed maximum number of two successful broods within a breeding season (Bennetts et al. 1998). Analysis by Fletcher et al. (2015) indicates that average annual snail kite breeding season lengths have increased concomitantly with the exotic island apple snail (*Pomacea maculata*) invasion.

Pair bonds are established prior to egg-laying and are relatively short, typically lasting from nest initiation through most of the nestling stage (Beissinger 1986; Sykes et al. 1995). Male kites select nest sites, usually over water, and conduct most nest-building, which is probably part of courtship (Sykes 1987c; Sykes et al. 1995). Unlike most raptors, snail kites do not defend large territories and frequently nest in loose colonies or in association with wading bird nesting colonies (Sykes 1987b; Sykes et al. 1995). Kites actively defend small territories extending about 4 miles around the nest (Sykes 1987b). Copulation can occur from early stages of nest construction, through egg-laying, and during early incubation, if the clutch is not complete.

Egg-laying begins soon after completion of the nest but may be delayed a week or more (Sykes 1987c). An average 2-day interval between laying each egg results in the laying of a 3-egg clutch in about 6 days (Sykes et al. 1995). The clutch size ranges from one to five eggs, with a mode of three (Sykes 1987c; Beissinger 1988; Snyder et al. 1989). Incubation may begin after the first egg is laid, but generally after the second egg (Sykes 1987c). In Florida, the incubation period lasts 24 to 30 days (Sykes 1987c). Incubation is shared by both sexes, but the contribution of incubation time between the male and female is variable (Beissinger 1987).

Hatching success is variable from year-to-year and between areas. In nests where at least one egg hatched, hatching success averaged 2.3 chicks per nest (Sykes 1987c).

After hatching, both parents initially participate in feeding young, but there is variability in the contribution of each member of the pair (Beissinger 1987). The nestling period lasts about 23 to 34 days and fledging dates may vary by 5 days among chicks (Sykes et al. 1995). Following fledging, young are fed by one or both adults until they are 9 to 11 weeks old (Beissinger 1987). In total, snail kites have a nesting cycle that lasts about 4 months from initiation of nest-building through independence of young (Beissinger 1986; Sykes et al. 1995).

Snail kites also have a relatively unique mating system in Florida that is described as ambisexual mate desertion, in which either the male or female may abandon nests part way through the nestling stage (Beissinger 1986, 1987). This behavior appears to occur primarily under conditions when prey is abundant, and it may be an adaptation to maximize productivity during favorable conditions. Following abandonment, the remaining parent continues to feed and attend chicks through independence (Beissinger 1986). Abandoning parents presumably form new pair bonds and initiate a new nesting attempt.

Snail kites mature early compared with many other raptors and can breed successfully the first spring after they hatch, when they are about 8 to 10 months old. However, not all kites breed at this age. Bennetts et al. (1998) reported that only 3 out of 9 first-year snail kites attempted to breed, while all 23 adults that were tracked attempted to breed. Reichert et al. (2012) evaluated breeding probabilities using marked birds and found that annual breeding probabilities for after-hatch-year snail kites were generally low (around 0.17 during non-drought years). Annual breeding probabilities for this group increased during drought years to 0.48, which, given that adult breeding probabilities declined during drought years, probably reflects inexperience in young kites or density dependence in breeding opportunities (Reichert et al. 2012). In contrast, reproductively active adult snail kites breeding probabilities averaged 0.87 during non-drought years and 0.62 during drought. Annual breeding probabilities vary among snail kites based on environmental conditions and individual characteristics (*e.g.*, fitness, previous breeding experience), but are significantly <1 (Reichert et al. 2012). During severe drought years, a large portion of the population (~30-70 percent [Reichert et al. 2012], up to 80-90 percent [Beissinger 1986]) may not attempt to breed. In addition, non-breeding (potentially less fit) adults were unlikely to breed in the following year (probability ≤ 0.10; Reichert et al. 2012). The oldest confirmed breeding snail kite in Florida is 24 years (Reichert et al. 2015), and the maximum lifespan of a snail kite in the wild is at least 25 years (Reichert et al. 2010).

4.3.2 Diet and Feeding Behavior

Snail kites are dietary specialists, a relatively rare foraging strategy among raptors. Throughout the range of all subspecies of snail kites, apple snails (*Pomacea* spp.) consistently compose the primary prey of snail kites, who possess several unique adaptations that allow them to efficiently capture, extract, and consume the snails (*e.g.*, the slender, deeply hooked, sharp-tipped bill that allows kites to efficiently extract snails from their shells; long slender toes that allow kites to

grasp large snails) (Sykes 1987a; Sykes et al. 1995; Beissinger 1990). Historically, snail kites in Florida foraged primarily on the Florida apple snail (*P. paludosa*), which is the only species of *Pomacea* native to North America (Sykes 1987b; Rawlings et al. 2007). Several species of non-native apple snails have recently become established within the snail kite's range in Florida. Of these, *P. maculata* is commonly eaten by snail kites, and in some wetlands composes the vast majority of the snail kite's forage base. These highly invasive exotic snails are larger, more fecund, and more drought tolerant, and have faster growth rates and longer life spans than Florida apple snails (Ramakrishnan 2007; Kyle et al. 2013; Horgan et al. 2014). Because of these factors, *P. maculata* has the potential to influence a wide variety of snail kite behaviors and demographic rates, both positively and negatively, through direct and indirect pathways (Fletcher et al. 2015; see Invasive Nonnative Species under Threats to the Species).

Under normal conditions, snail kites are nearly completely dependent on apple snails as prey. However, other prey items have been documented, especially during periods of limited prey availability, such as drought conditions or cold spells. Beissinger (1990) reported that kites captured and consumed small turtles, such as the musk turtle (*Sternotherus odoratus*) and mud turtles (*Kinosternon* spp), and they captured and consumed another type of small freshwater snail (*Viviparus georgianus*). Other prey that have been occasionally documented include crayfish (*Procambarus* spp.), speckled perch (*Pomoxis nigromaculatus*), and small snakes (Sykes et al. 1995).

Snail kites use two visual foraging methods: course-hunting, while flying 5 to 33 ft above the water surface, or still-hunting from a perch (Sykes 1987a; Sykes et al. 1995). In Florida, course-hunting is more frequent than still-hunting; still-hunting may be limited by perch availability or prey abundance (Cary 1985; Valentine-Darby et al. 1998). While course-hunting, the flight is characterized by slow wing beats alternating with gliding; the flight path is usually into the wind, with the head oriented downward to search for prey. Snails are captured with the feet at or below the surface, to a maximum reach of about 6 inches below the surface. Snail kites do not plunge into the water to capture snails and never use the bill to capture prey. Individuals may concentrate hunting in a particular foraging site, returning to the same area as long as foraging conditions are favorable (Cary 1985). Capture rates are higher in summer than in winter (Cary 1985), with no captures observed at a temperature less than 10°C (50°F). Snail kites frequently transfer snails from the feet to the bill while in flight to a perch. Feeding perches include living and dead woody-stemmed plants, blades of sawgrass (*Cladium jamaicense*) and cattails (*Typha* spp.), and fence posts. Snail kites are gregarious and may forage in common areas in proximity to other foraging kites.

Non-breeding snail kites may fly long distances over the course of days or months while tracking prey resources across the landscape (Bennetts and Kitchens 2000). Nesting snail kites often forage within 1-2 km of their nests under favorable conditions but have been observed traveling more than 6 km to find snails to feed young (Beissinger and Snyder 1987).

Pias (2012) found a negative relationship between foraging rates and home range size on Lake Tohopekaliga (Toho), suggesting that smaller home ranges may have higher densities of

available snails. However, foraging rates were not significantly different between parents of successful nests and those of failed nests (Pias 2012). Similarly, analyses investigating the effect of foraging rates on snail kite reproductive parameters did not show a strong association (Fletcher et al. 2015). Reasons for this may include over-riding factors (*e.g.*, predation, environmental factors) that have a greater effect on reproductive success, or a potential foraging/snail density threshold above which there is low variation in foraging rates and below which kites will not stay to forage (Reichert et al. 2010; Darby et al. 2012, Olbert 2013, Fletcher et al. 2015).

4.4 Habitat and Hydrologic Requirements

Snail kites and apple snails are wetland-dependent species and rely on wetland habitats for all aspects of their life histories. The primary wetland habitat types upon which kites rely consist of freshwater marshes and the shallow-vegetated littoral zones along the edges of lakes (natural and man-made) where apple snails occur in relatively high abundance and can be found and captured by kites. Within these habitats, water levels and recession/ascension rates can affect snail kite and apple snail reproductive efforts and success.

4.4.1 Nesting Habitat

Nesting almost always occurs over water, which deters predation (Sykes 1987b). An important feature for snail kite nesting habitat is the proximity of suitable nesting sites to favorable foraging areas. Thus, extensive stands of contiguous woody vegetation are generally unsuitable for nesting, whereas suitable nest sites consist of single trees or shrubs or small clumps of trees and shrubs within or adjacent to an extensive area of suitable foraging habitat. Trees usually less than 32 ft tall are used for nesting and include willow (*Salix* spp.), bald cypress (*Taxodium distichum*), pond cypress (*Taxodium ascendens*), melaleuca (*Melaleuca quinquenervia*), sweetbay (*Magnolia virginiana*), swamp bay (*Persea borbonia*), pond apple (*Annona glabra*), and dahoon holly (*Ilex cassine*). In some cases, snail kites also nest in crowns of living cabbage palms (*Sabal palmetto*) which may be present in recently or infrequently flooded areas. Shrubs used for nesting include wax myrtle (*Myrica cerifera*), cocoplum (*Chrysobalanus icaco*), buttonbush (*Cephalanthus occidentalis*), *Sesbania* spp., elderberry (*Sambucus simpsonii*), and Brazilian pepper (*Schinus terebinthifolius*). Nesting also can occur in herbaceous vegetation, such as sawgrass, cattail, bulrush, and reed (*Phragmites australis*) (Sykes et al. 1995). Nesting in lake littoral zones, especially those of the Kissimmee Chain of Lakes, is often observed in herbaceous vegetation. Nests constructed in herbaceous vegetation on the waterward side of the lakes' littoral zone are more vulnerable to collapse due to the weight of the nests, wind, waves, and boat wakes and are more exposed to disturbance by humans (Chandler and Anderson 1974; Sykes and Chandler 1974; Sykes 1987b; Beissinger 1986, 1988; Snyder et al. 1989).

Impacts of seasonal water levels and transitions on nesting snail kites and their habitat are discussed more below (see Incompatible Water Management and Nest Predation under Threats to the Species), and WCA-3A-specific impacts and targets are discussed in detail in the Environmental Baseline section of this Biological Opinion.

4.4.2 Foraging Habitat

While kites are capable of foraging successfully under a variety of habitat conditions, the preferred foraging habitat is typically a combination of relatively short-stature, sparse graminoid marsh vegetation less than 6.5 ft in height. The apple snail requires emergent aquatic plants to provide substrate that allows them to reach the water surface to breathe. However, for kites to feed, the emergent vegetation must be sparse enough that they are capable of locating and capturing snails (Kitchens et al. 2002). Snail availability is influenced by both vegetation structure and water depth. Marshes, wet prairies, and lake littoral zones composed of interconnected areas of open water 0.6 to 4.3 ft deep which are relatively clear and calm and patches of herbaceous emergent wetland plants or sparse continuous growth of herbaceous wetland plants generally provide the appropriate balance of emergent vegetation and open water (Sykes et al. 1995; Kitchens et al. 2002). Marsh species that commonly occur within favorable kite foraging habitat include spike rush (*Eleocharis cellulosa*), maidencane (*Panicum hemitomon*), sawgrass, bulrush (*Scirpus* spp.), and/or cattails. Shallow open-water areas may also contain sparse cover of species such as white water lily (*Nymphaea odorata*), arrowhead (*Sagittaria lancifolia*), pickerel weed (*Pontederia lanceolata*), and floating heart (*Nymphoides aquatica*). Snail kites also forage in deeper water in lacustrine habitats dominated by submergent or floating-leaved vegetation (Pias 2012). Periphyton growth on the submerged substrate provides a food source for apple snails, and submergent aquatic plants, such as bladderworts (*Utricularia* spp.) and eelgrass (*Vallisneria* spp.), may contribute to favorable conditions for apple snails while not preventing kites from detecting snails (Sykes et al. 1995).

Using field data from 1995 to 2004, Darby et al. (2006) estimated that snail densities less than 0.14 individuals per square-meter are unable to support kite foraging. To manage for sufficient densities, Darby et al. (2009) recommended a range of water depths between 4 and 20 inches during the peak apple snail breeding period between April and June. Deeper water can delay or reduce apple snail egg cluster production, while shallower water can prevent snail movement and breeding, also resulting in decreased egg cluster production and subsequently lower snail densities.

Foraging habitat conditions that differ substantially from those described above will result in either reduced apple snail density or reduced ability of snail kites to locate and capture snails. Vegetation cover that is either too dense or too sparse can result in reduction in the quality of the area as foraging habitat. Impacts of seasonal water levels and transitions on apple snails, foraging snail kites, and their habitat are discussed more below (see Incompatible Water Management under Threats to the Species), and WCA-3A-specific impacts and targets are discussed in detail in the Environmental Baseline section of this Biological Opinion.

4.4.3 Roosting Habitat

Outside of the breeding season, snail kites may roost communally, usually over water, typically in groups of 2 to 200 (Bennetts et al. 1994). Roost sites are typically in taller vegetation among

low profile marshes. On average, in Florida, 91.6 percent of roost sites are located in willows, 5.6 percent in melaleuca, and 2.8 percent in pond cypress. Snail kites tend to roost around small openings in willow stands at a height of 5.9 to 20.0 ft, in stand sizes of 0.05 to 12.35 acres. Roosting also has been observed in melaleuca or pond cypress stands with tree heights of 13 to 40 ft (Sykes 1985).

4.5 Distribution and Movement

4.5.1 Historic and Current Distribution

The subspecies *R. s. plumbeus* occurs in Florida, Cuba (including Isla de la Juventud), and northwestern Honduras. There is no evidence of movement of birds between Cuba and Florida, but this possibility has not been ruled out (Sykes 1979; Beissinger et al. 1983). A recent genetic survey of *R. s. plumbeus* and the two other subspecies of snail kites, *R. s. major* and *R. s. sociabilis,* that range in Mexico, Guatemala and Belize, and Nicaragua, Costa Rica, Panama and South America respectively, conducted by Haas et al. (2009) indicated that there are no genetic differences between the Florida and Cuba populations of *R. s. plumbeus*. However, due to their small sample size, additional studies would be needed to confirm these results in order to make proper inference regarding the possibility of employing translocation as a viable recovery action for the species.

In Florida, the historic range of the snail kite was larger than at present. The current distribution of the snail kite in Florida is limited to central and southern portions of the State. Six large freshwater systems are located within the current range of the snail kite: Upper St. Johns marshes, the Kissimmee Chain of Lakes (KCOL), Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin (Beissinger and Takekawa 1983; Sykes 1984; Rodgers et al. 1988; Bennetts and Kitchens 1997; Rumbold and Mihalik 1994; Sykes et al. 1995; Martin et al. 2006a). Other areas that have supported snail kites include the East Orlando Wilderness Park, the Blue Cypress Water Management Area, the St. Johns Reservoir, and the Cloud Lake, Strazzulla, and Indrio impoundments. In the KCOL, snail kites may occur within most of the lakes and adjacent wetlands, with the majority of snail kite nesting occurring within Lake Kissimmee, Lake Toho, and East Lake Toho. In the KCOL, snail kites have also nested in lower numbers on Lakes Hatchineha and Jackson. Snail kite nesting, sometimes in relatively large numbers, has occurred periodically since about 2002 in Lake Istokpoga. Lake Okeechobee and surrounding wetlands represent significant snail kite nesting and foraging habitats that have historically supported snail kites. In the Loxahatchee Slough region of Palm Beach County, snail kites may occur in the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) and throughout the remaining marshes in the vivinity, most frequently nesting within Grassy Waters, also known as the West Palm Beach Water Catchment Area. Snail kites may occur within nearly all remaining wetlands of the Everglades region, with nesting occurring within WCA-2B, WCA-3A, WCA-3B, and ENP (Martin et al. 2006a). Within the Big Cypress basin, snail kites may occur within most of the non-forested and sparsely forested wetlands.

Historically, the extensive littoral marshes of Lake Okeechobee, located within Fisheating Bay and near the inflow of the Kissimmee River, were used by snail kites for foraging and nesting (Martin et al. 2006). However, a significant decline in foraging and nesting occurred from 1996 through 2006, and Lake Okeechobee made only minor contributions to the snail kite population during this time (Cattau et al. 2008a). The reduction in foraging and nesting was attributed to habitat degradation resulting from the hurricanes that occurred during 2004 (Cattau et al. 2008a) and the water management practices that occurred during this time period (Bennetts and Kitchens 1997). Water management actions have resulted in more water being retained in the lake with a concomitant increase in water levels. High water levels in the 1990s resulted in a significant loss of emergent herbaceous and woody vegetation in Lake Okeechobee's emergent wetlands. The loss of emergent vegetation reduced the abundance of apple snails (the snail kite's primary prey item), because snails require emergent vegetation for feeding and egg-laying. The reduction of trees and shrubs in the littoral zone has reduced nesting and perching sites available to the snail kite.

There was no nesting within Lake Okeechobee from 2007 to 2009 and only limited nesting in 2010 within portions of the lake that are outside of the historic nesting areas. The 2010 nesting occurred in two general areas: (1) the littoral zone from just west of where the Kissimmee River enters the lake northward to the city of Okeechobee, including Eagle Bay Marsh and (2) near Observation Island, located along the open water edge of the littoral zone in the southwest portion of the lake.

Since 2010, water levels in the lake have generally been lower and aquatic vegetation has improved in the lake, resulting in increased snail kite nesting efforts (Fletcher et al. 2015). Moderate water levels observed on Lake Okeechobee in 2011 and 2012 were correlated with an increase in snail kite nesting. A total of 39 nesting attempts resulted in 16 successful nests that produced 26 nestlings in 2011, and 76 nesting attempts resulted in 23 successful nests that produced 43 nestlings in 2012. Lake Okeechobee accounted for 25 percent of the range-wide nesting effort and produced 21 percent of the fledglings in 2012 (Cattau et al. 2012). For all sites monitored in 2013, Lake Okeechobee was the most productive in terms of overall snail kite production, with 24 percent of observed fledglings (Fletcher et al. 2014). Between 2013 and 2015, there was an average of 73 active nests (range 55-107) that produced an average of 36 fledglings (range 24-44) on Lake Okeechobee. In 2016, there were 231 active nests and at least 123 were successful producing 255 fledglings (Fletcher et al. 2017); however, most of this production came from a summer nesting event where water levels were relatively stable. In 2018, there were an estimated 161 active nests on Lake Okeechobee, and 87 of these nests were determined to be successful producing a total of 167 fledglings (Fletcher et al. 2018).

Lake Okeechobee is of particular importance since it serves as a critical stopover point as snail kites traverse the network of wetlands within their range. A loss of suitable habitat and refugia, especially during droughts in the lake, may have significant demographic consequences (Takekawa and Beissinger 1989; Kitchens et al. 2002; Martin et al. 2006b). Lake Okeechobee will be critical to the snail kite's long-term population persistence, especially given the susceptibility of juvenile snail kites in the Kissimmee River Valley to an increased frequency of

local disturbance events and the treatment of hydrilla (*Hydrilla verticillata*) (Reichert et al. 2011).

WCA-3A was once an important snail kite foraging and nesting area. Historically, the WCAs, and WCA-3A in particular, have fledged proportionally the large majority of young in the region. However, no young were fledged in WCA-3A in 2001, 2005, 2007, 2008, 2010, or 2012. The decline in breeding activity and success observed in WCA-3A over recent years may reflect deteriorating habitat quality as well as significantly decreased prey abundance. Although the overall trend in WCA-3A has been down, a slight increase in nesting attempts in 2013 and 2014 may indicate a positive change in prey densities or suitable habitat, although nesting effort was down again 2015. In 2013, there were 60 nesting attempts in WCA-3A of which 12 were successful and produced 13 fledglings (Fletcher 2015). In 2014, there were 57 nesting attempts in WCA-3A of which 20 were successful and produced 34 fledglings (Fletcher 2015). In 2016, there were 16 active nests in WCA-3A and 3B, but they all failed (Fletcher et al. 2017). In 2018 WCA- 3A produced 17 successful nests out of 40 nesting attempts. WCA-3A yielded 15 successful nests in 2019 out of 28 nesting attempts (Fletcher et al 2018).

The shift in dependence from Lake Okeehobee and the WCAs to the KCOL was apparent as reproduction within this watershed has accounted for 52, 12, 89, 72, and 61 percent of the successful nesting attempts range-wide in 2005, 2006, 2007, 2008, and 2009, respectively (Cattau et al. 2009). Lake Tohopekaliga accounted for 41 percent of all successful nests and 57 percent of all fledged young that were documented on a range-wide basis from 2005-2010. In 2012, Lake Tohopekaliga accounted for 25 percent and 24 percent of all successful nests and fledged young, respectively. Additionally, in 2011 and 2012, East Lake Tohopekaliga, accounted for 27 percent and 30 percent of all successful nests and fledged young, respectively. A small number of nests have also been documented on Lake Hatchineha, Lake Istokpoga, and Lake Jackson within recent years. In 2013, the KCOL produced 37 percent of all nests and 38 percent of all fledglings. Fletcher et al. (2016) indicated that out of 72 total known-fate snail kite nests in Lakes Tohopekaliga, East Toho, and Kissimmee, only 16 were successful producing 30 fledglings. It is not clear why the success in 2014 was so low. Fletcher et al. (2016) hypothesized it could be due to changes in KCOL habitat conditions rather than from improving conditions elsewhere attracting breeding snail kites. In 2016, KCOL produced 65 fledglings from 187 known-fate nests.

Since 2010, snail kites have also nested in the Everglades Stormwater Treatment Areas 1, 3, and 5, with the majority of nesting occurring in STA 5. According to Fletcher et al (2016), "Nesting effort in STAs 1, 3, and 5 increased annually from 0 percent in 2012, to 13 percent in 2013, and 32 percent in 2014, but decreased in 2015 to 19 percent." During the 2019 nesting season, only one pair of snail kites nested within the Everglades STAs. This nest was determined to have failed (Fletcher, et al 2019).

In addition to the primary wetlands discussed above, there are numerous records of snail kite occurrence and nesting within isolated wetlands throughout the region. In the 1990's, Sykes et al. (1995) observed snail kites using smaller, more isolated wetlands including the Savannas

State Preserve in St. Lucie County, Hancock Impoundment in Hendry County, and Lehigh Acres in Lee County. Takekawa and Beissinger (1989) identified numerous wetlands that they considered drought refugia, which may provide snail kite foraging habitat when conditions in the larger more traditionally occupied wetlands are unsuitable. Radio tracking and satellite telemetry of snail kites has also revealed that the network of habitats used by the species includes many smaller, widely dispersed wetlands within this overall range (Bennetts and Kitchens 1997; Meyer 2015). Snail kites may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. For example, 2010 snail kite nesting surveys documented nesting in surprisingly high numbers in peripheral areas such as Harns Marsh, in Lehigh Acres. That year, a snail kite nest and juveniles were also observed for the first time in the S-332D detention area in eastern ENP, also known as the Frog Pond. WCA-3B also contributed fledglings in both 2013 and 2014. In 2015, a large number of nests (most of them successful) were found in a new area, Mary A Mitigation Bank in Brevard County, and one successful snail kite nest was found on Lake Smart in Polk County. In addition, reports of foraging snail kites have been increasing in Polk County as well as Sarasota County.

4.5.2 Movements

Snail kites have generally been considered nomadic, probably responding to changing hydrologic conditions (Sykes 1979). During the breeding season, kites remain close to their nest sites until they fledge young or fail. Following fledging, adults may remain around the nest for several weeks, but once young are fully independent adults may depart the area. Outside of breeding season, snail kites regularly travel long distances within and among wetland systems in southern Florida (Bennetts and Kitchens 1997). While most movements may be in response to droughts or other unfavorable conditions, kites may also move away from wetlands when conditions appear favorable. Movements within large wetlands and movements among adjacent wetland units occurred frequently, while movements among spatially isolated wetlands occurred less frequently (Martin et al. 2006a). Fledgling kites also move frequently but are more likely to move to immediately adjacent wetland units than adults, which may indicate a degree of familiarity with the availability of wetlands across the landscape that adult kites acquire through experience.

Between breeding seasons, Fletcher et al. (2015) found a high degree of site and regional philopatry for breeding snail kites. This pattern was observed as both natal and breeding philopatry. Natal philopatry reflects the proportion of 1-year old (or 2-year old, given many 1-year old birds do not attempt to breed) birds that have their first nesting attempt in the wetland that they were born in, whereas breeding philopatry reflects the likelihood that adult birds will breed in the same site (or region) that they previously were observed to breed in. These results indicate the importance of distinguishing and interpreting movement associated with reproduction (dispersal) versus more nomadic non-breeding movements (*e.g.*, foraging that tracks variation in food availability). Analysis results of Fletcher et al. (2015) show that regional philopatry has been very high for the Kissimmee River Valley (northern region) and the Everglades (southern region); immigration between these and other portions of the population between breeding seasons still occurs, but at lower rates (Figure 20). In contrast, Lake

Okeechobee and the STAs, being centralized, appear to serve as "mixing grounds" and "stepping stones" for nesting birds. This information suggests that the snail kite population in Florida is currently experiencing significant spatial structuring; however, based on the amount of immigration occurring between regions, it is premature to consider these as separate subpopulations.

4.6 Population Dynamics

4.6.1 Population Size

Several authors (Nicholson 1926; Howell 1932; Bent 1937) indicated that the snail kite was numerous in central and southern Florida marshes during the early 1900s, with groups of up to 100 birds. Reports of snail kite population declines in the 1940s and 1950s suggested that as few as 6 to 100 individuals remained (Sykes 1979). When the snail kite was listed as endangered in 1967, the species was considered to be at an extremely low population level. In 1965, only 10 birds were found with 8 in WCA-2A and 2 at Lake Okeechobee. A survey in 1967 found 21 birds in WCA-2A (Stieglitz and Thompson 1967). Relatively large fluctuations in the snail kite population size have been widely reported and generally attributed to environmental conditions (Beissinger 1986; Beissinger 1995; Martin et al. 2006b; Cattau et al. 2008b). It is unclear whether the reports of declines were completely from a loss in the number of individuals or a result of the snail kite's nomadic behavior, limited survey efforts, and the lack of biological knowledge of the species. As it was not known at the time that snail kites are nomadic in response to unfavorable hydrologic conditions (Sykes 1979), it is possible the surveys were documenting more the absence of snail kites from their usual locations, including Lake Okeechobee and the headwaters of the St. John's marsh (Sykes 1979), and not entirely from the actual loss of individual snail kites. In addition, limited resources were available at that time for researchers to reach potential snail kite habitats. As such, the resulting low level of survey effort may have biased these low snail kite population estimates. Rodgers et al. (1988) have stated that it is unknown whether decreases in reported snail kite numbers in the annual count were due to mortality, dispersal (into areas not counted), decreased productivity, or a combination of these factors. However, there is little doubt that the snail kite was endangered at the time of its listing and that its range had been dramatically reduced.

Prior to 1969, the snail kite population was monitored only through sporadic and inconsistent surveys (Sykes 1979, 1984). From 1969 to 1994, an annual quasi-systematic, mid-winter snail kite count was conducted by a succession of principal investigators, with counts ranging from a low of 65 snail kites in 1972 to a high of 996 snail kites in 1994 (Sykes 1979; Sykes 1983a; Beissinger 1986; Bennetts et al. 1999a). Bennetts et al. (1993, 1994) cautioned that the 1993 and 1994 counts were performed with the advantage of having numerous birds radio-tagged. This likely increased the total count because radio-tagged birds could easily be located and often led researchers to roosts that had not been previously surveyed. Bennetts and Kitchens (1997) identified issues with the count surveys and recommended that they should not be the basis of population estimates or used to infer demographic parameters such as survival or recruitment.

Bennetts et al. (1999b) analyzed these counts and the sources of variation in these counts and determined that count totals were influenced by differences in observers, survey effort, hydrologic conditions, and site effects. While significant sources of error were identified, these data could provide a crude indication of trends if one assumes all influences of detection rates had been adequately taken into account. Because this is highly unlikely, the sources of variation in the counts should be recognized prior to using these data in subsequent interpretations, especially in attempting to determine population viability and the risk of extinction.

Beginning in 1997, refined population estimates were generated for the snail kite using a mark-recapture method (Dreitz et al. 2002). These new population estimates, which incorporate detection probability (less than 1.0), were higher than those resulting from the previous counts. Population size estimates generated from mark-recapture techniques for 1997 to 2000 are approximately 2 to 3 times higher than previous count-based estimates (*e.g.*, 800 to 1,000 estimated snail kites based on count-based surveys in 1993 and 1995, compared to an estimated 2,700 to 3,500 snail kites based on mark-recapture analyses from 1997 to 2000) (Bennetts and Kitchens 1997; Dreitz et al. 2002). Confidence intervals could also be generated for population estimates using the new method, which increased the validity of comparing population estimates among years.

Since 1997, population estimates and estimates of demographic parameters have been generated exclusively employing mark-recapture methods that incorporate detection probabilities (Figure 21). From 1997 through 1999, the snail kite population was estimated to be approximately 3,000 birds (Dreitz et al. 2002). From 1999 through 2002, the population estimates declined each year until they reached a low level of approximately 1,400 birds in 2002 and 2003, then increased slightly to about 1,700 birds in 2004 and 2005 (Martin et al. 2006b). The snail kite population exhibited steep declines in both 2007 and 2008, with estimates of 1,204 birds and 685 birds, respectively, but rebounded slightly starting in 2010. The 2012 population estimate was 1,218 birds (Cattau et al. 2012). The 2013 population estimate was similar – 1,198 birds (Fletcher et al. 2014). In 2014, the population estimate was significantly higher (1,754 birds [95 percent CI = 1605-1897]) primarily due to stable fledging rates in Lake Okeechobee and an increase in fledging in the Everglades and STAs (Fletcher et al. 2015). As shown in Figure 15, in 2015, the population estimate increased to approximately 2,100 birds, and in 2017 the estimate rose to approximately 2,600 birds. The 2018 population estimate slightly decreased to 2,347 birds. The 2019 population is currently being calculated (Fletcher et al. 2019).

4.6.2 Demographic Rates

Snail kites appear to exhibit high levels of variability in many demographic parameters, while others remain relatively constant. Adult snail kite survival appears to be relatively constant over time at a relatively high level (>80 percent) (Bennetts et al. 1999a; Martin et al. 2006a; Cattau et al. 2009). Adult survival is probably reduced in drought years (Takekawa and Beissinger 1989; Martin et al. 2006a), as was observed by the appreciable drops from 2000 through 2002, and again from 2006 through 2008 (Figure 22). These temporary low adult survival rates coincided with significant declines in the overall population associated with region-wide droughts during

2001 and 2007. Researchers have also observed geographic variation of adult snail kite survival rates, with higher rates in southern regions relative to northern regions of their range (Martin et al. 2006a, Martin et al. 2007, Fletcher et al. 2015).

In contrast to relatively constant adult survival estimates, juvenile survival appears to be highly variable among years, reaching a record low in 2002 (Figure 22) (Beissinger 1995; Bennetts and Kitchens 1999; Martin et al. 2003; Martin et al. 2006b; Cattau et al. 2009). The observed variability in juvenile survival is likely related to variation in environmental conditions, including those hydrologic conditions that directly affect the survival and productivity of the apple snail.

Other variable demographic parameters such as distribution of nesting and productivity are also likely driven by annual variability of environmental factors, most notably apple snail density and availability (which in turn, are affected by prevailing and previous year water levels). Duration of the breeding season and amount of double-brooding are also variable (Beissinger 1986). Under favorable environmental conditions, snail kites have the ability to achieve high reproductive rates (Beissinger 1986), and similarly, juvenile survival rates appear to be higher under more favorable conditions.

The observed declines in the snail kite population from 1999 to 2002 (Figure 21) coincided with a regional drought that affected central and south Florida during 2000 to 2001. During this period, nest success was generally low, and demographic parameters estimated using mark-recapture methods indicated low juvenile survival rates (Martin et al. 2006b). Despite the return to normal or wetter-than-normal hydrologic conditions from 2002 to 2006, which generally provide favorable snail kite nesting conditions, population estimates remained low, and nest success and juvenile survival rates also remained low (Martin et al. 2006b). Additionally, snail kite nesting ceased in WCA-3A due to the 2004 crash of the native apple snail population there caused by extended high water conditions during the snail breeding season. Nest success and number of young fledged increased slightly in 2007 and 2008 (Cattau et al. 2009), despite severe drought conditions in 2007. Juvenile survival significantly increased from 0.226 in 2006 to 0.558 in 2007, then decreased again to 0.381 in 2008 (Cattau et al. 2009). Conversely, adult survival decreased significantly in 2007 from 0.834 to 0.538, then rebounded to 0.826 in 2008 (Cattau et al. 2009). These irregularities are likely a result of the increased utilization of the KCOL, where a majority of young fledged in 2007. Historically, water levels in KCOL have been less affected by adverse drought conditions (Bennetts and Kitchens 1997).

Figure 15 shows that during the six years from 2009 to 2014 the number of successful snail kite nests and number of fledglings had generally increased range wide (where sampling occured). Since 2011, nesting efforts and success on Lake Okeechobee have improved greatly. Lake Okeechobee was the most productive water body in terms of overall snail kite production during 2013. Between 2013 and 2015, there were an average of 73 active nests (range 55-107) that produced an average of 36 fledglings (range 24-44) per year on Lake Okeechobee. In 2016, there were 231 active nests and at least 123 were successful, producing 255 fledglings (Fletcher

et al. 2017); however, most of this production came from a summer nesting event where water levels were relatively stable.

There was also a marked increase in nesting attempts in WCA-3A in 2013 and 2014 (36 active nests each year), with 14 and 30 fledged young observed, respectively (Fletcher 2015a). In 2015, 2016, 2017, 2018, and 2019, WCA-3A produced 10, 0, 2, 17, and 15 successful nests respectively (Fletcher et al 2019).

Snail kites appear to exhibit high levels of variability in some demographic parameters, while others remain relatively constant. For example, distribution of nesting appears to fluctuate dramatically based on annual variability of specific environmental factors, such as habitat and apple snail availability (which in turn, are affected by prevailing and previous year water levels). Similarly, productivity appears to be highly variable and heavily influenced by environmental conditions (Sykes 1979; Beissinger 1989, 1995; Sykes et al. 1995). Duration of breeding season and amount of double or triple-brooding are also variable (Beissinger 1986). Juvenile survival also appears to be highly variable among years, reaching a record low in 2002 (Fletcher et al. 2017; Beissinger 1995; Bennetts and Kitchens 1999; Martin and Kitchens 2003; Martin et al. 2006a). From 2010 to present, juvenile survival has been trending down (Fletcher et al 2019). The observed variability in juvenile survival is related to variation in environmental conditions, including those hydrologic conditions that directly affect the survival and productivity of apple snails. Because apple snails are the primary source of food for the snail kite, hydrologic conditions that affect the survival and productivity of apple snails may have significant effects on snail kite nest success and the survival of juvenile snail kites.

4.6.3 Trends

Recent population estimates are 2 to 3 times more accurate than those produced prior to 1997 owing to the improved mark-resighting method first applied in 1997-2000 and refined in 2002 (Dreitz 2000; Dreitz et al. 2002). While it is not possible to compare the current population size to those recorded from the 1970s through 1997 due to differences in sampling methods, several lines of evidence suggest that the current snail kite population declined drastically from 2000 to 2008. Two major reductions in numbers occurred following region-wide droughts in 2001 and 2007 (Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008b). The snail kite population estimate dropped by more than 75 percent during this time, from an estimate of approximately 3,400 birds in 1999 to fewer than 700 in 2008 and 2009 (Figure 21; Cattau et al. 2009).

Concurrent with the apparent population declines, number of nesting attempts, nest success, and the number of young fledged, particularly in wetlands such as Lake Okeechobee and the WCAs historically used by breeding kites, also generally declined (Fletcher et al. 2015). Recent retrospective analyses by Fletcher et al. (2015) indicate the population decline was largely driven by reduced contributions of these southern regions to total population growth.

As shown in Figure 15, since 2009, snail kite population growth has been generally positive, which marks a period of population recovery (Fletcher et al. 2015). This overall trend has been

driven by increased contributions from the Kissimmee Chain of Lakes since 2005 and is due primarily to increases in reproduction and juvenile recruitment (Fletcher et al. 2015). Both demographic parameters have been positively linked to the invasion of the exotic apple snail, *Pomacea maculate*, as discussed below (see Invasive Nonnative Species under Threats to the Species). However, during this recovery period, dispersal has become increasingly limited between the northern and southern regions (Fletcher et al. 2015). Such limited dispersal highlights the importance of suitable local demographic rates and, for the southern region, quality breeding and foraging habitat in "stepping stone" wetlands to maintain the population into the future.

4.6.4 Population Viability Analysis

Based on demographic parameters generated using mark-recapture methodology, a population viability analysis (PVA) for the snail kite was conducted in 2006. This PVA indicated there was a high probability of quasi-extinction (identified as ≤50 female snail kites) within the next 50 years if current reproduction, survival, and drought frequency rates remained the same as those observed from 1996 to 2006 (Martin et al. 2007; Cattau et al. 2008b, 2009). Quasi-extinction risk is the probability of a population falling below a critical density – an extremely undesirable population level that may be unlikely to be recoverable even with drastic management steps, such as captive breeding. In 2010, snail kite researchers conducted a new PVA which updated the demographic parameters and incorporated effects of variable environmental (hydrologic) states. According to Cattau et al. (2012), preliminary results from this PVA "predict a 95 percent probability of population extinction within 40 years." They further stated, "These results are especially concerning, as they indicate an increased risk of extinction when compared to results from a previous PVA conducted in 2006." Their analyses also provided indications of an aging population with problems inherent to older individuals, including increased adult mortality rates and decreased probabilities of attempting to breed, both of which have been shown to be exacerbated during times of harsh environmental conditions (Cattau et al. 2012).

More recent analyses conducted by Fletcher et al (2015) indicated population growth rates near or above 1.0 when exotic snail effects were included in demographic rates, compared to 0.974 and 0.925 under scenarios without *Pomacea maculata* effects. This retrospective analysis showed an increasing trend in the contribution of juvenile recruitment to population growth rate in the northern region. Based on per capita contributions, the northern region was a population source five out of seven years from 2007 to 2013, primarily due to this increase in local recruitment. Conversely, per capita contribution for the southern region had been <1.0 for all but 4 years during the 18-year study duration, and the highest contribution to population growth rate in the southern region was from surviving adults (not immigrants). Declines in per capita contribution of local adult survival in the southern region were not offset by increases to emigration from the northern region (Fletcher et al. 2015).

4.7 Threats to the Species

There are a variety of threats that have been identified which can affect snail kite nesting, foraging, and survival. These threats include loss and degradation of wetland habitat, incompatible water management, nest predation, invasive nonnative species, potential disease and contaminants concerns, human disturbance, and environmental stochasticity (*e.g.*, extreme weather events).

4.7.1 Habitat Loss and Degradation

The principal threat to the snail kite is the loss, fragmentation, and degradation of wetlands in central and southern Florida resulting from urbanized and agricultural development and alterations to wetland hydrology through ditching, impoundment, and water level management. Nearly half of the Everglades have been drained for agriculture and urban development (Davis and Ogden 1994; Corps 1999). The Everglades Agricultural Area (EAA) eliminated 3,100 square-miles of the original Everglades and the urban areas in Miami-Dade, Broward, and Palm Beach Counties have contributed to the reduction of habitat. North of ENP, which has preserved only about one-fifth of the original extent of the Everglades, the remaining marsh has been fragmented into shallow impoundments (*i.e.*, WCAs). The Corps' C&SF Project encompasses 18,000 square-miles from Orlando to Florida Bay and includes about 994 miles each of canals and levees, 150 water control structures, and 16 major pump stations. This system, which was originally designed and constructed to serve flood control and water supply purposes, has disrupted the volume, timing, direction, and velocity of freshwater flow and has resulted in habitat loss and degradation in the WCAs and other portions of the historic Everglades. Drainage of Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail and the snail kite (Sykes 1983b). Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once kite habitat.

Habitat loss and fragmentation are also factors influencing survival during droughts, despite the species' dispersal ability (Martin et al. 2006a). As discussed above, the snail kite may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. In dry years, snail kites depend more on water bodies that normally are suboptimal for feeding, such as canals, impoundments, or small marsh areas, remote from regularly used sites (Beissinger and Takekawa 1983; Bennetts et al. 1988; Takekawa and Beissinger 1989). The fragmentation or loss of wetland habitat significantly limits the snail kites' ability to be resilient to disturbance events such as various climatic events. As wetland habitats become more fragmented, the dispersal distances become greater, putting increased stress on dispersing kites that may not be able to replenish energy supplies.

Degradation of wetland habitat, particularly due to water quality impacts associated with runoff of phosphorus from agricultural and urban sources, is another concern for the snail kite. The Everglades was historically an oligotrophic system (*i.e.*, having a deficiency of plant nutrients that is usually accompanied by an abundance of dissolved oxygen), but major portions have

become eutrophic (*i.e.*, rich in nutrients and supporting a dense plant population, the decomposition of which may kill aquatic animal life by depriving it of oxygen), primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Most of this increase has been attributed to non-point source runoff from agricultural lands north of Lake Okeechobee, in the Kissimmee River, Taylor Slough, and Nubbin Slough drainages (Federico et al. 1981). Elevated phosphorus concentrations and loads in the Everglades have long been associated with increases in cattail expansion, which may influence the critical habitat for the snail kite. In lacustrine environments, cultural eutrophication also is a concern, especially in the KCOL. Nutrient enrichment leads to growth of dense stands of herbaceous emergent vegetation and floating vegetation (primarily water hyacinth [*Eichhornia crassipes*] and water lettuce [*Pistia stratiotes*]), which inhibit the ability of snail kites to forage along the shorelines of lake areas. Large areas of marsh are also heavily infested with water hyacinth, which inhibits the kite's ability to see its prey (Service 2007b). The Service is not aware of any scientific investigations that directly relate effects of differing nutrient concentrations to the reproductive success of snail kites; however, there is a weight of evidence that indicates that most of the lakes and large areas of Everglades wetlands within the snail kite's range have received nutrient inputs higher than normal and at levels which require various governmental agencies to perform aquatic plant management. These attempts to control, reduce, and eliminate the spread of invasive and exotic plant species have had positive as well as negative effects on snail kites, as discussed below in section 4.7.7.

4.7.2 Incompatible Water Management

The snail kite has experienced population fluctuations associated with hydrologic influences, both man-induced and natural (Sykes 1983a; Beissinger and Takekawa 1983; Beissinger 1986; Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008a). Of particular concern are the water management strategies that have negatively affected snail kite nesting and foraging habitat in Lake Okeechobee, the WCAs, and the Kissimmee Basin. Within Lake Okeechobee and WCA-3A, water management activities, in part, have rendered unsuitable large areas that were once productive breeding grounds. For example, the Clewiston Flats was the primary area within Lake Okeechobee which provided suitable nesting and foraging habitat for snail kites prior to 2006. However, the water stages in 2006 to 2009 were too low to allow successful nesting and foraging in the Clewiston Flats. Despite higher stages in 2010, the habitat within the Clewiston Flats did not support snail kite nesting or foraging as it became too thick to support sufficient numbers of apple snails; and as of 2014, Clewiston Flats still did not support snail kite nesting (Fletcher et al. 2014). In other portions of Lake Okeechobee's littoral zone, prolonged deep water caused vegetation changes resulting in loss of snail kite foraging habitat as well as decreasing growth and survival of woody plants that snail kites use for nesting and perching. Fortunately, relatively lower lake levels in later years, coupled with improvements to the aquatic vegetation and an increase in the exotic apple snail population, have allowed snail kites to nest in some areas of the lake (Moonshine Bay, Observation Island, Okeetantie, and Eagle Bay Marsh) since 2010.

Similar to effects seen on Lake Okeechobee, water management activities have increased water depths and hydroperiods in WCA-3A as well as some of the other WCAs, converting significant areas within these impoundments from wet prairie habitats to slough-type habitats. Vegetation changes have also occurred on lakes within the Kissimmee Basin, although deep water is not the culprit. Water regulation schedules designed to maximize flood control, and in some cases water supply, have greatly decreased the amount of intra-annual and inter-annual variation in lake stages. As a result, lake littoral zones have shrunk, as have the amounts of suitable snail kite habitat within them. Lack of extreme (high and low) water levels also contributes to the need for more frequent aquatic plant management activities, of both native and nonnative species, which can negatively affect kites as discussed below (see Human Disturbance). All of these vegetative changes represent a reduction in the quality of foraging habitat for snail kites, and a reduction in the suitability of habitat to support abundant apple snails. Managing for appropriate seasonal water levels in lakes and the WCAs is particularly important to maintain the balance of vegetative communities required to sustain snail kites. Restoration of habitat, including the management of appropriate water levels within the WCAs and Lake Okeechobee, as suggested by several researchers, is the key to successful recovery of the snail kite as it is predicated on their ability to successfully nest in these areas.

In addition to habitat effects, hydrologic conditions, and thus water management actions, may also adversely affect snail kite nest success, productivity, and juvenile survival both directly (*e.g.*, increased predation) and indirectly (*e.g.*, decreased foraging opportunities). Rapid recession rates during the dry (breeding) season and associated low water levels can allow nests to become accessible to land-based predators (discussed below), resulting in decreased nest success (Beissinger 1986; Sykes 1987b). The potential for this effect is higher for kites nesting near land (*i.e.*, in lakes or reservoirs) compared to those nesting in expansive marsh systems such as WCA-3A. Extremely low water levels and rapid recession rates can also limit foraging opportunities for nesting adults and juvenile snail kites, both of which require a sufficient forage base in the vicinity of the nest (Mooij et al. 2002). A decrease in the amount of suitable foraging habitat (snail availability) within the vicinity of a nest can lead to increased nest failures (due to nest abandonment by adults), decreased productivity (*i.e.*, less young fledged), and decreased juvenile survival and recruitment. Apple snail abundance has also been definitively linked to water regimes (Kushlan 1975; Sykes 1979, 1983a; Darby et al. 2005). Water levels which are too high or too low during the snail breeding season can delay, curtail, or entirely preclude egg cluster production in a given year, thereby resulting in decreased snail abundance and density in the following year(s). In addition, dry season reversals or very rapid wet season ascension rates can curtail egg cluster production and potentially kill native apple snail eggs if they become submerged. If reversals or ascension rates are large, they can also flood snail kite nests, causing nests to fail or nestlings to die. Impacts of water management operations and related water levels specifically within WCA-3A are discussed in more detail in the Environmental Baseline section of this Biological Opinion.

4.7.3 Nest Predation

Nest predation is another threat to snail kites. In 2010 and 2011, Olbert (2013) used cameras to monitor nests on Lake Toho. She found predation to be the primary cause of nesting failure, with almost no instances of nest collapse. Over the course of the study, she recorded a total of 32 predation events (57 eggs or young) where there was either a partial or complete loss of nest contents. The observed predator community included yellow rat snakes (*Elaphe obsoleta quadrivittata*), marsh rice rats (*Oryzomys palustris*), raccoons (*Procyon lotor*), American alligators (*Alligator mississippiensis*), a great horned owl (*Bubo virginianus*), fish crow (*Corvus ossifragus*), and a purple gallinule (*Porphyrio martinica*). Yellow rat snakes were the most common predator to consume both eggs and young (Olbert 2013). Fletcher et al. (2015) reported a snail kite nestling predation by a bald eagle (*Haliaeetus leucocephalus*) in WCA-3A.

According to Olbert (2013), raccoons were observed accessing nests in shallower water (approximately 18.79 ± 14.7 cm deep). The likelihood of predation by yellow rat snakes was not affected by water depth beneath the nest but did increase for nests closer to shore (average distance of 4.15 m) compared to nests sites farther away (average 32.78 m). Alternatively, marsh rice rats were found to be present in nests farther from shore (average distance of 115.08m) but were absent from nest sites closer (approximately 16.01 m) to shore. Out of the 30 predation events where the predator was successfully recorded, seven events (23 percent) occurred diurnally and 23 events (77 percent) were nocturnal (Olbert 2013). Other sources of nest failure resulted from abandonment of eggs (n=10), unhatched eggs (n=3), accidental egg or young loss (n=2), and nest collapse (n=1) (Olbert 2013).

4.7.4 Invasive Non-native Species

Exotic snails can directly impact kite demography by facilitating or hindering energy acquisition, while indirect impacts derive from effects on kite behavioral decisions including movement, habitat use, and the timing of reproduction. Fletcher et al. (2015) found that snail kite breeding distribution closely tracked the spread of *Pomacea maculata* over the last decade. They did not find evidence that the exotic snail has direct negative effects on snail kite vital rates, but instead found a positive association with kite breeding rates, breeding season length, number of young fledged per successful nest, and juvenile apparent survival. They found no direct effects of *P. maculata* on adult apparent survival, but suggest that indirect negative effects may exist associated with altered spatial dynamics as it relates to geographically varied adult survival (*i.e.*, more kites breeding in the northern half of their range where adult survival is lower). This could partially offset the direct positive effects on snail kite recruitment, which likely result from increased prey density and availability in wetlands with *P. maculata* (Fletcher et al. 2015).

Nonetheless, their modeling indicates that the cumulative impacts of the exotic snail have resulted in a small positive population growth, and "…that the exotic snail invasion has (overall) likely helped to lower short-term extinction risk for the snail kite, particularly in light of recent habitat degradations elsewhere in their range" (Fletcher et al. 2015). However, long-term effects of exotic snails on kite habitat and kite health are unknown. *P. maculata* has been known to

profoundly alter the structure, function and composition of wetland ecosystems (Horgan et al. 2012; Monette 2014). In addition, exotic snails may serve as intermediate hosts of parasites and as vectors for diseases such as Avian Vacuolar Myelinopathy (AVM) as discussed below (see Disease) (Wilde and Netherland 2015). Although more investigation is needed, the presence of large numbers of exotic snails could also produce an evolutionary trap, if snail kites are attracted to areas subject to elevated rates of disturbance, predation, or other risks (Fletcher et al. 2015). Due to the amount of uncertainty related to potential future impacts of exotic snail populations on snail kite survival and recovery, growing and sustaining populations of the Florida apple snail remain important considerations when developing management strategies for, and addressing potential impacts to, the snail kite.

4.7.5 Disease

AVM is a neurological disease that comes from direct or indirect consumption of neurotoxins produced by blue-green algae (cyanobacteria) that can grow on the leaves of submersed plants, especially hydrilla. When herbivores consume hydrilla while the cyanobacteria and the neurotoxin are present, they can display loss of muscle control resulting in difficulty flying or swimming, and eventual death. AVM has been found to affect many species that consume infested hydrilla or that prey on species which do. Apple snails can accumulate the toxin, though not all show clinical signs of the disease (Wilde and Netherland 2015). Feeding trials have verified that the exotic apple snails can accumulate the toxin from hydrilla and pass AVM to their predators (chickens in the feeding trial).

Several studies on the KCOL have confirmed that at least some portions of hydrilla populations in lakes East Toho, Toho, Cypress, Hatchineha, and Kissimmee have the cyanobacteria present. These studies have also verified through a feeding trial (using chickens) that hydrilla collected from Lake Toho can pass AVM to consumers (Wilde and Netherland 2015). A smaller, follow-up study found that feeding exotic apple snails collected directly from Lake Toho to chickens did produce some signs of AVM (2 of 3 birds had mild brain lesions upon necropsy), but none of the birds showed any clinical signs of the disease (Wilde and Netherland 2015). Further, biologists collected coots from Lake Toho that they suspected may be showing clinical signs of AVM (slower flying, erratic flight, inability or reluctance to fly, etc) and necropsies confirmed several had mild AVM lesions (5 of 22 birds). To date, no sightings of eagles or snail kites displaying signs of AVM have been reported.

4.7.6 Contaminants

Additional potential threats to snail kites include exposure to bioaccumulated contaminants in their prey. Copper, used in fungicide applications and commonly found in disturbed areas of Everglades wetlands such as former agricultural lands, has been shown to bioaccumulate in apple snails and may lead to birth defects in snail kite nestlings (Frakes et al. 2008). Uptake of copper through sediments and diet has been demonstrated, with uptake from the latter being the primary exposure route for the Florida apple snail (Frakes et al. 2008; Hoang et al. 2008a). The ability of Florida apple snails to bioaccumulate copper has implications for the successful survival and

recruitment of the Florida apple snail and its predator, the snail kite, at STAs and water reservoirs created for Everglades restoration projects; however, there is still uncertainty regarding the amount of copper that is actually bioavailable to snail kites. Additional information on Florida apple snail bioaccumulation of copper, copper bioavailability, and average exposure patterns of snail kites under various environmental conditions may be necessary to identify appropriate risk management scenarios for Everglades restoration projects.

Preliminary research has also been conducted to investigate potential effects of mercury on snail kites. Fletcher et al. (2015) evaluated mercury levels of snail kite nestlings (obtained from feathers collected in 2013 across the breeding range) to examine potential effects at the individual level (nestling size, juvenile survival), nest level (number of eggs, nestlings, and fledglings per successful nest), and site level (daily nest survival, number of fledglings per successful nest). Their analyses did not find significant correlations between nestling mercury levels and snail kite vital rates, although mercury concentration had a negative (but non-significant) effect on monthly juvenile apparent survival (Fletcher et al. 2015). However, they recognize that some potential effects of mercury could limit reproductive success prior to fledging (*e.g.*, egg viability), and that additional research is needed in this area including investigation into the relationship between adult/parent mercury levels and reproductive metrics (Fletcher et al. 2015).

4.7.7 Human Disturbance

Snail kites can be negatively impacted by a variety of human activities including habitat management activities (*e.g.*, aquatic plant maintenance, prescribed burning) and recreational activities (*e.g.*, boating, fishing, hunting, wildlife viewing). The Service works cooperatively with many agencies, organizations, and entities to avoid negative impacts to snail kites associated with these types of activities. Rodgers et al. (2001) described a program to reduce impacts of aquatic plant management on snail kites. They found that the actions of several agencies in controlling aquatic plants have caused nest collapse, particularly in herbaceous vegetation such as cattail and bulrush. They state that these impacts in Lake Okeechobee and the KCOL were reduced through cooperation and improved communication between agencies. In addition to the potential collapse of nests, the Service is concerned about any excessive application of herbicides, because this would reduce available habitat for apple snails. In some cases, the removal of vegetation has improved habitat for snail kites and the apple snails by opening up areas for snail kite foraging. The Service has expanded on these coordination efforts by notifying aquatic plant management groups during the snail kite nesting season of the location of active snail kite nests (Service 2006c) to assist them in avoiding effects, and by proactively coordinating throughout the year to optimize aquatic plant management to benefit, or at least avoid negative impacts to, kite nesting and foraging areas.

4.7.8 Environmental Stochasticity

Natural variation in weather patterns and inclement weather may also affect snail kite nesting success and survival. Windstorms can cause toppling of nests, particularly on Lake Okeechobee

and Lake Kissimmee due to the long wind fetch across these large lakes. Heavy rain can cause mortality of young through exposure, decreased foraging ability of tending adults, or nest collapse. Cold weather can halt or delay nest-building and courtship as well as cause nest failure, either through decreased availability of apple snails or mortality of young snail kites due to exposure. Abandonment of nests before egg-laying is also common, particularly during drought or following passage of a cold front.

4.8 Summary of Species Status

As previously explained, the overall snail kite population exhibited steep declines from 1999 to 2002 and from 2006 to 2008 but began to rebound starting in 2010. In 2014, the population estimate was significantly higher (1,754 birds). As shown in Figure 15, in 2015, the population estimate increased to approximately 2,100 birds, and in 2017 the estimate rose to approximately 2,600 birds. However, the 2018 population estimate slightly decreased to an estimate of 2,347 birds. The 2019 population is currently being calculated (Fletcher et al. 2019).

On average, adult snail kites have relatively high annual survival rates although it is probably reduced in drought years. Snail kites are considered nomadic; following fledging, adults may remain around the nest for several weeks, but once young are fully independent adults may depart the area. Outside of the breeding season, snail kites regularly travel long distances within and among wetland systems in southern Florida. The observed variability in juvenile survival is related to variation in environmental conditions, including those hydrologic conditions that directly affect the survival and productivity of the apple snail.

Additionally, hydrologic conditions have significant effects on snail kite nest success. Marshes and lake littoral zones with patches of herbaceous emergent wetland plants and open water generally provide the best snail kite foraging habitat. Native and exotic apple snails are critical because they comprise the great majority of the snail kites' diet. Apple snail survival and recruitment can be impacted by dry conditions. Optimal water depths should range between 4 and 20 inches during the peak native apple snail breeding period (April and June). Snail kite nesting primarily occurs between January and June with peak nest initiation from February to April. The clutch size ranges from one to five eggs, with a mode of three. Nesting almost always occurs over water, which may deter predation. Nests constructed in herbaceous vegetation are more vulnerable to collapse due to the weight of the nests, wind, waves, and boat wakes and are more exposed to disturbance by humans.

The principal threat to the snail kite is the loss, fragmentation, and degradation of wetlands. Hydrologic conditions, both natural and unnatural (*i.e.,* water management), may also adversely affect snail kite nest success and juvenile survival both directly (*e.g.,* increased predation) and indirectly (*e.g.,* decreased foraging opportunities). Rapid recession rates during the dry (breeding) season and associated low water levels can allow nests to become accessible to land-based predators, resulting in decreased nest success. The abundance of apple snails is also linked to water regimes. Extremely low water levels and rapid recession rates can limit foraging

opportunities for juvenile and nesting adult snail kites, both of which require a sufficient forage base in the vicinity of the nest.

4.9 Environmental Baseline

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Everglade snail kite within the Action Area.

4.9.1 Status of the Species within the Action Area

The information in the Status of the Species section also addresses the status of the species within the action area and is incorporated here by reference. The following discussion provides supplemental information specific to WCA-3A.

In the unaltered Everglades ecosystem, Everglade snail kites were able to cope with extreme and varying hydrologic conditions during a given year or at a given location due to their nomadic behavior and the network of suitable habitat that existed within the Everglades and throughout the rest of the kite's range in Florida. These extremes, when experienced at a natural frequency, are essential to maintaining suitable nesting and foraging habitat for the Everglade snail kite and its prey, and the natural variability within the system resulted in a habitat mosaic which ensured long-term persistence of suitable habitat for Everglades wildlife, including Everglade snail kites and apple snails. The impoundment and management of the Everglades has changed the timing, duration, and frequency of high and low water conditions, and has resulted in the observed long-term adverse effects of extreme low and high water levels in WCA-3A.

After serving as a stronghold for snail kite breeding for several decades, reproductive effort and productivity in WCA-3A dropped sharply after 1998. The number of young known to have fledged from the area between 1999 and 2013 (162 fledglings) is less than the number of young fledged in WCA-3A during 1998 alone (176 fledglings) and about half of the number fledged in 1997 alone (303 fledglings). No young were reported as fledged from WCA-3A during 2001, 2005, 2007, 2008, 2010, or 2012, and only two young (from one nest) successfully fledged in 2009. More recently, nesting effort and productivity have slightly increased in WCA-3A, with 36 active nests in both 2013 and 2014, with 14 and 30 fledglings in those years, respectively. In 2015 there were 10 successful snail kite nests in WCA-3A, but in 2016 there were no successful nests out of 11 nesting attempts. In 2017 there were two successful nests out of five nesting attempts.

Snail kite nesting productivity increased in WCA-3A during 2018 with 17 successful nests out of 40 nesting attempts. In 2019 nesting productivity slightly decreased as there were 15 successful nests out of 28 nesting attempts. (Fletcher et al. 2019).

While short-term drops in kite nesting can be attributed to drought conditions in a given year, it is believed that the longer-term decrease in kite nesting in WCA-3A is due to previous and concurrent decreases in apple snail populations and habitat quality and quantity in this area.

Although high apple snail densities (*e.g.*, >1.0 snail per m^2) were found in WCA-3A in 2002 and 2003, this was followed by lower egg cluster production in the spring of 2003 and a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004 (Darby et al. 2005). Relatively low densities (0.02 to 0.40 snails per m^2) continued at sampled sites into 2005 to 2007 and again at a subset of these sites in 2010 (0.06 to 0.08 snails per m^2). Sampling in WCA-3A in 2010-2012 by Wight et al. (2013) also found slightly higher but still relatively low densities of native apple snails, suggesting that these populations had not recovered since their decline in 2004 (Figure 23). Snail densities in southern WCA-3A in 2010-2012 were 5 to 10 times lower than densities observed in 2002-2003 (Wight et al. 2013). Observed egg cluster densities and per capita egg cluster (PCE) estimates were also relatively low in 2010-2012, indicating that the reproductive rate and recruitment into the apple snail population was relatively low (Wight et al. 2013). Subsequent annual sampling has found higher apple snail densities at some sites within kite foraging polygons in southwestern WCA-3A. In 2014, native apple snail densities ranged from 0.16 to 0.94 snails per m^2 in eight sites supporting foraging kites (Therrien and Darby 2014). However, in this same year, zero native apple snails were found at seven of eight random sites. In 2015, native apple snail densities ranged from 0.30 to 0.70 snails per m^2 in four sites supporting foraging kites (Therrien and Darby 2015). In two "poor kite foraging sites" (kites observed foraging but not capturing snails) and 14 of 16 random sites, zero native apple snails were found (Therrien and Darby 2015). Observed native apple snail egg cluster densities continue to be relatively low in nearly all sites.

The somewhat higher densities of native apple snails found in areas supporting foraging kites in southwestern WCA-3A during 2014 and 2015 is promising, but continued low (to zero) densities throughout the rest of the water conservation area indicate that native apple snail populations have not begun to recover from the 2004 population crash. Continued low densities have caused researchers to question whether an Allee effect is, at least in part, to blame (Wight et al. 2013; Pomacea Project 2013). This can occur when population densities decline to such low levels that scattered individuals have trouble finding mates. Thus, low snail populations resulting in low egg cluster production in addition to high predation rates may explain the continued low snail densities in WCA-3A (Wight et al. 2013).

Foraging kites in southwestern WCA-3A are also utilizing exotic snails, and the increase in exotic snail populations in this area have likely been a contributing factor to the increase in kite nesting in this area in recent years. *Pomacea maculata* was first found in samples at several sites in southwestern WCA-3A during 2011, and subsequent monitoring has indicated the exotic snail is still concentrated in this area (near SR 41), radiating from the 40-mile bend boat ramp and, beginning in 2015, starting to spread further east (Wight et al. 2013; Therrien and Darby 2015). The percentage of exotic snails found in throw traps has continued to increase since 2011, and exotic snails have been found in all kite-foraging sites in recent years. Observations by Darby (2015) indicate that kites are foraging in proportion to what is available (native versus exotic snails).

Apple snails are found in varied wetland habitats in WCA-3A, although densities tend to be higher in sparse prairies and emergent sloughs, compared with much lower densities (often by a

factor of two to three) in *Nymphaea odorata*-dominated sloughs (Karunaratne et al. 2006). Within wet prairie habitats, Karunaratne et al. (2006) found greater snail densities in P*anicum hemitomon* as compared to *Eleocharis cellulosa*. Significantly fewer snails were found in dense *E. cellulosa* as compared to habitats with lower stem density. Wight et al. (2013) found that apple snail egg cluster density was significantly greater along the *Cladium jamaicense* (sawgrass) ecotone than in wet prairie habitat, which was consistent with previous studies (Turner 1996; Darby et al. 1999), and that egg cluster densities were greatest along the western sawgrass ecotone. However, their results also indicated that egg cluster production in wet prairie habitat contributed to over 50 percent of total egg cluster production in most sites (although, in 4 of 11 sites, there was zero egg cluster production in wet prairie) (Wight et al. 2013). This information suggests that wet prairie habitat contributes more significantly to egg production than had been described in the past (Wight et al. 2013). Wight et al. (2013) concluded that habitat containing a sawgrass ecotone and transitional wet prairie habitat (for egg cluster production), as well as deeper water slough habitats (which may provide refugia for some snails during a drying event) would provide the greatest variety of habitats to support local apple snail populations.

Previous studies in this region (Wood and Tanner 1990; David 1996) indirectly documented the conversion of wet prairies to aquatic sloughs, which constitutes a loss of quality snail kite foraging habitat (Kitchens et al. 2002). These studies, occurring largely outside kite foraging and nesting areas, were not designed to provide inferences beyond the isolated sites in which they were conducted. Because of the concern that conversion of wet prairie/emergent slough habitats to deeper, less desirable sloughs will lower kite reproduction, primarily through lower prey base availability in those communities, Dr. Christa Zweig and other researchers initiated a study in 2002 to monitor critical kite breeding and foraging habitat in WCA-3A. Three communities (as described by cluster/indicator species analysis; Fletcher et al. 2014) important to kite foraging in southern WCA-3A are eleocharis, eleocharis/sawgrass prairie, and *Bacopa caroliniana* transitional. During the period of study by Zweig, the eleocharis community only occurred in the western side of the study area (WCA-3A south of Interstate 75 and west of the Miami Canal) and had disappeared from four out of five plots under continuous sampling from 2009 to 2011 (Fletcher et al. 2015). Further analyses suggested a continuing decreasing trend for eleocharis communities in WCA-3A from 2010-2013, indicating further declines of foraging habitat for snail kites in this area (Fletcher et al. 2014).

The eleocharis/sawgrass community has appeared intermittently across the landscape, but predominantly in southwestern WCA-3A. It is currently only present in one plot in the southwest quadrant (Fletcher et al. 2015). The bacopa transitional community also only occurs in the western portion of the study area and has been stable in two of the continuous sampling plots (Fletcher et al. 2015). Between 2012 and 2013, it appeared in four other plots, one in the southwest and three in the northwest of the study area. Continued significant increases in the *N. odorata* community and decreases in *E. elongata* community were also observed, although there was a small decrease in *N. odorata* in 2011 due to dry conditions (Fletcher et al. 2014). Stem density of *N. odorata* increased significantly over time, while stem density of all emergents decreased significantly over time (Fletcher et al. 2015). These data suggest further degradation

of snail kite foraging habitat has occurred over the last decade, although the extent has not yet been quantified across WCA-3A.

4.9.2 Factors Affecting the Species Environment within the Action Area

The persistence of the snail kite in Florida depends upon maintaining hydrologic conditions that support the specific vegetative communities that compose their habitat along with sufficient apple snail availability across their range each year (Martin et al. 2008). Operation of the C&SF Project and other hydrologic management actions has a significant effect on hydrologic conditions within most of the areas occupied by snail kites. Within the Action Area, the Corps and District manage water levels in snail kite habitat in accord with many different local and regional water management plans and schedules. The Service has conducted formal consultation on the MWD and C-111 Projects, IOP, ERTP, the Lake Okeechobee Regulation Schedule, and many other projects that have affected snail kites and their habitat. Water operations affect water levels in marshes and lakes upon which snail kites rely, the rates of water level recessions in lakes and marshes, and the timing of high and low water events. These factors, in turn, directly affect snail kite habitat suitability.

In the unaltered Everglades ecosystem, snail kites were able to cope with extreme and varying hydrologic conditions during a given year or at a given location due to their nomadic behavior and the network of suitable habitats that existed within the Everglades and throughout the rest of the kite's range in Florida. These extremes, when experienced at a natural frequency, are essential to maintaining suitable nesting and foraging habitat for the snail kite and its prey, and the natural variability within the system resulted in a habitat mosaic which ensured long-term persistence of suitable habitat for Everglades wildlife, including kites and apple snails.

The compartmentalization of Everglades' wetlands under the C&SF Project, and subsequent hydrologic management of each of the compartments, has reduced the connectivity of wetland systems upon which kites rely and has changed the timing, duration, and frequency of high and low water conditions within wetlands. Separate and independent management regimes for the different compartments have also impacted snail kites, in some cases by allowing unfavorable conditions in adjacent wetland units at the same time. Both short-term natural disturbances (*e.g.*, drought) and long-term habitat degradation, including impacts to their prey base, limit the snail kite's reproductive ability. WCA-3A has been identified as the most critical component of snail kite habitat in Florida, in terms of its influence on demography (Mooij et al. 2002; Martin 2007; Martin et al. 2007). A concern is the lack of or decreased reproduction within this area since the late 1990s.

Current water regulation schedules shorten the window of time during which kites can breed, and rapid recession rates often result in nest abandonment (Cattau et al. 2008a). Hydrologic conditions within WCA-3A have also resulted in reduced apple snail productivity, abundance, and density. Researchers have identified that high water during the breeding season can have significant negative impacts to apple snail egg cluster production (Darby et al. 2005; Darby et al. 2009). In addition, higher-water levels and longer hydroperiods have been implicated in the

conversion of wet prairies (prime kite foraging habitat) to sloughs within WCA-3A beginning around 2001 (Zweig 2008; Zweig and Kitchens 2014). The current WCA-3A Regulation schedule does not mimic the seasonal patterns driven by the natural hydrological cycle, resulting in water depths in southern WCA-3A that are too deep from September through January and sometimes into the spring (Cattau et al. 2008a). The subsequent rapid drop in water level recession rates from the elevated stage schedule to the dry season low decreases foraging opportunities around individual nests and locally within wetland units, negatively affecting nesting adult kites and their young and resulting in decreased nest success, juvenile survival, and recruitment (Cattau et al. 2008a).

Under the current WCA-3A Water Regulation Schedule, there are three primary factors which have the potential to adversely affect snail kites: (1) prolonged high water levels during September through January (or beyond in some years); (2) prolonged low water levels during the early spring and summer; and (3) rapid recession rates during the breeding season. Each is discussed in detail below.

4.9.2.1 Prolonged High Water Levels

During most years, water levels naturally peak late in the wet season (*i.e.*, September-October) and begin receding shortly thereafter. Water management in WCA-3A has resulted in high water levels that extend into the beginning of the dry season – often early January and sometimes beyond. This can result in decreased snail kite nest success and juvenile survival, decreased apple snail productivity and availability, and, if frequent, degradation of nesting and foraging habitat.

Prolonged high water extending into January is associated with decreased snail kite nest success and juvenile kite survival (Cattau et al. 2008a). From as early as late November into the spring, snail kite courtship and pair formation activities, including nest site selection and construction, are occurring. High water conditions during this time can act as an ecological trap in which kites build nests at higher ground surface elevations (GSEs) and are then left "high and dry" when water levels recede (Sykes et al. 1995; Cattau et al. 2008a). It is believed that snail kites choose nest sites based on water depths directly underneath the nest and in the immediate vicinity. Appropriate water depths in these areas are important to deter predation and provide sustained foraging opportunities for nesting adults and their young. If water levels change rapidly during the nesting season – for instance, due to water management operations conducted in order to meet the target water regulation schedule by alleviating high water conditions that extended into the dry season – nesting adult kites and juveniles fledged from these nests may suffer from reduced foraging opportunities, especially when low water levels cause snails to stop moving and become unavailable to foraging kites, resulting in both decreased nest success and lower juvenile survival rates.

High water during the breeding season also adversely affects apple snail productivity, and by extension snail density. Apple snail studies have documented a dramatic increase in spring egg cluster production as water depths fall below approximately 1.3 to 2.0 ft (40 to 60 cm) in

WCA-3A and other wetlands (Darby et al. 2005). Darby et al. (2005) found high snail densities (*e.g.*, >1.0 snail per m^2) in WCA-3A in 2002 and 2003, where densities reflected 2 years (2001 and 2002) of relatively low water levels. In contrast, water depths in 2003 remained above 1.3 to 2.0 ft during the peak reproductive season, and they observed a delay in the peak of egg laying and a decline in annual per capita egg production and egg cluster counts (*e.g.*, approximately 130 egg clusters per 50-meter transect in an area with >1.0 snail per m^2; Darby et al. 2008).

This decrease in 2003 spring egg cluster production resulted in a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004. Native apple snail densities in WCA-3A had still not recovered in 2013 compared to densities found in 2002-2003 (Wight et al. 2013). High water during the breeding season also significantly affected the proportion of juvenile snails – specifically, the deeper the water in the previous year, the greater the proportion of small (<20 mm) snails found in March and April (Darby et al. 2009). This may result from (1) a shift in egg production from summer to fall months, with snails still not of adult size as winter approaches, and/or (2) suppressed snail growth in deeper water, although the mechanism behind this has not been studied (Darby et al. 2005, Darby et al. 2009). Since kites typically select snails >20 mm for foraging (Sykes et al. 1995), a high percentage of apple snails with shells <20 mm in March and April may not support the energetic needs of nesting kites, resulting in fewer nest initiations and more nest failures (Darby et al. 2009).

To isolate the effect of water depth on apple snail egg production, Therrien and Darby (2015) conducted a mesocosm study in March-June 2015, utilizing 26 mesocosms in southeastern and southwestern WCA-3A, and compared the number of egg clusters between mesocosms located in shallow (30-49 cm), middle (50-80 cm), and deep (90-100 cm) water depths. Their results indicate that egg production was approximately four times greater in shallow versus deep water depths across all months (Darby 2015). Preliminary analyses suggest that depth alone explains approximately 50 percent of variation in mesocosm egg production, with the remaining variation probably explained by nutrients, behavior (*e.g.*, movement), and the presence of parasites (Darby 2015). Observations by Darby (2015), both during field surveys and the mesocosm study, indicate that the highest egg production consistently occurs at water depths between 20 to 50 cm.

High water levels and extended hydroperiods have resulted in vegetation shifts within WCA-3A, degrading snail kite habitat. The extended deep water conditions from September into January or beyond, whether resulting from weather conditions, water management operations, or a combination of both, appear to have reduced the amount of woody vegetation in the area and contributed to the transition of wet prairies to open water sloughs (Zweig 2008; Zweig and Kitchens 2008). These habitat conversions directly affect snail kites in several ways, most importantly by reducing the amount of suitable nesting and foraging habitat and reducing prey abundance and availability. Woody vegetation, such as pond apple, willow, and cypress which are used by kites for nesting and perch hunting, can be killed or severely stressed by extreme high water conditions and extended hydroperiods. Such vegetation is slightly elevated above the surrounding marsh and therefore is affected by prolonged higher-than-normal water levels.

Within WCA-3A and the Greater Everglades, wet prairie exists as a component of the ridge and slough landscape, occurring in the transition zone between higher sawgrass ridges and deeper lily-dominated sloughs. Wet prairies serve as the prime habitat for apple snail egg production and snail kite foraging, which species experts believe is the limiting factor to snail kite productivity in WCA-3A (Darby 2008; Kitchens 2008). In addition to deeper water conditions, hydroperiods in WCA-3A have increased, lengthening the time between drying events and further contributing to the conversion of wet prairie. Prolonged hydroperiods reduce habitat structure in the form of emergent vegetation, which is critical for apple snail aerial respiration and egg deposition (Turner 1996; Darby et al. 1999). Occasional drying events are essential to maintain healthy wet prairie and the mosaic of vegetation types that exist in the Everglades system (Sklar et al. 2002; Karunaratne et al. 2006; Darby et al. 2008). However, little annual variation in low water depths has occurred within WCA-3A since 1993, virtually eliminating these essential drying events. The effects of this are particularly apparent in southwestern WCA-3A, which has experienced excessive ponding in recent years, as the observed habitat community changes discussed above illustrate.

The transition of wet prairies to open water sloughs also affects prey availability for snail kites. Snails tend to avoid areas where water depths are greater than 50 cm (Darby et al. 2002). Avoidance of deeper depths may be related to the type and density of vegetation in deeper water areas, food availability, or energy requirements for aerial respiration (van der Walk et al. 1994; Turner 1996; Darby 1998; Darby et al. 2002). Water-lily sloughs support lower snail densities as compared with wet prairies (Karunaratne et al. 2006). Limited food quality and lack of emergent vegetation in the sloughs may account for the lower snail densities. Research indicates that snails depend upon periphyton for food (Rich 1990; Browder et al. 1994; Sharfstein and Steinman 2001), which may be limited within deeper water environments. Karunaratne et al. (2006) observed little or no submerged macrophytes and epiphytic periphyton in the sloughs they studied in WCA-3A. In contrast, species commonly encountered within wet prairie habitat (*e.g.*, *Eleocharis* spp., *Rhynchospora tracyi*, *Sagittaria* spp.) support abundant populations of epiphytic periphyton (Wetzel 1983; Browder et al. 1994; Karunaratne et al. 2006). Apple snails also depend upon emergent vegetation for aerial respiration and oviposition. A reduction in the number of available emergent stems for egg deposition would also contribute to the observed lower snail densities within sloughs.

4.9.2.2 Prolonged Low Water Levels

Low water levels have a significant effect on snail kite nest success in WCA-3A. If water levels become too low and food resources become too scarce, adults will abandon their nest sites and young (Sykes et al. 1995). Nest success analyses performed by Cattau et al. (2008) suggest that decreasing values of the annual minimum stage (*MIN*) has a significant negative effect on nest success. During the years used in their analysis, *MIN* in WCA-3A ranged from 8.51 to 9.43 ft NGVD. Within this range, observed nest success was highest (approximately 60 percent) at a stage of 9.3 ft NGVD. The highest minimum level (9.43 ft NGVD) occurred in a year with observed nest success equal to approximately 40 percent. In the regression analysis, this data point fell outside (below) the 95 percent confidence interval. This illustrates the observation of

Cattau et al. (2008) that, while values of *MIN* on the lower end of the scale have a predictable negative effect on nest success, high values of *MIN* do not guarantee high nest success. Based on the regression analysis, an annual minimum stage of 8.8 ft NGVD is associated with nest success of approximately 35 percent. Nest success observed in the 2 years (1999, 2000) with this approximate MIN value was calculated to be approximately 18 percent and 30 percent, respectively – below the regression line. However, during years with approximate *MIN* values near 8.5 ft NGVD (2002, 2004, 2006), observed nest success ranged from approximately 20 to 45 percent. The highest of these was observed in the year with the lowest stage (2004, 8.51 ft NGVD), and this data point fell outside (above) the regression line.

A strong relationship also exists between juvenile kite survival rate and annual minimum stage (Martin et al. 2007; Cattau et al. 2008a). Due to their inability to move large distances, juvenile snail kites rely upon the marshes surrounding their nests for foraging. If water levels within these marshes become too low to support foraging (due to decreased apple snail availability), juvenile survival will be diminished. Survival analyses performed by Cattau et al. (2008a) indicate that decreasing values of *MIN* also had a significant negative effect on juvenile kite survival. During the years used in the analyses, *MIN* in WCA-3A ranged from 8.51 to 9.70 ft NGVD. Within this range, model-averaged estimated juvenile survival was highest (approximately 54 percent) at a minimum stage of 9.07 ft NGVD (Cattau et al. 2008a). With the exception of the 2003 estimate, the data suggest that juvenile survival levels off near 50 percent at minimum water levels ≥9.0 ft NGVD. With the exception of the 2000 estimate (associated with a severe region-wide drought which also greatly affected adult kite survival), juvenile survival remained ≥40 percent at minimum water levels ≥8.8 ft NGVD. In terms of water depths (as opposed to stage), estimated juvenile kite survival rates for years when water levels fell below 10 cm was substantially lower compared to years where estimated water depths stayed above 10 cm (Cattau et al. 2008a).

While high water during the breeding season can result in delayed and decreased snail productivity, low water levels can also negatively affect snail egg cluster production, recruitment, and survival. Apple snail egg production is maximized when dry season low water levels are less than 40 cm but greater than 10 cm (Darby et al. 2002). Once water levels drop below approximately 0.33 ft (10 cm), snails stop moving (and reproducing), remaining stranded near the ground surface until water levels rise again (Darby et al. 2002; Darby et al. 2008). Thus, water levels below 0.33 ft will negatively affect snail egg cluster production. Depending upon the timing and duration of such low water conditions, apple snail recruitment can be significantly affected by the truncation of annual egg production and stranding of juveniles (Darby et al. 2008). Since apple snails have a 1.0 to 1.5-year life span (Hanning 1979; Ferrer et al. 1990; Darby et al. 2008), they only have one opportunity (*i.e.*, one dry season) for successful reproduction. Egg cluster production may occur from February to November (Odum 1957; Hanning 1979; Darby et al. 1999); however, approximately 77 percent of all apple snail egg cluster production occurs during April through June (Darby et al. 2008). Water levels <10 cm during peak apple snail egg cluster production substantially reduce annual per capita egg production, and thus recruitment and apple snail densities (Darby et al. 2008). If possible, dry downs during this critical time frame should be avoided. The length of the dry down, and age

and size of the snail, are all important factors in determining apple snail survival. Larger apple snails can survive dry downs better than smaller apple snails (Kushlan 1975; Darby et al. 2006, 2008). Darby et al. (2008) found that 94 percent of pre-reproductive adult-sized snails survived dry down conditions lasting 6 weeks, 71 percent survived after 12 weeks, and 27 percent survived after 18 weeks. Smaller snails exhibited significantly lower survival rates – approximately 50 percent after only 8 weeks dry (Darby et al. 2008). Snails in dry wetlands may experience significantly lower survival in the presence of substrate-probing predators.

However, short-term (same year) impacts can be balanced by longer-term improvements to apple snail habitat. Periodic dry downs promote maintenance of wet prairie habitat, as discussed below, and regeneration of emergent vegetation critical for snail oviposition and aerial respiration (Karunaratne et al. 2006). Periodic drying events may also result in a decrease in predation pressure on juvenile snails, thereby increasing recruitment and allowing a greater proportion of the annual snail cohort to reach adult size (Darby et al. 2009). When attempting to minimize dry down-associated impacts to apple snails, timing is as important as duration, and the two are often intertwined (*i.e.*, dry downs occurring earlier in the spring will typically be longer in duration). The longer the drying event overlaps with peak egg cluster production, the greater the impact on the population (Darby et al. 2008).

Wet prairie vegetation needs occasional dry downs (water depths <0.13 ft [4 cm], depending on vegetation species) for regeneration, and it has long been recognized that water levels should recede below ground periodically to maintain healthy wet prairie habitat, although moist soil conditions are needed for seed germination and establishment of new seedlings (Dineen 1974; Goodrick 1974; Zaffke 1983). Analyses conducted by Richards et al. (2009) defined a spikerush community occurring across the Everglades landscape which was dominated by *E. cellulosa* and contained *P. hemitomon*. This community contained an average dry season depth of 0.13±0.10 ft (4±3 cm) with a hydroperiod of 327±7 days. Ross et al. (2006) described a similar spikerush community in northern and central Shark Slough, ENP which exhibited a hydroperiod of 344 days. These results suggest a dry down duration of approximately 3 to 6 weeks. Frequency can be inferred from research on community composition and transition between communities in WCA-3A conducted by Zweig and Kitchens (2008). Based on their analyses of hydrological and vegetation data (sampling initiated in 2002), Zweig and Kitchens (2008) found evidence of wet prairie converting to deeper, less desirable habitats for snail kites (*e.g.*, sloughs) in as little as 4 years. Their results also suggested that such effects on community composition were highly correlated with recent (within 2 years) and historic (within 4 years) minimum and mean water levels during the dry season. These results suggest a minimum frequency for dry down conditions of approximately once every 4 years. Dry downs that occur more frequently, or for longer periods of time, can result in proliferation of sawgrass.

4.9.2.3 Rapid Recession Rates

Under high water conditions early in the nesting season, kites tend to initiate nests in upslope, shallower sites. Also, in these years, water regulation schedules can require water managers to initiate rapid recession rates in the spring to meet the target dry season low water level. Rapid

recession rates can also be caused or exacerbated by high rates of evapotranspiration and low precipitation. Whatever the reason, rapid recession rates during the breeding season, and the resulting large amplitude (overall difference between high and low water levels), can result in decreased snail kite nest success and decreased juvenile kite survival. Breeding adults may not be able to raise their young before the water levels reach a critical low water depth, below which snail availability to kites is drastically reduced. In addition, when water levels recede below an active snail kite nest, predation risk increases due to nest exposure to terrestrial predators (Sykes et al. 1995). As a result, nesting success can be further reduced in these areas. Nest success analyses performed by Cattau et al. (2008a) suggest that increasing recession rate (difference between stage on January 1 and the dry season minimum stage, divided by the number of days between these) had a significant negative effect on snail kite nest success. Of the eight single-variable models, recession rate had the strongest negative effect on nest success, with a beta parameter estimate almost 8 times greater than that of the annual minimum water level and more than 15 times greater than any other hydrological variable (Cattau et al. 2008a).

However, recession rate appears in only one of the top five multivariate models, suggesting that its effect on nest success may be buffered by other hydrological variables (*e.g.*, a high minimum water level) (Cattau et al. 2008). During the years used in their analyses, recession rates in WCA-3A ranged from approximately 0.04 to 0.14 ft per week in WCA-3A (Cattau et al. 2008a). Based on the regression analysis, a recession rate of 0.05 ft per week was associated with a nest success slightly above 50 percent, and recession rates of 0.06-0.10 ft per week were associated with a nest success of approximately 38 to 48 percent. Based on methodology used by Cattau et al. (2008), these recession rates can also be applied throughout the dry season to calculate related values of amplitude, where 0.05 ft per week translates to an amplitude of approximately 1.0 ft between January 1 and the dry season low (occurring, on average, around May 15). Their analysis also indicated a negative relationship between amplitude (between pre-breeding maximum and breeding season minimum water levels) and juvenile survival (Cattau et al. 2008a).

Studies of apple snails suggest that receding water promotes egg cluster production (Hanning 1979; Turner 1996); yet rapidly decreasing water levels associated with fast recessions may cause egg clusters laid on emergent stems during higher water levels to fall into the water and die, while rapid increases in water level (*e.g.*, dry season reversals, typically associated with storm events) may drown egg clusters. Thus, a slow, gradual recession, similar to that specified for snail kites, is preferred (as opposed to having no recession, rapid recession, or reversal of water levels).

4.9.2.4 Multi-Species Transition Strategy for WCA-3A

In order to address the adverse effects to snail kites in WCA-3A discussed above, the Service along with Drs. Kitchens, Darby, and Zweig, and others, developed a series of water level recommendations for WCA-3A that addressed the needs of snail kites, apple snails, and vegetation characteristic of their habitat. These recommendations were then incorporated with those for additional at-risk species and habitats to develop a comprehensive strategy for water

management in WCA-3A during the transition from current to "restored" conditions, using increased snail kite productivity as a success criterion. This water management strategy, the Multi-Species Transition Strategy for WCA-3A (MSTS), identified water stage and depth recommendations (based on the 3-gauge average of 3A-3, 3A-4 and 3A-28 (3AVG)) divided into 3 time periods representing: (1) the high peak-stage of the wet season (September 15 to October 15); (2) the pre-breeding season (January); and (3) the latter portion of the peak breeding season during which dry season water levels are typically lowest (May 1-31; hereafter referred to as the dry season low). Additionally, it identified recommended rates of change between high and low water levels between each of these time periods (*i.e.*, recession and ascension rates). Complete documentation of the MSTS, including its specific recommendations, discussions of the best available science used in its development, its intended implementation, and its limitations and recommendations for further refinement are provided in the ERTP 2010 BO.

By design, the MSTS does not attempt to incorporate extremely wet and extremely dry years which will naturally occur at some infrequent basis (*e.g.*, once every 10-20 years), during which attempts to meet minimum or maximum water levels or target recession rates may be impractical due to system constraints. In accordance with the intent of the MSTS, such events can be viewed as opportunities to incorporate natural stochasticity and inter-annual variability into the system. Such years will likely require additional coordination and may necessitate water management outside the MSTS but can still work to the benefit of species.

The intent of the MSTS is to facilitate decision-making amongst multiple interests and to serve as a tool when evaluating potential water management actions within WCA-3A. It is important to note that the water stages and depths identified in the MSTS are not targets which should be managed for in isolation or without consideration of appropriate biological, hydrological, and meteorological information. To properly implement and apply the MSTS to achieve the desired benefits for species and habitats, regular and close coordination is necessary between water managers and biologists.

The recommendations in the MSTS have provided the Service and other agencies with the best available scientific information to inform best professional judgment for multi-species management within WCA-3A. As such, the MSTS formed the basis for many ERTP Performance Measures (PMs) and Ecological Targets (ETs) in the Corps' BAs (2010 and 2015) and were incorporated into the Service's ITS. The MSTS is still used today. Another interagency group created as a result of the ERTP 2010 planning process, which included the Multi-Species Transition Strategy, is the Ecosystem Based Management Group. This group consists of staff from the Corps, ENP, FDACS, FWC, Service, SFWMD and others. The Ecosystem Based Management Group meets weekly during the dry season transition and seasonally three times annually to help guide the formation of recommendations of water managers.

The MSTS contains the best available science linking hydrologic ranges in WCA-3A to suitable conditions for several species such as snail kites, apple snails, wading birds and tree islands. As

water management scenarios change in the Everglades, the MSTS will need to be reassessed to ensure that the targets are still pertinent.

While we anticipate that this decision support tool will allow for comprehensive evaluations of water management and, ultimately, better-informed decisions to benefit the Everglades ecosystem, critical gaps (including further development and implementation of a snail kite HSI) must be filled before the tool can be used. Therefore, our analysis of effects under the COP will utilize the recommendations under the current MSTS, updated with any new or revised information as applicable.

4.9.2.5 Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species into snail kite habitat, reducing the habitat suitability for nesting and foraging. Dense growth of these plants also has the potential to reduce the ability of snail kites to forage for apple snails. In addition, the effects of higher nutrient inputs on plant growth can necessitate habitat management activities in areas used by snail kites. These activities can have negative effects on nesting kites if not conducted appropriately.

4.9.2.6 Climate Change

Climate change represents significant short- and long-term threats to the environmental baseline of the kite and their habitat (Miller and Traxler 2018). Surface temperatures and evapotranspiration are expected to increase which will likely increase recession rates during the snail kite breeding season and when native apple snail production is at its peak. Changes in rainfall patterns can create changes in vegetation and habitat resulting in changes in habitat suitability for both kites and snails.

Rainfall patterns are expected to change with more El Nino events resulting from climate change. For example, in 2016, wetter than average conditions due to the very strong El Nino effects prevailed in South Florida through the first half of 2016, encompassing the 2016 kite breeding season. These El Nino events have a significant effect on water levels and depths in the habitat. The occurrence of El Nino conditions resulted in a major short term negative effect on the environmental baseline for kite habitat in 2016 because of the wetter conditions. After the peak of El Nino, the first observation of kites in the WCA-3A during 2016 was in January (13 total kites). Kites began active nesting at the beginning of March (observed during the completion of the 3rd survey), and by April there were a total of 9 active nest in the WCA-3A with the highest number of kites observed at 34. After the completion of survey 5 (May 6 – 8, 2016) there was only one kite observed within the 3A area, and all active nesting during that time

had failed, indicating that there was no suitable habitat (foraging and nesting) for kites in the WCA-3A.

The Service will continue to monitor this situation closely and will implement Strategic Habitat Conservation Planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006b).

4.10 Summary of Baseline Conditions

From a high of 247 nests and 303 fledglings in 1997, snail kite nesting in WCA-3A has dropped drastically since. This long-term decrease is believed to be due to a similar crash in apple snail populations in WCA-3A and continued habitat degradation (primarily of foraging habitat). Over this same time span, the snail kite population in Florida decreased from approximately 3,000 birds in 1999 to a low of approximately 685 birds in 2008. While some of this steep decline was known to be caused by regional droughts, the population was also greatly impacted by the removal of WCA-3A (and Lake Okeechobee) as productive breeding grounds. As previously explained, since 2010, the snail kite population has begun rebounding. By 2014, the snail kite population estimate was significantly higher (1,754 birds) primarily due to stable fledging rates in Lake Okeechobee and an increase in fledging in the Everglades and STAs (Fletcher et al. 2015). As shown in Figure 15, in 2015, the population estimate increased to approximately 2,100 birds, and in 2017 the estimate rose to approximately 2,600 birds. The 2018 population estimate slightly decreased to an estimate of 2,347 birds (Fletcher et al. 2018). The increase is believed to be in part, due to the high nesting effort and productivity in the Kissimmee Chain of Lakes (KCOL) since 2005 and, in more recent years, in Lake Okeechobee. It is also believed to be, in part, due to the ability of shail kites to rapidly find and exploit novel habitat conditions, such as recently flooded areas where exotic snail populations boom, but often later bust._ WCA-3A has experienced modest, but not sustained, increases in nesting effort in recent years, although nesting success has been high in 2014, 2015, 2018, and 2019 at 53 percent, 53 percent, 43 percent, and 54 percent nesting success respectively for these years (Fletcher et al. 2019). While this is encouraging, there is no evidence that native apple snail populations in WCA-3A have recovered or that habitat degradation there has stopped.

4.11 Effects of the Action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

4.11.1 Effects of the Action to the Everglade Snail Kite

The effects of the COP to snail kites are expected to be completely hydrologic since the COP consists of water management operations and does not involve construction of structural features. Potential adverse effects from the COP to the Everglade snail kite that are included in this evaluation include effects to apple snail populations, vegetation types, prolonged high water levels during September through January (or beyond in some years), prolonged low water levels during the early spring and summer, and recession rates during the breeding season (December through July).

The COP is anticipated to be in place for 7 years until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and into Florida Bay. Thus, these effects are anticipated to occur throughout the projected 7-year operational period of the COP.

Based on the best available information regarding the Everglade snail kite, the foraging and habitat needs of the species, the project description, and the documented occurrences within and near the action area (see Figure 23), there is reasonable certainty that the COP will likely result in take of the Everglade snail kite.

Modeling and analyses related to how the COP operations may affect the Everglade snail kite, the apple snail, and habitat suitability for these species have been updated from previous evaluations that were done for IOP, ERTP, and ERTP 2016. The updates are primarily due to the synthesis of more recent and longer-term data sets which have encouraged the development of performance measures (PMs) and ecological targets (ETs). We recognize that past water management operations in WCA-3A have likely reduced the suitability of the area for apple snails and nesting kites. Decreases in suitable habitat, as well as the apparent significant decreases in population and estimated demographic parameters, also likely function to limit the Everglades snail kite's former resiliency to weather extreme conditions and the normally short-lived, adverse effects such conditions would have on productivity and survival.

4.11.2 Effects to Apple Snail Populations

As previously stated, Everglade snail kites are dietary specialists and feed almost exclusively on apple snails (*Pomacea* spp.). Nesting snail kites often forage within 1-2 km of their nests under favorable conditions but have been observed traveling more than 6 km to find snails to feed young (Beissinger and Snyder 1987). An ecological planning tool to describe the dynamics of the apple snail population as a function of hydrology and temperature was developed using the USGS Everglades Depth Estimation Network (EDEN). This tool was available to evaluate potential effects from the COP on apple snails within the Action area. For more information on the apple snail population model, refer to Darby et al. 2015. The numbers and size distribution of snails are simulated and can be calculated for any day of a year with input data. Adult apple snails during a given year are a product of egg production, and thus environmental conditions, from the previous year.

Figure 16 and Figure 17 depict apple snail adult population numbers for a dry year (2004) and a wet year (1995) respectively. Results are shown for adult snails (>20 mm) during the spring of a dry year (April 20), before that year's reproductive period. End of spring results are shown as this is the population of snails of the size class consumed by the Everglade snail kite. The top left panel of each graphic depicts the modelled existing condition (ECB19RR). The bottom left panel depicts ALT Q, and the bottom right panel depicts the difference between each alternative relative to ECB19RR. Changes in apple snail population numbers were observed within the boundaries of designated critical habitat for the Everglade snail kite. Snail kite nesting is currently concentrated in southern portions of WCA-3A. During a wet year, ALT Q would increase apple snail population numbers in portions of southern WCA-3A and ENP on the flanks of NESRS; however, decreases were observed within portions of eastern WCA-3B. During a dry year, similar patterns were observed; however potential decreases in apple snail population numbers appeared to be more severe where they occurred within the study area.

Figure 18 illustrates means of daily percent change in total apple snail population relative to ECB19RR by year for the COP area of interest (*i.e.,* light brown line in Figure 16 and Figure 17). Values begin in 1995, giving the model three years to calibrate. ALT Q improved apple snail production in six out of the 11 years, respectively. Observed differences between ALT Q and ECB19RR were most often not more than a ±10 percent change. Implementation of the COP may produce a variety of wetland habitats that would support conditions conducive to apple snail production. During a wet year, each COP alternative increased apple snail population numbers in the study area thereby increasing the spatial extent of suitable foraging opportunities for snail kites providing a minor long-term beneficial effect. However, decreases in apple snail population numbers were observed during a dry year. As shown in Figure 18, under ALT Q, the COP operations are expected to result in an overall approximate 2 percent decrease of snail production per year, on average.

4.11.3 Effects to Vegetation Types

While it is commonly observed that wet prairie habitat requires periodic dry downs during the spring for plant regeneration, it has also been documented that Everglades wet prairies occur in areas with typically lower wet season water depths (relative to sloughs). Based on management observations, Dineen (1974) recommended a "wet prairie" regulation schedule for WCA-2A that included a wet season high water level of 12.5 ft; using the average GSE in WCA-2A (10.5 ft NGVD), this equates to a wet season water depth of approximately 2.0 ft. No duration was recommended, but the regulation schedule reflects a high water peak occurring at the end of October and receding immediately thereafter. Goodrick (1974) reported on wet season water depths during 1963-1972 at both a wet prairie site (near gauge 3-2, north of Alligator Alley) and a slough site (near gauge 3A-28) in WCA-3A. He found that October water depths in the wet prairie site never exceeded 2.3 ft, compared to slough water depths which exceeded 2.5 ft approximately 40 percent of the time. These observations suggest that water depths >2.5 ft are more conducive to slough vegetation (*Nymphaea* and submerged species), and that such wet season water levels have the potential to contribute to the conversion of wet prairies to slough.

Maintaining water levels at such depths for prolonged periods of time would serve to increase the potential for this to occur. In addition, increasing the frequency of this occurrence in consecutive years could also increase the likelihood of wet prairie degradation and conversion. Recent research indicates that shifts from one vegetation type to another may occur in a relatively short time frame (1 to 4 years) following hydrological alteration (Armentano et al. 2006; Zweig 2008; Zweig and Kitchens 2008; Sah et al. 2008).

The Everglades Landscape Vegetation Succession Model (ELVeS) was used to predict vegetation community change over time in response to environmental conditions. The model uses empirically based probabilistic functions of vegetation community niche space and temporal lags to evaluate expected community response within the model's domain. For the evaluation, ELVeS was run with ten vegetation communities (1) sawgrass; (2) sawgrass short; (3) open marsh; (4) cattail; (5) floating emergent marsh; (6) marl prairie (drier); (7) marl prairie (wetter); (8) swamp shrub land; (9) willow shrub cattail; (10) cypress shrub sawgrass; (11) bay head shrub; and (12) rockland pine. Table 19 provides a description of the vegetation classes used in ELVeS as shown in Figures 19, 20, and 21. For more details, reference Pearlstine et al. 2011.

Figures 19, 20, and 21 illustrate changes in vegetation communities relative to ECB19RR for a representative wet year (1995), dry year (1989) and an average year (1978). Results of the modeling indicated that at the broad landscape scale there were vegetation community changes predicted to occur within most of the action area. The largest changes were predicted to occur during a representative dry year (1989) and average year (1978). Suitable foraging habitat for the Everglade snail kite is typically a combination of low-profile marsh and a mix of shallow open water. The lower right quadrant in these figures shows areas that were changed in each alternative (green = change). The light brown line noted as the COP area of interest in these figures was identified at the start of the planning efforts for the COP and was used to define the maximum acreage that could be potentially affected by the COP. Changes in vegetation primarily were observed to occur in northern WCA-3A east of the Miami Canal, in portions of WCA-3B, in southern WCA-3A and in portions of ENP including NESRS and Taylor Slough. Decreases in floating emergent marsh were observed in portions of WCA-3A adjacent to the L-67A/C levees. ELVeS was not available for ALT Q+ but it is believed that ALT Q+ would result in similar effects as discussed under ALT Q.

4.11.4 Effects to Water Levels

4.11.4.1 Prolonged high water levels during September through January (or beyond in some years)

During most years, water levels naturally peak late in the wet season (*i.e.,* September-October) and begin receding shortly thereafter. Water management in WCA-3A has resulted in high water levels that extend into the beginning of the dry season – often early January and sometimes beyond. This can result in decreased snail kite nest success and juvenile survival, decreased apple snail productivity and availability, and, if frequent, degradation of nesting and foraging habitat.

Prolonged high water extending into January is associated with decreased snail kite nest success and juvenile kite survival (Cattau et al. 2008a). From as early as late November into the spring, snail kite courtship and pair formation activities, including nest site selection and construction, are occurring. High water conditions during this time can act as an ecological trap in which kites build nests at higher GSEs and are then left "high and dry" when water levels recede (Sykes et al. 1995; Cattau et al. 2008a). It is believed that snail kites choose nest sites based on water depths directly underneath the nest and in the immediate vicinity. Appropriate water depths in these areas are important to deter predation and provide sustained foraging opportunities for nesting adults and their young. If water levels change rapidly during the nesting season – for instance, due to water management operations conducted in order to meet the target water regulation schedule by alleviating high water conditions that extended into the dry season – nesting adult kites and juveniles fledged from these nests may suffer from reduced foraging opportunities, especially when low water levels cause snails to stop moving and become unavailable to foraging kites, resulting in both decreased nest success and lower juvenile survival rates.

High water during the breeding season also adversely affects apple snail productivity. Apple snail studies have documented a dramatic increase in spring egg cluster production as water depths fall below approximately 1.3 to 2.0 ft (40 to 60 cm) in WCA-3A and other wetlands (Darby et al. 2005). Darby et al. (2005) found high snail densities (*e.g.,* >1.0 snail per m^2) in WCA-3A in 2002 and 2003, where densities reflected 2 years (2001 and 2002) of relatively low water levels. In contrast, water depths in 2003 remained above 1.3 to 2.0 ft during the peak reproductive season, and they observed a delay in the peak of egg laying and a decline in annual per capita egg production and egg cluster counts (*e.g.,* approximately 130 egg clusters per 50-meter transect in an area with >1.0 snail per m^2; Darby et al. 2008). This decrease in 2003 spring egg cluster production resulted in a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004. Relatively low densities (0.02 to 0.40 snails per m^2) continued at sampled sites into 2005-2007, and at those sites that were re-sampled in 2010 (0.06 to 0.08 snails per m^2) (Darby et al. 2008; Darby 2010).

High water during the breeding season also significantly affected the proportion of juvenile snails – specifically, the deeper the water in the previous year, the greater the proportion of small (<20 mm) snails found in March and April (Darby et al. 2009). This may result from: (1) a shift in egg production from summer to fall months, with snails still not of adult size as winter approaches and (2) suppressed snail growth in deeper water, although the mechanism behind this has not been studied (Darby et al. 2005, Darby et al. 2009). Since kites typically select snails >20 mm for foraging (Sykes et al. 1995), a high percentage of apple snails with shells <20 mm in March and April may not support the energetic needs of nesting kites, resulting in fewer nest initiations and more nest failures (Darby et al. 2009).

4.11.4.2 Prolonged low water levels during the early spring and summer

While high water during the breeding season can result in delayed and decreased snail productivity, low water levels can also negatively affect snail egg cluster production, recruitment, and survival. Once water levels drop below approximately 0.33 ft (10 cm), snails stop moving (and reproducing), remaining stranded near the ground surface until water levels rise again (Darby et al. 2002; Darby et al. 2008). Thus, water levels below 0.33 ft will negatively affect snail egg cluster production. However, such short-term (same year) impacts are balanced by longer-term improvements to apple snail habitat. Periodic dry downs promote maintenance of wet prairie habitat and regeneration of emergent vegetation critical for snail oviposition and aerial respiration (Karunaratne et al. 2006). Periodic drying events may also result in a decrease in predation pressure on juvenile snails, thereby increasing recruitment and allowing a greater proportion of the annual snail cohort to reach adult size (Darby et al. 2009). Depending on size, apple snails can survive weeks to months during periodic drying events. In lab studies by Darby et al. (2008), 94 percent of pre-reproductive adult-sized snails survived dry down conditions lasting 6 weeks, 71 percent survived after 12 weeks, and 27 percent survived after 18 weeks. Smaller snails exhibited significantly lower survival rates – approximately 50 percent after only 8 weeks dry (Darby et al. 2008). Snails in dry wetlands may experience significantly lower survival in the presence of substrate-probing predators. When attempting to minimize dry down-associated impacts to apple snails, timing is as important as duration, and the two are often intertwined (*i.e.,* dry downs occurring earlier in the spring will typically be longer in duration). The longer the drying event overlaps with peak egg cluster production, the greater the impact on the population (Darby et al. 2008).

The intent of low water evaluation criteria is twofold: (1) to assess the potential for frequent and extended extreme low water levels which result in reduced snail kite reproduction and recruitment, and reduced apple snail productivity and juvenile survival, and (2) to assess the opportunities for lower (but not extreme, frequent, or extended) water levels which are essential to restoration and maintenance of wet prairie habitat, and which species experts believe are necessary, at least in the transition period, to return WCA-3A to a productive kite area.

Nest success analyses performed by Cattau et al. (2008) suggest that decreasing values of the annual minimum stage (*MIN*) had a significant negative effect on nest success. During the years used in their analysis, *MIN* in WCA-3A ranged from 8.51 to 9.43 ft NGVD. Within this range, observed nest success was highest (approximately 60 percent) at a stage of 9.3 ft NGVD. The highest minimum level (9.43 ft NGVD) occurred in a year with observed nest success equal to approximately 40 percent. In the regression analysis, this data point fell outside (below) the 95 percent confidence interval. This illustrates the observation of Cattau et al. (2008) that, while values of *MIN* on the lower end of the scale have a predictable negative effect on nest success, high values of *MIN* do not guarantee high nest success. Based on the regression analysis, an annual minimum stage of 8.8 ft NGVD is associated with nest success of approximately 35 percent. Nest success observed in the 2 years (1999, 2000) with this approximate *MIN* value was calculated to be approximately 18 percent and 30 percent, respectively – below the regression line. However, during years with approximate *MIN* values near 8.5 ft NGVD (2002,

2004, 2006), observed nest success ranged from approximately 20 to 45 percent. The highest of these was observed in the year with the lowest stage (2004, 8.51 ft NGVD), and this data point fell outside (above) the regression line. Survival analyses performed by Cattau et al. (2008) indicate that decreasing values of *MIN* also had a significant negative effect on juvenile kite survival. During the years used in the analyses, *MIN* in WCA-3A ranged from 8.51 to 9.70 ft NGVD. Within this range, model-averaged estimated juvenile survival was highest (approximately 54 percent) at a minimum stage of 9.07 ft NGVD (Cattau et al. 2008a). The data suggest that juvenile survival rates typically level off near 50 percent at minimum water levels ≥9.0 ft NGVD. The lowest juvenile survival rate occurred in 2000 but it remained above 40 percent at minimum water levels ≥8.8 ft NGVD. It should also be noted that the estimate in 2000 was associated with a severe region-wide drought which greatly affected adult and juvenile survival.

4.11.5 Effects to Recession Rates

Rapid recession rates during the breeding season, and the resulting large amplitude, can result in decreased snail kite nest success (through increased predation or decreased forage availability) and decreased juvenile kite survival (due to decreased forage availability). The primary ecological driver for this is related to higher water conditions during the pre-breeding season (*e.g.,* early January) which encourage kites to build nests at higher ground surface elevations (GSEs). Under rapid recession rates, these locations are then left "high and dry" when water level recedes, reducing the availability of apple snails for nesting adult kites and juveniles fledged from these nests.

Nest success analyses performed by Cattau et al. (2008) suggest that increasing recession rate (difference between stage on January 1 and the dry season minimum stage, divided by the number of days between these) had a significant negative effect on snail kite nest success. Of the eight single-variable models, recession rate had the strongest negative effect on nest success, with a beta parameter estimate almost 8 times greater than that of the annual minimum water level and more than 15 times greater than any other hydrological variable (Cattau et al. 2008a). However, recession rate appears in only one of the top five multivariate models, suggesting that its effect on nest success may be buffered by other hydrological variables (*e.g.,* a high minimum water level) (Cattau et al. 2008a). During the years used in their analyses, recession rate in WCA-3A ranged from approximately 0.04 to 0.14 ft per week in WCA-3A (Cattau et al. 2008a). Based on the regression analysis, a recession rate of 0.05 ft per week was associated with a nest success slightly above 50 percent, and recession rates of 0.06 to 0.10 ft per week were associated with an approximate nest success of approximately 38 to 48 percent. Based on methodology used by Cattau et al. (2008), these recession rates can also be applied throughout the dry season to calculate related values of amplitude, where 0.05 ft per week translates to an amplitude of approximately 1.0 ft between January 1 and the dry season low (occurring, on average, around May 15).

Studies of apple snails suggest that receding water promotes egg cluster production (Hanning 1979; Turner 1996); yet rapidly decreasing water levels associated with fast recessions may

cause egg clusters laid on emergent stems during higher water levels to fall into the water and die, while rapid increases in water level (*e.g.,* dry season reversals, typically associated with storm events) may drown egg clusters. Thus, a slow, gradual recession, similar to that specified for snail kites, is preferred (as opposed to having no recession, rapid recession, or reversal of water levels).

In addition to the apple snail population model, an incidental take trigger developed during consultation between the Corps and the Service for the ERTP 2016 BO was also used to evaluate potential effects on the Everglade snail kite for the COP. In accordance with 50 CFR 402.14(I)(1)(I), the ERTP 2016 BO included exceedance criteria that are linked to habitat quality as a surrogate for incidental take of snail kites. Per the ERTP 2016 BO, those exceedance criteria are as follows: (1) Dry Season High Water: Number of days when maximum water levels exceed 9.2 feet, NGVD at gauge 3AS3W1 on or after April 15 in two consecutive years; (2) Wet Season High Water: Number of days maximum water levels exceed 10.5 feet, NGVD at gauge 3AS3W1 for 60 days in two consecutive years (June 1 – December 31); and (3) Recession Dry Season Amplitude: WCA-3A stage difference as measured at specific gauges should not recede by more than 1.7 feet, NGVD from January 1 through May 31 or the onset of the wet season, whichever is sooner as measured in two consecutive years. Rapid recession rates during the breeding season can also result in decreased nest success (through increased predation or decreased forage availability) and decreased juvenile survival (due to decreased forage availability) (Service 2016).

According to the BA, ALT Q reduced the number of years in the period of record (1965-2005) when maximum water levels exceed 9.2 feet, NGVD at gauge 3AS3W1 on or after April 15 in two consecutive years (exceedance criteria number 1 of the 2016 ERTP BO). The number of times in the period of record (1965-2005) when maximum water levels exceed 10.5 feet, NGVD at gauge 3AS3W1 for 60 days during the wet season (June 1-December 31) in two consecutive years (exceedance criteria #2 of the 2016 ERTP BO) for ALT Q did not deviate from ECB19RR.

ALT Q reduced the number of years over the period of record (1965-2005) the WCA-3A stage difference receded by more than 1.7 feet, NGVD during the dry season (January 1 through May 31) in a given year (exceedance criteria #3 of the 2016 ERTP BO) at gauges 3A-4 and 3AS3W1, which are two of the four gauges closest to where most snail kite nesting has occurred in WCA-3A. At gauges 3A28 the exceedance of this criteria is expected to increase from 6 times to 8 times for the POR under ALT Q. At gauge WCA3-W2 the exceedance of this criteria is expected to increase from 4 times to 8 times during the POR under ALT Q. Although, ALT Q is expected to increase the number of times this recession rate criteria is exceeded at gauge WCA3-W2, the depth duration curve at this gauge will be essentially the same with ALT Q as it is for ECB19RR for the entire period of record (1965-2005) (Figure 22).

The Service requested that these exceedance criteria be utilized during the COP to understand potential effects on the Everglade snail kite within WCA-3A. High water stages may reduce the abundance, growth, and reproduction of apple snails and reduce woody vegetation that kites use for nesting and perch-hunting. Depending on the amount of lost snail productivity and the initial

snail population size, a single year of high water during the dry season can result in long-term impacts to apple snail populations and decrease numbers of snail kite nest initiations, nest success, and juvenile survival in an area, as has been observed in WCA-3A.

4.12 Summary and Analysis of Effects of the Action

In summary, there is reasonable certainty that the proposed Action is likely to result in take of snail kites in the form of disturbance of adults and juveniles that leads to injury or mortality of juvenile snail kites, loss of nests, and reduced nest success. The mechanisms for these effects are reductions to apple snail populations, woody vegetation that snail kites use for nesting and perch-hunting, prolonged high water levels during September through January (or beyond in some years), prolonged low water levels during the early spring and summer, and recession rates during the breeding season (December through July).

These effects would occur throughout the projected operational period of the COP. According to the Corps' Integrated Delivery Schedule (IDS), the COP water management activities will be continuous over either: (1) the 7-year period identified in the IDS; (2) until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay; or (3) if new information becomes available through implementation of the COP Water Control Plan and/or the COP Adaptive Management and Monitoring Program (AMMP) that would necessitate a need to modify water management operations. Therefore, the expected reasonable duration of the COP operations is 7 years.

As shown in Figure 23, Everglade snail kites have been documented nesting and foraging within the Action area of the COP. Historic nesting patterns of Everglade snail kites indicate that the species has a propensity to nest in the same vicinity year after year. Therefore, it is reasonable to assume that Everglade snail kites will continue to use the Action area for nesting and foraging. Based on the best available data concerning the Everglade snail kite's use of the action area (Fletcher and University of Florida 2020), the foraging and habitat needs of the species, its life history, the project description, and the documented occurrences within and near the action area over the past 23 years, it is reasonably certain that the proposed action will adversely affect the reproductive and foraging capabilities of Everglades snail kites that utilize the proposed action area for nesting and foraging.

Based on best available data (Fletcher and University of Florida 2020), there have been a total of 807 successful Everglade snail kite nests produced within the action area from 1996 to 2019. This equates to an annual average of 35 (807/23) successful Everglade snail kite nests within the action area. A successful nest is defined as any nest that produces at least one fledgling. The average successful Everglade snail kite nest included in the 23-year dataset produced 1.8 fledglings. Therefore, we estimate that a total of 1,463 Everglade snail kites have successfully fledged from the Action area from 1996 to 2019, and that the action area produces an average of 63 (35 x 1.8) Everglade snail kite fledglings per year.

Depending on the amount of lost apple snail productivity and the initial apple snail population size, a single year of high water during the dry season can result in long-term impacts to apple snail populations and decrease numbers of snail kite nest initiations, nest success, and juvenile survival in an area, as has been observed in WCA-3A in recent years. Rapid recession rates during the breeding season can also result in decreased nest success (through increased predation or decreased forage availability) and decreased juvenile survival (due to decreased forage availability). For these reasons, we believe that of the previously mentioned affects, the reductions to apple snail populations provides the most direct and measurable criteria to measure and estimate the proposed Action's effects to Everglade snail kites.

As shown in Figure 18, the COP operations are expected to result in an overall approximate 2 percent decrease of snail production per year, on average. The projected annual 2 percent reduction in apple snails would occur throughout the projected 7-year operational period of the COP. Thus, we estimate that, on average, 1.26 (2 percent of 63) Everglade snail kites will be harmed as a result of the COP annually. Therefore, we estimate that a total of 9 (1.26 x 7) (rounded up from 8.8) Everglade snail kites will be harmed as a result of the COP during its 7-year operational period.

Even though this is a reasonable conclusion, based on the best available data, we realize that there is significant annual variability and uncertainty surrounding this estimate due to the following reasons:

- A reduction in the number of snail kites in WCA-3A or ENP in one year would not necessarily indicate a loss of snail kites due to the action if the unaccounted snail kites were elsewhere in the larger system. For example, if adult snail kites that encounter high water levels in WCA-3A subsequently nest in the STAs, KCOL or Lake Okeechobee, that disturbance does not necessarily indicate harm has occurred;
- It is impractical to monitor each individual snail kite and snail kite nest;
- It is impractical to discern the number of individual snail kites that are incidentally taken as a result of habitat impacts from other demographic and environmental parameters that will be occurring at the same time as the action, even if it was practical to monitor each individual snail kite; and
- Current methodologies for tracking population trends are insufficient to document the incidental taking of individual snail kites or their reproductive success from a specific action in a subset of the range of the species (Service 2010a).

Due to these factors of uncertainty and because it is impractical to monitor the number of individual snail kites that are incidentally taken, in accordance with 50 CFR 402.14(i)(1)(i), the estimated number of individuals will not be used to measure when the level of anticipated take has been exceeded. Only the surrogate measures based on species habitat will be used to measure when the level of anticipated take has been exceeded. Therefore, we re-affirm the evaluation and exceedance criteria that were developed for the ERTP 2016 BO that are linked to habitat quality as a surrogate for incidental take of snail kites. These criteria are described below and are summarized in Table 24.

4.13 Evaluation Criteria and Performance Measures

4.13.1 Prolonged High Water Criteria

Based on the potential for adverse effects to snail kites, apples snails, and their habitats as described in the Environmental Baseline section, the Service developed recommendations in the MSTS to guard against extended high water levels during the pre-breeding season (approximately January) and to provide favorable water levels associated with improved snail kite and apple snail productivity in the breeding (dry) season. These recommendations established the following criteria, as expressed as part of the following ERTP performance measures (PMs):

Performance Measure B (Snail Kites) – Pre-breeding Water Levels: Strive to reach water levels measured by 3AVG between 9.8 and 10.3 ft NGVD by December 31. These water levels, measured by 3AVG, when coupled with the recommended recession rate (0.05 ft per week, as described below), are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success during the peak breeding season (March-June). The Service determined it was most important to apply snail kite and apple snail PMs to conditions in southwestern WCA-3A, the area most frequently used by kites in recent years (Figure 24) and where adverse impacts to snail populations should be avoided or minimized.

Performance Measure C-1 (Apple Snails) – Pre-breeding Water Levels: Strive to reach water levels between 9.7 and 10.3 ft NGVD by December 31. These water levels are based on reaching maximum water depths of 40 cm to 60 cm at the 3AVG average GSE of 8.34 ft NGVD. When coupled with a slow, gradual recession rate (approximately 0.05 ft per week), these water depths were recommended to provide favorable conditions (*i.e.,* water depths ≤40 cm, as discussed below) for apple snail egg production beginning in March, and to prevent delayed or reduced apple snail egg production.

Performance Measure C-2 (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 and 9.7 ft NGVD between May 1 and June 1. The top end of the specified range (*i.e.,* 9.7 ft, measured using the 3AVG) is related to a depth of 40 cm at the 3AVG average GSE of 8.34 ft NGVD. As discussed above, snail research suggests that this approximate water depth acts as a threshold in its effects (positive or negative) on apple snail productivity in a given year. It is important to note that, in the MSTS, the Service recognized that the stages will result in deeper water (*i.e.,* >40 cm) in southern WCA-3A, which would negatively impact snail egg production in that area, and consequently reduced the top end of the multi-species recommended dry season range to 9.3 ft NGVD (measured using the 3AVG). Our evaluation took this discrepancy into account.

4.13.2 Low Water Criteria

The intent of low water evaluation criteria was twofold; 1) to assess the potential for frequent and extended extreme low water levels which would result in reduced snail kite reproduction and recruitment, and reduced apple snail productivity and juvenile survival, and 2) to assess the opportunities for lower (but not extreme, frequent, or extended) water levels which are essential to restoration and maintenance of wet prairie habitat, and which species experts believe are necessary, at least in the transition period, to return WCA-3A to a productive kite area. Based on the information described in the snail kite Environmental Baseline section, the Service developed recommendations in the MSTS to provide favorable water levels associated with improved snail kite and apple snail productivity in the breeding (dry) season. Recommended water levels were intended to represent the annual minimum stage which typically occurs sometime in May before the onset of wet season rains. These recommendations established the following criteria, as expressed as part of the following ERTP PMs and ET:

Performance Measure B (Snail Kites) – Dry Season Water Levels: Strive to reach water levels between 8.8 and 9.3 ft between May 1 and June 1. These water levels (measured using the 3AVG) are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success and juvenile survival, balanced with the need for lower water levels during the dry season to avoid negative effects to wet prairie vegetation.

Performance Measure C-2 (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 and 9.7 ft between May 1 and June 1. The bottom end of the specified range (*i.e.*, 8.7 ft, measured using the 3AVG) is related to a depth of 15 cm at the 3AVG average GSE of 8.34 ft NGVD. This water level translates to dry season minimum water depths ≥10 cm at GSE <8.36 ft NGVD, and thus, should avoid negative effects to snail movement and reproduction in these areas.

Ecological Target 3 (Wet Prairie): Hydroperiod: In dry years, strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in 4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water levels below ground surface for more than 4 to 6 weeks to minimize adverse effects on apple snail survival.

4.13.3 Recession Criteria

Based on the information described in the Environmental Baseline section, the Service developed a recession recommendation for snail kites in the MSTS, and this recommendation established the following criteria, as expressed as part of the following ERTP PM:

Performance Measure D (Snail Kites) – Dry Season Recession: Strive to maintain a recession rate of 0.05 ft per week from January 1 to June 1 (or the onset of the wet season). This equates to a stage difference of approximately 1.0 ft between January and the dry season low. The Service defined the onset of the wet season as a sustained increase in water levels associated with

increased rainfall frequency, which has occurred prior to June 1 over 50 percent of the time since 1965. The recession rate guideline is most important to follow during the peak snail kite breeding season (March-June). Recession rates >0.05 ft but <0.10 ft per week, while generally more rapid than desired, may be considered acceptable under certain environmental conditions (*e.g.*, unseasonably heavy rainfall). Rates >0.0 and <0.05 ft per week are not associated with direct negative impacts to nesting snail kites, although rates approaching 0.0 ft may result in delayed or reduced snail egg cluster production, depending on water depths at that time (*i.e.*, greater impacts when water is >40 cm deep).

4.13.4 Exceedance Criteria for Incidental Take

Incidental take of snail kites will be considered exceeded if any of the following three criteria are not met during the COP operations:

<u>Dry Season High Water Timing: by April 15</u>
Trigger: stage >9.2 ft NGVD at gauge 3AS3W1
Frequency: 2 consecutive years

<u>Wet Season High Water Timing: June 1 – December 31</u>
Trigger: stage >10.5 ft at gauge 3AS3W1 for 60 days
Frequency: 2 consecutive years

<u>Recession: Dry Season Amplitude</u>
Timing: January 1 – May 31 (or onset of wet season, whichever is sooner)
Trigger: stage difference >1.7 ft as measured at gauge(s) closest to kite nesting, as determined by the Service
Frequency: 2 consecutive years

4.14 Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Act.

Most of the wetlands within the Action Area for the Everglade snail kite are subject to Corps' jurisdiction and permitting under Section 404 of the CWA. In some instances, wetlands may be determined to be outside the Corps' jurisdiction. For an unknown percentage of these Federal exemptions, it is expected that the State, or county if delegated wetland permitting by the State, will claim jurisdiction and require the process of minimization of, and compensation for, wetland impacts, which should assist in minimizing impacts.

Lands surrounding or adjacent to wetlands used by the snail kite that do not require Federal involvement are where the majority of the cumulative effects are likely to occur. These lands

may be developed resulting in disturbance, habitat degradation, reduction in prey availability, isolated hydrologic changes, or permanent habitat loss. Land management activities conducted by State agencies may also have detrimental impacts to the species.

Some wetlands and the areas adjacent to those and other wetlands may be adversely affected by actions without Federal involvement, resulting in a decrease in habitat quality and quantity, prey availability, and productivity for snail kites. However, based on the status of the species discussed previously and the status of the species in the Action Area, we believe that this loss and reduction is not expected to affect the recovery or survival of the snail kite.

4.15 Conclusion

Pursuant to 50 CFR § 402.02, *"jeopardize the continued existence of"* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. *Recovery* is defined as the improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA (50 CFR § 402.02).

After reviewing the current status of the Everglade snail kite, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Everglade snail kite. Consequently, we do not expect the effects of the proposed action to impede the survival or recovery of the Everglade snail kite. We make these findings for the following reasons:

- The potential effects from the COP on the Everglade snail kite and its habitat are confined to the action area which is approximately 2,374,782 acres (See Figure 20). This area produces an average of 63 Everglades snail kites per year which is approximately 3 percent of the current estimated range wide snail kite population of 2,347 birds (See Figure 15). As explained in the *Summary and Analysis of the Effects of the Action* section, the COP is estimated to reduce snail kite production within the action area by 2 percent a year for 7 years, which is estimated to result in take to a total of 9 Everglade snail kites. Therefore, the COP is estimated to result in a 0.4 percent loss to the current range wide Everglade snail kite population estimate of 2,347 birds.
- The COP operations are expected to result in continued habitat degradation within WCA-3A, which has been one of the most significant areas of kite habitat within the past 30 years. The COP operations may result in reduced nest success of kites within WCA-3A, reduced foraging habitat suitability, and reduced abundance of the kite's primary prey. These impacts may limit population growth in WCA-3A and possibly cause further reductions in the overall kite population. However, a potential increase in hydroperiods resulting from the COP within ENP may provide an overall net benefit for Everglade snail kites and apple snail habitat. Increases in flow volume into NESRS provide an opportunity for improved vegetation, including expansion of sloughs and wet

prairies, and contraction of sawgrass ridges which would provide increased foraging and nesting habitat for the Everglade snail kite and apple snails.

- Snail kites are long-lived, have high rates of adult survival, and continue to successfully nest in other portions of their range in southern Florida, the impacts of the COP are not anticipated to appreciably reduce the likelihood of survival and recovery of the species in the wild during the expected 7-year duration of the COP operations.
- The Corps shall implement specific minimization measures as part of the COP, including species and habitat monitoring to identify population trends for the Everglade snail kite. The Corps will continue conducting and coordinating Periodic Science Calls (PSC) similar to those conducted in compliance with the ERTP 2016 BO (Service 2016). Periodic Science Calls (PSC) will allow the Corps and its Tribal and governmental partners to discuss ecological, hydrological, and meteorological conditions to achieve the objective of managing water levels and releases for the protection of multiple species and their habitats, including the Everglade snail kite. Regularly scheduled interagency PSC allow the Corps to gather input on desired long term (annual and/or seasonal) conditions within the system. In addition, the PSC occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP. The PSC focus on the status of a suite of species to allow for adaptive management of the system based upon the needs of multiple species and their habitats. Under the COP, the Corps will continue to implement PSC to provide real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process.

5.0 EVERGLADE SNAIL KITE CRITICAL HABITAT

5.1 Status of the Critical Habitat

This section summarizes the effects of all past human and natural activities or events that have led to the current status of designated critical habitat for the Everglade snail kite and are relevant to formulating the biological opinion about the proposed action.

5.1.1 Critical Habitat Description and Status

Approximately 841,635 acres (See Figure 24) were designated as critical habitat for the snail kite in 1977 (50 CFR 17.95). Because this designation was one of the earliest under the Act, specific physical or biological features that are needed by the species were not defined. Considering that snail kites feed almost exclusively on apple snails, we believe the presence of apple snail populations would be defined as a physical or biological feature of snail kite critical habitat. The designation identified nine critical habitat units that included two small reservoirs, a portion of the littoral zone of Lake Okeechobee, and areas of the Everglades' marshes within the WCAs and ENP. Since this designation, the utilization of these critical habitat units by snail kites as productive nesting areas has varied significantly. Since 2007, the Kissimmee Chain of Lakes (KCOL) has supported a large number, and in some years the majority, of nesting snail kites in Florida. This shift in productive nesting areas was in response to regional droughts as well as

habitat degradation in historic breeding locations. While the KCOL is now considered an important habitat for the snail kite, this was not the case when critical habitat was designated in 1977, and the KCOL was not included in the original designation. Since 2010, 347 snail kite nesting attempts have been documented within the Everglades STAs. STA-5 accounted for approximately 32 percent of successful snail kite nests and 35 percent of fledglings produced in 2014. However, in 2019 only one pair of Everglade snail kites nested within the Everglades STAs, and this nest failed. The STAs are designed and operated as water treatment wetlands and are not designated as critical habitat for the snail kite.

5.1.2 Factors Affecting Critical Habitat

The factors affecting designated snail kite critical habitat are generally the same as those described in the Environmental Baseline of this BO. Therefore, that information is incorporated here by reference. In general, habitat degradation occurs due to prolonged high water conditions and increased hydroperiods, and is manifested as a loss of woody vegetation and conversion of wet prairies (in WCAs) or marshes (in Lake Okeechobee, St Johns Marsh) to open, deeper water wetlands. High water levels and extended hydroperiods have resulted in vegetation shifts, degrading snail kite habitat. In addition to deeper water conditions, hydroperiods have increased, lengthening the time between drying events and further contributing to the conversion of wet prairie or marsh to less suitable habitat.

Since designation of critical habitat, the Service has consulted on the loss of 18.66 acres of critical habitat for the construction of C&SF Project infrastructure. A Biological Opinion, dated September 12, 2006, addressed the effects of construction of the Miccosukee Tribe's Government Complex Center, which resulted in the loss of 16.88 acres of critical habitat. In addition, the Service has consulted on impacts to 88,000 acres of critical habitat resulting from prolonged flooding and temporary degradation of critical habitat because of prescribed fire. Additional degradation of snail kite critical habitat has occurred because of the effects of long-term hydrologic management, natural climatic events, and eutrophication.

5.2 Environmental Baseline

5.2.1 Status of the Critical Habitat within the Action Area

The status of snail kite critical habitat is generally based on the same information in the *Status of the Species* section. Therefore, that information is incorporated here by reference. The Service does not anticipate that critical habitat outside of WCA-3A or ENP would be affected by this project. The previous loss of suitable snail kite foraging and nesting areas within WCA-3A (in both designated critical habitat and other habitat used by snail kites) have been attributed to shifts in water management regimes, and precipitation (including potential habitat degradation due to hurricanes).

WCA-3A, is an important snail kite foraging and nesting area, but the number of successful nests has fluctuated since 2001. There were no successful nests within WCA-3A in 2001, 2005, 2007,

2008, or 2010. An increased nesting effort was observed in both 2013 (12 successful nests) and 2014 (19 successful nests). The increase may be an indication that habitat quality was improving (Fletcher et al. 2015). However, in WCA-3A nesting decreased in 2015 (10 successful nests), and no successful nests were observed in WCA-3A in 2016. Only 2 successful nests were recorded in 2017. Nest success has increased recently with 17 successful nests observed in 2018 and 15 successful nests produced in 2019.

Similar to WCA-3A, snail kite nesting effort in ENP increased in 2014 as compared to 2013 (Fletcher et al. 2015). But, decreased in 2015 to 2018. In 2018, only one snail kite nest was recorded in Everglades National Park (Fletcher et al 2018).

5.2.2 Factors Affecting Critical Habitat within the Action Area

Habitat degradation within the WCA-3A Unit of critical habitat is discussed in detail in the *Threats to the Species* section of this Biological Opinion and incorporated here by reference. More specifically, prolonged high water conditions and increased hydroperiods (from September into January or beyond, whether resulting from meteorological conditions, water management operations, or a combination of both) have resulted in the loss of woody vegetation, conversion of wet prairies to open water sloughs, and vegetation shifts that degrade critical habitat within WCA-3A (Zweig 2008; Zweig and Kitchens 2008). The increased hydroperiods in WCA-3A have lengthened the time between drying events and further contribute to the conversion of wet prairie.

Similar habitat changes in ENP are likely less evident due to the lack of containment (*i.e.,* levees or embankments) that occurs around WCA-3A. The result is that water cannot "stack" over the ENP Unit of critical habitat to the same extent as is does in WCA-3A. This limits the extent of habitat degradation due to high water but could result in habitat changes due to low water, especially during droughts. For the effects of low water on kite habitat see *Prolonged Low Water Levels*.

5.3 Effects of the Action

The proposed Action Area overlaps approximately 531,910 acres of designated snail kite critical habitat (Figure 24), which is approximately 63 percent of the total range wide critical habitat for the species. As previously stated, no biological and physical features essential to the conservation of the species have been defined for snail kite critical habitat. Considering that snail kites feed almost exclusively on apple snails, we believe the presence of apple snail populations would be defined as a physical or biological feature of snail kite critical habitat. The effects analysis should use the best available scientific and commercial data available to determine and document those characteristics of the designated critical habitat that support the species' conservation.

The factors affecting the Everglade snail kite, as described previously in this BO, are similar to the factors affecting Everglade snail kite critical habitat. Like the species itself, the effects of the

COP to snail kite critical habitat is expected to be completely hydrologic since the COP consists of water management operations and does not involve construction of structural features. Potential adverse effects from the COP to Everglade snail kite critical habitat that are included in this evaluation include effects to apple snail populations, vegetation types, prolonged high water levels during September through January (or beyond in some years), prolonged low water levels during the early spring and summer, and recession rates during the breeding season (December through July).

We have considered these effects on the physical and biological features essential to the conservation of snail kites within their critical habitat, with emphasis on that portion of the critical habitat within the WCAs and ENP. Suitable water depths and hydroperiods are needed to support a moderately dense wet prairie or marsh community, with a predominance of spikerush, beakrush, and other herbaceous plants. Wet prairies (with interspersed aquatic sloughs) dominated by *Eleocharis* spp. and *Panicum* sp. are necessary for snail kite foraging, while areas with woody shrubs, such as tree islands, are optimal nesting locations (Kitchens et al. 2002). Water depths and the timing and rate of water recessions in the normally dry spring season must support survival and reproduction of apple snails during most years. Overly dense stands of vegetation, including rooted stands of cattails and floating tussocks of either cattails or other vegetation, are not suitable for the visual foraging technique of the snail kite even if apple snails are abundant in such areas.

5.4 Cumulative Effects

A variety of State and local government actions can directly or indirectly affect water volumes and water quality that could, in turn affect the quantity and quality of critical habitat for the snail kite (see section 4.14 *Cumulative Effects*). To the extent practicable, the Service attempts to track such State and local actions that may affect snail kite critical habitat and provide technical assistance, as appropriate. While these actions are not necessarily subject to the consultation requirements of the Act, the Service often becomes aware of such proposals through a variety of public forums, news reports, or through early inquiries by environmental consultants who request a list of threatened or endangered species that may be present in the project area. In the case of a wetland-dependent species such as the snail kite, any early comments by the Service will normally lead to the opportunity for consultations through the Corps' Section 404 permit process.

Exotic vegetation removal, habitat management, or fire management programs are on-going in designated snail kite critical habitat by FWC, District, FDEP, and some counties. These efforts are targeted at either removing exotic plants or opening up dense areas of cattails with herbicides or mechanical removal. No Corps permit would be required for such beneficial actions; however, the Service is engaged with these agencies to ensure adverse effects to snail kite critical habitat are avoided during vegetation removal.

General water quality conditions in snail kite critical habitat are likely stable or improving. The adoption of Total Maximum Daily Loads (TMDL) for phosphorus combined with Best

Management Practices upstream of Lake Okeechobee should benefit water quality conditions in critical habitat downstream of the lake. Similarly, the establishment of the phosphorus water quality standard in the Everglades Protection Area should serve to further improve water quality conditions in critical habitat in the WCAs and ENP.

In summary, although cumulative effects to snail kite critical habitat may occur, they would likely be limited in scope, because the larger water development projects which may affect wetlands or water quality and quantity are anticipated to require a Corps permit. Consequently, these actions are subject to section 7 consultation under the Act.

5.5 Summary and Analysis of Effects of the Action

The mechanisms for effects from the COP to Everglade snail kite critical habitat are the same as those for the species. They are reductions to apple snail populations, presence of woody vegetation that snail kites use for nesting and perch-hunting, prolonged high water levels during September through January (or beyond in some years), prolonged low water levels during the early spring and summer, and recession rates during the breeding season (December through July).

Although, there are no physical and biological features defined for Everglade snail kite critical habitat, we believe that apple snail populations are essential for the intent of snail kite critical habitat, which is to function for the conservation of the species. As previously explained, and as shown in Figure 18, the COP operations are expected to result in an overall approximate 2 percent decrease of snail production per year, on average.

These effects would occur throughout the projected operational period of the COP. According to the Corps' Integrated Delivery Schedule (IDS), the COP water management activities will be continuous over either: (1) the 7-year period identified in the IDS; (2) until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay; or (3) if new information becomes available through implementation of the COP Water Control Plan and/or the COP Adaptive Management and Monitoring Program (AMMP) that would necessitate a need to modify water management operations. Therefore, the expected reasonable duration of the COP operations is 7 years.

In summary of these findings, there is reasonable certainty that the proposed Action is likely to adversely affect Everglade snail kite critical habitat by decreasing apple snail production by 2 percent throughout the 531,910 acres of snail kite critical habitat that overlaps the action area of the COP (Figure 24). This area constitutes approximately 63 percent of the total rangwide snail kite critical habitat. The estimated 2 percent reduction in apple snail production is expected to be temporary and reversible with improved hydrologic conditions which are anticipated after full implementation of the CERP.

5.6 Conclusion

"Destruction or adverse modification" means the direct or indirect alteration that appreciably diminishes the value of critical habitat, as a whole, for the conservation of a listed species." (50 CFR 402.02). After reviewing the status of the snail kite critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the COP is not likely to result in the *"Destruction or adverse modification"* of Everglade snail kite critical habitat.

We find that the portion of snail kite critical habitat within the action area will remain functional to serve the intended conservation role for the Everglade snail kite. And, as a net result, this portion of the snail kite's critical habitat would remain functional to support conservation of snail kites. Consequently, we do not expect the effects of the proposed action to appreciably diminish the value of critical habitat, as a whole, for the conservation of the Everglade snail kite. We make these findings for the following reasons:

- No permanent loss of Everglade snail kite critical habitat is expected.
- Degradation of designated critical habitat within WCA-3A may continue under the COP during the expected 7-year duration of the COP, but this is reversible with improved hydrologic conditions which are anticipated after full implementation of the CERP.
- The Corps shall implement specific minimization actions as part of the COP, including species and habitat monitoring to identify population trends for the Everglade snail kite. The Corps will continue conducting and coordinating Periodic Science Calls (PSC) similar to those conducted in compliance with the ERTP 2016 BO (Service 2016). Periodic Science Calls (PSC) will allow the Corps and its Tribal and governmental partners to discuss ecological, hydrological, and meteorological conditions to achieve the objective of managing water levels and releases for the protection of multiple species and their habitats, including the Everglade snail kite. Regularly scheduled interagency PSC allow the Corps to gather input on desired long term (annual and/or seasonal) conditions within the system. In addition, the PSC occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP. The PSC focus on the status of a suite of species to allow for adaptive management of the system based upon the needs of multiple species and their habitats. Under the COP, the Corps will continue to implement PSC to provide real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process.

6.0 WOOD STORK

6.1 Status of the Species

6.1.1 Legal Status

The United States breeding population of the wood stork (*Mycteria americana*) was first listed under the Act as endangered on February 28, 1984. Recent population estimates indicate the wood stork population has reached its highest level since it was listed as endangered in 1984. Approximately 12,105 wood stork pairs nested within their breeding range in the southeastern United States in 2018, primarily in Georgia, Florida and South Carolina and the number of colonies increased to 100 (Service 2018). The U.S. Fish and Wildlife Service upgraded the status for wood storks from endangered to threatened under the Endangered Species Act on July 30, 2014 (79 FR 37077). No critical habitat has been designated for the wood stork.

6.2 Species Description

The wood stork is a large, long-legged wading bird, with a head to tail length of 33 to 45 inches and a wingspan of 59 to 65 inches (Coulter et al. 1999). Wood storks are distinguishable in flight as they fly with their neck and legs extended. Their plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. On adults, the rough scaly skin of the head and neck is un-feathered and blackish in color, the legs are dark, the feet are dull pink, and the bill is blackish in color. Immature wood storks (*i.e.*, wood storks up to the age of about three years) have yellowish or straw-colored bills and varying amounts of dusky feathering on the head and neck (Coulter et al. 1999). During courtship and the early nesting season, adults may develop buff or pinkish coloration on the wing linings; fluffy, plume-like under tail coverts; and bright pink toes.

6.3 Life History

The wood stork is found primarily in the Southeast and is the only stork that breeds in the United States. Storks typically begin breeding at three to four years of age. Egg laying in wood storks historically began in early October in south Florida and nesting continued into June (Rodgers 1990) but has shifted to between January and March in recent decades (Ogden 1996). In addition, there was a significant north-south temporal difference in clutch initiation with egg laying in central Florida occurring from February to May. The wood storks in the northern distribution of their range (Georgia, South Carolina, North Carolina) begin pair formation in early March or April. A single clutch of two to five (average three) eggs are laid per breeding season, but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation between years in the clutch sizes, and clutch size does not appear to be related to longitude, nesting density, or nesting numbers. Clutch size may be more related to habitat conditions at the time of egg-laying. Egg-laying is staggered, and

incubation, which lasts about 30 days, begins after the first egg is laid. Therefore, the eggs hatch at different times and the nestlings vary in size (Coulter et al. 1999).

Wood storks produce an average of 1.29 (±1.16) fledglings per nest and 0.42 (±0.37) fledgling per egg. The probability of survival for each egg during the nesting season (egg-laying to fledging) was 46 percent (Rodgers and Schwikert 1997) (Table 18). The greatest loss (30 percent) occurs from egg-laying to hatching. From hatching to nestlings of two weeks of age, nest productivity loss is an additional eight percent. Corresponding losses for the remainder of the nesting cycle are on the average of six percent per two-week increase in age of the nestling (Rodgers and Schwikert 1997). The young fledge in about eight weeks but will stay at the nest for three to four additional weeks while they continue to be fed by the adults.

Adults feed the young by regurgitating whole fish into the bottom of the nest. This occurs at a rate of approximately three to ten times per day. Feedings are more frequent when nestlings are young (Coulter et al. 1999) and are influenced greatly by the distance adults must fly to locate food (*i.e.*, as foraging flight distance increases feeding rate decreases) (Bryan et al. 1995). The total nesting period, from courtship and nest-building through the independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous, and consequently a colony may contain breeding wood storks for a period much longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site following the completion of breeding.

Wood storks feed almost entirely on fish sized anywhere from 1 to 10 inches long (Kahl 1964; Ogden et al. 1976; Coulter 1987), but may occasionally consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions (Kushlan 1979). Storks typically wade through the water with their beak immersed and open about 2.5 to 3.5 inches. When the wood stork encounters prey within its bill, the mandibles snap shut, the head is raised, and the food swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956; Kahl 1964; Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

During the nesting period, storks are dependent on consistent foraging opportunities in wetlands within about 18.6 miles of the nest site with the greatest energy demands occurring during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 201 kilograms of fish, crustaceans, and other prey during the breeding season with 50 percent of the nestlings' food requirement occurring during the middle third of the nestling period (Kahl 1964). It is estimated that about 50 kilograms of food are needed to meet the foraging requirements of the adults and nestlings in the first third of the nesting cycle. Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964; Kushlan et al. 1975).

Gawlik (2002) characterized wood storks as "searchers" that employ a foraging strategy of seeking out areas of high-density prey and optimal (shallow) water depths. They seem to abandon foraging sites when prey density begins to decrease below a particular efficiency threshold but while prey is still sufficiently available for other wading bird species to forage in large numbers (Gawlik 2002). Wood stork choice of foraging sites was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely due to their lack of experience and the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage effectively (Hylton et al. 2006). In southern Florida, both adult and juvenile storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile storks from southern Florida move beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004, Borkhataria et al. 2006). Some flocks of juvenile storks have also been reported to move well beyond the breeding range of storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Adult and juvenile storks return southward in the late fall and early winter months. In a study employing satellite telemetry, Borkhataria et al. (2006) reported that nearly all storks that had been tagged in the southeastern United States moved into Florida near the beginning of the dry season, including all sub-adult storks that fledged from Florida and Georgia colonies. Adult storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during the annual Christmas bird surveys, suggest that the majority of the southeastern United States population occurs in central and southern Florida. Relative abundance of storks in this region was 10 to 100 times higher than in northern Florida and Georgia (Service 2007a). Because of these general population-level movement patterns during the earlier period of the breeding season in southern Florida, it is apparent that the wetlands upon which nesting storks depend are also heavily used by a large portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and sub-adult storks from throughout the species' range. In addition, these same wetlands support a variety of other wading bird species (Gawlik 2002).

The wood stork life history strategy has been characterized as a "bet-hedging" strategy (Hylton et al. 2006) in which high adult survival rates and the capability of relatively high reproductive output under favorable conditions allow the species to persist during poor conditions and

capitalize on favorable environmental conditions. This life-history strategy may be adapted to variable environments (Hylton et al. 2006) such as the wetland systems of southern Florida.

6.4 Habitat

Wood stork nesting habitat consists of mangroves as low as 3 feet, cypress as tall as 100 feet, and various other live and dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962; Rodgers et al. 1987; Ogden 1991; Coulter et al. 1999). Wood storks generally occupy the large-diameter trees at a colony site because storks often nest in conjunction with other wading bird species (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of change to nest site hydrology, wood storks may abandon a site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Borkhataria et al. 2004; Crozier and Cook 2004).

Between breeding seasons or while foraging, wood storks roost in trees over dry ground, on levees, or large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002). While the majority of stork nesting occurs within traditional stork rookeries, a handful of new stork nesting colonies are discovered each year (Meyer and Frederick 2004; Brooks and Dean 2008). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Wood storks forage in a wide variety of wetland types within 31 miles of the colony site, where prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987; Bryan and Coulter 1987). However, foraging occurs most frequently within 12.5 miles of the colony (Coulter and Bryan 1993). Fixed width areas around colonies (*i.e.,* Core Foraging Areas (CFA)) needed for nesting wood storks to successfully produce and fledge offspring have been delineated as 13, 15, and 18.6 miles for North, Central, and South Florida, respectively (Kahl 1964; Browder 1984; Frederick and Collopy 1988; Cox et al. 1994; Bryan et al. 2012). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available during shifts in seasonal and annual rainfall and surface water patterns to support nutritional changes. Calm water, about 2 to 16 inches deep and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993). Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, seasonally flooded shallow roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993). Generally, storks use wet prairie ponds early in the dry season

then shift to slough ponds later in the dry season, thus following water levels as they recede into the ground (Browder 1984).

Several factors affect the suitability of potential foraging habitat for wood storks. Suitable foraging habitats must provide both a sufficient density and biomass of forage fish and other prey, and have vegetation characteristics that allow storks to locate and capture prey. Hydrologic and environmental characteristics have a strong effect on fish density and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida. Areas with longer hydroperiods generally support more and larger fish (Loftus and Eklund 1994; Turner et al. 1999; Trexler et al. 2002). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites also affect fish density and biomass. Wetlands of varying hydroperiod are typically needed to provide sufficient food resources for parent storks and their young during the 85 to 105-day breeding season (Fleming et al. 1994). Within the highly modified environments of southern Florida, fish availability varies with respect to hydrologic and nutrient availability gradients, and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a variety of hydroperiod classes, nutrient conditions, and spatial variability.

6.5 Distribution

The wood stork occurs from northern Argentina, eastern Peru and western Ecuador, north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (American Ornithologists Union 1983). Only the population segment that breeds in the southeastern United States is listed as threatened. In the United States, wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910; Bent 1926; Howell 1932; Oberholser 1938; Dusi and Dusi 1968; Cone and Hall 1970; Oberholser and Kincaid 1974).

Storks are found year-round throughout their breeding range, except in South Carolina, North Carolina, and Georgia. Most individuals retreat to Florida and South Georgia during midwinter after breeding season dispersal. Currently, wood stork nesting occurs in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks exist in all southern Florida counties, except for Okeechobee County. Additional expansion of the breeding range of wood storks in the southeastern United States has continued, both to the north and to the west along the Gulf Coast (Service 2007a).

6.6 Population Dynamics

The United States breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 (49 FR 7332). From the early 1960s, the wood stork population has declined in southern Florida and increased in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The number of nesting pairs in the Everglades and Big

Cypress ecosystems (southern Florida) declined from 8,500 pairs in 1961 to 969 pairs in 1995. During the same period, nesting pairs in Georgia and South Carolina increased from 4 to 1,501 and from 11 to 829, respectively (Service 1997).

Since being listed under the ESA in 1984, annual nest counts have increased significantly in south Florida from 1,245 pairs in 1984 to 5,777 pairs in 2018 (Service 2014; Cook and Baranski 2019). However, despite two previously successful nesting seasons in 2017 and 2018, wood storks in the Everglades region had a poor year with all nests failing in 2019 (Frederick and Garner 2020). The 5-year averages for nesting in the Everglades and Big Cypress Systems are below 2,500 nesting pairs, as nesting in south Florida remains variable (Service 2014). From 1991 to 2005 statewide surveys in Florida suggest that the nesting population increased, and, while colonies were declining in size, the overall number of colonies was also increasing (Frederick and Meyer 2008). Florida's nest counts have increased from 5,647 to up to 9,428 pairs since listing (Service 2018). Historically, colonies in the south were associated with extensive wetland systems and predictable patterns of prey availability. Ogden et al. (1987) suggested the population shift was the result of deteriorating feeding conditions in south Florida and better nesting success rates in north-central Florida that compound population growth in that area. Further evidence of a general northern breeding range expansion occurred in 2005 when storks were first documented nesting successfully in North Carolina. Wood storks have continued to nest in North Carolina and have increased their nesting pairs to 128 in 2018, from 32 in 2005 (Service 2018).

Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony varies from year-to-year based on availability of suitable wetland foraging areas, which can be affected by local rainfall patterns, regional weather patterns, and anthropogenic hydrologic management (Service 1997). A colony site may be vacant in years of drought or unfavorable conditions due to inadequate foraging conditions in the surrounding area (Kahl 1964). Storks may abandon traditional colony nesting sites completely when hydrological changes occur such as removing surface water from beneath the colony trees (Service 1997; Coulter et al. 1999). Nesting failures and colony abandonment may also occur if unseasonable rainfall causes water levels to rise when they are normally receding, thus dispersing rather than concentrating fish prey (Kahl 1964; Service 1997; Coulter et al. 1999).

6.7 Threats

The primary cause of the wood stork population decline in the United States was the loss of wetland habitats or loss of wetland function that resulted in reduced prey availability. Dahl (1990) estimates about 38 million acres, or 45.6 percent, of historic wetlands were lost between the 1780s and the 1980s. However, it is important to note wetlands and wetland losses are not evenly distributed in the landscape. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres of the wetlands lost in the southeastern United States between the mid-1970s and mid-1980s were located in the Gulf-Atlantic Coastal Plain. These wetlands were strongly preferred by wood storks as nesting habitat. Since the 1970s, wood storks have been observed shifting their nest sites to artificial impoundments or islands created by dredging activities (Ogden 1991).

The percentage of nests in artificial habitats in central and north Florida has increased from about 10 percent of all nesting pairs in 1959 to 1960 to 60 to 82 percent between 1976 and 1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper or Australian pine (*Casuarina equisetifolia*). Ogden (1996) suggested the use of these artificial wetlands indicated wood storks were not finding suitable conditions within natural nesting habitat, or they were finding better conditions at the artificial wetlands. The long-term effect of these nesting areas on wood stork populations is unclear.

Ogden and Nesbitt (1979) indicated a reduction in nesting sites was not the cause of the population decline, because the number of nesting sites used from year to year was relatively stable. They suggested loss of an adequate food base was a contributing cause of wood stork declines. Changes in remaining wetland systems in Florida, including drainage and impoundment, may have been a larger problem for wood storks than loss of foraging habitat (Ogden and Nesbitt 1979). Almost any shallow wetland depression where fish become concentrated, through either local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year, but only a small portion of the available wetlands support foraging conditions (high prey density and favorable vegetation structure) that storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and total acreage of wetland types (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and saw grass marshes) occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973 and found these habitat types had been reduced by 35 percent.

The alteration of wetlands and the manipulation of wetland hydroperiods have also reduced the amount of foraging habitat available to wood storks. The decrease in wood storks nesting on Cape Sable was related to the construction of the drainage canals during the 1920s (Kushlan and Frohring 1986). Water level manipulation can aid raccoon predation of wood stork nests when water is kept too low (alligators deter raccoon predation when water levels are high). Artificially high water levels may retard nest tree regeneration since many wetland tree species require periodic droughts to establish seedlings. Water level manipulation may decrease food productivity if the water levels and length of inundation do not match the breeding requirements of forage fish. Dry-downs of wetlands may selectively reduce the abundance of the larger forage fish species that wood storks tend to use, while still supporting smaller prey fish.

6.7.1 Non-native Invasive Species

The Burmese python, native to South Asia, is now breeding and expanding its range in the greater Everglades ecosystem increasing concerns among land managers about the potential impacts of this invasive snake. More than 1,400 Burmese pythons have been removed from ENP since 2000. Their population numbers are now estimated to be in the thousands in ENP, potentially impacting a wide variety of listed and native species. A growing wild population of pythons has the potential to create a major ecological problem in ENP and threaten successful restoration of the greater Everglades (NRC 2005, Hart et al. 2015).

The rapid and widespread invasion of Burmese pythons is facilitated by aspects of their natural history such as diverse habitat use, broad dietary preferences, long lifespan (15 to 25 years), high reproductive output, and ability to move long distances. Burmese python hatchlings are larger than hatchlings of native species and are less susceptible to predators. These multiple advantages may allow pythons to compete with native snakes and other predators for food, habitat, and space.

Burmese pythons are generalist predators that consume a wide variety of mammal and bird species, as well as other reptiles, amphibians, and fish (Snow et al. 2007). Like other constrictors, the Burmese python seizes prey with its teeth and then wraps its body around the animal and kills it by constriction. Pythons in Florida have consumed prey as large as white-tailed deer (*Odocoileus virginianus*) and adult American alligators (Snow et al. 2007). As Burmese pythons expand their range in south Florida, it becomes increasingly important to learn what they are eating in order to assess their impact on native fauna and to predict what species are at risk. Previous studies found fourteen species of mammals, five species of birds, and one species of reptile in the stomachs of pythons collected and examined in Florida (Snow et al. 2007). More recent studies have discovered as many as 25 bird species in the digestive tracts of Burmese pythons in ENP including the wood stork (Dove et al. 2011). Juveniles of these large constrictors will climb to remove prey from bird nests and capture perching or sleeping birds. The overall risk of python predation on wood storks is currently unknown. By preying on native wildlife, and competing with other native predators, pythons have the potential to seriously impact the natural order of south Florida's ecological communities.

6.7.2 Contaminants

The role of contaminants in the decline of the wood stork is unclear. Pesticide levels high enough to cause eggshell thinning have been reported in wood storks, but decreased productivity was not linked to contaminants (Ohlendorf et al. 1978; Fleming et al. 1984). Burger et al. (1993) studied heavy metal and selenium levels in wood storks from Florida and Costa Rica. Adult birds generally exhibited higher levels of contaminants than young birds. Burger et al. (1993) attributed this to bioaccumulation in the adults who may be picking up contaminants at the colony nesting site and while foraging at other locations during the non-breeding season. There were higher levels of mercury in young birds from Florida than young birds or adult birds from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. Though Burger et al. (1993) recommended the lead levels in Florida be monitored; they drew no conclusions about the potential health effects of contaminants to wood storks.

6.7.3 Ongoing Conservation Efforts (Recovery)

Reasonable actions believed to be required for the recovery of the wood stork are outlined in the Service's recovery plan (1997). The plan's recovery criteria for reclassification from endangered to threatened is 6,000 nesting pairs and annual regional production greater than 1.5 chicks per nest/year (both calculated over a 3-year average). Delisting could be considered when there are

10,000 nesting pairs calculated over a 5-year period beginning at the time of reclassification and annual regional production is greater than 1.5 chicks per nest/year (calculated over a 5-year average). As a subset of the 10,000 nesting pairs, a minimum of 2,500 nesting pairs must occur in the Everglades and Big Cypress systems in south Florida.

In 2001, the Service reinitiated another 5-year synoptic aerial survey effort for wood stork colonies throughout the southeast range of the species (Service 2003), and surveys have been conducted annually since then. The wood stork population is increasing and expanding its overall and breeding ranges in the southeastern United States (Brooks and Dean 2008). The southeastern U.S. total wood stork population has exceeded 10,000 nesting pairs in multiple years following the 2006 breeding season but has not entirely met recovery goals for south Florida (Cook and Baranski 2019). Three-year averages calculated from nesting data from 2001 through 2013 indicated that the total nesting population had been consistently above the reclassification threshold of 6,000 nesting pairs. These averages have ranged from about 7,086 to 10,147 nesting pairs during this time period (Service 2014). Consequently, on July 30, 2014, the wood stork was downlisted to threatened (79 FR 37077).

The 5-year average since 2013 has been above 10,000 pairs. The previous period that the nesting population surpassed 10,000 pairs was in the early 1960s. Wood stork nesting continues to be recorded in North Carolina after it was first documented there in 2005. This suggests that the northward expansion of wood stork nesting may be continuing. The number of colonies also continues to increase with 100 nesting colonies reported in 2018 throughout the southeastern United States (Table 19).

6.7.4 Wood Stork Nesting in the Everglades and Big Cypress Systems

The number of nesting pairs in south Florida's Everglades and Big Cypress ecosystems declined from 8,500 pairs in 1961 to fewer than 500 pairs from 1987 through 1995 (Service 2007a). The *South Florida Multi Species Recovery Plan* (Service 1999) defines the Everglades and Big Cypress ecosystems as the area south of Lake Okeechobee from Lee County on the west coast to Palm Beach County on the east coast. Total nesting pairs for colonies in this region have varied from year to year. In a review of nesting data for the Everglades and Big Cypress basin region, wood stork nesting effort has shown an increase from 2005 to 2018 with 634 and 5,777 pairs, respectively (Table 20). The highest peak of nesting occurred in 2009 with over 6,000 nesting pairs. These observed fluctuations in nesting between years and nesting sites have been attributed primarily to variable hydrologic conditions during the nesting season. Frequent heavy rains during nesting can cause water levels to rise rapidly. The abrupt increase in water levels (*i.e.*, a "reversal") during nesting may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success have been reported to affect most wading bird colonies in southern Florida (Crozier and Cook 2004; Cook and Call 2005; Cook and Kobza 2008). (*Note: Hydrologic condition can be located in the South Florida Wading Bird reports for each breeding season from 1996-2018*).

Since 1996, the annual South Florida Wading Bird Report has included a summary of nesting patterns for wood storks in the Everglades using a set of performance measures meant to capture ecological relationships found in the historical ecosystem. These annual summaries are useful for characterizing pre-CERP nesting patterns. The key parameters are number of nesting pairs, location of nesting colonies, timing of stork nesting, and the occurrence and frequency of wood stork "super colonies". The Service's recovery goal for wood storks in south Florida include a 5-year running average of 2,500 nesting pairs per year and a nest production that averages at least 1.5 young per active nest (Service 1997). The 5-year average has been above 2,500 pairs 6 times since 1996 and was 3,079 in 2018 (Table 20).

6.8 Environmental Baseline

6.8.1 Status of the Species within the Action Area

Since 1986, the Corps has funded a program to monitor nesting effort and success of wading birds, including wood storks, in the WCAs. The objectives are to track the demographics of the various species in an attempt to understand the environmental variables that relate to successful breeding. The program includes aerial surveys that identify locations of wading bird nesting colonies each year and estimate the number of nests produced by each wading bird species. Ground surveys are also conducted in colonies that contain wood storks. The results of these surveys help researchers estimate nesting success (number of young fledged) in a sub-set of marked nests. Nesting effort (number of nests) of wood storks from 2009 to 2018 in the various colonies in the WCAs and just south of WCA-3B in ENP is summarized in Table 21. There is no clear trend in the number of storks nesting in the action area. Nesting effort from the years 2009 through 2018 is variable with an average of 80.9 nests per year and an average 3-year running average over the same period of 54.7 nests per year (Table 21).

The implementation of ERTP began in October 2012 and the anticipated date for the COP implementation is August 2020. The Restoration Coordination & Verification (RECOVER) program establishes Performance Measures (PMs) to estimate the ecological response to restoration projects and evaluate the impact and effectiveness of CERP. The RECOVER PM for wood storks uses the 3-year running average of the numbers of wood stork nesting pairs in the mainland Everglades (target of 1,500 nesting pairs), the timing of wood stork nesting, and the proportion of the population that nest in the coastal ecotone (Ogden et al. 1997). Wood storks met their 3-year running average RECOVER PM targets for the Everglades in 2012-2014, 2013-2015, and 2016-2018 (Cook and Baranski 2019).

The 5-year running average of wood stork nesting pairs occurring in the Everglades and Big Cypress Basins met the Service's wood stork recovery goal for delisting (target of 2,500 nesting pairs) in 2017 and 2018 (Table 20). During the period of 2012 to 2018, the 3-year running average number of wood stork nests initiated in South Florida had an average annual growth rate of 19 percent (Table 20). Additional data are needed to discern whether the increase was related to 1) improved water management operations under ERTP (recession rates/water depths), or 2) the increase in overall abundance of the wood stork breeding population.

The initiation of wood stork nesting in the action area has shifted from November-December (1930s through 1960s) to January-March (1980s to present). This shift increases the risk of mortality of nestlings and overall nest failures. Wood storks in South Florida have shown a consistent trend towards later nesting between the 1930s and the 1980s, with variation around a February mean initiation date since the 1980s (Cook and Baranski 2019). This is even more evident as nest initiation has occurred later than the average date of early February during the implementation of ERTP (2012-2017), except for 2018 when wood storks initiated nesting by the end of December.

In 2012, 2015, 2016, and 2019 wood storks did not initiate any nesting activity in the WCAs; however, wood storks did nest within ENP. The 2012 season had above average water levels throughout the system despite strong recession rates that were within 60 percent of years in the period of record. A strong reversal, due to rain starting in late April, pushed water levels well above average. High water levels limit nest success by decreasing prey availability. It is believed that most nests failed due to heavy rains that occurred before any young had fledged. Similar conditions were apparent in 2015 and 2016, when widespread storms and water-level reversals in late April also led to widespread nest failures. The overall low nesting effort in 2019 was clearly related to record rainfall in late January and then subsequent reversals in February and March. This provided essentially none of the water recession and drying that has in the past been important to wading bird nesting numbers and nesting success in the region.

Wood stork nesting success is highly dependent on the availability of aquatic prey (fish), which are easy to find and feed upon when concentrated at high densities in shallow water during the dry season (winter-spring) but are not available during the wet season (summer-fall) when they move into deeper waters and disperse across the landscape. To successfully fledge their young, wood storks require a continuous supply of abundant and concentrated fish throughout the reproductive period. In a hydrologically fluctuating wetland such as the Everglades, prey production is influenced largely by the duration and frequency of wetland flooding and drying, with optimal conditions for population growth varying by species. Most fish populations peak after extended periods (multiple years) of relatively deep, flooded conditions over extensive areas of wetland (Trexler et al. 2005). These conditions seem to have been most prevalent in 2013-2014 and 2017-2018 when conditions were conducive for nesting within the action area.

6.9 Factors Affecting the Species Environment within the Action Area

6.9.1 Hydrology

Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over 3 feet during the wet season (June to October), and then receding gradually during the dry season (November to May). Historically, the annual climatological pattern that appeared to stimulate the heaviest nesting efforts by wood storks was a combination of the average or above-average rainfall during the summer rainy season prior to colony formation and an absence of unusually rainy or cold weather during the following winter-spring

nesting season (Kahl 1964). This pattern produced widespread and prolonged flooding of summer marshes that maximized production of freshwater fishes, followed by steady drying that concentrated fish during the dry season when storks nest (Kahl 1964).

Wood storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the wood stork nesting period, any one site may only be suitable for wood stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for wood storks to access the wetlands. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging, and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964; Gawlik 2002).

Short hydroperiod wetlands are an important pre-nesting food source and have a greater effect on early nestling survival for wood storks than indicated by the amount of foraging base (ounces of fish per square foot) produced in these wetlands (Fleming et al. 1994; Ceilley and Bortone 2000). For instance, Loftus and Eklund (1994) provide an estimate of 5 fish per square foot for long hydroperiod wetlands and 0.5 fish per square-foot for short hydroperiod wetlands. Because of the consistent pattern of drying that normally occurs during the wood stork nesting season, the short hydroperiod wetlands would also be the areas used for foraging early in the season when long hydroperiod wetlands remain too deep for wood storks to forage effectively, or sufficient prey concentration has not yet occurred due to drying. Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for wood storks during colony establishment, courtship and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.,* 30 and 8 percent, respectively, from egg-laying to hatching and from hatching to nestling survival to 2 weeks) (Rodgers and Schwikert 1997).

Based on Kahl's (1964) estimate that 201 kg (443 lbs) of fish, crustaceans, and other prey are needed for the success of a nest and that 50 percent of the foraging base is needed in the middle third of the nesting cycle when chicks are about 23 to 45 days old (Kahl 1962), it is estimated about 50 kg (110 lbs) are needed to meet the foraging needs of the adults and nestling in the first third of the nesting cycle. Considering the relatively low foraging values these short hydroperiod wetlands provide in relation to corresponding long hydroperiod wetlands, a much larger proportion of long hydroperiod wetlands are needed to ensure survival and to sustain development of nestlings. The disproportionate reduction (85 percent) of long hydroperiod wetlands known to have occurred from development and over drainage has been postulated as a major cause of late colony formation and a reduction in early nestling survival rates (Fleming et al. 1994).

Consequently, the Corps began testing new operating rules for water management facilities in the Modified Water Deliveries (MWD) project in October 2015. The goal of the MWD operational tests is to increase water deliveries from WCA-3A through Northeast Shark River Slough (NESRS) to ENP. The construction phase of the MWD project was completed in 2018.

The MWD project was expected to result in continued high water levels in WCA-3A during the wet season and early dry season, followed by a rapid spring recession and rapidly increasing stages in the early wet season (Service 2002; Service 2006a; Service 2010a; Service 2012a; Service 2016). The ERTP provided avenues for near real-time water management decisions to provide benefits to multiple species within WCA-3A. It also provided a means for reducing high water periods and prolonged flooding within WCA-3A, with the intent of restoring vegetation within the area (Corps 2011). These effects would result in relatively high abundance of wood stork prey because of high stages and long hydroperiods, allowing prey to become available to wood storks at a rapid rate in the late dry season.

On September 15, 2017, the Corps initiated an emergency and a planned temporary deviation from MWD Increment 1 Plus and the 2012 Water Control Plan in order to provide high water relief for Water Conservation Area 3A and the South Dade Conveyance System in the wake of Hurricane Irma. The planned temporary deviation included delayed closure of the S-12A, S-12B, S-343A, S-343B and S-344 structures until the WCA 3 three gage average (3AVG) falls below the MWD Increment 1 Action Line or January 1, 2018. The WCA-3A emergency and planned temporary deviations resulted in an increased rate of recession beginning on October 13, 2017. Depths and recession rates during the dry season were near optimal for wading bird foraging, and wading birds responded by feeding in large numbers along the drying front in WCA-3A throughout the nesting season (Cook and Barinsky 2019). The expected effect of this hydrologic condition was early nesting initiation and increased rates of nest initiation in those colonies closely associated with WCA-3A (*i.e.*, L-28 Crossover, Jetport, Jetport South, WCA13, and Cypress City). However, water levels peaked on October 30, 2017 at nearly one foot above the historic average in WCA-3B, which meant water levels remained too deep for optimal wading bird foraging until the beginning of April. Consequently, no nesting was initiated in those colonies closely associated with WCA-3B (*i.e.*, 3B Mud East, Tamiami Trail). Within the vicinity of western ENP and lower SRS, the emergency and planned temporary deviations resulted in water levels peaking in October with early recession rates within the short-hydroperiod marshes south of Tamiami Trail. This resulted in early initiation of nesting within these areas and increased amounts of potential foraging habitat for the active colonies closely associated with this region (*i.e.*, Broad River, Grossman Ridge West).

The MWD field tests in addition to the planned and emergency deviations from 2016 to 2018 have provided opportunities to increase water deliveries to NESRS. Since the start of the MWD field tests stage levels within NESRS have routinely exceeded the upper quartile of the 2002–2015 operational, pre-project baseline conditions, including prolonged durations above the pre-project baseline maximums (RECOVER 2019). Two of the three highest annual inflow volumes to NESRS (since water year 2003) have occurred since the start of the field test in water year

2016. Modeling indicated that the MWD field tests under ERTP 2016 would occasionally result in increased water levels in NESRS during the spring dry season. These conditions occurred when stages were sufficiently low that the G-3273 constraint did not restrict inflows, and water from WCA-3A was diverted into NESRS through the S-333 structure. In these cases, water levels within NESRS, in the immediate vicinity of the Tamiami West stork colony, would rise by up to 1 ft during the period when storks were nesting and when water levels were generally receding throughout the system. This type of action produces an artificial reversal, can cause a reduction in stork foraging conditions in areas near the colony, and may be significant enough to cause colony abandonment. Because the foraging radius of the Tamiami West colony includes parts of WCA-3A, WCA-3B, ENP, the Pennsuco Wetlands, and urban areas, sufficient foraging opportunities remained in other areas to offset the poor foraging conditions in NESRS that resulted from the MWD planned and emergency deviations.

Beneficial effects to wood stork foraging habitat in ENP have occurred through implementation of the incremental field tests conducted under the authority of the MWD Project. The Corps began implementation for the MWD Increment 2 Field Test to raise the L-29 Canal maximum operating limit up to 8.5 feet NGVD, subject to downstream constraints, on February 21, 2018. Raising of the L-29 Canal constraint above 7.8 feet NGVD (the maximum operating limit under Increment 1.2) was dependent upon completion of critical features necessary to operate the C-111 SD Project North Detention Area (NDA). Following completion of the C-111 SD Project construction (both the NDA and South Detention Area (SDA) components) in August 2018, and following recovery of the 8.5 SMA flood mitigation system from an early September 2018 rainfall event, the L-29 Canal maximum operating limit was incrementally increased from 8.3 feet NGVD to 8.5 feet NGVD on September 19, 2018. In 2018, 343,400 acre feet of water (inflow volume of S-333 plus S-356 minus S-334 outflows) was delivered to NESRS (Corps 2019a). Increased flows have continued through 2019 and as of October 31, 2019, more than 442,000 acre feet has been delivered. This is an increase of more than 235,725 acre feet of water into NESRS as compared to the average of 105,125 acre feet delivered per year from 2012 through 2015 prior to implementation of the MWD incremental field tests (Corps 2019a).

6.9.2 Invasive and Exotic Species

Invasive and exotic species may also affect wood storks. Invasive plant species such as melaleuca, Australian pine, Brazilian pepper, and other woody species can become established in wood stork habitat and reduce habitat suitability, although wood storks are known to use such habitat, it is considered of lower quality than native habitats (Service 2007a). The potential expansion of dense stands of cattail due to high phosphorus may also reduce wood stork foraging habitat. Dense submergent and emergent vegetation may reduce foraging suitability by preventing wood storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993).

Limited information is available on the effects of invasive exotic animals on wood storks. Species such as the Burmese python have become established in wood stork habitat, and telemetry data collected in the southern Everglades suggests the large constrictors are attracted to

wading bird colonies. There has been one documented case of a python consuming a juvenile wood stork. In 2013 and 2014, camera traps revealed pythons were moving towards initiating colonies and even have been found in empty nests. However, there was no recorded activity of pythons predating on wading birds throughout the study, and this may be due to the cryptic behavior of the species (Cook 2013, 2014).

6.9.3 Water Quality

The Everglades were historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions of the Everglades have become enrich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species that reduce the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey.

6.9.4 Climate Change

Climate change represents significant short- and long-term threats to the environmental baseline of the wood stork and their habitat (Miller and Traxler 2018). Surface temperatures and evapotranspiration are expected to increase which will likely adversely impact recession rates during the wood stork foraging and breeding season. Rainfall patterns are expected to change with more rain in the fall and winter months and less rain during the spring and summer months. Changes in rainfall patterns can increase the incidence of reversals during nesting causing nest abandonment, re-nesting, late nest initiation, and poor fledging success. Climate change may also lead to changes in breeding and foraging behavior.

The Service will continue to monitor this situation closely and will implement Strategic Habitat Conservation Planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006b).

6.9.5 El Niño

Wetter than average conditions due to the very strong El Niño effects prevailed in South Florida through the first half of 2016, encompassing the 2016 wood stork breeding season. These El Niño events have a significant effect with higher water levels and deeper water depths in the core foraging areas. The occurrence of El Niño conditions resulted in a major short-term negative effect on the environmental baseline for wood storks ability to forage and fledge their young in 2016 because of the wetter conditions. It is likely that wood storks started to be affected by El Niño in early February when reported observations of dead and dying storks where showing up in southwest Florida and ENP. By mid-March there was some nesting occurring in south Florida at three colony sites (Paurotis Pond, Broad River, and Cabbage Bay). Within WCA-3A there

were poor conditions for foraging and nesting. As the 2016, wet season approached, recommendations for water management were made to discourage wood stork nesting in the WCA-3A due to the low probability of a breeding colony being able to fledge young.

Weak El Niño effects prevailed in South Florida from late 2018 through 2019, encompassing the 2019 wood stork breeding season. High waters in early 2018 were followed by a general and steady dry down throughout the system until mid-May when significant rain events resulted in atypical water level increases by late May. A steady dry down in late 2018 gave way to dryer than normal conditions by January 2019. Atypical heavy rain occurred in late January and multiple reversals followed in late February, March, and May, with little dry down through May. Wood storks failed to nest in the WCAs in 2019 and had a poor year in ENP with all nests failing (Frederick and Garner 2020).

6.9.6 Summary of Environmental Baseline

Wood storks nest during the dry season and are dependent on drying wetlands as an environmental cue for nest initiation. The reduction of long hydroperiod wetlands known to have occurred from development and over drainage has been postulated as a major cause of late colony formation and a reduction in early nestling survival rates (Fleming et al. 1994). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for wood stork foraging for a narrow window of time when water levels within wetlands have sufficiently receded to begin concentrating prey and making water depths suitable for wood storks to access the wetlands. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern, because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species reducing the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey. Furthermore, an invasive exotic animal such as the Burmese python can affect the success of wood storks during the breeding season.

6.10 Effects of the Action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

6.10.1 Factors to be considered

The purpose of the COP is to define the water management operations for the WCA-3A and WCA-3B outlets, structures in the L-31N and C-111 basins constructed as part of the C&SF Project, and the recently constructed components of the MWD and C-111 SD Projects. The components of the COP that may affect the wood stork include the water management operations

for WCA-3A, ENP, and the SDCS. In addition, the WCA-3A PSC will continue to provide a mechanism to evaluate hydrological and ecological conditions within wood stork habitat to allow for adaptive management of the system to protect the needs of multiple species, including the wood stork and other wading bird species.

The COP goals are to improve the timing, location, and volume of water and restore natural hydrologic conditions in ENP (Corps 2019a). Through these modifications, the Corps has additional flexibility in releasing water from WCA-3A in order to: (1) better manage recession and ascension rates, (2) alleviate high water conditions, and (3) minimize effects to the wood stork and its habitat.

Water management operations may have a number of consequences on the wood stork and wood stork habitat. These may include: (1) the permanent loss of available habitat for foraging, breeding, and roosting wood storks; (2) changes in hydroperiods of wetlands that affect wood stork foraging, breeding, and roosting; (3) the fragmentation of wood stork habitat; (4) a reduction in the spatial extent of habitat for the species; (5) increases in disturbance frequency, intensity, or severity to wood storks in the project vicinity due to human activities; (6) changes in the wood stork prey base; and (7) changes in the value of wood stork habitat within the action area due to project-related hydrological alterations and water quality.

The analysis discussed below are based on conditions observed within the action area since the initiation of ERTP 2016. The Service anticipates future effects to the wood stork as a result of the proposed action will be similar to those documented within the action during this period. Our analysis focuses only on the hydrological variables most closely associated with wood stork foraging behavior, prey base biomass, and nesting success where the Corps has discretionary federal involvement or control. There is limited information on the effects of invasive and exotic species, water quality, and disturbance from human activities (*i.e.*, outdoor recreation, airboat operations, etc.).

The action area contains wood stork foraging habitat and is located within the CFA of 27 wood stork colonies that have been active for at least one year since 2009 (Figure 25). The CFAs of these wood stork colonies encompass about 2,163,068 acres of the COP action area. The COP does not impact suitable foraging habitat for the nearby Collier-Hendry, Barron Collier, and the LOX NC-4 colonies, therefore, these colonies were omitted from any further analysis. The COP water management activities will be continuous over either (1) the 7-year period identified in the Integrated Delivery Schedule (IDS); (2) until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay; or (3) if new information becomes available through implementation of the COP Water Control Plan and/or the COP Adaptive Management and Monitoring Program (AMMP) that would necessitate a need to modify water management operations. Wood storks may be found near the action area year-round, though they may be partially migratory and act as facultative migrants (Picardi et al. 2019). Habitat loss associated with the water operations will result from hydroperiod and vegetation changes in the wetlands currently available to the wood stork for foraging.

The potential effects from the proposed action on wood storks were evaluated using the Wood Stork Foraging Analysis described in Appendix A (Service 2010b). This method combines the effects of canopy cover and prey availability on the relative suitability of these wetlands for wood stork foraging. Potential effects to wood storks are determined based on the calculated spatial changes within each hydroperiod class and estimates of the difference in prey availability (fish and crayfish biomass) between the existing baseline and the proposed action. The biomass estimates are calculated from fish density (Trexler et al. 2002), fish biomass (Kushlan et al. 1986; Turner et al. 1999), crayfish biomass (Acosta and Perry 2002), suitable prey size and base (Ogden et al. 1976; Trexler et al. 2002), and consumption competition (Fleming et al. 1994) for each hydroperiod class (Service 2010b).

6.11 Analysis for Effects of the Action

The implementation of the COP has the potential to affect the wood stork through changes to the hydrology within the action area by (1) moving water further east along the L-29 canal before releasing that water south into Shark River Slough, and (2) moving water further east through operations and infrastructure along the L-28 canal and Tamiami canal. Specifically, maintaining seasonal closures of the S-12A, S-12B, S-343A, and S-343B; removal of the seasonal closures at S-344 and limited adjustments to the S-332D seasonal pump restrictions; increased canal stage in the L-29 canal; increased capacity for flows through S-333; operation of the Decomp Physical Model features; improved connectivity between WCA-3A and WCA-3B; and increased flows to the east will result in changes to the annual stage, hydroperiod, and wood stork foraging conditions within the action area.

A regional hydrologic model (South Florida Regional Simulation Model Glades-LECSA Implementation (RSM-GL)) was used to evaluate system conditions. The COP is the last step to implement operational changes to convey water from WCA-3A to the ENP using the constructed features of the pre-CERP Foundation Projects (*i.e.*, MWD and C-111 SD Project) and would result in a change to the 2012 WCAs, ENP, and ENP-South Dade Conveyance System (SDCS) Water Control Plan. The main component of the COP that improves water deliveries to ENP is the Tamiami Trail Flow Formula (TTFF). The TTFF replaces the 1985 WCA-3A Rainfall Plan. The TTFF uses information from water stages (WCA-3A and NESRS), rainfall (historical median WCA-3A and BCNP inflows with forecast adjustments), potential evapotranspiration (historical median), and recent structure flows to predict upcoming weekly flow target volumes across Tamiami Trail.

The RSM-GL model run that most closely represents the COP for this area is the Round 3 Alternative Q (ALT Q) while the existing condition under the ERTP 2016 baseline were modeled under the run labeled ECB19RR (Corps 2019a). The proposed action (ALT Q+) is largely based on the ALT Q with minor tweaks based on sensitivity runs (Corps 2019a). ALT Q+ was not modeled; however, hydrologic model output from ALT Q and the sensitivity runs on ALT Q were used to evaluate the potential effects of ALT Q+ on federally listed species. In general, ALT Q+ meets all the project objectives and does not violate project constraints.

Additional ecological planning tools developed by the Joint Ecosystem Modeling (JEM) group (https://www.jem.gov) were also identified to be used for purposes of evaluating habitat suitability for fish and wildlife resources (Corps 2019a). Information from the Wader Distribution and Evaluation Modeling (WADEM), Small Fish, and the Everglades Landscape Vegetation Succession (ELVeS) models were used to evaluate potential effects to wood storks. As stated previously, water depth and recession rate are the two most important hydrological variables for wood storks (Gawlik et al. 2004). To have a successful nesting year, wood storks must have access to suitable habitat throughout the dry season, but the location of the suitable habitat can vary across the landscape. Under the selected model runs in the RSM-GL and WADEM models, changes to the annual stage, annual hydroperiod, and mean foraging conditions are predicted to occur primarily within portions of northern and northeastern ENP and throughout WCA-3A and WCA-3B. However, the following results should be interpreted cautiously given the inherent uncertainty associated with the use of models.

The RSM-GL model results for ALT Q indicate that annual hydroperiod will be decreased by up to 30 days in north central WCA-3A and 30 to 45 days in northeast WCA-3B (Figure 26). The model results for WCA-3A and 3B under ALT Q indicate there is a slight to moderate decrease in annual average stage in east central, central, and southern WCA-3A and minor to moderate decreases in annual stage from the baseline conditions within the northeast corner of WCA-3B (Corps 2019a). The annual hydroperiod and annual stage are expected to decrease within portions of wood stork CFAs throughout the majority of WCA-3 (Figure 26).

The RSM-GL model results for ALT Q indicate that in portions of northeastern ENP annual stage and hydroperiod will increase up to 0.25 feet and 90 days, respectively. Annual stage will decrease 0.25 feet and hydroperiod shortened by up to 30 days in northern ENP east of Big Cypress National Preserve and south of the Tamiami canal (Figure 26). The annual hydroperiod and annual stage are expected to increase within portions of wood stork CFAs throughout the majority of ENP (Figure 26). However, some colonies will see a decrease to stage and average annual hydroperiod within their CFA in northern ENP (Figure 26). Grossman Ridge West, Jetport South, Jetport, and Big Cypress Mitchell Landing may experience these decreases in up 12,033 acres, 10,803 acres, 11,422 acres, and 6,657 acres of their respective CFA that is within the COP action area.

The WADEM ecological planning tool was utilized to determine spatially explicit changes in high quality foraging conditions for wading birds for ALT Q relative to ECB19RR. WADEM uses a spatiotemporal species distribution model (SDM) framework to evaluate the foraging responses of wood storks. Using a multi-model approach, a spatial foraging conditions model (SFC) predicts wading bird abundance over time at a fixed spatial scale (400 meter) and a temporal foraging conditions model (TFC) predicts daily abundance across space. The resulting indices represent proxies for different components of patch dynamics: patch quality within suitable depths is reflected by TFC and landscape patch abundance by SFC. The product of these two indices (area × quality; or foraging index) provides a metric to account for both processes. To evaluate the effects of the COP on wading bird patch quality and patch

abundance, mean abundance (TFC) and mean quality (SFC) over the years 1975-2005 was calculated. For more detailed information on WADEM, refer to Beerens et al. (2015a), Beerens et al. (2015b), and Cook and Kobza (2009).

The WADEM model results display the percent change between the COP (ALT Q) and the baseline (ECB19RR) of the wood stork mean spatial foraging conditions index over the months of March and April of 1975-2005. Observed differences between ALT Q and ECB19RR were most often not more than a ±10 percent change across the majority of WCA-3 and ENP. The WADEM model results indicate that foraging conditions will be improved for wood storks over a large area of northern and northeastern ENP, in NESRS, and along the C-111 canal south of the S-177 spillway. Foraging conditions decreased in northeast WCA-3A and along the L-67 canal in WCA-3B (Figure 27). Based on the location of known wood stork colonies, the greatest improvement to foraging conditions is predicted to occur within the CFA of at least seven colonies (*i.e.*, Tamiami Trail East 1, Tamiami Trail East 2, Tamiami Trail West, 3B Mud East, Lower Taylor Slough, Rookery Branch, and Grossman Ridge West). Of these, the Tamiami Trail West and Grossman Ridge West colonies have been active since implementation of the MWD Increment 1.1, 1.2 and Increment 2 field tests (Table 21). At least five colonies will see a decrease to mean foraging conditions within their CFA (Figure 27). Sawgrass Ford, Cypress City, Emerald Estates 1 and 2 Griffin, Kinich, and 3B Mud East may experience negative effects to foraging conditions in up to 42, 34, 42, 33, and 21 percent of their respective CFA that is within the COP action area. 3B Mud East saw both an improvement and decrease in mean foraging conditions in 237,592 acres and 87,207 acres, respectively, due to its CFA location encompassing the NESRS and the area along the L-67 canal.

Water depth and recession rate are the two most important hydrological variables for wood storks (Gawlik et al. 2004). To have a successful nesting year, wood storks must have access to suitable habitat throughout the dry season, but the location of the suitable habitat can vary across the landscape. Gawlik et al. (2004) developed a wood stork suitability index based solely on the physical processes that concentrate aquatic prey and make them vulnerable to capture by wood storks. The index was calculated from the South Florida Water Management Model (SFWMM) and Natural Systems Model (NSM) output for the 2-mile by 2-mile grid cells in the remnant Everglades. At any one time, a highly suitable landscape will likely consist of cells that have not yet reached their peak suitability for the year, cells that have already passed their peak suitability, and cells that are at their highest suitability. According to Gawlik et al.'s (2004) habitat suitability index for wood storks, 23 percent of a core foraging area is occupied at any one time by feeding wood storks during a good nesting year.

In 2010, wood stork-related water management recommendations for ERTP were developed by James Beerens and Dr. Mark Cook of the District. Using average daily stage data in WCA-3A and foraging flock observational data from 2000 to 2005, Beerens and Cook (2010) identified water levels (stages) that provide foraging habitat at the start (January 1) and at the end (May 31) of the breeding season and determined the minimum and maximum water depths for foraging according to the average of the following gauges in WCA-3A: 3A-3, 3A-4, and 3A-28 (3AVG). In addition, they used presence-absence observations of foraging wood storks from systematic

reconnaissance flights conducted during 2000-2009 in conjunction with mean used water depth (*i.e.*, observed water depths where storks were located averaged over each instance of use) and recession rate data (estimated using Everglades Depth Estimation Network [EDEN] and calculated using SAS version 9.3 software [SAS Institute 2003]) to determine the optimal recession rate and site-specific optimal water depths used by wood storks over a 10 year period. This recession rate was then applied to the 3AVG water levels to determine lower and upper thresholds at the start and end of the breeding season, respectively. The resulting range of water levels encompasses short hydroperiod areas in northwest WCA-3A (available early in the season) to longer hydroperiod areas in southeast WCA-3A (which become available later in the season).

The implementation of ERTP 2016 was meant to provide the ability to better manage WCA-3A for multiple species including the wood stork. The Corps and Service, in conjunction with the multi-agency ERTP team, developed performance measures (PMs) and ecological targets (ETs) for each species and their habitats. PMs and ETs contained within ERTP incorporated recommendations found within the Service's Multi-Species Transition Strategy (MSTS) for WCA-3A which was specifically designed to identify water depths and stages within WCA-3A to benefit species and the habitats on which they rely (Service 2010a). The inclusion of these recommendations represented a significant improvement in water management operations.

Specifically, PMs were defined as a set of operational rules that identify optimal WCA-3A water stages and recession rates to improve conditions in WCA-3A for the snail kite, wood stork, wading birds, and tree islands. The two PMs developed specifically for wood storks were:

- (PM-F) - WCA-3A (Dry Season Recession Rate): Strive to maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1.
- (PM-G) - WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 25 cm) within the Core Foraging Area (CFA) (18.6-mile radius) of any active wood stork colony.

6.11.1 Recession Rate

A recession rate of 0.07 ft per week (1.89 cm per week), with an optimal range of 0.06 to 0.07 ft per week (1.82 to 2.03 cm per week), is recommended from January 1 to June 1 to provide foraging opportunities for breeding wood storks. Based on their analysis of recession rates used by foraging wood storks during the 2000 to 2009 dry seasons, Beerens and Cook (2010) further described recession rates as follows: the "suboptimal rapid" category included rates from 0.07 to 0.17 ft per week (2.03 to 5.11 cm per week); the "too rapid" category included rates from 0.17 to 0.37 ft per week (5.11 to 11.34 cm per week); the "suboptimal slow" category included rates from -0.05 to 0.06 ft per week (-1.40 to 1.82 cm per week); and the "reversal" category included rates from -0.05 to -0.23 ft per week (-1.40 to -7.00 cm per week). Recession rates greater than 0.37 ft per week (11.34 cm per week) and reversals greater than -0.23 ft per week (-7.00 cm per

week) were considered too rapid to support wood stork foraging [Note that negative values indicate increasing water levels (*i.e.*, reversals)].

The optimal recession rate of 0.07 ft per week was used to back-calculate from the minimum 3AVG stage associated with stork use of 8.02 ft NGVD (Figure 28) to the beginning of the breeding season on January 1. This calculation corresponded to a 3AVG stage of 9.5 ft (Figure 28). This same recession rate was applied forward from the maximum 3AVG stage (10.37 ft) associated with wood stork use of WCA-3A (Figure 28) and resulted in a value of 8.86 ft at the end of the breeding season on June1. These two lines represent the ideal range of the 3AVG that provides wood stork foraging in WCA-3A throughout the course of the breeding season.

Under the current WCA-3A Interim Regulation Schedule, recession rates have been too rapid in many years to support successful snail kite nesting and foraging; however, wood storks and other wading birds require a more rapid recession rate to concentrate their prey items into shallow pools for more effective foraging. Conversely, too rapid drying conditions, if repeated year after year, would soon reduce the prey base required for successful wood stork breeding (Fleming et al. 1994).

The COP attempts to avoid recession rates that are unfavorable to wood storks and other wading birds by including a recommended range of recession rates targets (PM-F). The ERTP recommended recession rate for wood storks and other wading birds was 0.06 to 0.07 ft per week from January 1 to June 1. The recession rate for any given period of time was determined based upon recommendations made during the WCA-3A PSC. Results from the SFWMM were evaluated for recession rate and suggested an improvement in recession rates under ERTP implementation. It is important to note that the recession rates can be improved using real time water management operations and incorporation of WCA-3A PSC recommendations. Implementation of the ERTP WCA-3A Interim Regulation Schedule was expected to produce a mosaic of wetland habitats within WCA-3A that would provide favorable foraging opportunities for wood storks. In addition, the incorporation of foraging depth requirements (PM-G) into ERTP addressed wood stork foraging particularly within the highly important marshes of their core foraging area during the breeding season. The COP will continue to avoid recession rates that are unfavorable to wood storks and other wading birds by including a range of recession rate targets (PM-F) that are recommended through the PSC forums and the MSTS. Performance measures from the MSTS are not explicitly included in the COP WCA-3A Regulation Schedule and COP Water Control Plan. Scientific and species input (including the MSTS metrics) will continue to be collected through the PSC forums, and the Corps will utilize the operational flexibility cited in Section 7.1 of the COP Water Control Plan to consider adjustments to the TTFF weekly release targets (Corps 2019a).

6.11.2 Water Depth

Water levels between 9.5 and 10.37 ft NGVD on January 1 at the 3AVG were recommended to provide favorable conditions for wood storks and other wading birds foraging in WCA-3A. Based on their review of wood stork survey data and hydrological data between 2000 and 2005,

Beerens and Cook (2010) found that the maximum 3AVG stage associated with wood storks feeding in WCA-3A (beginning in the northwest) was approximately 10.37 ft NGVD (Figure 28). Their analysis also indicates that wood storks used a mean depth of 0.48 ft (14.63 cm), with the optimal range including the 95 percent confidence interval equal to 0.46-0.50 ft (13.93-15.33 cm). Beerens and Cook (2010) further described high water foraging depths as follows: the "suboptimal wet" category included depths from 0.50 ft (15.33 cm) up to 1.35 ft (41.26 cm); the "too wet" category included depths from 1.35 ft (41.26 cm) up to 2.09 ft (63.67 cm); depths greater than 2.09 ft (63.67 cm) were considered too wet for stork feeding.

Beerens and Cook (2010) also determined minimum 3AVG water levels between 8.00 and 8.86 ft NGVD would provide favorable conditions for wood stork and other wading bird foraging in WCA-3A. Based on their review of wood stork survey data and hydrological data during 2000 to 2005, Beerens and Cook (2010) found that the minimum 3AVG stage associated with wood storks still feeding in southeastern WCA-3A was approximately 8.02 ft (Figure 28). Flock size appeared to increase consistently with a decrease in stage during the breeding seasons during the years 2000-2005. In addition to their categorization of high water foraging depths, Beerens and Cook (2010) further described low water foraging depths as follows: the "suboptimal dry" category included depths from 0.46 ft (13.93 cm) down to -0.31 ft (-9.33 cm); the "too dry" category included depths from -0.31 ft (-9.33 cm) down to -1.63 ft (-49.66 cm); depths less than -1.63 ft (-49.66 cm) were considered too dry for feeding. [Note that negative depths indicate water levels below ground surface based on the 3AVG ground elevation - at such levels there may be water in the southern end of WCA-3A and in deeper pockets throughout the conservation area.]

6.12 Effects on Foraging Habitat

For this action, direct effects include the impacts to wood stork foraging habitat as a result of recession rate and water depth. Without the supply of concentrated prey that results from dry season recessions, adult wood storks are unable to support their offspring. The Service used two performance measures to interpret the potential direct effects to the wood stork from the proposed action: (1) the goal of maintaining a recession rate of 0.07 feet per week from January 1 to June 1 (PM-F), and (2) the goal of maintaining areas of appropriate foraging depths between 5 and 25 cm within the CFA of any active wood stork colony (PM-G).

6.12.1 Recession rate (PM-F)

Observed weekly recession rates in WCA-3A during the four breeding seasons (2016, 2017, 2018 and 2019) in which water management operations were as described within ERTP 2016 are reported in Cook and Barinski (2017, 2018, and 2019) and Frederick and Garner (2020). During WY 2016, despite long periods of rapid recession rates from January to May, the occurrence of multiple extreme water-level reversals meant that depths remained too high for wading bird foraging throughout the nesting season. During WY 2017 and WY 2018, recession rates for wood storks met or minimally exceeded the optimal rate with some minor late reversals. In WY

2019, significant reversal occurred in late January and multiple reversals followed in late February, March, and May, with little dry down through May.

The Corps conducted retrospective reviews in 2017 and 2018 to determine the potential cause(s) of recession rates outside the preferred range experienced during each of the respective dry seasons (*i.e.*, January 1 through June 1) and how future operations could avoid exceeding these thresholds (Corps 2017, Corps 2018). The Corps concluded that WCA-3A outlet structures were opened and closed as per the WCA-3A regulation schedule and reversals during the dry season were attributed to extreme rainfall events. However, there may be some additional opportunities to use operational flexibility to assist in attaining recession rates within the preferred range for wood storks.

6.12.2 Foraging depths (PM-G)

As shown in Table 23, based upon the two-gauge average of 3A-3 and 3A-4, water depths did not exceed 16 inches between March 1 and May 31, 2017; however, during May 2018, water depths exceeded 16 inches for 11 days. Water depths during this time ranged between 16.74 and 26.76 inches, with an average of 21.29 inches. The ERTP 2016 ITS states that allowable incidental take will be exceeded if operations from implementing the RPA results in water depth greater than 16 inches (41 cm) from March 1 through May 31 throughout WCA-3A for two consecutive years.

A series of mid-May storms in 2018 caused conditions to change rapidly from very dry to very wet conditions in South Florida, with Lake Okeechobee, the WCAs, and the eastern coast of Florida accumulating most of the rainfall. The area as a whole received 301 percent of average rainfall. WCA-3 received 12.33 inches in precipitation during May of 2018, which is 285 percent of the average for this time of year. May 2018 was the wettest May on record within the SFWMD Service Area with 11.5 inches of rain recorded. The previous record for May was 9.25 inches in 1895. This record area-wide rainfall caused water stages in the three WCAs to rise above their maximum regulation schedules. The Corps undertook several water management measures in order to reduce high stages within WCA-2A, WCA-3A, and WCA-3B. These measures included three planned temporary deviations, one in WCA-2A, one in WCA-3A, and one in WCA-3B. As part of these planned temporary deviations, the Corps conducted emergency ESA consultation with the Service and documented potential environmental effects within three National Environmental Policy Act documents (EA/FONSI, June 30, 2018).

The RSM-GL model results for the COP indicated the number of times in the period of record (1965-2005) when water depths exceeded 16 inches (41 cm) from March 1 through May 31 throughout WCA-3A in two consecutive years as measured by the two gauge average (based upon a ground surface elevation of 8.4 feet NGVD) at gauges 3A-3 and 3A-4. The model indicates that implementation of the COP can reduced the number of times the threshold was exceeded by six events relative to the baseline condition.

6.13 Effects on Wood Stork Prey Availability

Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high and the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Prey availability to wood storks is dependent on a composite variable consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too deep (greater than 30 cm) for storks to forage or the tree canopy at the site is too dense for storks to land. Calm water, about 5-40 cm (2-16 in) in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993).

We have identified four variables in assessing wood stork foraging:

- the density of vegetation within habitats suitable for wood stork foraging;
- the hydroperiod of the wetland, which includes two subcomponents (1) the fish and crayfish density per hydroperiod, and (2) the fish and crayfish biomass per hydroperiod;
- the suitability of prey size for the wood stork, which provides an adjustment to the fish biomass per hydroperiod and is referenced hereafter as the wood stork suitable prey base; and
- the likelihood the wood stork is the wetland species that actually consumes the concentrated prey and is referenced as the competition factor.

All four of these parameters, when combined, provide us with an estimate of the effect of wetland foraging losses and gains in kilograms of prey in our assessment of the effects of the action on wood storks.

6.13.1 Effects of Density of Vegetation Within Habitats Suitable for Wood Stork Foraging

Wetland suitability for wood stork foraging is partially dependent on vegetation density. Melaleuca is a dense-stand growth plant species, effectively producing a closed canopy and dense understory growth pattern that generally limits a site's accessibility to foraging by wading birds. O'Hare and Dalrymple (1997) indicated that the number of fish species present in a wetland system remains stable at certain levels of melaleuca infestation. However, the number of fish families and fish abundance decreased with increasing melaleuca infestation (Ceilley et al. 2005). Avian species data from wetland-dependent, wading, and mixed habitat use species showed a decrease in the number of species and individuals with increased density of melaleuca, which corresponds with the habitat uses shown by O'Hare and Dalrymple (1997). The availability of the prey base for wood storks and other wetland dependent species is reduced by the restriction of access caused from dense and thick exotic vegetation. Wood storks and other wetland-dependent bird species can forage in these systems in open area pockets (*e.g.*, wind blow-downs), provided multiple conditions are optimal (*e.g.*, water depth, prey density).

Estimates from 2013 digital mapping revealed that melaleuca occurs on more than 5,452 acres in ENP and is primarily concentrated in the East Everglades Acquisition Area (NPS 2006, 2013). Although melaleuca is a difficult species to eradicate, District and NPS efforts, along with those of other governmental agencies and private groups, are containing its spread through an integrated management approach within the ENP and the Everglades Water Conservation Areas (WCAs). Melaleuca has been completely cleared from WCA-2A, -3A, and -3B, south of Alligator Alley (Laroche 1998). These areas are now under "maintenance control". Maintenance control means applying management techniques on a continuous basis to keep an invasive plant population at its lowest feasible level.

In O'Hare and Dalrmyple's study (1997), they identify five cover types (Appendix A, Table WSM1) and provide information on the number of wetland dependent bird species and the number of individuals observed within each of these vegetation classes (Appendix A, Table WSM2). The Service used this approach to develop an exotic foraging suitability index (Appendix A, Table WSM3) that assesses wetland acreages and their relationship to prey densities and prey availability. We consider wetland dependent bird use to be a general index of food availability. Using this approach, we can assign a Foraging Suitability Value of 100 percent due to the current low overall percent coverage of melaleuca in the COP action area (5,452 acres of melaleuca / 2,163,068 acres of the COP CFA = 0.003).

6.13.2 Effects on Wetland Hydroperiod

The hydroperiod of a wetland can affect the prey densities in a wetland. For instance, research on Everglades fish populations using a variety of quantitative sampling techniques (pull traps, throw traps, block nets) has shown that the density of small forage fish increases with hydroperiod. Marshes inundated for less than l20 days of the year average ± 4 fish/m^2; whereas, those flooded for more than 340 days of the year average ±25 fish/m^2 (Loftus and Eklund 1994, Trexler et al. 2002).

The Service (1999) described a short hydroperiod wetland as wetlands with between 0 and 180-day inundation, and long hydroperiod wetlands as those with greater than 180-day inundation. However, Trexler et al. (2002) defined short hydroperiod wetlands as systems with less than 300 days per year inundation. In our discussion of hydroperiods, we are considering short hydroperiod wetlands to be those that have an inundation of 180 days or fewer. The most current information on hydroperiods in south Florida was developed by the SFWMD for evaluation of various restoration projects throughout the Everglades Protection Area (Appendix A, Table WSM4). The SFWMD characterizes hydroperiods into seven distinct classes based on the number of days a year a wetland is inundated as follows: Class 1 0-60 days inundated; Class 2 60-120 days inundated; Class 3 120-180 days inundated; Class 4 180-240 days inundated; Class 5 240-300 days inundated; Class 6 300-330 days inundated; and Class 7 330-365 days inundated. These hydroperiod classes were used to assess effects of the project on wood stork foraging habitat (Table 22).

The RSM-GL results for the COP (ALT Q) indicate that the hydroperiod class will be changed in 55,095 acres in wood stork CFAs (Table 22). This total is the sum of the individual changes within each hydroperiod class. Some changes may be positive whereas others may be negative. Most notably is the reduction of 17,269 acres of floating emergent marsh (Class 7 hydroperiod wetlands) and 9,795 acres of willow shrub/cattail and marl prairie (Class 1,2, and 3 hydroperiod wetlands) (Table 22). The COP will increase the Class 5 and 6 hydroperiod sawgrass wetland acreage by 1,162 and 26,385, respectively (Table 22). The ELVeS model simulated the dominant vegetation community output in response to the COP (ALT Q) against the existing conditions baseline (ECB19RR) for an average (Figure 19), dry (Figure 20), and wet (Figure 21) years. In average and dry years, the vegetation community response to these hydrologic changes reduced the spatial extent of floating emergent marsh, willow shrub/cattail, and marl prairie. It increased the extent of sawgrass and swamp shrubland in all water year types (Figures 19-21) and cypress shrub_sawgrass in wet years (Figure 21).

The proposed action will result in a conversion of 9,795 acres of short hydroperiod wetland to long hydroperiod wetland. Within the project action area, short hydroperiod wetlands are estimated at 278,590 acres and long hydroperiod wetlands are estimated at 1,884,194 acres (see Table 22). The short hydroperiod wetland loss represents an estimated 3.5 percent of the short hydroperiod wetlands in the action area (9,795 acres lost/278,590 acres of short hydroperiod wetland = 0.035). The corresponding long hydroperiod wetland increase represents less than one percent (9,795 acres gained/1,884,194= 0.005).

The loss of 3.5 percent of short hydroperiod wetlands in the project action area is a significant change over baseline conditions. Moreover, as discussed previously, the acreage loss consists primarily of wetlands dominated by either willow shrub/cattail and marl prairie and their foraging biomass contribution to wood storks provide an important pre-nesting food source and a greater effect on early nesting survival.

6.13.3 Fish Density

For the COP, an ecological planning tool was also available to evaluate potential effects on small sized fish density (defined as less than eight centimeters adult standard length) within the study area (Donalson et al. 2010). The ecological planning tool or prey based freshwater fish density model estimates the densities of small-sized freshwater fish, primarily livebearers (poeciliids) and killifishes (cyprinodontids and fundulids). High densities of these fish characterized the pre-drainage central Everglades ecosystem. Maximizing densities is an objective of many restoration scenarios. Because prey fish dominate the prey community in both biomass and abundance, they are an important energy source for higher-trophic levels, such as wading birds. Thus, ecological planning tool estimates of prey fish can be used as a general measure of trophic conditions within the central Everglades. The mean percent change in total fish density for the COP (ALT Q) relative to the baseline conditions under ERTP 2016 (ECB19RR) for each year in the period of record (1965 - 2005) showed an overall improvement across the landscape with annual increases ranging from 1 to 20 percent (Corps 2019a). The observed differences in mean total fish density at individual points across the action area between ALT Q and ECB19RR were

most often not more than a ±10 percent change in average, dry, or wet years. Negative percent changes ranging from -10.1 to -32.6 percent fish density were observed in a number of locations in portions of WCA-3A and WCA-3B and northern ENP, particularly in dry years in central WCA-3A and along the L-67A (Corps 2019a).

In the Service's assessment of project related impacts to wood storks, the importance of fish data specific to individual hydroperiods is the principle basis of our assessment. In order to determine the fish density per individual hydroperiod, the Service relied on the number of fish per hydroperiod developed from throw-trap data in Trexler et al.'s (2002) study. The Trexler et al. (2002) throw-trap data represents a surrogate assessment tool to predict the changes in total fish density and the corresponding biomass per hydroperiod for our wood stork assessment. Turner et al. (1999) provided an estimated fish biomass of 6.5 g/m^2 for all fish for a Class 7 hydroperiod and used the number of fish per square-meter per hydroperiod from Trexler et al.'s data to extrapolate biomass values per individual hydroperiods. We based our prey fish evaluation on the assessment of Trexler et al.'s (2002) and Turner et al.'s (1999) study results described in Appendix A.

Trexler et al.'s (2002) studies in the Everglades provided fish densities, calculated as the square-root of the number of fish per square meter, for only six hydroperiods; although these cover the same range of hydroperiods developed by the SFWMD described in Section 6.13.2 (Appendix A, Table WSM5). For our assessment, we squared these numbers to provide fish per square meter, a simpler calculation when other prey density factors are included in our evaluation of adverse effects to listed species from the proposed action. We also extrapolated the densities over seven hydroperiods, which is the same number of hydroperiods characterized by the SFWMD. For example, Trexler et al. (2002) had one hydroperiod classification for wetlands inundated for 0 to 120 days while the SFWMD model broke this out into a Class 1 hydroperiod (0-60 days) and a Class 2 hydroperiod (60-120 days). We then used linear interpolation to determine the squared density value of the SFWMD Class 2 hydroperiod wetland from the values associated with a SFWMD Model Class 1 and Class 3 hydroperiod wetland of 2 and 9 $fish/m^2$, respectively. Based on the above discussion, the mean annual fish densities were extrapolated to the seven SFWMD Model hydroperiods as shown in Appendix A, Table WSM6.

6.13.4 Fish and Crayfish Biomass

A more important parameter than fish per square-meter in defining fish densities is the biomass these fish provide. We estimated the mean annual biomass densities per hydroperiod using standing stock estimates for ENP and WCA-3 from Turner et al. (1999), Turner and Trexler (1997), Trexler et al. (2002), and Carlson and Duever (1979). Dry weights were converted to wet weights following procedures referenced in Kushlan et al. (1986) and Turner et al. (1999). The mean annual fish biomass per hydroperiod class were extrapolated to the seven SFWMD Model hydroperiods as shown in Appendix A, Table WSM7. The wood stork forage analysis also needs to consider the suitable prey base and the biomass consumption related to competition with other wetland dependent species. To estimate the fraction of the available fish biomass that might be consumed by wood storks, we used an assessment of prey consumption by wood storks

in Ogden et al.'s (1976) study and Trexler et al.'s (2002) throw trap data. The fish biomass per hydroperiod values were adjusted accordingly for size and species composition (Appendix A, Table WSM9).

In 2006, the Service developed an approach using Fleming et al.'s (1994) assessment of prey base consumed versus prey base assumed to be available to wood stork that provided a foraging efficiency estimate of the available biomass that was actually consumed by wood storks (Service 2006d). In 2012, the Service included crayfish biomass in their foraging habitat assessment to account for crayfish in the wood stork's diet (Service 2012b). Acosta and Perry (2002) assessed the biomass of crayfish (*P. alleni*) from seasonal wetlands of various hydroperiods within the Florida Everglades. To estimate the total forage biomass available to the wood stork for each wetland hydroperiod class (Appendix A, Table WSM9), we added the value of mean annual crayfish biomass derived from Acosta and Perry (2002) to the value of mean annual biomass estimated for fish (Appendix A, Table WSM10). This approach was refined, and biomass values adjusted to reflect the competition factor from Service (2006d) and represents the amount of biomass consumed by wood storks and is the basis of our effects analysis (Appendix A, Table WSM11).

We used the hydrologic model outputs for the average annual hydroperiod distribution from the period 1965-2005 to determine the acres in each hydroperiod class under the ECB19RR (baseline) and ALT Q (proposed action). We then subtracted the difference between the baseline and proposed action to determine the change in acres for each hydroperiod class. The equation to calculate the biomass for each hydroperiod class is: the number of acres, converted to square-meters, times the amount of actual biomass consumed by the wood stork (Appendix A, Table WSM11), times the exotic foraging suitability index (Appendix A, Table WSM3), equals the amount of grams lost or gained, which is converted to kg. The acres and the biomass lost or gained for each hydroperiod class is shown in Table 22.

The net overall change is an estimated increase of 24,367 kg of prey biomass available for wood stork foraging (Table 22). In our assessment of the proposed action, we estimate that hydrological effects in the COP action area are projected to result in a decrease of 9,795 acres of short hydroperiod wetlands and a corresponding gain of 9,795 acres of long hydroperiod wetlands, although the project will result in both positive and negative changes depending on the hydroperiod (Table 22). We also note an estimated net decrease of 12,774 kg of short hydroperiod biomass and a net increase of 37,140 kg of long hydroperiod biomass. Even though the overall net change in biomass is positive, a decrease to short hydroperiod biomass is significant due to its impact on pre-nesting foraging food sources, early nestling survivorship, and nest productivity of wood storks (Flemming et al. 1994; Ceilley and Bortone 2000).

6.13.5 Wood Stork Nest Production

Based on Kahl's (1964) estimate that 201 kg (443 lbs) of fish, crustaceans, and other prey are needed for the success of a nest and that 50 percent of the foraging base is needed in the middle third of the nesting cycle when chicks are about 23 to 45 days old (Kahl 1962), it is estimated

about 50 kg are needed to meet the foraging needs of the adults and nestling in the first third of the nesting cycle. Because of the consistent pattern of drying that normally occurs during the stork nesting season, the short hydroperiod wetlands would also be the ones used for foraging early in the season, when long hydroperiod wetlands remain too deep for storks to forage effectively or sufficient prey concentration has not yet occurred as a result of drying. Therefore, in our analysis of nest gains or losses by hydroperiod, we defined these changes as a composite of either short, long, and/or total biomass values as follows:

- Short hydroperiod wetlands include hydroperiod classes 1, 2, and 3. Nest production is based on the 50 kg of prey biomass needed in the first third of the nesting cycle when short hydroperiod wetlands are suitable for foraging.
- Long hydroperiod wetlands include hydroperiod classes 4, 5, 6, and 7. Nest production is based on the 151 kg of prey biomass needed in the final two thirds of the nesting cycle when long hydroperiod wetlands are suitable for foraging.
- Total hydroperiods includes the sum of short hydroperiod classes 1, 2, 3 and long hydroperiod classes 4, 5, 6, and 7. Nest production is based on the 201 kg of prey biomass needed for nesting success.

Using the hydroperiod biomass difference between the COP and ECB19RR in Table 22, we calculated the short hydroperiod nest production loss that may occur under the COP as -255.5 nests = -12,774 kg total short hydroperiod biomass / 50 kg of biomass needed per nest. The loss of 255.5 nests due to short hydroperiod wetland changes represents a 4.4 percent reduction from the baseline (ECB19RR) condition ((-255.5 nests x 50 kg)/(288,547 kg of short hydroperiod biomass available during ECB19RR) = -0.044). The long hydroperiod nest production gains of 245.9 nests = 37,141 kg total long hydroperiod biomass /151 kg of biomass needed per nest represents 0.5 percent ((245.9 nests x 151 kg of biomass)/(8,022,758 kg of long hydroperiod biomass) = 0.0046) of the long hydroperiod nest production (Table 22).

In our assessment of nest production, we provided an analysis of all the individual gains and losses by hydroperiod class, which, based on Table 22, shows that over the 7-year life of the COP, a projected loss of nest production of 67.2 nests (-9.6 nests per year x 7 years = -67.2 x 1.29 nestlings per nest = 86.7) or 87 nestlings is expected. We utilized the average fledglings per nest value of 1.29 that was reported by Rodgers and Schwikert (1997) to calculate the number of nestlings. This loss represents 12 percent (67.2 nests/(80.9 average nests per year x 7 years) = 0.12) of the total estimated nest production of the affected wood stork colonies in Table 21.

6.13.6 Nutrients

The duration of the proposed action is expected to last until implementation for the Central Everglades Planning Project (CEPP) currently scheduled for 2027. The main indirect effect considered by the Service includes the potential increased nutrient loading into ENP by a redistribution of flows through the S-333 and S-12 structures. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern, because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic

species that reduce the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey. However, the increased risk of habitat change to the wood stork resulting from the proposed action is difficult to predict and assess.

6.14 Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Most of the wetlands within the Action Area for the wood stork are subject to Corps' jurisdiction and permitting under Section 404 of the CWA. In some instances, wetlands may be determined to be outside the Corps' jurisdiction. For an unknown percentage of these Federal exemptions, it is expected that the State, or county if delegated wetland permitting by the State, will claim jurisdiction and require the process of minimization of, and compensation for, wetland impacts, which should assist in minimizing impacts.

Lands surrounding or adjacent to wetlands used by the wood stork that do not require Federal involvement are where the majority of the cumulative effects are likely to occur. These lands may be developed resulting in disturbance, habitat degradation, reduction in prey availability, isolated hydrologic changes, or permanent habitat loss. Land management activities conducted by State agencies may also have detrimental impacts to the wood stork.

Some wetlands and the areas adjacent to those and other wetlands may be adversely affected by actions without Federal involvement, resulting in a decrease in habitat quality and quantity, prey availability, and productivity for wood storks. For evaluation of the cumulative effects, the Service is considering the wood stork action area to include the following counties: Broward, Collier, Miami-Dade, and Monroe. Loss of wetland foraging habitat for wood storks within these counties may have adverse effects to individual colonies found within the Action Area.

6.15 Conclusion

Water depths and recession rates are the two most important evaluation criteria for analyzing any impacts the COP may have on wood storks. A variety of water conditions have been experienced since the implementation of ERTP 2016. Weekly recession rates within the action area were in the "poor" category for the majority of WY 2016 due to extreme water-level reversals that caused water depths to remain high throughout the nesting season. In WY 2017 and WY 2018, recession rates and water depths met or minimally exceeded the optimal rate for wood stork foraging with reversals occurring in May. In WY 2019, a significant reversal occurred in late January and multiple reversals followed in late February, March, and May, with little dry down through May. Based upon the two-gauge average of 3A-3 and 3A-4, water depths did not exceed 16 inches between March 1 and May 31, 2017; however, during

May 2018, water depths exceeded 16 inches for a period of 11 days. Water depths during this time ranged between 16.74 and 26.76 inches, with an average of 21.29 inches.

Recession rates that are considered "too rapid" and reversals due to extraordinary rainfall events during the onset of the wet season or prior to nest initiation have occurred under ERTP operations. Reversals occurring early in the dry season reduce foraging opportunities for adult wood storks and delay nest initiation. Wood stork colonies that initiate late during the dry season (February/March) are affected by reversals when trying to fledge nestlings, and concentrated prey becomes unavailable.

Despite long periods of time within the most recent breeding seasons where foraging depths were unfavorable to wood storks as measured at individual gauges, no obvious correlation between wood stork nesting effort and the foraging depth measured at a particular gauge was apparent in the wading bird monitoring data collected during these years. This is likely due to the availability of suitable water depths (optimal/sub-optimal) throughout much of these wood stork breeding seasons as measured at other gauges throughout the action area. Nesting effort by wood storks was above average within the WCAs in both WY 2017 and WY 2018. However, in WY 2019 there was no nesting activity by wood storks in the WCAs, and the only active wood stork colonies within the COP action area were in ENP (Frederick and Garner 2020).

Wetlands located within the core foraging area of wood stork colonies may be affected by non-federal actions not subject to Service review. The additional loss of these wetlands may result in impacts to wood storks that are expressed in terms of reproductive output or productivity. However, the potential impacts to wetlands not subject to Service review and the loss or reduction of foraging value to the wood storks associated with these systems is not likely to be significant.

Impacts to wood stork foraging and nesting are likely to occur under the COP as a result of reduced foraging habitat suitability and increased potential risk of depredation for some wood stork colonies. These effects are not expected to appreciably reduce the likelihood of survival and recovery of the species in the wild.

Due to general uncertainties related to model results, the Service has determined that the implementation of the COP is not likely to have significantly different effects to the wood stork than those that have been observed under the ERTP 2016. In addition, the temporal distribution of the changes to foraging conditions, hydroperiod, and stage described above is unknown.

After reviewing the status of the wood stork, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the COP, as proposed, is not likely to jeopardize the continued existence of the wood stork. No critical habitat has been designated for this species; therefore, none will be affected.

7.0 INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of the agency action, is not considered to be prohibited taking under the Act provided such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Corps shall report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement.

7.1 Surrogate Measures for Monitoring

For the CSSS, Everglade snail kite, and wood stork, detecting take that occurs incidental to the Action is not practical. The reasons for each species, (*e.g.*, individuals are small, cryptic, displaced from the Action Area to other areas where death or injury would occur, etc.) are described below in the subsequent sections.

In accordance with 50 CFR §402.14(i)(1)(i), when it is not practical to monitor take in terms of individuals of the listed species, the regulations indicate that an ITS may express the amount or extent of take using a surrogate (*e.g.*, a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

We have identified surrogate measures in our analyses of effects that satisfy these criteria for monitoring take of the species named above during Action implementation. We estimated the

amount of take caused by the habitat modifications and determined that it was not practical to monitor take-related impacts and/or the level of anticipated take exceedance in terms of individuals of the listed species. Therefore, in accordance with 50 CFR 402.14(i)(1)(i), the surrogate measures based on species habitat will be used to measure when the level of anticipated take has been exceeded. Table 24 lists the species, life stage, surrogate measure, and the section of the BO that explains the causal link between the surrogate and the anticipated taking. We describe procedures for this monitoring in section 7.4.

7.2 Amount or Extent of Take Anticipated

This section specifies the amount or extent of take of federally listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" sections of this BO. The Service acknowledges that it may sometimes be difficult to separate the effects of water management operations conducted under the COP from the effects of weather-related factors that affect hydrologic conditions, such as the amount, patterns and timing of rainfall, hurricanes, and drought. Thus, when exceedance criteria trigger(s) are reached, the Service will use the Corp's report and the best available data to reasonably determine if the exceedance triggers have been reached as a result of the COP or uncontrollable weather events, before determining if reinitiation is recommended.

7.2.1 Cape Sable Seaside Sparrows

While many components of the COP will contribute to the conservation of the CSSS in the long run, it does not avoid all adverse effects of water management operations.

Incidental take of individuals, especially nestlings or eggs, resulting from water operations is likely, either by direct drowning when routing water into CSSS habitats during the nesting season, or indirectly by making nests more susceptible to predation and other threats. High water levels can also stress adult birds reducing their fitness and making them more susceptible to predation and other causes of mortality.

Incidental take of CSSS resulting from water operations will be difficult to detect. The sparrow's reclusive habits and the general inaccessibility of its preferred habitat have long discouraged critical comprehensive life history studies (Lockwood et al. 1997). Seasoned observers typically have difficulty seeing individuals and usually rely on the chirping sound of singing adult males defending their breeding territory and vocalizing to attract females to determine presence or absence in an area. Detection by sound prompts more intensive searching that sometimes results in visually locating individuals and nests. Compounding these detection difficulties, the sparrow's distribution is patchy and temporally dynamic (Pimm et al. 2002).

Previous court opinions and court-ordered reviews of the Service's biological opinions have concluded that the standardized method used to estimate population abundance, known as the extensive survey method, is an insufficient basis for predicting or monitoring the amount or extent of incidental take of sparrows resulting from water management actions, because several

other factors influence the species' population dynamics. However, because the species' range is fully within areas that are influenced by the Corps' water management operations, and hydrologic conditions are strongly linked to reproductive success and the persistence of the sparrow's habitat, this method can serve as the starting point for predicting the amount of incidental take that is reasonably certain to occur, and as an indicator of the amount that has occurred. Potentially all adult birds are encompassed by the extensive survey method, and the previous year's reproductive success and productivity are reflected in the current year's survey results since CSSS are capable of breeding in the year after hatching.

The extensive survey method to estimate sparrow populations uses a helicopter to place observers at remote sites within sparrow habitat. The remote locations are determined by overlaying a 1 km grid over a map of sparrow habitat. The observers then record the number of sparrows seen or heard. To estimate the number of sparrows from the number observed (seen or heard), a correction factor is used. Kushlan and Bass (1983) were the first to develop and use a correction factor for their sparrow observations and it is still used today. A value of 15.87 (rounded to 16.0) is used based on the range at which observers can detect the sparrow's distinctive song, and on the assumption that each singing male is accompanied by one female. An individual male sparrow's territory is roughly 5 acres in size and the correction factor of 16 assumes that observers will count all birds within 656 ft of the observation station. Therefore, the correction factor of 16 is based on the fraction of total area sampled and detection probability, such that the area sampled multiplied by the detection probability equals 1/16 (Pimm et al. 2002; Walters et al. 2000). For that reason, one singing male heard or one individual seen is corrected to equate to a total of 16 individuals. This assumes statistically that an additional 15 individuals were also present in the area sampled, but due to factors governing the probability of detection, were not seen or heard during the time of observation. It has been statistically determined that under good survey conditions, the chance or probability of detection is better than 60 percent using this method. The correction factor methodology has been the subject of two external reviews. The most recent review (1999/2000) was conducted as a result of a recommendation by the American Ornithologists Union (AOU) external peer review committee. The outcome of the second review resulted in a determination by the AOU committee that the methodology employed is a reliable and accurate measure of abundance (Walters et al. 2000). However, this is not to say that it is a reliable method to track and count individual sparrows, rather it provides a reliable trend in population estimates comparable over time.

For the ERTP 2010 BO, the Service computed the mean total population estimate and standard deviation of these estimates (the customary statistical measure of variance for a set of measurements) for the years 2001-2009, which represented the timeframe under which operations for the protection of the CSSS had been implemented. Though the range of population estimates over this time frame varied due to water management and other factors, the Service determined that the mean population estimate from 2001 to 2009 had been relatively stable. Lacking methods that could separate the effects of water management from the effects of other factors, the Service used the standard deviation of the 9-year mean annual population estimate as a measure of all effects contributing to population variability. Subtracting the standard deviation of the population size estimates of previous years from the population size

estimate of the current year represented a conservative basis for estimating the amount of incidental taking due to water management. The amount of incidental take anticipated in the ERTP 2010 BO was exceeded in 2014, and consultation was reinitiated when the total estimated population fell to 2,720 (threshold was 2,915) individuals.

Through this reinitiated consultation, the Service revised the amount of anticipated take associated with ERTP 2016. The preliminary population estimate was 2,416 individuals at the time the 2016 BO was written. To compute the variability in annual population size as was done for the 2010 BO and establish the starting point for estimating anticipated take, the Service used the most recent years to reflect the current trend and variability. For this purpose, the Service used the previous 10-year period (2007-2016).

The mean population estimate for the period 2007-2016 was 2,727 sparrows with a standard deviation of 271. Rather than using one (1.0) standard deviation as the basis for estimating anticipated take as was done in the 2010 BO, ERTP 2016 used one half (0.5) of the standard deviation (271 x 0.5 = 135 birds) for this 10-year period, because (a) the estimated population had declined during that time; and (b) the Service believed that the RPA would have less adverse effects than ERTP, due to the additional conservation measures it incorporated. The Service concluded at that time that take of 135 sparrows represented the amount of incidental take that would result from implementing the RPA. Therefore, a decline from the 2016 population estimate of 2,416 sparrows to less than 2,281 sparrows (2,416 – 135 = 2,281) at any time during the course of the action would warrant a reinitiation of consultation. This threshold was not surpassed during the years 2016-2019.

The CSSS estimated population from 2016-2019 was 2,416, 3,280, 3,184 and 2,688 respectively. Although the 2019 estimate represented a decline of 496 birds, it did not trigger the ERTP 2016 reinitiation threshold (2,281). The Service believes that with the implementation of the proposed water management operations under the COP, the slow decline in population numbers should end and the population should begin to stabilize or increase. Therefore, the reinitaion threshold for the duration of the COP should be higher than that used in 2016. To this end, the Service calculated the 10-year (2010-2019) mean of the total population estimate (2,981) with associated standard deviation (SD) of 301. Subtracting this SD from the 2019 population estimate (2,688 – 301 = 2,387) sets the reinitiation threshold for the COP at 2,387 birds.

7.2.1.1 Exceedance Criteria for Incidental Take

A decline from the 2019 population estimate of 2,688 sparrows to less than 2,387 sparrows (2,688 – 301 = 2,387) at any time during the course of the action would warrant a reinitiation of consultation.

7.2.1.2 Monitoring and Reporting

Survey results for CSSS populations are not instantaneous since it may take several months to analyze the data and develop an estimate in any given year. Therefore, the Service has also

identified hydrologic parameters, described below, for monitoring to provide an earlier indication of conditions resulting from water management that may cause incidental take. These parameters, if exceeded, would indicate that the effects of the action are greater than anticipated in this BO, and would signal a potential for exceeding the amount of incidental take measured by the population estimate described above. If these parameters are exceeded, the adaptive management procedures in Section 7.4.1 should be initiated. Exceedance of these parameters alone does not trigger reinitiation of consultation. The Interagency Coordination Team (ICT) established for ERTP 2016, as a part of the adaptive management procedure, will examine causation of the exceedance and whether the exceedance resulted from water operations or natural events. The ICT will inform the Service and Corps leadership group of their findings.

CSSS build their nests near the ground surface at an average height of only 16 cm (6 inches) between the soil surface and the base of the nest. Accordingly, they are especially vulnerable to flooding caused by rising water levels due to rainfall or water management actions. Incidental take in the form of harm is anticipated to occur to individual sparrow eggs or nestlings as a result of high water levels during the breeding season. Therefore, during the breeding season, the monitoring of water levels within occupied sparrow habitat will provide an additional measure of incidental take of sparrow eggs and young not yet capable of flight. We do not anticipate the loss of adult sparrows since the water levels in question are not known to directly harm adult sparrows.

In addition to the exceedance criteria for incidental take described above based on the estimated total population of sparrows and recent variability in these estimates, the following targets should also be monitored by the Corps in the eastern and western subpopulations. These targets have been developed to improve the conditions for the CSSS and contribute towards the survival and recovery of the species. Based on current model output, the Service acknowledges that these targets are not technologically feasible for all subpopulations in every year at this time. Exceedance of the targets should be addressed in the reporting mechanisms included in this BO and do not require re-initiation of consultation.

As discussed in previous sections, the Service tracks two important hydrologic metrics that pertain to the availability of suitable nesting habitat during the breeding window and the annual discontinuous hydroperiod which affects vegetation composition and overall habitat suitability. The Sparrow Viewer can track the status of these metrics on a real-time basis so conversations can take place early and often if conditions are not staying within the bounds of these metrics.

7.2.1.3 Dry Nesting Conditions

1. Subpopulation Ax - At least 24,000 acres of suitable habitat within and adjacent to CSSS subpopulation Ax must have 90 consecutive dry days between March 1 and July 15 (CSSS breeding season) every year.

2. Subpopulations B through F – At least 40 percent of each designated CSSS critical habitat unit must have 90 consecutive dry days between March 1 and July 15 (CSSS breeding season) every year.

7.2.1.4 Habitat Criteria (Discontinuous Hydroperiod)

1. Subpopulation Ax – At least 24,000 acres of suitable habitat within and adjacent to CSSS subpopulation Ax must show a 4-year running average discontinuous hydroperiod range of 90 to 210 days, with no 2 consecutive years failing to meet this target.

2. Subpopulations B through F – At least 40 percent of each designated CSSS critical habitat unit must show a 4-year running average discontinuous hydroperiod range of 90 to 210 days, with no 2 consecutive years failing to meet this target.

7.2.1.5 Eastern Marl Prairie

Operation of the S-332 structures may result in flooding of sparrow nests that occur within 0.6 mile of the S-332 Detention Areas, either because of increased water levels resulting from seepage or from overflow from the detention areas directly into sparrow habitat within ENP. This will result in loss of the contents of all nests within 0.6 mile of S-332 structures. Operation of the detention areas that raise water levels from a groundwater condition to a surface water condition beyond 0.6 mile from the detention areas prior to July 15 could result in incidental take. Specific instructions for monitoring and reporting this habitat surrogate for incidental take in the eastern marl prairies are provided in section 7.4.4.

7.2.1.6 Western Marl Prairie

Information from various sources identifies different amounts of potential and available habitat in the western marl prairies. To date, there is still limited detailed information about the condition and susceptibility to flooding within all portions of this area; therefore, we rely upon the data that were presented in the Service's 1999 Biological Opinion.

The Service anticipates that a maximum of 74 square-miles (47,333 acres) of potential and historic sparrow habitat for the extended Subpopulation Ax is subject to flooding during the nesting season due to water releases. This area corresponds to 60 percent of potential sparrow habitat for Subpopulation Ax. Any adult birds that have territories within the 74 square miles would be impacted by water levels too high to allow breeding or by lower fecundity associated with nest abandonment. Likewise, injury or death to juvenile sparrows or eggs could result from discharges that raise the water level above existing nests. Specific instructions for monitoring and reporting this habitat surrogate for incidental take in the western marl prairies are provided in section 7.4.4.

7.2.2 Everglade Snail Kite

As previously explained in section 4.12 Summary and Analysis of Effects of the Action of this BO, based on best available data, the COP is reasonably certain to result in take of the Everglade snail kite. We estimate that a total of nine (9) Everglade snail kites will be harmed as a result of the COP during its 7-year operational period.

However, even though this is a reasonable conclusion, based on the best available data, we realize that there is significant uncertainty surrounding this estimate due to the following reasons:

- A reduction in the number of snail kites in WCA-3A or ENP in one year would not necessarily indicate a loss of snail kites due to the action if the unaccounted snail kites were elsewhere in the larger system. For example, if adult snail kites that encounter high water levels in WCA-3A subsequently nest in the STAs, KCOL, or Lake Okeechobee, that disturbance does not necessarily indicate harm has occurred;
- It is impractical to monitor each individual snail kite and snail kite nest;
- It is impractical to discern the number of individual snail kites that are incidentally taken as a result of habitat impacts from other demographic and environmental parameters that will be occurring at the same time as the action, even if it was practical to monitor each individual snail kite;
- Current methodologies for tracking population trends are insufficient to document the incidental taking of individual snail kites (Service 2010a).

7.2.2.1 Exceedance Criteria for Incidental Take

Incidental take of snail kites will be considered exceeded if any of the following three exceedance criteria are not met during the COP operations:

<u>Dry Season High Water Timing: by April 15</u>
Trigger: stage >9.2 ft NGVD at gauge 3AS3W1
Frequency: 2 consecutive years

<u>Wet Season High Water Timing: June 1 – December 31</u>
Trigger: stage >10.5 ft at gauge 3AS3W1 for 60 days
Frequency: 2 consecutive years

<u>Recession: Dry Season Amplitude</u>
Timing: January 1 – May 31 (or onset of wet season, whichever is sooner)
Trigger: stage difference >1.7 ft as measured at gauge(s) closest to kite nesting, as determined by the Service
Frequency: 2 consecutive years

For all exceedance criteria, if the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service within 60 days of the exceedance. These incidental take surrogates are in accordance with Service policy in that they set a clear standard for determining when take has been exceeded and there is a causal link between the surrogate and the take of the species.

7.2.2.2 Monitoring and Reporting

Due to these factors of uncertainty, in accordance with 50 CFR 402.14(i)(1)(i), we re-affirm the evaluation criteria, performance measures, and exceedance criteria that were developed for the ERTP 2016 BO. The evaluation criteria and performance measures were used to inform the exceedance criteria and provide a mechanism to report on the effects of the COP. The exceedance criteria are linked to habitat quality as a surrogate for incidental take of snail kites. Those evaluation criteria and performance measures are-stated below. Exceedances of the evaluation criteria and performance measures should be addressed in the reporting mechanisms included in this BO and do not require re-initiation of consultation.

7.2.2.3 Everglade Snail Kite Evaluation Criteria and Performance Measures

Prolonged High Water Criteria

Based on the potential for adverse effects to snail kites, apples snails, and their habitats as described in the Environmental Baseline section, the Service developed recommendations in the MSTS to guard against extended high water levels during the pre-breeding season (approximately January) and to provide favorable water levels associated with improved snail kite and apple snail productivity in the breeding (dry) season. These recommendations established the following criteria, as expressed as part of the following ERTP PMs:

<u>Performance Measure B (Snail Kites) – Pre-breeding Water Levels</u>: Strive to reach water levels measured by 3AVG between 9.8 and 10.3 ft NGVD by December 31. These water levels, measured by 3AVG when coupled with the recommended recession rate (0.05 ft per week, as described below), are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success during the peak breeding season (March-June). The Service determined it was most important to apply snail kite and apple snail PMs to conditions in southwestern WCA-3A, the area most frequently used by kites in recent years (Figure 24) and where adverse impacts to snail populations should be avoided or minimized.

<u>Performance Measure C (Apple Snails) – Pre-breeding Water Levels:</u> Strive to reach water levels between 9.7 and 10.3 ft NGVD by December 31. These water levels are based on reaching maximum water depths of 40 cm to 60 cm at the 3AVG average GSE of 8.34 ft NGVD. When coupled with a slow, gradual recession rate (approximately 0.05 ft per week), these water depths were recommended to provide favorable conditions (*i.e.*, water depths ≤40 cm, as

discussed below) for apple snail egg production beginning in March, and to prevent delayed or reduced apple snail egg production.

Performance Measure C (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 and 9.7 ft NGVD between May 1 and June 1. The top end of the specified range (*i.e.*, 9.7 ft, measured using the 3AVG) is related to a depth of 40 cm at the 3AVG average GSE of 8.34 ft NGVD. As discussed above, snail research results suggest that this approximate water depth acts as a threshold in its effects (positive or negative) on apple snail productivity in a given year. It is important to note that, in the MSTS, the Service recognized that the stages will result in deeper water (*i.e.*, >40 cm) in southern WCA-3A, which would negatively impact snail egg production in that area, and consequently reduced the top end of the multi-species recommended dry season range to 9.3 ft NGVD (measured using the 3AVG). Our evaluation took this discrepancy into account.

Low Water Criteria

The intent of low water evaluation criteria was twofold; 1) to assess the potential for frequent and extended extreme low water levels which would result in reduced snail kite reproduction and recruitment, and reduced apple snail productivity and juvenile survival, and 2) to assess the opportunities for lower (but not extreme, frequent, or extended) water levels which are essential to restoration and maintenance of wet prairie habitat, and which species experts believe are necessary, at least in the transition period, to return WCA-3A to a productive kite area. Based on the information described in the snail kite Environmental Baseline section, the Service developed recommendations in the MSTS to provide favorable water levels associated with improved snail kite and apple snail productivity in the breeding (dry) season. Recommended water levels were intended to represent the annual minimum stage which typically occurs sometime in May before the onset of wet season rains. These recommendations established the following criteria, as expressed as part of the following ERTP PMs and ET:

Performance Measure B (Snail Kites) – Dry Season Water Levels: Strive to reach water levels between 8.8 and 9.3 ft between May 1 and June 1. These water levels (measured using the 3AVG) are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success and juvenile survival, balanced with the need for lower water levels during the dry season to avoid negative effects to wet prairie vegetation.

Performance Measure C (Apple Snails) – Dry Season Water Levels: Strive to reach water levels between 8.7 and 9.7 ft between May 1 and June 1. The bottom end of the specified range (*i.e.*, 8.7 ft, measured using the 3AVG) is related to a depth of 15 cm at the 3AVG average GSE of 8.34 ft NGVD. This water level translates to dry season minimum water depths ≥10 cm at GSE <8.36 ft NGVD, and thus, should avoid negative effects to snail movement and reproduction in these areas.

Ecological Target 3 (Wet Prairie): Hydroperiod: In dry years, strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in

4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water levels below ground surface for more than 4 to 6 weeks to minimize adverse effects on apple snail survival.

Recession Criteria

Based on the information described in the Environmental Baseline section, the Service developed a recession recommendation for snail kites in the MSTS, and this recommendation established the following criteria, as expressed as part of the following ERTP PM:

Performance Measure D (Snail Kites) – Dry Season Recession: Strive to maintain a recession rate of 0.05 ft per week from January 1 to June 1 (or the onset of the wet season). This equates to a stage difference of approximately 1.0 ft between January and the dry season low. The Service defined the onset of the wet season as a sustained increase in water levels associated with increased rainfall frequency, which has occurred prior to June 1 over 50 percent of the time since 1965. The recession rate guideline is most important to follow during the peak snail kite breeding season (March-June). Recession rates >0.05 ft but <0.10 ft per week, while generally more rapid than desired, may be considered acceptable under certain environmental conditions (*e.g.*, unseasonably heavy rainfall). Rates >0.0 and <0.05 ft per week are not associated with direct negative impacts to nesting snail kites, although rates approaching 0.0 ft may result in delayed or reduced snail egg cluster production, depending on water depths at that time (*i.e.*, greater impacts when water is >40 cm deep).

7.2.3 Wood Stork

Although wood storks nest colonially and often in the same site for many years, the ability to count individual wood storks and their young and attribute any changes from year-to-year as an effect of the action is complicated by many factors. First, wood stork colonies are surveyed and results are reported as estimates and do not reflect actual counts, not all wood storks return to the same colony every year even if the colonial site is used again (Kushlan and Frohring 1986), nesting sites may be abandoned if water levels recede too far (Rodgers et al. 1996) or there is disturbance to the site and the colony or individual birds may re-nest elsewhere (Ogden 1991, Borkhataria et al. 2004, Crozier and Cook 2004). In addition, new wood stork colonies are often discovered which may represent a shift from historic colonies due to environmental conditions (Meyer and Frederick 2004).

The annual hydrologic pattern in south Florida is consistent, with water levels rising during the wet season (June through October), then receding gradually during the dry season (November to May). Wood storks nest during the dry season and rely on the drying wetlands to concentrate prey items for optimal foraging. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging and will not be suitable again until water levels rise and the area is repopulated with fish. Wood storks prefer calm water, approximately 2 to 16 inches deep and free of dense vegetation for foraging (Coulter

and Bryan 1993). More recently, Beerens and Cook (2010) defined a foraging depth range of -0.31 to 1.34 ft (-9.33 to 41.26 cm) for wood storks feeding in WCA-3A.

Accordingly, there is a general progression in the suitability of wetlands for wood stork foraging based on their hydroperiods and the distance of the wetlands from the nest. Short hydroperiod wetlands are used early in the nesting season, the mid-range hydroperiod sites are used during the middle of the nesting season, and the longest hydroperiod areas (typically slough habitat) are used later in the nesting season. Adult wood storks feed farthest from the nesting site prior to laying eggs, forage in wetlands closer to the colony site during incubation and early stages of raising the young, and then farther away again, when the young are able to fly.

The implementation of the COP is expected to influence wetland hydroperiods causing changes in foraging suitability and prey availability for wood storks. If the COP contributes to reduced depth and hydroperiod during the preceding wet season, the effects generally result in decreased productivity and abundance of prey. Additionally, if increased hydroperiod and water depth occurs during the nesting season, such effects generally result in reduced foraging suitability and densities of wood stork prey. Examples of this could include water level manipulations of several inches in and around the colonies which could make it more difficult for wood storks to forage and provide for young as well as increase the availability of wood stork nests to predators. In some years, conditions for wood storks may be favorable under operations. The Service does not anticipate widespread abandonment or nest failures as a result of the COP.

The Service anticipates incidental take in the form of harm, from loss of forage biomass and reductions in foraging habitat suitability, may result in injury or death of 9.6 nests or 12 nestlings each year. We noted that over the 7-year life of the COP, the annual conversion of 9,795 acres of short hydroperiod to long hydroperiod wetlands may result in the loss in nest production of nestlings. As previously explained, detecting direct take of individual storks that occurs incidental to the action is not practical. Therefore, we have identified the following surrogate measures in our analyses of effects for monitoring take of the wood stork:

7.2.3.1 Exceedance Criteria for Incidental Take

Incidental take of wood storks will be considered exceeded if the following criteria occur during the COP operations:

- Water depth greater than 16 inches (41 cm) from March 1 through May 31 throughout WCA-3A for two consecutive years as measured by the two gauge average (based upon a ground surface elevation of 8.4 feet NGVD) at gauges 3A-3 and 3A-4. A water depth greater than 16 inches (41 cm) across WCA-3A during the nesting season (January 1 to June 1) would lower the suitability of foraging habitat to the point where the ability for wood storks to forage would be severely impaired and most likely result in widespread abandonment of nests and fledglings within the affected colony (Gawlik et al. 2004, J.M. Beerens, FAU, personal communication 2010).

For exceedance criteria, if the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service within 60 days of the exceedance. These incidental take surrogates are in accordance with Service policy in that they set a clear standard for determining when take has been exceeded and there is a causal link between the surrogate and the take of the species.

7.2.3.2 Monitoring and Reporting

Due to these factors of uncertainty, in accordance with 50 CFR 402.14(i)(1)(i), we re-affirm the performance measures, and exceedance criteria that were developed for the ERTP 2016 BO. The performance measures were used to inform the exceedance criteria and provide a mechanism to report on the effects of the COP. These measures, listed below, are linked to habitat quality as a surrogate for incidental take of wood storks. Exceedances of the performance measures should be addressed in the reporting mechanisms included in this BO and do not require re-initiation of consultation.

7.2.3.3 Recession criteria

Based on the information described in Beerens and Cook (2010), the Service developed PMs and a recession recommendation for wood storks in the MSTS. These PMs are used to monitor and inform the exceedance criteria in Section 7.2.3.2. Exceedances of these PMs should be addressed in the reporting mechanisms included in this BO and do not require re-initiation of consultation.

Performance Measure F (PM-F) - WCA-3A (Dry Season Recession Rate): Maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1.

Performance Measure G (PM-G) - WCA-3A (Dry Season): Maintain areas of appropriate foraging depths (5 to 25 cm) within the Core Foraging Area (CFA) (18.6-mile radius) of any active wood stork colony.

In addition to the two Performance Measures cited above, the Service has included two additional Performance Measures that we believe should be monitored.

Performance Measure 1 (PM-1) - Recession rates greater than 0.37 ft per week (11.34 cm per week) and reversals greater than -0.23 ft per week (-7.00 cm per week) in WCA-3A during the nesting season (January 1 to June 1) are considered too rapid to support wood stork foraging. The methodology used to estimate recession rates in WCA-3A are described in Bereens and Cook (2010). (Note that negative values indicate increasing water levels [*i.e.*, reversals]).

Performance Measure 2 (PM-2) – Maintain sufficient short hydroperiod wetlands for wood stork foraging. The effects analysis determined that the COP would result in an annual average impact to 9,795 acres of short hydroperiod wetlands with appropriate foraging depths (5-25 cm) within the Core Foraging Area (CFA) (18.6-mile radius) of active wood stork colonies. Daily water surface changes over time should be measured from the Everglades Depth Estimation Network (EDEN) and reported on to determine average annual changes to short hydroperiod wetlands (*i.e.*, wetlands inundated 0 to 180 days per year).

Survey results for wood stork nesting are not instantaneous since it may take several months to analyze the data and develop an estimate in any given year. Therefore, the Service identified hydrologic criteria, described above, for monitoring to provide an earlier indication of conditions resulting from water management that may cause incidental take. These criteria, if exceeded, would indicate that the effects of the action are greater than anticipated in this BO, and would signal a potential for exceeding the amount of incidental take measured in our analysis. If these criteria are exceeded, the adaptive management procedures in Section 7.4.1 should be initiated.

7.3 Reasonable and Prudent Measures

As part of the proposed action, the Corps has committed to implementing a series of conservation measures, which are continued from the ERTP 2016 Biological Opinion. For clarity, the Service has incorporated these measures as Reasonable and Prudent Measures (RPM) and believes they are necessary and appropriate to minimize impacts of incidental take of Cape Sable seaside sparrows, Everglade snail kites and wood storks.

- Continue to use operational flexibility during the implementation of the COP to minimize impacts related to hydrology. During periods when water regulations are not restricted by constraints, the Corps will work with the Service and other partners to identify operations that minimize detrimental impacts or reduce the future risk of detrimental impacts to the CSSS, Everglade snail kite, wood stork or their habitats.

- Under the COP, species and habitat monitoring currently being conducted in compliance with the ERTP 2016 BO (Service 2016) will continue to identify population trends for the CSSS, snail kite, wood stork and the vegetation characteristic of their habitats.

- Under the COP, the Corps will continue to implement Periodic Scientist Calls (PSC) to provide real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process.

- The Corps will continue to evaluate how water management operations within the flexibility available to water managers under the water control plan, may be conducted to maximize beneficial effects for the CSSS.

- The Corps will continue to utilize best available methods to monitor and estimate the spatial and temporal extent of hydrologic conditions (water above or below ground surface) relative to the CSSS habitat targets (*i.e.*, dry nesting days and annual discontinuous hydroperiod).

- The Corps will continue discussions with the Service in the event of operational modifications of the COP if such modifications are proposed to occur in the future. The Corps will track implementation of the COP and communicate the status of all actions to the Service as appropriate through regular interagency discussions (*i.e.*, COP PSC, COP AMMP Meetings).

7.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

7.4.1 Species-wide Terms and Conditions

- Operational flexibility will be identified through the COP AMMP, Ecosystem Based Management multispecies meetings, and Periodic Scientist Calls. Implementation of these operational flexibilities may result in operational changes throughout the COP study area for CSSS, snail kites and wood storks. This will help reduce the hydrologic effects of the COP and prepare for full implementation of CEPP. Operational flexibility will be used to avoid consecutive years of adverse hydrologic conditions for the three avian species and their habitat. Details of the operational flexibility will be adjusted in coordination with cooperating agencies as additional CERP project components are implemented. Additional detail regarding the information needed to assess and implement operational flexibility can be found in the individual species sections below.

7.4.2 Everglade Snail Kite

1. In order to assure the effects of these actions do not exceed the level of impacts anticipated in this Biological Opinion, obtain information on:

    a. The annual status of the Everglade snail kite population and apple snail populations within the action area;
    b. The reproductive effort of the Everglade snail kite population and apple snail populations within the action area, including:

        i. The number of Everglade snail kites initiating nesting in the action area, the success rate and productivity of those nesting efforts, and subsequent recruitment resulting from those nesting efforts each year; and

ii. The amount of apple snail egg cluster production in the action area each year;

c. Impacts of hydrologic changes caused by the action on the Everglade snail kite, its prey, and its habitat. For all exceedance criteria, if the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service within 60 days of the exceedance; and
d. The effects of operational changes at specific structures related to these actions and their operations on hydrology in the habitats occupied by the Everglade snail kite.

Monitoring plans designed to obtain the information above must be developed by the Corps and approved by the Service within 90 days of this signed Biological Opinion, and snail kite and apple snail monitoring programs must be in place prior to the beginning of the nesting season. Range wide snail kite monitoring (as required under ERTP) must be continued under the COP in order to obtain estimates of the snail kite population and related breeding parameters, and to allow sufficient time for other funding arrangements to be made.

7.4.3 Wood Stork

1. In order to assure the effects of these actions do not exceed the level of impacts anticipated in this Biological Opinion, the Corps must obtain information on:

   a. The annual status of wood stork populations in the action area;
   b. Determine annually the number of wood storks initiating nesting in the action area and the success rate of those nesting efforts each year;
   c. Impacts of hydrologic changes caused by the action on the wood storks and their habitat. For all exceedance criteria, if the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service within 60 days of the exceedance; and
   d. The effects of operational changes at specific structures related to these actions and their operations on hydrology in the habitats occupied by the wood stork.

7.4.4 Cape Sable Seaside Sparrow

In order to monitor the impacts of incidental take, the Federal agency must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement (50 CFR 402.14(i)(3)).

1. Annual Population Surveys – To determine how water management is affecting the CSSS and to monitor population size and trends, the Corps will ensure that appropriate annual population surveys are conducted in all CSSS subpopulations. The Corps will confer with the Service, Everglades National Park, and USGS to determine whether to modify

the current survey protocol. The Corps will provide a report on the results of the surveys annually to the Service by December 31.

2. Eastern Marl Prairies – To determine whether water management is causing incidental take of CSSS in the eastern marl prairies in excess of that anticipated in the BO, the Corps will utilize the USGS EDEN TransectPlotter program (Corps 2014) or similar analysis, in combination with the USGS SparrowViewer for plotting daily water level surfaces and extent of dry CSSS habitat. Regular reporting on this metric will be included in the Periodic Science Calls.

3. Western Marl Prairies – To determine whether water management is causing incidental take of CSSS in the western marl prairies in excess of that anticipated in the BO, the Corps will utilize the USGS Sparrow Viewer for determining daily water levels over the expanded Subpopulation Ax. Regular reporting on this metric will be included in the Periodic Science Calls.

7.5 Reporting Requirements

1. The Interagency Coordination Team (ICT), established during the ERTP, will continue to meet twice each year, once prior to the CSSS nesting season (~February) and once after the CSSS nesting season (~September) to discuss details of the operations and monitoring results for each species and to make recommendations for the upcoming seasons.

2. The Corps will incorporate the Conservation Measures, as previously discussed in their BA into their reporting requirements.

3. The Corps will continue to implement provisions of the ERTP 2016 BO which require the Corps to provide a report to the Service on the results of CSSS monitoring at least twice annually to evaluate progress toward meeting the performance targets (Service 2016). Bi-annual reports will evaluate nesting season conditions and include information such as the operations that occurred and their effectiveness, and the spatial and temporal extent of hydrologic conditions within each CSSS subpopulation (Service 2016).

4. Upon locating a dead, injured, or sick specimen of any threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office (U.S. Fish and Wildlife Service, 9549 Koger Boulevard, Suite 111, St. Petersburg, Florida 33702; 727-570-5398). Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission, South Region, 3900 Drane Field Road, Lakeland, Florida, 33811-1299; 1-800-282-8002. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens or preservation of

biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Service Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

5. The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918 as amended (16 USC Section 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 USC Section 668-668d), if such take is in compliance with the terms and conditions specified herein.

8.0 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to further minimize or avoid adverse effects of a proposed action on federally listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Continue to monitor the series of existing hydrological gauges to measure hydrologic impacts within the COP project area.

2. In cooperation with the Service and other parties, continue to explore ways to increase the outlet capacity of WCA-3A and 3B, as authorized and envisioned as part of the MWD and CERP projects to benefit listed species.

3. In cooperation with the Service, collaborating researchers and other partners, support the development and application of real-time models to better inform snail kite-related water recommendations in the Everglades by meeting the following objectives:

    a. Develop spatially explicit hydrologic relationships for snail kite reproductive responses and adapt an existing snail kite population model (EverKite) to be run in real-time and near-term forecasts.
    b. Adapt the existing Florida apple snail model (EverSnail) to a real-time/ forecast application.
    c. Code models for online dissemination of software that runs the new models.
    d. Integrate snail kite and apple snail model outputs into a broader multi-species decision support framework.

4. Fund range-wide snail kite monitoring under section 7(a)(1) of the ESA to ensure that robust population estimates continue to be obtained and available to inform proposed projects and management activities conducted by the Corps and other agencies, as well as to inform recovery actions and evaluate progress toward meeting recovery criteria. A unified funding approach would also help ensure that data are collected in a seamless way

and that the scientific integrity of the monitoring is maintained and would increase monitoring efficiencies to leverage limited resources.

5. In cooperation with the Service, collaborating researchers and other partners, develop and implement an apple snail monitoring program across the range of the Everglade snail kite in Florida.

6. In cooperation with the Service and collaborating researchers, provide technical assistance to develop methods to restore marl prairie vegetation that has been impacted by high water levels.

7. The expectation from COP modeling, as assessed in this document, is that hydroperiods in the vicinity of CSSS-Ax could be shortened by up to 30 days. If this does not occur or the hydroperiod increases after four years of COP operations, then the Corps in conjunction with ENP and the Service should seek to investigate all sources of flow into this area to determine the cause.

8. In coordination with ENP and the Service, increase the Corps' contribution to CSSS population surveys and habitat conservation practices.

9. Investigate the potential for automating the S-12A and S-12B structures. Automating the S-12A/B would allow for more rapid responses to changes in conditions in WCA-3A and CSSS-A. If this is feasible, and hasn't already been completed, then modify the structures as appropriate.

10. In addition to those actions mentioned above, the Service feels that the Corps should exercise their capabilities as outlined under section 7(a)(1) of the Endangered Species Act. The Service, in cooperation with our DOI partners, has developed an MOU outlining a variety of actions that we feel would provide benefits to the CSSS in the near term. We would welcome the Corps' active participation in the activities outlined in the DOI MOU for the Cape Sable seaside sparrow.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

9.0 REINITIATION NOTICE

This concludes formal consultation on the action outlined in the Corps' BA on the COP. As provided in 50 CFR Section 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

1. the amount or extent of incidental take is exceeded;

2. new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion;
3. the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or

Measures of anticipated incidental take relative to criterion #1 above are provided in sections 7.2.1, 7.2.2, and 7.2.3, for the CSSS, Everglade snail kite, and wood stork, respectively. Specific instructions for monitoring and reporting are provided in section 7.4.

The Corps may request an extension of the BO if and when it is determined that operations under the COP will continue beyond 2027. At that time, the Service will evaluate if the level of take authorized by this BO has been exceeded, or if an extension can be granted.

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11.0 Tables

Table 1. CSSS Helicopter Survey Bird Count and Population Estimates 1981-2019. Population estimate fluctuation from ERTP Reinitiation Trigger (2001-2009 Ave. - 1 Std. Dev. Or 3,145 - 230 = 2,915) and ERTP 2016 Reinitiation Trigger (2016 to present; 2,416 – 135 = 2,281) is shown in final column with exceedances in red.

Population Year	A		B		C		D		E		F		Total		
	BC	**Est**	**BC**	**Est**	**BC**	**Est**	**BC**	**Est**	**BC**	**Est**	**BC**	**Est**	**BC**	**Est**	**Δ ERTP Trig.**
1981	**168**	**2,688**	**147**	**2,352**	**27**	**432**	**25**	**400**	**42**	**672**	**7**	**112**	**416**	**6,656**	**3,741**
1992	**163**	**2,608**	**199**	**3,184**	**3**	**48**	**7**	**112**	**37**	**592**	**2**	**32**	**411**	**6,576**	**3,661**
1993	**27**	**432**	**154**	**2,464**	**0**	**0**	**6**	**96**	**20**	**320**	**0**	**0**	**207**	**3,312**	**397**
1994*	**5**	**80**	**139**	**2,224**	**NS**	**NS**	**NS**	**NS**	**7**	**112**	**NS**	**NS**	**151**	**2,416**	**-499**
1995	**15**	**240**	**133**	**2,128**	**0**	**0**	**0**	**0**	**22**	**352**	**0**	**0**	**170**	**2,720**	**-195**
1996	**24**	**384**	**118**	**1,888**	**3**	**48**	**5**	**80**	**13**	**208**	**1**	**16**	**164**	**2,624**	**-291**
1997	**17**	**272**	**177**	**2,832**	**3**	**48**	**3**	**48**	**52**	**832**	**1**	**16**	**253**	**4,048**	**1,133**
1998	**12**	**192**	**113**	**1,808**	**5**	**80**	**3**	**48**	**57**	**912**	**1**	**16**	**191**	**3,056**	**141**
1999a	**25**	**400**	**128**	**2,048**	**9**	**144**	**11**	**176**	**48**	**768**	**1**	**16**	**222**	**3,552**	**637**
1999b	**12**	**192**	**171**	**2,736**	**4**	**64**	**NS**	**NS**	**60**	**960**	**0**	**0**	**247**	**3,952**	**1,037**
2000a	**28**	**448**	**114**	**1,824**	**7**	**112**	**4**	**64**	**65**	**1,040**	**0**	**0**	**218**	**3,488**	**573**
2000b	**25**	**400**	**153**	**2,448**	**4**	**64**	**1**	**16**	**44**	**704**	**7**	**112**	**234**	**3,744**	**829**
2001	**8**	**128**	**133**	**2,128**	**6**	**96**	**2**	**32**	**53**	**848**	**2**	**32**	**204**	**3,264**	**349**
2002	**6**	**96**	**119**	**1,904**	**7**	**112**	**0**	**0**	**36**	**576**	**1**	**16**	**169**	**2,704**	**-211**
2003	**8**	**128**	**148**	**2,368**	**6**	**96**	**0**	**0**	**37**	**592**	**2**	**32**	**201**	**3,216**	**301**
2004	**1**	**16**	**174**	**2,784**	**8**	**128**	**0**	**0**	**40**	**640**	**1**	**16**	**224**	**3,584**	**669**
2005	**5**	**80**	**142**	**2,272**	**5**	**80**	**3**	**48**	**36**	**576**	**2**	**32**	**193**	**3,088**	**173**
2006	**7**	**112**	**130**	**2,080**	**10**	**160**	**0**	**0**	**44**	**704**	**2**	**32**	**193**	**3,088**	**173**
2007	**4**	**64**	**157**	**2,512**	**3**	**48**	**0**	**0**	**35**	**560**	**0**	**0**	**199**	**3,184**	**269**
2008	**7**	**112**	**NS**	**2,512**	**3**	**48**	**1**	**16**	**23**	**368**	**0**	**0**	**34**	**3,056**	**141**
2009	**6**	**96**	**NS**	**2,512**	**3**	**48**	**2**	**32**	**27**	**432**	**0**	**0**	**38**	**3,120**	**205**
2010	**8**	**128**	**119**	**1,904**	**2**	**32**	**4**	**64**	**57**	**912**	**1**	**16**	**191**	**3,056**	**141**
2011	**11**	**176**	**NS**	**1,904**	**11**	**176**	**1**	**16**	**37**	**592**	**2**	**32**	**62**	**2,896**	**-19**
2012	**21**	**336**	**NS**	**1,904**	**6**	**96**	**14**	**224**	**46**	**736**	**4**	**64**	**91**	**3,360**	**445**
2013	**18**	**288**	**112**	**1,792**	**8**	**128**	**1**	**16**	**45**	**720**	**1**	**16**	**185**	**2,960**	**45**
2014	**4**	**64**	**114**	**1,864**	**7**	**112**	**2**	**32**	**42**	**672**	**1**	**16**	**170**	**2,720**	**-195**
2015	**13**	**208**	**120**	**1,920**	**7**	**112**	**4**	**64**	**55**	**880**	**2**	**32**	**201**	**3,216**	**301**
2016	**3**	**48**	**112**	**1,792**	**7**	**112**	**5**	**80**	**24**	**384**	**0**	**0**	**151**	**2,416**	**-499**
2017	**1**	**16**	**121**	**1,936**	**3**	**48**	**4**	**64**	**75**	**1,200**	**1**	**16**	**205**	**3,280**	**688**
2018	**2**	**32**	**120**	**1,920**	**9**	**144**	**16**	**256**	**50**	**800**	**2**	**32**	**199**	**3,184**	**592**
2019	**0**	**0**	**96**	**1,536**	**5**	**80**	**11**	**176**	**55**	**880**	**1**	**16**	**168**	**2,688**	**96**

NS = Not Surveyed

Includes Subpopulation B most recently conducted survey data for years not surveyed.

Table 2. USGS Sparrow Viewer data showing the percent area of habitat meeting the ≥90-day dry nesting window for each subpopulation from 1991-2019. The target is to achieve 90 or more days in at least 40 percent of each subpopulation. Red shaded numbers indicate where the target has not been met.

Year	AX	B	C	D	E	F
1991	1.40%	32.30%	82.60%	19.50%	27.90%	78.80%
1992	41.00	90.70	100.00	80.90	99.10	100
1993	0.40	60.10	97.50	58.50	62.40	100
1994	8.00	73.00	82.20	22.80	70.20	100
1995	0.00	44.70	89.80	20.30	19.10	99.30
1996	9.80	42.00	43.20	34.10	48.90	86.80
1997	21.40	55.10	81.40	70.70	35.40	100
1998	8.60	47.50	95.30	17.50	44.70	100
1999	15.20	71.00	100	72.00	79.60	100
2000	23.00	73.80	95.80	40.20	65.20	100
2001	52.60	100	100	89.00	99.50	100
2002	40.40	62.30	100	68.70	59.70	100
2003	5.70	25.50	58.90	18.30	23.80	10.60
2004	44.20	93.30	100	84.10	90	100
2005	39.30	83.00	100	55.70	93.40	100
2006	47.80	43.70	100	57.30	64.70	100
2007	17.60	35.60	97.50	18.70	36.40	100
2008	37.00	69.60	99.20	20.30	74.80	100
2009	33.30	67.00	86.90	20.30	15.80	100
2010	18.70	58.60	94.50	22.80	66.30	60.30
2011	70.40	99.60	100	93.50	100	100
2012	20.30	22.60	8.50	0.80	8.00	35.80
2013	1.60	13.00	8.90	2.00	0.00	100
2014	35.60	67.80	100	46.30	74.90	100
2015	47.60	30.50	97.50	6.50	45.60	100
2016	4.80	31.90	3.40	3.70	5.20	0.00
2017	46.80	69.20	100	59.80	79.60	100
2018	1.80	18.00	14.40	5.70	5.60	80.80
2019	33.70	55.10	100	40.70	79.90	100
Ave.	25.10	56.43	80.60	39.68	54.33	88.01
1991-2008 Ave.		61%	90%	47%	61%	93%
2009-2019 Ave.		48%	65%	27%	44%	80%

Table 3. Percentage of each subpopulation displaying 0 to 89, 90 to 210 (target) or greater than 211-day hydroperiod for the years 1991-2019. Green sahded cells indicate where the target was met.

	AX Annual			B Annual			C Annual			D Annual			E Annual			F Annual		
Year	0 to 89	90 to 210	≥ 211	0 to 89	90 to 210	≥ 211	0 to 89	90 to 210	≥ 211	0 to 89	90 to 210	≥ 211	0 to 89	90 to 210	≥ 211	0 to 89	90 to 210	≥ 211
1991	0%	24.80%	75.20%	27.40%	50.70%	21.90%	91.90%	8.10%	0%	12.60%	57.70%	29.70%	35.70%	59.40%	4.90%	94.70%	5.30%	0%
1992	0%	38.40%	61.60%	26.80%	56.90%	16.40%	91.50%	8.50%	0%	32.90%	44.30%	22.80%	32.60%	67.20%	0.20%	100%	0%	0%
1993	0%	0.60%	99.40%	34.80%	26.90%	38.30%	44.10%	54.70%	1.30%	8.50%	52.40%	39%	31.20%	34.50%	34.30%	92.70%	7.30%	0%
1994	0%	6.90%	93.10%	20.90%	52.20%	26.90%	16.10%	80.10%	3.80%	3.70%	51.60%	44.70%	4.90%	75.40%	19.70%	68.20%	31.80%	0%
1995	0%	0%	100%	6.40%	31.20%	62.40%	8.50%	50%	41.50%	0%	5.70%	94.30%	0%	5.50%	94.50%	49.70%	27.20%	23.20%
1996	0%	0.20%	99.80%	32.80%	27%	40.10%	57.20%	41.50%	1.30%	5.70%	52.40%	41.90%	17.40%	26.30%	56.30%	88.70%	11.30%	0%
1997	0%	6%	94%	18.70%	30.80%	50.50%	14.40%	85.60%	0%	3.70%	54.90%	41.50%	7.40%	28.20%	64.40%	88.70%	11.30%	0%
1998	0%	2.20%	97.80%	25.10%	13.80%	61.10%	59.30%	33.10%	7.60%	6.50%	19.90%	73.60%	14.60%	16.50%	69%	94.70%	5.30%	0%
1999	0%	0.20%	99.80%	24.50%	22.10%	53.40%	8.50%	80.10%	11.40%	2.80%	29.30%	67.90%	2.70%	31%	66.30%	55%	44.40%	0.70%
2000	2.20%	15.60%	82.20%	32.60%	28.30%	39.10%	8.50%	91.50%	0%	3.70%	33.70%	62.60%	20.40%	28.50%	51.10%	95.40%	4.60%	0%
2001	0%	40.60%	59.40%	24.90%	64.40%	10.80%	8.90%	91.10%	0%	3.70%	76.40%	19.90%	14.30%	81.30%	4.40%	86.10%	13.90%	0%
2002	0%	11.90%	88.10%	26.40%	29.60%	44.10%	25.40%	74.60%	0%	9.30%	49.20%	41.50%	13.60%	25.20%	61.10%	84.80%	15.20%	0%
2003	0%	10.90%	89.10%	20.60%	24.30%	55.10%	10.20%	80.90%	8.90%	3.70%	27.60%	68.70%	5.80%	26.20%	68%	4.60%	68.90%	26.50%
2004	0%	11%	89%	35.90%	34.60%	29.50%	41.10%	58.90%	0%	19.90%	39.80%	40.20%	19.60%	33.20%	47.20%	89.40%	10.60%	0%
2005	0%	11%	89%	22.50%	59.60%	18%	3%	96.20%	0.80%	2.80%	52.40%	44.70%	3.10%	57.50%	39.30%	2.60%	97.40%	0%
2006	0.10%	15%	84.90%	29%	47.20%	23.80%	90.30%	9.70%	0%	17.50%	50.80%	31.70%	29.90%	32.90%	37.10%	100%	0%	0%
2007	11.50%	25.10%	63.40%	28.60%	41.50%	29.80%	66.50%	33.50%	0%	6.50%	52.80%	40.70%	37%	34.80%	28.20%	100%	0%	0%
2008	0%	48.60%	51.40%	29%	56.70%	14.30%	4.70%	95.30%	0%	3.70%	72.80%	23.60%	2.40%	95%	2.70%	16.60%	83.40%	0%
2009	0.40%	13.40%	86.10%	23.30%	33.60%	43.10%	6.40%	58.10%	35.60%	3.70%	16.70%	79.70%	5.30%	24.30%	70.40%	52.30%	47.70%	0%
2010	0%	24.10%	75.90%	26.50%	27.60%	45.90%	11.40%	87.70%	0.80%	3.70%	22.80%	73.60%	9.70%	39.30%	50.90%	19.20%	80.80%	0%
2011	8.10%	30.80%	61.20%	31.70%	42.60%	25.70%	36.90%	63.10%	0%	11.80%	57.70%	30.50%	26.50%	59.90%	13.60%	96%	4%	0%
2012	0%	12%	88%	17.40%	19.70%	62.90%	0.80%	25%	74.20%	0.40%	5.70%	93.90%	0%	18%	82%	2.60%	74.80%	22.50%
2013	0%	5.60%	94.40%	20.50%	20.60%	58.90%	2.10%	57.20%	40.70%	2%	12.60%	85.40%	1.70%	17.40%	80.90%	4%	89.40%	6.60%
2014	1.20%	17.60%	81.30%	38.80%	17.60%	43.60%	38.10%	58.10%	3.80%	6.50%	13%	80.50%	25.10%	21.30%	53.60%	79.50%	20.50%	0%
2015	11.30%	34.90%	53.80%	31.10%	42.30%	26.70%	80.10%	19.90%	0%	11%	51.20%	37.80%	35.10%	51.60%	13.30%	100%	0%	0%
2016	0%	2.20%	97.80%	18.10%	17.40%	64.50%	0.80%	7.60%	91.50%	0.40%	3.30%	96.30%	0%	6.70%	93.30%	0%	29.80%	70.20%
2017	0%	16.40%	83.60%	8.80%	43.50%	47.70%	0.40%	96.20%	3.40%	0%	20.30%	79.70%	0%	42.60%	57.40%	0%	100%	0%
2018	0%	12.80%	87.20%	18.30%	17.40%	64.30%	2.50%	21.20%	76.30%	2%	2.40%	95.50%	0%	8%	92%	9.90%	78.80%	11.30%
2019	9.30%	18.10%	72.60%	23.40%	30.30%	46.30%	14%	58.90%	27.10%	2.80%	20.70%	76.40%	9.70%	28.40%	61.90%	49%	51%	0%
Ave.	2%	16%	83%	25%	35%	40%	29%	56%	15%	7%	36%	57%	14%	37%	49%	59%	35%	6%

Table 4. One and four-year rolling average annual hydroperiods for each subpopulation from 1991–2019. The target range is 90–210 days and the color coding on averages indicate whether the target was met (green) or the severity of missing the target (yellow and red).

Year	AX		B		C		D		E		F	
	1-yr	4-yr	1-yr	4-yr	1-yr	4-yr	1-yr	4-yr	1-yr	4-yr	1-yr	4-yr
1991	228		139		31		171		120		15	
1992	251		145		34		145		117		16	
1993	347		165		95		207		156		22	
1994	315		163		127		230		160		63	
1995	365	285	239	153	190	72	291	188	308	138	112	29
1996	329	319	173	178	89	112	207	218	209	185	31	53
1997	315	339	189	185	135	126	208	234	205	208	29	57
1998	320	331	201	191	95	136	261	234	226	220	20	59
1999	316	332	188	200	151	127	230	242	223	237	85	48
2000	291	320	164	188	149	118	239	226	193	216	33	41
2001	237	311	135	185	137	132	170	235	151	212	61	42
2002	275	291	179	172	120	133	197	225	212	198	43	50
2003	289	279	204	166	155	139	231	209	218	195	177	56
2004	278	273	134	170	102	140	168	209	172	194	48	78
2005	275	269	156	163	174	128	208	191	196	188	178	82
2006	279	279	145	168	66	138	168	201	161	199	16	112
2007	257	280	158	160	66	124	208	194	141	187	5	105
2008	241	272	128	148	126	102	188	188	169	168	111	62
2009	274	263	174	147	180	108	232	193	220	167	84	77
2010	289	263	182	151	137	110	263	199	211	173	119	54
2011	227	265	136	160	99	128	179	222	137	185	37	80
2012	289	256	198	154	215	136	265	215	244	184	186	88
2013	312	268	206	172	190	158	264	235	249	203	156	106
2014	274	278	155	179	106	160	249	243	183	210	60	124
2015	224	275	150	172	64	152	193	239	131	203	26	110
2016	345	275	233	177	288	144	346	243	333	202	259	107
2017	277	289	212	186	183	162	249	263	218	224	131	125
2018	292	280	224	188	246	160	298	259	284	216	146	119
2019	269	285	197	205	165	195	264	272	217	241	95	140
2020		296		217		220		289		263		158
Ave.	286	287	175	174	135	137	225	226	199	201	81	83

Table 5. Average annual flow in thousand-acre-feet for select structures and transects along the Tamiami Trail as modeled for the period of record (1965-2005). Results for ECB, ALT Q and the difference between the two are displayed. Positive numbers in the difference column represent reductions in flow from ECB19RR to ALT Q while negative numbers represent increases (Corps 2019a).

Structure or Transect	ECB19RR	ALT Q	Difference ECB19RR - ALT Q
S-343 A/B	14.9	4.1	10.8
S-344	7.0	2.1	4.9
S-12A	29.8	21.4	8.4
S-12A Weir*	5.9	5.0	0.9
S-12B	34.9	24.9	10
S-12B Weir*	4.7	4.0	0.7
S-12C	142.9	93.1	49.8
S-12D	218.6	172.9	45.7
Total	-	-	131.2
T17	239	172	67
T18	332	561	-229
T20	118	245	-127
TSH1	20	24	-4
TSH2	21	24	-3
T23A	24	24	0
T23B	86	92	-6
T23C	113	143	-30

Table 6. Partial reproduction of Corps' table (Corps 2019a) showing the percentage of CSSS-Ax that meets the 90-day nesting window target for the modeled ECB19RR, ALT Q and the overlapping period of Sparrow Viewer observed data (first column). It is unusual to compare observed data with modeled data, however, in this case the comparison between ALT Q and the ECB19RR may be masking benefit to the hydrology in CSSS-Ax.

Year	Observed	ECB19RR (CSSS-Ax)	ALT Q (CSSS-Ax)
1991	1.4%	17.8%	17.9%
1992	41.0%	60.9%	50.7%
1993	0.4%	15.4%	16.5%
1994	8.0%	32.4%	28.2%
1995	0.0%	0.0%	0.0%
1996	9.8%	21.8%	19.2%
1997	21.4%	40.5%	36.3%
1998	8.6%	13.4%	13.8%
1999	15.2%	21.9%	18.3%
2000	23.0%	22.3%	17.9%
2001	52.6%	94.9%	95.3%
2002	40.4%	56.4%	50.4%
2003	5.7%	27.9%	27.7%
2004	44.2%	80.8%	76.8%
2005	39.3%	94.9%	95.8%
Average (Difference from ECB19RR)	**20.7%** (-19.3%)	**40%**	**37.6%** (-2.4%)
Number of times target (40%) met in 15-year POR	**4**	**6**	**5**

Table 7. Partial reproduction of Corps' table (Corps 2019a) showing the percentage of CSSS-E that meets the 90-day nesting window target for the modeled ECB19RR, ALT Q and the overlapping period of Sparrow Viewer observed data (first column). It is unusual to compare observed data with modeled data, however, in this case the comparison between ALT Q and the ECB19RR may be masking impacts to the hydrology in CSSS-E.

Year	Observed	ECB19RR (CSSS-E)	ALT Q (CSSS-E)
1991	27.9%	10.0%	10.7%
1992	99.1%	74.9%	46.7%
1993	62.4%	32.8%	25.1%
1994	70.2%	28.8%	12.1%
1995	19.1%	0.2%	0.0%
1996	48.9%	43.4%	22.6%
1997	35.4%	14.7%	8.8%
1998	44.7%	8.8%	13.6%
1999	79.6%	71.8%	54.2%
2000	65.2%	51.6%	29.0%
2001	99.5%	100.0%	100.0%
2002	59.7%	79.0%	58.6%
2003	23.8%	54.7%	50.3%
2004	90%	99.7%	96.1%
2005	93.4%	100.0%	100.0%
Average (Difference from ECB19RR)	**61.3%** (+9.9%)	**51.4%**	**44.1%** (-7.3%)
Number of times target (40%) met in 15-year POR	**11**	**9**	**7**

Table 8. Partial reproduction of Corps' table (Corps 2019a) showing the percentage of CSSS-D that meets the 90-day nesting window target for the modeled ECB19RR, ALT Q and the overlapping period of Sparrow Viewer observed data (first column). It is unusual to compare observed data with modeled data, however, in this case the comparison between ALT Q and the ECB19RR may be overestimating impacts to CSSS-D.

Year	Observed	ECB19RR (CSSS-D)	ALT Q (CSSS-D)
1991	19.5%	1.5%	1.2%
1992	80.9%	89.6%	63.8%
1993	58.5%	47.3%	25.4%
1994	22.8%	12.3%	7.3%
1995	20.3%	10.4%	4.6%
1996	34.1%	63.8%	21.9%
1997	70.7%	92.7%	91.5%
1998	17.5%	66.2%	51.5%
1999	72.0%	89.2%	68.8%
2000	40.2%	86.9%	77.3%
2001	89.0%	88.1%	93.8%
2002	68.7%	89.2%	50.8%
2003	18.3%	14.2%	15.8%
2004	84.1%	93.5%	92.7%
2005	55.7%	89.6%	89.6%
Average (Difference from ECB19RR)	**50.2%** (-12.1%)	**62.3%**	**50.4%** (-11.9%)
Number of times target (40%) met in 15 yr POR	**9**	**11**	**9**

Table 9. Modeled average annual hydroperiod for ECB19RR and ALT Q (1965 – 2005) plus the observed data (gray column) from the Sparrow Viewer from 1991-2019.

Subpopulation	Observed (1991-2019)	ECB19RR	ALT Q
CSSS-Ax	286 ± 37	242 ± 56	243 ± 57
CSSS-B	175 ± 31	146 ± 52	148 ± 52
CSSS-C	135 ± 60	102 ± 57	109 ± 55
CSSS-D	225 ± 46	188 ± 46	214 ± 50
CSSS-E	199 ± 53	204 ± 64	217 ± 65
CSSS-F	81 ± 65	136 ± 72	152 ± 75

Table 10. Observed data (Gray column) from the Sparrow Viewer displayed next to model data from ECB19RR and ALT Q for the overlapping period of record 1991–2005. The target for the habitat performance metric is 40% of each subpopulation (in this case CSSS-Ax) with an average annual discontinuous hydroperiod of 90 to 210 days (center column under each scenario). Green shading indicates years in which the target was met.

	Observed AX			ECB19RR AX			ALT Q AX		
Year	0 to 89	90 to 210	≥211	0 to 89	90 to 210	≥211	0 to 89	90 to 210	≥211
1991	0%	24.80%	75.20%	0.10%	25%	74.90%	0.20%	26%	73.80%
1992	0%	38.40%	61.60%	0.10%	18.80%	81.10%	0.50%	16.80%	82.70%
1993	0%	0.60%	99.40%	0.90%	10.20%	89%	2.80%	10.10%	87.10%
1994	0%	6.90%	93.10%	0%	16%	84%	0%	14.90%	85.10%
1995	0%	0%	100%	0%	0%	100%	0%	0%	100%
1996	0%	0.20%	99.80%	0.50%	7.90%	91.60%	1.20%	8.20%	90.60%
1997	0%	6%	94%	0.10%	21.30%	78.60%	0.20%	21%	78.80%
1998	0%	2.20%	97.80%	0.80%	4.80%	94.40%	1.10%	4.90%	94%
1999	0%	0.20%	99.80%	0%	2.30%	97.60%	0%	3.10%	96.90%
2000	2.20%	15.60%	82.20%	6.20%	23%	70.90%	6.40%	21.60%	72%
2001	0%	40.60%	59.40%	2.20%	61.60%	36.10%	2.50%	67.50%	30%
2002	0%	11.90%	88.10%	1.10%	10.40%	88.50%	3.60%	10.80%	85.70%
2003	0%	10.90%	89.10%	3.40%	12.70%	83.90%	4.10%	13.60%	82.30%
2004	0%	11%	89%	13.30%	34.90%	51.80%	13.10%	36.90%	50%
2005	0%	11%	89%	1.50%	65.80%	32.70%	2.50%	71.90%	25.60%
Ave.	0%	12%	88%	2%	21%	77%	3%	22%	76%

Table 11. Observed data (Gray column) from the Sparrow Viewer displayed next to model data from ECB19RR and ALT Q for the overlapping period of record 1991–2005. The target for the habitat performance metric is 40% of each subpopulation (in this case CSSS-E) with an average annual discontinuous hydroperiod of 90 to 210 days (center column under each scenario). Green shading indicates years in which the target was met.

	Observed E			**ECB19RR E**			**ALT Q E**		
Year	0 to 89	90 to 210	≥211	0 to 89	90 to 210	≥211	0 to 89	90 to 210	≥211
1991	35.70%	59.40%	4.90%	0.00%	22%	78.20%	0.00%	16%	83.90%
1992	32.60%	67.20%	0.20%	0.90%	46.20%	52.80%	0.60%	28.10%	71.30%
1993	31.20%	34.50%	34.30%	4.70%	16.30%	79%	3.40%	9.90%	86.70%
1994	4.90%	75.40%	19.70%	0%	38%	62%	0%	22.30%	77.70%
1995	0%	5.50%	94.50%	0%	0%	100%	0%	0%	100%
1996	17.40%	26.30%	56.30%	0.60%	13.20%	86.20%	0.60%	10.50%	88.90%
1997	7.40%	28.20%	64.40%	0.00%	16.50%	83.50%	0.00%	10%	89.80%
1998	14.60%	16.50%	69%	0.30%	5.50%	94.20%	0.20%	5.80%	94%
1999	2.70%	31%	66.30%	0%	7.40%	92.50%	0%	6.10%	93.90%
2000	20.40%	28.50%	51.10%	15.70%	38%	46.40%	10.30%	36.20%	53%
2001	14.30%	81.30%	4.40%	1.40%	97.30%	1.30%	0.90%	95.90%	3%
2002	13.60%	25.20%	61.10%	10.30%	43.60%	46.10%	9.10%	37.00%	53.90%
2003	5.80%	26.20%	68%	16.60%	34.50%	48.90%	15.00%	36.40%	48.60%
2004	19.60%	33.20%	47.20%	51.70%	29.90%	18.30%	43.90%	37.80%	18%
2005	3.10%	57.50%	39.30%	13.20%	77.60%	9.20%	12.70%	79.30%	8.00%
Ave.	15%	40%	45%	8%	32%	60%	6%	29%	65%

Table 12. Observed data (Gray column) from the Sparrow Viewer displayed next to model data from ECB19RR and ALT Q for the overlapping period of record 1991–2005. The target for the habitat performance metric is 40% of each subpopulation (in this case CSSS-D) with an average annual discontinuous hydroperiod of 90 to 210 days (center column under each scenario). Green shading indicates years in which the target was met.

	Observed D			**ECB19RR D**			**ALT Q D**		
Year	0 to 89	90 to 210	≥211	0 to 89	90 to 210	≥211	0 to 89	90 to 210	≥211
1991	12.60%	57.70%	29.70%	1.90%	41%	57.30%	1.90%	13%	85.00%
1992	32.90%	44.30%	22.80%	3.50%	36.90%	59.60%	3.50%	10.40%	86.20%
1993	8.50%	52.40%	39%	8.10%	18.10%	74%	4.20%	11.20%	84.60%
1994	3.70%	51.60%	44.70%	2%	31%	67%	2%	12.30%	85.80%
1995	0%	5.70%	94.30%	0%	10%	89%	0%	5%	95%
1996	5.70%	52.40%	41.90%	3.50%	35.80%	60.80%	3.50%	13.80%	82.70%
1997	3.70%	54.90%	41.50%	1.90%	39.60%	58.50%	1.90%	12%	86.20%
1998	6.50%	19.90%	73.60%	3.50%	23.50%	73.10%	3.50%	3.50%	93%
1999	2.80%	29.30%	67.90%	2%	20.00%	77.70%	2%	12.30%	85.80%
2000	3.70%	33.70%	62.60%	14.60%	50%	35.80%	9.60%	26.20%	64%
2001	3.70%	76.40%	19.90%	4.60%	88.80%	6.50%	3.50%	90.00%	7%
2002	9.30%	49.20%	41.50%	11.90%	75.40%	12.70%	5.00%	32.30%	62.70%
2003	3.70%	27.60%	68.70%	6.90%	47.70%	45.40%	4.60%	22.30%	73.10%
2004	19.90%	39.80%	40.20%	32.70%	61.90%	5.40%	23.50%	70.00%	7%
2005	2.80%	52.40%	44.70%	10.40%	85.80%	3.80%	6.20%	88.80%	5.00%
Ave.	8%	43%	49%	7%	44%	48%	5%	28%	67%

Table 13. Habitat acreage in target 90 to 210-day discontinuous hydroperiod range divided by CSSS population estimate by year and subpopulation).

Habitat Acreage in Target 90 to 210 Day Discontinuous Hydroperiod Range Divided by CSSS Population Estimate by Year and Subpopulation)								
	# Acres/Bird							
	A	B	C	D	E	F		Total
1992	5.2	7.0	14.3	42.3	25.3	0.0		8.5
1993	0.3	4.3		58.4	24.1			8.7
1994	15.7	9.2			149.9			
1995	0.0	5.7			3.5			7.1
1996	0.2	5.6	70.3	70.0	28.3	35.9		9.9
1997	6.2	4.2	144.1	122.3	7.6	35.9		8.2
1998	2.2	3.0	33.5	44.3	4.1	17.0		4.8
1999a	0.1	4.2	44.9	17.8	9.0	142.1		7.7
1999b	0.3	3.2	101.0		7.2			7.0
2000a	10.8	6.1	66.1	56.3	6.1			9.6
2000b	12.1	4.5	115.6	225.2	9.0	2.1		8.9
2001	115.9	11.8	76.8	255.3	21.4	22.3		22.8
2002	38.0	6.1	54.1		9.8	48.9		12.2
2003	29.0	4.0	68.1		9.9	108.2		10.0
2004	190.8	4.8	37.4		11.6	34.1		9.4
2005	29.9	10.2	97.2	116.7	22.3	152.6		18.4
2006	47.0	8.9	4.9		10.4			12.1
2007	160.8	6.4	56.7		13.9			13.4
2008	187.5		160.6	486.5	57.5			27.5
2009	41.8		97.5	55.8	12.6			10.1
2010	70.6	5.7	221.5	38.1	9.6	252.3		13.8
2011	71.4		29.1	385.6	22.5	6.3		18.7
2012	13.2		20.5	2.7	5.4	57.3		6.7
2013	6.6	4.5	36.3	84.2	5.5	275.6		8.2
2014	93.5	3.9	42.1	44.8	7.1	67.8		9.3
2015	67.9	8.6	15.0	82.2	13.1			15.2
Ave.	46.8	6.0	69.9	121.6	19.5	78.7		11.5

Table 14. Acreages within individual sparrow subpopulations that show differences between ALT Q and ECB19RR of the percent to target achieved according to the Marl Prairie Indicator. Categories show whether ALT Q increase or decrease the percentage of target met (in 20 percentage point increments) as compared to the ECB19RR.

	CSSS Subpopulation					
ALT Q – ECB19RR	Ax	B	C	D	E	F
21 to 40	0.0	0.0	0.0	0.0	0.0	0.0
1 to 20	35,469	11,197	6,096	0.0	1,577	2,986
0 (-0.99 to 0.99)	16,032	15,402	864	681	1,775	411
-1 to -20	27,480	12,451	1,098	9,506	18,402	1,411
-21 to -40	0.0	0.0	0.0	513	523	149

Table 15. Sparrow Viewer data of the average annual discontinuous hydroperiod in days for individual subpopulations during 1991-2008 and 2009-2019 of the observed record.

	CSSS-B	**CSSS-C**	**CSSS-D**	**CSSS_E**	**CSSS-F**
1991 - 2008	167 days	113 days	207 days	185 days	59 days
2009 - 2019	188 days	170 days	255 days	221 days	118 days

Table 16. Description of vegetation classes utilized in ELVeS.

Vegetation Class	Description
Sawgrass	Sawgrass (*Cladium jamaicense*) dominated marsh
Sawgrass-Short	Sawgrass dominated marsh with average height less than 2.5 meters.
Open Marsh	Open water dominated freshwater marsh often with a mix of sparse graminoids, herbaceous, and/or emergent freshwater vegetation, such as Spikerush (*Eleocharis spp.*), Panicgrass (*Panicum spp.),* low stature sawgrass, Cattail (*Typha spp.*), Arrowhead (*Sagittaria spp.*), Pickerelweed (*Pontederia* cordata), Waterlily (Nymphaea spp.), Green Arum (Peltandra virginica), Swamp-Lily (*Crinum americanum*), Spiderlilies (*Hymenocallis spp.*), among others.
Cattail	Greater than or equal to 50% areal coverage of Cattail.
Floating Emergent Marsh	Typically Nuphar or Nymphaea. Also Lemna, Salvinia
Drier Marl Prairie	Short hydroperiod marsh characterized primarily by graminoids that includes low-stature sawgrass, Muhly Grass (*Muhlenbergia capillaris var. filipes*),
Wetter Marl Prairie	Short hydroperiod marsh characterized by a mix of graminoids that includes low-stature sawgrass, Little Bluestem (*Schizachyrium scoparium*), Gulfdune Paspalum (*Paspalum monostachyum*), Beakrush (*Rhynchospora spp.*), Black Sedge (*Schoenus nigricans*), among others.
Swamp Shrubland	Primrose willow and wax myrtle
Willow Shrub Cattail	Willow (*Salix caroliniana*) dominant shrub land with freshwater marsh species. Cattail may be prominent.
Cypress Shrub Sawgrass	Dwarf Cypress (*Taxodium spp.*) with freshwater marsh species. Dwarf cypress may be in a sawgrass matrix.
Bayhead Shrubland	Mix of Cocoplum (*Chrysobalanus icaco*), Swamp Bay (*Persea palustris*), Red Bay (*Persea borbonia*), Dahoon Holly (*Ilex cassine*), Willow (*Salix caroliniana*), Wax Myrtle (*Myrica cerifera*), Sweetbay (*Magnolia virginiana*), Cypress (*Taxodium spp.*), Pond Apple (*Annona glabra*), among others.
Pine Rockland	Pine upland found on low ridges of oolitic limestone. Found on the Miami rock ridge, in the Florida Keys, ENP, and in BCNP.

Table 17. Snail Kite exceedance criteria for ECB19RR and ALT Q.

	ECB19RR	ALT Q
Dry Season High Water	7	4
Wet Season High Water	2	2
Recession: Dry Season Amplitude Gauge 3A28	6	8
Recession: Dry Season Amplitude Gauge 3A4	7	5
Recession: Dry Season Amplitude Gauge 3AS3W1	8	5
Recession: Dry Season Amplitude Gauge W2	4	8

Table 18. Wood stork egg survival per nesting chronology phase.

Age	Percent Survival
Egg-laying to Day 14	80
Egg-laying to Day 28 (hatching)	70
Egg-laying to Day 42	62
Egg-laying to Day 56	56
Egg-laying to Day 70	50
Egg-laying to fledging	46

Table 19. Wood stork nesting data in southeastern United States.

YEAR	TOTAL		FLORIDA		GEORGIA		SOUTH CAROLINA		NORTH CAROLINA	
	Pairs	Colonies	Pairs	Colonies	Pairs	Colonies	Pairs	Colonies	Pairs	Colonies
1981	4,442	22	4,156	19	275	2	11	1		
1982	3,575	22	3,420	18	135	2	20	1		
1983	5,983	25	5,600	22	363	2	20	1		
1984	6,245	29	5,647	25	576	3	22	1		
1985	5,193	23	4,562	17	557	5	74	1		
1986	5,835	36	5,067	29	648	4	120	3		
1987			**		506	5	194	3		
1988			**		311	4	179	3		
1989			**		543	6	376	3		
1990			**		709	10	536	6		
1991	4,073	37	2,440	25	969	9	664	3		
1992			**		1,091	9	475	3		
1993	6,729	43	4,262	29	1,661	11	806	3		
1994	5,768	47	3,588	26	1,468	14	712	7		
1995	7,853	54	5,523	31	1,501	17	829	6		
1996			**		1,480	18	953	7		
1997	5,166	59	2,870	36	1,379	15	917	8		
1998			**		1,665	15	1,093	10		
1999	7,768	71	8,319	50	1,139	13	520	8		
2000			**		566	7	1,236	11		
2001	5,582	44	3,246	23	1,162	12	1,174	9		
2002	7,855	70	5,463	48	1,256	14	1,136	10		
2003	8,813	78	5,804	49	1,653	18	1,356	11		
2004	8,379	93	4,726	63	1,596	17	2,057	13		
2005	5,572	74	2,304	40	1,817	19	1,407	13	32	1
2006	11,279	82	7,216	48	1,928	21	2,010	13	125	1
2007	4,406	55	1,553	25	1,054	15	1,607	14	192	1
2008	6,118	73	1,838	31	2,292	25	1,839	16	149	1
2009	12,720	86	9,428	54	1,676	19	1,482	12	134	1
2010	8,149	94	3,828	51	2,708	28	1,393	14	220	1
2011	9,579	88	5,292	45	2,160	19	2,031	23	96	1
2012	8,452	77	4,539	39	1,905	17	1,827	19	181	2
2013	11,076	100	6,948	57	1,873	19	2,020	21	205	2
2014	11,238	105	5,511	58	2,942	22	2,501	23	284	2
2015	10,058	96	4,705	51	2,496	21	2,496	22	361	2
2016	10,639	104	5,223	55	2,310	22	2,512	25	594	2
2017	11,188	108	6,344	58	2,027	26	2,480	22	337	2
2018	12,105	100	8,525	57	1,594	19	1,858	22	128	2

**Incomplete data set from Florida as all colonies are not surveyed every year.

Table 20. Total number of wood stork nesting pairs within the Everglades and Big Cypress Basins (South Florida), 1996 to 2018. ESA Note: *Data was retrieved from the South Florida Wading Bird Reports from 1996-2018.*

Year	Nesting Pairs	3-Year Running Average	5-Year Running Average
1996	600	-	-
1997	445	-	-
1998	475	507	-
1999	4,549	1,823	-
2000	3,996	3,007	2,013
2001	2,681	3,742	2,429
2002	2,880	3,186	2,916
2003	2,386	2,649	3,298
2004	1,015	2,094	2,592
2005	634	1,345	1,919
2006	2,710	1,453	1,925
2007	770	1,371	1,503
2008	704	1,395	1,167
2009	6,452	2,642	2,254
2010	1,220	2,792	2,371
2011	2,131	3,268	2,255
2012	1,234	1,528	2,348
2013	3,059	2,141	2,819
2014	2,799	2,364	2,089
2015	1,469	2,442	2,138
2016	1,457	1,908	2,004
2017	3,894	2,273	2,536
2018	5,777	3,709	3,079
Average	**2,319**	**2,269**	**2,298**

Table 21. Number of wood stork nests in the COP Action Area as reported in the South Florida Wading Bird Reports from 2009 through 2018.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Average	168.4	43.5	71.9	34.2	104.6	75.0	30.1	27.5	102.0	152.25	80.9
3-Year Average	0	0	94.6	49.8	70.2	71.3	69.9	44.2	53.2	93.9	54.7
Tamiami East 1 (ENP)	10	15	0	0	5	0	0	0	0	0	30
Tamiami East 2 (ENP)	20	30	0	0	0	0	0	0	0	0	50
Tamiami West (ENP)	1300	350	400	120	400	300	75	0	138	0	3,083
Grossman Ridge West (ENP)	60	75	60	0	50	50	0	0	55	105	455
Paurotis Pond (ENP)	400	325	500	320	500	270	285	230	326	682	3,838
Broad River (ENP)	50	0	30	60	150	300	193	340	545	746	2,414
Cabbage Bay (ENP)	100	0	70	75	150	60	65	10	224	430	1,184
Rogers River Bay Island (ENP)	5	5	0	0	0	0	0	0	25	10	45
Rogers River Bay Peninsula (ENP)	400	165	80	135	200	110	0	0	0	0	1,090
Rookery Branch (ENP)	20	0	25	0	150	0	0	0	0	0	195
Lower Taylor Slough (ENP)	5	0	0	0	50	0	0	0	0	0	55
Cuthbert Lake (ENP)	100	35	90	60	150	130	30	0	0	0	595
Big Cypress Mitchell Landing (ENP)	2	0	0	0	0	0	0	0	0	0	2
Lostmans Creek (ENP)	130	0	0	50	200	40	0	0	0	0	420
Jetport (WCA-3A)	1167	0	0	0	43	60	0	0	129	520	1,919
Jetport South (WCA-3A)	238	0	350	0	463	400	0	0	857	953	3,261
WCA13 (WCA-3A)	0	0	0	0	0	0	0	0	0	72	72
L-28 Crossover South (WCA-3A)	28	0	0	0	0	0	0	0	0	0	28
L-28 Gap (WCA-3A)	0	A	0	0	0	0	0	0	0	0	0
Kinich (WCA-3A)	0	0	120	0	0	0	0	0	0	0	120
Cypress City (WCA-3A)	0	0	0	0	0	0	0	0	23	0	23
Mud East (WCA-3B)	7	0	0	0	0	0	0	0	0	0	7
Sawgrass Ford	0	0	0	0	0	80	74	52	83	80	369
Emerald Estates 1 and 2 Griffin	0	0	0	0	0	0	0	A	43	56	99

Table 22. Estimate of average annual hydrological effects on hydroperiod and wood stork prey biomass between ECB19RR (baseline) and the ALT Q (proposed action).

Hydroperiod Class (Days)	Baseline (ECB19RR)		Proposed Action (ALT Q)		Change		
	Acres	kg	Acres	kg	acres	biomass (kg)	nests**
1 (0-60)	109,366	44,591	109,305	44,566	-61	-25	-0.5
2 (60-120)	54,129	44,139	49,622	40,464	-4,507	-3,675	-73.5
3 (120-180)	115,095	199,817	109,868	190,743	-5,227	-9,074	-181.5
4 (180-240)	198,147	609,826	197,663	608,337	-484	-1,489	-9.9
5 (240-300)	532,657	2,052,666	533,819	2,057,143	1,162	4,477	29.6
6 (300-330)	412,157	1,821,398	438,542	1,937,998	26,385	116,600	772.2
7 (330-365)	741,233	3,538,868	723,964	3,456,420	-17,269	-82,447	-546.0
Short (0 to 180)	278,590	288,547	268,795	275,773	-9,795	-12,774	-255.5
Long (180 to 365)	1,884,194	8,022,758	1,893,989	8,059,898	9,795	37,141	245.9
Total	2,162,784	8,311,305	2,162,784	8,335,671	55,095*	24,367	-9.6

*The total is the sum of the individual changes within each hydroperiod and notes that some changes may be positive whereas others may be negative.
** Hydroperiods 1,2, and 3 are based on 50 kg per nest and 4,5,6, and 7 are based on 151 kg per nest. Total is the sum of all the nests estimated from the biomass change for each hydroperiod.

Table 23. Number of days water depth exceeded 16 inches (41 centimeters) based upon the two-gauge average (3A-3 and 3A-4) between March 1 and May 31 in 2017 and 2018.

Month	March 1 to May 31, 2017	March 1 to May 31, 2018
March	0	0
April	0	0
May	0	11
Total	0	11

Table 24. Surrogate measures for monitoring take of listed wildlife species caused by the Action, based on the cited BO effects analyses. If the trigger is reached in any single year the Corps is to conduct a review of water management operations that may have contributed to the hydrologic condition(s) of concern and provide this report to the Service.

Common Name	Life Stage	Surrogate (units)	Quantity*	BO Effects Analysis Section
Cape Sable seaside sparrow	Egg to Fledgling	Provide at least 90 consecutive dry nesting days over 40% of each subpopulation between March 1 and July 15.	None within two consecutive years	2.11.2
Cape Sable seaside sparrow	All	Provide an average annual discontinuous hydroperiod between 90-210 days over 40% of each subpopulation	None within two consecutive years	2.11.3
Everglade snail kite	Egg to Fledgling	Dry Season High Water Timing: by April 15 Trigger Value: stage >9.2 ft NGVD at gauge 3AS3W1 Frequency: 2 consecutive years	None within two consecutive years	4.13.4
Everglade snail kite	Egg to fledgling	Wet Season High Water Timing: June 1 – December 31 Trigger: stage >10.5 ft at gauge 3AS3W1 for 60 days Frequency: 2 consecutive years	None within two consecutive years	4.13.4
Everglade snail kite	Egg to fledgling	Recession: Dry Season Amplitude Timing: January 1 – May 31 (or onset of wet season, whichever is sooner) Trigger: stage difference >1.7 ft as measured at gauge(s) closest to kite nesting, as determined by the Service Frequency: 2 consecutive years	None within two consecutive years	4.13.4
Wood stork	Egg to fledgling	# of days water depth exceeded 16 inches (41 centimeters) based upon the 2-gauge average (Gauge 3A-3 and 3A-4) between March 1 and May 31	None within two consecutive years	6.11.2

*Due to natural environmental variability, some exceedances will be out of the Corps' control.

12.0 Figures

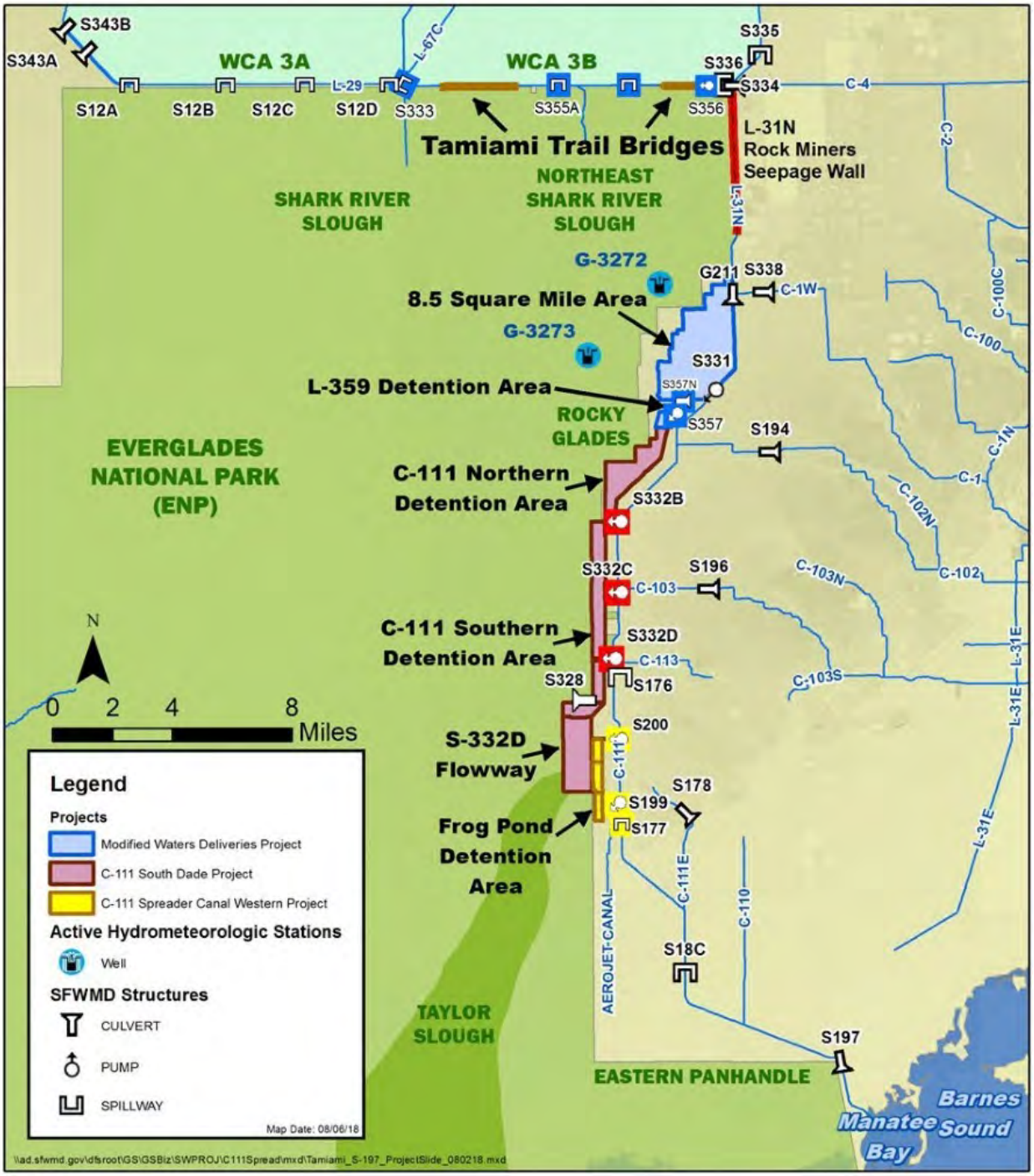


Figure 1. Study area and major project components of the MWD and C-111 Projects.

Figure 2. Overview map of the COP Action Area.

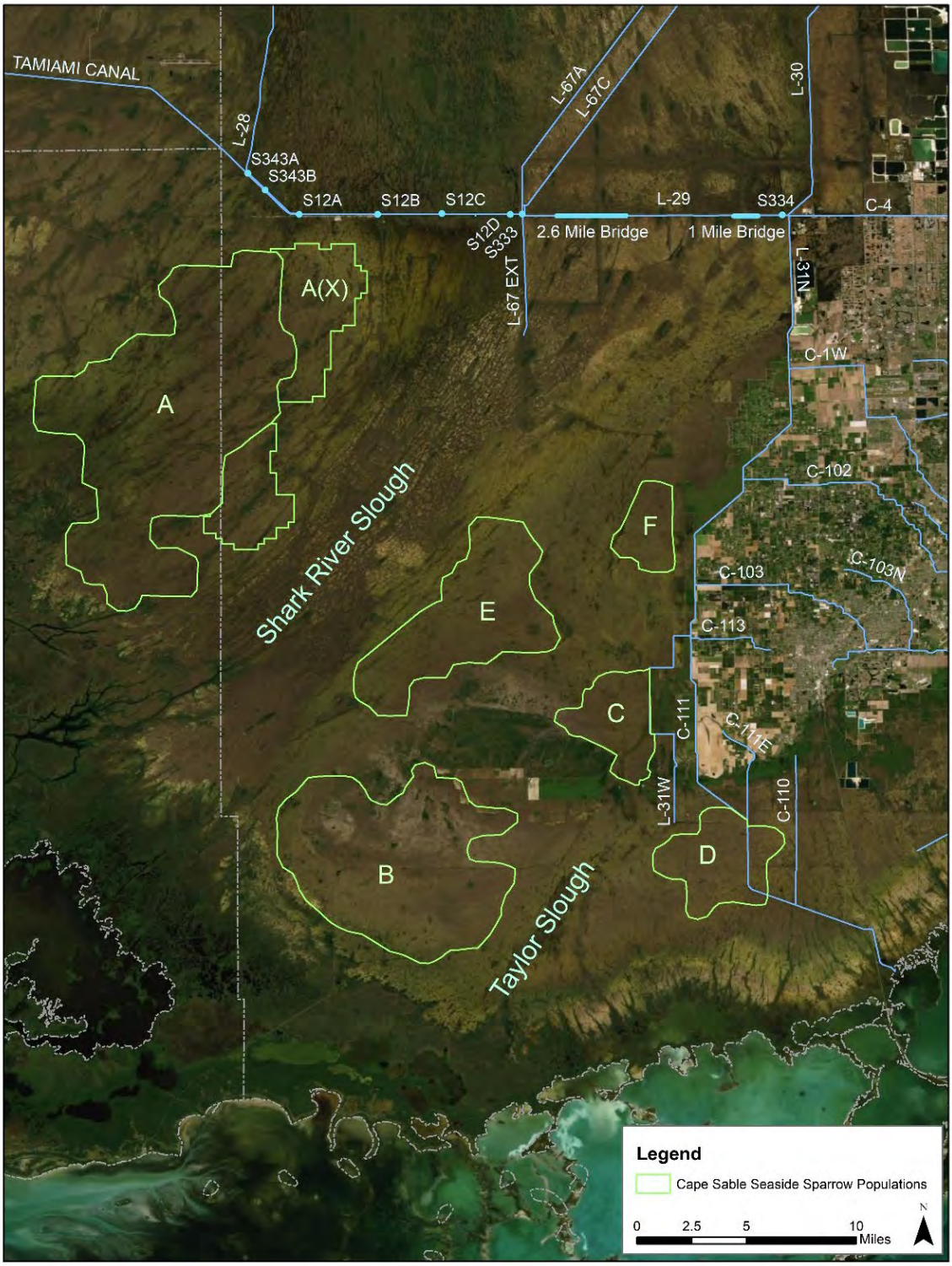


Figure 3. Location of Cape Sable seaside sparrow subpopulations.

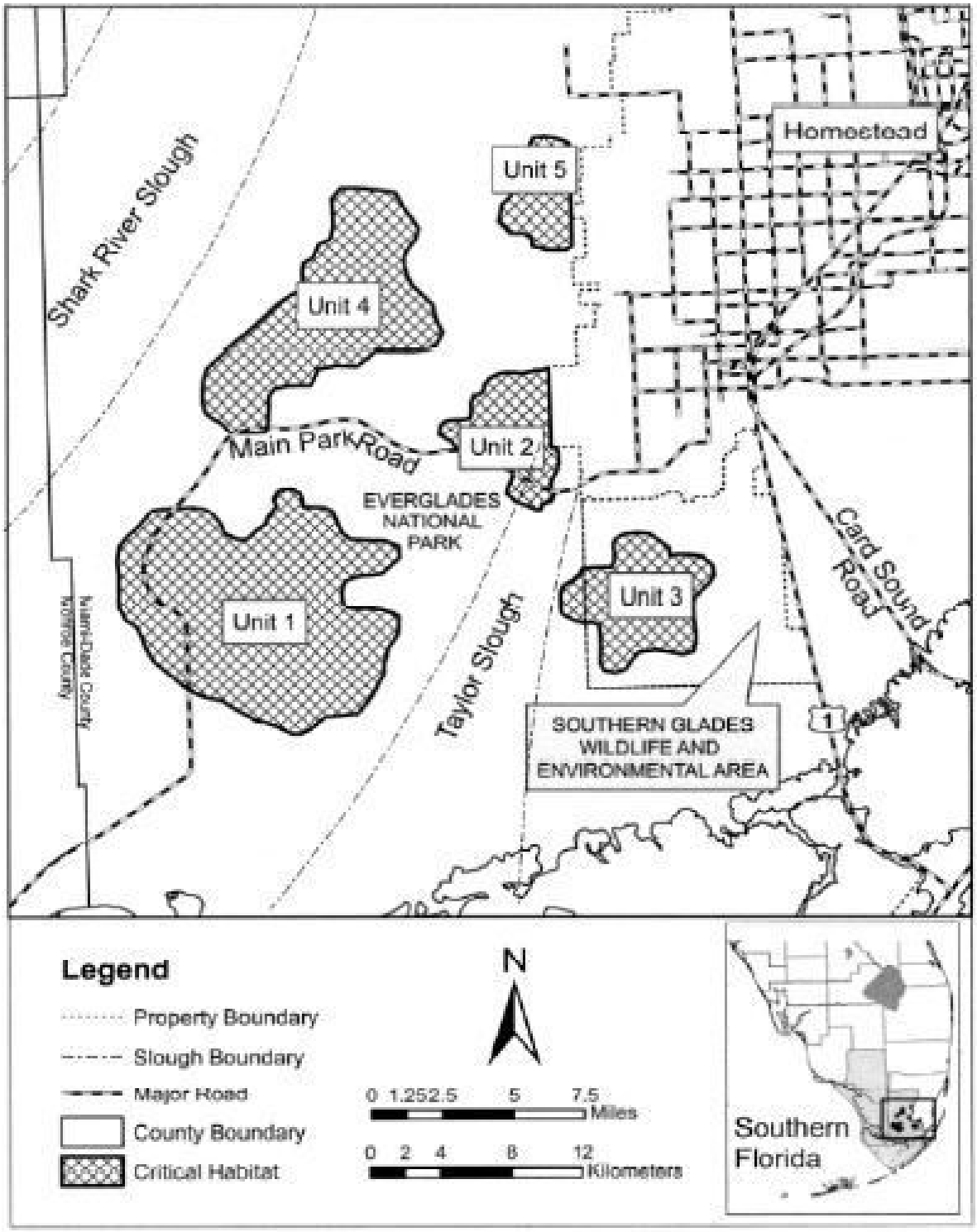


Figure 4. Critical habitat for the Cape Sable seaside sparrow.

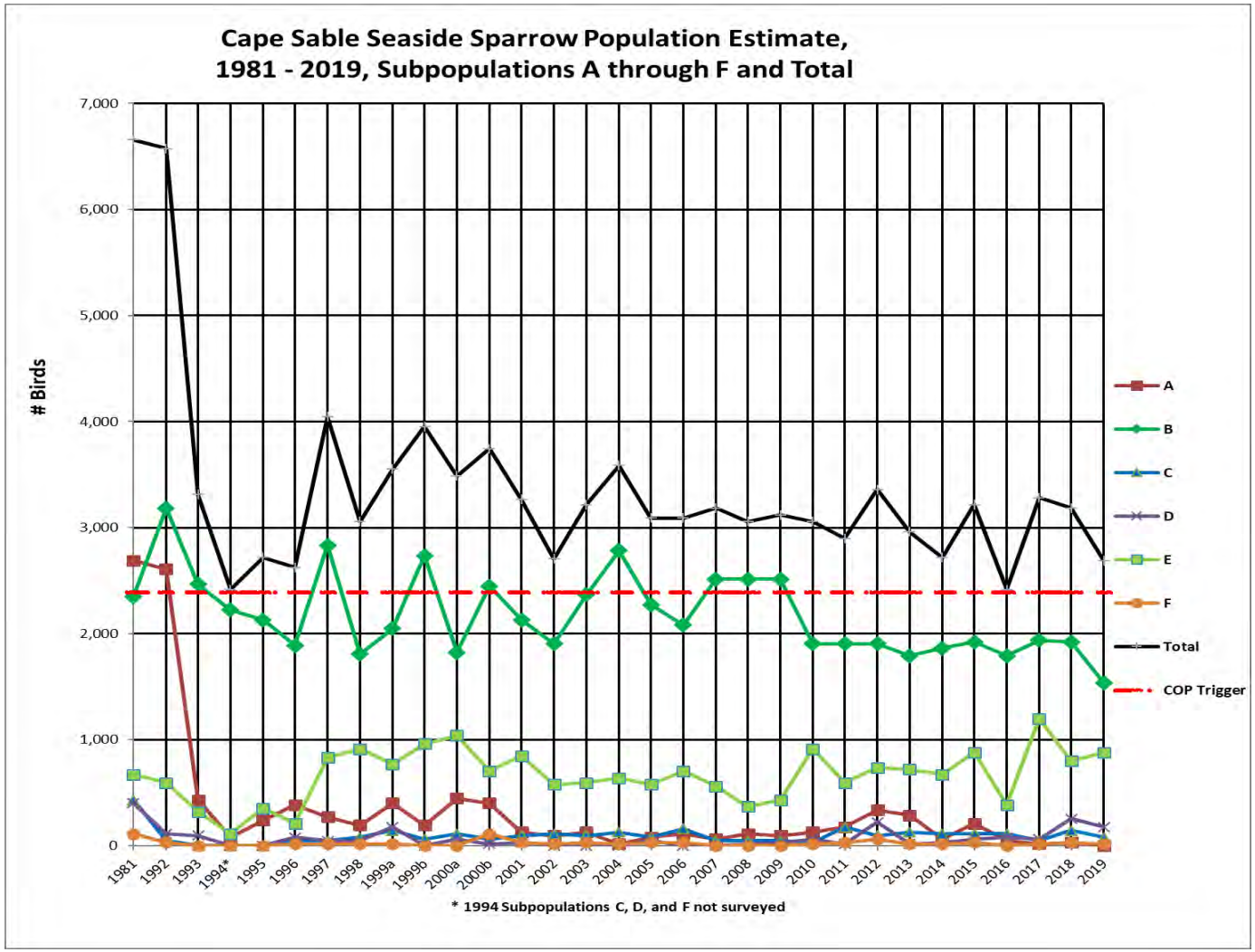


Figure 5. CSSS Population estimate total and by subpopulation for the years 1981-2019. Red line is the COP re-initiation threshold.

Figure 6. Documented locations of invasive constrictor snakes and tegus in the vicinity of CSSS-D and CSSS-C circa 2016. Data source http://www.eddmaps.org/florida/distribution/.

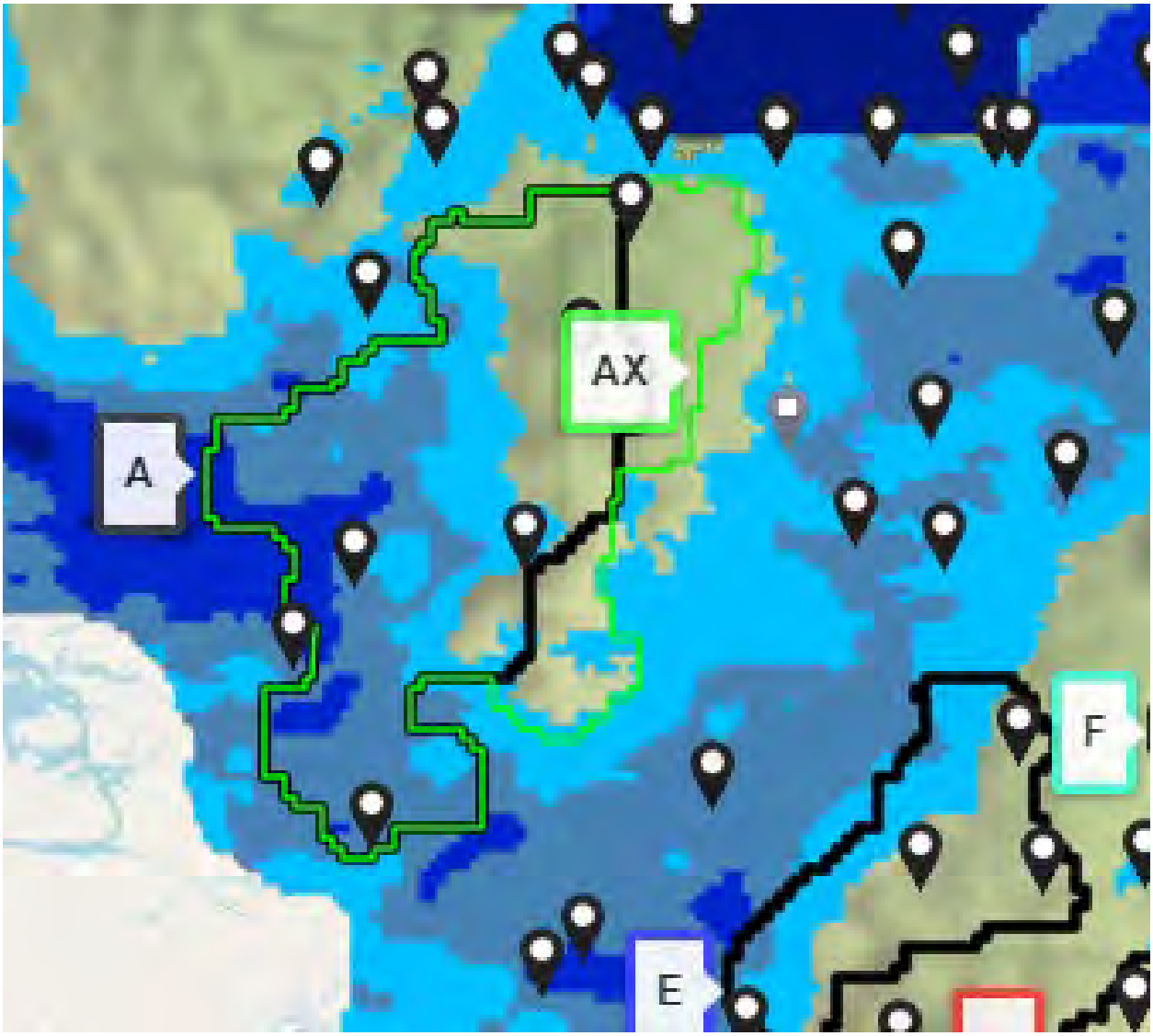


Figure 7. Snapshot of Sparrow Viewer output on January 27, 2020. Original CSSS-A delineated habitat is outlined at center in black (green overlay on some parts). CSSS-Ax which is CSSS-A plus expanded areas in northeast and southeast corners is delineated with green line. Blue areas show water levels above ground and green areas are dry. Note the extent of expanded dry area indicated to the East of the outlined delineated habitat.

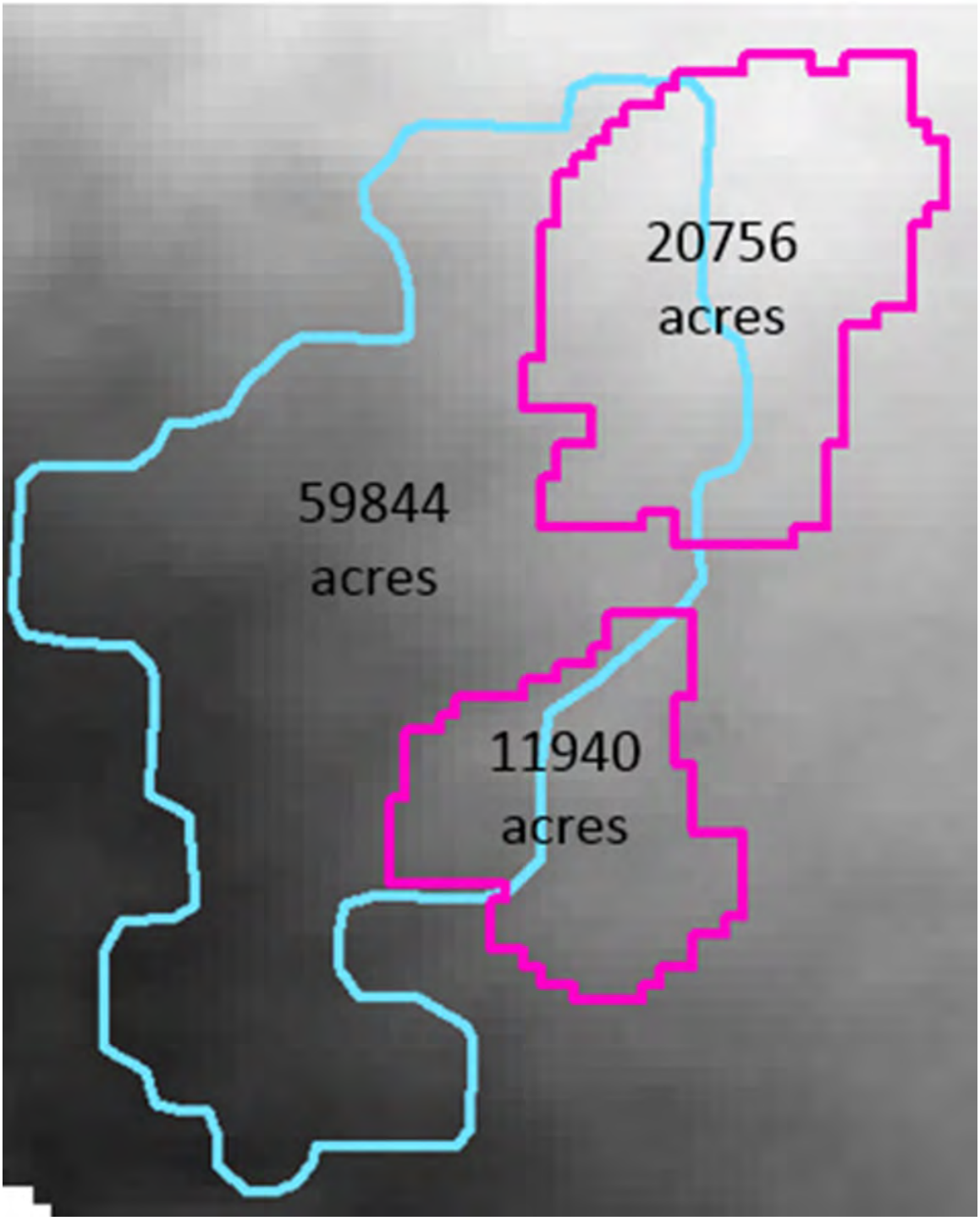


Figure 8. CSSS-A delineated habitat (light blue), and expanded habitat areas (tdN and tdS, purple) to the east and their acreages analyzed as part of the COP RSM modeling. Together, these areas comprise CSSS-Ax and essentially replaces the original A.

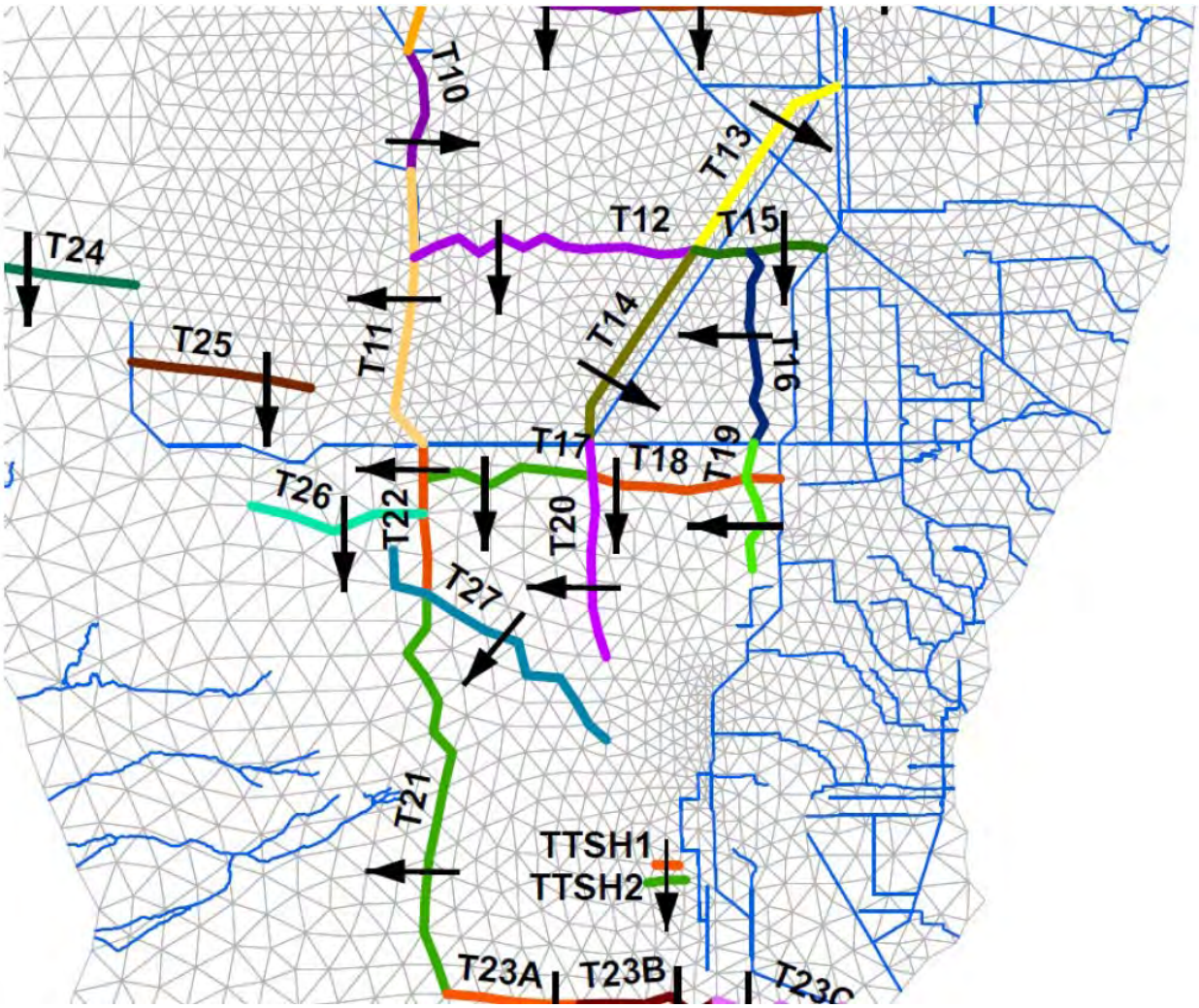


Figure 9. Shows the location and flow direction of transects used to assess modeled flows throughout the action area.

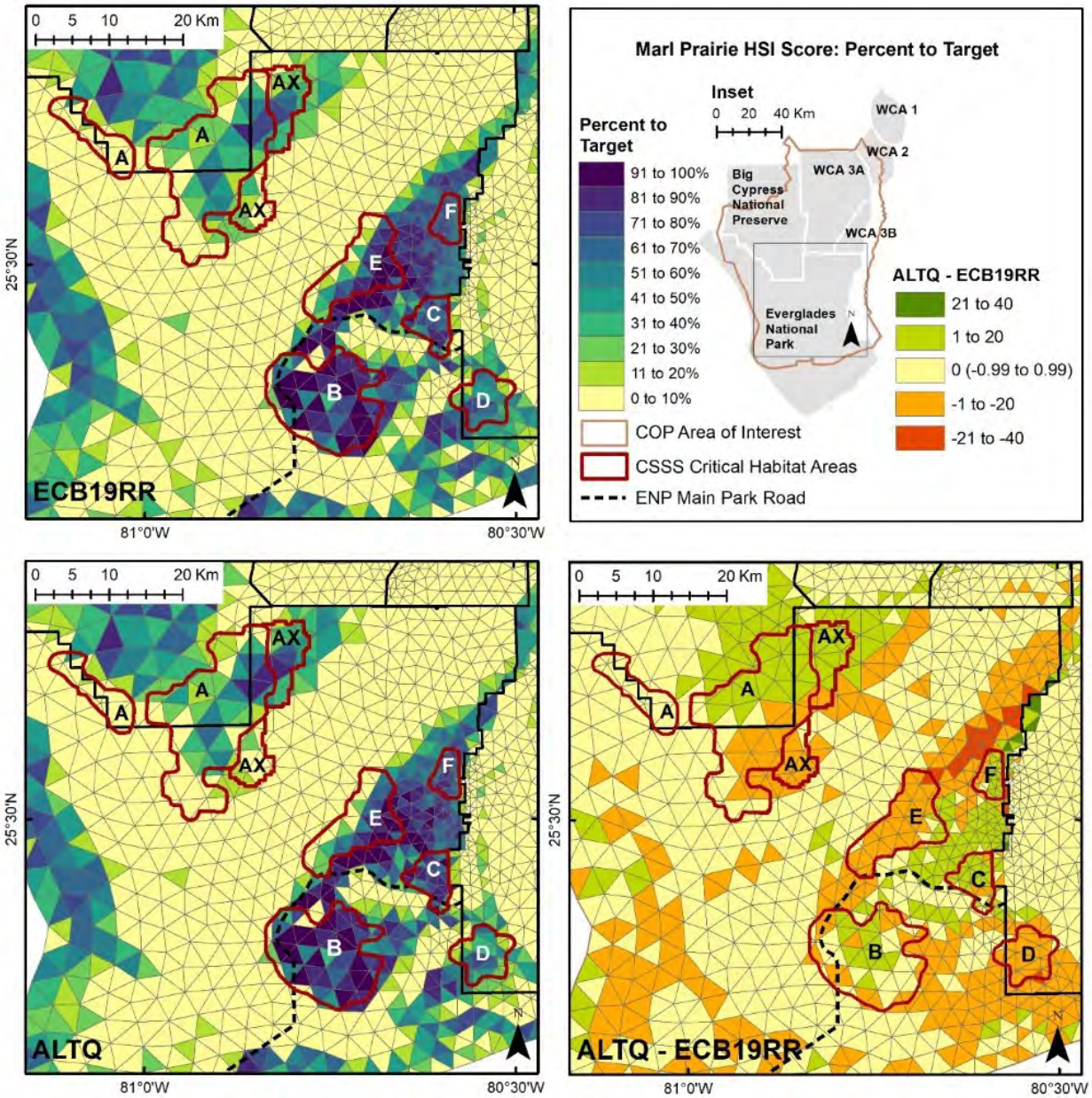


Figure 10. Model output from the Marl Prairie Habitat Suitability Index (Pearlstine et al., 2016). The bottom right map labeled ALT Q – ECB19RR shows the differences between these two runs and uses the color ramp located in the top right corner.

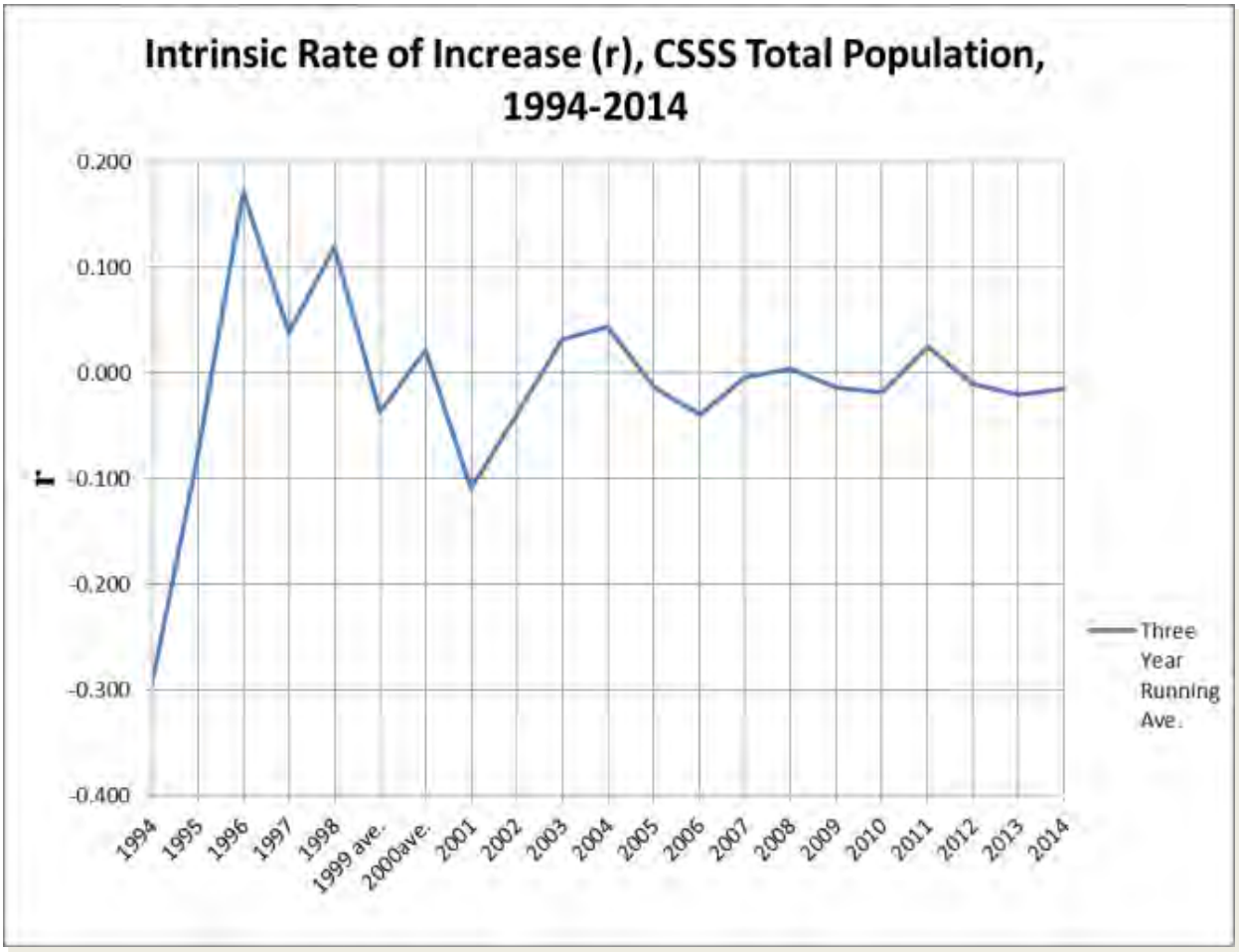


Figure 11. The intrinsic rate of increase of the total Cape Sable seaside sparrow population from 1994 to 2014. An (r) greater than 0 indicates an increasing population; r less than 0 indicates a declining population. From 1994 to 2004, the three-year running average of r was greater than 0 in 6 years, and less than 0 in 4 years. Within the last 10 years, the three-year running average of r was greater than 0 in 2 years, and less than 0 in 8 years.

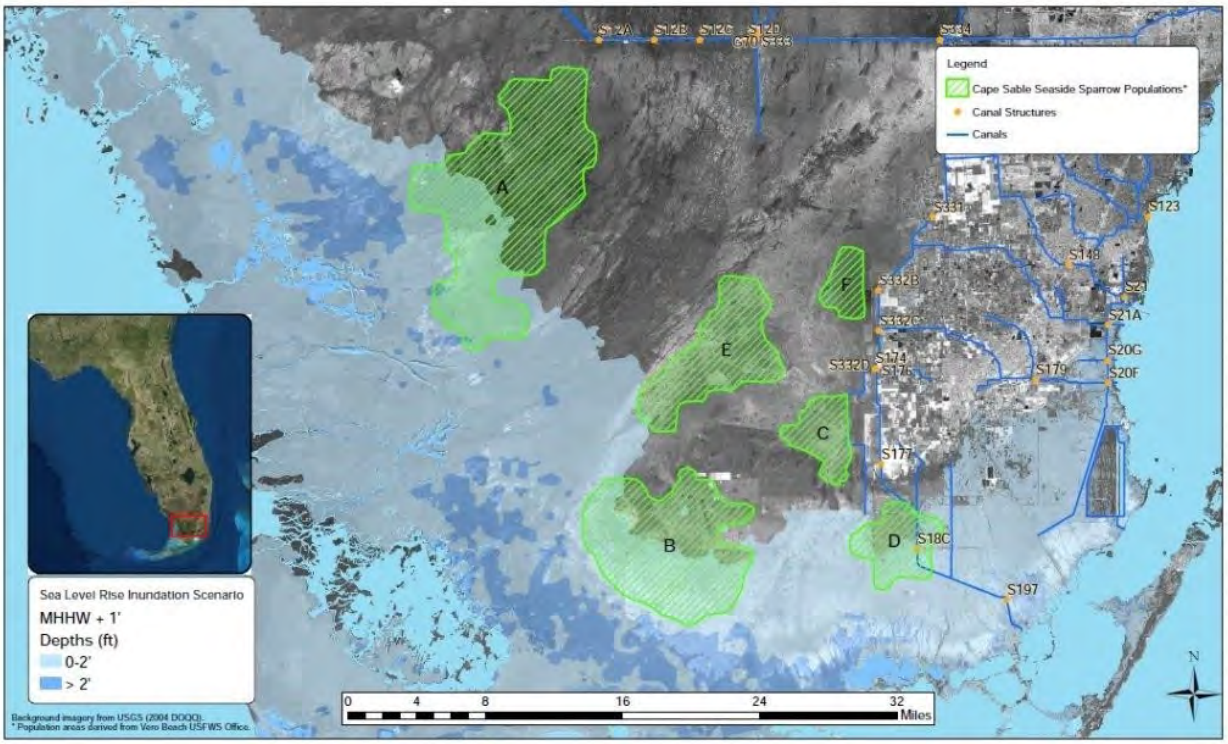


Figure 12. Sea level rise (MHHW +1ft.). Cape Sable seaside sparrow subpopulations are shown in green.

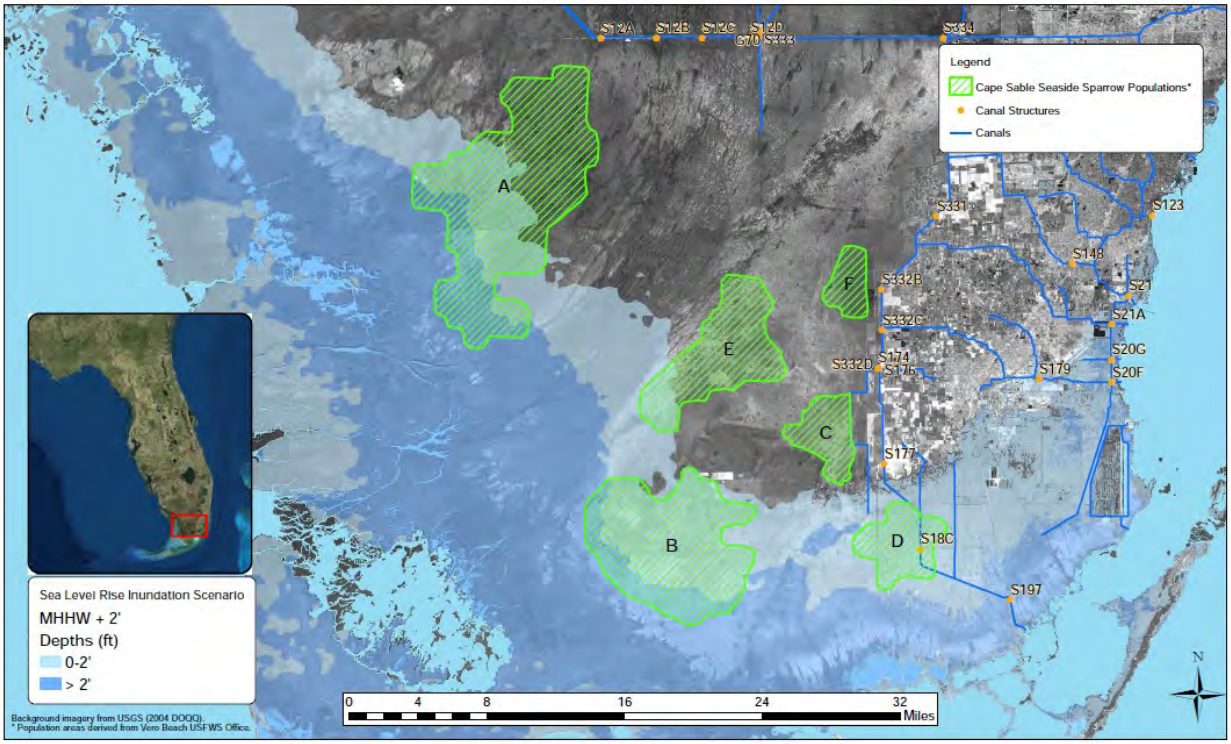


Figure 13. Sea level rise (MHHW +2ft.). Cape Sable seaside sparrow subpopulations are shown in green.

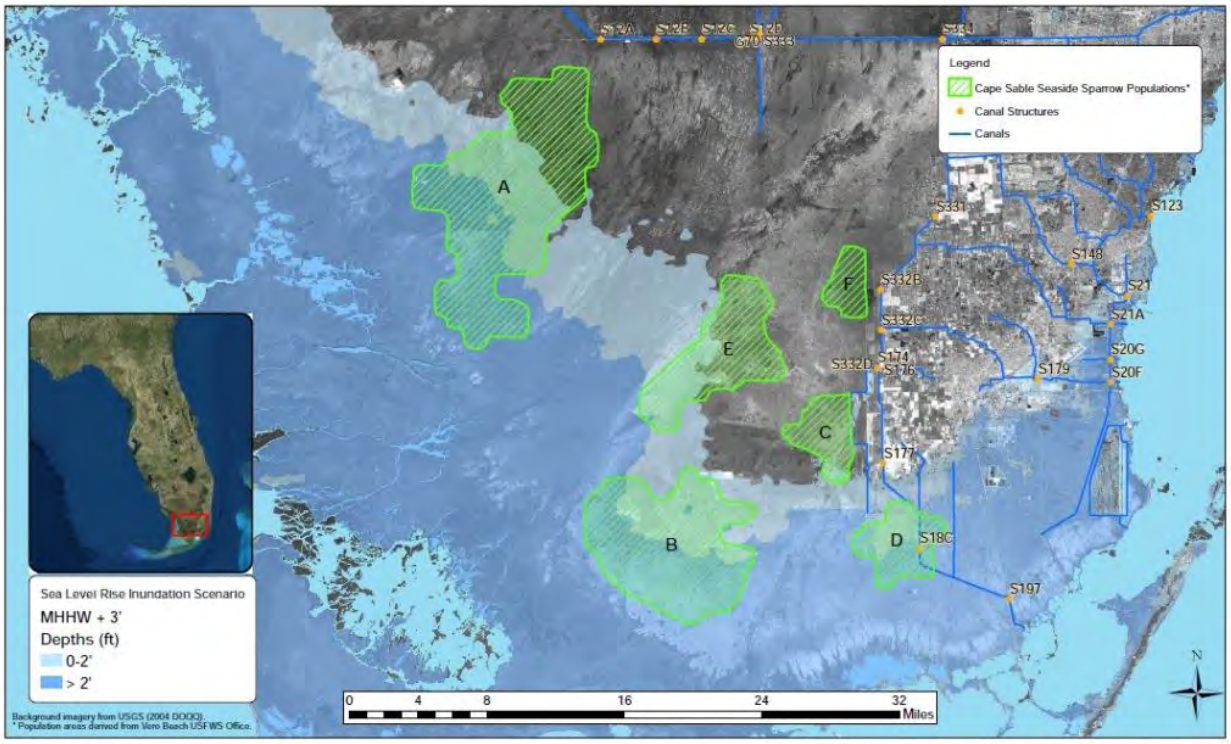


Figure 14. Sea level rise (MHHW +3ft.). Cape Sable seaside sparrow subpopulations are shown in green.

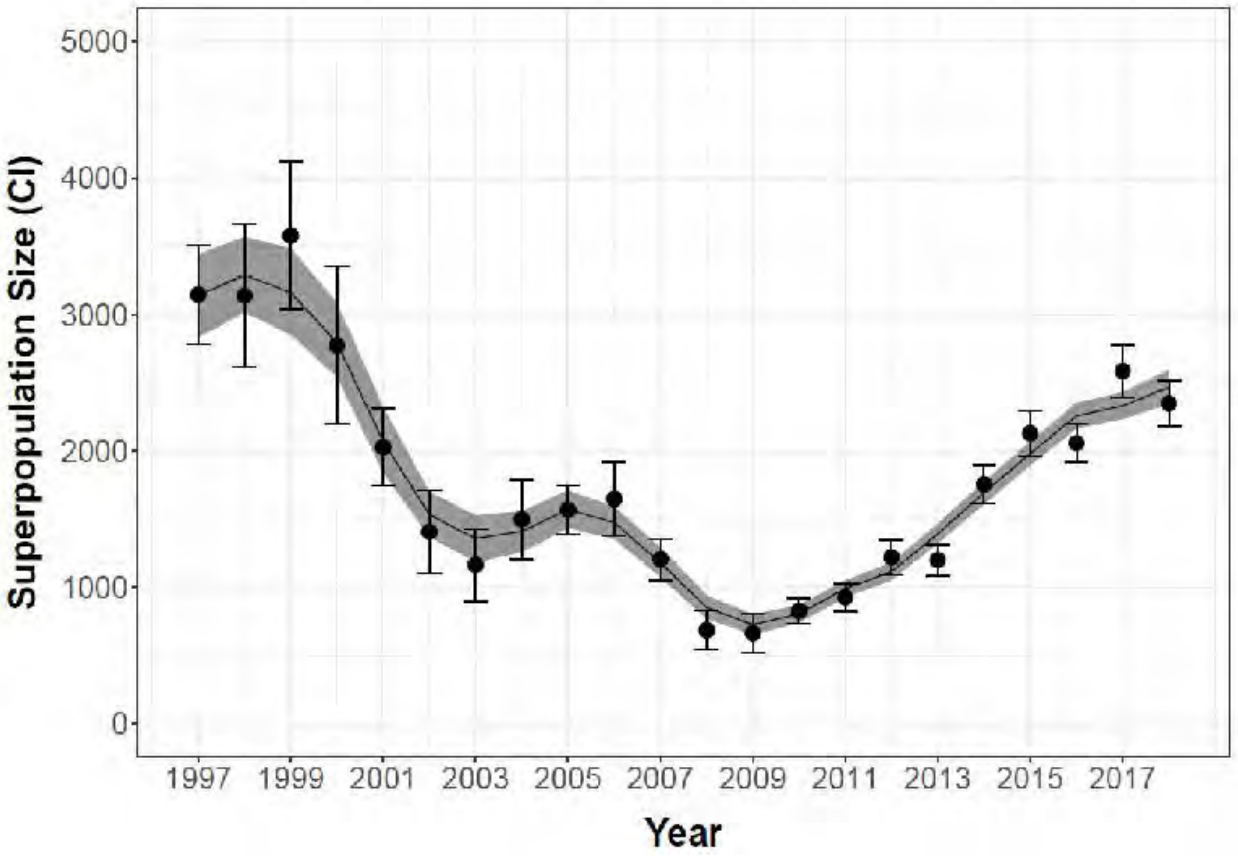


Figure 15. Snail Kite range wide population size and trends: 1997-2018 (Fletcher and University of Florida, 2018).

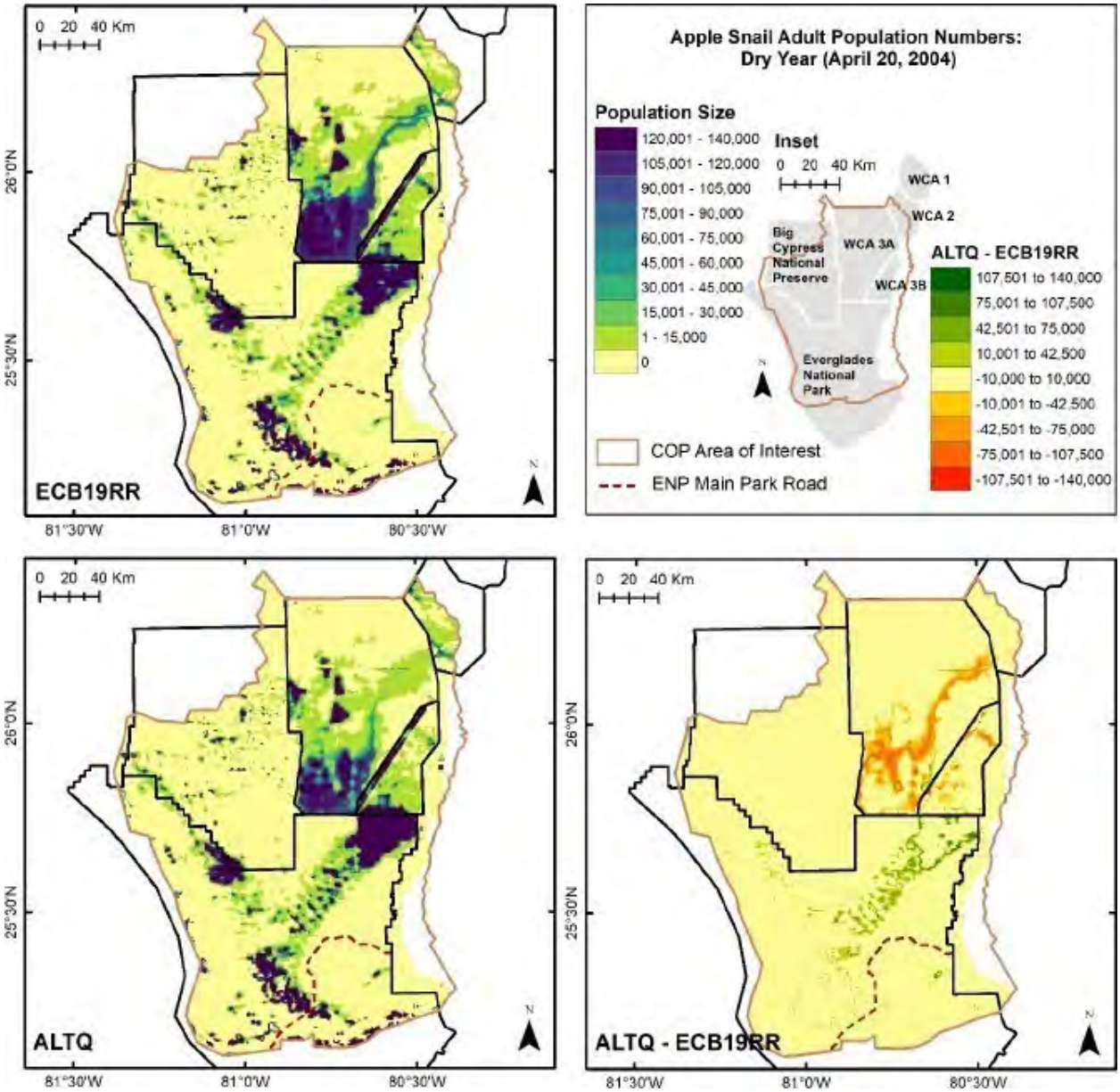


Figure 16. Apple snail adult population numbers for a dry year (April 20, 2004) ALT Q.

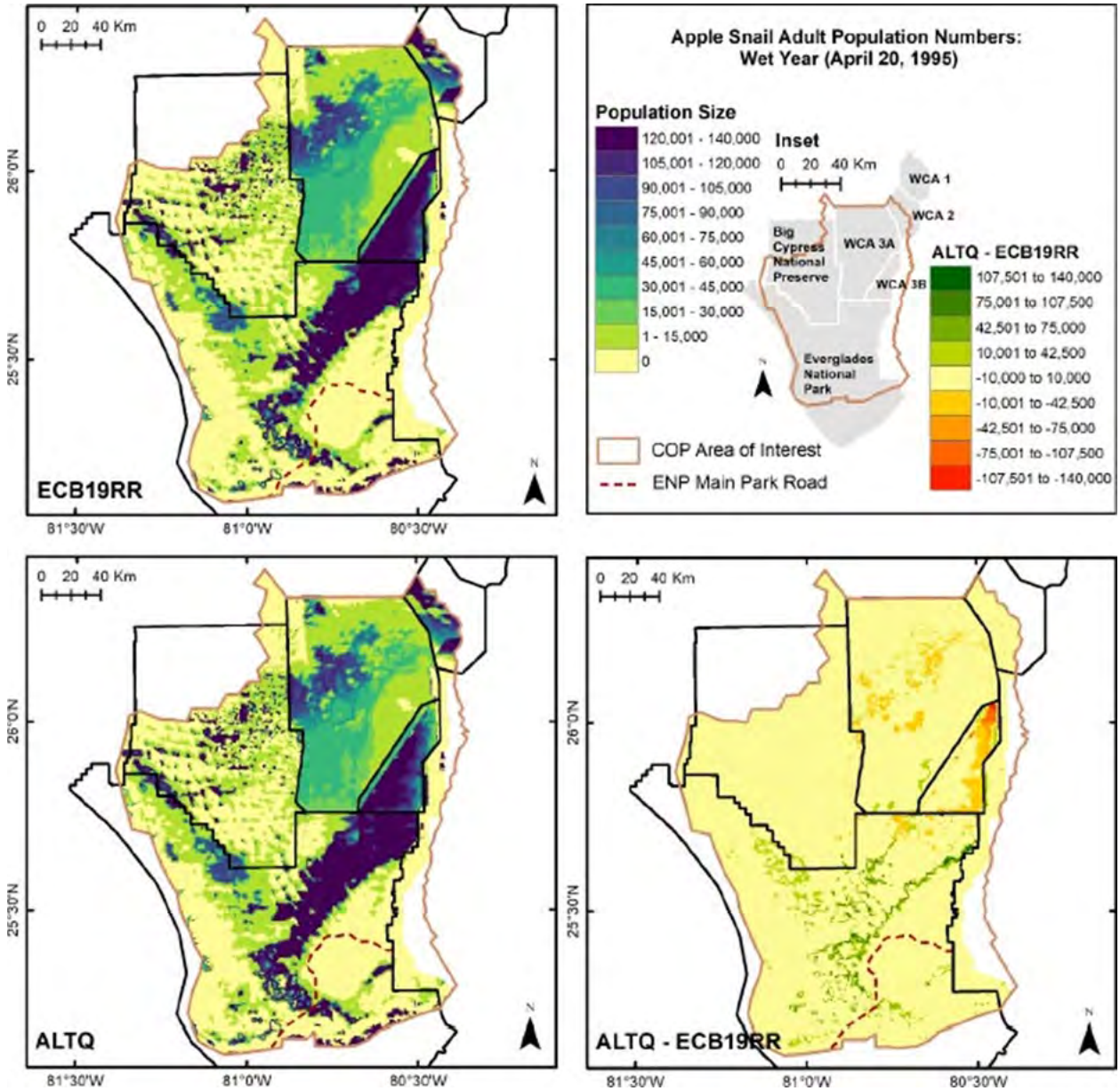


Figure 17. Apple snail adult population numbers for a wet year (April 20, 1995) ALT Q.

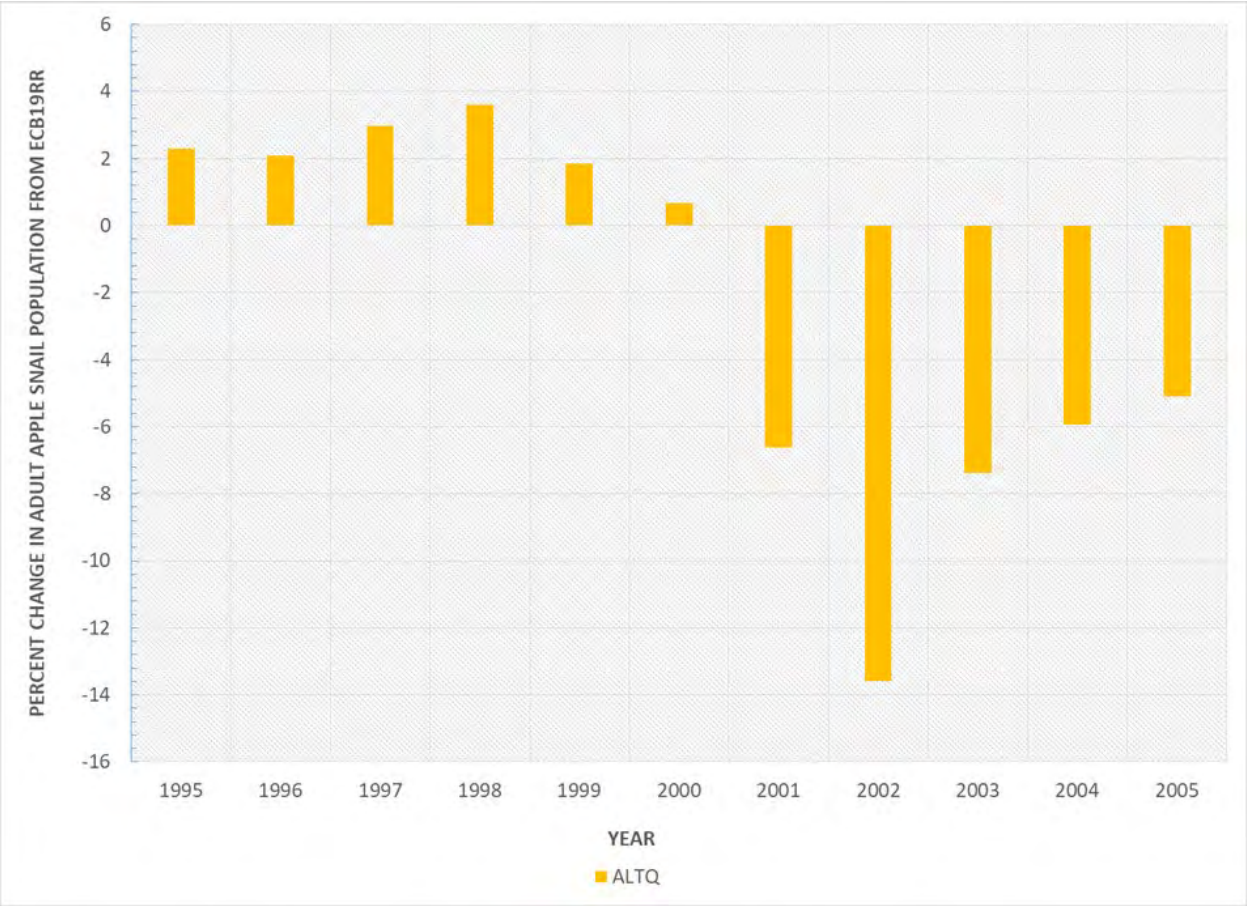


Figure 18. Mean percent change in adult apple snail population for each modeled year.

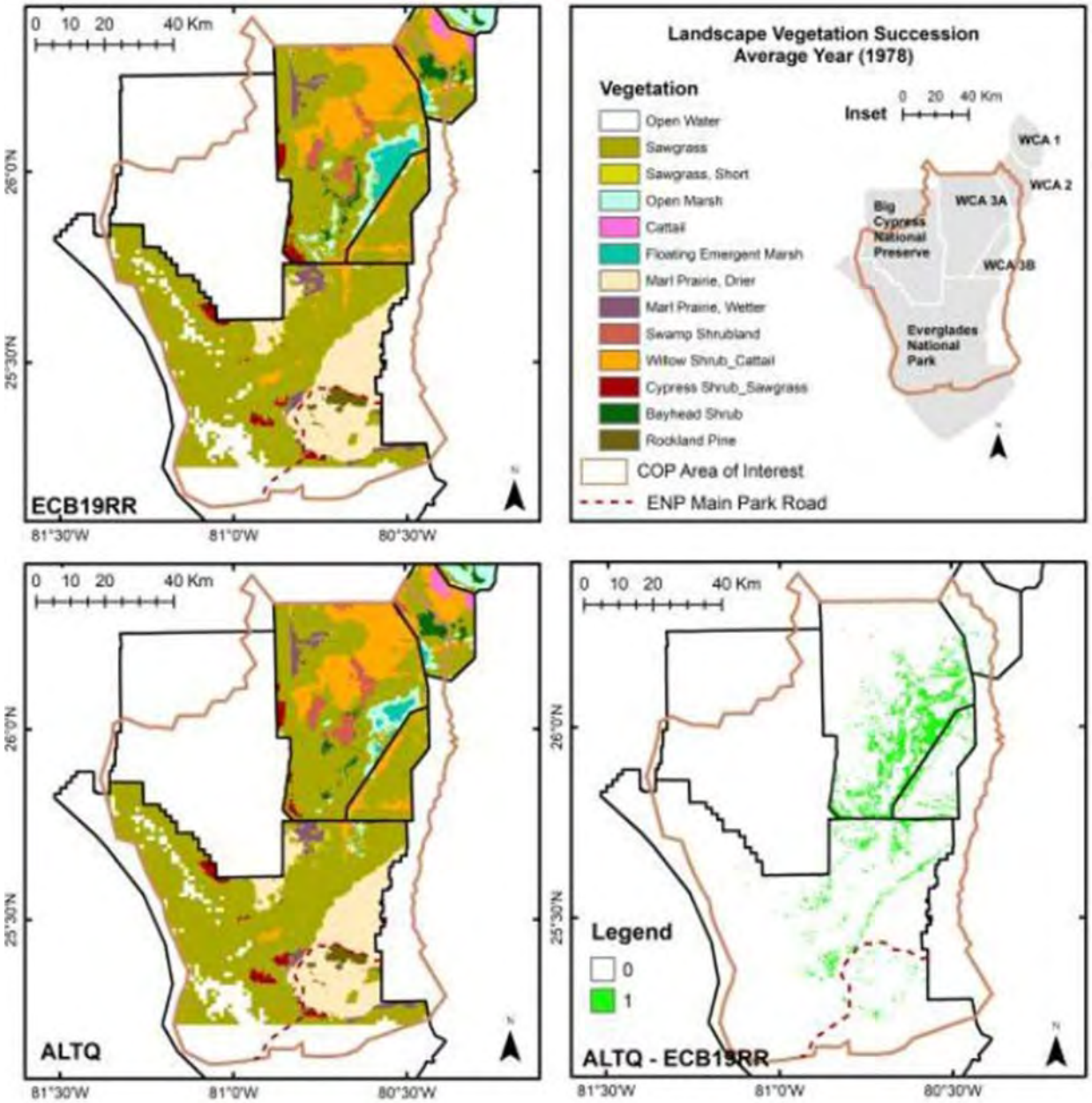


Figure 19. Landscape vegetation succession for an average year (1978) for ALT Q.

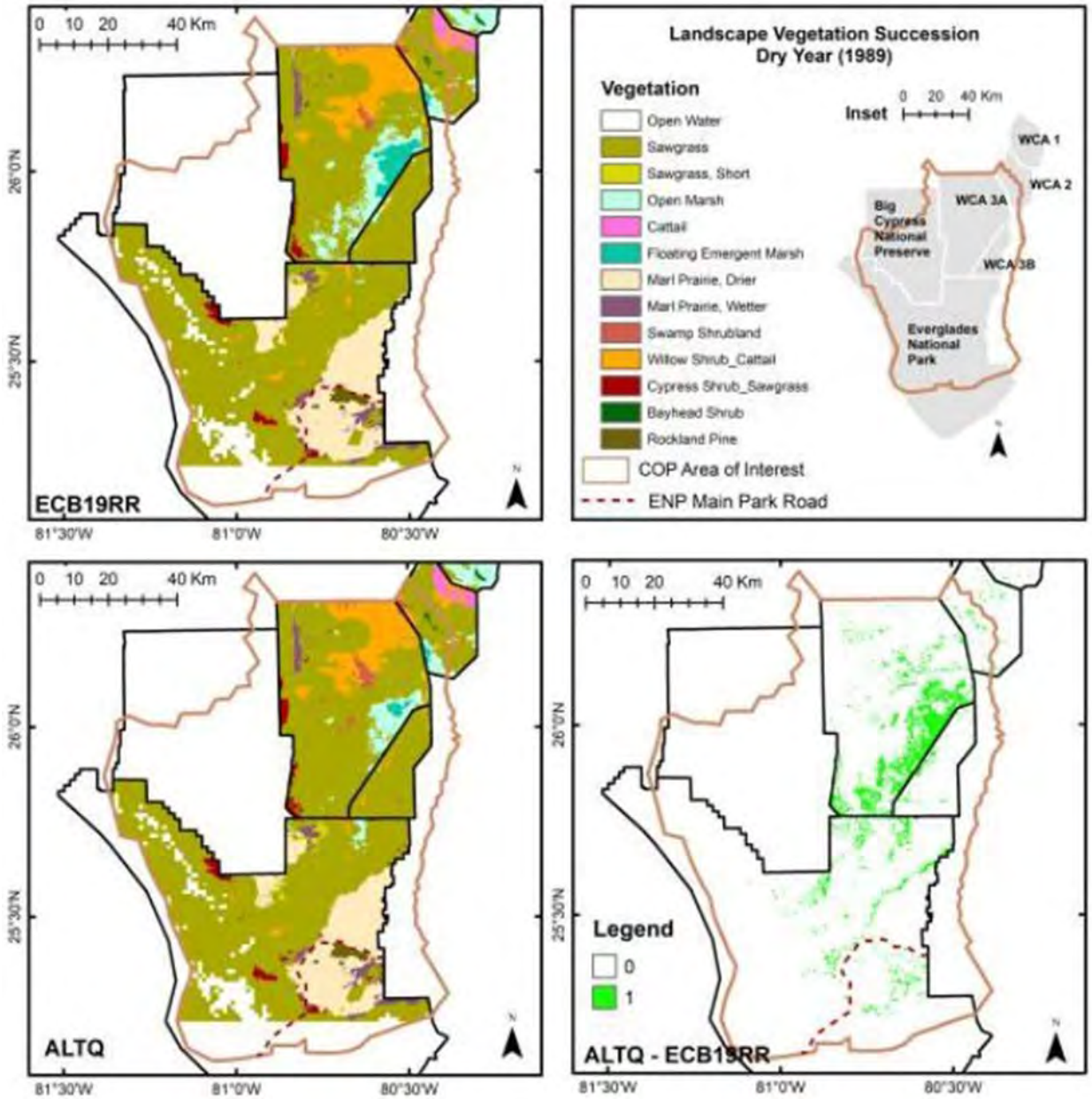


Figure 20. Landscape vegetation succession for a dry year (1989) for ALT Q.

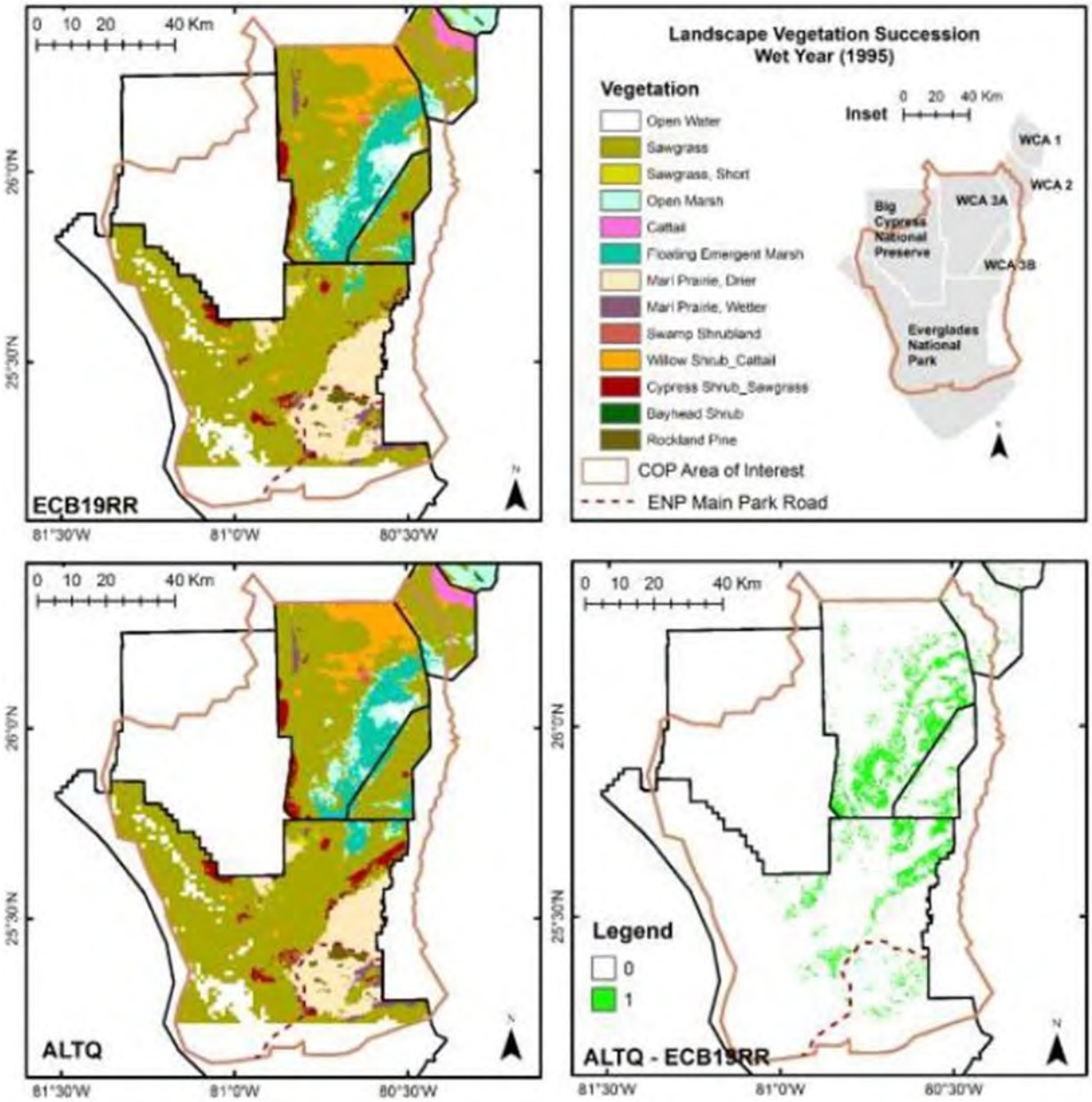


Figure 21. Landscape vegetation succession for a wet year (1995) for ALT Q.

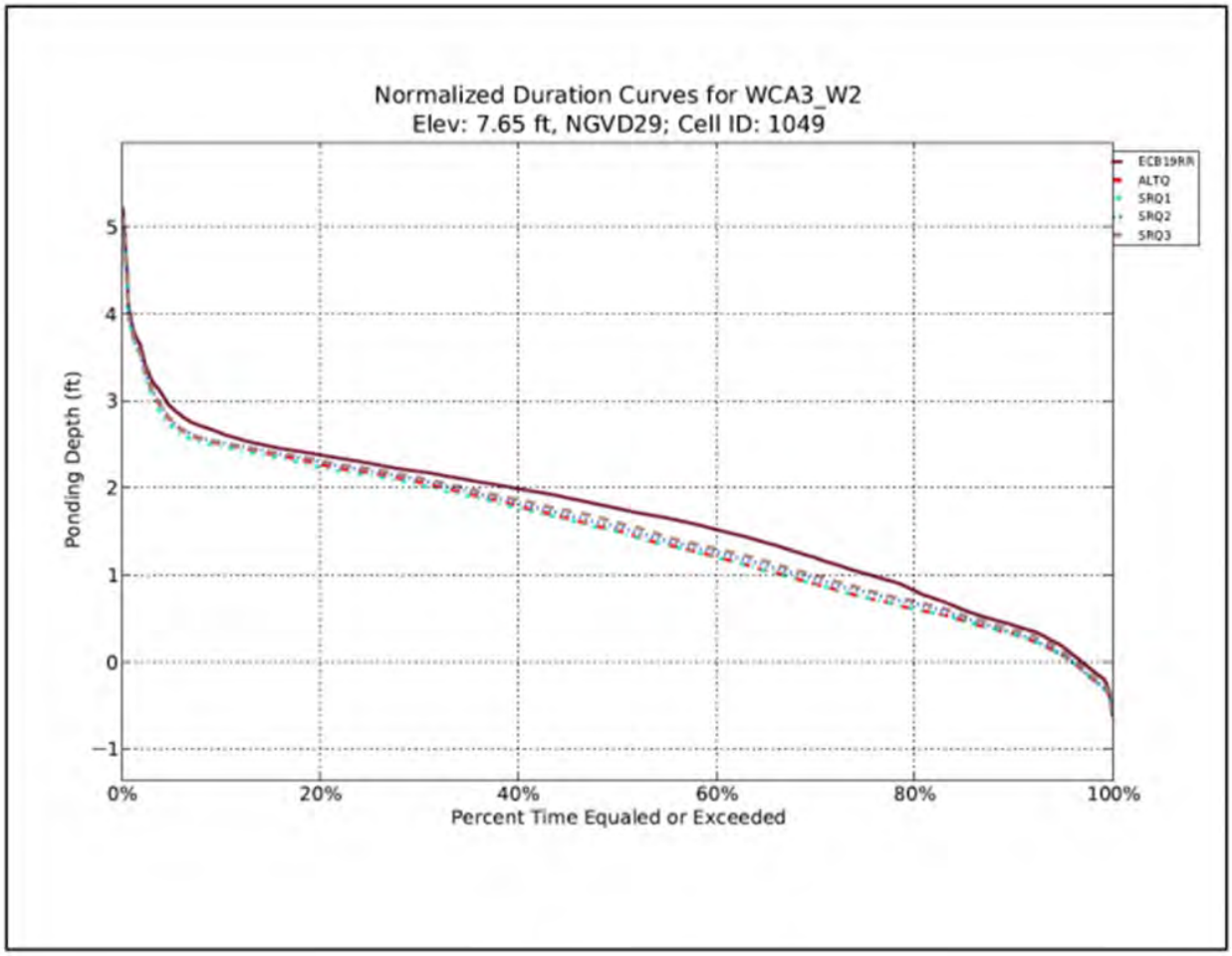


Figure 22. Depth duration curves for gauge WCA-3_W2.

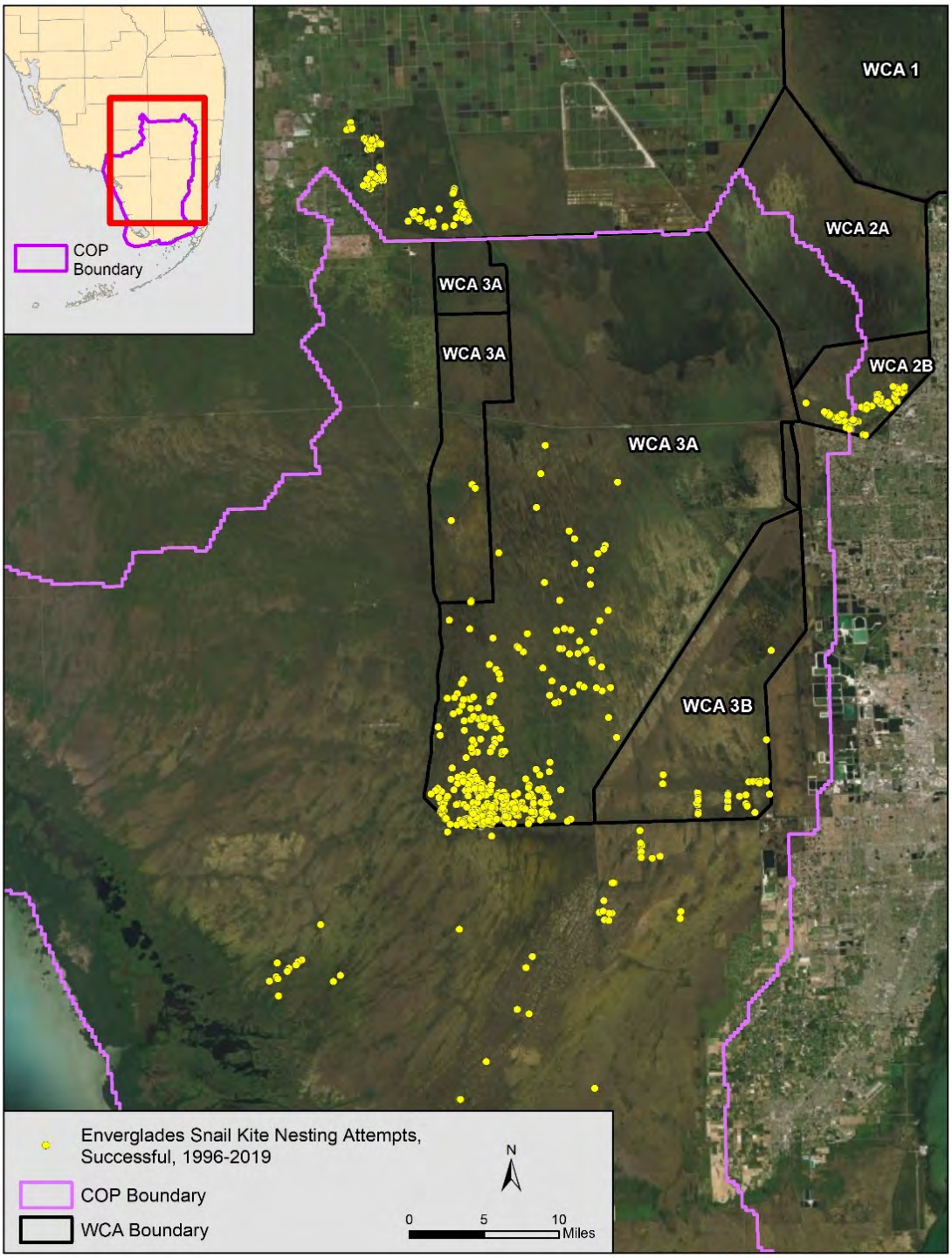


Figure 23. Successful Everglade snail kite nesting attempts within the COP action area from 1996 to 2019.

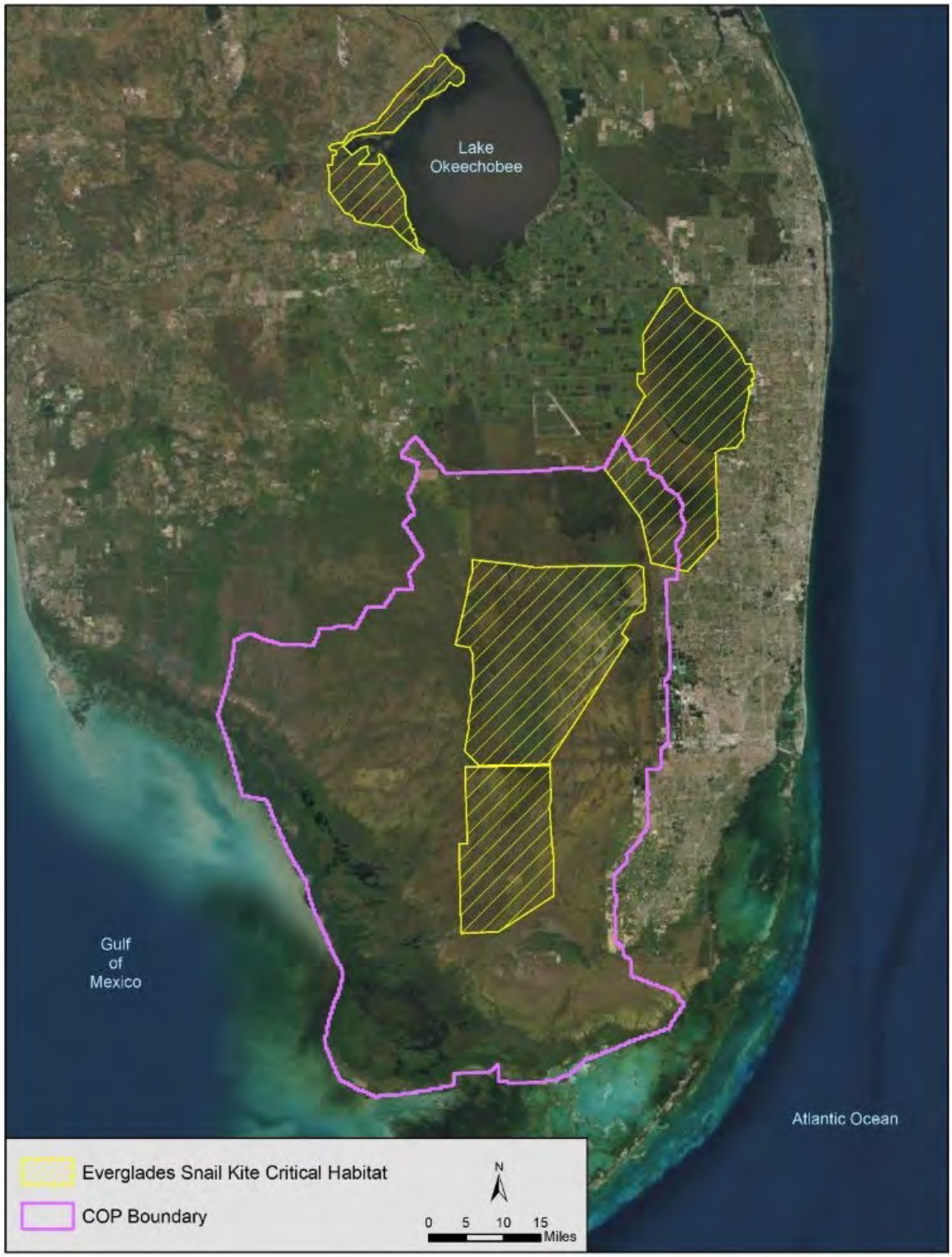


Figure 24. Everglade snail kite critical habitat within the COP action area.

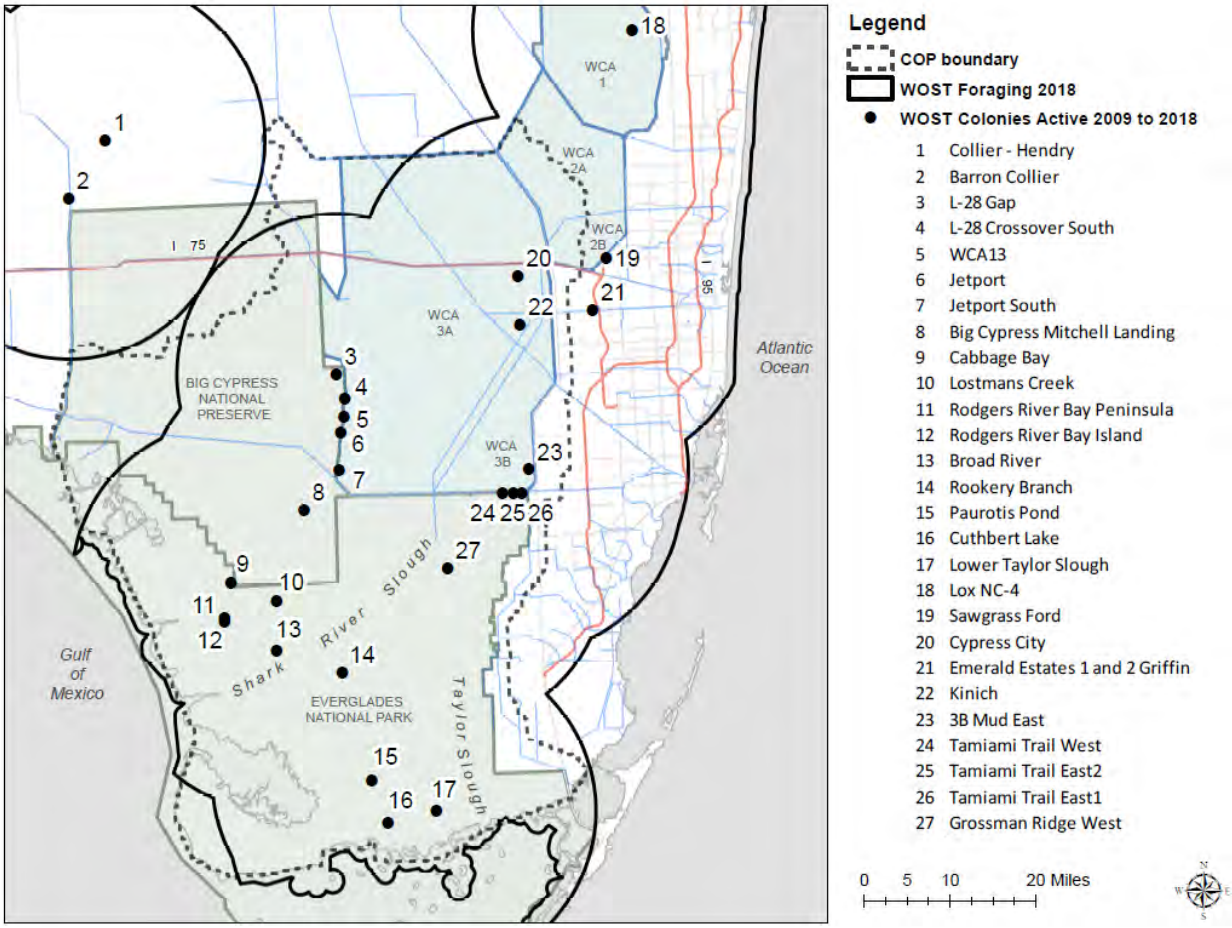


Figure 25. Wood stork (WOST) colonies and Core Foraging Areas (CFA) located within the COP boundary in WCA-3 and Everglades National Park, Florida.

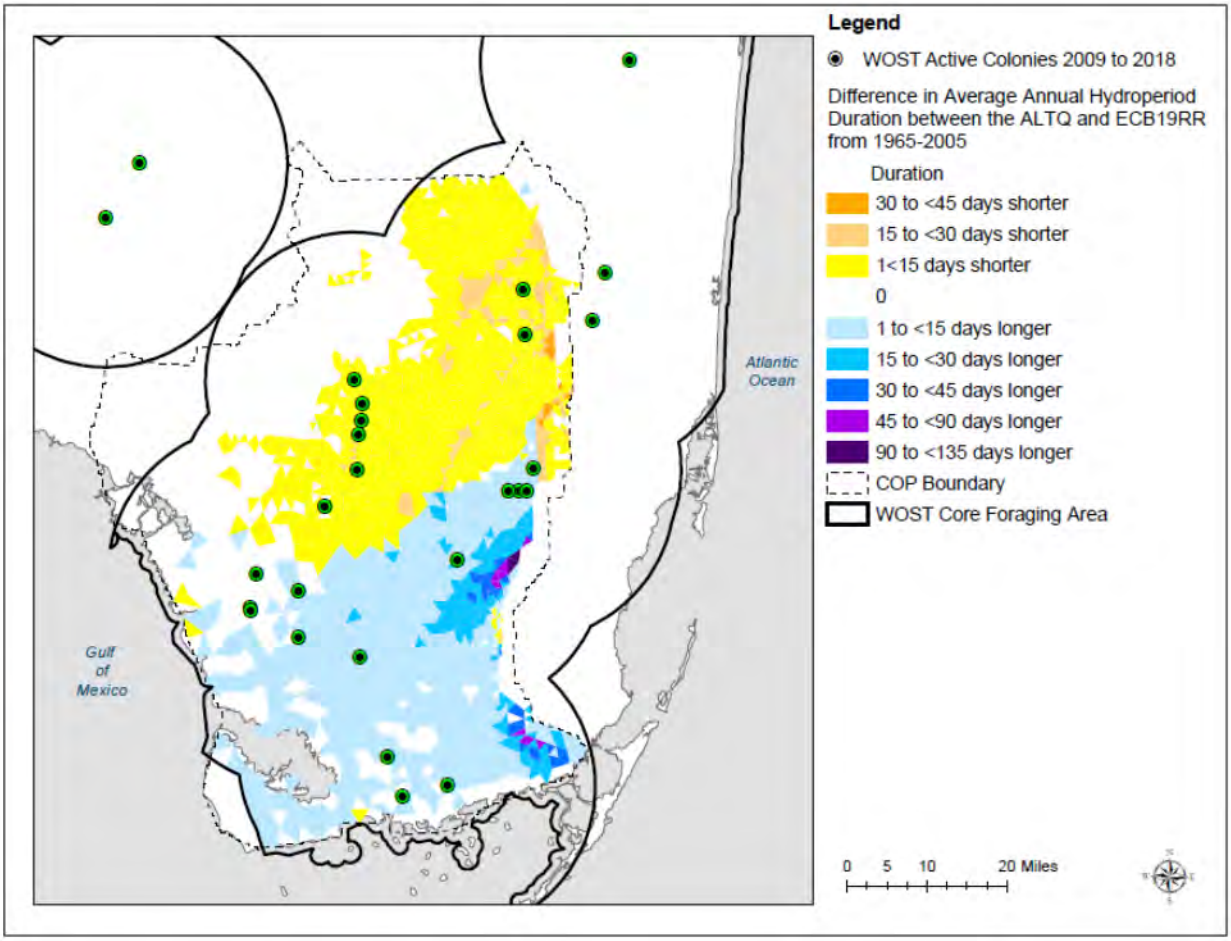


Figure 26. The difference between the COP (ALT Q) and the baseline (ECB19RR) average annual hydroperiod duration from 1965-2005. The average annual extent of reduced hydroperiods for east central and northeastern WCA-3A is shown as well as increased hydroperiods in NESRS and Taylor Slough.

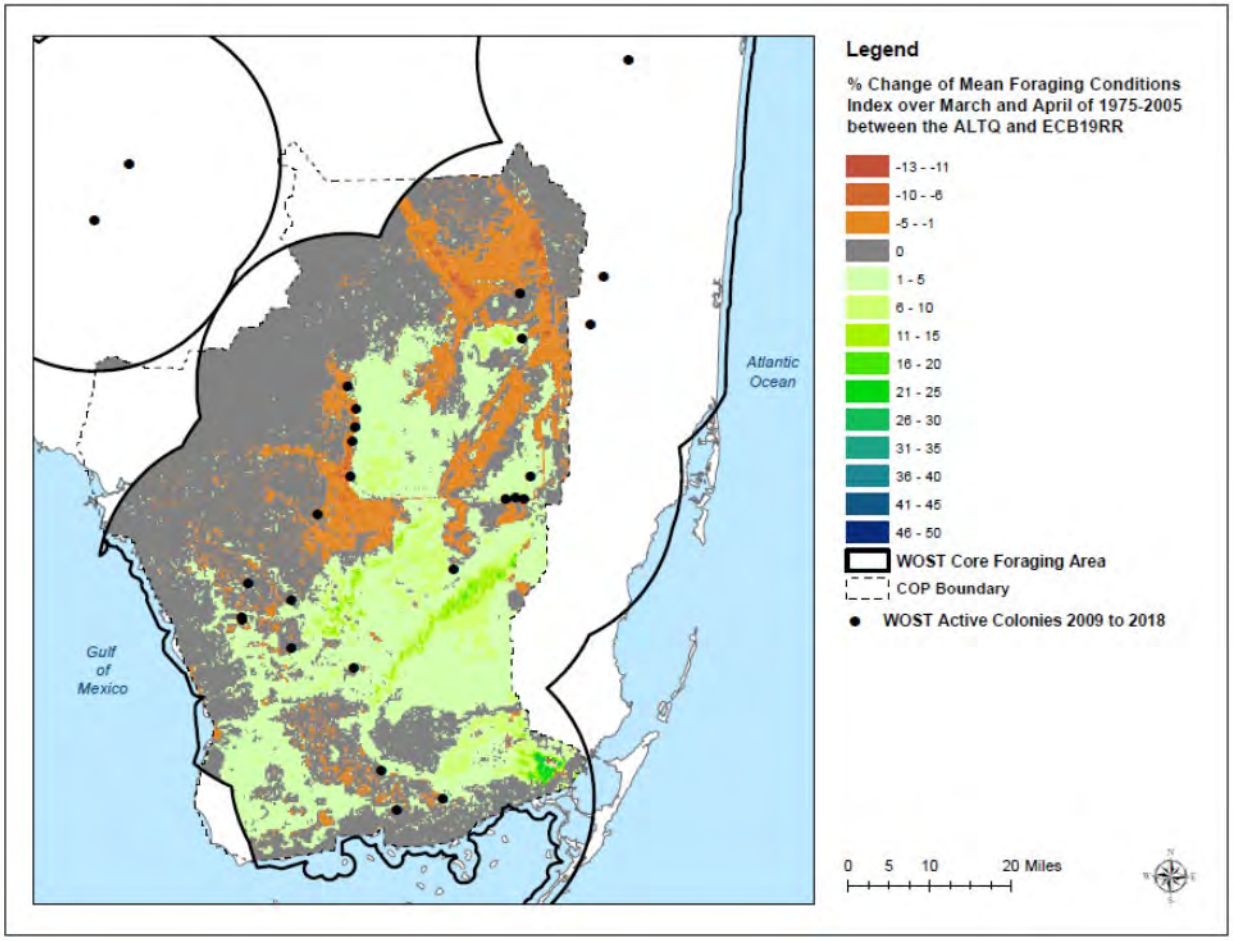


Figure 27. The percent change between the COP (ALT Q) and the baseline (ECB19RR) of the wood stork (WOST) mean spatial foraging conditions index over the months of March and April of 1975-2005. A color ramp is used to show changes in suitability for wood stork foraging across WCA3 and ENP. Observed differences between ALT Q and ECB19RR were most often not more than a ±10 change across the majority of WCA-3 and ENP. Improvements in foraging conditions were observed in NESRS and Taylor Slough while foraging conditions decreased in northeast WCA-3A and along the L-67 canal in WCA-3B under ALT Q.

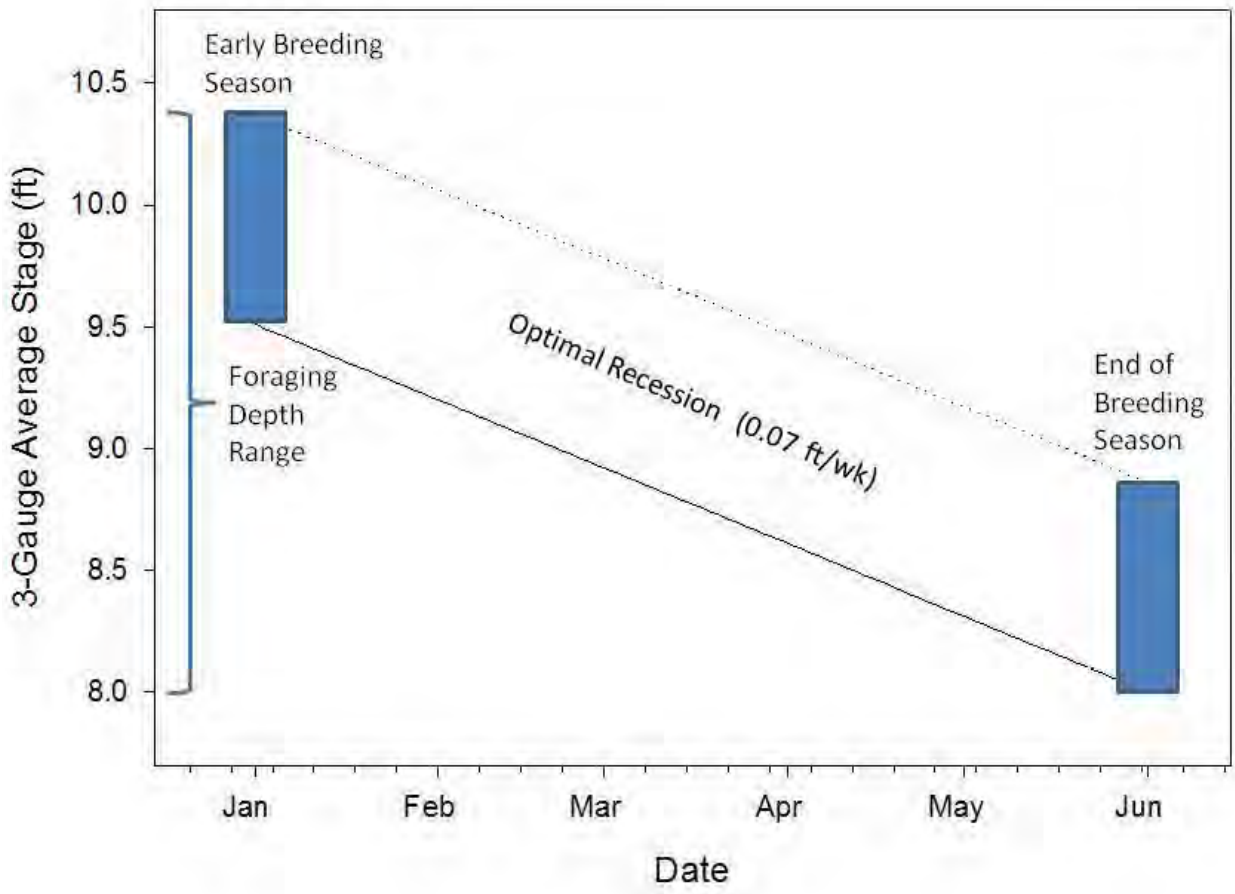


Figure 28. Beerens and Cook (2010) maximum 3AVG stage associated with wood storks feeding in WCA-3A.

Appendix A -
Wood Stork Foraging Habitat Assessment Methodology
July 12, 2012

The decline of the wood stork in the United States is primarily due to the loss of wetland habitats and the concomitant reduction in prey availability. To determine the effect of development actions on the wood stork in south Florida, the Service has chosen to assess the action's effect on wood stork foraging habitat. As such, the Service has developed a functional assessment known as the "Wood Stork Foraging Habitat Assessment Methodology" (Methodology), as described below. The Methodology can be used to estimate the biomass of wood stork forage provided per unit quantity of wetland habitat. The assessment can be applied to both wetlands being lost by a development project and the wetlands proposed as mitigation.

The Service has identified four parameters that can be used in the estimation of wood stork prey biomass:

1. Vegetation Density
2. Wetland Hydroperiod
3. Prey Size Suitability
4. Competition with other wading bird species for forage

Parameter 1 - Density of vegetation

As discussed previously, a wetland's suitability for wood stork foraging is partially dependent on its vegetation density. Coulter and Bryan (1993) found that wood storks prefer to forage in ponds and marshes with little or no canopy. Wood storks have been observed foraging in forested wetlands (*e.g.,* swamps, mesic woodlands etc.), but prefer open areas within these habitat types (Coulter and Bryan 1993; P.C. Frederick, University of Florida, personal communication 2006; J.A. Rodgers, FWC, personal communication 2006). Coulter and Bryan (1993) suggested that wetlands with open canopies may be more readily detected by wood storks and are easier to land at than at closed-canopy sites. Wetlands with sparse canopies also allow wood storks to take flight more quickly to avoid predators.

Parameter 1 - Foraging suitability value (Vegetation Density)

To determine how the presence of invasive exotic vegetation may affect wood stork foraging, we developed foraging suitability indices for wetlands (as described below) using data from O'Hare and Dalrymple (1997). O'Hare and Dalrymple (1997) identified five vegetation classes based on coverage of melalueca (Table WSM1):

Table WSM1. Classes of Melalueca Coverage (from O'Hare and Dalrymple 1997).

75-100 percent mature dense melaleuca coverage (DMM)
75-100 percent sapling dense melaleuca coverage (DMS or SDM)
50-75 percent melaleuca coverage (P75)
0-50 percent melaleuca coverage (P50)
0-10 percent melaleuca coverage (Marsh [MAR])

The number of wetland-dependent bird species and individuals observed per cover type by O'Hare and Dalrymple (1997) are listed in columns 2 and 3 in Table WSM2.

Table WSM2. Foraging suitability indices for wetland-dependent birds species.

Cover type	**No. of species (S)**	**No. of individuals (I)**	**S*I**	**Foraging suitability**
DMM	1	2	2	0.001
DMS	4	10	40	0.025
P75	10	59	590	0.372
P50	11	92	1,012	0.639
MAR	12	132	1,584	1.000

The foraging suitability index for wetlands dependent birds is calculated for each cover type from O'Hare and Dalrymple (1997) (Table WSM2) by multiplying the number of species observed (S) by the number of individuals observed (I). The product (S*I) is then divided by the product of the number of species for MAR and the number of individuals for MAR.

(12 x 132 = 1,584) observed by O'Hare and Dalrymple (1997). Based on the calculations listed above, we developed foraging suitability indices for wetlands used by wood storks based on the coverage of exotic plants (Table WSM3). The Service chose 0.03 (the foraging suitability index for the DMS cover type, rounded up from 0.025) to define foraging suitability for exotic plant coverage ranging from 76 percent to 100 percent.

Table WSM3. Wood Stork Foraging Suitability Indices.

Exotic Plants (percent coverage)	Foraging Suitability Index
0 to 25	1.00
26 to 50	0.64 (rounded up from 0.639)
51 to 75	0.37 (rounded down from 0.372)
76 to 100	0.03 (rounded up from 0.025)

Parameter 2 – Wetland Hydroperiod

Hydroperiod: The hydroperiod of a wetland can affect the density of wood stork prey species. For example, studies of Everglades fish populations using a variety of quantitative sampling techniques (pull traps, throw traps, block nets) have shown that the

density of small forage fish increases with hydroperiod. Marshes inundated for less than 120 days per year average

± 4 fish/meter $(m)^2$, and marshes inundated for more than 340 days per year average ± 25 fish/m^2 (Loftus and Eklund 1994; Trexler et al. 2002).

Kushlan (1990) described short hydroperiod wetlands as wetlands inundated from 0 to 180 days per year, intermediate hydroperiod wetlands as wetlands inundated from 180 to 270 days per year, and long hydroperiod wetlands as wetlands inundated from 270 to 360 days per year.

However, Trexler et al. (2002) defined short hydroperiod wetlands as wetlands with less than 300 days per year inundation. For the purposes of our Methodology, the Service defines wetlands inundated from 0 to 180 days per year as "short hydroperiod" wetlands and wetlands inundated from 180 to 360 days per year as "long hydroperiod" wetlands. In addition, we have adopted the seven wetland hydroperiod classes for wetlands in south Florida used by the SFWMD in their evaluation of various restoration projects throughout the Everglades Protection Area (Table WSM4).

Table WSM4. SFWMD's hydroperiod classes for Everglades Protection Area.

Hydroperiod Class	Number of days inundated
1	0-60
2	60-120
3	120-180
4	180-240
5	240-300
6	300-330
7	330-365

The Service estimated the fish biomass available to the wood stork for each of the SFWMD's hydroperiod classes listed in Table WSM4 as follows. First, we took estimates of fish density (number of fish/ m^2) for the various hydroperiod classes presented in Trexler et al. (2002) (Table WSM5). Trexler et al. (2002) derived these density estimates from throw trap sampling of wetland sites in the Everglades, and the estimates were presented as the square root of the number of fish/m^2 for each of six hydroperiod classes. It is important to note that Trexler et al. (2002) used six hydroperiod classes to characterize the length of inundation during the year compared to the seven hydroperiod classed employed by the SFWMD and used by the Service in our Methodology (Table WSM4). The fish density estimates presented Trexler et al. 2002, increase with hydroperiod class, and this trend has been noted by other investigators (Turner et al. 1999, Turner and Trexler 1997, Carlson and Duever 1979).

Table WSM5. Fish densities per hydroperiod from Trexler et al. (2002).

Hydroperiod class	Days inundated	Fish Density(fish/m^2)*
Class 1	0-120	2.0
Class 2	120-180	3.0
Class 3	180-240	4.0
Class 4	240-300	4.5
Class 5	300-330	4.8
Class 6	330-365	5.0

*As presented, these densities are square root transformed, as described in Trexler et al 2002.

For our assessment, we transformed the fish density data provided by Trexler et al. 2002 to obtain fish density values for each of seven hydroperiods defined by the SFWMD. We obtained a fish density value of 2 fish/m^2 for the SFWMD's Class 1 hydroperiod (0 to 60 days inundated; Table WSM6) by extrapolating Trexler et al.'s Class 1 hydroperiod fish density value of 2.0 fish/m^2 for 0 to 120 days inundated to 1.0 fish/m.^{2} and doubling this value. To calculate fish density values for the remaining SFWMD hydroperiods (Classes 2 through 7), the fish density values for hydroperiod classes 1 through 6 presented by Trexler et al. 2002 (Table WSM5) were squared. Fish density values for each of the seven SFWMD hydroperiod classes are as presented in Table WSM6.

Table WSM6. Extrapolated values of fish density per each SFWMD hydroperiod.

Hydroperiod class	Days inundated	Fish density
Class 1	0-60	2 fish/m^2
Class 2	60-120	4 fish/m^2
Class 3	120-180	9 fish/m^2
Class 4	180-240	16 fish/m^2
Class 5	240-300	20 fish/m^2
Class 6	300-330	23 fish/m^2
Class 7	330-365	25 fish/m^2

The Service is aware the throw-trap method used by Trexler et al. (2002) generally only captures fish 8 centimeters (cm) (3.15 inches [in]) or less in total length. However, the Service believes the data provide a good approximation of the fish sizes preferred by wood storks. We note Ogden et al (1976) found wood storks generally consume fish ranging in total length from 1.5 cm (0.59 in) to 9 cm (3.54 in), and Kushlan et al. (1975) reported wood storks feed primarily on fish from 6 cm (2.36 in) to 8 cm (3.15 in) total length. The Service is aware wood storks will occasionally forage on fish larger than 8cm total length, and we acknowledge this size class of fish is not completely captured by our methodology. However, we note only a small proportion of the wood stork's diet consists of fish greater than 8 cm total length. As such, we do not believe our assessment of wood stork foraging biomass is significantly flawed.

The transformed estimates of fish density listed in Table WSM6 are now used to estimate fish biomass for each of the seven hydroperiods. For our assessment, we considered class 7 hydroperiod wetlands with a density of 25 fish/m^2 to have a mean annual biomass of 6.5 grams /m^2 (wet mass). This estimate of mean annual biomass was based on studies conducted by Turner et al. (1999), Trexler et al. (2002), and Carlson and Duever (1979) in Everglades National Park and WCA-3A. In these studies, the mean biomass (standing stock) of fish from Class 5 and 6 hydroperiod wetlands ranged from 5.5 to 6.5 grams/m^2 (wet mass). These data were originally calculated as g/m^2 dry mass and converted to g/m^2 wet mass following the procedures referenced in Kushlan et al (1986) and also referenced in Turner et al (1999). The fish density data provided in Turner et al. (1999) included both data from samples representing fish 8 cm or smaller and fish larger than 8 cm (3.15 in) and included summaries of data presented in Turner and Trexler (1997), Carlson and Duever (1979), and Loftus and Eklund (1994). These data sets also applied a 0.6 g/m^2 (dry mass) correction estimate for fish greater than 8 cm (3.15 in) based on Turner et al's (1999) block-net rotenone samples.

We estimated the biomass for the SFWMD hydroperiod classes 1 through 6 based on the fish density of 25 fish/m^2 and the biomass of 6.5 grams/m^2 wet mass derived for the Class 7 hydroperiod described above. First, we calculated a mean biomass per fish value of 0.26 grams/m^2 wet mass by dividing 6.5 grams/m^2 wet mass by 25 fish/m^2. We then multiplied the mean biomass per fish value of 0.26 grams/m^2 wet mass by the fish density values for hydroperiod classes 1 through 6. For example, the biomass of fish provided by the Class 3 hydroperiod is 2.3 grams/m^2 (9 x 0.26 = 2.3). The calculated values of fish biomass are presented in Table WSM7.

Table WSM7. Estimated mean annual fish biomass for SFWMD's hydroperiods.

Hydroperiod class	Days inundated	Mean annual fish biomass
Class 1	0-60	0.5 gram/m^2
Class 2	60-120	1.0 gram/m^2
Class 3	120-180	2.3 grams/m^2
Class 4	180-240	4.2 grams/m^2
Class 5	240-300	5.2 grams/m^2
Class 6	300-330	6.0 grams/m^2
Class 7	330-365	6.5 grams/m^2

Parameter 3 – Prey Size Suitability

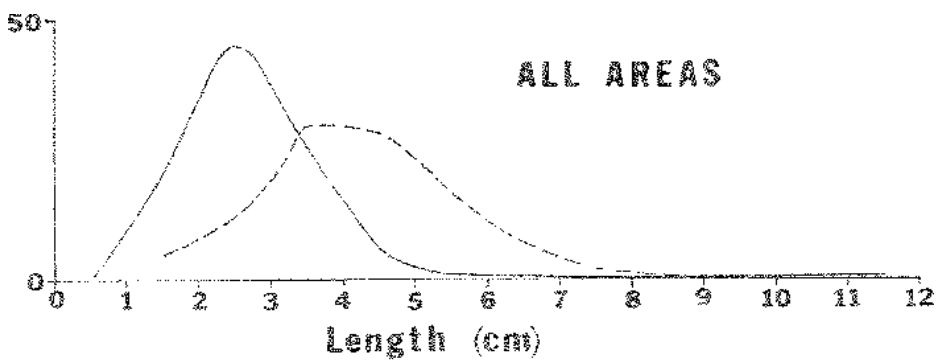
Wood storks are highly selective in their feeding habits. Ogden et al. (1976) reported that five species of fish comprised over 85 percent of the number and 84 percent of the biomass of over 3,000 prey items collected from adult and nestling wood storks (Table WSM8). These species were also observed to be consumed by wood storks in greater proportion than smaller and more abundant fish species [*e.g.*, mosquito fish (*Gambusia affinis*), least killifish (*Heterandria formosa*), and bluefin killifish (*Lucania goodei*)]. This may be the

result of the small body size of these species not eliciting a bill-snapping reflex by wood storks (Coulter et al. 1999).

Table WSM8. Primary fish species consumed by wood storks from Ogden et al. (1976).

Common name	Scientific name	Percent individuals	Percent biomass
Sunfishes	*Centrarchidae* spp.	14	44
Yellow bullhead	*Italurus natalis*	2	12
Marsh killifish	*Fundulus confluentus*	18	11
Flagfish	*Jordenella floridae*	32	7
Sailfin molly	*Poecilia latipinna*	20	11

The following figure from Ogden et al. (1976) compares the frequency (expressed as percent, 0 to 50) of the fish size available to wood storks (solid line) and the frequency of fish size consumed by wood storks (dashed line). The area under the dashed line represents the size of fish most likely consumed by wood storks (1.5 to 9.0 cm in total length).



The Service has adopted this range of fish sizes as those most likely to be consumed by the wood stork and we will use this size range in our assessment of wood stork forage (see discussion below). As discussed above, the throw-trap method used by Trexler et al. (2002) generally only captures fish 8 cm or less in total length, and wood storks occasionally consume fish larger than 8cm in total length. However, the Service believes the data from Trexler et al. (2002) provide a good approximation of the fish sizes preferred by wood storks.

The next element of our wood stork Methodology is the wood stork suitable prey base (biomass per hydroperiod). The wood stork suitability prey base is comprised of two components: (1) the amount of biomass per hydroperiod class within the range of fish sizes likely to be consumed by wood storks and (2) the likelihood that this prey base is actually consumed by the wood stork.

To estimate the fraction of the available fish biomass within the size range of fish likely to be consumed by wood storks (1.5 to 9.0 cm), the Service used the following approach. We noted that Kushlan et al. (1986) listed the mean biomass of the warmouth (*Lepomis*

gulosus) as 36.76 g (rounded to 36.8 g in Appendix WSM-A [see page 12]). In Trexler et al. (2002), the warmouth accounts for about 0.048 percent (18/37,715=0.000477) of the total number of fish collected during the study (Appendix WSM-A). We then multiplied the mean biomass of 36.76 g of the warmouth reported by Kushlan et al. (1986) by the percent occurrence value of 0.048 percent provided by Trexler et al. 2002 to calculate an adjusted mean biomass of 1.75 g (36.76 g x 0.048 = 1.75 g). The mean biomass of the warmouth (1.75 g) accounts for 6.57 percent (1.75/26.715 = 0.0657) of the estimated average biomass (26.715 g) of Trexler et al.'s (2002) samples. Using the Service's estimate of mean annual biomass for class 7 hydroperiod wetlands of 6.5 g/m^2, the warmouth biomass for class 7 hydroperiod wetlands would be 0.427 g/m^2 (6.5 g/m^2 x 0.0657 = 0.427 g/m^2).

However, the Service noted the size frequency distribution (assumed normal) of warmouth from Kushlan et al. (1986) indicate that 48 percent of warmouth sampled were greater than 9 cm total length and 0.6 percent were less than 1.5 cm total length. As such, 48.6 percent of warmouth were outside of the size range (1.5 cm to 9 cm total length) of fish most likely consumed by the wood stork. The mean annual biomass for warmouth for class 7 hydroperiod wetlands in the size range likely consumed by the wood stork is calculated as 0.208 g/m^2 [0.427 x (0.48 + 0.006)] = 0.2075 g/m^2 (rounded to 0.208). Using this approach for all fish species collected by Trexler et al. 2002 (Appendix WSM-A) for class 7 hydroperiod wetlands, the Service estimates that only 3.685 g/m^2 of the 6.5 g/m^2 mean annual fish biomass consists of fish within the size range likely consumed by wood storks (about 57 percent [3.685/6.5 x 100=56.7] of the total mean annual fish biomass available).

The Service also used data in Ogden et al 1976 (Appendix WSM-A) to estimate the available mean annual fish biomass for fish within the size range likely consumed by wood storks for class 7 hydroperiod wetlands. We calculated that 2.97 g/m^2 of the 6.5 g/m^2 mean annual fish biomass for a class 7 hydroperiod wetland (about 45.7 percent) consists of fish within the size range likely to be consumed by wood storks.

Finally, we adjusted the values of estimated mean annual fish biomass for each of the SFWMD's hydroperiods (Table WSM7) to reflect the size of fish most likely consumed by woods storks.

This was accomplished by adding the biomass value of 3.685 g/m^2 (derived from data in Kushlan et al. 1986 and Trexler et al. 2002; Appendix WSM-A) to the biomass value of 2.97 g/m^2 (derived from data in Ogden et al 1976 2002; Appendix WSM-A) and dividing the sum of 6.665 g/m^2 by to obtain a mean value of 3.33 g/m^2 for class 7 hydroperiod wetlands. The Service notes that the mean biomass value of 3.33 g/m^2 s for class 7 hydroperiod wetlands comprises 51 percent of the mean annual biomass estimate of 6.5 g/m^2 for class 7 hydroperiod wetlands listed in Table WSM7 (3.33 g/m^2/6.5 g/m^2 = 0.51 or 51 percent). Therefore, we multiplied each value of mean annual fish biomass listed in Table WSM7 to calculate values of mean annual fish biomass per hydroperiod adjusted for the size range of fish (1 to 9 cm total length) most likely to be consumed by wood storks (*i.e.,* the wood stork suitable prey base) (Table WSM9).

Table WSM9. Estimates of suitable fish biomass per hydroperiod.

Hydroperiod class	Days inundated	Fish biomass
Class 1	0-60	0.26 gram/m^2
Class 2	60-120	0.52 gram/m^2
Class 3	120-180	1.196 grams/m^2
Class 4	180-240	2.184 grams/m^2
Class 5	240-300	2.704 grams/m^2
Class 6	300-330	3.12 grams/m^2
Class 7	330-365	3.38 grams/m^2

Crayfish Biomass

Although the diet of the wood stork is made up primarily of fish, wood storks are known to forage on crayfish (*Procambarus* spp.) (J. Lauritsen, Audubon Corkscrew Swamp Sanctuary, personal communication 2007, 2009; Depkin et al. 1992; Bryan and Gariboldi 1998; Kahl 1964). Depkin et al. (1992) report that crayfish make up 1 percent of the biomass and 1.9 percent of the prey items observed for wood storks from east-central Georgia and also noted the presence of crayfish in the diets of wood storks (fish represented 92 percent of all individual prey items and 93 percent of the total biomass). Lauritsen (Audubon Corkscrew Swamp Sanctuary, personal communication 2007, 2009) suggests crayfish may be an important source of food for wood storks. The importance of crayfish in the wood stork's diet in unclear. Nonetheless, the Service has decided to assess crayfish biomass as part of our estimate of biomass production per hydroperiod.

The presence of melalueca in wetlands does not seem to affect the use of these habitats by crayfish. O'Hare and Dalrymple (1997) found that crayfish are randomly distributed among cover types and melaleuca coverage did not largely affect dispersion patterns. Lauritsen (Corkscrew Swamp Sanctuary 2007, 2009) noted crayfish occur in wetlands with dense melaleuca and migrate to more open areas as water levels fall during the dry season. Hendrix and Loftus (2000) noted that *P. alleni* typically burrow during the dry season, a behavior which provides persistence during droughts, and *P. fallax* was typically found in long hydroperiod wetlands.

Acosta and Perry (2002) assessed the biomass of the *P. alleni* from seasonal wetlands of various hydroperiods within the Florida Everglades. However, Acosta and Perry (2002) defined wetland hydroperiods in terms of months of inundation. Therefore, the Service converted the hydroperiod class used in Acosta and Perry (2002) from months of inundation to days of inundation for use in our Methodology. Acosta and Perry (2002) only provided crayfish density and biomass estimates for wetlands of hydroperiod class 2, 4, and 5, and the converted values are 0.10 gram/m^2, 0.15 gram/m^2, and 0.23 gram/m^2, respectively (Table WSM10). Acosta and Perry (2002) noted that long hydroperiod wetlands typically had densities of crayfish two times greater than medium hydroperiod wetlands and five

times greater than short hydroperiod wetlands. Therefore, we estimated the crayfish biomass for hydroperiod Class 3 wetlands by adding the crayfish biomass estimate for hydroperiod class 2 wetlands (0.10 gram/m^2) to the crayfish biomass estimate for hydroperiod class 4 wetlands (0.15 gram/m^2) and divided the sum (0.25 gram/m^2) by 2 to obtain a value of 0.125 gram/m^2 (rounded to 0.13 gram/m^2 in Table WSM10). The Service estimated the mean annual crayfish biomass for Class 1 hydroperiod wetlands based on Acosta and Perry's (2002) comment that long hydroperiod wetlands typically had densities five times greater than short hydroperiod wetlands.

Therefore, the Service used Acosta and Perry's (2002) average long hydroperiod value for crayfish biomass of 0.229 grams/m^2 and divided this value by 5 to calculate a value of 0.05 gram/m^2 for Class 1 hydroperiod wetlands (0.229/5=0.045). We estimated the crayfish biomass value for the Class 7 hydroperiod wetlands based on the maximum density recorded in Acosta and Perry's (2002) study (0.248 gram/m^2, rounded to 0.25 gram/m^2 in Table WSM10). Finally, we estimated the crayfish biomass for class 6 hydroperiod wetlands by adding the crayfish biomass estimate for hydroperiod class 5 wetlands (0.23 gram/m^2) to the crayfish biomass estimate for hydroperiod class 7 (0.25 gram/m^2) and divided the (0.48 gram/m^2) by 2 to obtain a value of 0.24 gram/m^2 (Table WSM10).

To estimate the total forage biomass available to the wood stork for each wetland hydroperiod class (Table WSM9), we added the value of mean annual crayfish biomass derived from Acosta and Perry 2002 to the value of mean annual biomass estimated for fish (Table WSM10).

Table WSM10. Estimates of suitable fish biomass and crayfish biomass per hydroperiod.

Hydroperiod class	Fish biomass	Crayfish biomass	Total biomass	Percent change
Class 1	0.26 gram/m^2	0.05 gram/m^2	0.31 gram/m^2	19.2
Class 2	0.52 gram/m^2	0.10 gram/m^2	0.62 gram/m^2	19.2
Class 3	1.19 grams/m^2	0.13 gram/m^2	1.32 grams/m^2	10.5
Class 4	2.18 grams/m^2	0.15 gram/m^2	2.34 grams/m^2	7.0
Class 5	2.70 grams/m^2	0.23 gram/m^2	2.93 grams/m^2	8.4
Class 6	3.12 grams/m^2	0.24 gram/m^2	3.36 grams/m^2	7.7
Class 7	3.38 grams/m^2	0.25 gram/m^2	3.63 grams/m^2	7.4

Parameter 4 – Competition with other wading bird species for forage

The computer simulations of wood stork colony population size by Fleming et al. (1994) assumed that only 10 percent of the wood stork forage prey base is available to be consumed by wood storks. This reduction in prey availability was attributed to water level of the foraging habitat, and in part to the effects of competition with other wading bird species. Fleming et al. (1994) did not specify the magnitude of each effect, but the Service believes it is likely competition with other wading bird species limits the availability of

prey to wood storks. As such, the Service has included competition with other wading bird species for forage as a parameter in our assessment of wood stork forage biomass.

The Service has chosen to assess the effects of competition of other wading bird species on wood stork biomass availability as follows. We have adopted the assumption made by

Fleming et al. (1994) that only 10 percent of the potential forage at a wetland site is available to wood storks for foraging. This figure represents a 90 percent reduction of total forage biomass actually available to wood storks at a wetland site. The Service considers competition for forage with other wading bird species, as well as the 3 factors described above (vegetation density, wetland hydroperiod, and prey size) as all contributing equally to the reduction in forage availability.

Consequently, we find that each factor comprises 0.225 or 22.5 percent of the total 90 percent reduction in forage availability (4 x 22.5 = 90 percent). As discussed above, our assessment has already accounted for the effects of vegetation density, wetland hydroperiod, and prey size. To adjust the estimates of total biomass per hydroperiod presented in Table WSM10 for the effects of competition with other wading bird species, we have established a competition adjustment factor of 0.325. This factor was calculated by subtracting 0.675 (the sum of reduction in forage availability due to vegetation density, wetland hydroperiod, and prey size [0.225 + 0.225 + 0.225 = 0.675) from 1 (this number represents 100 percent of the total forage biomass present at a wetland site) (1 – 0.675 = 0.325). Table WSM11 presents estimates of total forage biomass adjusted for competition.

Table WSM 11. Estimates of total biomass of fish and crayfish per hydroperiod adjusted for the effect of competition with other wading birds.

Hydroperiod class	Total Fish and Crayfish Biomass	Competition Factor	Adjusted Total biomass (Total Fish and Crayfish Biomass x Competition Factor)
Class 1	0.31 gram/m^2	0.325	0.1008 gram/m^2
Class 2	0.62 gram/m^2	0.325	0.2015 gram/m^2
Class 3	1.32 grams/m^2	0.325	0.4290 grams/m^2
Class 4	2.34 grams/m^2	0.325	0.7605 grams/m^2
Class 5	2.93 grams/m^2	0.325	0.9523 grams/m^2
Class 6	3.36 grams/m^2	0.325	1.0920 grams/m^2
Class 7	3.63 grams/m^2	0.325	1.1798 grams/m^2

Summary of the factors affecting vulnerability of wetland habitats to wood stork foraging in the action area

Through the above discussions, we have identified that there are essentially four parameters in assessing wood stork foraging habitat:

1. The density of vegetation within habitats suitable for wood stork foraging;

2. The hydroperiod of the wetland, including two subcomponents: (a) the fish density per hydroperiod (number of fish), and (b) the fish biomass per hydroperiod (g/m^2);

3. The size of prey size; and

4. Competition with other wading bird species

All four of these parameters can be used to calculate an estimate of the forage biomass available to wood storks in a wetland. As such, the Methodology can be applied to both wetlands being lost by a development project and the wetlands proposed as mitigation to assess the effect of an action on wood stork foraging. The following example illustrates the use of the Methodology:

A development project results in the loss of 50 acres of wetland (25 acres of Class 3 hydroperiod and 25 acres of Class 4 hydroperiod), each containing 10 percent cover of melaleuca. The forage biomass of each wetland is calculated by multiplying the number of acres of wetlands impacted by 4,047 m^2 (to convert acres to m^2) by the amount of actual biomass consumed by the wood stork (Table WSM11) and the exotic foraging suitability index (Table WSM3). The Service's Methodology considers the portion of the wetland covered by exotic vegetation (*i.e.*, the 10 percent melalueca in this example) as 100 percent suitable to wood storks. To adjust for habitat availability and the wood stork competition factor, the value of forage biomass derived in Table WSM11 is multiplied by 1.0 (*i.e.,* habitat is 100 percent suitable for wood storks). The product is divided by 1,000 grams to convert the forage biomass value calculated in grams to kilograms.

The 25 acres of class 3 hydroperiod wetlands provide 43.4 kg of biomass forage [(25 acres x 4,047 m^2 /acre x 0.4290 g/m^2 (Table WSM11) x 1.0 (Table WSM3))/1,000 grams = 43.4 kg)], and the 25 acres of class 4 hydroperiod wetlands provide 76.94 kg of biomass forage [(25 acres x 4,047 m^2 /acre x 0.7605 g/m^2 (Table WSM11) x 1.0 (Table WSM3) x 1.0)/1,000 grams =76.94 kg)]. The total forage biomass (fish and crayfish) lost due to the action is 120.34 kg (43.4 kg from class 3 hydroperiod wetlands + 76.94 kg from class 4 hydroperiod wetlands), and this value represents the loss of 0.61 nest based on Kahl's (1964) estimate that 201 kg of forage was needed for a successful wood stork nest.

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Appendix WSM-A.

Data from Kushlan et al. (1986), Ogden et al. 1986, and Trexler et al. (2002) used by the Service to estimate the fraction of the available fish biomass within the size range of fish that may be consumed by wood storks.

		Kushlan et al. (1986)				Ogden et al. (1976)		Everglades - Trexler et al. (2002)				
Species	**Common name**	**Mean Mass (g)**	**Proportion of fish <15mm**	**Proportion of fish >90mm**	**Proportion within 15-90 mm wood stork preference**	**% items consumed by stork**	**% biomass consumed by stork**	**Total collected**	**% of total collected**	**Mean mass based on % collected**	**Mass within 6 g/m2**	**Mass within stork prey size**
Osteichtheyes												
Amia calva	Bowfin	1307.3	0.000	0.997	0.002	0.1	0.1		0.000	0.000	0.000	0.000
Lepisosterus platyrhincus	gar	182.5	0.012	0.948	0.039	0.2	2.8	1	0.003	0.484	0.109	0.004
Elops saurus	lady fish	346.7	0.000	1.000	0.000				0.000	0.000	0.000	0.000
Notemigonus crysoleucas	golden shiner	2.5	0.086	0.028	0.885	0.1	0.2		0.000	0.000	0.000	0.000
Notropis petersoni	coastal shiner	0.3	0.029	0.000	0.971			60	0.159	0.046	0.010	0.010
Notropis maculatus	taillight shiner					0.2	0.1	1	0.003	0.000	0.000	0.000
Erimuzon sucetta	Lake cubsucker	20.5	0.300	0.211	0.489				0.000	0.000	0.000	0.000
Ictalurus natalis	yellow bullhead catfish	29.0	0.063	0.438	0.499	1.7	11.8	29	0.077	2.228	0.500	0.250
Ameiurus nebulosus	brown bullhead catfish								0.000	0.000	0.000	0.000
Noturus gyrinus	tadpole madtom	1.4	0.052	0.000	0.948	0.2	0.1	8	0.021	0.029	0.007	0.006
Clarias batrachus	walking catfish	40.5	0.016	0.796	0.188			4	0.011	0.429	0.096	0.018
Bagre marinus	gafftopsail catfish	464.4	0.000	0.997	0.003				0.000	0.000	0.000	0.000
Opsanus beta	gulf toadfish	14.9	0.001	0.339	0.660				0.000	0.000	0.000	0.000
Strongylura notata	redfin needlefish	3.9	0.034	0.669	0.297				0.000	0.000	0.000	0.000
Adinia xenica	diamond killfish	0.7	0.002	0.000	0.998				0.000	0.000	0.000	0.000
Cyprinidon variegatus	sheepshead minnow	0.3	0.278	0.000	0.722	4.1	2.7	41	0.109	0.035	0.008	0.006
Floridichthylys carpio	goldspotted killfish	1.1	0.033	0.000	0.967				0.000	0.000	0.000	0.000
Fundulus chrysotus	golden topminnow	0.4	0.273	0.000	0.727	1.3	0.8	1844	4.889	1.750	0.393	0.286
Fundulus confluentus	marsh killifish	0.5	0.188	0.000	0.812	18.0	10.7	87	0.231	0.120	0.027	0.022
Fundulus grandis	gulf killfish	9.9	0.001	0.118	0.881				0.000	0.000	0.000	0.000
Fundulus seminolis	seminole killifish	5.8	0.000	0.110	0.890	0.7	3.1	1	0.003	0.016	0.003	0.003
Jordanella floridae	flagfish	0.3	0.260	0.000	0.740	32.0	7.0	1783	4.728	1.480	0.332	0.246
Lucania goodei	bluefin killifish	0.1	0.280	0.000	0.720	0.1	0.1	8391	22.248	2.759	0.620	0.446
Lucania parva	rainwater killifish	0.2	0.150	0.000	0.850	0.3	0.1	1	0.003	0.001	0.000	0.000
Gambusia affinus	mosquitofish	0.1	0.464	0.000	0.536	6.3	0.5	9825	26.051	2.214	0.497	0.266
Heterandria formosa	least killifish	0.0	0.917	0.000	0.083	0.5	0.1	12713	33.708	1.315	0.295	0.025
Poecilia latipinna	sailfin molly	0.2	0.292	0.000	0.708	19.8	10.6	1699	4.505	1.081	0.243	0.172
Labidesthes sicculus	brook silverside	0.5	0.002	0.000	0.998	0.1	0.1	5	0.013	0.007	0.002	0.002
Menidia beryllina	tidewater silverside	0.8	0.000	0.000	1.000	0.1	0.1		0.000	0.000	0.000	0.000
Elassoma evergladei	everglades pygmy sunfish	0.2	0.250	0.000	0.750			487	1.291	0.200	0.045	0.034
Enneacanthus gloriosus	bluespotted sunfish	0.5	0.155	0.000	0.845	0.8	0.9	238	0.631	0.321	0.072	0.061
Lepomis gulosus	warmouth	36.8	0.006	0.484	0.510	4.8	27.2	18	0.048	1.754	0.394	0.201
Lepomis macrochirus	bluegill	21.2	0.047	0.283	0.670	0.3	0.7	6	0.016	0.337	0.076	0.051
Lepomis marginatus	dollar sunfish	2.1	0.046	0.000	0.954			14	0.037	0.077	0.017	0.016
Lepomis microlophus	redear sunfish	30.8	0.052	0.362	0.586	2.3	5.4	55	0.146	4.490	1.008	0.591
Lepomis punctatus	spotted sunfish	7.0	0.182	0.030	0.787	2.8	8.7	197	0.522	3.661	0.822	0.647
Lepomis	unidentified sunfish	12.6	0.137	0.134	0.729	2.5	1.0	16	0.042	0.534	0.120	0.087
Sunfish	unidentified sunfish	9.8	0.175	0.070	0.754	2.5	1.0		0.000	0.000	0.000	0.000
Micropterus salmoides	largemouth bass	104.0	0.007	0.855	0.138	0.3	4.4	4	0.011	1.103	0.248	0.034
Etheostoma fusiforme	swamp darter	0.4	0.002	0.000	0.998			2	0.005	0.002	0.001	0.001
Astronotus ocellatus	oscar								0.000	0.000	0.000	0.000
Hemichromis bimaculatus	jewelfish	4.2	0.092	0.000	0.908				0.000	0.000	0.000	0.000
Spilotum nicaraguense	Nicaraguan cichlid								0.000	0.000	0.000	0.000
Eucinostomus gula	jenny mojarra	2.9	0.000	0.000	1.000				0.000	0.000	0.000	0.000
Haemulon plumieri	white grunt	6.2	0.000	0.011	0.988				0.000	0.000	0.000	0.000
Lagodon rhomboides	pinfish	7.1	0.001	0.039	0.960				0.000	0.000	0.000	0.000
Bairdiella chrysoura	silver perch	7.1	0.000	0.047	0.953				0.000	0.000	0.000	0.000
Cichlasoma bimaculatum	black acara	13.0	0.000	0.005	0.995			7	0.019	0.242	0.054	0.054
Cichlasoma urophthalmus	mayan cichlid							21	0.056	0.000	0.000	0.000
Mugil curema	white mullet					0.1	0.8		0.000	0.000	0.000	0.000
Rivulus marmoratus	rivulus					0.1	0.1		0.000	0.000	0.000	0.000
Esox niger	chain pickerel					0.1	0.1	5	0.013	0.000	0.000	0.000
Erimyzon sucetta	lake chubsucker							145	0.384	0.000	0.000	0.000
Belonesox belizanus	pike killifish							3	0.008	0.000	0.000	0.000
Tilapia mariae	spotted tilapia							4	0.011	0.000	0.000	0.000
Total								**37715**	**100.000**	**26.715**	**6.000**	**3.539**

*Shaded estimate of average mass from length-weight relationship given for species on www.fishbase.org with average length assumed to be 5 cm (FLMNH). The proportion of fish length less than 1.5 cm was set to be the average of all sunfish.

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SYSTEM OPERATING MANUAL
VOLUME 4

WATER CONSERVATION AREAS,
EVERGLADES NATIONAL PARK, AND
ENP-SOUTH DADE CONVEYANCE SYSTEM

APPENDIX G

WATER CONTROL PLANS, PROJECT OPERATING MANUALS AND PERMITS

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
JANUARY 2020

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CENTRAL AND SOUTHERN FLORIDA PROJECT

INTERIM WATER CONTROL PLAN FOR SEMINOLE BIG CYPRESS RESERVATION WATER CONSERVATION PLAN CRITICAL PROJECT – BASIN 1

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
19 March 2012

List of Acronyms

BMP	Best Management Plan
CAP	Corrugated Aluminum Pipe
cfs	cubic feet per second
EA	Environmental Assessment
ENP	Everglades National Park
EPA	Everglades Protection Area
HDPE	High Density Polyethylene
IC	Irrigation Storage Cell
NGVD	National Geodetic Vertical Datum
ppb	parts per billion
SBC	Seminole Big Cypress
SFWMD	South Florida Water Management District
SOF	Statement of Finding
STA	Stormwater Treatment Area
STOF	Seminole Tribe of Florida
WCA	Water Conservation Area
WCP	Water Control Plan
WRA	Water Resource Area
WRDA	Water Resources Development Act

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VII - INTERIM WATER CONTROL PLAN

7-01. General Objectives. The Seminole Big Cypress Reservation Water Conservation Plan Project (SBC Project) is authorized under Section 528 (b)(3) of the Water Resources Development Act (WRDA) of 1996, P.L. 104-303 (Central and Southern Florida Ecosystem Restoration Critical Project) to improve quality of agricultural water runoff within the reservation; restore storage capacity, and return native vegetation within the Big Cypress Reservation (Reservation). The network of surface water management structures in the SBC Project is intended to produce the following substantial restoration, preservation, and protection benefits:

- Remove phosphorous and other pollutants from water discharged from Reservation lands flowing to the Everglades Protection Area (EPA)
- Provide the opportunity to restore more natural hydroperiods to wetlands in the Big Cypress National Preserve
- Restore a more natural hydropattern and hydroperiod in the 14,000 acres of the Native Area, located south of the West Feeder Canal on the Reservation and north of Big Cypress Preserve
- Increase water storage capacity
- Provide improved flood control designed to mimic the historic timing and distribution of flows

This is an Interim Water Control Plan to be placed in the Water Conservation Areas, Everglades National Park (ENP) and ENP-South Dade Conveyance System Master Water Control Manual. This Interim Water Control Plan is for implementation prior to the construction of other Basins of the SBC Project and will be updated as other SBC Project Basins become available. The SBC Project is separated into four basins, identified as Basins 1 through 4 (Figure 1). This Interim Water Control Plan contains water management operating criteria for Basin 1 only (Figure 2).

7-02. Constraints. Constraints to achieve the objectives of the project include:

High Permeability of Impoundment Soil. The high permeability of the impoundment soils, specifically the irrigation storage cells, has resulted in much higher seepage losses out of the impoundments than was originally expected, resulting in shorter retention times and less water for irrigation and water supply. See Section 7-03 for more detailed information.

7-03. Overall Plan for Water Management. Basin 1 is located in the northwest corner of the Reservation. It is bound by the West Feeder Canal to the south, the Reservation's western boundary to the west, the existing field ditch system to the east that serves as a common boundary between Basin 1 and Basin 2, and the existing field ditch system to the north. Basin 1 consists of a newly constructed Water Resource Area (WRA), which is split into two parts, WRA1E and WRA1W. Basin 1 also contains six newly constructed Irrigation Storage Cells (ICs), named I1A, I1B, I1C, I1D, I1E and I1F. The ICs will not function fully as designed. The ICs were intended to hold water for up to six months for irrigation and water supply. Because of high soil permeability, the ICs will not store water for a sufficient period of time to serve a water supply function. Instead, the ICs are used to attenuate stormwater runoff and/or to convey excess water to the WRA. Basin 1 also includes a system of levees, canals, culverts, a siphon and pump stations.

Water is pumped into 3-Mile Canal (to the east of Basin 1) from G-409, which is a water supply pump station in the L-3 borrow canal. The 3-Mile Canal is hydraulically connected to the E-1 Canal. The E-1 Canal is hydraulically connected to the E-1A Canal and the E-2 Canal. Water can be pumped or gravity flowed through gated culverts from the E-1A Canal, the E-1 Canal and the E-2 Canal into the North Feeder Canal. The North Feeder Canal is hydraulically connected to the West Feeder Canal. Water is pumped into Basin 1 from the West Feeder Canal via pump station P1. Additionally, water enters Basin 1 via rainfall. Rainfall runoff within the project area is pumped into the ICs for stormwater attenuation. Discharges from the ICs may occur during major rainfall events to safely convey excess water

located in the ICs back to the existing field ditch system. Excess water in the ICs may also be conveyed to the WRAs through culverts. When water levels in I1C and I1D reach a certain stage, excess water will flow into the adjacent WRA through culverts. Basin 1 discharges water through Siphon 1 to the Native Area to the south. Basin 1 also discharges to the West Feeder Canal through OUT1A and OUT1B, the outfall structures described below. Optimum stages in the West Feeder Canal are maintained by the SFWMD gated structure S-190. The structure descriptions for S-190, G-409, and G-404 are given below. G-409 pumps are operated by the South Florida Water Management District (SFWMD) to provide a maximum of 47,000 acre-feet of water per year into the East Conveyance Canal System to meet the entitlement for the Seminole Tribe of Florida as established by the 1996 Compact Agreement, the entitlement Technical Report and associated District Final Order.

a. External Project Features. Although structures S-190, G-404, and G-409, operated by the SFWMD, are not part of the SBC Project, they provide inflow to the project and prevent over drainage of the canals. The structure descriptions here are provided for reference only. Flows from the SFWMD G-409 pump station represent Basin 1's available water sources. G-409 supplies irrigation water to the Reservation from the Miami Canal via G-404 pump station and the L-4 borrow canal (or the L-3 extension canal), west over the L-28 borrow canal. Structure 190 (S-190) is a gated spillway that helps control water levels in the West Feeder Canal and North Feeder Canal.

1. Structure 190 (S-190). The structure is located on the L-28 Interceptor Canal about 32 miles south of Clewiston. This structure is a reinforced concrete, gated spillway with discharge controlled by two cable-operated, vertical lift gates. Operation of the gates is automatically controlled in accordance with the established operational criteria. This structure maintains optimum upstream water control stages in the North and West Feeder Canals, and prevents over drainage of these canals.

2. Pump Station G-404. Pump station G-404 is located in Broward County on the Miami Canal at the confluence with the L-4 borrow canal. The pump station is located adjacent to structure G-357, just north of the S-8 pump station, and adjacent to the southeastern corner of the Rotenberger Wildlife Management Area. G-404 provides

supplemental irrigation water supply to the Reservation and to US Sugar Southern Division's Unit 2 farm.

3. Pump Station G-409. Pump station G-409 is located in Hendry County immediately south of STA-6 in the L-3 borrow canal at the point commonly referred to as "Confusion Corner." Waters are then delivered to various locations within the eastern portion of the Reservation for irrigation and also to the North and West Feeder Canals.

b. Pump Stations. Basin 1 contains 10 pump stations (P1 through P10, see Figure 2) which may function for flood control and water supply. Pumps P4, P5, P8, P9 and P10 transfer excess water away from the citrus groves and other agricultural fields located inside the basin to the ICs. P6 and P7 transfer water from agricultural fields and pastures to ICs located adjacent to a WRA. P1 provides irrigation water from the West Feeder Canal into citrus groves. P2 and P3 transfer water from the agricultural fields and Billie Swamp Safari wildlife area into WRA1W. See Table 1 for pump station data.

Table 1: Pump Station Data

Pump	Intake Level ft, NGVD	Auto-matic or manual	Shutoff Level ft, NGVD	Discharge Level ft, NGVD	Flow (cfs)	Total Dynamic Head (ft)	Max HP
P1	*	Manual	12.0	18.0	40	11.08	82
P2-1	14.0	Auto	13.5	20.2	35	9.52	62
P2-2	15.5	Auto	15.0	20.2	35	8.02	52
P3-1	17.3	Auto	16.8	20.2	56	6.49	67
P3-2	17.8	Auto	17.3	20.2	100	7.99	147
P3-3	18.8	Auto	18.3	20.2	100	6.99	129
P4	*	Manual	14.6	22.7	15	15.55	43
P5	*	Manual	14.2	22.4	14	17.87	45
P6-1	13.7	Auto	13.2	23.1	48	15.3	135
P6-2	15.2	Auto	14.7	23.1	48	13.8	122
P7-1	14.3	Auto	13.8	23.0	34	11.99	75
P7-2	15.8	Auto	15.3	23.0	53	10.8	106
P8	*	Manual	14.2	22.7	14	18.52	48
P9	*	Manual	13.8	22.7	56	12.87	133
P10	*	Manual	14.2	22.7	7	15.82	21

*Activated when water levels rise to within two feet of the average ground elevation

c. Water Resource Areas. Water Resource Areas (WRAs) are designed to improve the hydroperiod of historically impacted wetlands and the water quality of surface water as it flows from the basins. They have relatively shallow (approximately one foot) flow depths with a nine month long hydroperiod. Basin 1 contains one WRA (WRA1), which is split into two parts, WRA1W and WRA1E, by a road (See Figure 2). An equalization structure, EP1, connects WRA1W and WRA1E to allow unrestricted movement of water between the two cells. See Table 2 for EP1 structure data. WRA1 is designed for a maximum stage of 20.2 feet, National Geodetic Vertical Datum of 1929 (ft, NGVD), preserving a minimum of one foot of freeboard between the maximum stage and the crest of the levee. WRA1 outfall culvert structures, OUT1A and OUT1B (Table 3) and Siphon 1 (Table 4) have control elevations set to prevent exceeding this maximum stage criterion. OUT1A and OUT1B discharge treated stormwater to the West Feeder Canal. These structures have been sized not to exceed the total allowable discharge to the West Feeder Canal dictated by the operating capacity of S-190 to discharge water from the West Feeder Canal and the North Feeder Canal to the L-28 interceptor canal. S-190 can achieve a discharge rate of 2960 cfs (cubic feet per second). When the design capacity is achieved, water is siphoned under the West Feeder Canal for flood protection through Siphon 1. The siphon’s tailwater elevation will equalize to, or be below that of the pool elevation of WRA1. A spreader swale will spread the discharged water into the Native Area south of the West Feeder Canal.

Table 2: EP1 Connection WRA1W and WRA1E Structure Data

Culvert Data	**EP1**
Number of Barrels	5
Barrel Type	CAP
Culvert Diameter	60 inches
Culvert Length	250 feet
Upstream Invert Elevation	6 ft, NGVD
Slide Gate Control	No

Table 3: OUT1A and OUT1B Structure Data

Culvert Data	**OUT1A**	**OUT1B**
Number of Barrels	2(West and East)	2 (West and East
Barrel Type	CAP	CAP
Culvert Diameter	48 inches	48 inches
Culvert Length	70 feet	70 feet
Upstream Invert Elevation	12.62 (West) 12.69 (East)	11.97 (West) 12.31 (East)
Slide Gate Control	No	No
Riser Data		
Riser Diameter	48 inches	48 inches
Riser Fixed Crest Elevation	18.75 (West) 19.04 (East)	18.20(West) 18.24(East) 18.70(Design El.)

Table 4: Siphon 1 Structure Data

WRA Data	**Siphon 1**
Bottom Elevation	17.5 ft, NGVD
Top of Berm Elevation	21.3 ft, NGVD
Culvert Data	
Number of Barrels	2
Barrel Type	HDPE
Culvert Diameter	60 inches
Culvert Length	450 feet
Upstream Invert Elevation	11.2 ft, NGVD
Slide Gate Control	NO
Riser/Weir Box Data	
Weir Box Length	42 feet
Riser Fixed Crest Elevation	19.2 ft, NGVD
Spreader Swale	
Swale Crest Elevation	18.5 ft, NGVD
Swale Length	2400 ft, NGVD

d. Outfall Structures. Basin 1 contains two outfall structures, OUT1A and OUT1B. Each outfall structure contains two culverts (OUT1A East, OUT1A West, OUT1B East and OUT1B West). These structures allow water to flow from WRA1E into the West Feeder Canal when the water surface

elevation in WRA1E exceeds the riser crest elevations. See Table 3 for outfall structure data.

e. Irrigation Storage Cells. Basin 1 contains six ICs, named I1A, I1B, I1C, I1D, I1E and I1F. Water is pumped into these ICs when flood protection for adjacent lands is needed. The ICs contain three types of culvert structures: overflow structures (OF1A, OF1C2, OF1C3, OF1D2 and OF1D3), irrigation return structures (IR1A, IR1C, IR1D and IR1E), and irrigation return/overflow structures (OF1B, OF1C1, OF1D1, OF1E, and OF1F). The IC soils have proven to be too porous to hold water for storage.

1. Overflow Structures. I1A self-contains water up to a depth of approximately four feet before discharging into the I1AS canal via overflow structure OF1A (Table 5). I1C and I1D self-contain water up to a depth of approximately four feet before discharging into WRA1E via overflow structures OF1C1, OF1C2, OF1C3, OF1D1, OF1D2 and OF1D3 (Table 6 and 7). The riser fixed crests of the overflow structures allow water from the ICs to overflow when the water surface elevation exceeds the crest elevation. The function of OF1C1 and OF1D1 is similar to the other overflow structures with the following exception. Both of these structures contain a gate at the ground surface elevation that can be opened to allow water to drain from its respective IC. OF1C1 and OF1D1 provide overflow from I1C and I1D, respectively, into WRA1E.

Table 5: OF1A Structure Data

Culvert Data	**OF1A**
Number of Barrels	1
Barrel Type	CAP
Culvert Diameter	48 inches
Culvert Length	75 feet
Upstream Invert Elevation	11.42 ft, NGVD
Slide Gate Control	No
Riser Data	
Riser Diameter	96 inches
Riser Fixed Crest Elevation	22.36 ft, NGVD

Table 6: OF1C1, OF1C2 and OF1C3 Structure Data

Culvert Data	**OF1C1**	**OF1C2**	**OF1C3**
Number of Barrels	1	1	1
Barrel Type	CAP	CAP	CAP
Culvert Diameter	48 inches	48 inches	48 inches
Culvert Length	80 feet	70 feet	70 feet
Upstream Invert Elevation	15.07 ft, NGVD	15.13 ft, NGVD	15.46 ft, NGVD
Slide Gate Control	Yes	No	No
Riser Data			
Riser Diameter	96 inches	96 inches	96 inches
Riser Fixed Crest Elevation	22.30 ft, NGVD	22.14 ft, NGVD	22.21 ft, NGVD

Table 7: OF1D1, OF1D2 and OF1D3 Structure Data

Culvert Data	**OF1D1**	**OF1D2**	**OF1D3**
Number of Barrels	1	1	1
Barrel Type	CAP	CAP	CAP
Culvert Diameter	48 inches	48 inches	48 inches
Culvert Length	80 feet	70 feet	70 feet
Upstream Invert Elevation	15.14 ft, NGVD	15.33 ft, NGVD	15.64 ft, NGVD
Slide Gate Control	Yes	No	No
Riser Data			
Riser Diameter	96 inches	96 inches	96 inches
Riser Fixed Crest Elevation	22.30 ft, NGVD	22.22 ft, NGVD	22.23 ft, NGVD

2. <u>Irrigation Return Structures</u>. When water is available within the ICs for irrigation of adjacent pasture, citrus fields and vegetable fields, irrigation return structures (Table 8) allow water stored in the ICs to be returned to the irrigation system as needed. Each of these structures contains a gate at the ground surface elevation that can be opened to allow water to drain from its respective IC.

Table 8: IR1A, IR1C, IR1D and IR1E Structure Data

Culvert Data	**IR1A**	**IR1C**	**IR1D**	**IR1E**
Number of Barrels	1	1	1	1
Barrel Type	CAP	CAP	CAP	CAP
Culvert Diameter	24 inches	24 inches	24 inches	24 inches
Culvert Length	105 feet	105 feet	105 feet	105 feet
Upstream Invert Elevation	12.26 ft, NGVD	13.39 ft, NGVD	13.25 ft, NGVD	13.26 ft, NGVD
Slide Gate Control	Yes	Yes	Yes	Yes

3. <u>Irrigation Return/Overflow Structures</u>. These structures are dual-purpose control structures. The primary purpose is to limit stages in the ICs during major rainfall events. The overflow elevation for these structures is approximately four feet above the cell bottom. Overflows released from these structures are conveyed through the existing field ditch system to pump stations that discharge to WRA1. The secondary purpose of these structures is to control the release of water stored in the ICs to the existing field ditch system for use in irrigation (Tables 9, 10 and 11). Each of these structures contains a sluice gate in an inlet sump that can be opened manually to allow water to drain from its respective IC.

Table 9: OF1B Structure Data

Culvert Data	**OF1B**
Number of Barrels	1
Barrel Type	CAP
Culvert Diameter	48 inches
Culvert Length	87 feet
Upstream Invert Elevation	12.22 ft, NGVD
Slide Gate Control	Yes
Riser Data	
Riser Diameter	96 inches
Riser Fixed Crest Elevation	22.10 ft, NGVD

Table 10: OF1E Structure Data

Culvert Data	**OF1E**
Number of Barrels	1
Barrel Type	CAP
Culvert Diameter	48 inches
Culvert Length	87 feet
Upstream Invert Elevation	12.34 ft, NGVD
Slide Gate Control	Yes
Riser Data	
Riser Diameter	96 inches
Riser Fixed Crest Elevation	22.20 ft, NGVD

Table 11: OF1F Structure Data

Culvert Data	**OF1F**
Number of Barrels	1
Barrel Type	CAP
Culvert Diameter	48 inches
Culvert Length	87 feet
Upstream Invert Elevation	12.58 ft, NGVD
Slide Gate Control	Yes
Riser Data	
Riser Diameter	96 inches
Riser Fixed Crest Elevation	22.40 ft, NGVD

f. Levees. Basin 1 levees encompass two WRAs and six ICs. See Table 12 for levee elevations.

Table 12: Levee Design Elevations for WRAs and ICs

Area	Levee Crest Elev. (ft, NGVD)
WRA1-W	21.30
WRA1-E	21.30
I1A	25.30
I1B	25.10
I1C	25.30
I1D	25.30
I1E	25.20
I1F	25.20

g. Canals. Basin 1 contains four canals (I1ANE, I1AS, I1FS and I1ES) used for the conveyance of basin water. See Table 13 for canal data.

Table 13: Basin 1 Canal Data

Canal	Design Discharge (cfs)	Min. Cross Sectional Flow Area (sq ft)	Side Slopes	Bottom Width (ft)	Length (ft)
I1ANE	50 - 256	18 - 102	2H:1V	5 (Varies)	6472
I1AS	256	102	2H:1V	5	1524
I1FS	50	18	2H:1V	5	2794
I1ES	87	33	1H:1V	6	2385

7-04. <u>Standing Instructions to Project Operator</u>. During normal conditions, the project structures shall be operated in accordance with this Interim Water Control Plan, and in accordance with the structure design criteria as described in Tables 1 through 13.

a. Pump Stations. Some of the pumps serve citrus groves. These pumps may be started when the water level rises to within four feet of the average citrus grove ground elevation. For pump stations serving pastures and vegetable fields, pumps will be activated automatically when water levels rise to within two feet of the average ground elevation. The shutoff water level for all pumps (except those manually operated) will be one-half foot below the startup water level to prevent pumps from

starting up and shutting down in response to rapid drawdown. The pump connecting the West Feeder Canal to WRA1W (P1) is manually started and stopped. Pumps adjacent to isolated Irrigation Cells (P4, P5, P8, P9 and P10) can be set to run automatically. Where multiple pumps are available (P2, P3, P6 and P7), the second pump will activate at one foot below the average ground level. See Table 1 for pump station on/off trigger elevations.

b. Structures. In transition periods from irrigation purposes back to flood control purposes, the gates on the structures should be set at an elevation to be determined by the owners to maintain anticipated levels of flood damage reduction. The surface level gates at OF1C1, OF1D1, the irrigation return structures and the irrigation return/overflow structures must be fully closed in order to provide flood protection.

c. Unusual Conditions/Emergency Situations. In the event that unusual conditions arise requiring a deviation from normal regulation, refer to Section 7-12. During emergency situations where communication is interrupted, the damtender (Project Operator) shall take any action deemed necessary. Such actions shall be documented in writing and shall be forwarded to the Jacksonville District at the address below as soon as is practicable:

U.S. Army Corps of Engineers, Jacksonville District
Chief, Water Management Section
701 San Marco Blvd.
Jacksonville, FL 32207
Phone: 904.232.2914

Upon the resumption of normal communications, the Project Operator shall report the sequence of events that lead to unplanned releases and receive additional instructions from the Water Management Section, Jacksonville District.

7-05. Flood Control. As indicated in Section 7-03. Overall Plan for Water Management, water is pumped from the Basin 1 watershed into the ICs when flood protection is needed. From the IC, flood waters are discharged through an overflow structure where it enters, or is conveyed, to WRA1. From WRA1, water is discharged to the West Feeder Canal via OUT1A or OUT1B, or to the Native Area via Siphon 1. The siphon inlet control elevation prevents the WRA control structures from exceeding their maximum

allowable discharge so that the WRA will not overtop the levee during storm conditions. For example, flood control operations in I1A would begin with manually-started pumping through P4 into I1A when the elevation in the canal adjacent to P4 reaches 14.6 (ft, NGVD). Pumping should continue until the elevation recedes back below 14.6 (ft, NGVD). When the water elevation within I1A reaches 22.3 (ft, NGVD), discharges at OF1A should begin. The discharged water is conveyed to pump P3 where it enters WRA1W.

7-06. Recreation. This plan has no specified water management operational provisions for recreation. However, recreation in the project area may consist of eco-tourism.

7-07. Water Quality. The project has Critical Project designation because it is designed to improve water quality by removing phosphorous and pollutants from water discharged from the Reservation that ultimately flows into the Big Cypress National Preserve and the Everglades Protection Area. This is accomplished by allowing phosphorus and other pollutants to settle out. The project also seeks to re-establish sheet flow into the Native Area south of the West Feeder Canal and establish a more natural hydropattern that will subsequently re-water the Big Cypress National Preserve.

7-08. Water Supply. Currently Basin 1 consists of approximately 1,317 acres of existing citrus groves, 305 acres of improved pasture and 357 acres of native range. Rainfall on the project area and flows from the SFWMD's G-409 pump station to the West and North Feeder Canals represent Basin 1's available water sources. Water also enters the West Feeder Canal from the West Weir, by P1. Excess water that is pumped from the Basin 1 watershed and captured within the ICs may be temporarily stored for stormwater attenuation, or may be conveyed through I1C or I1D to the WRA.

7-09. Navigation. This project has no specified water management operational provisions for navigation.

7-10. Drought Contingency Plan. There is no Drought Contingency Plan for this project at this time. Should one become available, it may be added as an attachment to this Interim Water Control Plan.

7-11. Flood Emergency Action Plan. The Flood Emergency Action Plan is part of the Interim Operation, Maintenance, Repair, Replacement, and Rehabilitation document for this project.

7-12. Deviation from Normal Regulation.
The Jacksonville District US Army Corps of Engineers Water Management Section is responsible for handling deviation requests and transmitting them through the District Commander to the Division Engineer for final decision. The District Commander is occasionally requested to deviate from normal operating criteria. Prior approval for a deviation is required from the Division Engineer except as noted in subparagraph "a" below. Deviation requests usually fall into the following categories:

a. Emergencies. Examples of some emergencies that can be expected to occur at a project are: drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Districts must inform their division office as soon as practicable. Prepare written confirmation of the deviation and description of the cause and furnish it to the division water control manager. Divisions may develop forms to facilitate the reporting of emergency deviations.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. Construction accounts for the major portion of these incidents and typical examples include utility stream crossings, bridge work, and major construction contracts. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threats and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied with providing there are no foreseen adverse effects on the overall regulation of the project (or projects) for the authorized purposes. Approval for these

minor deviations normally will be obtained from the division office by telephone. Written confirmation explaining the deviation and its cause will be furnished to the division water control manager.

c. Planned Deviations. Each condition should be analyzed on its own merits. Sufficient data on flood potential, watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or facsimile to the division for review and approval.

Figures

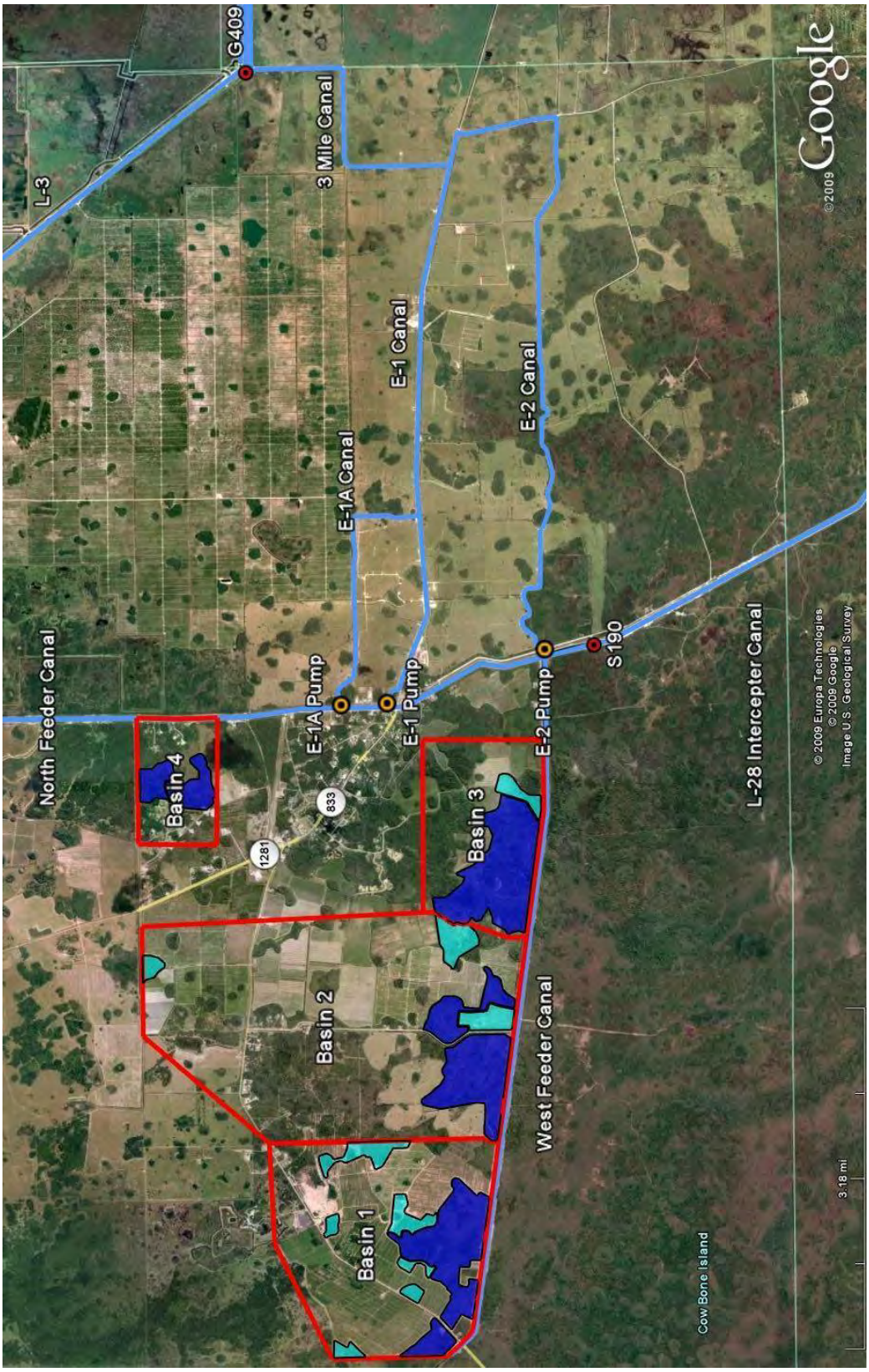

Figure 1: General Location Map

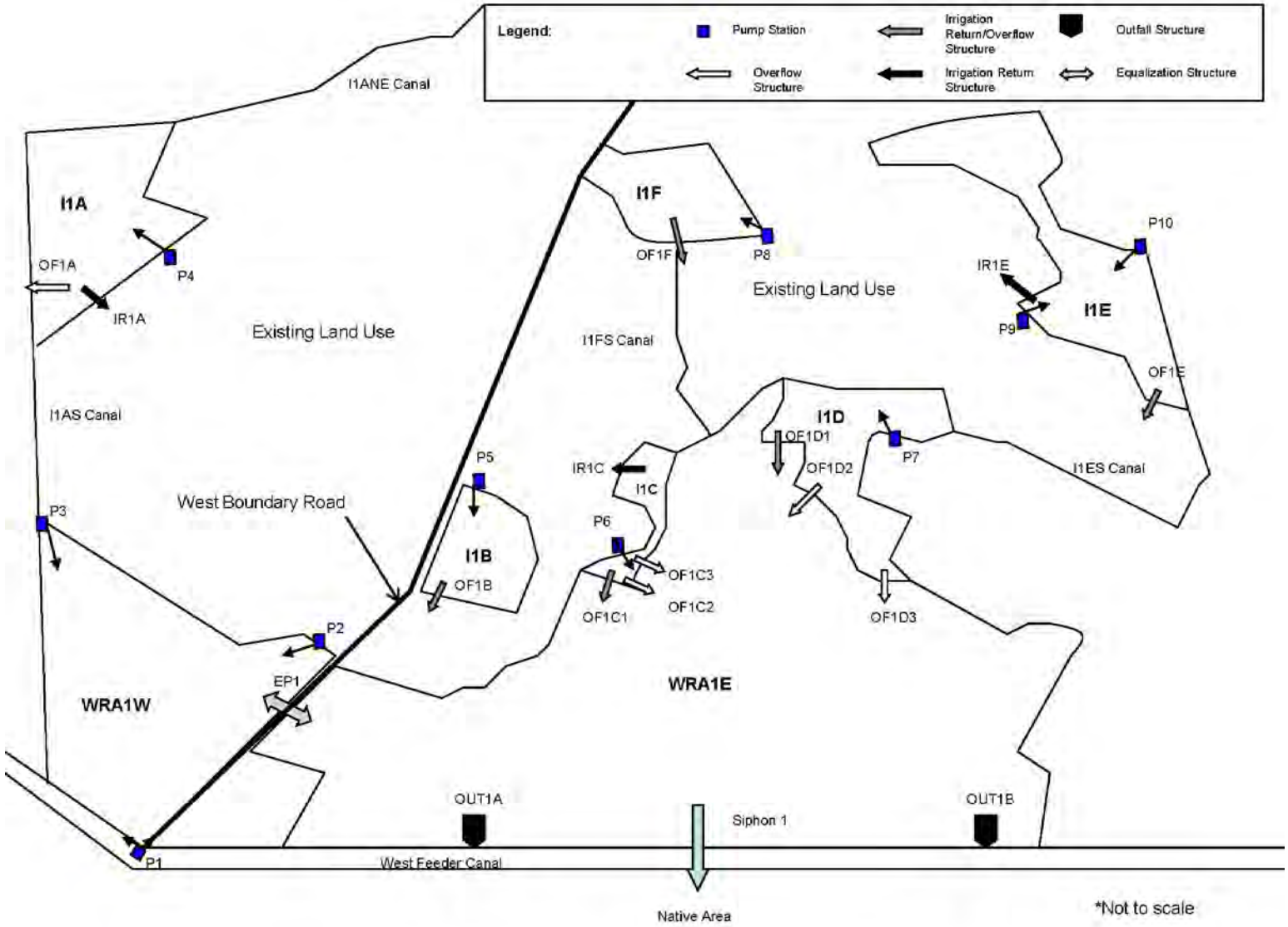

Figure 2: Basin 1 Layout

CENTRAL AND SOUTHERN FLORIDA PROJECT

BIG CYPRESS SEMINOLE INDIAN RESERVATION
WATER CONSERVATION PLAN CRITICAL RESTORATION PROJECT
WATER CONTROL PLAN FOR BASIN 4

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS
May 17, 2013

List of Acronyms

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VII - WATER CONTROL PLAN

7-01. General Objectives. The Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project (SBC Project) (Figure 1) is authorized under Section 528 (b)(3) of the Water Resources Development Act (WRDA) of 1996, P.L. 104-303 (Central and Southern Florida Ecosystem Restoration Critical Project), for the purpose of environmental restoration through improving the quality of agricultural water runoff, improving flood control, and promote water conservation within the Big Cypress Seminole Indian Reservation. The SBC Project is separated into four basins, identified as Basins 1 through 4 (Figure 1). This Water Control Plan contains water management operating criteria for Basin 4 only (Figure 2). The network of surface water management structures in the SBC Project Basin 4 is intended to produce the following substantial restoration, preservation, and protection benefits:

- The project features improve the quality, quantity, timing and distribution of water flows to the ecosystem. Historically, most rainwater soaked into the ground in the wetlands. The Feeder canal system effectively drained much of the marsh to prevent flooding. The drained water now carries phosphorous and other pollutants. The storage features of the Plan serve multiple objectives including recharge to ground water and attenuation of peak discharges to mimic the historic timing and distribution of flows.
- Remove phosphorous and other pollutants from water discharged from Reservation lands flowing into the Big Cypress National Preserve and the Everglades Protection Area (EPA). The EPA comprises several defined regions: the Arthur R. Marshall Loxahatchee National Wildlife Refuge, which contains Water Conservation Area 1; Water Conservation Areas 2A and 2B; Water Conservation Areas 3A and 3B; Everglades National Park; and Florida Bay.

This Water Control Plan is to be placed as an annex of the Central and Southern Florida Project for Flood Control and Other Purposes, Master Water Control Manual, Water Conservation Areas, Everglades national Park, and ENP-South Dade Convenience System, Volume 4, June 1996 (C&SF WCA-ENP WCM VOL 4). A standalone Big Cypress Seminole Indian Reservation Water Conservation Plan Critical Restoration Project Water Control Manual will be also prepared at the end of construction of all four Basins. This standalone

Water Control Manual will contain specifics that are located throughout C&SF WCA-ENP WCM VOL 4.

7-02. Constraints. Constraints to achieve the objectives of the project include the high permeability of the impoundment soils is expected to result in high seepage losses out of the storage areas, resulting in relatively shorter retention times.

7-03. Overall Plan for Water Management. Basin 4 is located north of the Reservation in (Figure 1). The northern boundary is an unimproved road along the north boundary of Township 48 South which is also the divide line of Township 47 South (T47S) and 48 South (T48S) of Hendry County (USGS Quad Sheets Goddens Strand, FLA and Cow Bone Island, FLA) and the southern boundary is approximately one mile south of the northern boundary. The eastern boundary runs along the North Feeder Canal and the westward extent is near vicinity of County Road No. 833 (BIA Road No.1281).

Basin 4 consists of a Stormwater Attenuation Cell (S4A) and a Water Resource Area (WRA4) (Figure 1). Basin 4 also includes a system of levees, borrow canals, culverts, and two pump stations (Figure 2). The borrow canal with conveyance are 1) outside S4A named S4A canal, 2) outside of WRA4 on western side named WRA4A canal, and 3) outside of WRA4 on eastern side named WRA4C canal. The borrow canals with no conveyance are 1) inside WRA4 on northern side named WRA4B canal and 2) inside WRA4 along S4A and WRA4 boundary named WRA4D canal.

Basin 4 water is pumped into S4A from the S4A canal via pump stations P25 and P26. Additionally, water enters Basin 4 via rainfall. S4A discharges water into the WRA4 via uncontrolled culvert structure (OF4A). WRA4 discharges water to WRA4E Canal (Figure 2) through Outfall 4 (OUT4). WRA4E canal moves the water to North Feeder Canal through an existing culvert named PC-17. Excess stormwater runoff from the Basin not pumped into S4A is collected in the canals S4A, WRA4A, and WRA4C. The water from these canals is discharged into WRA4E canal, which discharges into the North Feeder Canal via an existing culvert named PC-17.

a. External Project Features

Structure 190 (S-190): The West and North Feeder Canals join together at the headwaters of the L-28 Interceptor (L28-I) Canal (Figure 1). Approximately one third of a

mile downstream of this connection, flow is controlled by S-190, an automated reinforced concrete gated spillway with 2-24.8 feet vertical gates. This structure maintains optimum upstream water control stages in the North and West Feeder Canals, and prevents over drainage of these canals. The operations of S-190 are included in C&SF WCA-ENP WCM VOL 4.

Culvert PC-17: WRA4E canal discharges into the North Feeder Canal via an existing culvert named PC-17. This is a single barrel steel culvert 72 inches diameter and 88 feet long through the west levee of L28-I. The flashboard risers are located on the canal side of the levee and the discharge end is on the land side of the levee. The riser width is 94 inches, riser height is 12 feet, and board length is 47 inches.

b. Pump Stations. Basin 4 contains two manually operated pump stations (P25 and P26, see Figure 2) which provide flood control capacity. P25 and P26 transfer water from S4A's borrow Canal (S4A canal) (Figure 2) into S4A. The shutoff water level is one-half foot below the startup level to prevent pumps from starting pump up and shutting down in response to rapid drawdown. See Table 1 for pump startup (i.e. intake level), shutoff levels, and the discharge level (i.e. Maximum Water Surface Elevation in the receiving water body). Excess stormwater runoff from the Basin not pumped into S4A is discharged into WRA4E canal. WRA4E canal discharges into North Feeder Canal through PC-17, an existing culvert.

Table 1: Pump Station Data

Pump	Intake Level ft, NGVD	Auto-matic or manual	Shutoff Level ft, NGVD	Discharge Level ft, NGVD	Flow (cfs)	Total Dynamic Head (ft)
P25	17.0	Manual	16.5	21.2	12	12.98
P26	17.6	Manual	17.1	21.2	12	11.98

*Activated when water levels rise to within two feet of the average ground surface elevation of 18.5 ft, NGVD of the agricultural land around S4A

c. Water Resource Area. Water Resource Areas (WRA) is designed to improve the hydroperiod of historically impacted wetlands and the water quality of surface water as it flows from the basins. It has relatively shallow flow

depth. Basin 4 contains one WRA (WRA4, See Figure 1) with an area of 58 acres. WRA4 is designed for a maximum stage of 20.5 feet, National Geodetic Vertical Datum of 1929 (ft, NGVD), preserving a minimum of one and half foot of freeboard between the maximum stage and the crest of the levee. The average ground surface elevation in WRA4 is 18.5 ft, NGVD.

d. Outfall Structure. Basin 4 contains one outfall structure, OUT4 (Table 2). The outfall structure is a 24 inches Corrugated Aluminum Pipe (CAP) Riser Culvert with a riser crest elevation of 19.5 ft, NGVD. There are no side openings in this pipe. Under low-head conditions this will behave as a sharp-crested weir, but as the head increases it will transition to orifice flow. This structure allows water to flow from WRA4 into the North Feeder Canal via WRA4E canal when the water surface elevation in WRA4 exceeds the riser crest elevations. The maximum operable water surface elevation in WRA4 is 20.5 ft, NGVD. The northern boundary of Basin 4 is defined by a farm road, WRA4E canal is located south of the farm road. The WRA4E canal generally runs west to east discharging into North Feeder Canal through an existing culvert, PC-17. But WRA4E also extends 80 feet South along WRA4 eastern levee connecting with WRA4C canal. OUT4 discharges from WRA4 to the WRA4E canal south extension. The design releases from this structure for a head water elevation of 20.5 ft, NGVD and a tailwater elevation of 17.0 ft, NGVD will be approximately 15 cfs which is significantly smaller than the discharge capacity of 2960 cfs of S-190.

Table 2: OUT4 Structure Data

Culvert Data	**OUT4**
Number of Barrels	1
Barrel Type	CAP
Culvert Diameter	24 inches
Culvert Length	60 feet
Upstream Invert Elevation	13 ft, NGVD
Slide Gate Control	No
Riser Data	
Riser Diameter	24 inches
Riser Fixed Crest Elevation	19.5 ft, NGVD
Discharge Data	
Headwater Elevation	20.5 ft, NGVD
Tailwater Elevation	17.0 ft, NGVD
Discharge	15.0 cfs

e. Stormwater Cell. Basin 4 contains one Stormwater Cell, named S4A with an area of 84 acres. Water is pumped into this cell when flood protection for adjacent lands is needed. The hydroperiod of the stormwater cell will be dependent on the need for tribal members to protect their lands from flooding. S4A discharges water into the WRA4 via uncontrolled culvert structure OF4A (Table 3). The maximum operable water surface elevation in the stormwater cell (S4A)is 21.2 ft, NGVD, this provides 3 feet of superiority to the crest elevation of the surrounding levee. The average ground surface elevation in S4A is 18.5 ft, NGVD.

Table 3: Culvert Structure OF4A Data

Culvert Data	**S4A to WRA4**
Number of Barrels	1
Barrel Type	CAP
Culvert Diameter	36 inches
Culvert Length	56 feet
Upstream Invert Elevation	18.5 ft, NGVD
Discharge Data	
Headwater Elevation	21.2 ft, NGVD
Tailwater Elevation	20.50 ft, NGVD
Discharge	17.5 cfs

f. Levees. Basin 4 levees encompass one WRA (WRA4) and one Stormwater Cell S4A. See Table 4 for levee elevations.

Table 4: Levee Design Elevations for WRA and S4A cell

Levee	**Levee Crest Elevation (ft, NGVD)**
S4A (around S4A)	24.2
WRA4 (North/East/West)	22.0

g. Canals. Basin 4 contains borrow canals along S4A and WRA4 used for the conveyance of basin water as well as WRA4E draining the Basin 4 water to North Feeder Canal (Figure 2). See Table 5 for canal data, the side slope is 2H:1V for all canals.

Table 5: Basin 4 Canal Data

Canal	Design Discharge (cfs)	Bottom Width (ft)	Length (ft)	Invert (ft, NGVD)
WRA4E	15	5.0	2466	13.0
S4A	12	6.0	8486	10.0
WRA4A	12	8.0	2995	13.5
WRA4B	NA(2)	10.0	1585	13.5
WRA4C	12	10.0	1555	13.5
WRA4D	NA(1)	6.0	1513	10.0

(1) No conveyance, borrow canal inside S4A
(2) No conveyance, borrow canal inside WRA4

7-04. <u>Standing Instructions to Project Operator</u>. During normal conditions, the project structures shall be operated in accordance with this Water Control Plan, and in accordance with the structure design criteria as described in Tables 1 through 6.

a. Pump Stations. There are two pump stations (P25 and P26) in Basin 4. Pumps will be operated manually when flood protection is needed. See Table 1 for pump station operating parameters. Additionally, when maximum water surface elevation of 21.2 ft, NGVD in S4A or 20.5 ft, NGVD in WRA4 is reached (whichever occurs first), pumps are shutoff (Table 6).

Table 6: Additional Pump Shutdown Elevations

Water Surface Elevations	S4A	WRA4
The maximum operable water surface elevation	21.2 ft, NGVD	20.5 ft, NGVD
Levee Crest	24.2 ft, NGVD	22.0 ft, NGVD

b. Unusual Conditions/Emergency Situations. In the event that unusual conditions arise requiring a deviation from normal regulation, refer to Section 7-12 of this document. During emergency situations where communication is interrupted, the Project Operator shall take any action deemed necessary. Such actions shall be documented in writing and shall be forwarded to the Jacksonville District at the address below as soon as is practicable:

U.S. Army Corps of Engineers, Jacksonville District
Chief, Water Management Section
701 San Marco Blvd.
Jacksonville, FL 32207
Phone: 904.232.2914

Upon the resumption of normal communications, the Project Operator shall report the sequence of events that lead to unplanned deviation and receive additional instructions from the Water Management Section, Jacksonville District.

7-05. Flood Control. As indicated in Section 7-03 of this document, the overall Plan for Water Management is to pump water from Basin 4 watershed into the Stormwater Cell S4A when removal of excess water is needed from the basin. From S4A, water is discharged through a culvert structure where it enters, WRA4. From WRA4, water is discharged to the North Feeder Canal via OUT4 and WRA4E canal. For example, excess water removal operations in Basin 4 would begin with pumping through P25 and P26 into S4A when the elevation in the canal adjacent to S4A at P25 is 17 ft, NGVD and at P26 is 17.6 ft, NGVD. Pumping should continue until the elevation recedes back below 16.5 ft, NGVD and 17.1 ft, NGVD, respectively. Excess stormwater runoff from the Basin not pumped into S4A is discharged into North Feeder Canal via WRA4E canal through an existing culvert structure, PC-17.

7-06. Recreation. This plan has no specified water management operational provisions for recreation. However, recreation in the project area may consist of eco-tourism.

7-07. Water Quality. The project has Critical Project designation because it is designed to improve water quality by removing phosphorous and pollutants from water discharged from the Reservation that ultimately flows into the Big Cypress National Preserve and the Everglades Protection Area. This is accomplished by allowing phosphorus and other pollutants to be biologically removed in the WRA and other nutrients attached to soil particles settled in the S4A water column.

7-08. Water Supply. Currently Basin 4 consists of approximately 306 acres of improved pasture and 293 acres of native range. Excess water that is pumped from the Basin 4 watershed will be pumped in S4A for stormwater

attenuation, then conveyed through uncontrolled culvert structure OF4A to WRA4 for retention and discharge into North Feeder Canal through WRA4E canal. There is no structure that can be used to re-use this water.

7-09. Navigation. This project has no specified water management operational provisions for navigation.

7-10. Drought Contingency Plan. There is no Drought Contingency Plan for this project at this time. Should one become available, it may be added as an attachment to this Water Control Plan.

7-11. Flood Emergency Action Plan. The Emergency Action Plan for this project is included as part of the Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual.

7-12. Deviation from Normal Regulation.
The Jacksonville District US Army Corps of Engineers Water Management Section is responsible for handling deviation requests and transmitting them through the District Commander to the Division Engineer for final decision. The District Commander is occasionally requested to deviate from normal operating criteria. Prior approval for a deviation is required from the Division Engineer except as noted in subparagraph "a" below. Deviation requests usually fall into the following categories:

a. Emergencies. Examples of some emergencies that can be expected to occur at a project are: drowning and other accidents, failure of the operation facilities, chemical spills, and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Districts must inform their division office as soon as practicable. Prepare written confirmation of the deviation and description of the cause and furnish it to the division water control manager. Divisions may develop forms to facilitate the reporting of emergency deviations.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. Construction accounts for the major portion of these incidents and typical examples include

utility stream crossings, bridge work, and major construction contracts. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threats and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied with providing there are no foreseen adverse effects on the overall regulation of the project (or projects) for the authorized purposes. Approval for these minor deviations normally will be obtained from the division office by telephone. Written confirmation explaining the deviation and its cause will be furnished to the division water control manager.

c. Planned Deviations. Each condition should be analyzed on its own merits. Sufficient data on flood potential, watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or facsimile to the division for review and approval.

Figures

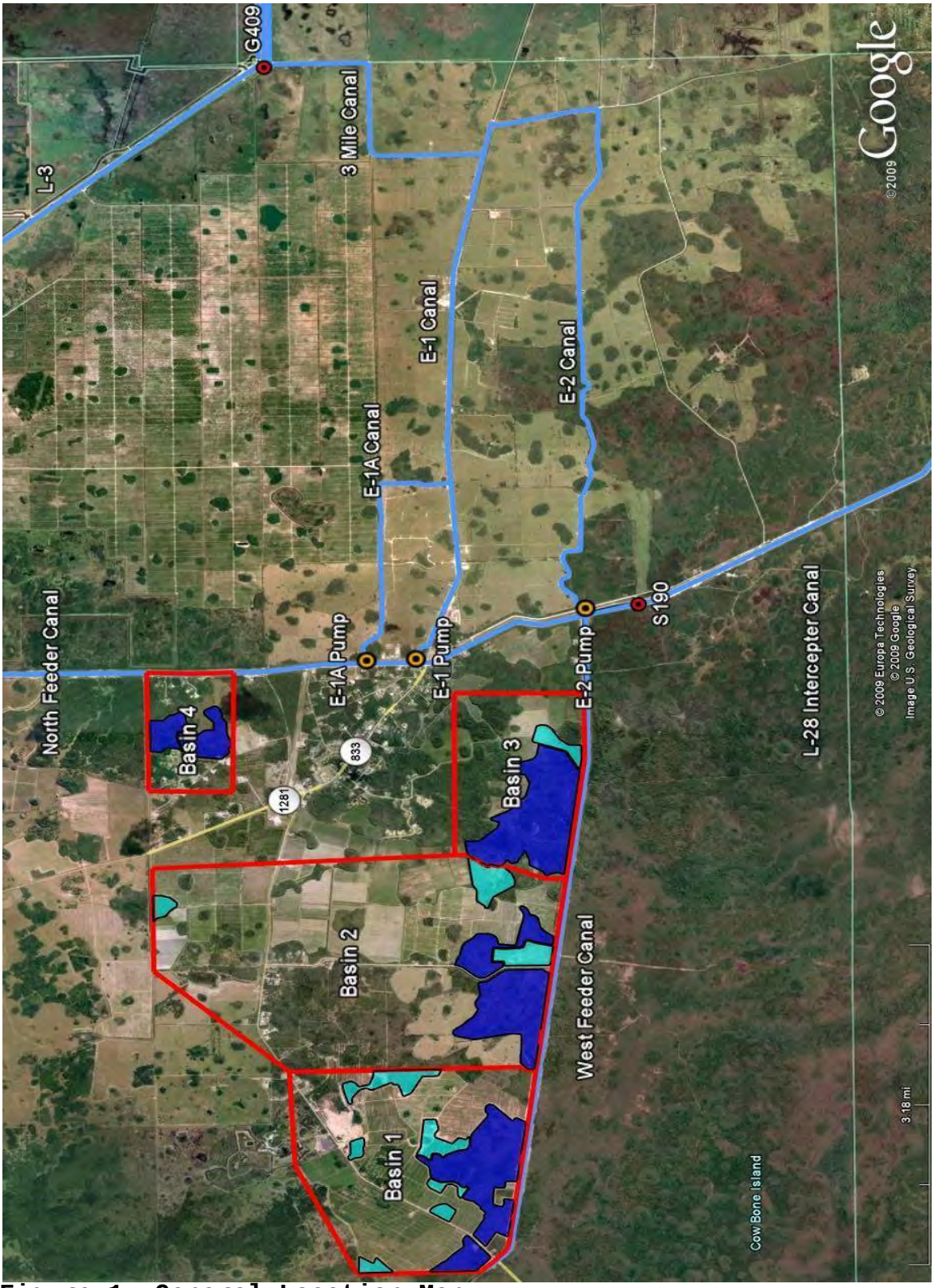

Figure 1: General Location Map

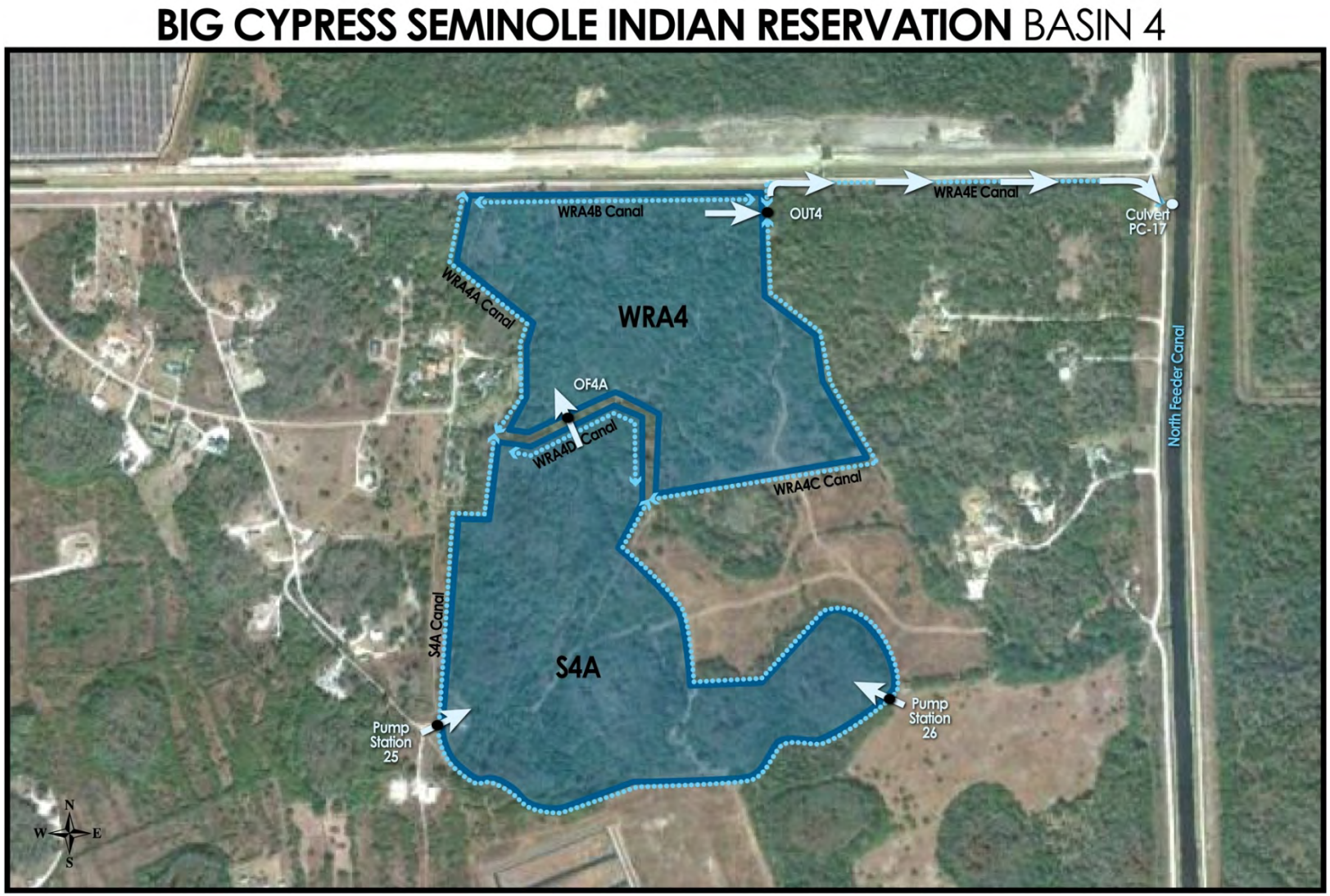

Figure 2: Basin 4 Layout

APPENDIX A – CENTRAL AND SOUTHERN FLORIDA PROJECT OPERATIONAL STRATEGY FOR WATER CONSERVATION AREA 3 DECOMPARTMENTALIZATION (DECOMP) AND SHEET FLOW ENHANCEMENT PROJECT – PHYSICAL MODEL PHASE 2

JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

OCTOBER 2017

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OPERATIONAL STRATEGY FOR WATER CONSERVATION AREA 3 DECOMPARTMENTALIZATION (DECOMP) AND SHEET FLOW ENHANCEMENT PROJECT - PHYSICAL MODEL PHASE 2

1 GENERAL OVERVIEW

The Comprehensive Everglades Restoration Plan (CERP) was authorized by Congress in 2000. The main objective of the plan is hydrologic restoration which will be achieved by increasing water storage capacity and redistributing water to reestablish ecologically desirable patterns of depth, distribution, and flow in the freshwater wetlands and salinity regimes in estuaries. CERP contains multiple elements, designed to restore ecosystem function and ensure adequate water supply (storage and distribution) while other efforts are designed to address water quality. The Water Conservation Area 3 Decompartmentalization and Sheet Flow Enhancement (Decomp) Project aims to reestablish sheet flow in the Everglades by decompartmentalization (i.e., removing barriers to flow and unnatural preferential flow paths provided by canals). The goal of Decomp is to hydrologically reconnect a significant component of the Everglades peatland: Water Conservation Area (WCA) 3A, WCA-3B, and Northeast Shark River Slough (NESRS). The Decomp effort will require a significant amount of engineering and deconstruction activities which will result in dramatic alteration to the ecosystem. The Decomp components originally proposed under CERP entails the full or partial removal of several levees, the full or partial backfilling of canals, and alteration of a major roadway, Tamiami Trail. This operational strategy for the DPM was developed to help guide operations of the temporary design-test structure (S-152) consistent with the April 2010 Installation, Testing and Monitoring of a Physical Model for the Water Conservation Area 3 Decompartmentalization and Sheet Flow Enhancement Project Final Environmental Assessment and Design Test Documentation Report (2010 EA) and with the science objectives stated in the 2010 DPM Science Plan. The 2010 EA included a Finding of No Significant Impact (FONSI). Information on the Decomp Physical Model (DPM) design test, a field-scale test, can be found in the 2010 EA. The 2010 EA anticipated operational testing of the DPM to begin in early 2011 and continue until late 2014. Construction of the DPM was delayed. Two operational periods of DPM testing were performed from 5 November 2013 to 30 December 2013 and from 4 November 2014 to 29 January 2015. A Supplemental FONSI was signed on 8 July 2015 to address potential effects of two additional operational periods in 2015 and 2016, not proposed in the 2010 EA. The Supplemental FONSI concluded that two additional operational periods starting in 2015 (October 2015 – January 2016) and 2016 (October 2016 – January 2017) would not result in a significant effect on the human environment. Two additional operational periods of DPM testing were performed from 16 November 2015 to 28 January 2016 and from 17 October 2016 to 31 January 2017.

The physical features of the DPM (see DPM Overview map in **Figure 1** and DPM Location map in **Figure 2**) are temporary and are expected to be removed at the end of the field test. The DPM includes four phases: pre-installation monitoring, installation, operations/testing, and disbandment/return to pre-test conditions. The project site would be returned to original conditions at the conclusion of the test. The DPM has been a large-scale field test designed to address hypotheses about reintroducing flow with marsh velocities thought to be representative of those that occurred historically from WCA-3A to WCA-3B. The physical features and operations are designed to mimic historic flow conditions in a controlled and predictable manner that will enable scientifically relevant investigations. The information gained from this field test has provided critical information for 1) assessing various canal backfilling options that will likely be evaluated in the Decomp Project and 2) understanding the extent to which the magnitude and direction of sheetflow is necessary to maintain the landscape characteristics of the Everglades. All elevations in this document are in feet, North American Vertical Datum of 1988 (ft., NAVD) unless otherwise noted. To convert elevations at S-152 from ft., NAVD to ft., NGVD, the conversion is: ft., NAVD + 1.52 ft = ft., NGVD.

The Corps is proposing a fifth year of testing in 2017, with the potential for additional years of testing through the year 2021 for purposes of gaining information to further address scientific, hydrologic and water management uncertainties that require clarification prior to the design of decompartmentalization features within WCA 3, included in CERP. Water flow, stage, sediment movement, water quality and ecological parameters will continue to be measured consistent with the DPM EA and FONSI (dated April 13, 2010). Extension of DPM operations from the previously evaluated October-January (end of the wet season through the early dry season) time frame to a year-round operational window subject to conditions, as well as additional years of DPM field test operations, will provide greater confidence in the overall reliability of the data collected and will allow the opportunity to more accurately address uncertainties associated with decompartmentalization of WCA 3. Continued operation of the DPM will also increase the likelihood of capturing a wider range of hydrologic events to substantiate lessons learned to date.

Furthermore, additional operation of the DPM beyond the October 2016-January 2017 time frame is being pursued to address the mandated Reasonable and Prudent Alternative (RPA) of the July 22, 2016 Everglades Restoration Transition Plan (ERTP) Biological Opinion by the United States Fish and Wildlife Service (FWS). The RPA requires that the Corps, in partnership with the SFWMD and subject to the successful completion of National Environmental Policy Act and other environmental requirements, continue to operate the field test, pursuant to State Water Quality Certification, for purposes of obtaining additional information through fiscal year 2017 and fiscal year 2018 (October through September). The RPA acknowledged that continued utilization of the DPM during the time limited effort is expected to provide direct and incidental benefits to the Cape Sable Seaside Sparrow by shifting additional water east concurrent with the ongoing incremental field tests conducted under the Modified Water Deliveries to Everglades National Park (MWD) Project.

Phase 2 of the DPM field test will begin early in the 2017-2018 dry season via the opening of all gates of S-152 and may continue, subject to constraints as noted in this Operational Strategy (including Section 4.1 OPERATIONAL WINDOW), through 2021. Because of the short duration (up to four years) of Phase 2 of the DPM, a Project Operating Manual is not necessary. However, an operational strategy is necessary for successful implementation and completion of the DPM Phase 2.

DPM Science Team:

The primary purpose of Phase 2 of the DPM is to conduct scientific tests and obtain scientific data related to the ecological effects of backfilling canals and modifying levees. The scientific tests have been carefully designed by the DPM Science Team and the test results are of significant value to future Everglades restoration efforts. The DPM Science Team is comprised of scientists and hydrologists from the U.S. Army Corps of Engineers (USACE), South Florida Water Management District (SFWMD), U.S. Geological Survey (USGS), FWS, and Everglades National Park (ENP). Prior to Phase 2 of the DPM, the DPM Science Team will review existing hydrologic, ecologic, and water quality data of canals, marshes, and tree islands in WCA-3. Based on review of the data and conditions, and consideration of the operational constraints, the DPM Science Team will exchange information relevant to the optimal time and duration to operate S-152 in order to meet project objectives. The DPM Science Team will coordinate with USACE Water Management Section staff (OD-MW) regarding gate operations of S-152.

2 DPM SITE LOCATION AND FEATURES DESCRIPTION

The DPM is situated between WCA-3A and WCA-3B (**Figure 2**) in a region referred to as the "pocket". The pocket is approximately 1.2 miles in width and is bounded on the upstream (northwest) by the L-67A and downstream (southeast) side by the L-67C canal and levee system. The DPM will focus its efforts in a region in the pocket referred to as the flow-way. The flow-way is oriented along an apparent historic flow-path from approximately north-northwest to south-southeast. The flow-way is approximately 1.8 miles in length and is not oriented perpendicular to the existing L-67A and L-67C. The flow-way contains several large sloughs and sawgrass ridges; however, no tree islands are contained within the flow-way.

The L-67A canal is both a borrow canal and conveyance canal, receiving waters from the Miami Canal, S-9 pump station, and WCA-3A. The L-67A canal is bounded on the east by the L-67A levee and on the west by a spoil mound due to placement of soil sidecast during the excavation of the L-67A borrow canal. A series of gaps in the spoil mound allows mixing of canal water with WCA-3A marsh water. The L-67C levee and the associated L-67C borrow canal were constructed to reduce seepage under the eastern perimeter levees of WCA-3, L-33 and L-30, by providing a step down of the water level difference between WCA-3A and WCA-3B, thereby providing flood protection for the developed communities east of WCA-3B. The

L-67C borrow canal does not directly receive discharges from control structures nor is it used for conveyance. The L-67C canal is bounded to the southeast by the L-67C levee and to the west by a small discontinuous spoil mound created during the excavation of the L-67C borrow canal. Inflow into the pocket occurs through seepage, from WCA-3A, and direct rainfall. Under pre-DPM conditions, water leaves the pocket through a combination of evaporation, seepage, and surface discharge through an approximately 1,000 feet (ft) long gap in the L-67C levee located about eight miles southwest of the Miami Canal (C-304) within WCA-3B.

During Phase 2 of DPM operations, flow will be manipulated by allowing water to pass from WCA-3A through the L-67A canal into the pocket through ten gated 60-inch diameter high density polypropylene culverts (S-152) with a combined maximum flow rate of 750 cubic feet per second (cfs). The ten culverts with vertical slide gates have been installed side-by-side and will discharge directly into sloughs within the flow-way. The S-152 culvert structure will not be remotely operated but will be manually operated on-site. In order to establish sheet flow and evaluate canal back filling options, a 3,000 ft long gap has been opened in the L-67C levee downstream of S-152. Levee material was deposited in the L-67C canal to create a 1,000 ft long completely full backfill segment and a 1,000 ft long partially full backfill segment. The remaining 1,000 ft long segment of the L-67C canal within the DPM flow-way was left unaltered. The S-152 gated culverts and L-67C backfill treatments are unchanged from the features originally constructed for Phase 1 of the DPM. Following completion of the DPM Phase 2, it is expected that S-152 will no longer be operated and the L-67C canal and levee will be reconstructed to pre-construction (or better) conditions. **Figure 3 and Figure 4** contain a depiction of the schematic layout of the DPM at L-67A and L-67C, respectively.

3 DPM CONSISTENCY WITH EXISTING OPERATING CRITERIA

The U.S. Army Corps of Engineers (USACE) is responsible for conducting water management operations at the S-12s and S-355s, as well as working closely with the South Florida Water Management District (SFWMD), in ensuring that the current WCA-3A Interim Regulation Schedule and South Dade Conveyance System (SDCS) operations are implemented. Water levels in WCA-3A are currently managed according to the WCA-3A Interim Regulation Schedule and a temporary deviation to the MWD Increment 1.1 and 1.2 Operational Strategy. Increment 1.1 and 1.2 includes the WCA-3A regulation schedule and SDCS operations. The WCA-3A regulation schedule stipulates that the L-67A Borrow Canal stage should not be drawn down below 7.5 ft., NGVD unless water is supplied from another source. When WCA-3A water levels are in Zones D/E/E1 of the WCA-3A regulation schedule, releases from WCA-3A are determined by the Rainfall Plan (WCA-3A Surface Water Deliveries to Everglades National Park). The WCA-3A regulation schedule relies on the Rainfall Plan for determining the amount, timing, and distribution of surface water flows from WCA-3A to SRS. When WCA-3A water levels are in Zone A, releases from WCA-3A are to be made up to maximum practicable. The SFWMD is responsible for operation and maintenance of S-333 which releases water from WCA-3A to the L-29 Canal, which distributes these inflows into

NESRS through existing culverts and the MWD 1-mile eastern bridge across the Tamiami Trail roadway.

The current WCA-3A regulation schedule and Increment 1.1 and 1.2 (including the temporary deviation until it ends) will continue to be used during the DPM unless replaced by subsequent authorized operating criteria documented through NEPA. Operation of the S-355A and S-355B structures are included within Increment 1.1 and 1.2. Florida Department of Environmental Protection (FDEP) permit (FDEP Permit Number 0246512-003) has been issued to USACE for operation of S-355A and S-355B. Total surface water deliveries to NESRS during the DPM are anticipated to increase under the current Increment 1.1 and 1.2 operations. In addition, deliveries to meet water supply demands in the Lower East Coast will be maintained.

The USACE will be responsible for operation and maintenance of S-152. S-152 discharges initiated during Phase 2 of the DPM are intended to proceed until scientific objective(s) of the DPM Science Plan are met or until constraint(s) are anticipated to be exceeded. If either the WCA-3A interim regulation schedule or Increment 1.1 and 1.2 is modified or replaced prior to or during implementation of the DPM, the modified or new operations and associated constraints, where applicable, will be in effect. The USACE water management section will exchange information with the DPM science team regarding whether and how the changes might affect DPM scientific objectives.

4 CONSTRAINTS

A number of operational constraints are described in Section 5.2.

4.1 OPERATIONAL WINDOW

Phase 2 of the DPM field test may include year-round operation of S-152, with all of the S-152 gates open full, subject to constraints as noted in Section 5.2, from as early as November 2017 through 2021. Water quality operational rules for year round operations provided in Appendix B of the EA have been developed to guide initiation of DPM testing within a given year and to determine the continuation of operations once S-152 is opened in addition to the above criteria. Collection of canal water Total Phosphorus (TP) data from the L67A Canal during prior DPM operations has enabled robust statistical analyses for forecasting when canal water TP is sufficiently low and flow can occur as needed to maintain oligotrophic conditions within the downstream marsh. Information regarding the operational rules for year round operations are defined in Appendix B of the EA. Operational rules for year round operations are based on the forecasted geometric mean for TP concentrations at S-151, as well as biweekly data collection to ensure low inflow TP concentrations into WCA 3B. These rules are anticipated to be included in the FDEP authorization by modifying the existing FDEP Permit Number 0304879, prior to the start of DPM Phase 2 operations. During Phase 2 of the DPM, operation

of S-152 will be consistent with the FDEP Permit for DPM Phase 2 (including any modifications of the permit) to reflect year round operations and will be consistent with the FWC WCA 3B operational guidance, to the maximum extent practical.

4.2 WCA-3B STAGE

The current level of flood protection east of the L-30 and L-31N levees must be maintained. Increased water levels within WCA-3B may result in increased seepage to the east as well as potential impacts to the protective levee system. This may occur when the stage at SRS-1 and/or Site 71 in WCA-3B rises to 8.5 ft., NGVD or higher.

4.3 FISH AND WILDLIFE

Adverse impacts to protected fish and wildlife species are not expected, consistent with the conclusions identified in the 2010 EA. Should an adverse impact be anticipated or occur, the field test will be halted. The U.S. Fish and Wildlife Service (FWS) and Florida Fish and Wildlife Conservation Commission (FWC) will be consulted and the test adjusted accordingly. FWS and FWC staff will have the opportunity to participate in approximately bi-weekly sharing of information mentioned in Section 5.1 of this Operational Strategy.

4.4 L-67A BORROW CANAL

The WCA-3A regulation schedule stipulates that the L-67A Borrow Canal stage should not be drawn down below 7.5 ft., NGVD unless water is supplied from another source.

4.5 SOUTH DADE CONVEYANCE SYSTEM

Typically the SDCS conveys water that includes seepage from WCA-3B. The SDCS must have available capacity to effectively manage the increased seepage volume that could occur if stages within WCA-3B rise to 8.5 ft., NGVD or higher at SRS-1 and/or Site 71.

4.6 WATER QUALITY OF DISCHARGES TO WCA'S AND ENP

The DPM will include control measures to ensure that there are no unanticipated adverse impacts to water quality as a result of this test. If water quality monitoring data indicates the potential for an adverse effect on water quality, the DPM operations will be suspended or adjusted to minimize or eliminate the potential effect. Any discharges through S-355A and B will continue to be monitored in accordance with the FDEP monitoring requirements. It is anticipated that this test will include operation of the S-355A and B structures in accordance with FDEP permit conditions and DPM objectives and constraints. The DPM field test is not dependent on operation of the S-355A and B structures.

Water Quality Operational Rules:

Water Quality Operational Rules provided in Appendix B of the EA have been developed using S-151 water quality data and marsh stage data (Eden 8) for determining a recommendation on whether, in the permitted Phase 2 of the DPM, discharges through S-152 may be performed. These rules, or updated versions of them, if applicable, will have been incorporated into the FDEP Permit for DPM Phase 2, prior to the start of Phase 2 of the DPM. It is possible that this permit will be modified in the future, thereby incorporating changes and/or additions to water quality operational rules. During Phase 2 of the DPM, operation of S-152 will be consistent with the FDEP Permit for DPM Phase 2 (including any modifications to the permit).

Prior to Phase 2 of the DPM, an interagency team (different than the Science Team), which would consist of interested members from each stakeholder agency such as the Corps, SFWMD, FWS, FWC, FDEP, ENP, USGS and appropriately Federally recognized Tribes will be assembled to review data and exchange information related to the latest site specific sampling and relevant Science Team work. The Corps, in consultation with the SFWMD, will determine S-152 operations using the Water Quality Operational Rules described above and consideration of interagency team information; also the Corps may consider any additional information obtained at the S-152 sampling site.

4.7 L-29 BORROW CANAL

The Tamiami Trail transportation corridor must remain functional during operation of the DPM. The high water constraint for the Tamiami Trail L-29 Borrow Canal will initially remain consistent with Increment 1.1 and 1.2 or with the current temporary deviation to Increment 1.1 and 1.2, whichever is applicable, for the duration of the DPM Phase 2. The current temporary deviation raises the L-29 stage maximum operating limit to 8.5 ft NGVD. Under Increment 1.1 and 1.2, S-333 discharges are typically discontinued if L-29 canal levels exceed 7.5 ft., NGVD under Increment 1.1 and 7.8 ft., NGVD under Increment 1.2. If the L-29 stage maximum operating limit is modified again prior to or during implementation of Phase 2 of the DPM (anticipated for the planned 2018 Increment 2 of the MWD field test), the modified constraint will replace the previous high water constraint.

In addition, there has been a history in which the tailwater at the S-355s has exceeded the headwater. During the DPM, consistent with Increment 1.1 and 1.2, the S-355s will remain closed when there is no head or a reverse head across the S-355s.

4.8 G-3273

The G-3273 constraint of 6.8 ft., NGVD has been relaxed and will not be modified from the current Increment 1.1 and 1.2 for the purposes of the DPM Phase 2. During the DPM Phase 2, operation of S-333 will follow the Increment 1.1 and 1.2 criteria. If the G-3273 constraint is

re-established or otherwise modified prior to or during implementation of the DPM, the modified constraint will be in effect.

4.9 WEATHER/CLIMATE CONDITIONS

Phase 2 of the DPM field test may include year-round operation of S-152, with all of the S-152 gates open full, subject to constraints as noted in this Operational Strategy, from as early as November 2017 through 2021. However, DPM (S-152) operations will be consistent with the FDEP Permit for DPM Phase 2 (including any modifications to the permit; see section 4.1 OPERATIONAL WINDOW). Tropical storm events or unusually dry or wet conditions can occur prior to or during this timeframe. Any of these conditions may require modification of this timeframe with appropriate review and approval from FDEP and coordination with the DPM science team to ensure operations can achieve scientific objectives of this project.

5 OVERALL PLAN FOR WATER MANAGEMENT

The operational window is anticipated to be November 2017 through 2021 subject to constraints as noted in this Operational Strategy (see section 4.1 OPERATIONAL WINDOW) and will consist of one or more cycles of opening/closing S-152. S-152 may discharge up to 750 cfs to facilitate the DPM Phase 2 field test, until either DPM objective(s) are met or S-152 is closed subject to the constraints. DPM (S-152) operations will be consistent with the FDEP Permit for DPM Phase 2 (including any modifications to the permit; see section 4.1 OPERATIONAL WINDOW).

Water will flow from S-152 across the pocket towards the 3,000-foot gap in the L-67C levee and into WCA-3B. An FDEP permit (FDEP Permit Number 0246512-003) has been issued to USACE for operation of S-355A and S-355B. Any discharges through S-355A and/or S-355B will be in accordance with this permit. WCA-3B will be managed by targeting to convey S-152 discharges through WCA-3B to the L-29 borrow canal via S-355A and B. S-152 releases will be determined based upon several conditions including but not limited to: Rainfall Plan, DPM test objectives, WCA-3B water level, L-29 borrow canal water level, and SDCS status.

During Phase 2 of the DPM, the S-355A and S-355B structures are anticipated to be used to the maximum extent practicable for providing the surface water deliveries to NESRS specified by the Rainfall Plan and the WCA-3A regulation schedule. Closure of the S-355s may be initiated during high water conditions in WCA-3A to maximize regulatory releases from S-333. During periods of WCA-3A regulatory releases to the SDCS, the capability to continue operation of the S-355s will be assessed. S-333 is the primary structure for releasing the Rainfall Plan target discharge. S-355A and S-355B or S-12 structures may be used as secondary structures for releasing the Rainfall Plan target discharge. Operational adjustments

of the S-355s will be determined with consideration of test conditions and system conditions which include S-152 discharges.

5.1 IMPLEMENTATION OF RAINFALL PLAN.

During Phase 2 of the DPM field test, frequent exchange of information is expected to occur between USACE Jacksonville District Water Management Section staff (OD-MW) and member(s) of the DPM Science Team regarding gate operations. Before the start of DPM Phase 2, a conference call or meeting will occur between the DPM Science Team and OD-MW to discuss communication regarding operations during Phase 2. Science Team and OD-MW points of contact (POCs) will be established and contact information may be exchanged. It is expected that on an approximately bi-weekly basis throughout Phase 2, the Rainfall Plan target discharge amount(s) to NESRS will be shared with OD-MW and Science Team POC(s). It will be the responsibility of USACE Jacksonville District Environmental Branch (PD-E), not the operator or OD-MW, to make decisions that affect project compliance regarding fish and wildlife and water quality constraints. Science Team POC(s) will share information with OD-MW staff regarding the target discharge at S-152 on an approximately bi-weekly basis throughout Phase 2. The Corps will develop assurances that fish and wildlife and water quality constraints are met for the S-152 target discharge for the week(s) of S-152 discharge being considered. A compliance determination that fish and wildlife and water quality constraints are met for the S-152 target discharge that week(s), based on the assurances, will be made by PD-E. Should an adequate compliance determination not be provided to OD-MW for an S-152 target discharge, then S-152 will be closed.

Based on the above information, OD-MW will operate the S-355s and coordinate with SFWMD on their operation of S-333 to achieve the Rainfall Plan target discharge amount to NESRS.

5.2 S-152 OPERATING CRITERIA.

During each cycle S-152 may discharge up to 750 cfs to facilitate the DPM field test, until either DPM objective(s) are met or S-152 is closed as outlined below.

1. When WCA-3B stages (at SRS-1 and/or Site 71) equal or exceed 8.5 ft., NGVD, S-152 releases may be discontinued unless the 8.5 ft., NGVD criteria has been modified under subsequent NEPA and required approvals.

2. When S-355A and B are closed due to high water in L-29 Borrow Canal, S-152 releases may be reduced or discontinued before the 7.5 ft., NGVD (Increment 1.1) or 7.8 ft., NGVD (Increment 1.2) or 8.5 ft NGVD (current temporary deviation) stage limit is reached. If the L-29 stage maximum operating limit is modified again prior to or during

implementation of Phase 2 of the DPM, the modified constraint will replace the previous high water constraint. This is scheduled to happen by March 1, 2018.

3. When water quality constraint criteria per the FDEP Permit for DPM Phase 2 (including any modifications to the permit) are exceeded, S-152 releases may be reduced or discontinued.

4. When the L-67A Borrow Canal stage is below 7.5 ft., NGVD and water is not available from another source, S-152 releases will be discontinued as no water is available from WCA-3A.

Also, operation of S-152 will be consistent with the FDEP permit for the S-355s (FDEP Permit Number 0246512-003).

6 DATA COLLECTION AND ANALYSIS.

Headwater, tailwater, flow, and precipitation data pertinent to the DPM will be made available at an OD-MW website. During testing within Phase 2 of the DPM, headwater and tailwater stages will be frequently monitored (e.g., one reading per fifteen to 60 minutes) as will water quality (per the FDEP Permit for DPM Phase 2 including any modifications to the permit). DPM Science Team staff will be monitoring and interpreting data. A Water Control Data Acquisition System Plan (WCDASP) can be found in Annex B.

7 WCA-3B SCHEDULE OF MAXIMUM ALLOWABLE STAGES.

Implementation of the Rainfall Plan may include the use of a schedule for WCA-3B water levels. Due to the intra-annual variability of water levels within WCA-3, increased operational flexibility may be expected during the dry season and following the end of the hurricane season (i.e., November 30). A schedule of maximum allowable stages at Site 71 and/or SRS-1 may be developed by OD-MW in coordination with the DPM Science Team and approved by USACE and SFWMD water managers. The weekly values of this schedule would be developed based on the state of the system just before the test. However, the DPM Phase 2 test can be implemented without this schedule.

8 STANDING INSTRUCTIONS TO S-152 OPERATOR.

Culvert structures can have four possible flow regimes resulting from the effects of gates and tailwater effects. The flow regimes are:

1. Uncontrolled Free Flow. The gates are fully opened and the discharge is unaffected by the tailwater stage.

2. Uncontrolled Submerged Flow. The gates are fully opened and the discharge is reduced by tailwater conditions.

3. Controlled Free Flow. The gates are partially opened and the discharge is unaffected by the tailwater stage.

4. Controlled Submerged Flow. The gates are partially open and the discharge is reduced by the tailwater conditions.

The S-152 discharge rating curve that is being used must be applicable to the particular flow regime encountered. Discharge rating curves for S-152 for anticipated flow regimes at S-152 (controlled/uncontrolled submerged flow) are found in Annex A, Figures A-1 through A-4. The gates should be opened and closed gradually to provide an even transition to the new flow regime and to minimize hydraulic effects downstream. Figure A-5 (Annex A) shows the S-152 maximum gate opening for the design discharge of 800 cfs.

9 DEVIATION FROM NORMAL REGULATION.

The USACE Jacksonville District Water Management Section is responsible for handling deviation requests and transmitting them through the USACE Jacksonville District Commander to the South Atlantic Division (SAD) Engineer for final decision. The USACE Jacksonville District Commander is occasionally requested to deviate from normal regulation schedules. Prior approval for a deviation is required from the SAD Engineer except as noted in subparagraph "9.1" below. Deviation requests usually fall into the following categories:

9.1 EMERGENCIES.

Examples of some emergencies that may potentially occur at a project are: drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. USACE Districts must inform their Division office as soon as practicable, prepare written confirmation of the deviation and description of the cause and furnish it to the USACE Division water control manager. Divisions may develop forms to facilitate the reporting of emergency deviations.

9.2 UNPLANNED MINOR DEVIATIONS.

There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. Construction accounts for the major portion of these incidents and typical examples include utility stream crossings, bridge work, and major construction contracts. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally

involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threat, and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied with providing there are no foreseen adverse effects on the overall regulation of the project (or projects) for the authorized purposes. Approval for these minor deviations normally will be obtained from the SAD office by telephone. Written confirmation explaining the deviation and its cause will be furnished to the SAD water control manager.

9.3 PLANNED DEVIATIONS.

Each condition should be analyzed on its own merits. Sufficient data on flood potential, watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the USACE Jacksonville District recommendation, will be presented by letter or telefacsimile to SAD for review and approval.

FIGURES

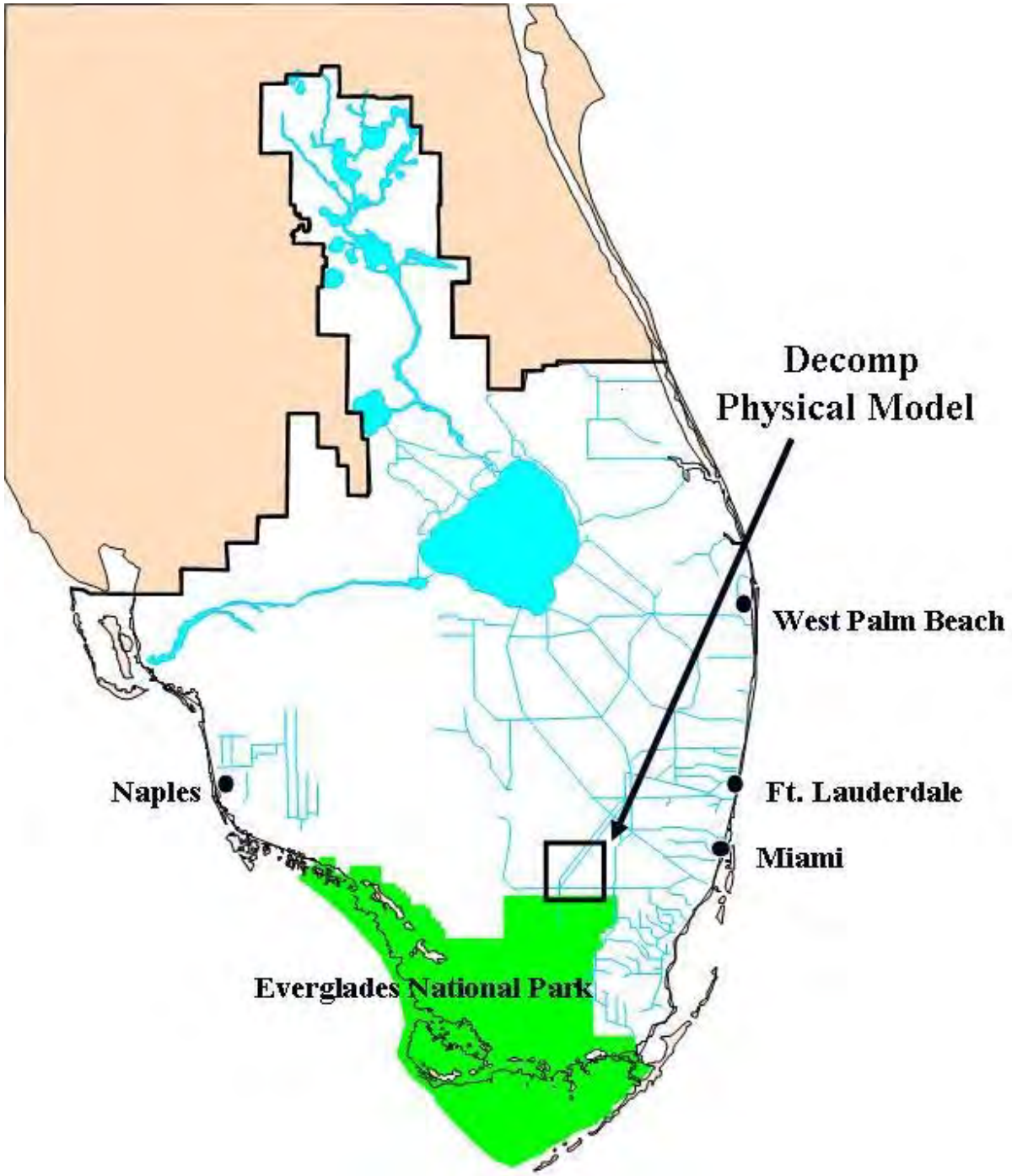

FIGURE 1: DECOMP PHYSICAL MODEL OVERVIEW

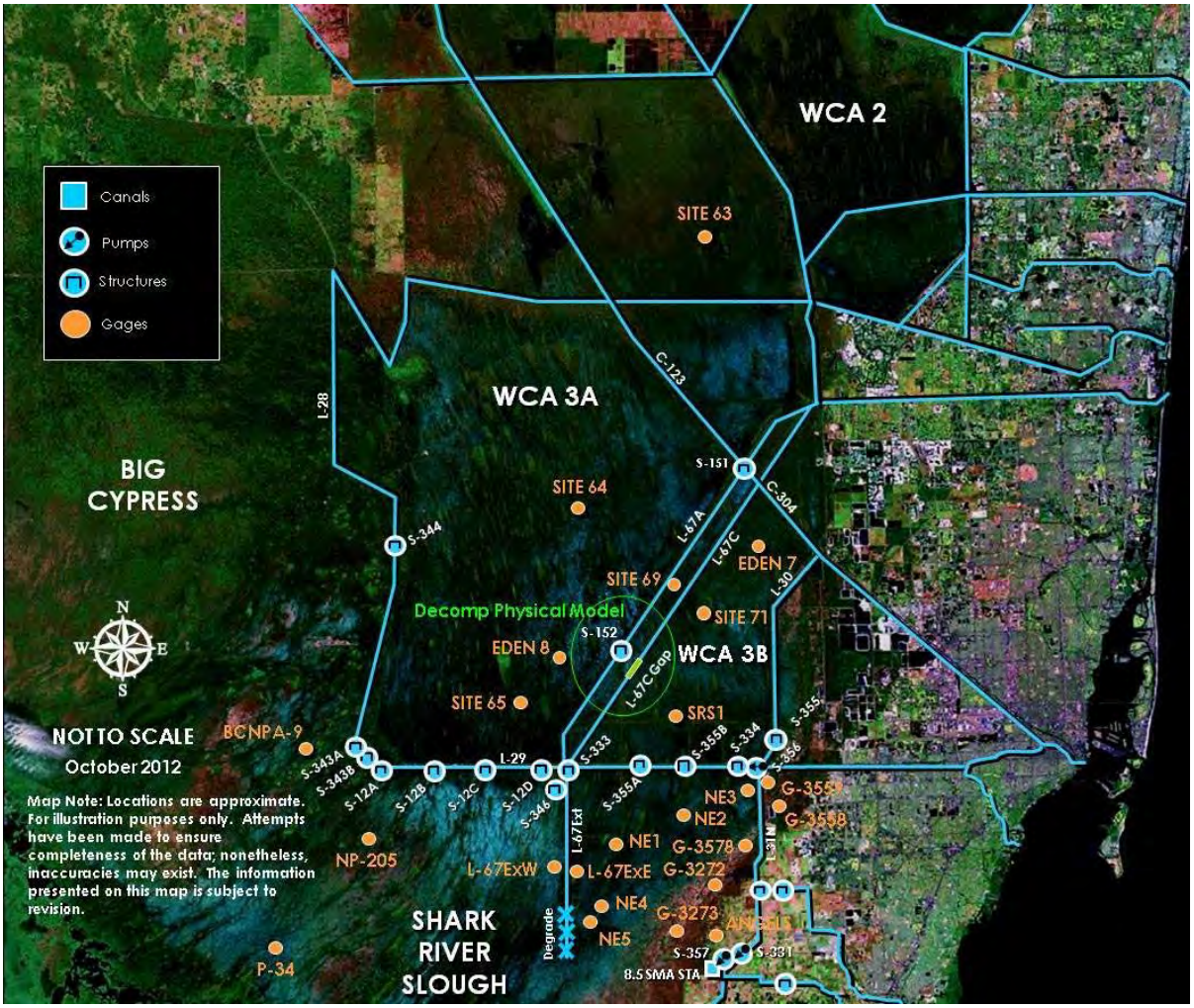

FIGURE 2: DECOMP PHYSICAL MODEL LOCATION

FIGURE 3: DECOMP PHYSICAL MODEL - DEPICTION OF SCHEMATIC LAYOUT AT L-67A

FIGURE 4: DECOMP PHYSICAL MODEL - DEPICTION OF SCHEMATIC LAYOUT AT L-67C

APPENDICES

ANNEX A

STRUCTURE DESCRIPTION

Structure 152 (S-152)

Location. This culvert structure is located in the L-67A levee at NAD 1983 coordinates x = 780,838.878 y = 556,457.152.

Description. S-152 consists of ten High Density Polypropylene (HDPP) 60 inch diameter barrels with discharge controlled by vertical slide gates.

Purpose. S-152 will control flows from WCA-3A through the pocket to WCA-3B for the DPM field test.

Operation. See Section 5 Overall Plan for Water Management.

TABLE A-1: S-152 HYDRAULIC DESIGN DATA SHEET

Location (NAD 1983): L-67A Levee x = 780,838.878 y = 556,457.152

Design Conditions	Discharge (CFS)	800	cfs
	Headwater Elevation	7.20	ft., NAVD 88
	Tailwater Elevation	6.70	ft., NAVD 88
SPF Conditions	Discharge (CFS)	NA	cfs
	Headwater Elevation	13.1	ft., NAVD 88
	Tailwater Elevation	11.1	ft., NAVD 88
Culvert Data	Number of Barrels	10	
	Barrel Type	HDPE	
	Culvert Diameter	60	inches
	Culvert Length	100	ft
	Upstream Pipe Invert	1.0	ft., NAVD 88
	Downstream Pipe Invert	1.0	ft., NAVD 88
	Upstream Headwall	No	
	Downstream Headwall	No	
	Type of Control	Vertical Slide Gate	
Culvert Entrance/Exit Data	Side Slopes (Vert. on Hor.)	1 on 3	
	Upstream Bottom Width	108.0	ft
	Upstream Bottom Elevation	0.0	ft., NAVD 88
	Downstream Bottom Width	108.0	ft
	Downstream Bottom Elevation	0.0	ft., NAVD 88
Energy Dissipation	**Riprap Requirements**		
	Rip Rap Design Velocity	7.50	fps
	Upstream Length	10.00	ft
	Upstream Protection Elevation	13.00	ft., NAVD 88
	Downstream Length	20.00	ft
	Downstream Protection Elevation	11.00	ft., NAVD 88
	Energy Dissipator	No	

Note: To convert elevations at S-152 from ft., NAVD to ft., NGVD, the conversion is:

ft., NAVD + 1.52 ft = ft., NGVD. This is based on NGS monument reports on the following established benchmarks: PID AC4780, AC4779, AC4421, AC4776, and AC4775.

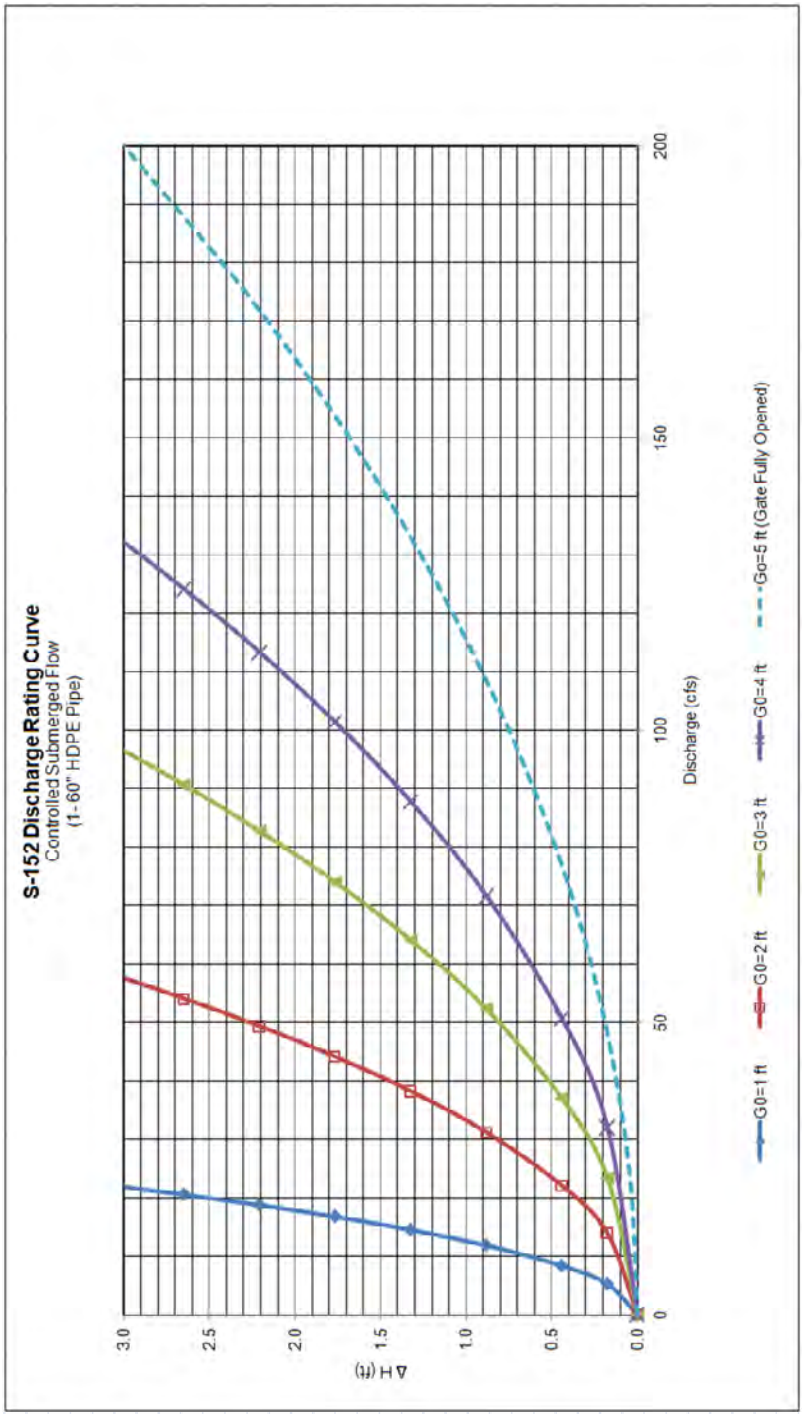

FIGURE A-1: S-152 DISCHARGE RATING CURVE – CONTROLLED FLOW (1 PIPE)

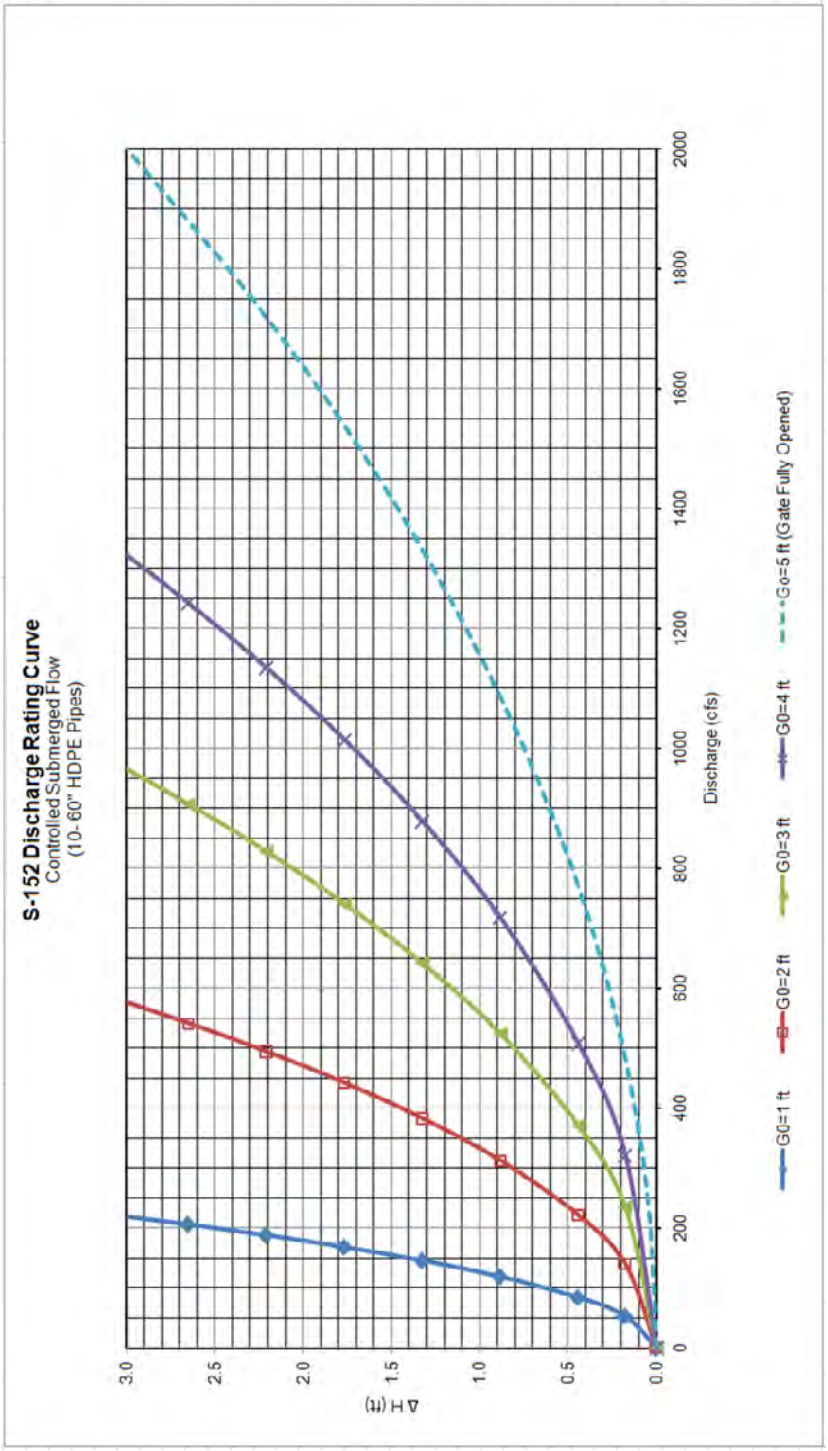

FIGURE A-2: S-152 DISCHARGE RATING CURVE – CONTROLLED FLOW (10 PIPES)

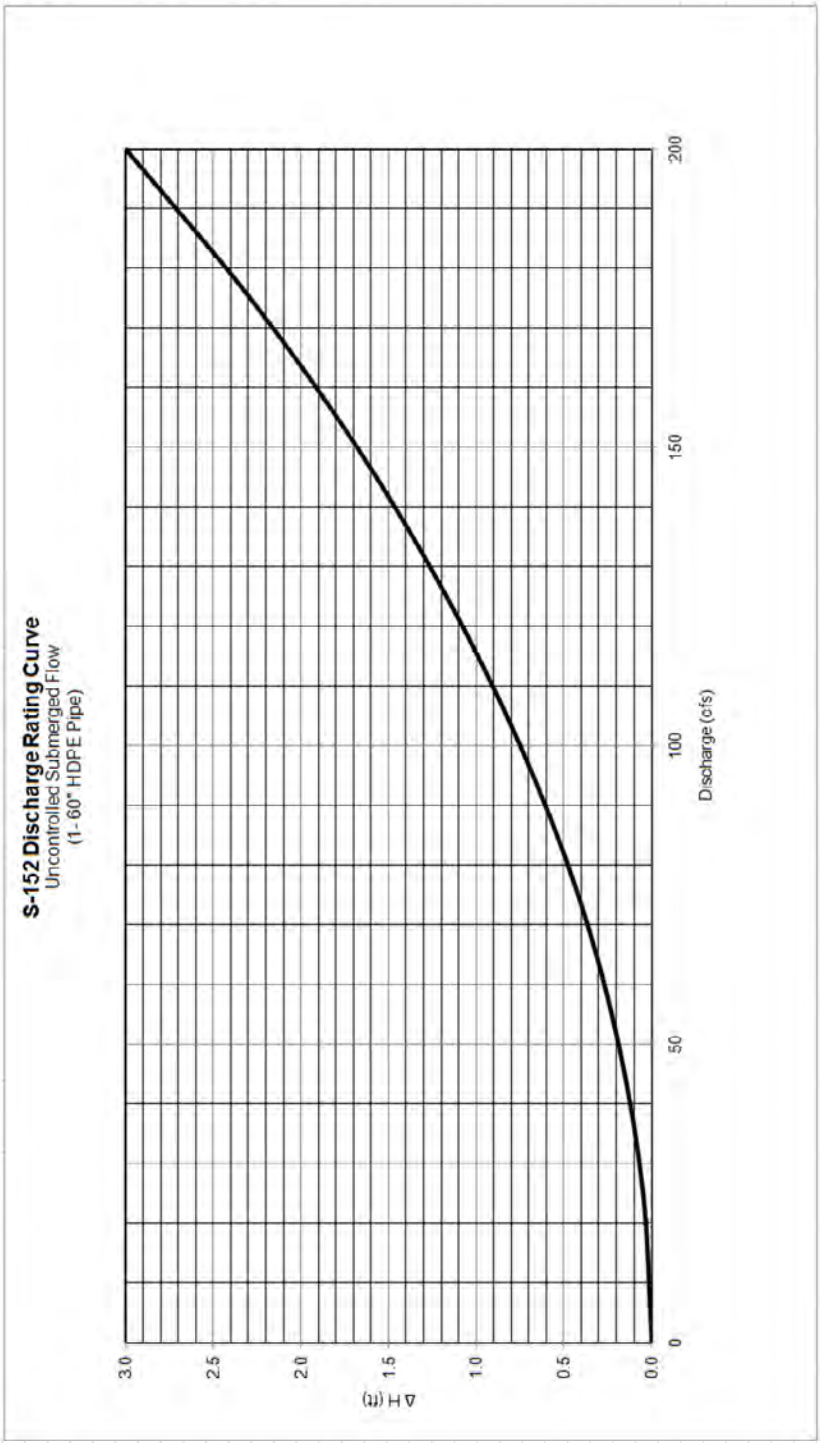

FIGURE A-3: S-152 DISCHARGE RATING CURVE – UNCONTROLLED FLOW (1 PIPE)

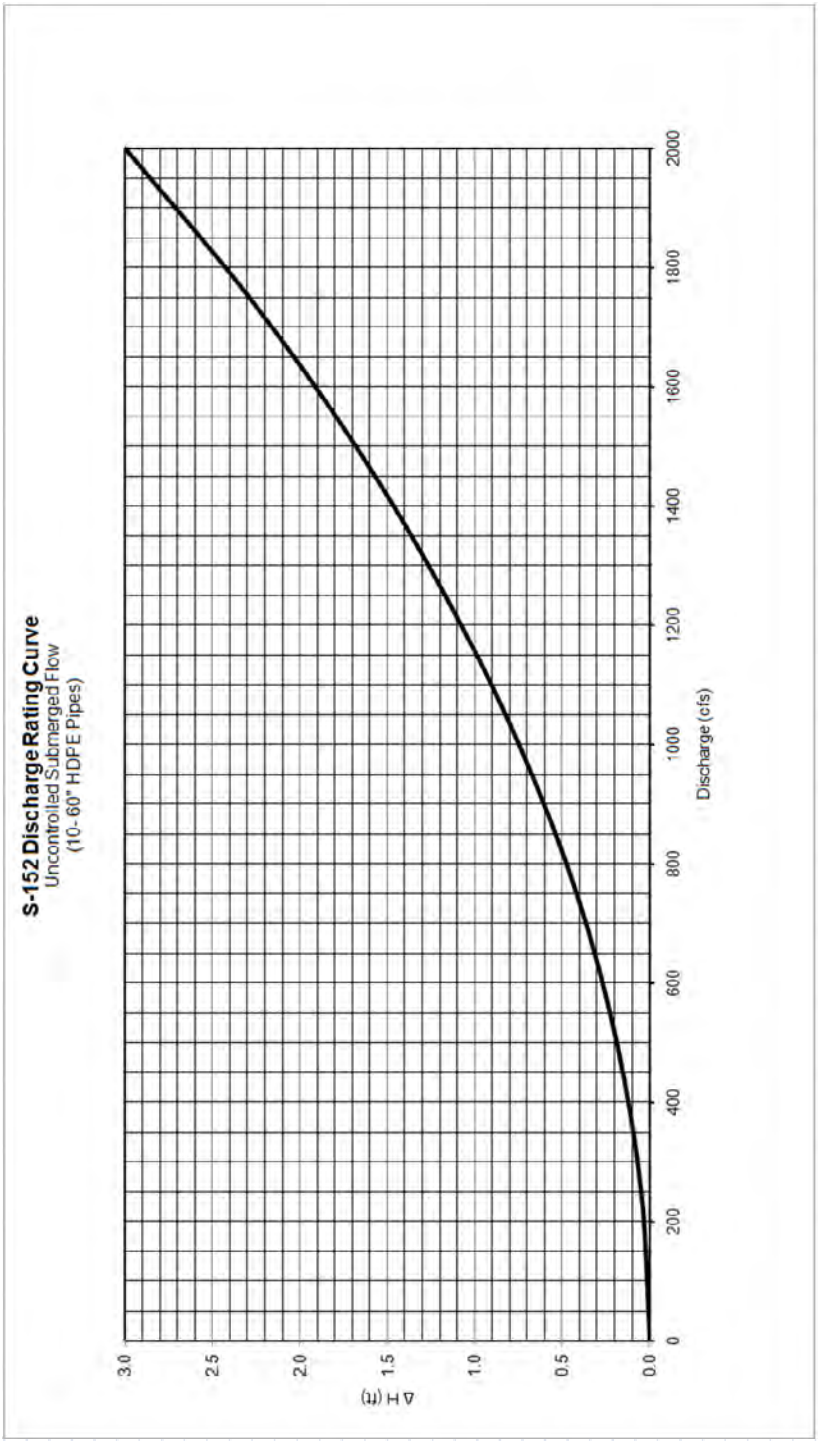

FIGURE A-4: S-152 DISCHARGE RATING CURVE – UNCONTROLLED FLOW (10 PIPES)

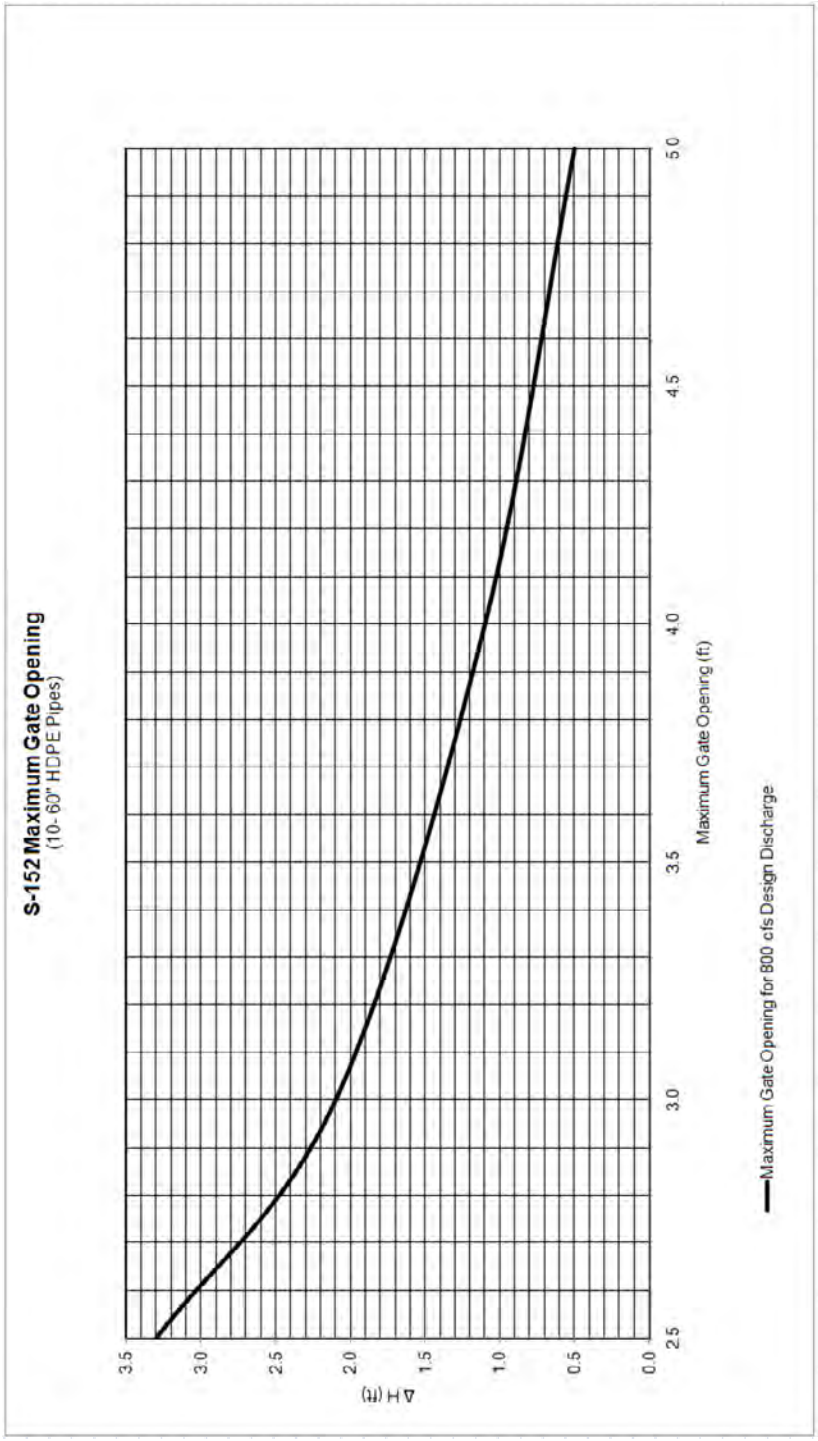

FIGURE A-5: S-152 MAXIMUM GATE OPENING

ANNEX B

WATER CONTROL DATA ACQUISITION SYSTEM PLAN (WCDASP)

ANNEX B

WATER CONTROL DATA ACQUISITION SYSTEM PLAN (WCDASP)

The S-152 is a manually operated gated culvert structure (Annex A). S-152 will be equipped for remote monitoring of the headwater stage, tailwater stage, and point velocity meters if required. This Water Control Data Acquisition System Plan discusses data acquisition essential to the water control management function. This WCDASP will be a subset of the Water Control Data System specific to CERP.

Real time stage information will be available from stage recorders on the headwater and tailwater sides of S-152, and from existing gages in the project area including the SRS-1 and Site 71 gages in WCA-3B. Headwater, tailwater, and flow data from S-152 will be sent to the SFWMD operation center and to the Water Management Section, Jacksonville District, USACE via radio telemetry and/or Geostationary Operational Environmental Satellite telemetry and/or interagency data exchange procedures.

Stage, flow, and precipitation data for the DPM would be maintained in SFWMD and USACE databases. Data from the SFWMD operated data acquisition system such as stage, flow, and rainfall data will be available at a frequency of one reading per hour.

During testing within DPM Phase 2, headwater and tailwater stages will be frequently monitored (e.g., one reading per fifteen to 60 minutes) as will water quality per the FDEP Permit for DPM Phase 2 (including any modifications to the permit).

Florida Department of Environmental Protection

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Noah Valenstein
Secretary

COMPREHENSIVE EVERGLADES RESTORATION PLAN
REGULATION ACT (CERPRA) PERMIT
CONSTRUCTION AND EMERGENCY LIMITED OPERATIONS AUTHORIZATION

PERMITTEE:
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406

ATTENTION:
Mr. Ernie Marks
Executive Director

Permit Number: **0362076-001**
Project: Central Everglades Planning Project
Phase: S-333 N Gated Spillway
County: Miami-Dade

Date of Issue: July 30, 2018
Expiration Date: July 30, 2023

This permit is issued by the State of Florida Department of Environmental Protection (Department/FDEP) under the authority of the Comprehensive Everglades Restoration Plan Regulation Act (CERPRA), Chapter 373.1502, Florida Statutes (F.S.); Title 62, Florida Administrative Code (F.A.C.); and pursuant to the Department's authority under Chapters 373 and 403, F.S. This activity is not exempt from the requirement to obtain a CERPRA Permit.

The South Florida Water Management District (Permittee/District) is hereby authorized to construct and utilize under emergency limited operations described on the application and approved associated drawing(s), plans, and other documents attached hereto or on file with the Department and made a part hereof. The activities authorized by this permit must be conducted in conformance with all the provisions of this permit. Failures to comply with all permit conditions and documents referenced herein shall constitute grounds for revocation of the permit and appropriate enforcement action.

Authorizations or permits for this activity may be required by other federal, state, regional, or local entities including but not limited to local governments or municipalities. This permit does not relieve the Permittee from the requirements to obtain all other required permits or authorizations.

This permit constitutes a finding of consistency with Florida's Coastal Zone Management Program, as required by Section 307 of the Coastal Management Act, 16 United State Code (U.S.C.) § 1456 and constitutes certification of compliance with water quality standards under Section 401 of the Clean Water Act, 33 U.S.C. § 1341. Activities described in the related documents are not authorized until the project is determined to be in conformance with all applicable rules and with the general and specific conditions of this permit/certification/authorization, as specifically described below.

PROJECT DESCRIPTION:

This permit is for the construction, emergency limited operations, and maintenance of a fully automated, electrically operated two (2) gate spillway with design capacity of 1,150 cfs to be built adjacent to the existing S-333 Gated Spillway at the intersection of the L-67A and L-29 canals, in Miami-Dade County. The structure's purpose is to provide emergency, high water relief to Water Conservation Area (WCA) 3, the future purpose of the proposed S-333N Gated Spillway after modification of this permit would be to provide additional operational flexibility and

conveyance of flows to Everglades National Park (ENP) as a part of the Comprehensive Everglades Restoration Plan (CERP). The total acreage within the project area for the S-333N Gated Spillway Phase is 14.41 acres with approximately 0.36 acres of impacts to wetlands and approximately 0.83 acres of impacts to manmade canals. Under future operations, the overarching benefits provided to tree islands and associated wildlife in WCA 3A through the reduction in prolonged high-water events will off-set the direct wetland impacts associated with the construction of the structure.

The S-333N Gated Spillway is a component of the Central Everglades Planning Project (CEPP). The CEPP includes a suite of storage, treatment, conveyance and seepage management measures that will provide the necessary components to deliver additional fresh water from Lake Okeechobee south to WCA 3, ENP and Florida Bay. Once implemented, the project will restore more natural quantity, quality, timing and distribution of water flows to the remaining portions of Everglades. The Final Integrated Project Implementation Report (PIR) for CEPP was published in the Federal Register in July 2014, the Chief of Engineers Report was signed in December 2014 and the Record of Decision was signed in August 2015. The District Governing Board Resolution was approved on April 10, 2014, and FDEP's Final Order was executed on April 10, 2014, both which state terms related to the District's agreement to participate as CEPP's local sponsor. The project received Congressional authorization in December of 2016 and is awaiting appropriations. The S-333N Gated Spillway is the first component of the CEPP to move forward for construction. CEPP recognized that updates to Appendix A of the current operational Consent Decree (Case No. 88-1886-CIV-Moreno) would be required in order to achieve long-term hydrologic improvement and to reflect increased inflows and new discharges into ENP since the Consent Decree was entered.

As envisioned in CEPP the sequencing of construction requires seepage management features, including the expanded capacity of the existing S-356 Pump Station, to be constructed prior to increasing conveyance for inflow into ENP at the S-333N Gated Spillway. Only emergency limited operations of the S-333N Gated Spillway is authorized as part of this permit because the terms stated in the District's Governing Board Resolution and FDEP's Final Order regarding CEPP, as well as sequencing of CEPP components, such as seepage management, and conveyance features have not yet been constructed. One of the design objectives of CEPP is to eliminate the diversion of seepage from the Everglades into the south Miami-Dade canal system through the G-211 structure by maximizing the use of the enlarged S-356 Pump Station before opening G-211. For routine operations of the S-333N Gated Spillway, this permit anticipates that the operational phases be developed incrementally based on additional seepage management features and that each phase of operations obtain separate operational permits from the Department. The operational criteria for the S-333N Gated Spillway needs to be developed as part of future regional Water Control Plans concurrent with future seepage management features in the CEPP.

Under the emergency limited operations authorized in this permit, the proposed S-333N Gated Spillway will work in conjunction with the existing S-333 Gated Spillway, S-356 Pump Station, and Central & Southern Florida (C&SF) Project's Water Control Plan for Water Conservation Areas, Everglades National Park (ENP), and ENP-South Dade Conveyance System (WCAs-ENP-SDCS Water Control Plan) to provide limited operational flexibility and limited increase to hydraulic connectivity between the Everglades and Francis S. Taylor Wildlife Management Area (EWMA) and ENP to help alleviate extended high-water conditions, while not causing excessive seepage and potential flooding to adjacent agricultural and residential lands.

Prior to approval of future operation plans, the S-333N Gated Spillway will only be operated under emergency limited operational criteria when there is capacity in the L-29 Canal to operate the existing seepage control S-356 Pump Station with priority over the new S-333N Gated Spillway, in combination with the S-333 Gated Spillway consistent with the currently approved operating plans (currently Increment 2 Field Test) for the region.

PROJECT COMPONENTS:

The proposed S-333N Gated Spillway Phase of the CEPP, see Figures 1-3, includes construction and emergency limited operations of the S-333N Gated Spillway that is designed to work in conjunction with the existing S-333 Gated Spillway to increase operational flexibility and hydraulic connectivity between Water Conservation Area (WCA) 3A and ENP, and will effectively increase the design discharge capability at the S-333 "complex" from 1,350 cfs to 2,500 cfs. The S-333N Gated Spillway Phase includes the following construction components:

- **S-333N Gated Spillway –** which has been designed as a fully automated, electrically operated two (2) gate spillway with peak capacity of 1,150 cfs
- minor modifications to the L-67A and L-29 levees and canals with the associated canal excavation, levee construction and stabilization needed to support the spillway construction
- rip-rap armoring of approximately 351 linear feet of adjacent canal bank
- sidewalks, pavement, and a new control building with instrumentation, motor operators, telemetry, site lighting, underground propane tank, and an electric service conduit with associated horizontal directional drill under the L-29 Canal
- a new air boat ramp
- construction of stilling wells, water quality monitoring station, staff gauges, steel walkways, and removal of the existing water quality monitoring platform. The monitoring station for the S-333 Gated Spillway will be maintained as is for concurrent monitoring with the anticipated replacement location at the S-333N Gated Spillway

PROJECT LOCATION:

This phase of the project is located just north of U.S. 90 (Tamiami Trail) and approximately 12 miles west of its intersection with SW 177th Ave. (Krome Ave.) in Section 6, Township 54 South, and Rage 37 East, within Miami-Dade County, Florida. The proposed S-333N Gated Spillway is located at the southern end of the L-67A Canal in the southeast corner of WCA 3A and adjacent to the existing S-333 Gated Spillway at the intersection of the L-67A Canal and the L-29 Canal.

DECLARATION OF REASONABLE ASSURANCES:

In issuing this permit, the Department finds that the District has given reasonable assurances sufficient to satisfy the requirements of the CERPRA, Section 373.1502, F.S. The Department bases these findings on the implementation of specific conditions contained herein and the following documents:

1. South Florida Water Management District, CEPP, S-333N Gated Spillway Phase, Construction and Emergency Limited Operations CERPRA Permit Application and associated materials, FDEP File No. 0362706-001 (received March 7, 2018 and additional information on March 14, 2018, March 16, 2018, April 13, 2018, May 11, 2018, May 18, 2018, June 15, 2018, June 20, 2018, June 22, 2018, June 26, 2018, and July 2, 2018)
2. U. S. Department of Interior - Fish and Wildlife Service, CEPP, Biological Opinion (May 7, 2013)
3. U.S. Army Corps of Engineers and South Florida Water Management District, CEPP, Final Integrated Project Implementation Report and Environmental Impact Statement (July 2014, revised December 2014) (Including the caveats in section 8.3, which must be addressed prior to routine operations)
4. U. S. Department of Interior - Fish and Wildlife Service, Everglades Restoration Transition Plan, Biological Opinion (July 22, 2016)
5. South Florida Water Management District, Monitoring Plan for Everglades National Park Inflows North PIN (August 22, 2017)
6. U.S. Army Corps of Engineers, Jacksonville District, Final Environmental Assessment (EA) and Finding of No Significant Impacts (FONSI) for the 2018: L-29 Canal and G-3273 Constraint Relaxation Including the Northern Detention Area (Revised Operational Strategy Increment 2) (February 21, 2018)
7. South Florida Water Management District, Compliance Monitoring Plan for S-333N Gated Structure (July 02, 2018)
8. South Florida Water Management District, Hydrological Monitoring Plan for S-333N Structure Monitoring Program (July 2, 2018)
9. South Florida Water Management District, Design Report S-333N Gated Structure, Work Order 4600003017-WO13, Erdman Anthony Job No: 60245.13 (June 6, 2018)
10. South Florida Water Management District, Engineering Design Standards for Water Resource Facilities - Technical Specifications for S-333N Structure, RFB 6000000906 (June 6, 2018)

11. South Florida Water Management District, Corrected Final (RTA) Construction Plans for S-333N Structure, RFB 6000000906, Miami Dade County, Florida, Project ID. No. 101013 (June 11, 2018)

Specifically, there are reasonable assurances, pursuant to Section 373.1502, F.S., that

- "The project components will achieve the design objectives set forth in the detailed design documents submitted as part of the application."
- "State water quality standards, including water quality criteria and moderating provisions, will be met. Under no circumstances shall the project component cause or contribute to violation of state water quality standards."
- "Discharges from the project component will not pose a serious danger to public health, safety, or welfare."
- "Any impacts to wetlands or threatened or endangered species resulting from implementation of the project component will be avoided, minimized, and mitigated, as appropriate."

The District agrees to construct, operate, and maintain the project in accordance with the provisions of this permit, permit application, and the associated documentation on file with the Department. The District is responsible for construction, operation, maintenance, repair, replacement, and rehabilitation of each of this project's components. All conditions found herein apply to the District.

GENERAL CONDITIONS:

In accordance with Section 373.1502(3)(e)(2), F.S., of the CERPRA, this permit may include any standard conditions provided by Department rule, which are appropriate and consistent with the CERPRA.

1. **Enforcement**. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 373.129, 403.141, 403.727, 403.859 through 403.861 F.S. The Permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. **Scope of Permit.** This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. **Limitation of Rights.** The issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total Project which are not addressed in this permit. However, this permit is in lieu of other permits under Chapter 373 or Chapter 403, F.S., except for permits issued under Section 403.0885, F.S., if applicable.

4. **Limitations upon Title.** This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. **Liability.** This permit does not relieve the Permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the Permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department. The Permittee shall hold and save the

Department harmless from any and all damages, claims, or liabilities which may arise by reason of the construction, alteration, operation, maintenance, removal, abandonment or use of any system authorized by the permit.

6. **Operation and Maintenance Responsibilities.** The Permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the Permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. **Access Rights.** The Permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

   A. Have access to and copy any records that must be kept under conditions of the permit;
   B. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
   C. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

   Reasonable time may depend on the nature of the concern being investigated.

8. **Noncompliance.** If, for any reason, the Permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the Permittee shall immediately provide the Department with the following information:

   A. A description of and cause of noncompliance; and
   B. The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

   The Permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. **Records as Evidence.** In accepting this permit, the Permittee understands and agrees that all records, notes, monitoring data, and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Sections 403.111, F.S. and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. **Changes in Law.** The Permittee agrees to comply with changes in applicable Department rules and applicable Florida Statutes after a reasonable time for compliance; provided, however, the Permittee does not waive any other rights granted by Florida law.

11. **Transferability.** This permit is transferable only upon Department approval in accordance with Rules 62-4.120 and 62-330.340, F.A.C., as applicable. The Permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. **Permit at Work Site.** This permit or a copy thereof shall be kept at the work site of the permitted activity. For the purposes of this permit, the work site shall be defined as the South Florida Water Management District Headquarters located at 3301 Gun Club Road in West Palm Beach, Florida.

13. **Records Retention.** The Permittee shall comply with the following:

    A. Upon request, the Permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department;

    B. The Permittee shall hold at the facility or other location designated by this permit records of all monitoring information required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least five years from the date of the sample, measurement, report, and application unless otherwise specified by Department rule; and

    C. Records of monitoring information shall include:

        i. the date, exact place, and time of sampling or measurements;
        ii. the person responsible for performing the sampling or measurements;
        iii. the dates analyses were performed or the appropriate code as required by Chapter 62-160, F.A.C.;
        iv. the person responsible for performing the analyses;
        v. the analytical techniques or methods used, including but not limited to method detection limit (MDL); and
        vi. the results of such analyses, including identification of potential outlier values.

14. **Requests for Information.** When requested by the Department, the Permittee shall within a reasonable time furnish any information required by law, which is needed to determine compliance with the permit. If the Permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

15. **External Agency Requirements.** Should any other regulatory agency require changes to the permitted system, the Permittee shall notify the Department in writing of the changes prior to implementation so that a determination can be made whether a permit modification is required.

16. **Sovereign Lands.** The Permittee is hereby advised that Florida law states: No person shall commence any excavation, construction, or other activity involving the use of sovereign or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund or the Department of Environmental Protection under Chapter 253, until such person has received from the Board of Trustees of the Internal Improvement Trust Fund the required lease, license, easement, or other form of consent authorizing the proposed use. Therefore, the Permittee is responsible for obtaining any necessary authorizations from the Board of Trustees prior to commencing activity on sovereignty lands or other state-owned lands.

17. **Artifacts.** If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlements are encountered at any time within the project site area, the permitted project should cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance and Review Section at (850) 245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, F.S.

SPECIFIC CONDITIONS:

1. **Addresses.** Reports, plans and notices submitted to the Department in accordance with this permit, unless otherwise specified, shall be submitted to the Department's Office of Ecosystem Projects (OEP), 3900 Commonwealth Boulevard, MS 24, Tallahassee, Florida, 32399-3000, telephone number (850) 245-2228.

Electronic copies of reports, plans and notices required by this permit may be sent to RPPS_Comp@dep.state.fl.us.

2. **Florida Threatened and Endangered Species.** The Permittee shall coordinate with the appropriate wildlife agency for appropriate guidance and recommendations to avoid, minimize or mitigate impacts to Florida Threatened and Endangered species resulting from implementation of the project components.

3. **Blasting Activities.** Prior to commencing blasting activities, the Permittee shall coordinate with the FWC and USFWS to eliminate the potential for harmful effects on protected species from the use of explosives within the project area, and any other appropriate agencies and municipalities. The activities shall be consistent with the requirements outlined in Specific Condition No. 2.

4. **Contaminated Sites and Residual Agrichemicals.** The Permittee shall address all contaminated sites within the project footprint in accordance with all applicable Department statutes and rules including but not limited to Chapter 62-780, F.A.C. If contamination is discovered after operations, the Permittee shall send to the Department at the addresses specified in Specific Condition No. 1 an assessment and remedial action plan for Department approval. Upon the Department's approval, the Permittee shall implement the assessment and remedial action plan and provide quarterly reports to the Department on the progress of the remediation until the cleanup is completed to the Department's satisfaction.

5. **On-Site Wetland Impacts and Restoration.** The S-333N Gated Spillway is a component of the U.S. Army Corps of Engineers' congressionally approved CEPP and is intended to increase hydraulic connectivity between WCA-3A and ENP, specifically Northeast Shark River Slough. The S-333N Gated Spillway will work in conjunction with the existing S-333 Gated Spillway to help reduce detrimental effects of prolonged high-water events and lessen adverse impacts to tree islands and associated wildlife within WCA-3A which is managed as part of the Francis S. Taylor Wildlife Management Area. These overarching benefits will off-set the impacts to 0.36 acres of non-unique nuisance dominated wetlands within WCA 3. At this time, the Department does not require any mitigation to offset the functional loss of wetland areas. However, if construction or operations are discontinued once impacts have occurred, the District shall coordinate with the Department to determine whether or not a modification to the permit is necessary to address these impacts.

Construction

6. **Authorized Construction.** This permit authorizes the construction and maintenance of the project components that are listed in the Project Components section of this permit. Authorized construction includes construction of the new S-333N Gated Spillway with the associated canal excavation, levee construction and stabilization in accordance with the District's final design report for the S-333N Gated Structure dated June 6, 2018 and the Corrected Final Construction Plans and Technical Specifications for the S-333N structure (RFB 6000000906) dated June 11, 2018 and June 6, 2018, respectively.

   The Permittee shall construct the project components in accordance with the plans and documentation submitted by the Permittee as part of the permit application and any subsequent submittals that have been approved and are on file with the Department. Any substantial modifications to the construction plans, such as, but not limited to hydrologic modifications or the addition/removal/modification of water control structures or changes to their location must be submitted for review and approval by the Department prior to construction and operation of such modifications. Substantial modifications shall be determined on a case-by-case basis by the Department in consultation with the Permittee.

   The Permittee shall submit final plans and technical specifications, signed and sealed, to the Department for all components of the project for consistency review at least 60 days prior to initiating construction activities. Upon review of the submitted plans and specifications, the Department will determine whether a permit modification is required.

7. **Construction Schedule.** The Permittee shall provide the Department with timely notice of a proposed construction schedule and any modified schedules at the addresses specified in Specific Condition No. 1.

8. **Pre-construction Activities.** At least two weeks prior to execution of each contract, the Permittee shall conduct a pre-construction meeting for attendance by the contractor(s), and representatives from the Corps, the Department, the District, and other environmental regulatory agencies. The Department shall receive at least 14 days' notice of the meeting to allow for Department attendance and participation.

9. **Instructions to Construction Personnel and/or Contractors.** The Permittee shall ensure that training be provided regarding the identification and avoidance of harming, harassing, or killing State and Federal listed species and that the conditions contained within this permit, are explained to all construction personnel working on the project. A copy of this permit shall be provided to each contractor and subcontractor before the authorized work begins. Prior to execution of each contract and subsequent construction activities, the Permittee shall schedule a pre-construction meeting for attendance by the contractor(s), and representatives from the District, the Department, the Corps, and other environmental regulatory agencies. The Department shall receive at least two weeks' notice of the meeting. The Permittee shall provide the Department with timely notice of a proposed construction schedule and any modified schedules at the addresses specified in Specific Condition No. 1.

10. **Construction Status Reports.** Construction Status Reports which summarize progress of all maintenance activities, project components, phases and/or contracts, and Construction Meeting Minutes shall be available to the Department upon request and such reports shall continue to be available throughout the duration of construction activities until all disturbed areas are successfully stabilized. These Reports may be requested through the Project Manager, Construction Manager, or obtained at the construction meetings.

11. **Construction and Maintenance Best Management Practices (BMPs).** The Permittee shall submit a BMP Plan to the Department for review and approval to the addresses specified in Specific Condition No. 1 at least 30 days prior to construction activities including but not limited to installation of erosion controls, clearing and grubbing, and other earthwork. Acceptable BMP Plan formats may include Erosion Control Plans, Storm Water Pollution Prevention Plans (SWPPP), or an Environmental Protection Plan. Modifications to the BMP Plan may necessitate further review and approval by the Department. The BMP Plan shall describe the methods used to protect environmental resources as a direct result of construction activities. Upon installation of the erosion controls identified in this/these plan(s), the Permittee shall contact the Department to determine whether inspections of the installed controls are necessary. At a minimum, the plan shall include strategies and procedures to be implemented and maintained at all times during construction and maintenance activities to:

    A. prevent negative impact(s) to Florida threatened and endangered species and the habitats and habitat characteristics that support them;

    B. prevent negative impact(s) to prehistoric or historic artifacts, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement;

    C. minimize or eliminate project generated turbidity, including details regarding the use of sediment controls to minimize the suspension and transport of soils, levee materials, and roadway materials into waters adjacent to or downstream of the construction site;

    D. prevent negative impacts to adjacent wetlands, including, but not limited to, specifications for demarcation of said wetlands and exposed soils with construction fencing or other effective physical barriers to prevent encroachment;

    E. prevent the transport of any material into wetlands and surface waters both during and after completion of the construction; and

F. limit the extent of clearing and grubbing such that impacts to native vegetation, either within or immediately adjacent to the project area shall be minimized or avoided.

12. **Adjacent Wetlands.** Wetlands adjacent to construction activities shall be staked and fenced off with construction fencing or other effective physical barriers to prevent encroachment into these wetlands prior to the commencement of construction. Temporary impacts to wetlands, including the construction of haul roads, outside the construction footprint are not authorized in this permit. All areas of exposed soils shall be isolated from wetlands and surface waters to prevent erosion and deposition of sediments into these wetlands during permitted construction activities. All excavated or dredged material shall be placed strategically to prevent the transport of any material into wetlands and surface waters both during and after completion of the construction. Upon completion of the barrier installation, the District shall notify the Department at the addresses specified in Specific Condition No. 1 to schedule an inspection of the required barriers. The barriers shall remain in place until all adjacent construction activities are complete.

13. **Stockpiles/Soil Disposal Areas.** Vegetative and demolition debris, as well as unwanted excavated material shall be properly disposed.

14. **Site Stabilization.** All graded areas shall be stabilized and vegetated no greater than seven days after construction activities have temporarily or permanently ceased for any portion of the site to minimize erosion. All screens, silt fences, sheet pile, and other turbidity control devices and preventive operation procedures shall remain in place for the duration of each construction activity and maintained until all project-generated turbidity has subsided, the project site has been stabilized, and the turbidity level at the point of discharge from the construction or maintenance work area to receiving waters meets state standards. Once these conditions are met, turbidity and erosion control devices shall be removed within a timely manner and prior to completion of construction. If there are multiple work areas within a feature, contract or phase, individual work areas shall be stabilized if there will be a significant lag time prior to completion of the entire feature, contract or phase.

15. **Site Inspections.** Throughout the construction, maintenance, and operational activities, the Department will conduct periodic site inspections to ensure permit compliance and to monitor progress. The Department will coordinate with the Permittee representative prior to performing any on-site inspections. A third-party inspector and/or consultant may accompany representatives of the Department at any time.

16. **Manatee Protection During Construction.** The Permittee shall comply with the following conditions intended to protect manatees from direct project effects:

A. Instruct all personnel associated with the project about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The Permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.

B. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

C. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

D. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of

the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.

E. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922, and to FWC at ImperiledSpecies@myFWC.com. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or Vero Beach (1-772-562-3909) for south Florida.

F. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the Permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 ½" by 11" explaining the requirements for "Idle Speed/No Wake" and the shutdown of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at MyFWC.com/manatee. Questions concerning these signs can be sent to the email address listed above.

17. **Water Use Authorization.** This permit does not authorize the use of water for any purpose, including, but not limited to, construction dewatering, industrial uses or potable water supply.

For activities that require construction dewatering authorization, the Permittee shall require that the contractor(s) submit the required application, fees and applicable site-specific information to the South Florida Water Management District. The Permittee shall ensure that Water Use authorization is received from the South Florida Water Management District in accordance with Chapter 40E-2 F.A.C. and that copies of the final site specific dewatering plan and water use permit are provided to the FDEP OEP at the address specified in Specific Condition No. 1.

For all other water use authorizations, including those required for operation, the Permittee shall coordinate with the Department's Office of Water Policy.

18. **NPDES Generic Permit for Stormwater Discharge from Large and Small Construction Activities and Generic Permit for Discharge of Ground Water from Dewatering Operations.** The issuance of this Permit does not constitute coverage under the National Pollutant Discharge Elimination System (NPDES) Generic Permit for Stormwater Discharge from Large and Small Construction Activities (CGP) pursuant to Rule 62-621.300(4)(a), F.A.C., or from the discharge of groundwater resulting from construction-related dewatering activities pursuant to Rule 62-621.300(2)(a), F.A.C., incorporated by reference in the CGP. If the project activities require either of these generic permits, the Permittee must adhere to all conditions within such permits.

Emergency Limited Operations

19. **Emergency Limited Operations for WCA-3 High Water Relief**. This permit only allows for emergency limited authorization for operating the S-333N Gated Spillway for high water relief in WCA 3 during the following conditions:
    A. When the average stages at gauges WCA 3A-62 and WCA 3A-63 exceed elevation 11.6 ft. NGVD for 72 hours, the Permittee may operate the S-333N Gated Spillway subject to the L-29 Canal stage constraint. Discharges from the existing S-356 Pump Station shall have priority over the S-333N Gated Spillway discharges.
    B. The Permittee shall cease operations of the S-333N Gated Spillway when the L-29 Canal stage limits the operations of the S-356 Pump Station, or when the average of the WCA 3A-62 and WCA 3A-63 gauges recedes below an elevation of 11.0 ft. NGVD. The Permittee shall notify the Department within 24 hours of such occurrence and shall provide data justifying the conditions are met.
    C. During operations of S-333N Gated Spillway, the following operations shall take place:

i. There shall be no use of S-334 Gated Spillway to divert WCA-3A regulatory releases to the L-31N Canal; and
ii. The S-356 Pump Station will have priority over the S-333N Gated Spillway and the S-356 Pump Station will be operated up to its full available capacity prior to opening G-211 Gated Culvert, and as the water levels recede in WCA-3, the G-211 Gated Culvert will be closed before the pumping at the S-356 Pump Station is reduced.

D. Operations beyond the emergency limited operations will require a modification to the permit prior to implementation.

20. **Public Health, Safety, and Welfare.** Pursuant to Section 373.1502(3)(b)(3), F.S., of the CERPRA, discharges from the project shall not pose a serious danger to public health, safety, or welfare.

Monitoring Program

21. **Water Quality Monitoring.** The Permittee shall collect and analyze water quality monitoring data in accordance with the most current approved version of the Compliance Monitoring Plan for the project using the parameters and frequencies identified in Table 1 and the locations identified in Tables 1 and 2 that are illustrated in Figures 4 and 5. The Permittee shall report the results to the Department, in accordance with the annual reporting requirements specified in Specific Condition No. 34.

Concurrent monitoring at the S-333 and S-333N Gated Spillways shall be conducted until the Department reviews and approves discontinued monitoring at the S-333 Gated Spillway. The Permittee shall provide a written justification and analysis, using data collected during the period of concurrent monitoring at the S-333 and S-333N Gated Spillways, to the Department for review and approval. Monitoring at the S-333 Gated Spillway is required under the Non-ECP Permit. Any modifications to the Compliance Monitoring Plan shall be submitted to the Department for review and approval.

22. **Hydrological Monitoring.** The Permittee shall ensure that hydrological monitoring data is collected and analyzed in accordance with the locations and parameters in Table 1 at the locations identified in Table 3, and the most current approved Hydrological Monitoring Plan. Locations are illustrated in Figures 1 and 6. The Permittee shall report the results to the Department, in accordance with the annual reporting requirements specified in Specific Condition No. 34. Any modifications to the Hydrological Monitoring Plan shall be submitted to the Department for review and approval.

23. **Data Quality.** All monitoring data required during the construction and/or operation of this permit shall be conducted in accordance with the following:

A. **Quality Assurance and Quality Control.** Sampling and monitoring data shall be collected, analyzed, reported and retained in accordance with Chapter 62-160, F.A.C. Any laboratory test required by this permit shall be performed by a laboratory that has been certified by the Florida Department of Health (DOH) under Chapter 64E-1, F.A.C., where such certification is required by Rule 62-160.300, F.A.C. The laboratory must be certified for all specific method/analyte combinations that are used to comply with this permit. The analytical method used shall be appropriate so as to determine if the sample complies with Class III surface water quality standards as specified in Chapter 62-302, F.A.C. All field activities including on-site tests and sample collection, whether performed by a laboratory or another organization, must follow all applicable procedures described in the most current version of DEP-SOP-001/01. Alternate field procedures and laboratory methods may be used if they have been approved according to the requirements of Rules 62-160.220, and 62-160.330, F.A.C.

B. **Method Detection Limits (MDLs).** The sample collection, analytical test methods and MDLs applicable to this permit shall be performed and reported in accordance with Rule 62-4.246, F.A.C. A list of Department established analytical methods, and corresponding MDLs and practical quantification limits (PQLs), which is titled "Florida Department of Environmental Protection Table as Required by Rule 62-4.246(4) Testing

Methods for Discharges to Surface Water" dated April 25, 2006, is available from the Department on request. The MDLs and PQLs as described in this list shall constitute the minimum acceptable MDL/PQL values and the Department shall not accept results for which the laboratory's MDLs or PQLs are greater than those described above unless alternate MDLs and/or PQLs have been specifically approved by the Department for this permit. More stringent MDLs and PQLs may be necessary for specific parameters. If required, these will be identified in the permit monitoring plan.

24. **Water Quality Standards.** Under no circumstances shall the construction, operations and/or maintenance of the project or any project component cause or contribute to a violation of state water quality standards. The Permittee shall comply with all applicable state water quality standards described in Chapter 62-302, F.A.C.

25. **Water Quantity and Flooding Impacts.** The Permittee shall be responsible for ensuring that the project is operated so as not to adversely affect adjacent lands with regards to water quantity and/or flooding. The Permittee shall hold and save the Department harmless from any and all damages, claims or liabilities, which may arise from water quantity and/or flooding impacts resulting from operation of this project.

26. **Turbidity Monitoring During Construction and Maintenance.** Effective means of turbidity control shall be employed during all construction or maintenance activities that could result in project-generated turbidity in receiving water bodies. Turbidity control measures shall be in accordance with best management practices contained in the approved BMP Plan referenced in Specific Condition No. 11. Additionally, a project specific Turbidity Control Plan for turbidity monitoring shall be submitted to the Department for review and approval at the addresses specified in Specific Condition No. 1 at least 30 days prior to the initiation of any construction activity and at least 14 days prior to the implementation of any subsequent plan revisions. All turbidity control devices and/or preventive operation procedures shall remain in place until the turbidity level at the compliance sampling site meets state standards or as otherwise approved by the Department.

Turbidity Standard

A. Turbidity shall not exceed 29 Nephelometric Turbidity Units (NTUs) above background in Class III receiving waters.

Sampling Protocols

B. Sampling and analyses shall be performed as required by Chapter 62-160, F.A.C., and in accordance with appropriate FDEP Standard Operating Procedures (FDEP-SOP), located at http://www.dep.state.fl.us/water/sas/sop/sops.htm. Turbidity monitoring equipment and personnel trained to use it shall be available on site at all times during construction or maintenance activities that could result in project-generated turbidity levels beyond the work area that have the potential to be discharged to a receiving water body.

C. During construction or maintenance activities, the Permittee shall monitor turbidity levels at least twice daily for the background and compliance samples, with samples taken a minimum of once every four hours, at the locations described within the project's approved Turbidity Control Plan.

   i. Approximately 100 feet upstream of the work sites and clearly outside the influence of construction activities. (This shall serve as the natural background sample against which other turbidity readings shall be compared.)
   ii. Directly outside the turbidity curtains surrounding the work sites and within the densest portion of any visible turbidity plume. (This sample shall serve as the compliance sample.)

D. For monitoring purposes, work areas are defined by the turbidity curtains.

E. If there are multiple work areas where construction is creating a visible turbidity plume, each construction activity shall be monitored separately.

Turbidity Exceedance

F. If monitoring reveals project-generated turbidity exceeds the Turbidity Standard authorized in this permit the Permittee shall take the following measures:

i. Immediately cease all work contributing to the water quality violation;
ii. Immediately report turbidity violations to the Department;
   a. The Department shall be notified by phone and at RPPS_Comp@dep.state.fl.us within 24 hours; and
   b. The Permittee shall submit a turbidity exceedance report to the Department at the addresses specified in Specific Condition No. 1. The report shall include a copy of the monitoring data sheets, which indicate violation(s) and a description of the corrective actions taken or proposed. The report shall be made to the Department as soon as normal business hours resume if violation(s) are noted after normal business hours, on holidays, or on weekends.
iii. The possible cause of the violation shall be identified;
iv. Modify work procedures that may have contributed to the violation such as installing additional turbidity or erosion protection devices; repairing any non-functional turbidity containment devices, stabilizing exposed soils, and checking calibration of the meter; and
v. Work shall not resume until the activities can be conducted in compliance with the turbidity standards and the Department grants authorization.

Failure to report violation(s) or to follow corrective procedures before resuming work may constitute grounds for formal enforcement action.

Monitoring Logs and Reports

G. Turbidity monitoring results shall be compiled daily and summarized quarterly (every three calendar months) by project component beginning with the first calendar month in which construction or maintenance activities occur that could generate turbidity in receiving waters and continuing until all construction, dredging, stabilization and/or excavation is completed. If no construction activities occur that could generate turbidity and the project site has been stabilized during the entire or a specific portion of the quarterly monitoring period, this shall be noted in the report and include information regarding continuation of monitoring. Quarterly reports shall be sent to the addresses specified in Specific Condition No. 1.

H. Daily monitoring logs shall clearly identify the following information:

i. Project name and current permit number;
ii. Dates and times of sampling and analysis;
iii. Name of individual collecting samples;
iv. Unique identification of the specific instrument unit(s) used for sample collection and analysis as required by FDEP-SOP-001/01 FT 1600 Field Measurement of Turbidity;
v. Measurement value and reporting units;
vi. Water depth;
vii. Depth of sample;
viii. Weather conditions;
ix. Water level stage in the canal or water body and direction of flow;
x. Clear description of project component activities taking place at the time of sampling that may have contributed to turbidity; and

xi. Signature and statement of authenticity by a properly trained individual indicating that the instrument meets the outlined specifications and has been calibrated in accordance with FDEP-SOP-001/01 FT 1600 Field Measurement of Turbidity.

I. Quarterly reports shall include the daily logs and a summary of the following information:

i. Summary of construction activities that have taken place;
ii. Statement regarding sampling results, the net difference between compliance and background results, and whether the turbidity levels are in compliance;
iii. Summary of any significant compliance issues and how they were resolved;
iv. Statement which explains any gaps in sampling activity (e.g., no construction or maintenance activity that could contribute to turbidity generation in receiving waters, contractor not onsite, work shut down due to weather conditions); and
v. Map indicating the sampling locations and construction activity taken place during the reporting period.

27. **Removal of Parameters.** Upon demonstration that a specific parameter(s) is not present or is found consistently in compliance with water quality standards, the Permittee may request a modification to the monitoring program as appropriate. A minimum of one year's worth of data, for those parameters being sampled quarterly or more frequently, will be required prior to the Department approving any modification to the monitoring program. Parameters sampled semi-annually or annually will be examined on a case-by-case basis. The Department may approve a reduction of the monitoring frequency or waive the monitoring requirement for parameters that consistently are reported in compliance with State water quality standards.

28. **Addition of Monitoring Requirements.** If the Department has reason to believe that additional monitoring may be required or parameters exist that may cause or contribute to water quality violations or degradation of receiving waters, additional monitoring or parameters shall be added to the monitoring section of this permit through a permit modification.

Reports and Notices

29. **Real Estate.** Prior to the current right-of-entry expiration, copies of all real estate authorizations (i.e., right-of-way(s), right-of-entry, leases, easements, land certifications or other legal agreements that authorize the applicant to perform the activities described herein) shall be provided to the Department at the address listed in Specific Condition No. 1. All real estate information should include the tract numbers, folio numbers, section/township/range, and the status of the tracts. Operations activities shall not be permitted to commence on properties where real estate authorizations have not been received.

30. **Notification of Substantial Completion.** Within 60 days of construction substantial completion, the Permittee shall notify the Department of the tentative date of substantial completion.

31. **Notification of Final Completion.** Within 60 days of construction final completion, the Permittee shall notify the Department of the tentative date of final completion. This submittal shall serve to notify the Department that the project is ready for inspection to identify remaining actions necessary to verify site stabilization and functional use of the project. Additionally, the Permittee shall schedule a site visit with the Department for inspection of the project site after the physical barriers have been removed.

32. **As-Built Certification and Record Drawings.** Within 90 days after completion of construction and prior to commencement of routine operations of the project, the Permittee shall provide to the Department a written statement of completion and certification by a registered professional engineer or other appropriate individual as authorized by law to the addresses specified in Specific Condition No. 1. The statement of completion and certification shall be based on on-site observation of construction or review of as-built drawings for the purpose of determining if the work was completed in compliance with permitted plans and specifications. Additionally, if deviation from the permitted drawings, approved in accordance with Specific Condition No. 6, is discovered

during the certification process, the certification must be accompanied by a description of the substantial deviation(s) in writing and a copy of the approved permit drawings with deviations noted. Both the original and revised specifications must be clearly shown. The plans submitted to the Department must be clearly labeled as "as-built" or "record" drawings with electronic copies of both the plans and specifications provided in pdf format. The final surveys will be part of the as-builts provided by the contractor. All surveyed dimensions and elevations shall be certified by a registered surveyor.

33. **Inspection Plan and Reports.** The Permittee shall perform periodic inspections and provide a report one year post construction and every five years post construction thereafter evaluating the integrity and functionality of the reservoir, levees, and associated infrastructure including culverts, gates, water control structures, and pump stations in accordance with the guidelines established in the District's Structure Inspection Program and Dam Safety Program. The inspections shall be conducted by, or under the supervision of, a Professional Engineer registered in the State of Florida. The inspection report shall be signed and sealed by that Professional Engineer and submitted to the Department address identified in Specific Condition No. 1 and by e-mail to the RPPS_Comp@dep.state.fl.us no later than March 1st. The cover letter of the inspection report should summarize site conditions and work that was completed, or may be completed, in response to inadequacies found during these inspections. A Professional Engineer or the District's Dam Safety Officer shall review and approve major repair plans or remedial work associated with inadequacies identified during routine and formal inspections.

34. **Annual Reports.** The Permittee shall submit an "Annual Report" to the Department detailing the construction activities / operations of the project during the annual reporting period. The annual reporting requirements under this permit shall be incorporated into the South Florida Environmental Report (SFER) and submitted to the Department no later than March 1st of each year. If additional reporting modifications are required, the Permittee may request a modification of the annual report submission date and upon approval by the Department, the Permittee may modify the Annual Report submission date to coincide with other reporting requirements and time periods needed for data acquisition and analysis. The reports shall be submitted on an annual basis.

At a minimum, the following information should be included in the Annual Reports:

A. **General Information.**
   i. Permit number;
   ii. Permit/Project name;
   iii. Permit administrator;
   iv. List of key contacts with contact information; and
   v. Evaluation of project success in achieving its objectives.

B. **Construction/Operations/Maintenance Summary.** A construction, operations, and/or maintenance summary shall include, at a minimum:
   i. Construction/Operations/Inspections/Maintenance Progress Report;
   ii. Summary of the operational record;
   iii. Annual Compliance Monitoring Summary Report, including and not limited to data collected in accordance with the water quality monitoring plan and the hydrologic monitoring plan;
   iv. Summary of monitoring results for turbidity;
   v. Construction/Operations schedule;
   vi. Problems encountered during period covered;
   vii. Actions taken to address problems encountered;
   viii. Modifications or changes made to infrastructure of system; and
   ix. Any additional information specifically required by the conditions of this permit or separate authorization.

C. **Water Quality Data**. Records of monitoring information, where applicable, shall include:
   i. Date, location, and time of sampling or measurements;
   ii. Person responsible for performing the sampling or measurements;

iii. Dates analyses were performed or the appropriate code as required by Chapter 62-160, F.A.C.;
iv. Laboratory/Person responsible for performing the analyses;
v. Analytical techniques or methods used, including MDL;
vi. Results of such analyses, including appropriate data qualifiers;
vii. Depth of sampling;
viii. Directional flow conditions and weather conditions at time of sampling;
ix. Monthly flow volumes; and
x. Water quality summary that includes upstream, downstream, and within project area during operational period for all parameters monitored.

D. **Performance Evaluation**. The performance evaluation shall include the following:
i. The operations status of the project;
ii. A comparison of quarterly water quality data using the student's t-test with a 95% confidence interval;
iii. During operations, a statistical evaluation of whether the project is performing in a manner consistent with its design objectives/water quality performance estimates. In the event that the project is not performing in this manner, the Department may impose additional evaluation and reporting requirements; and
iv. Beginning with the second Annual Report, a comparison of performance of current reporting year with performance in previous years.

E. **Herbicide and Pesticide Tracking**. The Permittee shall provide in each annual report the dates and methods of used to exclude/eliminate undesirable vegetation and pests in the wetted area of the Project. Upon request of the Department, the names, concentrations, locations, and quantities of all herbicides and pesticides used shall be available.

F. **Implementation Schedules**. When appropriate, the Permittee shall include information on:
i. Comprehensive Everglades Restoration Plan Project implementation;
ii. Progress on related project features, and status of potential future operational changes;
iii. Program/Project level adaptive management;
iv. Project optimization;
v. Project design modifications; and
vi. Implementation of remedial measures in the event of noncompliance with permit conditions.

Factors Impacting Compliance

35. **Factors Outside the Permittee's Control.** In the event that non-compliance or failure to achieve performance objectives results for any reasons other than those listed below, the Permittee shall take appropriate remedial measures.

A. **Natural Background.** Deviations from water quality standards may occur as a result of natural background conditions, in accordance with Section 403.021(11), F.S.

B. **Random Variation.** The Permittee shall report any statistical uncertainty in the methodology using acceptable scientific methods.

C. **Other Factors**. Unavoidable legal barriers or restraints, including those arising from actions or regulations not under the control of the Permittee.

36. **Temporary Suspension of Sampling.** Under hurricane, tropical storm warnings, or other extreme weather conditions, the Permittee's normal sampling schedule may be suspended if necessary. The Permittee shall notify the Department's Office of Ecosystems Projects at the addresses and telephone number listed in Specific Condition No. 1, of any anticipated suspension of sampling associated with hurricanes, tropical storms, or other extreme weather events that may require deviation from the normal sampling schedule. Within seven days

following the cessation of conditions that warranted a suspension of sampling efforts, the Permittee shall notify the Department of when normal sampling is expected to resume.

Renewals and Modifications

37. **Permit Modifications.** The Permittee shall submit proposed modifications of the project to the Department, prior to implementation of the modifications, for review and approval by the Department. Such modifications may include, but not be limited to:

    A. **Modifications to Achieve Design Objectives**. The Permittee shall modify the project, including modifications to the operation plan(s), if the project facilities are not achieving the design objectives;

    B. **Modifications for Future Facilities.** If the monitoring data indicate the need for the construction/operation of future facilities or structures, prior to construction/operation the Permittee shall apply for modifications to the project, as appropriate to accommodate alterations in operations of the project in conjunction with the construction and operation of the new facilities or structures; and

    C. **Future Phases.** This permit does not authorize any construction or operational activities associated with future project components and phases of the project. Future project components and phases shall require a separate permit or modification to this permit by the Department. Permanent changes to the operation of structures shall require a separate permit or modification to this permit by the Department.

38. **Permit Renewal.** At least 60 days prior to the expiration of this permit, the Permittee shall apply for renewal of this permit. Renewal may be for a period of up to five years in accordance with Section 373.1502(3)(g), F.S., of the CERPRA.

39. **Department Review and Approval.** Where conditions in this permit require Department review and approval of remedial actions or plan modifications to be implemented pursuant to this permit, the Department shall consult with the Permittee to ascertain whether mutual agreement can be reached. If mutual agreement on the remedial actions or plan modifications cannot be reached, the action of the Department shall be deemed final agency action and shall be subject to judicial or administrative review, as appropriate.

Key for Table 1

Category	Acronym	Definition
Units	mg/L	Milligrams per Liter
	SU	Standard Units
	µS/cm	Micro-siemens per Centimeter
	Deg C	Degrees Celsius
	NTU	Nephelometric Turbidity Unit
	Ft, NGVD29	Feet, National Geodetic Vertical Datum of 1929
	cfs	Cubic feet per second
Sample Type	C	Continuous
	G	Surface Water Grab Sample
	SR	Stage Reading
Frequency	DAV	Daily Average
	WF/M	Weekly if Flowing, otherwise Monthly
	Q	Quarterly

Table 1. Monitoring Program for the S-333N Gated Spillway Phase

Parameter	Units	Sample Type	Sampling Frequency[2]	Sampling Location
Calcium (CA)	mg/L	G	WF/M	S-333[1], S-333N
Chloride (CL)	mg/L			
Nitrate-Nitrite (NO_x)	mg/L			
Orthophosphorus (OPO_4)	mg/L			
Total Kjeldahl Nitrogen (TKN)	mg/L			
Total Phosphorous (TP)	mg/L			
Total Suspended Solids (TSS)	mg/L			
Dissolved Oxygen (DO)	mg/L			
pH	SU			
Specific Conductance	µS/cm			
Temperature	Deg C			
Sulfate (SO_4)	mg/L	G	Q	
Turbidity	NTU			
Flow[3]	cfs	C	DAV	S-333N
Stage	Ft, NGVD29	SR	DAV	S-333N Headwater (HW), S-333N Tailwater (TW), WCA 3A-62, WCA 3A-63, S-333 TW, and S-334 HW

[1] Concurrent monitoring at the S-333 and S-333N Gated Spillways shall be conducted until the Department reviews and approves discontinued monitoring at the S-333 Gated Spillway. Data collected from the period of concurrent monitoring will be used to evaluate the use of the S-333N Gated Spillway monitoring location as a surrogate for the S-333 Gated Spillway monitoring location. Monitoring at the S-333 Gated Spillway is required under the Non-ECP Permit.

[2] WF/M monitoring shall occur if either the S-333 or the S-333N Gated Spillway is flowing in efforts to evaluate the replacement of the S-333 Gated Spillway monitoring location. For all water quality parameters, the S-333 and S-333N Gated Spillways must be sampled on the same day.

[3]Flow is calculated using data collected from each station's head water, tail water, and gate operations and reported as daily average value. Stage levels (head and tail) and gate operations are measured mostly by telemetry system.

Table 2. Surface Water Monitoring Locations

Stations	Latitude	Longitude	New or Existing	Description
S-333N	25.763	80.674	New	Sampling platform 350 feet north of the S-333 Gated Spillway
S-333[1]	25.762	80.674	Existing	Sampling platform immediately upstream from the S-333 Gated Spillway at the intersection of L-67A and L-29 canals.

The standard positional goal for station coordinates is detailed in the Establishing & Verifying WQ Monitoring Station Registration SOP (QS-SOP-031). The coordinates are relative to NAD83 HARN horizontal datum. GPS coordinates are estimated and will be updated upon structure completion.

Table 3. Hydrological Monitoring Locations

Site	Station ID	Type	Latitude	Longitude	Description
S333N	S333N-H	HW Stage	25.76245	80.67407	S333N Headwater
S333N	S333N-T	TW Stage	25.76245	80.67407	S333N Tailwater
S333N	S333N-1	S333N Gate 1	25.76245	80.67407	S333N Gate Operation 1
S333N	S333N-2	S333N Gate 2	25.76245	80.67407	S333N Gate Operation 2
S333N	S333N-S-Q	Calculated Flow	25.76245	80.67407	Flow Calculated from HW, TW & Gate Operations
3A-2	3-62	Stage	26.17481	80.75117	Stage station in WCA-3A
3A-3	3-63	Stage	26.18836	80.53109	Stage station in WCA-3A
S333	S333_T	TW Stage	25.76188	80.67381	Stage station in L-29 Canal
S334	S334_H	HW Stage	25.76125	80.50258	Stage station in L-29 Canal

Figure 1. S-333N Gated Spillway Phase Location Map

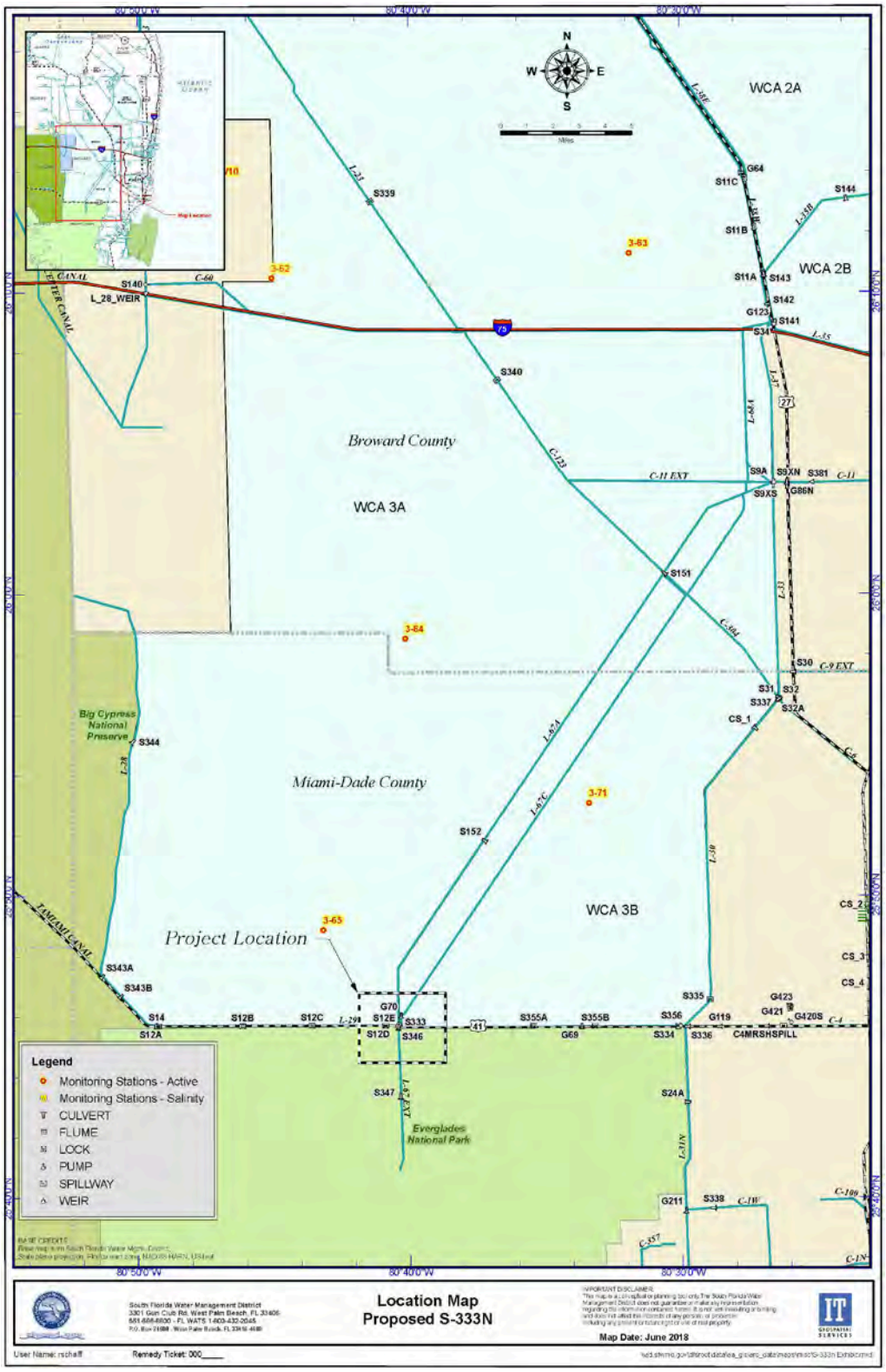

Figure 2. S-333N Gated Spillway Phase Location Map

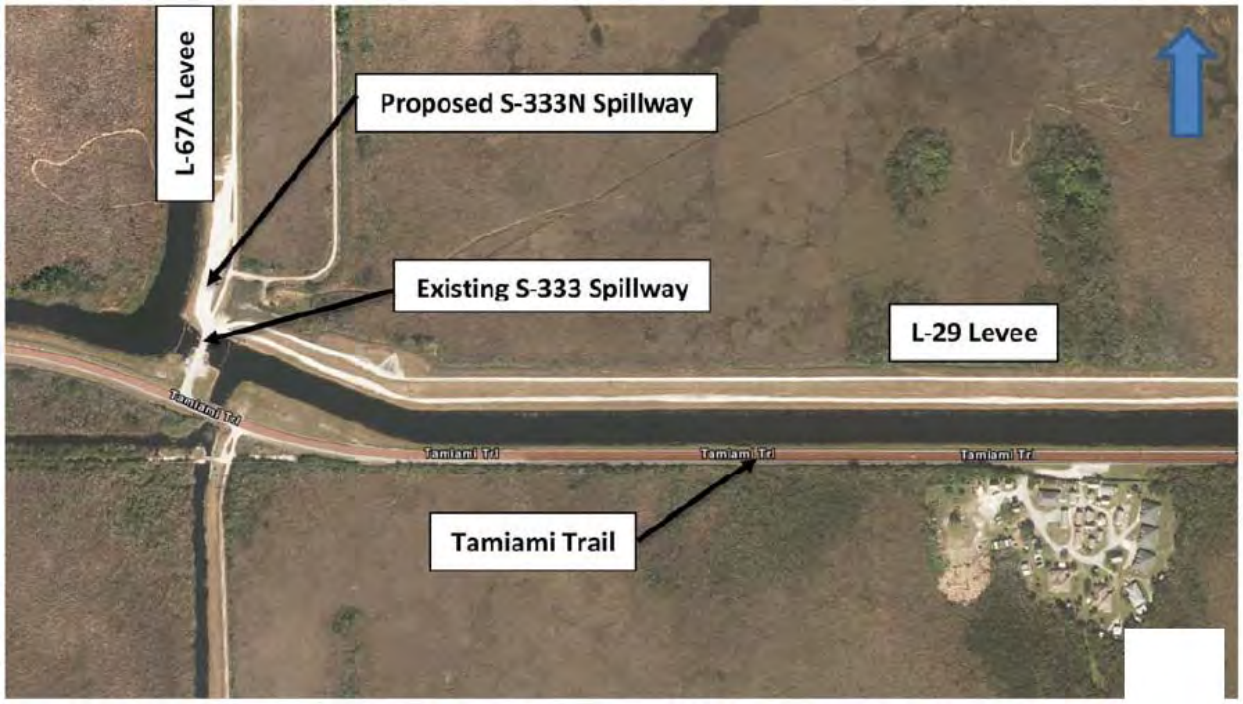

Figure 3. S-333N Gated Spillway Phase Location Map

Figure 4. Surface Water Quality Monitoring Locations Map

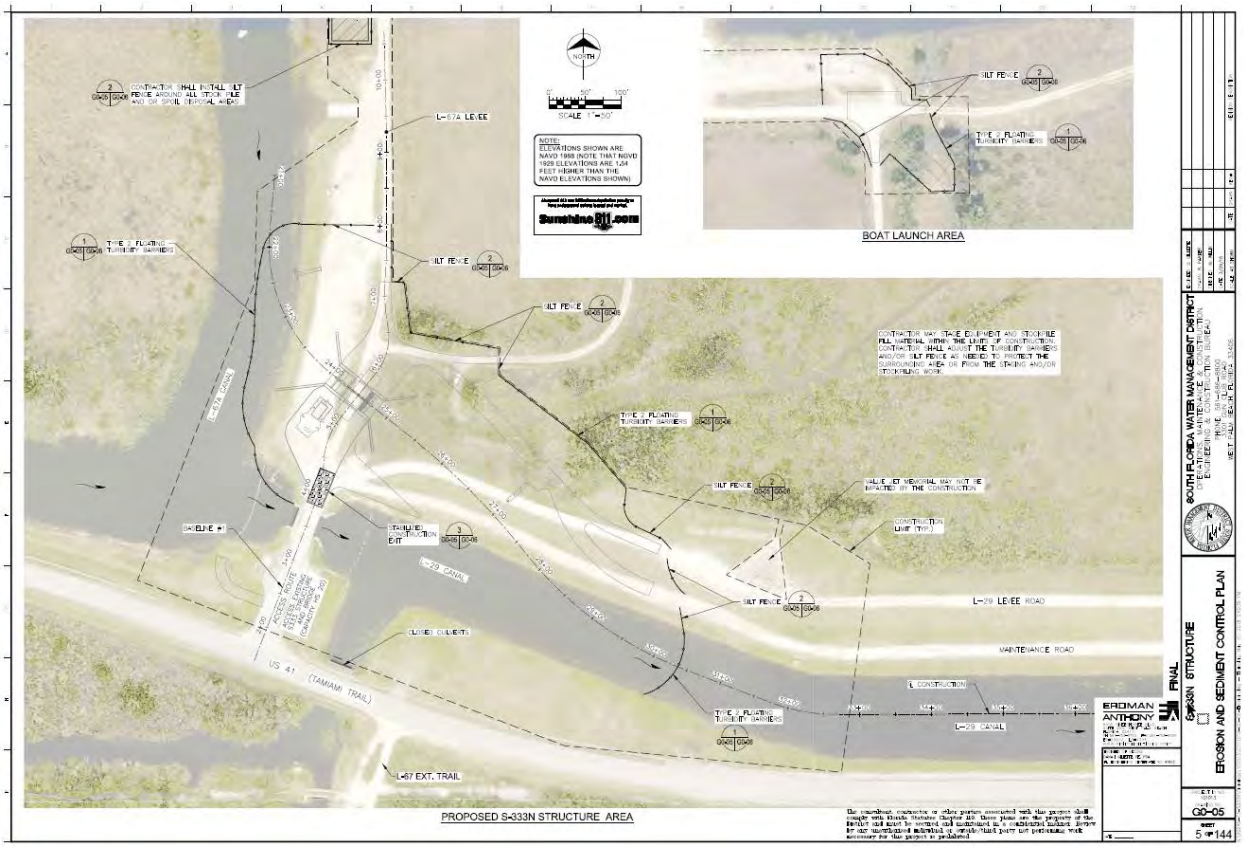

Figure 5. Surface Water Quality Monitoring Locations Map

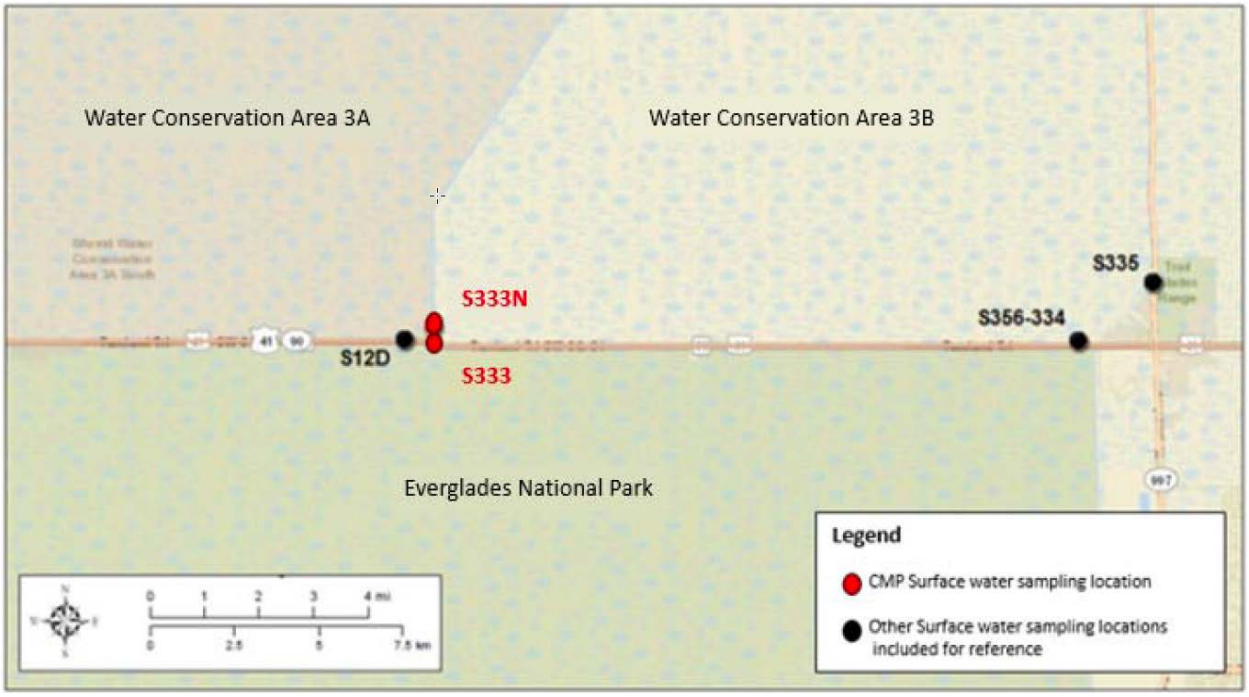

Figure 6. Hydrological Monitoring Locations in the L-29 Canal

Executed in Tallahassee, Florida.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Edward C. Smith, Director
Office of Ecosystem Projects

ECS/al/ro

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to 120.52(7), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk 7/30/18 Date

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Secretary

COMPREHENSIVE EVERGLADES RESTORATION PLAN
REGULATION ACT (CERPRA) PERMIT
INTERIM OPERATIONS AUTHORIZATION

PERMITTEE:
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

ATTENTION:
Mr. Ernie Marks
Executive Director

Permit Number: **0369865-001**
Project: WCA 3 Decompartmentalization and Sheetflow Enhancement Physical Model
County: Miami-Dade

Date of Issue: February 8, 2019
Expiration Date: February 8, 2024

This permit is issued by the State of Florida Department of Environmental Protection (Department) under the authority of the Comprehensive Everglades Restoration Plan Regulation Act (CERPRA), Chapter 373.1502, Florida Statutes (F.S.); Title 62, Florida Administrative Code (F.A.C.); and pursuant to the Department's authority under Chapters 373 and 403, F.S. This activity is not exempt from the requirement to obtain a CERPRA Permit.

The South Florida Water Management District (Permittee/District) is hereby authorized to initiate the activities described on the application and approved associated drawing(s), plans, and other documents attached hereto or on file with the Department and made a part hereof. The activities authorized by this permit must be conducted in conformance with all the provisions of this permit. Failures to comply with all permit conditions and documents referenced herein shall constitute grounds for revocation of the permit and appropriate enforcement action.

Authorizations or permits for this activity may be required by other federal, state, regional, or local entities including but not limited to local governments or municipalities. This permit does not relieve the Permittee from the requirements to obtain all other required permits or authorizations.

This permit constitutes a finding of consistency with Florida's Coastal Zone Management Program, as required by Section 307 of the Coastal Zone Management Act, 16 United State Code (U.S.C.) § 1456; and constitutes certification of compliance with water quality standards under Section 401 of the Clean Water Act, 33 U.S.C. § 1341. Activities described in the related documents are not authorized until the project is determined to be in conformance with all applicable rules and with the general and specific conditions of this permit/certification/authorization, as specifically described below.

PROJECT DESCRIPTION:

The Water Conservation Area 3 (WCA-3) Decompartmentalization and Sheetflow Enhancement (DECOMP) Physical Model (DPM) is a large-scale field test designed to address uncertainties with depth, hydroperiod, sheetflow, and canal backfilling associated with the full-scale Comprehensive Everglades Restoration Plan (CERP) DECOMP project. DECOMP is a project component of the Comprehensive Everglades Restoration Plan (CERP) as defined in Section 373.1501(1)(g), F.S. The Water Resources Development Act of 2000 approved CERP under Section 601 as a framework for modifications to the Central and South Florida (C&SF) Project necessary to restore the south Florida ecosystem. Information gathered from the DPM Test Project will be used in the planning and design of future phases of DECOMP and the Central Everglades Planning Project.

PROJECT LOCATION:

The DPM Test Project is located in Miami-Dade County along the southern end of the L-67A and L-67C Canals within Water Conservation Area 3 (WCA-3) in a region referred to as the "pocket". The pocket is bounded to the northwest and the southeast by the L-67A and L-67C levee and canal systems respectively in Sections 3, 10 and 15, Township 53 South and Range 37 East. Figures 1 through 3 illustrate the DPM Test Project location and features.

AUTHORIZED PROJECT COMPONENTS:

This permit allows for interim/test operations associated with the following DPM Test Project features: ten controllable gated culverts adjacent to the L-67A Canal (S-152) in the L-67A Levee, the degraded 3,000 linear ft. of the L-67C Levee, and three 1,000 ft. treatment areas in the L-67C Canal (no backfill, partial backfill, and complete backfill). Scientific and water quality monitoring activities will include field testing and monitoring for the scientific investigation through Fiscal Year 2021.

The S-152 structure has a maximum combined flow of 750 cubic feet per second (cfs), with velocities up to 3 centimeters (cm) per second (sec) to allow for pulse releases between the L-67A and L-67C Levees toward the various backfill treatments in the 3,000 ft. L-67C gap. The DPM Test Project features were constructed by the U.S. Army Corps of Engineers (USACE), who conducted the initial years of operations beginning in November 2013. In January 2018, Permit No. 0304879-008 was issued to the USACE to authorize the expansion of the operational window to extend to year-round operations.

DECLARATION OF REASONABLE ASSURANCES:

In issuing this permit, the Department finds that the District has given reasonable assurances sufficient to satisfy the requirements of the CERPRA, Section 373.1502, F.S. The Department bases these findings on the following documents:

1. South Florida Water Management District, WCA-3 Decompartmentalization Physical Model Project Test Operations Comprehensive Everglades Restoration Plan Permit Application, FDEP File No. 0369865-001 (received October 22, 2018 and additional information on January 10, 2019 and January 11, 2019)
2. United States Army Corps of Engineers, Jacksonville District, The DECOMP Physical Model Science Plan (October 2009)
3. United States Army Corps of Engineers, Jacksonville District, Final Environmental Assessment (EA) and Design Test Documentation Report: Installation, Testing, and Monitoring of a Physical Model for the WCA 3 Decompartmentalization and Sheet Flow Enhancement Project (April 2010)
4. United States Army Corps of Engineers, Jacksonville District, Final Supplemental EA and Finding of No Significant Impact (FONSI)- Installation, Testing, and Monitoring of a Physical Model for the WCA-3 Decompartmentalization and Sheet Flow Enhancement Project: Phase 2 (November 2017)
5. United States Army Corps of Engineers, Jacksonville District, Final Supplemental EA and Finding of No Significant Impact - Installation, Testing, and Monitoring of a Physical Model for the WCA-3 Decompartmentalization and Sheet Flow Enhancement Project: Phase 2, Appendix A – Central and Southern Florida Project Operational Strategy for Water Conservation Area 3 Decompartmentalization (DECOMP) and Sheet Flow Enhancement Project – Physical Model Phase 2 (November 2017)
6. United States Army Corps of Engineers, Jacksonville District, Final Supplemental EA and Finding of No Significant Impact - Installation, Testing, and Monitoring of a Physical Model for the WCA-3 Decompartmentalization and Sheet Flow Enhancement Project: Phase 2, Appendix B – Triggers Guiding Year Round DPM Operations (October 2017)
7. South Florida Water Management District, Compliance Monitoring Plan for Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement Physical Model (dated 1/10/19)
8. South Florida Water Management District, Hydrological Monitoring Plan for S-152 Structure Monitoring Plan (dated 10/11/18)
9. U.S. Army Corps of Engineers, DECOMP Physical Model, Comprehensive Everglades Restoration Plan, Vegetation Management Plan (February 2011)

Specifically, there are reasonable assurances, pursuant to Section 373.1502, F.S., that

- "The project component will achieve the design objectives set forth in the detailed design documents submitted as part of the application."

- "State water quality standards, including water quality criteria and moderating provisions, will be met. Under no circumstances shall the project component cause or contribute to violation of state water quality standards."

- "Discharges from the project component will not pose a serious danger to public health, safety, or welfare."

- "Any impacts to wetlands or threatened or endangered species resulting from implementation of the project component will be avoided, minimized, and mitigated, as appropriate."

The District agrees to operate and maintain the project in accordance with the provisions of this permit, permit application, and the associated documentation on file with the Department. The District is responsible for operation, maintenance, repair, replacement, and rehabilitation of each of this project's components. All conditions found herein apply to the District.

GENERAL CONDITIONS:
In accordance with Section 373.1502(3)(e)(2), F.S., of the CERPRA, this permit may include any standard conditions provided by Department rule, which are appropriate and consistent with the CERPRA.

1. **Enforcement**. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 373.129, 403.141, 403.727, 403.859 through 403.861 F.S. The Permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. **Scope of Permit.** This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. **Limitation of Rights.** The issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total Project which are not addressed in this permit. However, this permit is in lieu of other permits under Chapter 373 or Chapter 403, F.S., except for permits issued under Section 403.0885, F.S., if applicable.

4. **Limitations upon Title.** This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. **Liability.** This permit does not relieve the Permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the Permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department. The Permittee shall hold and save the Department harmless from any and all damages, claims, or liabilities which may arise by reason of the construction, alteration, operation, maintenance, removal, abandonment, or use of any system authorized by the permit.

6. **Operation and Maintenance Responsibilities.** The Permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the Permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. **Access Rights.** The Permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

   A. Have access to and copy any records that must be kept under conditions of the permit;
   B. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
   C. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

   Reasonable time may depend on the nature of the concern being investigated.

8. **Noncompliance.** If, for any reason, the Permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the Permittee shall immediately provide the Department with the following information:

   A. A description of and cause of noncompliance; and
   B. The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

   The Permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. **Records as Evidence.** In accepting this permit, the Permittee understands and agrees that all records, notes, monitoring data, and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Sections 403.111, F.S. and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. **Changes in Law.** The Permittee agrees to comply with changes in applicable Department rules and applicable Florida Statutes after a reasonable time for compliance, provided, however, the Permittee does not waive any other rights granted by Florida law.

11. **Transferability.** This permit is transferable only upon Department approval in accordance with Rules 62-4.120 and 62-330.340, F.A.C., as applicable. The Permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. **Permit at Work Site.** This permit or a copy thereof shall be kept at the work site of the permitted activity. For the purposes of this permit, the work site shall be defined as the South Florida Water Management District Headquarters located at 3301 Gun Club Road in West Palm Beach, Florida.

13. **Records Retention.** The Permittee shall comply with the following:

   A. Upon request, the Permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department;

B. The Permittee shall hold at the facility or other location designated by this permit records of all monitoring information required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least five years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule; and

C. Records of monitoring information shall include:

i. The date, exact place, and time of sampling or measurements;
ii. the person responsible for performing the sampling or measurements;
iii. the dates analyses were performed or the appropriate code as required by Chapter 62-160, F.A.C.;
iv. the person responsible for performing the analyses;
v. the analytical techniques or methods used, including but not limited to method detection limit (MDL); and
vi. the results of such analyses, including identification of potential outlier values.

14. **Requests for Information.** When requested by the Department, the Permittee shall within a reasonable time furnish any information required by law, which is needed to determine compliance with the permit. If the Permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

15. **External Agency Requirements.** Should any other regulatory agency require changes to the permitted system, the Permittee shall notify the Department in writing of the changes prior to implementation so that a determination can be made whether a permit modification is required.

16. **Sovereign Lands.** The Permittee is hereby advised that Florida law states: No person shall commence any excavation, construction, or other activity involving the use of sovereign or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund or the Department of Environmental Protection under Chapter 253, until such person has received from the Board of Trustees of the Internal Improvement Trust Fund the required lease, license, easement, or other form of consent authorizing the proposed use. Therefore, the Permittee is responsible for obtaining any necessary authorizations from the Board of Trustees prior to commencing activity on sovereignty lands or other state-owned lands.

17. **Artifacts.** If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlements are encountered at any time within the project site area, the permitted project should cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance and Review Section at (850) 245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, F.S.

SPECIFIC CONDITIONS:

1. **Addresses.** Reports, plans and notices submitted to the Department in accordance with this permit, unless otherwise specified, shall be submitted to the Department's Office of Ecosystem Projects (OEP), 3900 Commonwealth Boulevard, MS 24, Tallahassee, Florida 32399-3000, telephone number (850) 245-2228. Electronic copies of reports, plans and notices required by this permit may be sent to RPPS_Comp@dep.state.fl.us.

2. **Threatened and Endangered Species.** Florida Threatened and Endangered Species. The Permittee shall coordinate with the appropriate wildlife agency for appropriate guidance and recommendations to avoid, minimize or mitigate impacts to Florida Threatened and Endangered species resulting from implementation of the project components.

3. **Contaminated Sites and Residual Agrichemicals.** The Permittee shall address all contaminated sites within the project footprint in accordance with all applicable Department statutes and rules including but not limited to Chapter 62-780, F.A.C. If contamination is discovered after operations, the Permittee shall send to the Department at the addresses specified in Specific Condition No. 1 an assessment and remedial action plan for Department approval. Upon the Department's approval, the Permittee shall implement the assessment and remedial action plan and provide quarterly reports to the Department on the progress of the remediation until the cleanup is completed to the Department's satisfaction.

Interim/Test Operations

4. **Interim/Test Operational Strategy & Year Round Operational Triggers.** The District shall operate and maintain the DPM Test Project features in accordance with the operating criteria included in Appendices A and B of the November 2017 Final Supplemental EA and FONSI - Installation, Testing, and Monitoring of a Physical Model for the WCA-3 Decompartmentalization and Sheet Flow Enhancement Project: Phase 2, and continue to perform field testing and monitoring for the scientific investigation through Fiscal Year 2021.

   Modifications to the operational strategy or operational triggers shall be submitted to the Department for review and approval prior to implementation. At least 60 days prior to the end of Fiscal Year 2021, the Permittee shall submit an updated operations plan for review and approval.

5. **Interagency Team for Interim/Test Operations.** The Permittee shall schedule an operations meeting with an interagency team, such as the Project Delivery Team (PDT), to review applicable water quality, stage and site conditions. It is expected that this interagency team will meet at regular intervals throughout DPM operations in order to provide technical input on operational considerations during the interim operational testing period. An FDEP representative shall be included on the DPM Test Project operations team and be provided data and data summaries pertaining to the operational triggers/rules within a reasonable period of time prior to operational decisions that may result in the commencement of discharges from the S-152 structure(s).

Maintenance

6. **Vegetation Management.** The Permittee shall be responsible for nuisance and non-native vegetation control throughout the DPM Test Project operations. Vegetation management will involve control and surveillance of nuisance and non-native invasive plant species within the project area. Species of non-native vegetation to be treated includes, but is not limited to, species listed in the latest version of the Florida Exotic Pest Plant Council (FLEPPC) invasive plant list and the Florida Department of Environmental Protection prohibited plant list.

7. **Maintenance Best Management Practices (BMP).** The Permittee shall submit a BMP Plan to the Department for review and approval to the addresses specified in Specific Condition No. 1 at least 30 days prior to maintenance activities including but not limited to installation of erosion controls, clearing and grubbing, and other earthwork. Acceptable BMP Plan formats may include Erosion Control Plans, Storm Water Pollution Prevention Plans (SWPPP), or an Environmental Protection Plan. Modifications to the BMP Plan may necessitate further review and approval by the Department. The BMP Plan shall describe the methods used to protect environmental resources as a direct result of maintenance activities. Upon installation of the erosion controls identified in this/these plan(s), the Permittee shall contact the Department to determine whether inspections of the installed controls are necessary. At a minimum, the plan shall include strategies and procedures to be implemented and maintained at all times during maintenance activities to:

   A. prevent negative impact(s) to Florida threatened and endangered species and the habitats and habitat characteristics that support them;

   B. prevent negative impact(s) to prehistoric or historic artifacts, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement;

C. minimize or eliminate project generated turbidity, including details regarding the use of sediment controls to minimize the suspension and transport of soils, levee materials, and roadway materials into waters adjacent to or downstream of the maintenance site;

D. prevent and minimize impacts to adjacent wetlands, including, but not limited to, specifications for demarcation of said wetlands and exposed soils with fencing or other effective physical barriers to prevent encroachment;

E. prevent the transport of any material into wetlands and surface waters both during and after completion of the maintenance; and

F. limit the extent of clearing and grubbing such that impacts to native vegetation, either within or immediately adjacent to the project area shall be minimized or avoided.

8. **Stockpiles/Soil Disposal Areas.** Vegetative and demolition debris, as well as unwanted excavated material shall be properly disposed.

9. **Site Stabilization.** All graded areas shall be stabilized and vegetated no greater than seven days after maintenance activities have temporarily or permanently ceased for any portion of the site to minimize erosion. All screens, silt fences, sheet pile, and other turbidity control devices and preventive operation procedures shall remain in place for the duration of each maintenance activity and maintained until all project-generated turbidity has subsided, the project site has been stabilized, and the turbidity level at the point of discharge from the maintenance work area to receiving waters meets state standards. Once these conditions are met, turbidity and erosion control devices shall be removed within a timely manner and prior to completion of maintenance. If there are multiple work areas within a feature, contract or phase, individual work areas shall be stabilized if there will be a significant lag time prior to completion of the entire feature, contract or phase.

10. **Site Inspections.** Throughout the construction, maintenance, and operational activities, the Department will conduct periodic site inspections to ensure permit compliance and to monitor progress. The Department will coordinate with the Permittee representative prior to performing any on-site inspections. A third-party inspector and/or consultant may accompany representatives of the Department at any time.

11. **Manatee Protection:** The Permittee shall comply with the following conditions intended to protect manatees from direct project effects:

A. Instruct all personnel associated with the project about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The Permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.

B. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a 4-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

C. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

D. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shut down if a manatee(s) comes within 50 ft. of the operation. Activities will not resume until the manatee(s) has moved beyond the 50 ft. radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 ft. of the operation. Animals must not be herded away or harassed into leaving.

E. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922, and to FWC at ImperiledSpecies@myFWC.com. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or Vero Beach (1-772-562-3909) for south Florida.

F. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the Permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 ½" by 11" explaining the requirements for "Idle Speed/No Wake" and the shutdown of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at MyFWC.com/manatee. Questions concerning these signs can be sent to the email address listed above.

12. **Emergency Operations.** Under emergency conditions that threaten the safety of life, property or the project, the Permittee may modify operations of the project and immediately employ any remedial means to protect life and property in accordance with the emergency provisions of Chapter 373, F.S. The Permittee shall notify the Department within 48 hours of such occurrence and shall provide data justifying the need to employ the emergency modifications to operations of the project.

13. **Public Health, Safety, and Welfare.** Pursuant to Section 373.1502(3)(b)(3), F.S., of the CERPRA, discharges from the project shall not pose a serious danger to the public health, safety, or welfare.

Monitoring Program

14. **Monitoring Program.** The Permittee shall collect and analyze surface water quality monitoring data in accordance with the locations and the parameters in Tables 1 and 2, Appendices A and B of the project's Phase 2 Supplemental EA & FONSI, and the conditions of this permit. The Permittee shall provide the data, data summaries and a determination of compliance with the applicable criteria as part of the annual report required in Specific Condition No. 25. Prior to any modifications to the operational strategy or triggers guiding year round operations, revised documentation shall be submitted to the Department for review and approval.

15. **Water Quality Monitoring.** The Permittee shall collect and analyze water quality monitoring data in accordance with the most current approved version of the Compliance Monitoring Plan for the project using the parameters and frequencies identified in Table 1. Locations are included in Table 2 and Figure 2. The Permittee shall report the results to the Department, in accordance with the annual reporting requirements specified in Specific Condition No. 25. Any subsequent modifications to the Compliance Monitoring Plan shall be submitted to the Department for review and approval.

16. **Hydrological Monitoring.** The Permittee shall ensure that hydrological monitoring data is collected and analyzed in accordance with the locations and parameters in Tables 1 and 2, and the most current approved Hydrological Monitoring Plan. Locations are included in Figures 2 and 3. Any modifications to monitoring shall be submitted to the Department for review and approval.

17. **Data Quality.** All monitoring data required during the construction and operations of this permit shall be conducted in accordance with the following:

A. **Quality Assurance and Quality Control.** Sampling and monitoring data shall be collected, analyzed, reported and retained in accordance with Chapter 62-160, F.A.C. Any laboratory test required by this permit shall be performed by a laboratory that has been certified by the Florida Department of Health (DOH) under Chapter 64E-1, F.A.C., where such certification is required by Rule 62-160.300, F.A.C. The laboratory must be certified for all specific method/analyte combinations that are used to comply with this permit. The analytical method used shall be appropriate so as to determine if the sample complies with Class III surface water quality standards as specified in Chapter 62-302, F.A.C., and groundwater standards as specified in Chapter 62-520, F.A.C., whichever is more stringent. All field activities including on-site

tests and sample collection, whether performed by a laboratory or another organization, must follow all applicable procedures described in the most current version of DEP-SOP-001/01. Alternate field procedures and laboratory methods may be used if they have been approved according to the requirements of Rules 62-160.220, and 62-160.330, F.A.C.

B. **Method Detection Limits (MDLs).** The sample collection, analytical test methods and MDLs applicable to this permit shall be performed and reported in accordance with Rule 62-4.246, F.A.C. A list of Department established analytical methods, and corresponding MDLs and practical quantification limits (PQLs), which is titled "Florida Department of Environmental Protection Table as Required by Rule 62-4.246(4) Testing Methods for Discharges to Surface Water" dated April 25, 2006, is available from the Department on request. The MDLs and PQLs as described in this list shall constitute the minimum acceptable MDL/PQL values and the Department shall not accept results for which the laboratory's MDLs or PQLs are greater than those described above unless alternate MDLs and/or PQLs have been specifically approved by the Department for this permit. More stringent MDLs and PQLs may be necessary for specific parameters. If required, these will be identified in the permit monitoring plan.

18. **Water Quality Standards.** Under no circumstances shall the construction, maintenance, or operations of the project or any project component cause or contribute to a violation of state water quality standards. The Permittee shall comply with all applicable state water quality standards described in Chapter 62-302, F.A.C.

19. **Water Quantity and Flooding Impacts.** The Permittee shall be responsible for ensuring that each of the project features are constructed, maintained, and operated to not adversely affect adjacent lands with regards to water quantity and/or flooding. The Permittee shall hold and save the Department harmless from any and all damages, claims or liabilities that may arise from water quantity and/or flooding impacts resulting from construction and/or operation of this project.

20. **Turbidity Monitoring During Maintenance.** Effective means of turbidity control measures shall be employed during all maintenance activities that could result in project-generated turbidity in receiving water bodies. Turbidity control measures shall be in accordance with best management practices contained in the approved BMP Plan referenced in Specific Condition No. 7. Additionally, a project specific Turbidity Control Plan for turbidity monitoring shall be submitted to the Department for review and approval at the addresses specified in Specific Condition No. 1 at least 60 days prior to the initiation of any maintenance activity and at least 14 days prior to the implementation of any subsequent plan revisions. All turbidity control devices and/or preventive operation procedures shall remain in place until the turbidity level at the compliance sampling site meets state standards or as otherwise approved by the Department.

Turbidity Standard

A. Turbidity shall not exceed 29 Nephelometric Turbidity Units (NTUs) above background in Class III receiving waters.

Sampling Protocols

B. Sampling and analyses shall be performed as required by Chapter 62-160, F.A.C. and in accordance with appropriate FDEP Standard Operating Procedures (FDEP-SOP), located at http://www.dep.state.fl.us/water/sas/sop/sops.htm. Turbidity monitoring equipment and personnel trained to use it shall be available on site at all times during maintenance activities that could result in project-generated turbidity levels beyond the work area that have the potential to be discharged to a receiving water body.

C. During maintenance activities, the Permittee shall monitor turbidity levels at least twice daily for the background and compliance samples, with samples taken a minimum of once every four hours, at the locations described within the project's approved Turbidity Control Plan.

i. Approximately 100 ft. up-current of the work sites and clearly outside the influence of maintenance activities. (This shall serve as the natural background sample against which other turbidity readings shall be compared.)
ii. Directly outside the turbidity curtains surrounding the work sites and within the densest portion of any visible turbidity plume. (This sample shall serve as the compliance sample.)

D. For monitoring purposes, work areas are defined by the turbidity curtains.

E. If there are multiple work areas where maintenance is creating a visible turbidity plume, each maintenance activity shall be monitored separately.

Turbidity Exceedance

F. If monitoring reveals project-generated turbidity exceeds the Turbidity Standard authorized in this permit the Permittee shall take the following measures:

i. Immediately cease all work contributing to the water quality violation;
ii. Immediately report turbidity violations to the Department;

a. The Department shall be notified by phone and at RPPS_Comp@dep.state.fl.us within 24 hours; and
b. The Permittee shall submit a turbidity exceedance report to the Department at the addresses specified in Specific Condition No. 1. The report shall include a copy of the monitoring data sheets that indicate violation(s) and a description of the corrective actions being taken or proposed to be taken. The report shall be made to the Department as soon as normal business hours resume if violation(s) are noted after normal business hours, on holidays, or on weekends.

iii. The possible cause of the violation shall be identified;
iv. Modify work procedures that may have contributed to the violation such as installing additional turbidity or erosion protection devices; repairing any non-functional turbidity containment devices, stabilizing exposed soils, and checking calibration of the meter; and
v. Work shall not resume until the activities can be conducted in compliance with the turbidity standards and the Department grants authorization.

Failure to report violation(s) or to follow corrective procedures before resuming work may constitute grounds for formal enforcement action.

Monitoring Logs and Reports

G. Turbidity monitoring results shall be compiled daily and summarized quarterly (every three calendar months) by project component beginning with the first calendar month in which maintenance activities occur that could generate turbidity in receiving waters and continuing until all maintenance, dredging, stabilization and/or excavation is completed. If no maintenance activities occur that could generate turbidity and the project site has been stabilized, during the entire or a specific portion of the quarterly monitoring period, this shall be noted in the report and include information regarding continuation of monitoring. Quarterly reports shall be sent to the addresses specified in Specific Condition No. 1.

H. Daily monitoring logs shall clearly identify the following information:

i. Project name and current permit number;
ii. Dates and times of sampling and analysis;
iii. Name of individual collecting samples;
iv. Unique identification of the specific instrument unit(s) used for sample collection and analysis as required by FDEP-SOP-001/01 FT 1600 Field Measurement of Turbidity;
v. Measurement value and reporting units;
vi. Water depth;

vii. Depth of sample;
viii. Weather conditions;
ix. Water level stage in the canal or water body and direction of flow;
x. Clear description of project component activities taking place at the time of sampling that may have contributed to turbidity; and
xi. Signature and statement of authenticity by a properly trained individual indicating that the instrument meets the outlined specifications and has been calibrated in accordance with FDEP-SOP-001/01 FT 1600 Field Measurement of Turbidity.

I. Quarterly reports shall include the daily logs and a summary of the following information:

i. Summary of maintenance activities that have taken place;
ii. Statement regarding sampling results, the net difference between compliance and background results, and whether the turbidity levels are in compliance;
iii. Summary of any significant compliance issues and how they were resolved;
iv. Statement explaining any gaps in sampling activity (e.g., no construction or maintenance activity that could contribute to turbidity generation in receiving waters, contractor not onsite, work shut down due to weather conditions); and
v. Map indicating the sampling locations and maintenance activity taken place during the reporting period.

21. **Removal of Parameters.** Upon demonstration that a specific parameter(s) is not present or is found consistently in compliance with water quality standards, the Permittee may request a modification to the monitoring program as appropriate. A minimum of one year's worth of data, for those parameters being sampled quarterly or more frequently, will be required prior to the Department approving any modification to the monitoring program. Parameters sampled semi-annually or annually will be examined on a case-by-case basis. The Department may approve a reduction of the monitoring frequency or waive the monitoring requirement for parameters that consistently are reported in compliance with State water quality standards.

22. **Addition of Monitoring Requirements.** If the Department has reason to believe that additional monitoring may be required or parameters exist that may cause or contribute to water quality violations or degradation of receiving waters, additional monitoring or parameters shall be added to the monitoring section of this permit through a permit modification.

Reports and Notices

23. **Inspection Plan and Reports.** The Permittee shall perform annual inspections and provide a report every five years evaluating the integrity and functionality of the associated infrastructure including culverts, gates, water control structures, and levees in accordance with the guidelines established in the District's Structure Inspection Program and Dam Safety Program. The inspections shall be conducted by, or under the supervision of, a Professional Engineer registered in the State of Florida. The inspection report shall be signed and sealed by that Professional Engineer and submitted to the Department address identified in Specific Condition No. 1 and by e-mail to the RPPS_Comp@dep.state.fl.us no later than March 1st. The cover letter of the inspection report should summarize site conditions and work that was completed, or may be completed, in response to inadequacies found during these inspections. A Professional Engineer or the District's Dam Safety Officer shall review and approve major repair plans or remedial work associated with inadequacies identified during routine and formal inspections.

24. **Final Report.** The District shall submit to the Department a copy of the final report and analysis prepared for the DPM Test Project. The report shall contain the District's compilation and analysis of all monitoring data, and conclusions and provide to the PDT for the purposes of developing recommendations regarding the design of the full scale Decomp Project. A summary of the operations period and any actions taken to address problems/constraints observed during the implementation of the project shall also be included in the report. The report shall be submitted to the Department no later than one year after completion of the test operations period.

25. **Annual Reports.** The District shall submit an annual report to the Department providing hydrometeorological and water quality data for the interim operations and maintenance activities authorized herein. The annual reporting requirements under this permit shall be incorporated into the South Florida Environmental Report (SFER) and submitted to the Department no later than March 1st of each year. The District may request a modification to the annual report submission date, and upon approval by the Department, the District may modify the annual report submission date to coincide with other reporting requirements and time periods needed for data acquisition and analysis. At a minimum, the following information should be included in the annual reports:

A. **General Information.**
   i. Permit number;
   ii. Permit name;
   iii. Permit administrator;
   iv. List of key contacts with contact information; and
   v. Evaluation of project success in achieving its objectives.

B. **Operations/Maintenance Summary.** An operations or maintenance summary shall include, at a minimum:
   i. Operations/Inspections/Maintenance Progress Report;
   ii. Summary of the operational record;
   iii. Annual Compliance Monitoring Summary Report;
   iv. Annual Hydrologic Monitoring Summary;
   v. Summary of monitoring results for turbidity;
   vi. Problems encountered during period covered;
   vii. Actions taken to address problems encountered;
   viii. Modifications or changes made to infrastructure of system; and
   ix. Any additional information specifically required by the conditions of this permit or separate authorization.

C. **Water Quality Data**. Records of monitoring information, where applicable, shall include:
   i. Date, location, and time of sampling or measurements;
   ii. Person responsible for performing the sampling or measurements;
   iii. Dates analyses were performed or the appropriate code as required by Chapter 62-160, F.A.C.;
   iv. Laboratory/Person responsible for performing the analyses;
   v. Analytical techniques or methods used, including MDL;
   vi. Results of such analyses, including appropriate data qualifiers;
   vii. Depth of sampling;
   viii. Directional flow conditions and weather conditions at time of sampling;
   ix. Monthly flow volumes; and
   x. Water quality summary that includes upstream, downstream, and within project area during operational period for all parameters monitored.

D. **Implementation Schedules.** When appropriate, the District shall include information on:
   i. Progress on related project features, and status of potential future operational changes;
   ii. Program/Project level adaptive management;
   iii. Project design modifications; and
   iv. Implementation of remedial measures in the event of noncompliance with permit conditions.

Factors Impacting Compliance

26. **Factors Outside the Permittee's Control.** If non-compliance or failure to achieve performance objectives results for any reasons other than those listed below, the Permittee shall take appropriate remedial measures.

    A. **Natural Background.** Deviations from water quality standards may occur as a result of natural background conditions, in accordance with Section 403.021(11), F.S.

    B. **Random Variation.** The Permittee shall report any statistical uncertainty in the methodology using acceptable scientific methods.

    C. **Other Factors**. Unavoidable legal barriers or restraints, including those arising from actions or regulations not under the control of the Permittee.

27. **Temporary Suspension of Sampling.** Under hurricane, tropical storm warnings, or other extreme weather conditions, the Permittee's normal sampling schedule may be suspended if necessary. The Permittee shall notify the Department's Office of Ecosystems Projects at the addresses and telephone number listed in Specific Condition No. 1, of any anticipated suspension of sampling associated with hurricanes, tropical storms, or other extreme weather events that may require deviation from the normal sampling schedule. Within seven days following the cessation of conditions that warranted a suspension of sampling efforts, the Permittee shall notify the Department of when normal sampling is expected to resume.

Renewals and Modifications

28. **Permit Modifications.** The Permittee shall submit proposed modifications of the project to the Department, prior to implementation of the modifications, for review and approval by the Department. Such modifications may include, but not be limited to:

    A. **Modifications to Achieve Design Objectives**. The Permittee shall modify the project, including modifications to the operation plan(s), if the project facilities are not achieving the design objectives;

    B. **Modifications for Future Facilities.** If the monitoring data indicate the need for the construction/operation of future facilities or structures, prior to construction/operation the Permittee shall apply for modifications to the project, as appropriate to accommodate alterations in operations of the project in conjunction with the construction and operation of the new facilities or structures; and

    C. **Future Phases.** This permit does not authorize any construction or operational activities associated with future project components and phases of the project. Future project components and phases shall require a separate permit or modification to this permit by the Department. Permanent changes to the operation of structures shall require a separate permit or modification to this permit by the Department.

29. **Permit Renewal.** At least 60 days prior to the expiration of this permit, the Permittee shall apply for renewal of this permit. Renewal may be for a period of up to five years in accordance with Section 373.1502(3)(g), F.S., of the CERPRA.

30. **Department Review and Approval.** Where conditions in this permit require Department review and approval of remedial actions or plan modifications to be implemented pursuant to this permit, the Department will consult with the Permittee to ascertain whether mutual agreement can be reached. If mutual agreement on the remedial actions or plan modifications cannot be reached, the action of the Department shall be deemed final agency action and shall be subject to judicial or administrative review, as appropriate.

Table 1. DPM Test Project Monitoring Program

LOCATIONS	PARAMETER	UNITS	TYPE	FREQUENCY
BASELINE/TRIGGER				
S-152[1]	Phosphate, Total as P	mg/L	G	Biweekly[3]
EDEN 8	Stage	ft	Stage Recorder	Daily
Site-69W	Stage	ft	Stage Recorder	Daily
COMPLIANCE				
S-152 [1]	Phosphate, Total as P	mg/L	G	Biweekly[3]
	Flow	CFS	ADVM[2]	DAV
	Stage	ft	Stage Recorder	Daily

[1] S-152 includes 10 gated culverts.
[2] S-152 discharge is determined from an index velocity measured continuously by a SW ADVM (Acoustic Doppler Velocity Meter) within a culvert pipe, calibrated (by regression) to field discharge measurements made using an ADCP along transects upstream of the culvert gates. ADVM sensors are deployed in pipes #2 and #6 (numbering ordered from north to south), 2-ft from the downstream-end of each pipe.
[3] Reflects biweekly sampling over an entire water year.

Key for Table 1

Units:	mg/L	Milligrams per Liter
	CFS	Cubic feet per second
	ft	Feet, NGVD 29
Sample Type:	G	Grab sample
	ADVM	Acoustic Doppler Velocity Meter
Frequency:	DAV	Daily average of continuous sampling

Table 2. DPM Test Project Monitoring Locations

	Site	Latitude	Longitude
Baseline/Operation:	S-152	25° 51' 54.56" N	80° 37' 13.99" W
	EDEN 8	25° 52' 00.00" N	80° 40' 50.00" W
	Site-69W	25° 54' 24.70" N	80° 35' 21.10" W
Compliance:	S-152 (On the L-67A Levee 8.2 miles north of S-333. Platform is located 350 ft. northeast of the culverts.)	25° 51' 54.56"N	80° 37' 13.99"W

Horizontal Datum: WGS84
Units: Degrees, Minutes, Decimal Seconds

Figure 1: DECOMP DPM Test Project Location, Features, and Water Quality Monitoring Stations

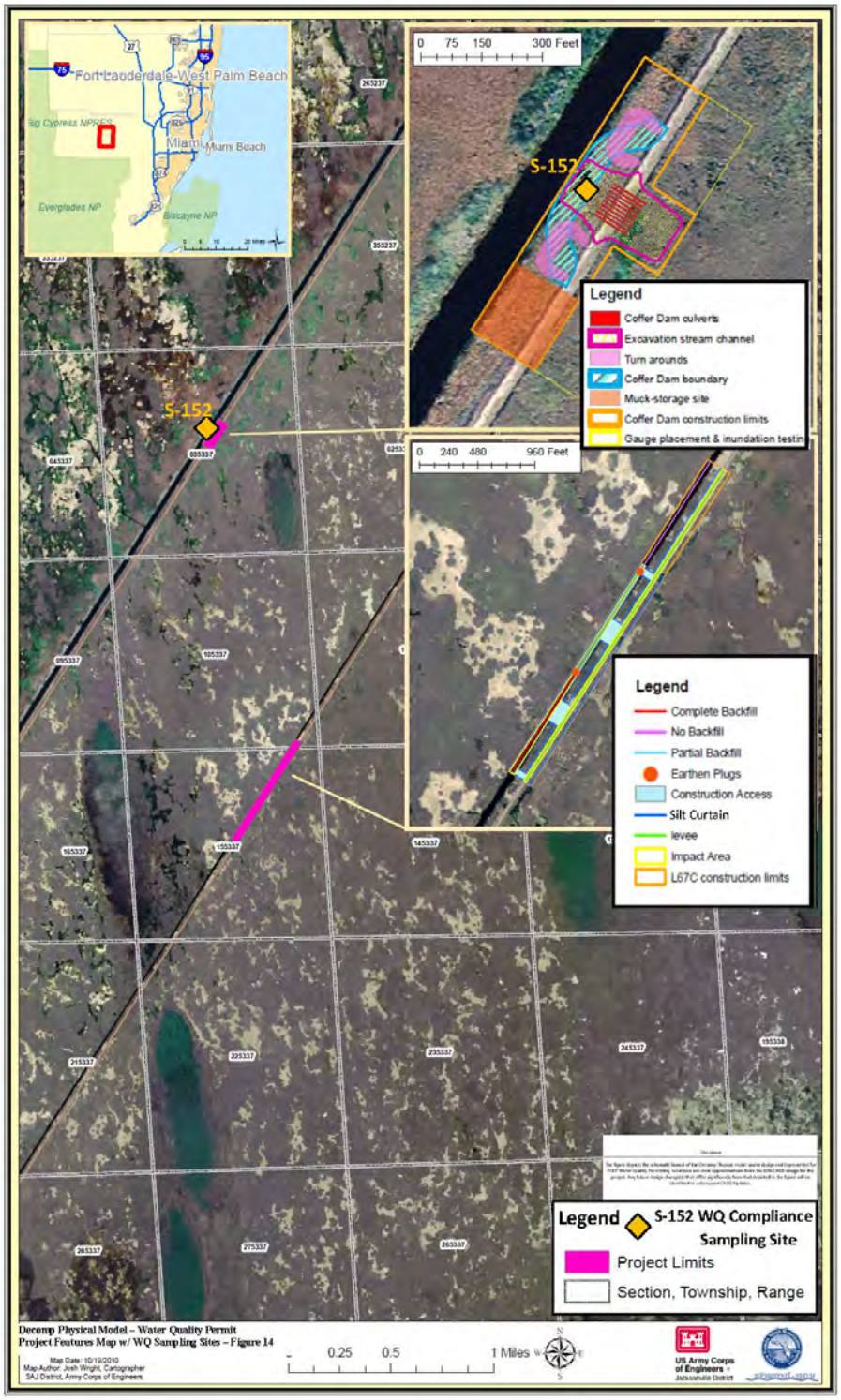


Figure 2. DPM Test Project's Water Quality Monitoring Stations

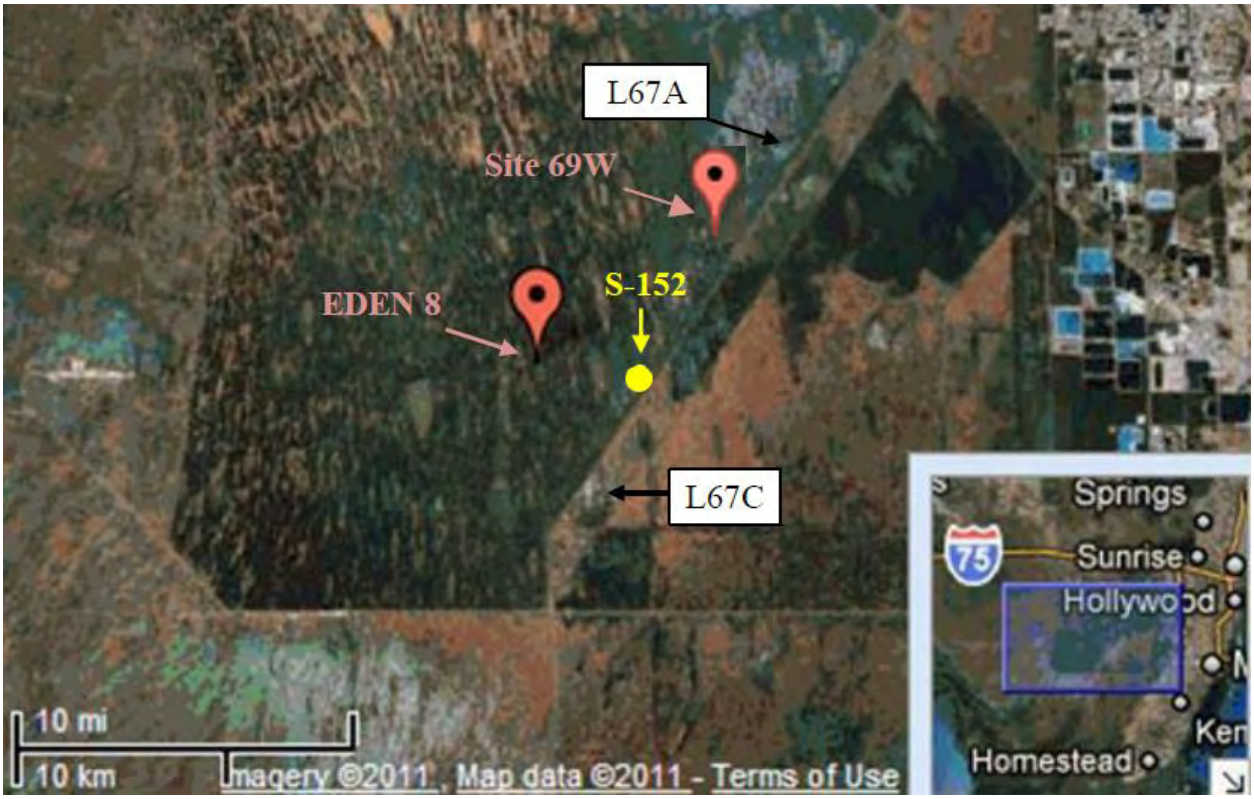
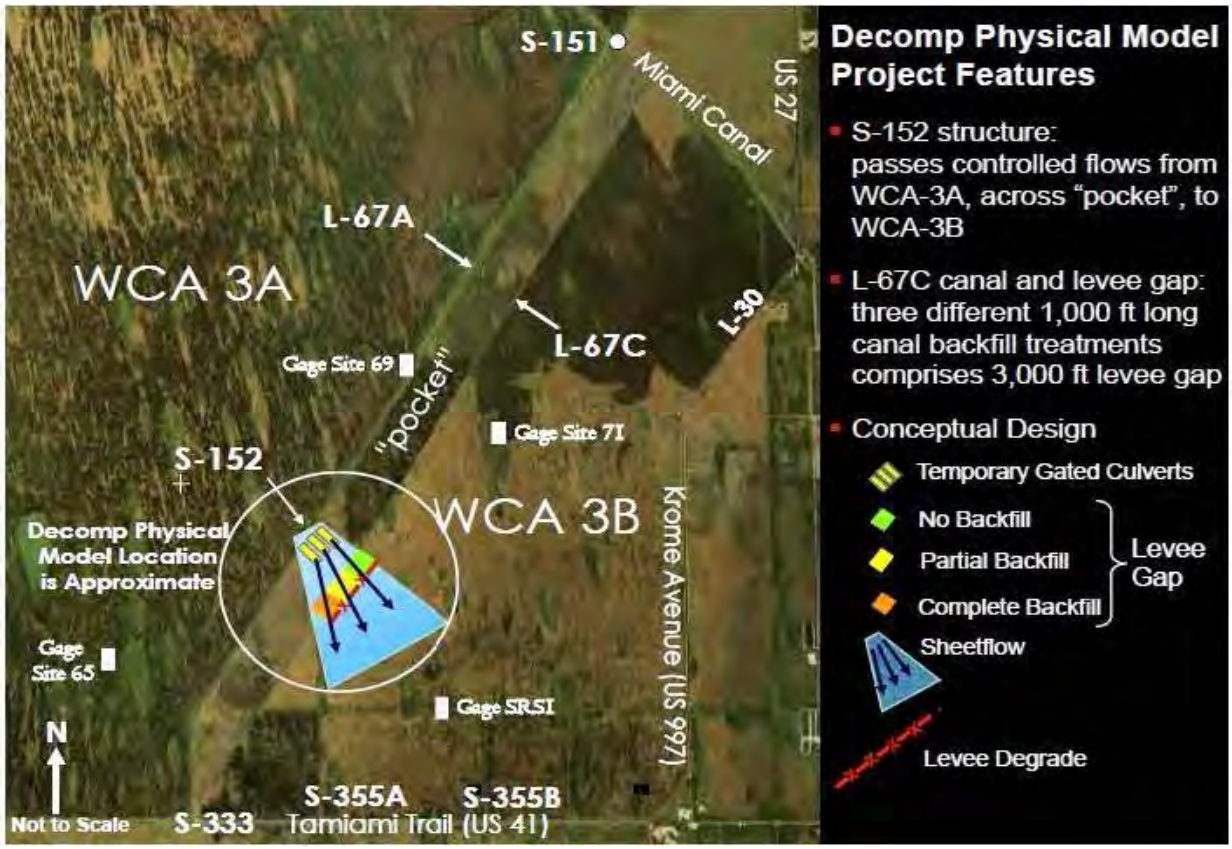


Figure 3: DECOMP DPM Test Project Area Illustrating Backfill Locations



Executed in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Edward C. Smith

Edward C. Smith, Director
Office of Ecosystem Projects

ECS/nb/ro

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to 120.52(7), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

D Jones 2/8/19
Clerk Date

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