EXECUTIVE SUMMARY

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT ON LAKE OKEECHOBEE REGULATION SCHEDULE LAKE OKEECHOBEE, FLORIDA

The U.S. Army Corps of Engineers (Corps) is proposing to implement a new water regulation schedule for Lake Okeechobee. This Supplemental Environmental Impact Statement (SEIS) supports the proposed operational changes to the current Water Control Plan. The SEIS explains the recommended Water Control Plan changes, and provides technical information explaining the basis for the recommendation. It includes a description of its impacts for various purposes, and the comparisons with alternative plans or changes and their effects. The Water Control Plan will be finalized after the public involvement process associated with its development or change is complete.

Need or Opportunity.
The need for a new regulation schedule has been clearly established by the continued deterioration of Lake Okeechobee's littoral zone and both the Caloosahatchee and St. Lucie estuaries. Lake regulation schedules trigger various management activities according to different lake levels. As past experience has shown, the current regulation schedule, Water Supply and Environment (WSE), limits some releases from Lake Okeechobee during periods when water levels are high. Higher lake levels contribute to poor ecological conditions within the lake, and can potentially result in undesirable high volume releases to the estuaries. There is also the need to ensure public health and safety as it pertains to the Lake Okeechobee Regulation Schedule (LORS) and the Herbert Hoover Dike (HHD) levee system that surrounds the lake.

Major Findings and Conclusions.
The Lake Okeechobee Regulation Schedule Study (LORSS) was initiated to address continued high lake levels, estuary ecosystem conditions, and lake ecology conditions that occurred since 2003. At the forefront of the LORSS were back to back historically significant hurricane seasons of 2004 and 2005 and the recognized integrity issues of the HHD. High lake stages can trigger large regulatory releases to Lake Okeechobee's two major outlets, the St. Lucie and Caloosahatchee Estuaries, which can result in adverse environmental effects to these ecosystems. Extended periods of high water levels in Lake Okeechobee have also resulted in significant loss of valuable habitat in the lake's littoral zone and marsh communities.

All alternatives evaluated were based on criteria for managing the lake at a lower level than the current regulation schedule. The issue of public health and safety based on the integrity issues of the HHD was a key factor in the decision making process to select a Preferred Alternative. For a multiple purpose lake, such as Lake Okeechobee, a

regulation schedule attempts to balance competing objectives including flood control, water supply, navigation and enhancement of fish and wildlife resources. Thus, managing for better performance of one objective often leads to poorer performance in satisfying competing objectives. Often trade-offs exist between the objective of managing the lake water levels for the health of the littoral zone and the objective of reducing high volume flows to the estuaries.

Alternatives. There have been various regulation schedules adopted in the past. The current schedule is Water Supply/Environment (WSE) which was recommended for implementation in 2000 upon completion of an Environmental Impact Statement (EIS) and Record of Decision (ROD) prepared by the Corps, Jacksonville District. The regulation schedules studied in this report do not require structural modifications and were developed by the Corps and the South Florida Water Management District (SFWMD). Performance measures (PMs) and objectives were developed by an interagency group of concerned Federal and State agencies. These PMs and objectives were used to compare the various alternatives using the South Florida Water Management Model (SFWMM). In addition to the current regulation schedule (WSE), five other alternative regulation schedules were evaluated in detail. The alternatives are referred to in the SEIS as: 1bS2, 1bS2-m, 2a, 2a-m and 4.

Preferred Alternative. The alternative regulation schedule (1bS2-m) recommended in this report represents the best operational compromise at this time to improve the environmental health of certain major Central and Southern Florida (C&SF) ecosystems, while providing for public health and safety as it pertains to the LORS and the impact it has on the safe operation of the HHD. Extended periods of high water levels in Lake Okeechobee have resulted in significant loss of valuable habitat in the lake's littoral zone and marsh communities which can only be restored by operating the lake under a lower schedule.

Issues Raised by the Public and Agencies. The following issues were identified during scoping and by the preparers of this Supplemental Environmental Impact Statement (SEIS) to be relevant to the proposed action and appropriate for detailed evaluation: Public Health and Safety, Flood Control, Water Supply, Impacts to Lake Okeechobee, Everglades and Estuarine Biota, Endangered and Threatened Species, Water Quality and Navigation.

Areas of Controversy. There will always be a level of controversy with any issue related to water management in south Florida. Regarding the proposed action, few issues remain unresolved with various commenting agencies and other non-governmental groups. However, stakeholder input obtained during the Planning phase of the study indicates much concern over the health of the Caloosahatchee Estuary. Stakeholders representing the Caloosahatchee Estuary have concerns that the alternatives analyzed show minimal benefits, if any, for the estuary.

Unresolved Issues. The Corps and the U.S. Fish and Wildlife Service (USFWS) are engaged in formal consultation under the Endangered Species Act (ESA) to identify and

evaluate the effects to the Everglade snail kite, wood stork and Okeechobee gourd. An initial determination of "may affect" was made for these species, and issuance of a Biological Opinion by the USFWS is forthcoming.

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LIST OF ACRONYMS

>	Greater than
<	Less than
ACTION	Active Citizens Together Improving Our Neighborhoods, Inc
ASR	Aquifer Storage and Recovery
C&SF	Central and Southern Florida
CAR	Coordination Act Report
CERP	Comprehensive Everglades Restoration Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLA	Classification Limit Adjustment
cm	centimeter
Corps	U.S. Army Corps of Engineers
CR	County Road
CSOP	Combined Structural and Operational Plan
CSSS	Cape Sable Seaside Sparrow
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
Decomp	Decompartmentalization
DRI	Development of Regional Influence
EA	Environmental Assessment
EAA	Everglades Agricultural Area
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ENP	Everglades National Park
E.O.	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAU-CURE	Florida Atlantic University-Center for Urban Redevelopment and Empowerment
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FFWCC	Florida Fish and Wildlife Conservation Commission
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
ft	foot/feet
GMFMC	Gulf of Mexico Fishery Management

IRL	Indian River Lagoon
km	kilometer
km^2	square kilometers
HHD	Herbert Hoover Dike
HTRW	Hazardous, Toxic and Radioactive Waste
LEC	Lower East Coast
LECSA	Lower East Coast Service Area
LORS	Lake Okeechobee Regulation Schedule
LORRS	Lake Okeechobee Regulation Schedule Study
LOSA	Lake Okeechobee Service Area
MFL	Minimum Flow Level
MISP	Master Implementation Sequencing Plan
MODWaters	Modified Water Delivery
MRR	Major Rehabilitation Report
MSCO	Multi-season Climate Outlook
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
mph	miles per hour
NEPA	National Environmental Policy Act
*NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NTO	Non-typical Temporary Operation
PL	Public Law
PM	Performance Measure
PDT	Project Delivery Team
POR	Period of Record
ppb	parts per billion
SAFMC	South Atlantic Fishery Management Council
SAV	Submerged Aquatic Vegetation
SCO	Seasonal Climate Outlook
SCP	State Comprehensive Plan
SEIS	Supplemental Environmental Impact Statement
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SHPO	State Historic Preservation Officer
SR	State Road
STA	Stormwater Treatment Area

THC	Tributary Hydrologic Condition
TMDL	Total Maximum Daily Loads
TSP	Tentatively Selected Plan
U.S.	United States
USA	United States of America
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WCA	Water Conservation Area
WMA	Wildlife Management Area
WRAC	Water Resources Advisory Commission
WRDA	Water Resources Development Act
WSE	Water Supply and Environment

*All references to elevation are above or below the NGVD of 1929

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SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE LAKE OKEECHOBEE REGULATION SCHEDULE

1. PROJECT PURPOSE AND NEED

1.1. PROJECT AUTHORITY

The original authority for this project was the Flood Control Act of 1948 (approved by Congress on June 30, 1948). It authorized the Central and Southern Florida Flood Control Project, which is a multipurpose project that provides flood control, water supply for municipal, industrial, and agricultural uses; prevention of salt water intrusion; water supply for Everglades National Park (ENP); recreation; and protection of fish and wildlife resources.

Authority to complete this study was granted under Section 310 of the 1990 Water Resources Development Act (WRDA) which reads in part:

> "… (1) CENTRAL AND SOUTHERN FLORIDA (C&SF). The Chief of Engineers shall review the report of the Chief of Engineers on central and southern Florida, published as house Document 643, 80th Congress, 2nd Session, and other pertinent reports, with a view to determining whether modifications to the existing project are advisable at the present time due to significantly changed physical, biological, demographic, or economic conditions, with particular reference to modifying the project or its operation for improving the quality of the environment, improving protection of the aquifer, and improving the integrity, capability, and conservation of urban water supplies affected by the project or its operation."

1.2. PROJECT LOCATION

Lake Okeechobee is located in south central Florida, and occupies portions of, Glades, Hendry, Martin, Okeechobee, and Palm Beach Counties (Figure 1-1). Lake Okeechobee has an area of approximately 730 square miles with its approximate center near 26° 56′ 55″ north latitude and 80° 56′ 34″ west longitude. The area that may be affected by the proposed alternative lake regulation schedules includes much of south Florida beyond the bounds of Lake Okeechobee proper. For the purposes of this study it has been determined that substantive effects may be regional in nature and importance, but perhaps due to the restricted operational changes being proposed, are not limitless in scope and effect. Hydrologic modeling, using the South Florida Water Management Model (SFWMM), indicate that the southern Water Conservation Areas (WCAs), including WCA 3A below I-75 (Alligator Alley), WCA 2B, 3B, and the ENP are not significantly affected by the operational changes being proposed to the lake regulation schedule. The areas considered to be most affected and which shall receive the greatest scrutiny in terms of impact assessment is the lake itself, particularly within the littoral and marsh areas of the lake, and major downstream estuaries including the St. Lucie and Caloosahatchee Estuaries. To a lesser degree, other areas considered

to be affected are within the Everglades Agricultural Area (EAA), and in the northern WCAs, including WCA 3A north of I-75, WCA 2A, and the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA 1). Figure 1-2 provides an overall image of the study area including its proximity within the central and south Florida ecosystem.

Part of the Okeechobee Waterway, the St. Lucie Canal is the main eastern flood control outlet for Lake Okeechobee. The St. Lucie Estuary is located within portions of both Martin and St. Lucie counties on the southeast coast of Florida. The two forks of the St. Lucie Estuary, the North Fork and South Fork, flow together near the Roosevelt Bridge at the City of Stuart, and then flow eastward approximately six miles to the Indian River Lagoon (IRL) and Atlantic Ocean at the St. Lucie Inlet.

The Caloosahatchee River is the only flood-control outlet leading west from Lake Okeechobee, part of the Okeechobee Waterway, and the only navigable passage between the Gulf of Mexico and the Atlantic Ocean. The river extends approximately 70 miles from Lake Okeechobee, through the Caloosahatchee Estuary, to the lower Charlotte Harbor Basin at San Carlos Bay. The Caloosahatchee River passes through parts of Glades, Hendry, and Lee counties.

The EAA, located south of Lake Okeechobee within eastern Hendry and western Palm Beach counties, encompasses an area totaling approximately 718,400 acres (1,122 square miles) of highly productive agricultural land comprised of rich organic peat or muck soils. A small portion of EAA mucklands is also found in western Martin County. The EAA is considered one of Florida's most important agricultural regions. The EAA extends south from Lake Okeechobee to the northern levee of WCA 3A. Its eastern boundary extends to the L-8 Canal. The L-1, L-2 and L-3 levees represent its westernmost limits.

The WCAs cover 1,372 square miles and are located south of Lake Okeechobee and the EAA. WCA 1, also known as the Arthur R. Marshall Loxahatchee National Wildlife Refuge, includes 227 square miles of Everglades wetland habitat. WCA 2, the smallest of the three WCAs, encompasses approximately 210 square miles. The area is divided into two cells by a levee constructed in 1961. The north cell, WCA 2A, covers 173 square miles, and the south cell, WCA 2B, covers 37 square miles. WCA 3, the largest of the WCAs covers an area of 915 square miles.

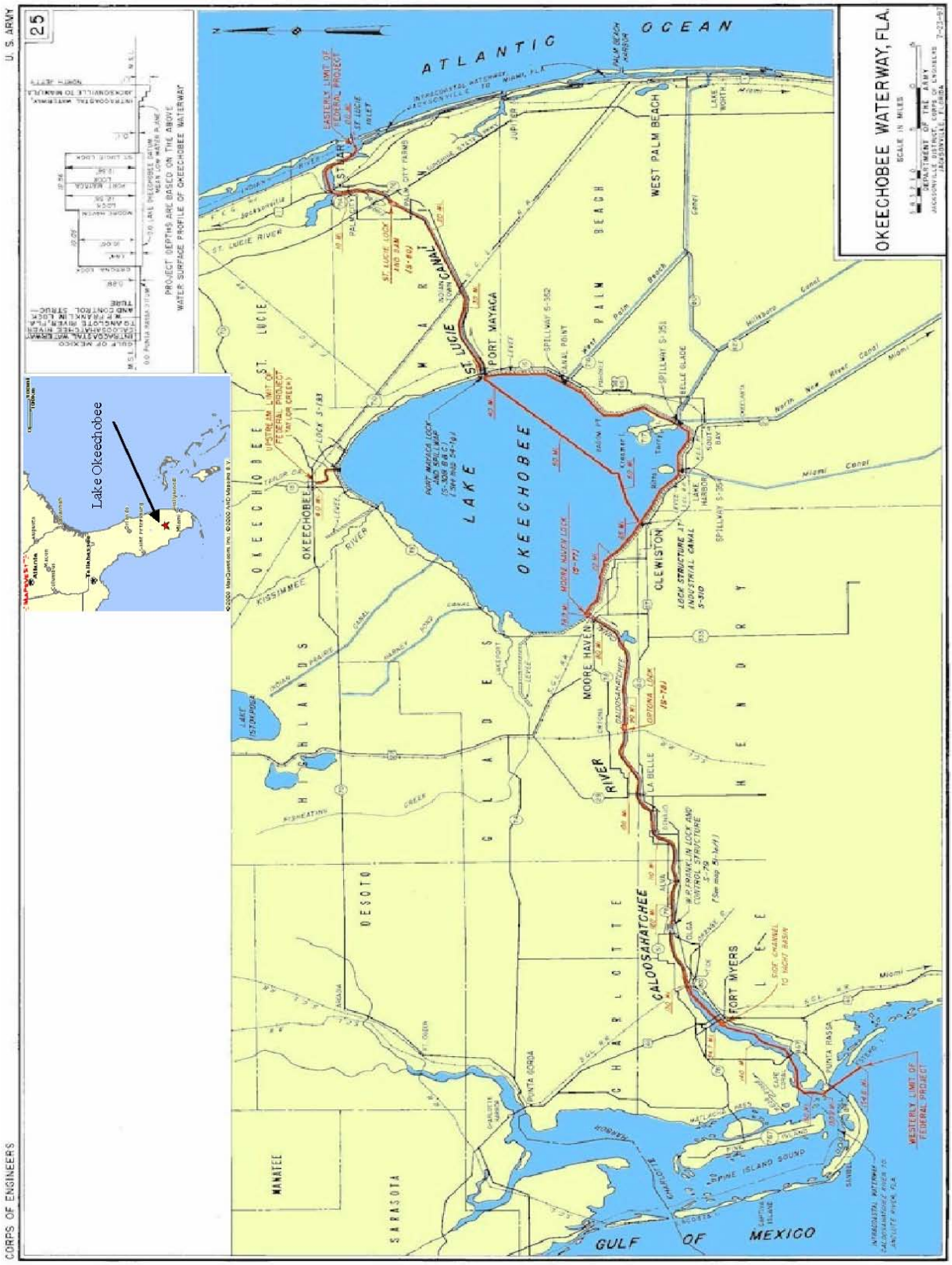

FIGURE 1-1: LOCATION MAP

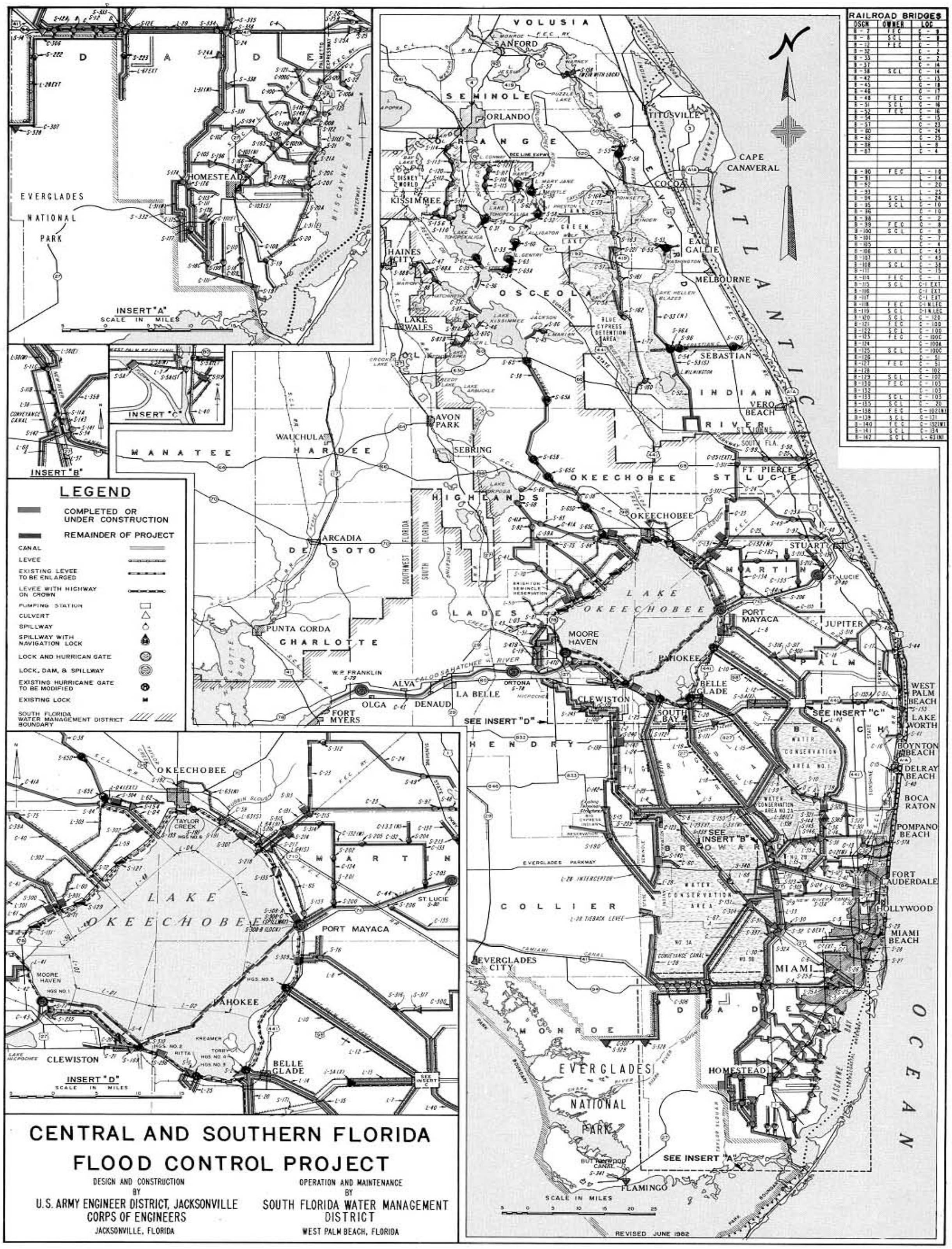

FIGURE 1-2: C&SF PROJECT MAP

1.3. PROJECT NEED OR OPPORTUNITY

The need for a new regulation schedule has been clearly established by the continued deterioration of Lake Okeechobee's littoral zone and both the Caloosahatchee and St. Lucie estuaries. Lake regulation schedules trigger various management activities according to different lake levels. As past experience has shown, the current regulation schedule, Water Supply and Environment (WSE), limits some releases from Lake Okeechobee during periods when water levels are high. Higher lake levels contribute to poor ecological conditions within the lake, and can potentially result in undesirable high volume releases to the estuaries.

1.4. AGENCY GOAL OR OBJECTIVE

The agency goal is to implement a new regulation schedule that would improve the health of Lake Okeechobee and the St. Lucie and Caloosahatchee estuaries, while continuing to ensure public health and safety, and with minimal or no impact to the competing project (lake) purposes. Study objectives consistent with this goal have been determined as follows:

a. Ensure public health and safety
b. Manage Lake Okeechobee at optimal lake levels to allow recovery of the lake's environment and natural resources
c. Reduce high regulatory releases to the estuaries
d. Continue to meet Congressionally authorized project purposes including, flood control, water supply, navigation, fish and wildlife enhancement, and recreation

1.5. BACKGROUND AND RELATED ENVIRONMENTAL DOCUMENTS

Lake Okeechobee benefits south Florida by storing large volumes of water during wet periods for subsequent environmental, urban and agricultural needs during dry periods. However, extended periods of high water levels in the lake have been identified as causing stress to the lake's littoral zone. In addition, south Florida's potential for heavy rains and hurricanes requires that water levels in the lake be carefully monitored to ensure that they do not rise to levels that would threaten the structural integrity of the Herbert Hoover Dike (HHD) surrounding Lake Okeechobee. Therefore, when water levels in the lake reach certain elevations designated by the regulation schedule, discharges are made through the major outlets to control excessive buildup of water in the lake. The timing and magnitude of these releases is not only important for preserving the flood protection of the region, but also for protecting natural habitats of downstream estuaries and the Everglades.

The WSE schedule was adopted as the official regulation schedule in July 2000 after an extensive multi-agency and multi-objective evaluation process (described in the Final EIS), led to a Record of Decision (ROD) signed in July 2000. The first releases made under WSE occurred in July 2002 (USACE, 2004). In the relatively short four-year period since releases began under WSE, the schedule demonstrated improved performance as compared with the previous regulation schedule (Run 25) although many weaknesses became evident. As the recent past has shown, the WSE regulation

schedule limits releases from Lake Okeechobee when water levels are high and during periods when the lake's littoral zone and estuaries would have benefited from such releases.

For example, the WSE schedule called for no releases to the estuaries during a long period from February to June 2003. During the same period, the schedule called for maximum practicable releases south to WCAs; however, releases were limited due to high WCA stages and limited treatment capacity in Stormwater Treatment Area (STA)-1 West. The Lake stage at the beginning of the 2003 wet season was about 14.6 ft., National Geodetic Vertical Datum of 1929 (NGVD). During August and September 2003, inflows pushed the lake stage up to 17.15 ft., NGVD. To regulate the high lake stage, large prolonged discharges to both estuaries were required. Public concern for the health of the lake and the downstream estuaries led to commitments by executive management of the U.S. Army Corps of Engineers (Corps) to re-examine the WSE regulation schedule.

The Corps initiated a multi-phase effort to improve the Lake Okeechobee regulation schedule (LORS). The first phase, which began in 2004, attempted to implement a modification to the schedule to increase the flexibility and opportunities to make releases when the lake stage is between the "no regulatory discharge" and "discharge maximum practicable" release zones. The Corps made the schedule modification as a temporary planned deviation referred to as the Classification Limit Adjustment (CLA), which was implemented to adjust classifications of hydrologic indicators and forecasts. An Environmental Assessment (EA) was prepared in December 2004, with a Finding of No Significant Impact (FONSI) signed on January 25, 2005 for the action. The intent of the CLA was to help lower above-average lake levels and to improve ecological conditions within Lake Okeechobee's littoral zone. However, long-term effects of the CLA could not be determined since the appropriate trigger conditions necessary to implement the deviation seldom occurred.

Phase 2 of the multi-phase effort to improve the regulation schedule began in July 2005, and is the current LORSS that has led to this draft Supplemental Environmental Impact Statement (SEIS). Phase 2 only takes into consideration operational changes to the regulation schedule.

Phase 3 efforts, expected to begin in 2007, will examine a new water regulation schedule based on the effects of the Comprehensive Everglades Restoration Plan (CERP) Band 1 projects and the Fast Track (Acceler8) projects. Band 1 is the group of priority CERP projects expected to be constructed by 2010. Projects include: C-111 Spreader, aquifer storage and recovery (ASR) Pilots, L-31 Seepage Pilot, C-44 Reservoir, EAA Reservoir, Picayune Strand, Hillsboro Site 1 Impoundment, Decompartmentalization, (Tamiami Trail, and Acme Basin B [Master Implementation Sequencing Plan {MISP}] 2005 at http://www.evergladesplan.org). The recommendation to adopt a new water regulation schedule should be viewed as one step in the longer process of developing a LORS that will take the CERP Band 1 projects into consideration. Adjusting the regulation schedule now changes the way the

system is operated, but the larger problems now existing in the system can only be solved by water storage on a regional scale which is being addressed by the CERP.

As a supplemental document, this SEIS incorporates by reference information contained in the Final EIS document (USACE, 1999) previously prepared by the Corps.

1.6. DECISIONS TO BE MADE

The LORSS was initiated to address continued high lake levels, estuary ecosystem conditions, and lake ecology conditions that occurred during the 2003 to 2005 time period. At the forefront of the LORSS were the back-to-back historically significant hurricane seasons of 2004 and 2005, the recognized integrity issues of HHD, and the potential danger that any hurricane season poses for the people relying upon the protection provided by HHD. Years 2004 and 2005 are ranked eighth and ninth for Lake Okeechobee's highest net inflow during the wet season (June-October) since 1914.

In light of the State's independent review report released in April 2006, which evaluated the structural integrity of the HHD, a great deal of public and media attention has been focused on the HHD issue. The State's independent report essentially validated the Corps previous findings from 1998 that the HHD is in need of rehabilitation (USACE, 1998). In response to the Corps findings back in 1998, a rehabilitation plan was developed and approved in 2000, and implementation of that plan is currently underway. After the State's independent report was released, the Corps received a letter of concern from the Governor of Florida (pertinent correspondence, Appendix C). The Governor's concern is the potential failure of the dike and the effects it could have on the communities around Lake Okeechobee. While the Corps considers public health and safety as its highest priority, the recent attention given to the HHD stability issue underscores the importance of the implementation of the plan. Issues such as seepage, piping, and boils are exacerbated when the lake elevation approaches 18.5 ft., NGVD (USACE, 2005). As a result, the LORSS only considered alternatives that would allow the lake to be managed at a lower average level year-round compared to the WSE regulation schedule. To ensure the integrity of the HHD is maintained, the Corps eliminated alternatives that did not achieve zero or close-to-zero days above lake elevation 17.25 ft., NGVD. The 17.25 feet constraint was based on the schedule's ability to store rainfall and runoff anticipated from a storm event comparable to Hurricane Wilma in 2005 without having HHD integrity issues.

Other important considerations for this study were the environmental needs of Lake Okeechobee, the Caloosahatchee and St. Lucie estuaries, and the greater Everglades (including the WCAs). The work being performed for this study consists of identifying the effects (both beneficial and adverse) associated with the alternatives developed for the LORSS and the approved regulation schedule currently in place, WSE. Broadly, the effort involved:

a. Identifying all environmental, fish and wildlife, cultural and recreational resources in the study area;

b. Assessing the effects of the alternative regulation schedules on these resources;
c. Quantifying impacts to the competing lake management objectives such as flood protection, water supply, water quality, recreation and navigation;
d. Evaluating the socio-economic impacts associated with the alternative regulation schedules; and
e. Preparing the required documentation including graphics to present the study's findings and recommendations.

1.7. PUBLIC CONCERNS

Lake Okeechobee plays a very important role as a primary source of water supply for nearby urban areas, the Lake Okeechobee Service Areas (LOSA) and the EAA that lies to the immediate south of the lake. The lake also continues to grow in importance as a backup water supply source for the heavily populated, and still growing, urbanized areas of the Lower East Coast (LEC) of Florida. In its water resources management role, the Corps has always strived to balance the competing, and often conflicting, purposes and objectives of the regulation and operation of the Lake Okeechobee infrastructure. In recent years, due to heavy rainfall and numerous hurricanes, the lake stage has reached, and sometimes remained at, higher than normal levels, which frequently resulted in large, and sometimes prolonged, regulatory releases to the downstream estuaries. These high lake stages and large releases to the estuaries may be a contributing factor in the deterioration of the lake's littoral zone and the estuarine ecosystems. Through numerous public meetings and coordination, local officials, residents, and environmental groups have expressed their concern over this deterioration and are looking to the Corps to resolve the problem. Environmentalists and scientists within the environmental community are strongly advocating for lowering the lake levels and reducing the large releases to the estuaries. With these concerns in mind, this study was implemented as an intermediate step to try and resolve these issues solely through operational modifications. In the future, as mentioned previously, Phase 3 of this effort will examine a new regulation schedule based on the effects of the CERP Band 1 projects that are expected to be initiated in 2010.

1.8. SCOPING AND ISSUES

1.8.1. ISSUES EVALUATED IN DETAIL

The following issues were identified during scoping and by the preparers of this SEIS to be relevant to the proposed action and appropriate for detailed evaluation:

- Public health and safety
- Flood control
- Water supply
- Impacts to the Lake, Everglades and estuarine biota
- Endangered and threatened species
- Water quality
- Navigation

1.8.2. ISSUES ELIMINATED FROM DETAILED ANALYSIS

The following issues were not considered important or relevant to the proposed action based on scoping and the professional judgment of the preparers of this SEIS:

- Historic properties
- Air quality
- Noise pollution
- Hazardous, toxic and radioactive waste (HTRW)

1.9. PERMITS, LICENSES, AND ENTITLEMENTS

Clean Water Act of 1972
As the proposed action is strictly of an operational nature, and does not involve any construction activity, water quality certification from the State of Florida is not required. Furthermore, as there are no structural components contained in the proposed action and no dredge and fill operations being considered, a Section 404 (b) Evaluation is not appropriate.

Coastal Zone Management Act
This action will be reviewed for consistency with the State's Coastal Zone Management Program, pursuant to the Coastal Zone Management Act (CZMA), 16 U.S.C., 1451-1464, as amended.

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2. ALTERNATIVES

This section describes in detail the no-action alternative, the proposed action, and other reasonable alternatives that were studied in detail. Section 4, Affected Environment, presents the beneficial and adverse environmental effects of all alternatives in comparison form, providing a clear basis for the decision maker and the public to choose among the options.

2.1. PLAN FORMULATION METHODOLOGY

While the issues that surround the implementation of a regulation schedule for Lake Okeechobee are very complex, as are the various scientific and engineering models used, the planning process is relatively straightforward. Various lake regulation schedules were developed and proposed to replace the existing schedule, WSE. Extensive coordination with a wide array of governmental agencies (Federal, State and local) and the general public was performed to determine the acceptability of the schedules being considered.

This study only considered operational changes. Therefore, no structural features were considered except for those embedded in the SFWMM, which were common to all alternative schedules. There were also no real estate concerns since the lake is self contained and no real estate needs are present. This further simplified the planning process.

The modeling effort takes into account the most recent information on water related needs and demands. Some CERP related projects are still in the planning phase and have not been factored into the SFWMM at this time. These projects may eventually trigger further revisions to the current schedule.

At the beginning of the LORSS, the Project Deliver Team (PDT) developed a preliminary array of three alternatives, not including the No Action Alternative. The preliminary alternatives were referred to as Alternatives 1, 2 and 3. Alternative 1 was formulated to modify WSE on a small scale. Alternative 2 was formulated to have a wholesale change in the WSE regulation schedule and Alternative 3 was formulated in the previous regulation schedule study (USACE, 1999) and was referred to as Run 22AZE. Since this was the alternative preferred by many resource agencies at that time, this alternative was pulled forward to compete in the initial array of alternatives in the current study. This alternative did not perform as well in this study due to the STA flow constraints which allowed much higher lake elevations than previously modeled in the 1999 study. Therefore, Alternative 3 was screened from further analysis in this SEIS. The alternatives described in detail below are variations of Alternatives 1 or 2.

2.2. DESCRIPTION OF LORS ALTERNATIVES

The section below (Section 2.3) describes both in text and graphically, the proposed alternative lake regulation schedules. Included is the No Action Alternative (WSE), the base regulation schedule against which all the alternatives were compared.

Water levels in Lake Okeechobee are currently regulated by a complex system of pumps, spillways, and locks according to a regulation schedule developed by the Corps. The term “regulation schedule” refers to a compilation of operating criteria, guidelines, rule curves and specifications that govern storage and release functions of a reservoir. A regulation schedule is a tool used by water managers to manage the water levels in Lake Okeechobee. Typically, a regulation schedule has water level thresholds which vary with the time of year and trigger discharges (referred to as regulatory releases). The threshold lines of regulation schedules define the release zones and are traditionally displayed graphically. Additionally, a corresponding table is typically used to identify the structure discharge rules for release zones. Regulatory discharges are made primarily to protect the integrity of the surrounding levees and developed areas, and are also made to lower water levels in preparation for wet season inflows. For a multiple purpose lake, such as Lake Okeechobee, a regulation schedule attempts to balance competing objectives including flood control, water supply, navigation, and environmental needs. Thus, managing for better performance of one objective often leads to poorer performance in satisfying competing objectives. This is particularly true for Lake Okeechobee, where managing the lake water levels for the health of the littoral zone ecosystem may cause damaging flows to the St. Lucie and Caloosahatchee estuaries.

With the exception of the No Action Alternative, the alternatives evaluated in this study were developed to achieve a few common goals: to achieve zero or close-to-zero days above lake elevation 17.25 ft., NGVD; to provide a base flow to one or both of the estuaries to minimize the occurrence of high, damaging releases to the estuaries; to include a maximum limit of the lake regulatory releases passed through Stormwater Treatment Area-3/4 (STA-3/4), based on assumed treatment capacity given the current nutrient levels within Lake Okeechobee; and to provide lake operators with as much flexibility as possible to lower the lake stages when needed to achieve project objectives.

All of the alternatives modeled assumed pumping to the WCAs unconditionally when the Lake levels are in the highest Zone. The assumed treatment capacity constraint for STA-3/4 is simulated in the SFWMM by restricting the wet and dry season conveyance capacities for the Miami and North New River canals to pass approximately 58,500 acre-feet, average annual during the dry season and 4,700 acre-feet average annual during the wet season from the Lake to the STA-3/4. STA-3/4 is one of six large treatment wetlands managed by the SFWMD as part of the Everglades Construction Project. STA-3/4 was designed to capture stormwater runoff from the basins adjacent to the North New River and Miami Canals as well as to capture and treat regulatory releases fro Lake Okeechobee. STA-3/4 is located immediately east (and north) of the

Holey Land Wildlife Management Area and north of WCA 3A and west of Highway U.S. 27.

All alternatives, except Alternative 2a and Alternative 2a-m, included similar use of the WSE meteorological guidelines and decision tree framework; all alternatives included use of a the Tributary Hydrological Conditions (THC) indicators concept, as found in WSE but modified to utilize the Palmer Drought Severity Index (in the place of net basin rainfall) and Lake Okeechobee net inflows (in the place of inflows at S-65E). The SFWMD Supply Side Management Line is assumed to be lowered by 1.0 feet from the current Supply Side Management line under all alternatives. The Supply Side Management is a computational method for allocating water under declared water shortages to Lake Okeechobee and the Lower East Coast Service Areas (LECSA). The assumption of a lowered Supply Side Management line serves as a surrogate for the Supply Side Management update effort anticipated to be completed by the SFWMD prior to implementation of a new Lake regulation schedule (to be identified by this LORS study), but the assumption is unable to be included as part of the No Action Alternative ; the assumption of a 1.0-foot lowering of the Supply Side Management line for all alternatives is based on a recommendation from the SFWMD technical staff working on the parallel effort to update the Supply Side Management rules. Completion of the SFWMD Supply Side Management update effort requires identification of the Preferred Alternative regulation schedule by the Corps.

The schedules which included the WSE decision tree framework were designed to increase operational flexibility. Considering the dynamic shifting of priorities for managing the Lake, it appears desirable to design flexible operating rules that give water managers some latitude to utilize best available multi-disciplinary information, and adjust operations as necessary to achieve a better balance of the competing objectives. Considering the potential benefits from recent lake inflow forecasting tools, and the rapid increase in the state-of-the art in forecasting technology, it is practical to establish more flexible rules which allow lake managers to utilize supplemental information and apply their sound judgement in making operational decisions. A detailed discussion of WSE will not be provided in this SEIS; however, differences from WSE will be discussed, below, as part of the individual alternatives.

All alternatives evaluated, including the No Action Alternative, assume operation of the SFWMD temporary forward pumps for water supply at S-354 (400 cfs), S-351 (600 cfs), and S-352 (400 cfs). Based on preliminary operational guidance from the SFWMD, the pumps simulated to trigger on for water supply demands if the Lake stage falls below 10.2 feet; the pumps are assumed turned off when the Lake stage recovers to 11.2 feet.

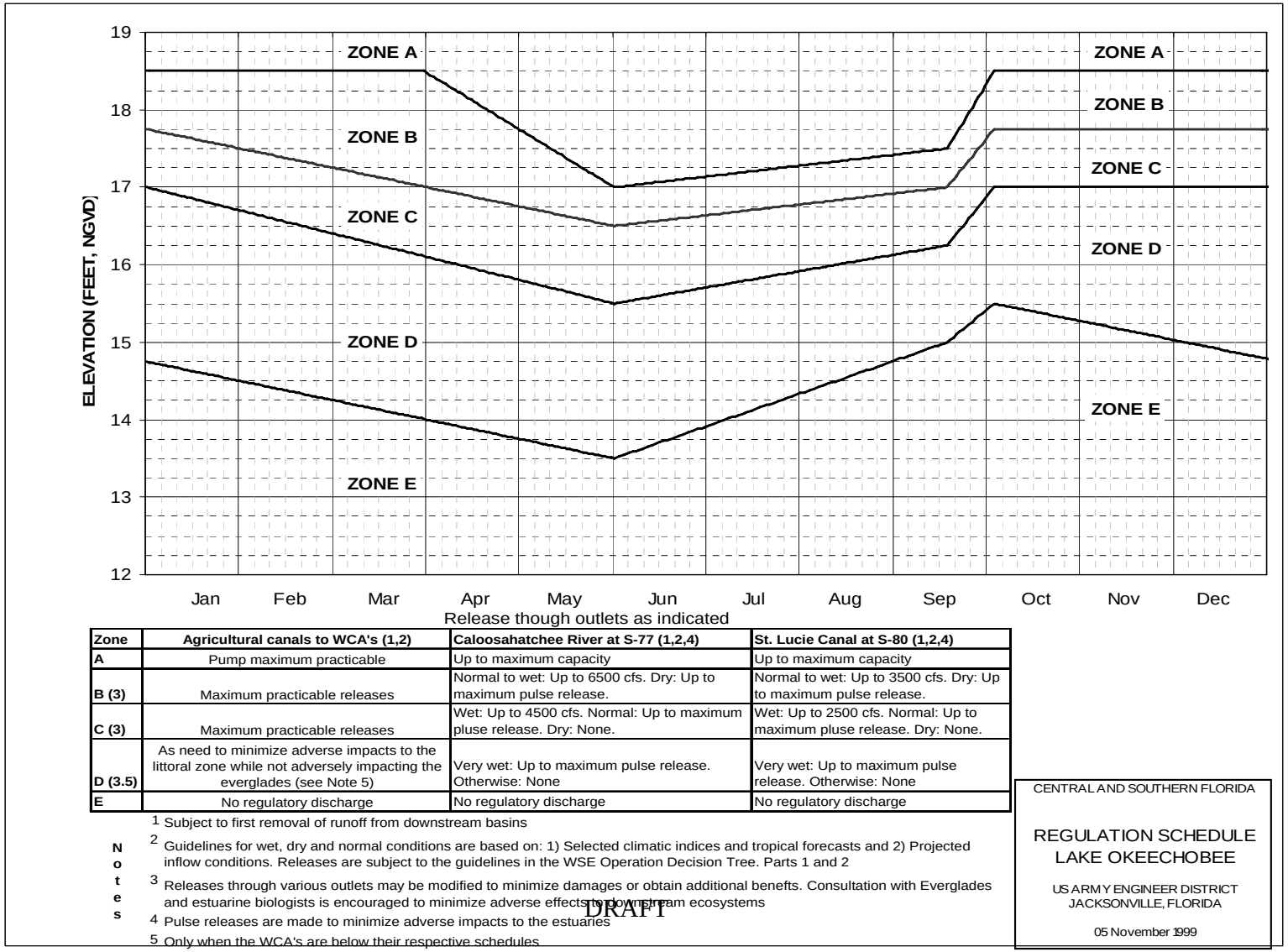
2.3. DESCRIPTION OF ALTERNATIVES

2.3.1. NO ACTION ALTERNATIVE (WSE)

The No Action Alternative is the current regulation schedule, WSE, with the addition of temporary forward pumps. The WSE schedule was approved in July 2000, with the first

releases occurring in July, 2002. The WSE regulation schedule (Figure 2-1) incorporates THC and climate forecasts into the operational guidelines and is used in conjunction with the Operational Guidelines Decision Tree. The Decision Tree is divided into two parts. Part 1 defines Lake Okeechobee discharges to the WCAs (Figure 2-2) and Part 2 defines Lake Okeechobee discharges to tidewater (Caloosahatchee and St. Lucie estuaries) (Figure 2-3). The operational flexibility of the WSE schedule allows for adjustments to be made in the timing and magnitude of Lake Okeechobee regulatory discharges based on conditions in the lake tributary basins and in the extended meteorological and climate outlooks. This schedule incorporates increased operational flexibility in the intermediate zones and permits excess water to be discharged from the lake at lower water levels when large inflows are expected, based on current and projected hydrologic conditions.

A key feature of the WSE schedule is the lower operational zone, labeled Zone D. This zone allows the operational flexibility to deliver water to the Everglades at lower lake water levels, which minimizes adverse impacts to the lake's littoral zone. If very wet conditions exist or are expected over the next six months, pulse releases may be initiated to tidewater in Zone D. The WSE schedule allows dry season discharges to tidewater to be gradually increased as necessary (up to the discharge rate recommended for the specific zone) to control water levels. This practice does not impact flood protection since there is no threat of hurricane surge during the dry season. The large outlet capacity virtually assures the ability to lower the water levels before the arrival of the hurricane season. This practice allows more water to be kept in the regional system for water supply and hydroperiod restoration.



Zone	Agricultural canals to WCA's (1,2)	Caloosahatchee River at S-77 (1,2,4)	St. Lucie Canal at S-80 (1,2,4)
A	Pump maximum practicable	Up to maximum capacity	Up to maximum capacity
B (3)	Maximum practicable releases	Normal to wet: Up to 6500 cfs. Dry: Up to maximum pulse release.	Normal to wet: Up to 3500 cfs. Dry: Up to maximum pulse release.
C (3)	Maximum practicable releases	Wet: Up to 4500 cfs. Normal: Up to maximum pluse release. Dry: None.	Wet: Up to 2500 cfs. Normal: Up to maximum pluse release. Dry: None.
D (3.5)	As need to minimize adverse impacts to the littoral zone while not adversely impacting the everglades (see Note 5)	Very wet: Up to maximum pulse release. Otherwise: None	Very wet: Up to maximum pulse release. Otherwise: None
E	No regulatory discharge	No regulatory discharge	No regulatory discharge

Notes

1 Subject to first removal of runoff from downstream basins

2 Guidelines for wet, dry and normal conditions are based on: 1) Selected climatic indices and tropical forecasts and 2) Projected inflow conditions. Releases are subject to the guidelines in the WSE Operation Decision Tree. Parts 1 and 2

3 Releases through various outlets may be modified to minimize damages or obtain additional benefits. Consultation with Everglades and estuarine biologists is encouraged to minimize adverse effects to downstream ecosystems

4 Pulse releases are made to minimize adverse impacts to the estuaries

5 Only when the WCA's are below their respective schedules

CENTRAL AND SOUTHERN FLORIDA

REGULATION SCHEDULE
LAKE OKEECHOBEE

US ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA

05 November 1999

Figure 1

FIGURE 2-1: CURRENT LAKE OKEECHOBEE REGULATION SCHEDULE: WSE

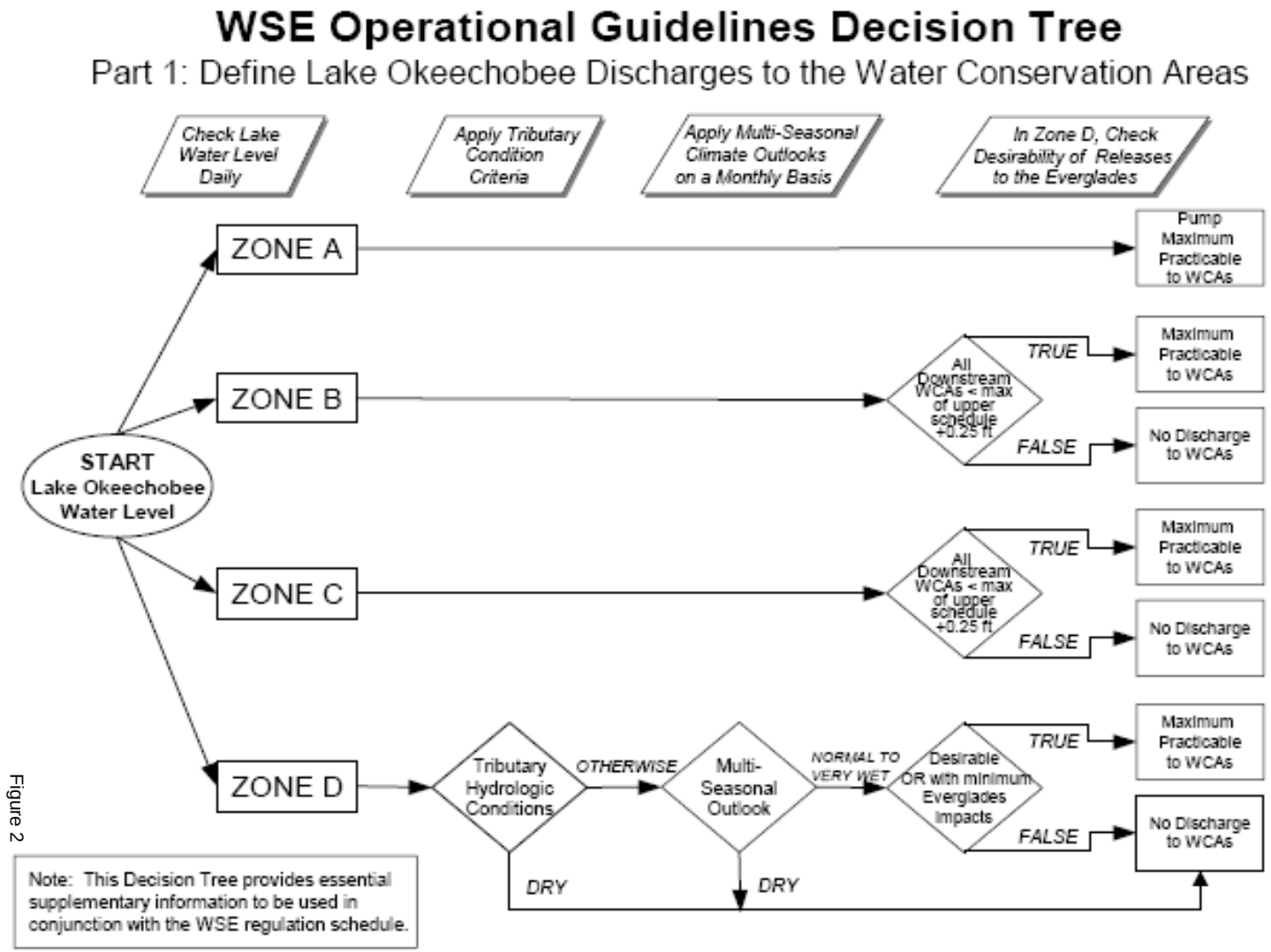


Figure 2

FIGURE 2-2: CURRENT LAKE OKEECHOBEE REGULATION SCHEDULE: WSE

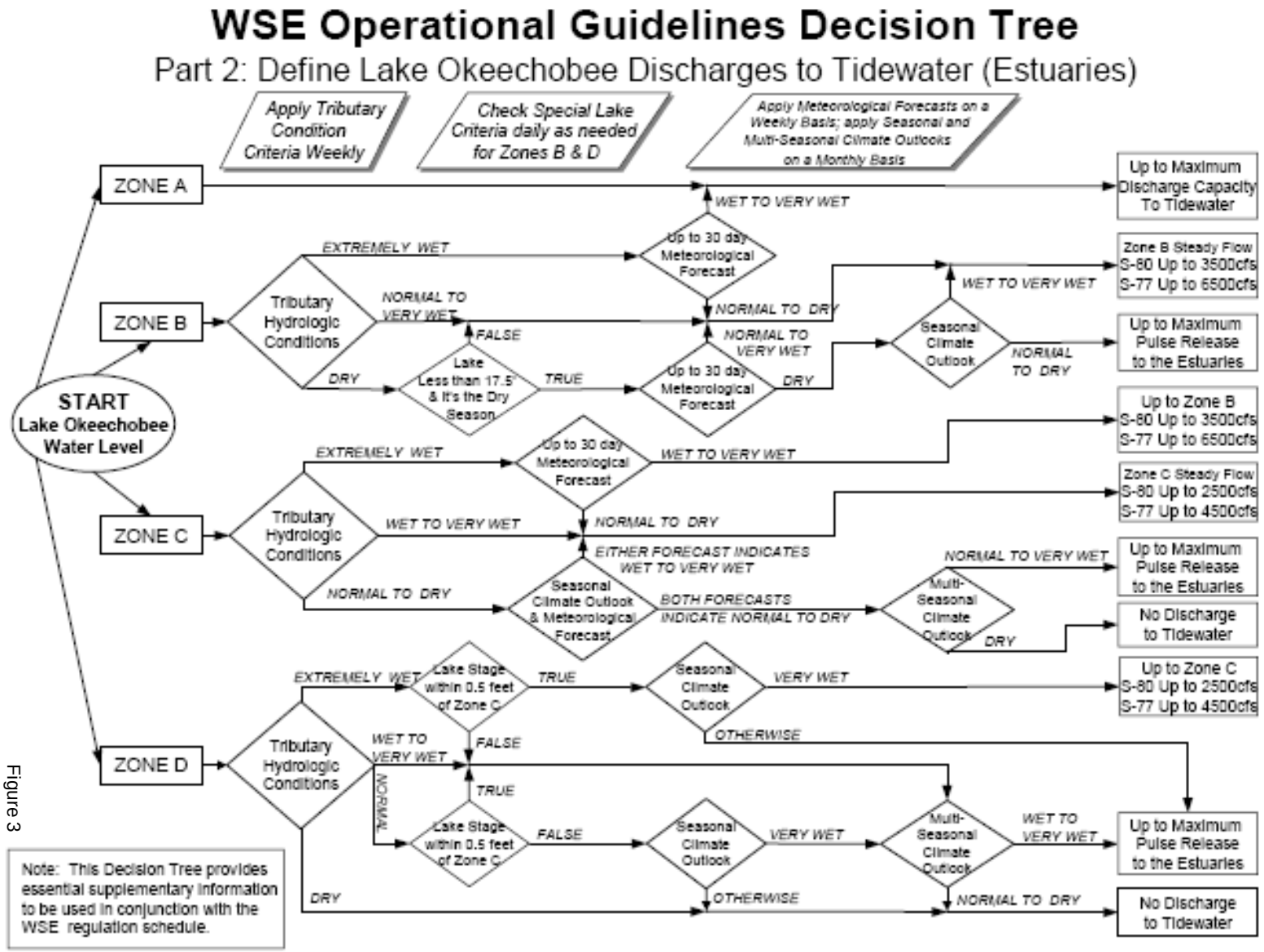


Figure 3

FIGURE 2-3: CURRENT LAKE OKEECHOBEE REGULATION SCHEDULE: WSE

2.3.2. ALT 1BS2-A17.25 (HEREINAFTER REFERRED TO AS 1BS2)

Alternative 1bS2 was developed from the current WSE decision tree structure. The regulation schedule and decision trees for Lake Okeechobee discharges to the Water Conservation Area (WCAs) and discharges to tidewater for Alternative 1bS2 are shown in Figures 2-4, 2-5, and 2-6, respectively. Operational experience under WSE and the availability of additional climatological data led to the following recommended modifications to WSE for this alternative:

1. Regulation schedule lines for Zone A, Zone B, and Zone C are lowered. If the stage of Lake Okeechobee exceeds 17.25 ft., NGVD, the regulation schedule decision tree specifies maximum practicable releases to the WCAs and tidewater. The lowering of the upper regulatory zones results in a regulation schedule that is more pro-active to limit potential high water conditions within the lake.

2. THC are applied that represent longer term wet or dry conditions that have persisted in the tributaries. Updated THC indicators enable the proposed regulation schedule to avoid frequent breaks in the regulatory outflows that may occur due to shorter dry periods. The Palmer Drought Index (PDSI) is proposed to replace the 30-day net rainfall, and the 14-day mean Lake Okeechobee net inflow (LONIN) is proposed to replace the 14-day mean S-65E flow. The classification bands for the PDSI and LONIN THC indicators are summarized in Table 2-1.

3. The line representing the divide between Zone D and Zone E is reshaped: the bottom of Zone D is flattened during the periods in which the estuary ecological systems may be more impacted by large freshwater discharges, especially in late winter, early spring, and during the October through November period. The modified regulatory line promotes a quicker response in the autumn and winter months to large inflows that often are generated during the hurricane season.

TABLE 2-1: DEFINITION OF TRIBUTARY CONDITIONS BASED ON THE PALMER INDEX AND NET INFLOW

Tributary Hydrologic Classification	Palmer Index Class Limits	2-wk mean L.O. Net Inflow Class Limits
Very Wet	3.0 or greater	Greater >= 6000 cfs
Wet	1.5 to 2.99	2500-5999 cfs
Near Normal	-1.49 to 1.49	500-2499 cfs
Dry	-1.5 to -2.99	-5000 – 500 cfs
Very Dry	-3.0 or less	Less than -5000 cfs

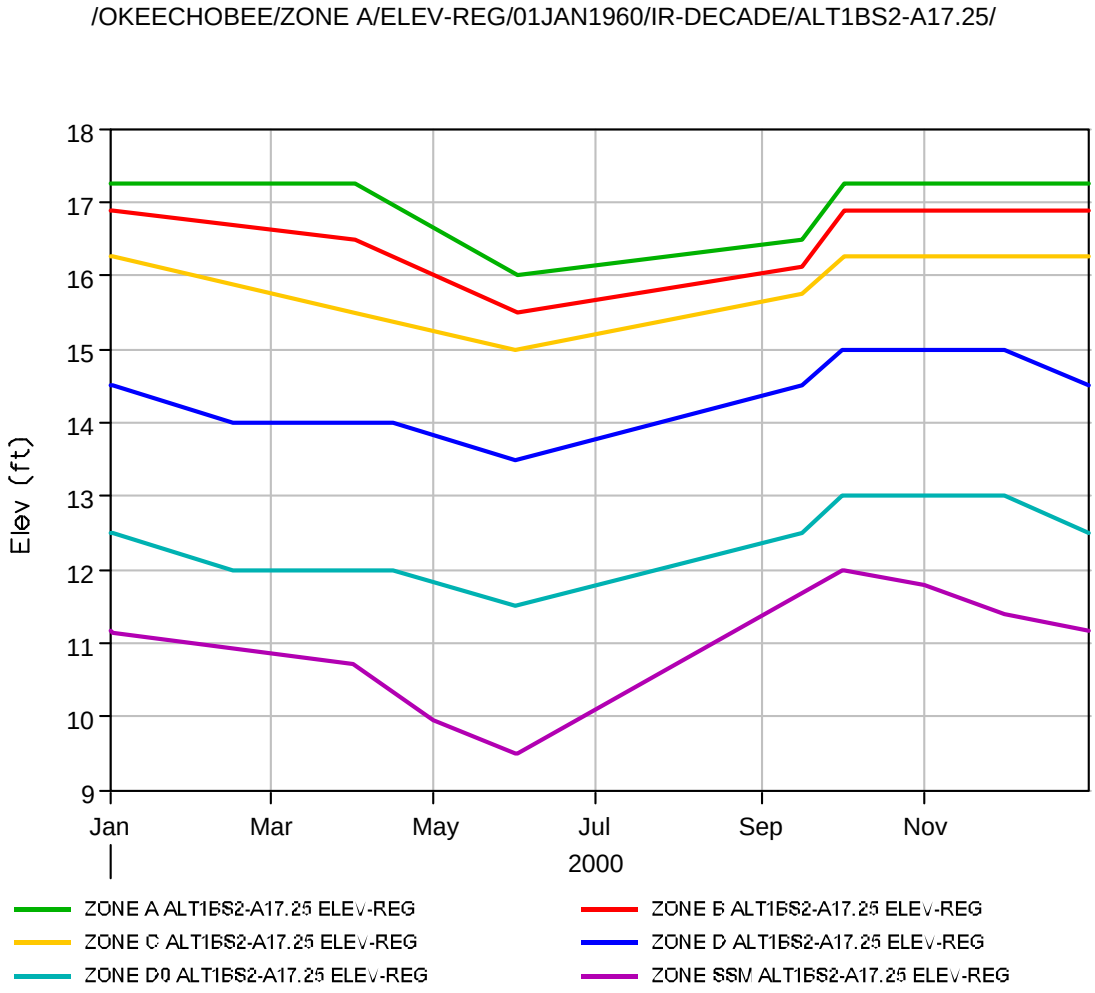


FIGURE 2-4: REGULATION SCHEDULE FOR ALTERNATIVE 1BS2

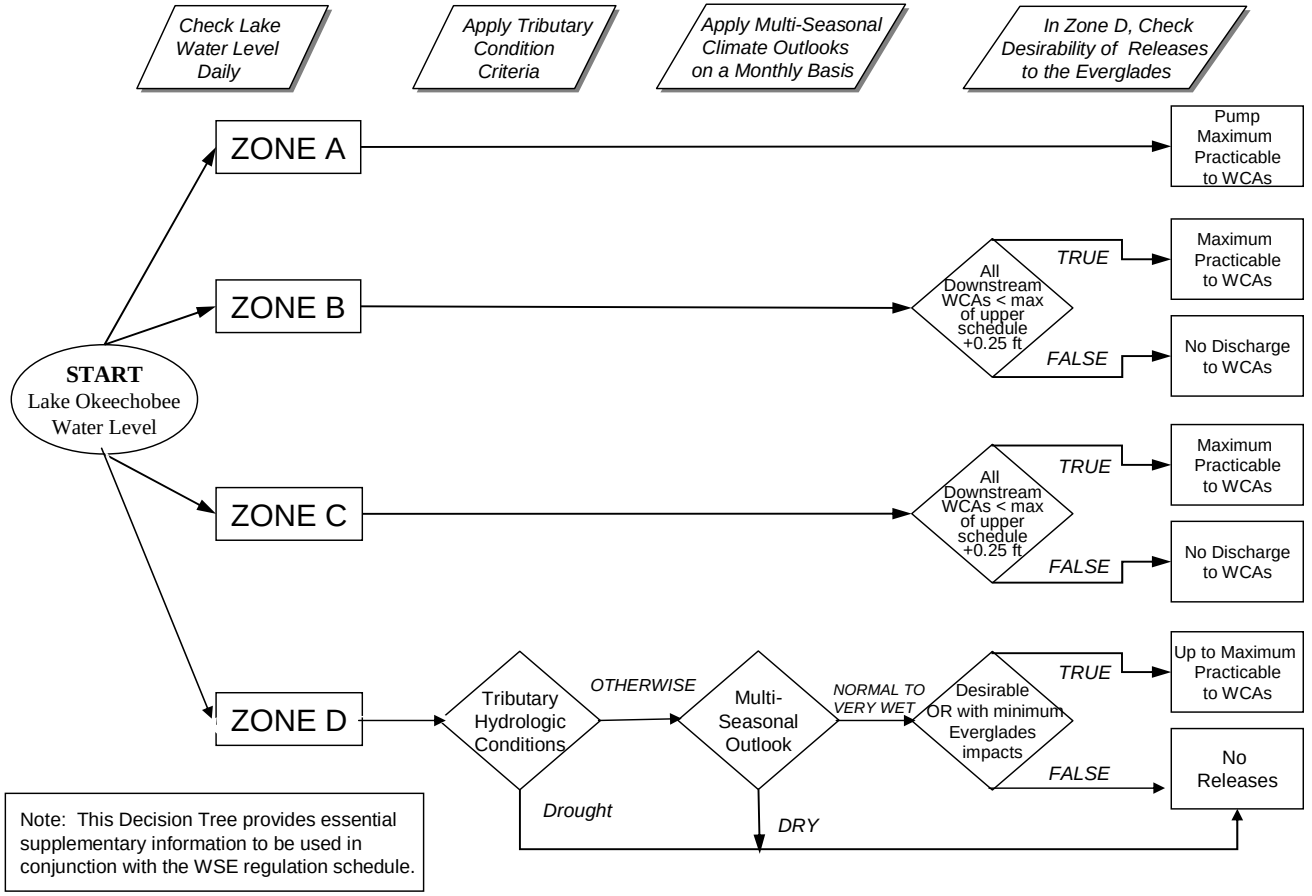


FIGURE 2-5: DECISION TREE, PART 1 FOR ALTERNATIVE 1BS2, ALTERNATIVE 1BS2-M, AND ALTERNATIVE 4

WSE Operational Guidelines Decision Tree

Part 2: Define Lake Okeechobee Discharges to Tidewater (Estuaries)

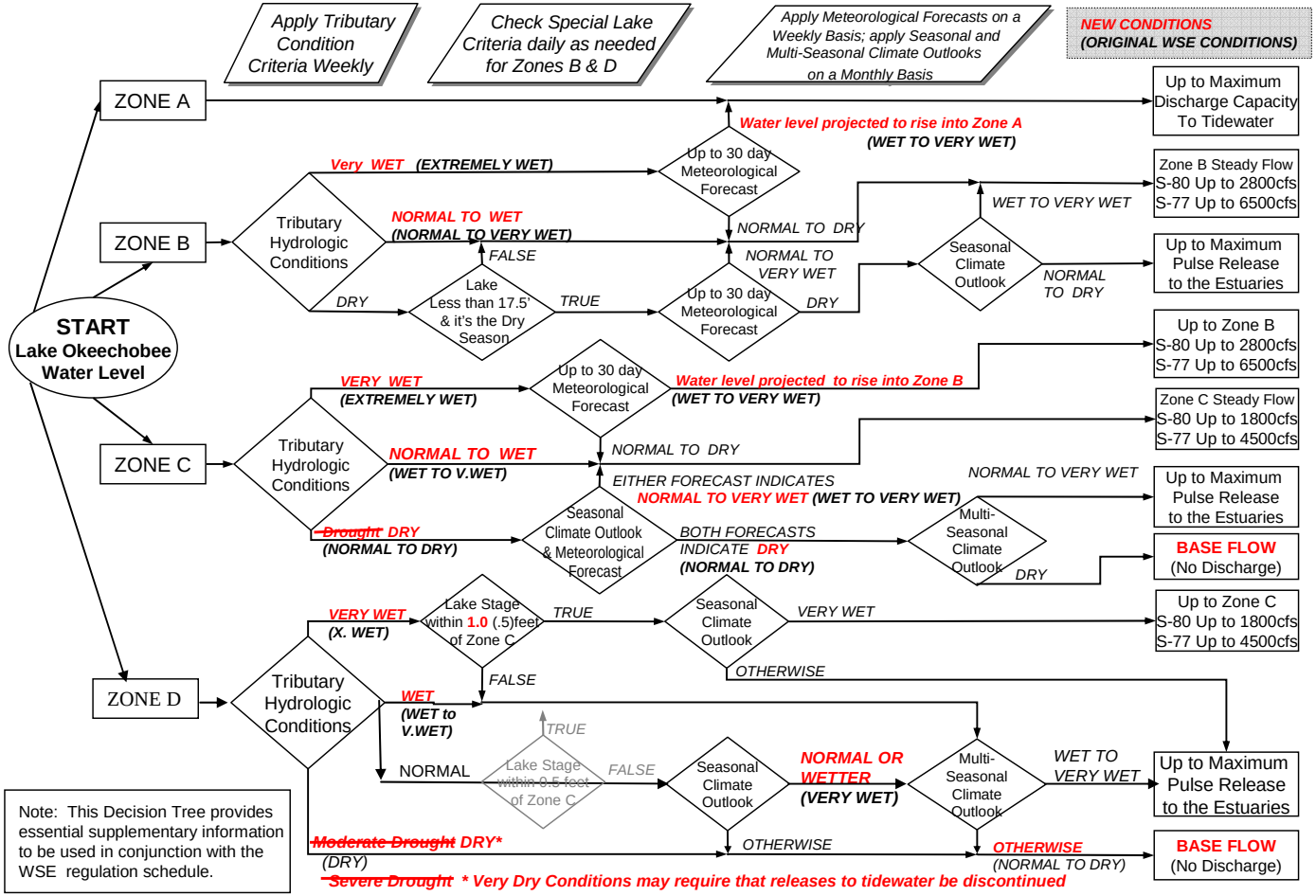


FIGURE 2-6: DECISION TREE, PART 2 FOR ALTERNATIVE 1BS2, ALTERNATIVE 1BS2-M, AND ALTERNATIVE 4

4. A new base flow zone (zone D0) is established below the bottom of the re-shaped zone D. Base flow is allowed when Lake Okeechobee water levels are in zone D0 or above (zone C decision tree outcome for dry THC, seasonal, and multi-seasonal forecasts is base flow), but no base flow releases are called for when the stage falls below the bottom of Zone D (Zone D0). During the alternative formulation process, data and recommendations were evaluated and the recommended base flow release was determined to be 450 cfs to the Caloosahatchee Estuary (measured at S-79) and zero base flow to the St. Lucie Estuary. Risks to the water supply performance objective are anticipated to be minimized with the forward pumps assumed in place to allow for water supply at lower Lake water levels. The bottom of the base flow zone ranges from 11.5 ft. NGVD on May 31 to 13.0 ft., NGVD during October and November. For Figure 2-5 (discharges to WCAs), releases to the WCAs when in zone D0 adhere to the same decision tree as the remainder of zone D; for Figure 2-6 (discharges to tidewater), releases when in Zone D0 will be base flow, and the decision tree of zone D is not applicable.

   THC and seasonal climate forecasts are updated to allow increased operational flexibility in managing lake stages, and specifically to avoid extreme high lake stages. A significant number of decision tree outcomes for THC and seasonal forecast are updated to allow the quicker release of lake water, as compared to WSE (for example, “Extremely wet” THC is changed to “very wet” or “wet to very wet” is changed to “normal to wet”). The additional inclusion of Lake stages forecasted to rise into Zones A or B also introduces additional operator flexibility by allowing for utilization of all available hydrologic and meteorological forecasting data. The changes to WSE for Alternative 1bS2 are indicated by the red font in Figure 2-6.

5. Moderate to extreme high discharges to the St. Lucie Estuary are reduced by modifying the maximum discharge rates for zone B and zone C from 3500 to 2800 cfs and 2500 to 1800 cfs, respectively.

2.3.3. ALTERNATIVE 1BS2-M (Preferred Alternative)

Alternative 1bS2-M is similar to Alternative 1bS2, but with lowering of the second and third regulatory release lines and a lowering of the top three regulatory release lines during the late hurricane season from September 15 through November 1. Basically, Alternative 1bS2 simulation output (SFWMM model) showed the 17.25 feet stage criteria for Lake Okeechobee extreme high water to be exceeded for 12 days during the 36-year simulation period-of-record. Alternative 1bS2 was modified to remove any simulated daily stage in excess of 17.25 feet within Lake Okeechobee for safety issues with the HHD. The modifications to Alternative 1bS2 to create Alternative 1bS2-m are summarized below:

1. Regulation zones A, B, and C are lowered during the late hurricane season (September 30 stage breakpoints are changed to November 1)
2. Regulation lines for the bottom of zones B and C were lowered. Zone B

breakpoints were first lowered to be mid-way between the bottom of Zone A and the bottom of Zone C. The bottom of Zone B was then lowered by an additional 0.15 feet and the bottom of Zone C was lowered by 0.10 feet, as required to achieve zero days with lake stage greater than 17.25 feet elevation. The simulated peak stage for Lake Okeechobee is 17.23 feet, during October 1995. The regulation schedule for Alternative 1bS2-m is shown in Figure 2-7; the decision tree remains unchanged from Alternative 1bS2 (Figure 2-5 and Figure 2-6).

2.3.4. ALTERNATIVE 2A-B (HEREINAFTER REFERRED TO AS 2A)

Alternative 2a represents a new appoach to defining the regulatory release bands, based on a defined target operational guideline, and includes removal of the seasonal and multi-seasonal forecasting indices utilized under the WSE decision tree framework, and the addition of a new regulatory base flow zone for the Caloosahatchee Estuary.

The regulation schedule and decision trees for Lake Okeechobee discharges to the Water Conservation Area (WCAs) and discharges to tidewater for Alternative 2a are shown in Figures 2-8, 2-9, and 2-10, respectively. The operational details of Alternative 2a are summarized below:

1. The operational guideline was developed by the Corps of Engineers Water Management Section based on evaluation of historical stages of Lake Okeechobee from 1965 through 2005. As the lake stages increase further above the operational guideline, regulatory releases increase according to the specified regulatory bands;

2. The upper two regulatory lines were defined based on the probability (50% and 25%) of Lake Okeechobee stages reaching 17.50 feet within the next 90 days, assuming discharge outlets to tidewater were significantly limited. If the stage of Lake Okeechobee exceeds 17.25 ft., NGVD, the regulation schedule decision tree specifies maximum practicable releases to the WCAs and tidewater (same as Alternative 1bS2);

3. Below the operational guideline, base flow to the Caloosahatchee Estuary of 450 cfs is permitted but discontinued if the lake falls below the assumed 12.56 ft., NGVD elevation for navigation (Lake Okeechobee navigation may be impaired at lower stages) or the current Supply Side Management line, whichever is higher;

4. The decision tree for Alternative 2a includes removal of the seasonal and multi-seasonal forecasting indices utilized under the WSE decision tree framework, utilizing only the THC Indicators of the PDSI and LONIN, as used in all alternatives;

5. Regulatory releases from Lake Okeechobee to the Water Conservation Areas are discontinued when the lake stage falls below 13.50 ft., NGVD.

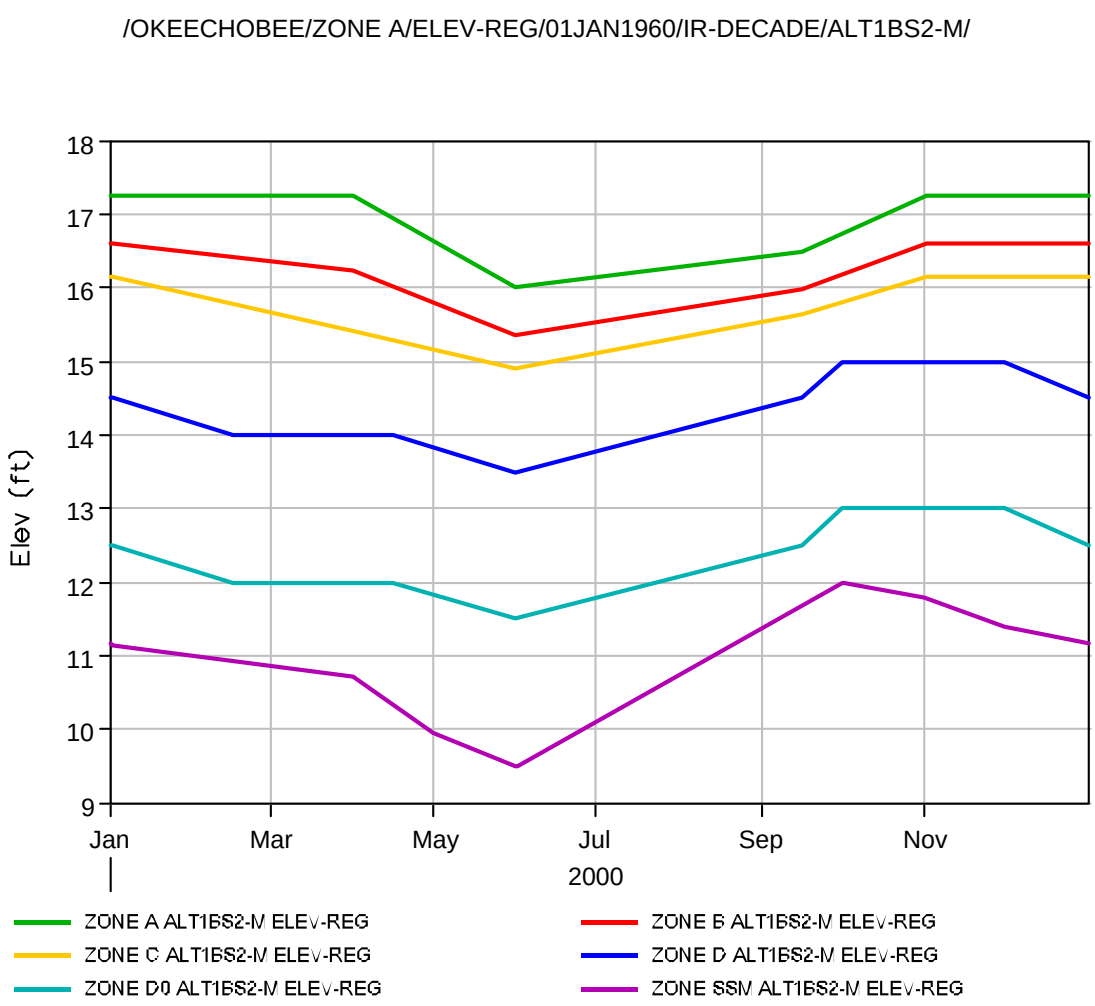


FIGURE 2-7: REGULATION SCHEDULE FOR ALTERNATIVE 1BS2-M

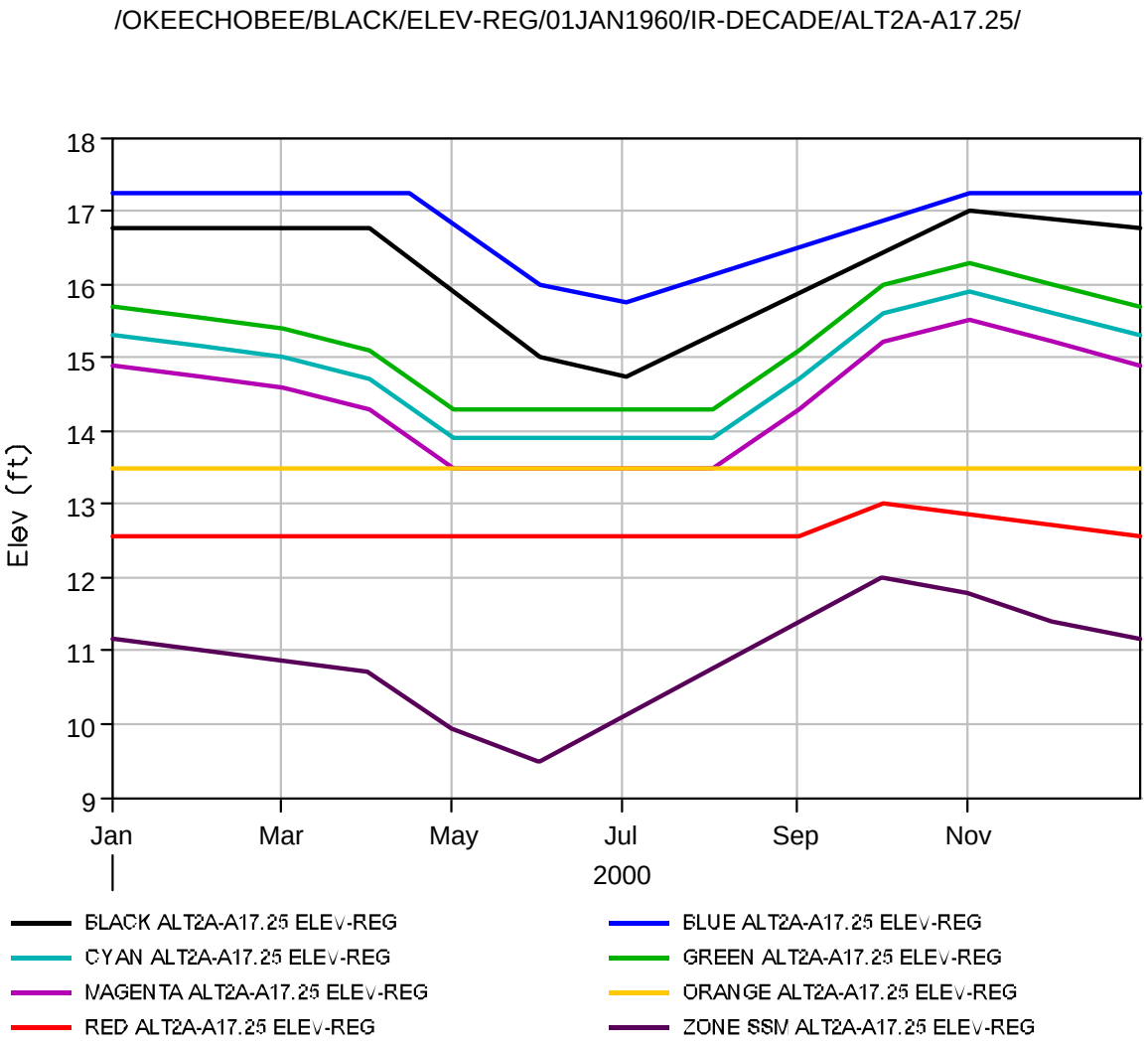


FIGURE 2-8: REGULATION SCHEDULE FOR ALTERNATIVE 2A

LORSS Operational Guidelines Decision Tree

Part 1: Define Lake Okeechobee Discharges to the Water Conservation Areas

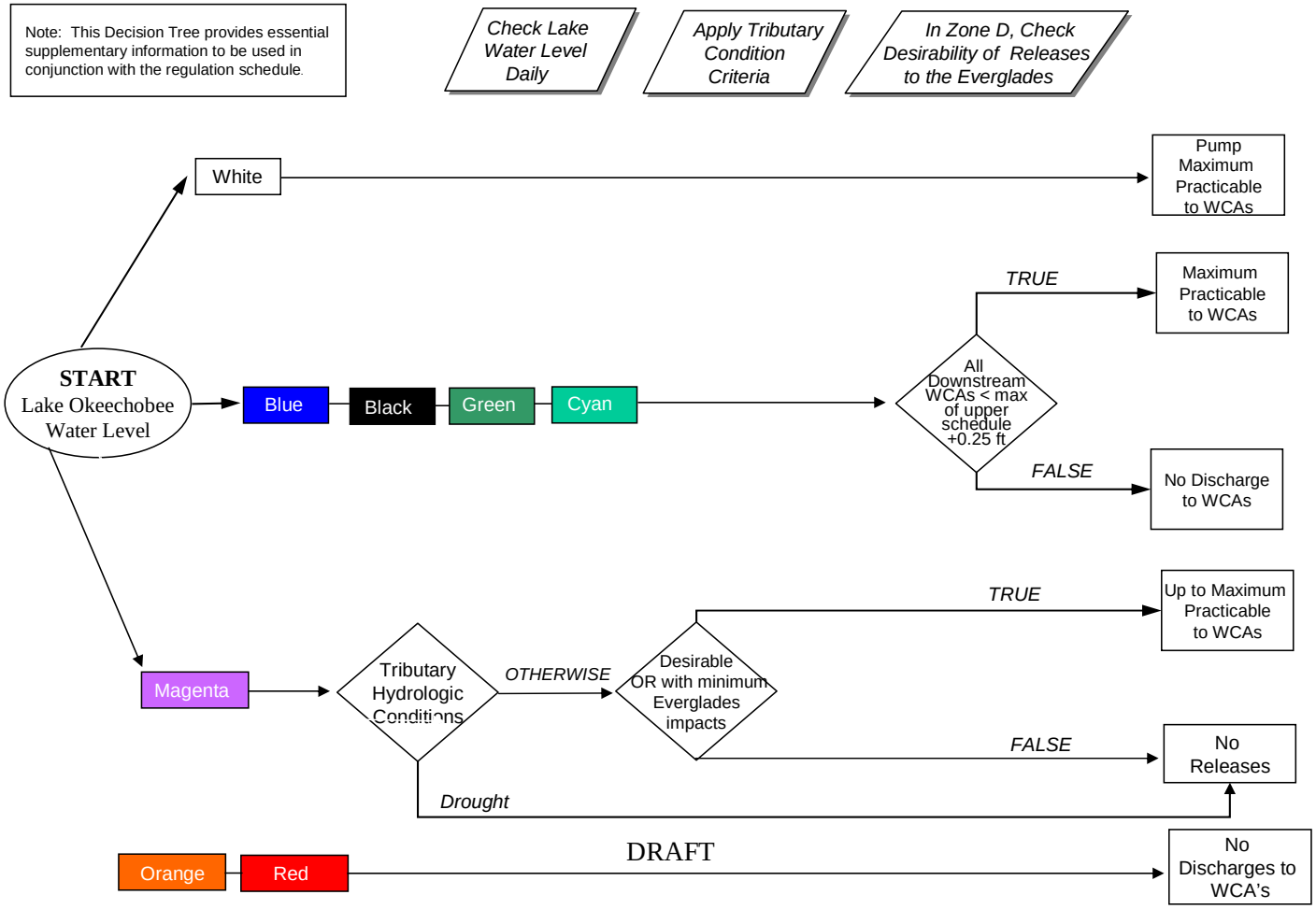


FIGURE 2-9: DECISION TREE, PART 1 FOR ALTERNATIVE 2A AND ALTERNATIVE 2A-M

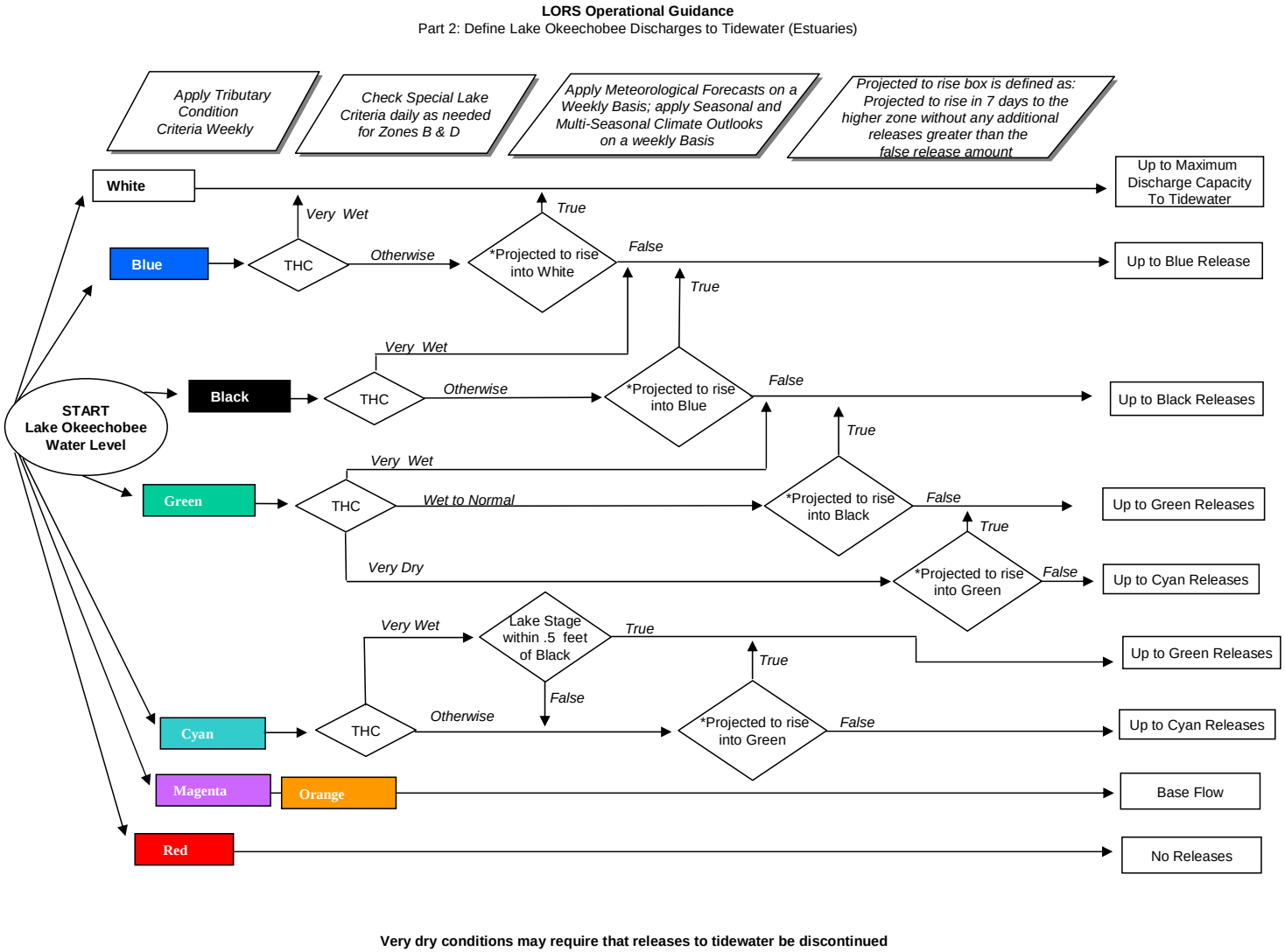


FIGURE 2-10: DECISION TREE, PART 2 FOR ALTERNATIVE 2A AND ALTERNATIVE 2A-M

2.3.5. ALTERNATIVE 2A-M

Alternative 2a was modified to significantly reduce the frequency of extreme high discharge to the Caloosahatchee and St. Lucie estuaries, with the resulting alternative being Alternative 2a-m. The modifications to Alternative 2a are summarized below, and the regulation schedule is shown in Figure 2-11. The decision tree for Alternative 2a-m is unchanged from the decision tree utilized for Alternative 2a (Figure 2-9 and Figure 2-10).

1. Releases to tidewater for the regulatory band between the 25 percent and 50 percent high water probability lines (Blue band) are increased from 6500 cfs to Caloosahatchee / 3500 cfs to St. Lucie to 7500 cfs / 5000 cfs, with the intention to reduce the duration of extreme high estuarine discharges but also recognizing the possibility that these higher release volumes may cause additional impacts to public health and safety downstream of the St. Lucie lock.

2. Releases to tidewater for the regulatory band between the operational guideline and 13.50 ft., NGVD elevation (magenta band) is modified from a regulatory band for Caloosahatchee Estuary baseflow to a low level regulatory release of 800 cfs to the Caloosahatchee Estuary and 400 cfs to the St. Lucie Estuary. The magenta regulatory band was also extended to include the area between 13.50 ft.,NGVD elevation and the operatinal guideline minimum elevation of 12.50 ft.,NGVD, which was not included for Alternative 2a;

3. The bottom of the base flow regulatory band (bottom the orange band / top of red band) was modified to be consistent with Alternative 1bS2 and Alternative 1bS2-m, with a minimum elevation of 11.50 ft., NGVD and a maximum elevation of 13.0 ft., NGVD.

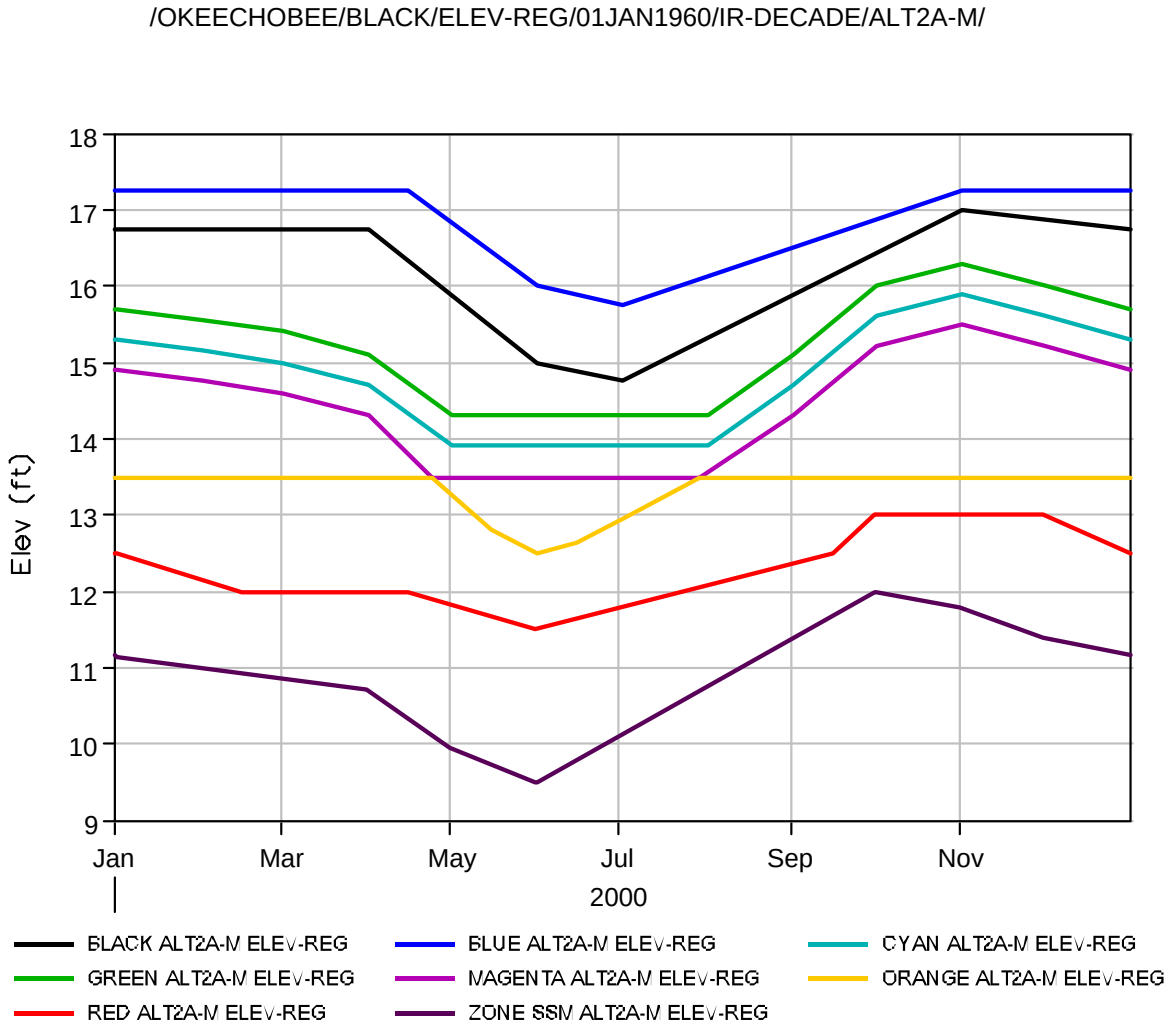


FIGURE 2-11: REGULATION SCHEDULE FOR ALTERNATIVE 2A-M

2.3.6. ALTERNATIVE 4-A17.25 (HEREINAFTER REFERRED TO AS 4)

Alternative 4 is a more aggressive modification, but similar to, Alternative 1bS2. Alternative 4 was intended to provide additional operational flexibility to manage the lake stages at lower levels than Alternative 1bS2. Alternative 4 includes higher maximum release magnitudes to tide for Zone B and Zone C, increased maximum release magnitudes to tide under dry seasonal forecast in Zone C and Zone D, and lowering of the top three regulatory release lines during the late hurricane season.

The regulation schedule for Alternative 4 is shown in Figures 2-12, 2-5 and 2-6. Alternative 4 includes all of the modifications to the No Action Alternative that were included in Alternative 1bS2, with the following additional modifications:

1. Maximum releases in zone B and zone C for normal to wet THC are unchanged from the No Action Alternative: 6500 to Caloosahatchee Estuary/3500 to St. Lucie Estuary in zone B and 4500/2500 in zone C. If the stage of Lake Okeechobee exceeds 17.25 ft., NGVD, the regulation schedule decision tree specifies maximum practicable releases to the WCAs and tidewater (same as Alternative 1bS2);

2. Regulation zones A, B, and C are lowered during the late hurricane season (September 30 stage breakpoints are changed to November 1);

3. Zone D decision tree outcome for THC “normal” and seasonal climate outlook “otherwise” (not “normal or wetter”), or THC “wet” or “normal” and multi-seasonal climate outlook “otherwise” (not “wet to very wet”) is changed from base flow to the Caloosahatchee Estuary to “up to level 1 pulse release”;

4. Zone C decision tree outcome for THC, seasonal climate outlook, and multi-seasonal climate outlook “dry” is changed from base flow to the Calosahatchee Estuary to “up to level 2 pulse release”;

5. Zone D0 for base flow to the Caloosahatchee Estuary is re-defined to discontinue base flow releases if the lake falls below the assumed 12.56 ft., NGVD elevation for navigation (Lake Okeechobee navigation may be impaired at lower stages) or the current Supply Side Management line, whichever is higher (Alternative 1bS2 allowed base flow to elevation 11.50 ft., NGVD at the minimum);

6. Consideration of active hurricane season forecast was recommended for inclusion with the THC decision, but this variable was not defined in detail adequate for SFWMM modeling, and it was therefore not included in the Alternative 4 simulation.

/OKEECHOBEE/BASE FLOW ZONE/ELEV-REG/01JAN1960/IR-DECADE/ALT4-A17.25/

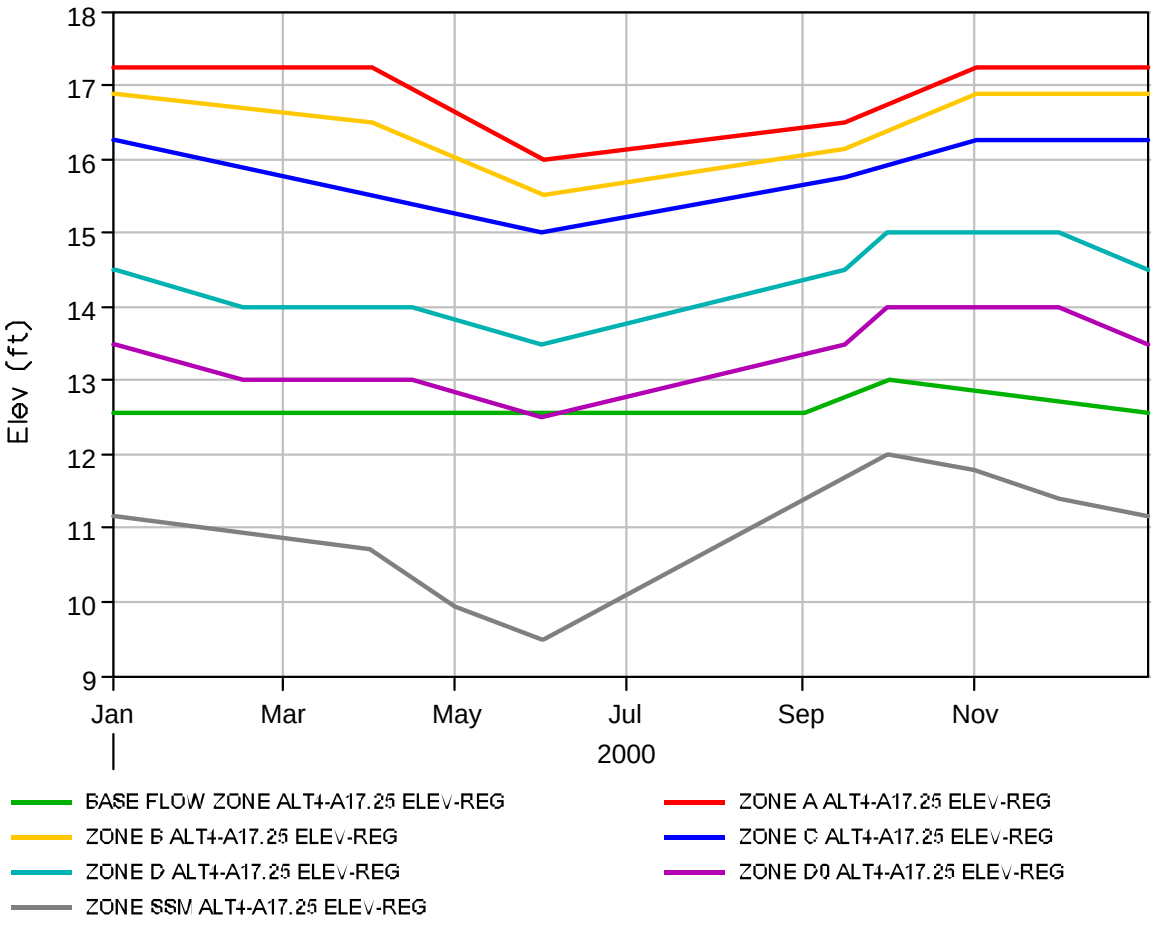


FIGURE 2-12: REGULATION SCHEDULE FOR ALTERNATIVE 4

2.4. ISSUES AND BASIS FOR CHOICE

As listed in Section 1.8, many issues were identified and taken into account during the identification of the Preferred Alternative. Recommendations and feedback from the LORSS Project Delivery Team, stakeholders and the general public were considered. Meeting the LORSS objectives was an important factor in choosing the Preferred Alternative. The selected alternative attempts to meet the objectives for lower lake management, and improvements to estuary performance, while continuing to meet the Greater Everglades water requirements, as well as limiting the impacts to water supply and commercial navigation. Additionally, the issue of public health and safety based on the integrity issues of the HHD was a key factor in the decision making process to select a Preferred Alternative.

2.5. IDENTIFICATION OF THE PREFERRED ALTERNATIVE

The Preferred Alternative is 1bS2-m.

2.6. ALTERNATIVES ELIMINATED FROM DETAILED EVALUATION

Alternatives eliminated from further detailed evaluation are alternatives referred to as Alternative 3 and Alternative LORS-FWO. Alternative 3 was formulated in the previous regulation schedule study (USACE, 1999) and was a restudy of Run 22AZE. Since this was the alternative preferred by the resource agencies at that time, this alternative was pulled forward to compete in the initial array of alternatives in the current study. However, Alternative 3 (a.k.a. Run 22AZE) was screened from further analysis in this SEIS. Alternative 3 was eliminated because it did not perform as well in this study due to the STA flow constraints which allowed much higher lake elevations than previously modeled in the 1999 study. Additionally, Alternative 3 did not achieve zero or close-to-zero days above lake elevation 17.25 ft., NGVD. As discussed in Section 1.6, the 17.25 ft, NGVD, constraint is based on the lake stage criteria for safety issues related to the HHD.

Alternative LORS-FWO is similar to the No Action Alternative with a general lowering of the top two regulatory release lines and the addition of a new regulatory base flow zone to the Caloosahatchee Estuary. Alternative LORS-FWO was eliminated from detailed evaluation because it did not achieve zero or close-to-zero days above lake elevation 17.25 ft., NGVD.

2.7. COMPARISON OF ALTERNATIVES

Table 2-2 lists alternatives that were considered and summarizes the major features and consequences of the proposed action and alternatives. The Environmental Effects of the alternatives are described in Section 4.

TABLE 2-2: SUMMARY OF DIRECT AND INDIRECT IMPACTS

ALTERNATIVE ENVIRONMENTAL FACTOR	Proposed Action (1bS2-m)	Alternative 1bS2	Alternative 2a	Alternative 2a-m	Alternative 4	No Action WSE
PROTECTED SPECIES	Possible effects to some species (snail kite, wood stork, Okeechobee gourd) due to extreme low water occurrences.	Same as IbS2-m	More significant effects to some species (snail kite, wood stork, Okeechobee gourd due to increase in extreme low water occurrences.	Similar effects as 2a. However more extreme low water occurrences.	Potential effects to some species (snail kite, wood stork, Okeechobee gourd) due to some extreme low water occurrences.	Potential adverse impacts to some species (snail kite, wood stork, Okeechobee gourd) due to extreme high water levels.
FISH AND WILDLIFE RESOURCES	Beneficial effects due to reduced high lake stages; Slight improvements to estuarine conditions through reduced regulatory discharges to St. Lucie Estuary.	Beneficial effects due to reduced high lake stages; Slight improvements to estuarine conditions through reduced regulatory discharges to St. Lucie Estuary.	Beneficial effects due to reduced high lake stages; Minimal improvement to St. Lucie and Caloosahatchee Estuarine F&W habitat.	Beneficial effects due to reduced high lake stages; Minimal improvement to St. Lucie and Caloosahatchee Estuarine F&W habitat.	Beneficial effects due to reduced high lake stages; Slight improvements to estuarine conditions through reduced regulatory discharges to St. Lucie Estuary.	High lake stage causes adverse effects to lake F&W habitat; Potential for adverse effects to estuaries.
VEGETATION	Beneficial effects for SAV and emergent vegetation; General improvement to fishery; Possible negative effects for spread of invasive exotic vegetation like torpedograss.	Beneficial effects for SAV and emergent vegetation; Beneficial effects for SAV and emergent vegetation; Possible negative effects for spread of invasive exotic vegetation like torpedograss.	Beneficial effects for SAV and emergent vegetation; Beneficial effects for SAV and emergent vegetation; Possible negative effects for spread of invasive exotic vegetation like torpedograss.	Similar effects as 2a. However more extreme low water occurrences.	Beneficial effects for SAV and emergent vegetation; Possible negative effects for spread of invasive exotic vegetation like torpedograss.	Potential for adverse effects to SAV and emergent vegetation due to high water events; May encourage spread of cattail to interior western and s, western marsh.

ALTERNATIVE ENVIRONMENTAL FACTOR	Proposed Action (1bS2-m)	Alternative 1bS2	Alternative 2a	Alternative 2a-m	Alternative 4	No Action WSE
FLOOD CONTROL	No impact.	No impact.	No impact.	No impact.	No impact.	Greater potential for adverse effects due to higher lake water schedule.
WATER QUALITY	No adverse effects.	No adverse effects.	No adverse effects.	No adverse effects.	No adverse effects.	No adverse effects.
HISTORIC PROPERTIES	No adverse effects.	No adverse effects.	No adverse effects.	No adverse effects.	No adverse effects.	No adverse effects.
RECREATION	Improves Lake sport fishery.	Improves Lake sport fishery.	Improves Lake sport fishery.	Improves Lake sport fishery.	Improves Lake sport fishery.	May negatively affect sport fishery due to loss of SAV and emergent vegetation.
AESTHETICS	Potential benefits.	Potential benefits.	Potential benefits.	Potential benefits.	Potential benefits.	Potential for adverse effects due to high water levels impacting vegetation and wildlife.
NAVIGATION	Adverse effects expected due to increased days below 12.56 ft.	Adverse effects expected due to increased days below 12.56 ft.	Adverse effects expected due to increased days below 12.56 ft.	Adverse effects expected due to increased days below 12.56 ft.	Adverse effects expected due to increased days below 12.56 ft.	No significant adverse effects expected.
ECONOMICS	Potential for effects.	Potential for effects.	Potential for effects.	Potential for effects.	Potential for effects.	Minimal effects expected.
WATER SUPPLY	No significant impacts.	No significant impacts.	Minor impact.	Minor impact.	Minor impact.	No significant impact.
ESSENTIAL FISH HABITAT (EFH)	No significant adverse impact expected.	No significant adverse impact expected.	No significant adverse impact expected.	No significant adverse impact expected.	No significant adverse impact expected.	No significant adverse impact expected.

3. PREFERRED ALTERNATIVE

3.1. OPERATIONAL FEATURES

The LORSS resulted in the development of several alternatives, including the Preferred Alternative (1bS2-m), that are considered to be modifications of the July 2000 WSE LORS (Figure 2-1). Both WSE and Alternative 1bS2-m are based on an Operational Guidance that includes: "Part 1: Define Lake Okeechobee Discharges to the Water Conservation Areas" and "Part 2: Define Lake Okeechobee Discharges to Tidewater (Estuaries)." Parts 1 and 2 of the WSE Decision Tree are shown on Figure 2-2 and Figure 2-3, respectively. The SFWMD and USACE 1999 report; "The Lake Okeechobee WSE Operational Guidelines" defines and describes the implementation of WSE.

Alternative 1bS2-m was identified to be effective and proficient at providing for public health and safety, containing flexibility to perform water management operations, and when unavoidable, having a more equal distribution of shared adversity than WSE. Selection of Alternative 1bS2-m was based on analysis of SFWMM (2x2) output. As was the practice with the 2x2 modeling prepared for WSE, the releases modeled in all alternatives, including Alternative 1bS2-m, using the 2x2 consisted of continuous releases at various volumes. In a similar manner as WSE, actual releases to be implemented may be performed in a pulse style of release to simulate natural hydrologic conditions, such as a rainfall event.

The 2x2 modeling output was generated using input representing each alternative, such as Alternative 1bS2-m Lake Okeechobee Management Bands (Figure 3-1), Lake Okeechobee Operational Guidance to WCAs (Figure 3-2), and the Lake Okeechobee Operational Guidance to Tide (Figure 3-3). The Operational Guidance and the Lake Management Bands establish the quantity, timing, and duration of releases from Lake Okeechobee allowable within the Preferred Alternative (1bS2-m). The differences between the decision tree for WSE and the Operational Guidance for Alternative 1bS2-m are shown in red on Figures 3-2 and 3-3. Details on the operational changes can be found in Appendix A.

The THC shown in red on Figure 3-3 has been changed to incorporate a better representation of hydrologic conditions than WSE included. THC within WSE only utilized average historical evapotranspiration and excluded rainfall over Lake Okeechobee. As proposed, THC within Figure 3-3 now includes a Drought Severity Index which encompasses these WSE short comings.

3.1.1. SUMMARY OF PREFERRED ALTERNATIVE, 1BS2-M

The proposed water management operational guidance to be used on a daily basis in the management of Lake Okeechobee includes the proposed Lake Okeechobee Management Bands (Figure 3-1), Operational Guidance (Figures 3-2 and 3-3), the Lake Okeechobee Regulation Schedule (Figure 3-4), various weather related forecasts, and historical as well as projected lake level information. In the future, more experience will

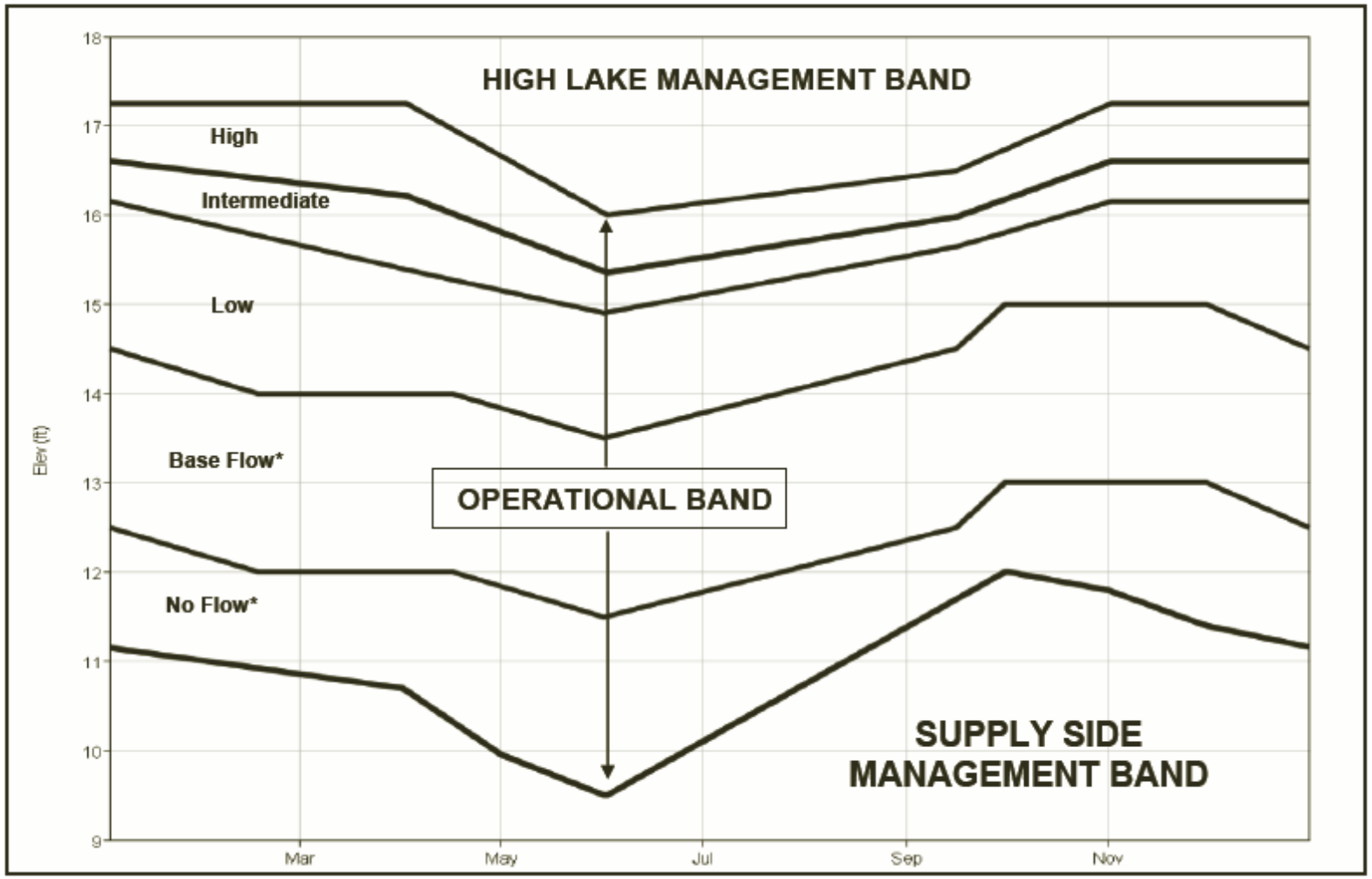


FIGURE 3-1: LAKE OKEECHOBEE MANAGEMENT BANDS

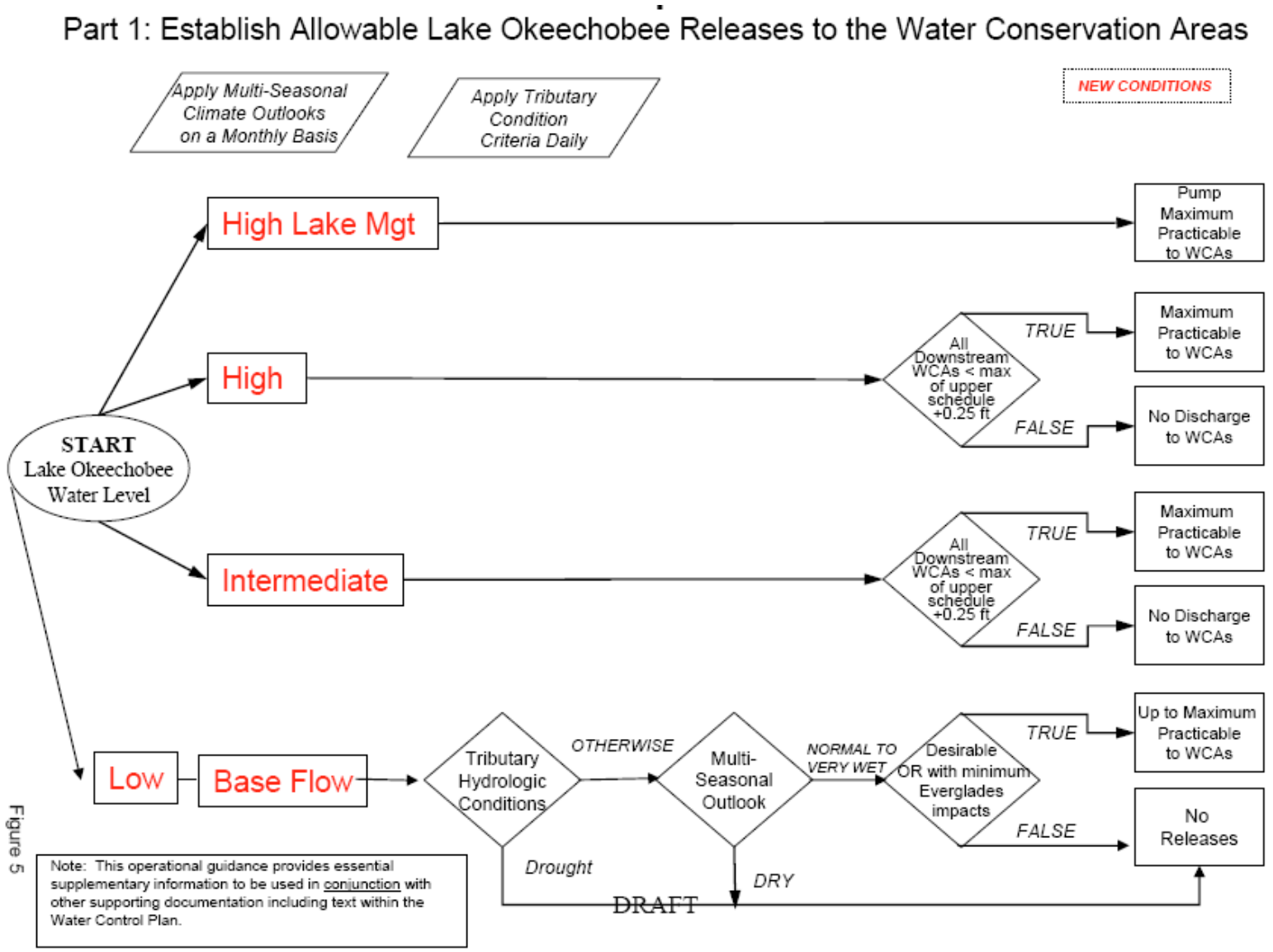


Figure 5

FIGURE 3-2: LAKE OKEECHOBEE OPERATIONAL GUIDANCE – PART 1

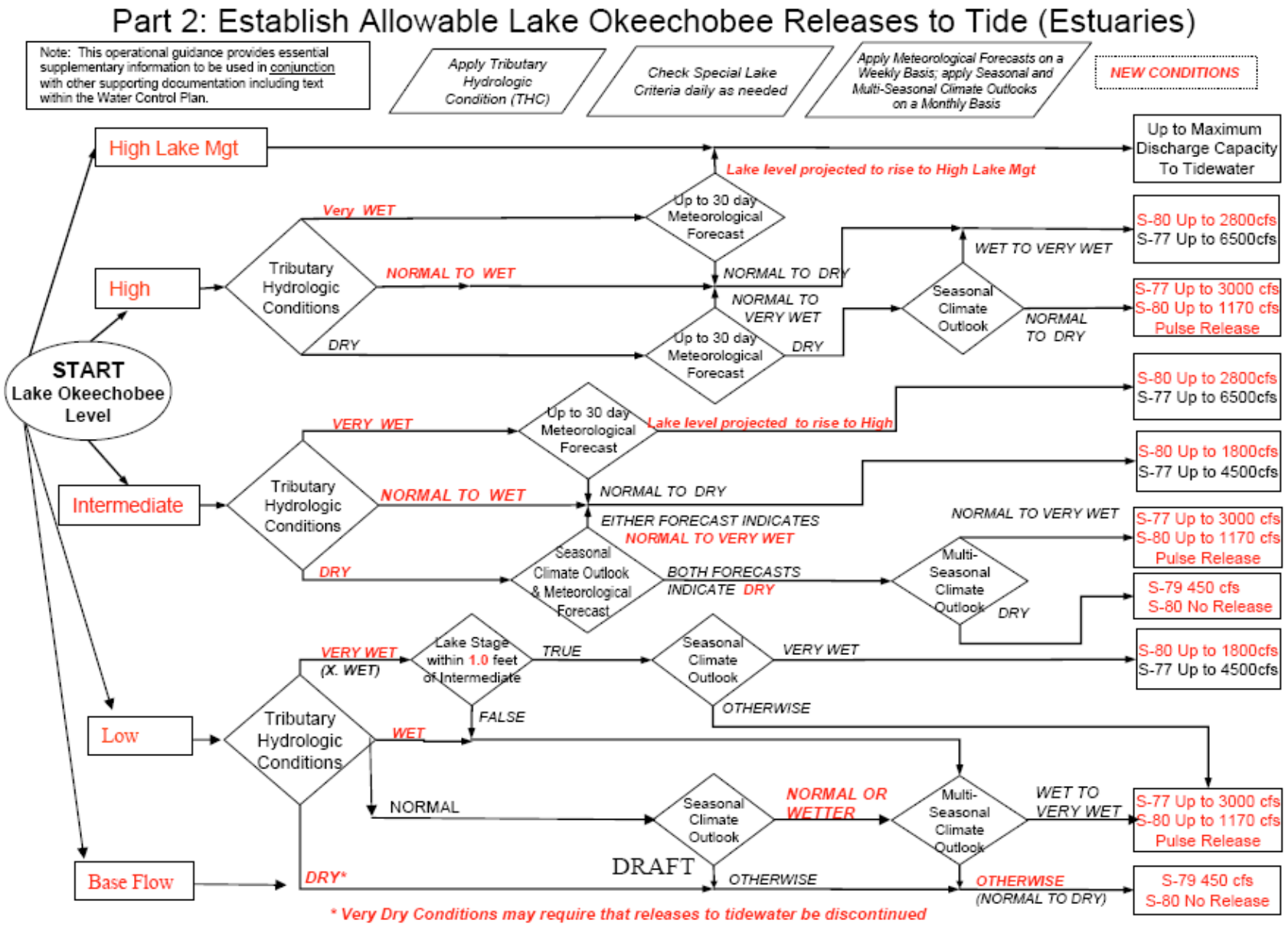


FIGURE 3-3: LAKE OKEECHOBEE OPERATIONAL GUIDANCE – PART 2

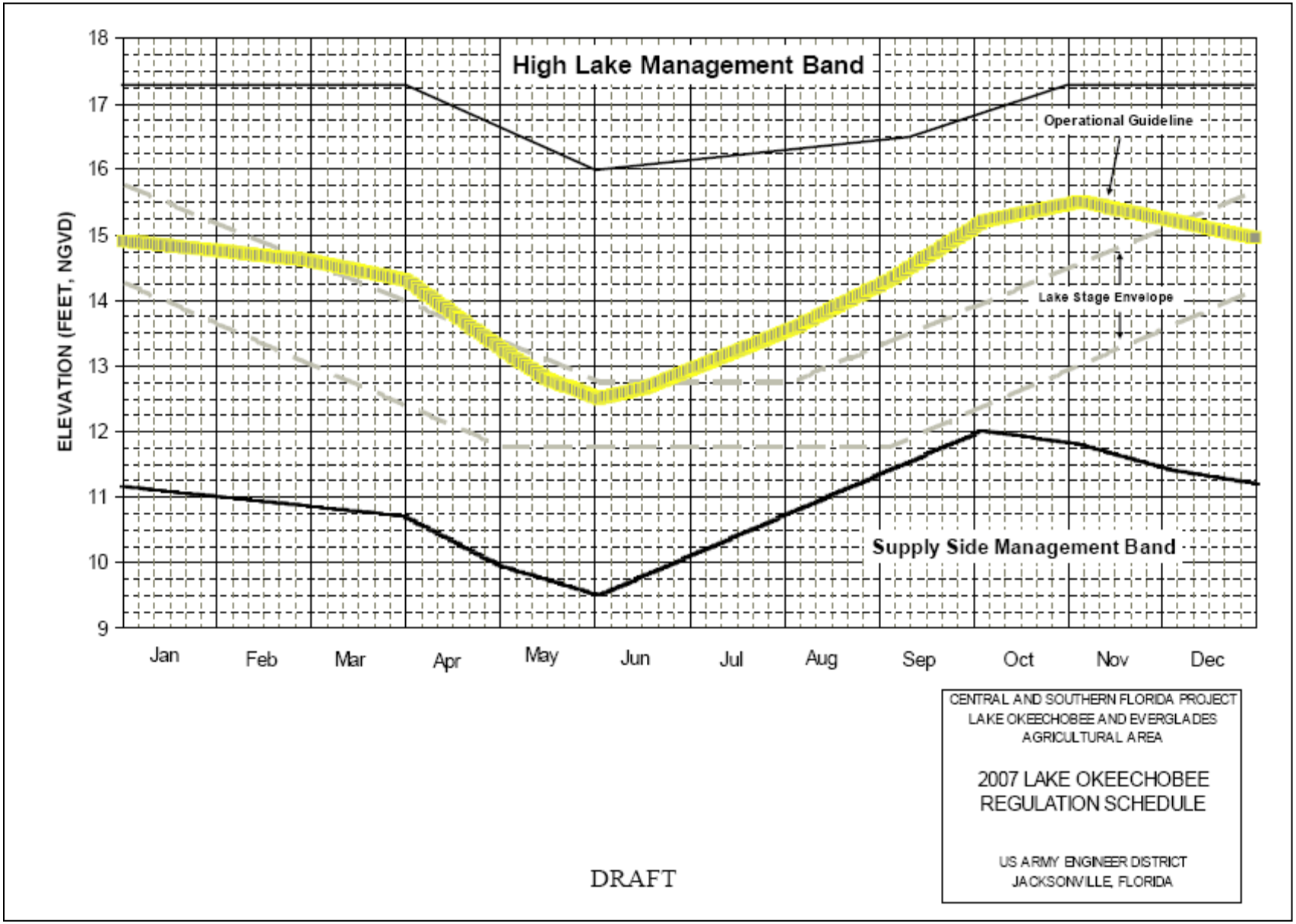


FIGURE 3-4: LAKE OKEECHOBEE REGULATION SCHEDULE FOR PREFERRED ALTERNATIVE

likely be gained through conducting water management operations, weather related forecasting improvements may occur, and additional C&SF Project infrastructure will be constructed. This will likely result in the water management operational guidance being updated or expanded to include additional items as necessary.

Management of Lake Okeechobee water levels and determination of Lake Okeechobee releases to the WCAs and to tide (estuaries) is based upon three guidelines as shown on the proposed Lake Management Bands (Figure 3-1). These guidelines include "High Lake Management" (top band), "Operational Band" (middle band), and "Supply Side Management" (bottom band). The High Lake Management Band is meant to address public health and safety especially related to known issues with the structural integrity of HHD. The Operational Guideline is meant to facilitate authorized project purposes by providing the ability to make various release volumes from Lake Okeechobee or to not make releases, depending upon but not necessarily limited to recent rainfall, the time of year, ecosystem conditions, and future climate projections. The Supply Side Management Band is meant to provide the water supply needs for service areas defined by the SFWMD.

To assist water management decision making, a "Lake Stage Envelope" as well as an "Operational Guideline" have been established and are shown on the Regulation Schedule (Figure 3-4). The Lake Stage Envelope varies seasonally between 15.75 ft, at its high point, to elevation 11.75 ft, at its lowest point. This envelope represents seasonal lake levels that are desirable for the lake ecosystem. The Operational Guideline varies on a seasonal basis from 12.5 ft to 15.5 ft., NGVD and represents a daily guide to be used for management of the lake level. The seasonal fluctuations were developed using the lake average elevation over the period of record (POR) from 1965 to 2005. The historical lake level data is a direct relationship to the historical management of the Lake over the POR. Therefore, since the Operational Guideline is based upon this historical lake level data, the Operational Guideline reflects a fundamental water management goal to facilitate all Lake Okeechobee authorized project purposes (fish/wildlife enhancement, flood control and water supply, etc.). While the Lake Stage Envelope provides seasonal guidance for lake levels, the Operational Guideline allows consideration of other factors including project conditions, historical lake levels, estuary conditions/needs, lake ecology conditions/needs, storm water treatment area available capacity/needs, current weather conditions, weather forecasts, projected lake level rise/recession, and water supply conditions/needs.

Lake Okeechobee is normally managed seasonally between 12.5 ft, and 15.5 ft to prevent ecologically damaging high and low lake levels. Releases to the WCAs and to the estuaries will reduce the likelihood of undesirable high lake levels that contribute to poor ecological conditions within the lake. High lake levels can also lead to the decline of emergent and submerged vegetation which is essential habitat for the lake's sport fishing population. Species of special concern and other issues will be considered in determination of the lake release to be performed at lower lake levels to avoid extreme low lake levels when possible. Forecasted dry weather conditions,

projected lake recessions, and/or anticipated lower lake levels will all be considered in determining if releases will be necessary to prevent lower lake levels below 12.5 ft., NGVD.

Public health and safety is ensured by maintaining the lake at desirable levels through the use of long-term low volume releases to the Caloosahatchee Estuary, St. Lucie Estuary, and WCAs. Determination of a desirable lake level can be influenced by many issues including, but not limited to: season, watershed conditions, and weather, and will be determined on a daily basis or as needed. A determination based on forecasted weather conditions and projected lake levels can also potentially result in undesirable high volume releases, but will allow Lake Okeechobee to be lowered to an acceptable level sooner than just basing the decision on the actual lake level. The seasonal fluctuation that lowers Lake Okeechobee prior to hurricane season is meant to provide storage for future anticipated extreme weather events. This has the potential to affect future water supply needs. The seasonal fluctuation that results in a higher lake level at the end of the hurricane season is meant to provide water for the upcoming dry season.

Management decisions for Lake Okeechobee will consider estuary conditions/needs, potential impacts from lake releases, local runoff, and dry weather conditions. This includes releasing an environmentally friendly volume of water over an acceptable period of time to the St. Lucie Estuary, the Caloosahatchee Estuary, and the WCAs. Low volume regulatory releases, low volume environmental releases and a base flow to the Caloosahatchee Estuary are used over long periods of time in an effort to reduce the potential for future prolonged high volume releases while providing appropriate amounts of freshwater to maintain desirable estuary salinity.

3.1.2. LAKE OKEECHOBEE MANAGEMENT BANDS

The proposed operational guidance has three distinct bands of lake level management (Figure 3-1). Each management band is designed to achieve specific lake objectives. The lowest band is known as Supply Side Management. In this band, water in Lake Okeechobee will be managed in accordance with the Supply Side Management Plan established by the SFWMD. The highest band is known as High Lake Management. The goal is to quickly lower high lake stages to make room for the next possible flood event, to reduce impacts on the Lake's littoral zone, and to ensure public health and safety. The middle and largest band is known as the Operational Band. It is anticipated that most of the time, water levels will be managed according to the operational criteria established within this band.

Supply Side Management Band – varies seasonally between 9.5 to 12.0 ft., NGVD. Operations in this zone are governed by the SFWMD Supply Side Management Plan. NOTE: The Supply Side Management name and numbers will likely change upon completion of SFWMD's rule making process in 2006. Releases will be governed by this plan. The goal of this band is to manage existing water supply within Lake Okeechobee in accordance with SFWMD rules and guidance.

High Lake Management Band – varies seasonally between elevations 16.0 and 17.25 ft,, NGVD and above. The goal of this band is to ensure public health and safety, therefore operations will be done to lower Lake Okeechobee to the bottom of the High Lake Management Band as quickly as possible using regulatory releases. For Lake Okeechobee, a regulatory release can be considered as release from Lake Okeechobee to achieve a lower lake level or prevent an anticipated higher lake level. It is of the utmost importance that the lake level be reduced as rapidly as possible to make room for the next possible flood event, to relieve stress on the HHD, and reduce impacts on the lake's littoral zone. Releases up to the maximum discharge capacity will be made to tide and pumping to the maximum practicable will be performed south to the WCAs and CERP impoundments. Rates of release will vary dependent on: downstream channel conditions; estuary conditions; conditions in the WCAs; and STAs and other constraints.

Operational Band - the largest management band varies seasonally between 9.5 ft. at its lowest point and 17.25 ft., NGVD at its highest point. The goal of the "Operational Band" is to manage the lake stage to best meet all authorized project purposes. This involves use of regulatory releases, environmental releases, base flow releases, and water supply releases. Within this Operational Band, several sub-bands have been established to define lake management practices. For Lake Okeechobee, an environmental release can be considered as a release from Lake Okeechobee to benefit the Lake ecosystem, downstream ecosystems, and/or upstream ecosystems. For Lake Okeechobee, a base flow release to the Calooshatchee Estuary is a release from Lake Okeechobee at S-77 to achieve a 450 cfs flow at S-79. For Lake Okeechobee, a water supply release can be considered a release from Lake Okeechobee to meet water supply demands. Lake Okeechobee releases to meet water supply demands may be made in all sub-bands of the Operational Band. Criteria and the decision making process for the sub-bands are described in the following text.

Sub-Band 1/No Flow: This sub-band varies seasonally between elevations 9.5 ft and 13.0 ft., NGVD, at its highest point. Except for navigation and fish and wildlife enhancement, SFWMD allocates water to various users in this sub-band. Navigation can typically be supported by releases from Lake Okeechobee that are conducted for other authorized project purposes. Fish and Wildlife enhancement may involve conducting an environmental release from Lake Okeechobee. No regulatory releases are made in this sub-band. In addition, SFWMD may allocate water to the environment through its "Adaptive Protocols" (SFWMD 2003).

Sub-Band 2/Base Flow: This sub-band varies seasonally between elevation 11.5 ft., and 15.0 ft., NGVD. In this sub-band a base flow will be provided to the Caloosahatchee Estuary. No base flow is provided to the St. Lucie Estuary, unless requested by the SFWMD under "Adaptive Protocols" or other authority. Releases through various outlets may be modified to minimize damages or obtain additional benefits.

Sub-Band 3/Low Lake Stage: This sub-band varies seasonally between elevation 13.5 ft. and 16.15 ft., NGVD. The Operational Guidance provides essential supplementary information to be used in conjunction with the 2007 LORS (Figure 3-4). Releases through various outlets may be modified to minimize damages or obtain additional benefits. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs

(2) Under wet tributary conditions up to 3000 cfs pulse release to the Caloosahatchee Estuary and up to 1170 cfs pulse release to the St. Lucie Estuary (3000/1170 pulse release), including a base flow to the Calooshatchee Estuary. Pulse releases are described below.

(3) Under very wet tributary conditions, releases up to 4500 cfs may be made at structure S-77, and up to 1800 cfs may be made at structure S-80.

Sub-Band 4/Intermediate Lake Stage: This sub-band varies seasonally between elevations 14.90 ft., NGVD at its lowest point to elevation 16.60 ft., NGVD. The Operational Guidance provides essential supplementary information to be used in conjunction with the Regulation Schedule (Figure 3-4). Releases through various outlets may be modified to minimize damages or obtain additional benefits. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs. If stages in the WCAs are more than 0.25 feet above the maximum of the upper regulation schedules, then no releases are made. These flows are secondary to the use of these canals for providing drainage and flood control for the local drainage area.

(2) Under dry tributary conditions, provide a base flow to the Caloosahatchee Estuary or if the seasonal outlook is normal to very wet releases up to 4500/1800 may be made, otherwise if multi-seasonal is not dry 3000/1170 pulse release, to the estuaries. For normal to wet THC, releases up to 4500/1800 may be made. Under very wet THC, and water levels are projected to rise into sub-band 5/High Lake Stage, then releases up to 6500 cfs at S-77 may be made and up to 2800 cfs at S-80 (6500/2800) may be made. Otherwise, releases up to 4500/1800 may be made.

Sub-Band 5/High Lake Stage: This sub-band varies seasonally between elevation 15.35 ft., NGVD at its lowest point and elevation 17.25 ft., NGVD. The Operational Guidance provides essential supplementary information to be used in conjunction with the Regulation Schedule (Figure 3-4). Releases through various outlets may be modified to minimize damages or obtain additional benefits. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs. If stages in the WCAs are more than 0.25 feet above the maximum of the upper regulation schedules, then no releases are made. These flows are secondary to the use of these canals for providing drainage and flood control for the local drainage area.

(2) Under dry tributary, and forecasted dry conditions, up to the maximum pulse releases to the estuaries can be utilized. For normal to wet THC, and the seasonal outlook is wet to very wet, the releases up to 6500/2800 may be made. Under very wet THC, and water levels are projected to rise into the High Lake Management Band, and then up to the maximum discharges to tide can be made.

3.1.3. PROPOSED OPERATIONAL GUIDANCE

On a daily basis, water management decisions will utilize Lake Okeechobee Management Bands (Figure 3-1), Operational Guidance Decision Trees, and the Lake Okeechobee Regulation Schedule (Figure 3-4) to provide guidance on releases of the Operational Guidance have been established; Part 1 (Figure 3-2) is utilized to establish the allowable releases to the WCAs and Part 2 (Figure 3-3) is utilized to establish the allowable releases to tide (estuaries).

The Operational Guidance establishes the allowable quantity, timing, and duration of releases from Lake Okeechobee to the WCAs and to tide (estuaries). Base flow releases from Lake Okeechobee to tide (Caloosahatchee Estuary) are permitted when the lake level is as low as 11.5 ft., NGVD. There are not provisions for base flow from Lake Okeechobee to the St. Lucie Estuary to be conducted. Regulatory releases from Lake Okeechobee to tide (both estuaries) are permitted when the lake level is as low as 11.5 ft., NGVD. Releases from Lake Okeechobee to the WCAs are permitted when the lake level is as low as 11.5 ft., NGVD.

The THC in the Lake Okeechobee Operational Guidance to WCAs (Figure 3-2) and the Lake Okeechobee Operational Guidance to Tide (Figure 3-3) utilize the Palmer Drought Index (Index) from the National Weather Service and the calculated Lake Okeechobee Net Inflow which are shown on Table 3-1. The Index uses temperature and rainfall information to determine dryness and is an indicator of drought conditions. The Index is a numerical value and climatological tool that responds to weather conditions that have been abnormally dry or abnormally wet.

Similar to WSE, the “Seasonal Climate Outlook”, “Meteorological Forecast”, and “Multi-Seasonal Climate Outlook” in the Lake Okeechobee Operational Guidance to Tide (Figure 2-3) incorporate weather forecasting. Figure 3-3 is used to establish the allowable Lake Okeechobee release to tide (estuaries). These release limits (allowable) represent the Preferred Alternatives allowable (quantity, timing, and duration of release) from Lake Okeechobee to the WCAs and to tide (estuaries).

TABLE 3-1: DEFINITION OF TRIBUTARY CONDITIONS BASED ON THE PALMER INDEX AND NET INFLOW

Tributary Hydrologic Classification	Palmer Index Class Limits	2-wk mean L.O. Net Inflow Class Limits
Very Wet	3.0 or greater	Greater >= 6000 cfs
Wet	1.5 to 2.99	2500-5999 cfs
Near Normal	-1.49 to 1.49	500-2499 cfs
~~moderate drought~~ Dry	-1.5 to -2.99	-5000 – 500 cfs
~~severe drought~~ Very Dry*	-3.0 or less	Less than -5000 cfs

The wettest of the two indicators describes the current tributary condition
*For modeling purposes, the dry and very dry classes can be combined into one class

The Net Inflow is represented by NI = RF – ET + Inflows,
where RF = rainfall over the lake, ET = lake evapotranspiration, and Inflows = all inflows to the Lake.

Using the basic mass balance equation, the Net Inflow can be calculated by NI = DS + Outflows,
where DS = storage change, and Outflows = measured outflows

The Palmer Index is a meteorological index that responds to weather conditions that have been abnormally dry or abnormally wet. The index is calculated based on precipitation and temperature data, as well as the local available water content of the soil.

Discussion on Palmer Index: http://www.drought.unl.edu/whatis/indices.htm#pdsi
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/wpdanote.shtml

Current Conditions:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif

As part of the preferred plan, the Lake Okeechobee Net Inflow includes actual rainfall over Lake Okeechobee, actual evaporation at Lake Okeechobee, and all available tributary inflows to Lake Okeechobee. Conversely, WSE utilized evaporation at Lake Alfred in the Kissimmee Basin, "regional rainfall", and inflow to Lake Okeechobee only from Structure 65E (S-65E) in the Lake Okeechobee Net Inflow.

The "Lake level projected to rise to" phase in the Lake Okeechobee Operational Guidance to Tide (Figure 3-3) can be determined on a daily basis, as necessary. Information to be considered includes, but is not necessarily limited to, the following: weather forecasts, release constraints due to downstream conditions, actual lake level rate of rise, historical lake levels, and C&SF Project conditions (including the CERP

Project). The WSE decision tree did not consider actual lake level rise or an anticipated or projected lake level.

3.1.4. DECISION MAKING PROCESS

The decision making process to determine quantity, timing, and duration of the potential release from Lake Okeechobee includes consideration of important information related to, but not necessarily limited to: C&SF Project conditions; historical lake levels; estuary conditions/needs; lake ecology conditions/needs; STA available capacity/needs; current weather conditions; weather forecasts, projected lake level rise/recession, and water supply conditions/needs. Either the possible release, something less than the possible release, or no release will be performed based upon this comparison and consideration of current and anticipated conditions/needs stated above. The release to be implemented will be limited by the allowable release determined from the Operational Guidance. This process allows for the quantity, timing, and duration of the releases to be performed to address the competing needs associated with water resources and the authorized project purposes while not exceeding the release ability provided by the LORS SEIS.

Use of the Lake Okeechobee Management Bands (Figure 3-1), the Operational Guidance (Figures 3-2 and 3-3), and the Regulation Schedule (Figure 3-4) will result in the determination of releases from Lake Okeechobee. The Regulation Schedule includes consideration of authorized project purposes (specifically; flood control, water supply, as well as fish and wildlife enhancement) represented by elevation guidelines (High Lake Management, Supply Side Management, Operational) to regulate the accumulation and drawdown of storage for various uses, with appropriate variations by season to conform with functional needs and rainfall runoff. As with WSE, recreation and navigation is provided for when water is available and/or through releases conducted for other project purposes.

The “Operational Guideline” (Figure 3-4) can be considered a starting point in the decision making process for Lake Okeechobee water management operations. If a lake release is needed, the possible quantity of the lake release, as determined through Part 1 and Part 2 of the Operational Guidance (Figures 3-2 and 3-3), will be compared to the calculated release value needed to achieve the Regulation Schedule’s Operational Guideline (Figure 3-4). The calculated release value will be based upon the difference between the actual daily lake level and the Operational Guideline with consideration of the appropriate anticipated conditions (“Wet Atlantic Multi-decadal Oscillation [AMO]”, “Dry AMO”, “El Nino”, “La Nina”, “Average”, etc.). Either the possible release, something less than the possible release, or no release will be performed based upon this comparison and consideration of current and anticipated conditions/needs stated above. The release to be implemented will be limited by the allowable release determined from Part 1 and Part 2 (Figures 3-2 and 3-3). This process allows for the quantity, timing, and duration of the releases to be performed to address the competing needs associated with water resource and the authorized project purposes while not exceeding the release ability provided by the Preferred Alternative.

3.1.5. PULSE RELEASE DESCRIPTION

Low volume releases from Lake Okeechobee to tide (estuaries) will be implemented in a pulse style release to produce a natural flow pattern in the estuaries. High volume releases from Lake Okeechobee to tide (estuaries) may also be implemented in a pulse style release to produce a natural flow pattern in the estuaries. These pulse releases will be named based on the total flow value and time period associated with each pulse release. For example, what was previously known as a Level 1 pulse release to the Caloosahatchee Estuary will be known as a 31,740 acre feet, 10-day, pulse release. Pulse release volume will also no longer be restricted to Level 1, 2, or 3 as with WSE but will be determined by the Operational Guidance. This allows greater consideration of estuary conditions and needs than WSE did. This naming convention will ease explanation of the various pulse releases that may be implemented in the future.

Historically, the planned Lake Okeechobee releases to tide (estuaries) have been subject to reduction or prevention by downstream conditions such as downstream local basin runoff, the tidal cycle, and tidal storm surge. When this occurs, reduction of the lake level will be delayed or discontinued. To address this issue, proposed operational guidance includes conducting releases from Lake Okeechobee to tide to make up releases that were previously reduced or prevented. These make-up releases from Lake Okeechobee to tide (estuaries) will occur as soon as possible and may even occur when Figures 3-3 does not allow releases or prescribes a lower volume release.

3.2. NON-TYPICAL TEMPORARY OPERATIONS

Non-typical Temporary Operations (NTO) will only be considered for use when the Lake Management Bands (Figure 3-1) and Parts 1 and 2 of the Operational Guidance are not effective at managing lake levels as defined under the conditions below. The Lake Management Bands (Figure 3-1) as well as Part 1 (Figure 3-2) and Part 2 (Figure 3-3) of the Operational Guidance are designed to achieve desirable lake levels over a variety of hydrologic conditions such as those conditions that occurred between 1965 and 2005. Occasionally there may be combinations of factors that may require NTO to achieve the results predicted by the Lake Okeechobee Operational Guidance or compensate for other constraints or changes which affect lake level management.

Only if the Management Bands (Figure 3-1) and Parts 1 and 2 of the Operational Guidance are not effective at managing lake levels as defined under the conditions below and it has been determined that it would be advantageous, NTO would be utilized. NTO and the determination of releases from Lake Okeechobee include the use the NTO Bands (Figure 3-5), temporarily replacing Figure 3-1 and the use of Part 3 (Figure 3-6) of the Operational Guidance, temporarily replacing Part 2. The release to be implemented will be limited by the allowable release determined from Part 1 (Figure -2) and Part 3 (Figure 3-6) of the Operational Guidance.

Temporary utilization of Part 1 (Figure 3-2) and Part 3 (Figure 3-6) during NTO allows for the quantity, timing, and duration of the releases to be performed to address the competing needs associated with water resources and the authorized project purposes while not exceeding the release ability provided by the LORS SEIS. Either the possible

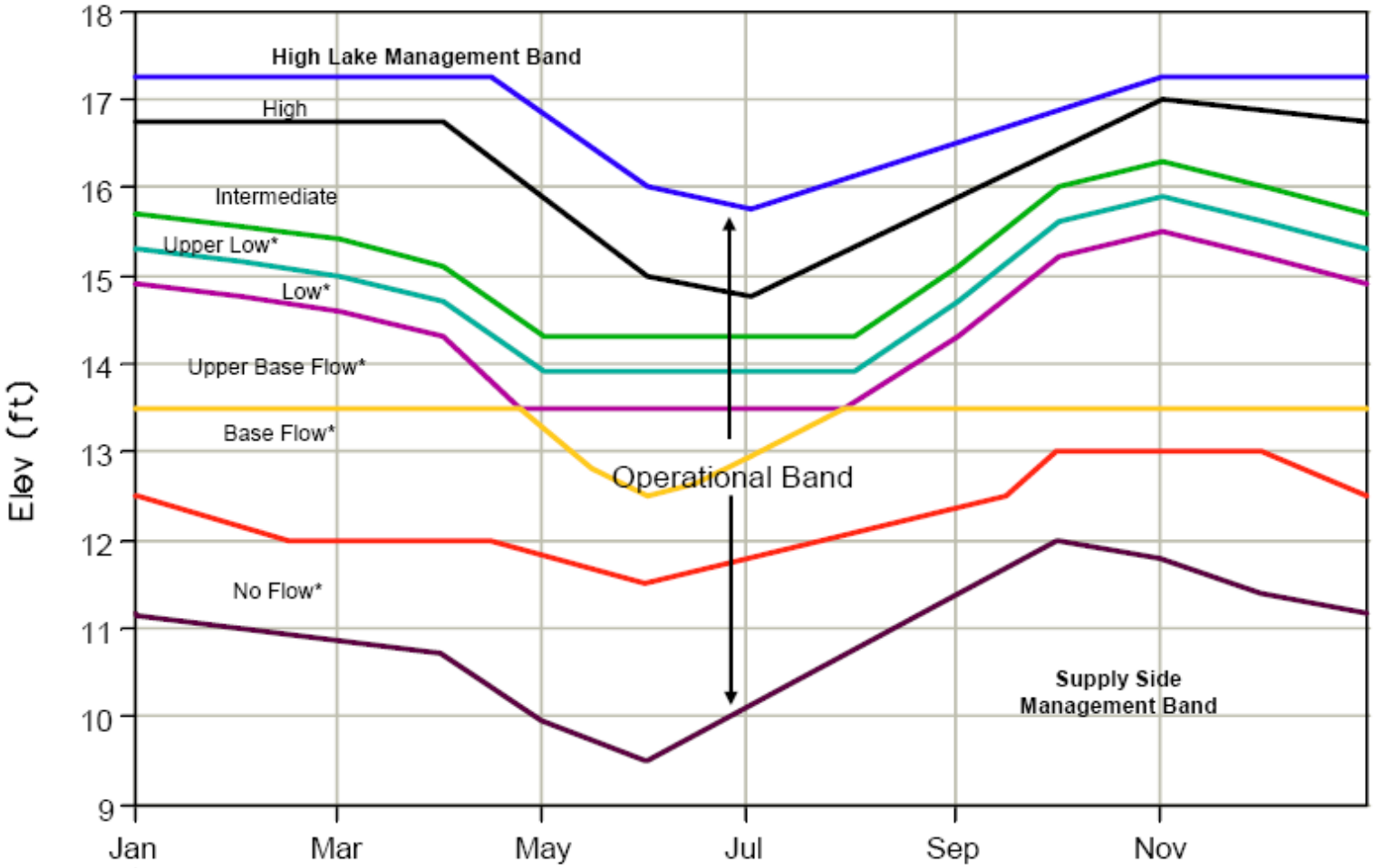


FIGURE 3-5: NON-TYPICAL TEMPORARY OPERATIONS BANDS

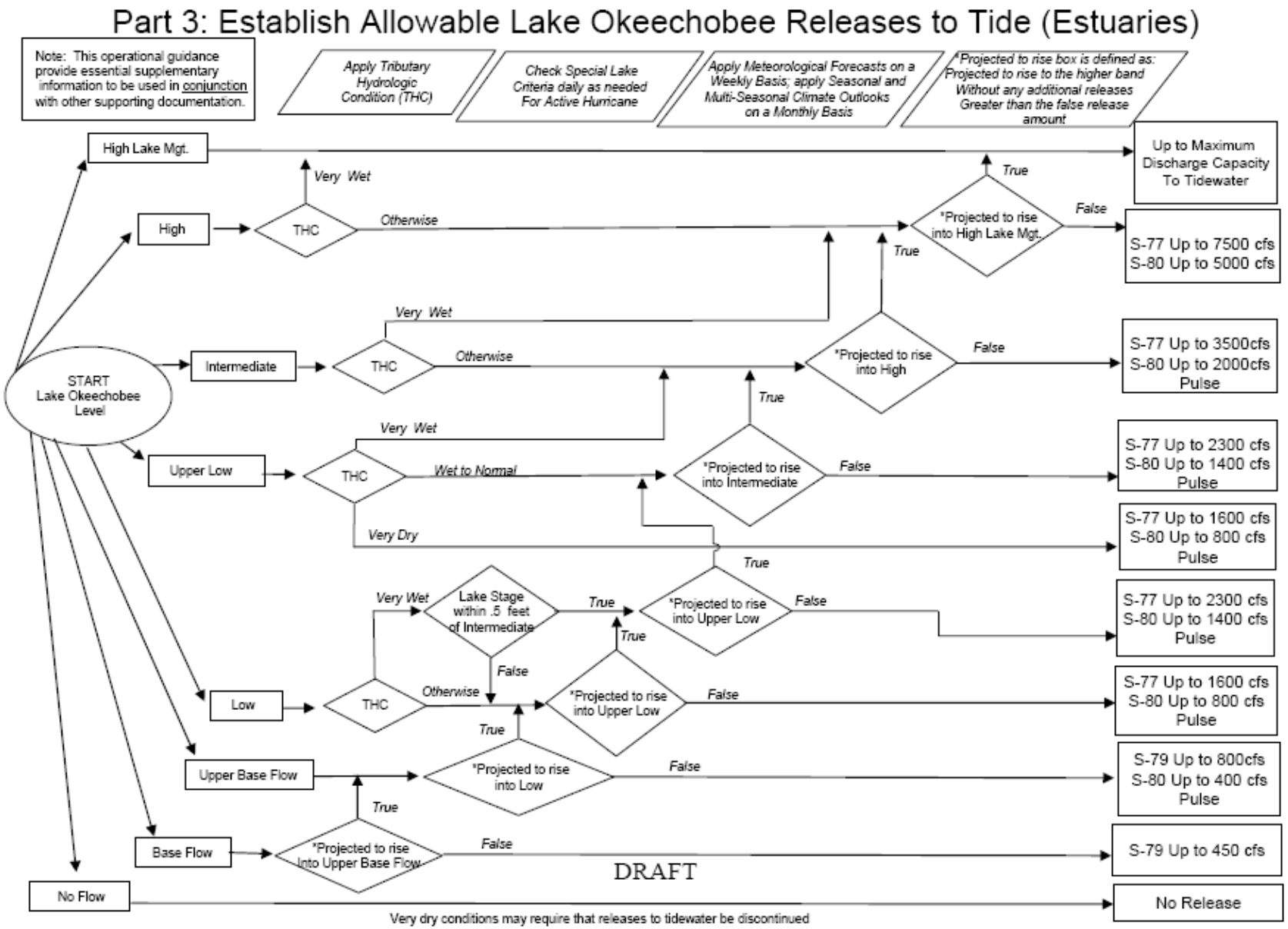


FIGURE 3-6: LAKE OKEECHOBEE OPERATIONAL GUIDANCE – PART 3

release, something less than the possible release, or no release will be performed based upon this comparison and consideration of current and anticipated conditions/needs.

Factors leading to the temporary utilization of NTO could include the prediction of very active hurricane seasons during a wet winter and spring, the occurrence(s) of hurricanes, unplanned changes in the CS&F Project (loss of structure capacities, temporary STA constraints, etc.), unusual THC, unusual predictions of lake level rise, or consensus among State and Federal agencies that hydro-meteorological information indicates an action is needed that was not anticipated by the Lake Okeechobee Operational Guidance.

Each NTO is unique and will be defined by a desired outcome or time-period. In most cases, it is expected that achievement of the lake level represented by the Operational Guideline will be the desired outcome of the NTO. Once implemented, the NTO will be discontinued once the conditions that prompted the NTO have ceased or will no longer cause a significant rise in lake level, the desired outcome is achieved, or the specified time-period has elapsed. Based upon historical conditions that have been experienced and expected performance of the Preferred Alternative, it is anticipated that use of NTO will be infrequent.

Examples of when a NTO may be implemented are: (1) an event where the Lake Okeechobee Operational Guidance is not effective at lowering undesirable high lake levels and/or preventing undesirable high or prolonged lake levels projected to occur or anticipated to occur based upon weather forecasts and/or historical information/data; (2) an unusual ongoing or planned temporary deviation activity at C&SF Project features upstream or downstream of Lake Okeechobee (e.g. planned muck removal operations which necessitate lake drawdowns in the Kissimmee River basin would require lower Lake Okeechobee levels in order to receive the excess flow) and undesirable high lake levels are projected to occur or anticipated to occur based upon any combination of planned water management operations, weather forecasts, and historical information/data; (3) weather conditions or forecasted weather conditions including but not limited to, El Nino, La Nina, and/or Active Hurricane Season forecasts are projected to create or continue undesirable high lake levels; (4) there is a need to facilitate periodic managed recessions of Lake Okeechobee to benefit the lake's ecosystem (e.g. the managed recession on Lake Okeechobee in 2000); or (5) consensus among State and Federal agencies that hydro-meteorological information indicates an action is needed that was not anticipated or indicated by the Lake Okeechobee Operational Guidance.

3.2.1. NON-TYPICAL TEMPORARY OPERATIONS BANDS

The proposed NTO have three distinct bands of lake level management very similar to the Lake Management Bands previously described.

Supply Side Management Band–is below 9.5 ft., NGVD and varies seasonally from 9.5 ft., NGVD up to 12.0 ft., NGVD. Operations in this band are governed by the

SFWMD Supply Side Management Plan. Note: Supply Side Management name and numbers will likely change upon completion of SFWMD's rule making process in 2006. Releases in this band will be governed by this plan. The goal of this band is to manage existing water supply within the lake in accordance with SFWMD rules and guidance.

High Lake Management Band–is above 17.25 ft., NGVD and varies seasonally from 17.25 ft., NGVD down to 15.75 ft, NGVD. The goal of this band is to ensure public health and safety, therefore operations will be done to lower the lake to the bottom of the High Lake Management Band as soon as possible. It is of the utmost importance that the lake level be reduced as rapidly as possible to make room for the next possible flood event, to relieve stress on the HHD, and reduce impacts on the lake's littoral zone. Releases up to the maximum practicable will be made to tide and south to the WCAs and CERP impoundments. Rates of release will vary dependent on: downstream channel conditions; estuary conditions; conditions in the WCAs; and STAs and other constraints.

Operational Band-the largest management band varies seasonally between 9.5 ft., NGVD at its lowest point and 17.25 ft., NGVD at its highest point. The goal of the "Operational Band" is to manage the lake stage to provide for all authorized project purposes. Within this Operational Band, several sub-bands have been established to define lake level management. Criteria and the decision-making process for the sub-bands are described below.

Sub-Band 1/No Flow: This sub-band is varies seasonally between 9.5 ft. at its lowest point, to 13.0 ft., NGVD at its highest point. Except for navigation and fish and wildlife enhancement, SFWMD allocates water to various users in this sub-band. No regulatory releases are made in this sub-band. In addition, SFWMD may allocate water to the environment through its "Adaptive Protocols."

Sub-Band 2/Base Flow: This sub-band varies seasonally between 11.5 ft. and 13.5 ft., NGVD. In this sub-band a base flow of up to 450 cfs measured at S-79 can be provided to the Caloosahatchee Estuary.

(1) Discharge up to maximum practicable flows to the WCAs.

(2) Under "projected to rise" condition, releases may reflect the release of the band the lake is projected to rise into. For lake that is projected to rise into "Upper Base Flow", up to 800 cfs pulse release to the Caloosahatchee Estuary and up to 400 cfs pulse release to the St. Lucie Estuary (800/400 pulse) may be made.

Sub-Band 3/Upper Base Flow: This sub-band varies seasonally between 12.5 ft. and 15.5 ft., NGVD. In this sub-band, release up to 800/400 pulse may be made.

(1) Discharge up to maximum practicable flows to the WCAs.

(2) Under "projected to rise" condition releases may reflect the release of the band the lake is projected to rise into. For lake that is projected to rise into "Low", up to 1600 cfs pulse release to the Caloosahatchee Estuary and up to 800 cfs pulse release to the St. Lucie Estuary (1600/800 pulse) may be made.

Sub-Band 4/Low Lake Stage: This sub-band varies seasonally between 13.5 ft. and 15.9 ft., NGVD. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs. If stages in the WCAs are more than 0.25 feet above the maximum of their upper regulation schedules, then no releases are made. These flows are secondary to the use of these canals providing drainage and flood control for the local drainage area.

(2) When THC is "otherwise" (not "very wet") and the lake is not "projected to rise" into "Upper Low", up to 1600/800 pulse may be conducted.

(3) Under very wet THC and lake is within .5 feet of Intermediate Band, up to 2300 cfs pulse release to the Caloosahatchee Estuary and up to 1400 cfs pulse release to the St. Lucie Estuary (2300/1400 pulse) may be made. Otherwise, release up to 1600/800 pulse may be made.

(4) Under "projected to rise" condition releases may reflect the release of the band the lake is projected to rise into. For lake that is "projected to rise" into "Upper Low", up to 2300/1400 pulse may be made.

Sub-Band 5/Upper Low Lake Stage: This sub-band varies seasonally between 13.9 ft. and 16.3 ft., NGVD. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs. If stages in the WCAs are more than 0.25 feet. above the maximum of their upper regulation schedules, then no releases are made. These flows are secondary to the use of these canals for providing drainage and flood control for the local drainage area.

(2) Under very dry THC, release up to 1600/800 pulse may be made.

(3) Under wet or normal THC, release up to 2300/1400 pulse may be made.

(4) Under very wet THC, releases up to 3500 cfs to the Caloosahatchee Estuary and releases up to 2000 cfs to the St. Lucie Estuary (3500/2000) may be made.

(5) Under "projected to rise" condition releases may reflect the release of the band the lake is projected to rise into. For lake that is "projected to rise" into "Intermediate", releases up to 3500/2000 may be made.

Sub-Band 6/Intermediate Lake Stage: This sub-band varies seasonally between 14.3 ft., NGVD to 17.0 ft., NGVD. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs. If stages in the WCAs are more than 0.25 feet above their maximum of their upper regulation schedules, then no releases are made. These flows are secondary to the use of these canals for providing drainage and flood control for the local drainage area

(2) Under very wet THC, releases up to 7500 cfs to the Caloosahatchee Estuary and releases up to 5000 cfs to the St. Lucie Estuary (7500/5000) may be made. When THC are "otherwise" (not "very wet"), releases up to 3500/2000 may be made.

(3) Under "projected to rise" condition releases may reflect the release of the band the lake is projected to rise into. For lake that is "projected to rise" into "High", releases up to 7500/5000 may be made.

Sub-Band 7/High Lake Stage: This sub-band varies seasonally between elevation 14.75 ft., NGVD and 17.25 ft., NGVD. The conditions displayed in the Operational Guidance are described as follows:

(1) Discharge up to maximum practicable flows to the WCAs. If stages in the WCAs are more than 0.25 feet above their maximum of their upper regulation schedules, then no releases are made. These flows are secondary to the use of these canals for providing drainage and flood control for local drainage area

(2) Under very wet THC, releases up to maximum practicable to the estuaries may be made. When THC are "otherwise" (not "very wet"), releases up to 7500/5000 may be made.

(3) Under "projected to rise" condition releases may reflect the release of the band the lake is projected to rise into. For lake that is "projected to rise" into "High Lake Management", releases up to maximum practicable to the estuaries may be made.

3.2.2. NON TYPICAL OPERATIONS AND WATER MANAGEMENT DECISIONS

To assist water management decision-making during NTO, a "Lake Stage Envelope" and an "Operational Guideline" have been established within the Operational Band, as shown on the Regulation Schedule (Figure 3-4). The Lake Stage Envelope varies

seasonally between 15.75 ft., NGVD at its high point, to elevation 11.75 ft., NGVD at its lowest point and is shown on Figure 3-4. This envelope was developed to best meet the ecological goals for the lake ecosystem. The Operational Guideline varies on a seasonal basis from 12.5 ft., NGVD to 15.5 ft., NGVD. The Lake Stage Envelope and the Operational Guideline may be used as a guide in developing NTO. While the Lake Stage Envelope provides seasonal guidance for lake levels, the Operational Guideline allows consideration of other factors including project conditions, historical lake levels, estuary conditions/needs, lake ecology conditions/needs, STAs available capacity/needs, current weather conditions, weather forecasts, projected lake level rise/recession, and water supply conditions/needs.

The proposed NTO will utilize Part 1 and Part 3 of the Operational Guidance and consider historical lake levels, projected lake level information, as well as calculated releases to achieve the desired lake level. The calculated release value will be based on the difference between the actual daily lake level and the Operational Guideline. However, the quantity, timing, and duration of Lake Okeechobee releases to the WCAs and to tide (estuaries) will be limited by Part 1 and Part 3 of the Operational Guidance.

(1) Undesirable/Prolonged High Lake Levels and Lake Level Fluctuations

In the event that the Lake Management Bands and Part 1 and Part 2 of the Operational Guidance are not effective at providing the desired lake level fluctuation, lowering undesirable high lake levels and/or preventing undesirable high lake levels projected to occur or anticipated to occur based upon weather forecasts and/or historical information/data, NTO may be considered for implementation. The NTO would be implemented to prevent and/or lower undesirable high lake levels. Determination of an undesirable lake level can be influenced by many issues including, but not limited to, season, watershed conditions, lake ecology conditions, projected lake levels, as well as weather, and can be determined on a daily basis, as needed. In 2003, high continuous lake levels (in excess of 13 months) resulted in a Temporary Planned Deviation to prevent additional impacts to Lake Okeechobee, reduce the loss of significant amounts of emergent and submerged vegetation, as well as reduce the potential for future high volume lake releases to the estuaries.

(2) Upstream/Downstream Activities

In the event that there are ongoing or planned activities at C&SF Project features including CERP Projects upstream or downstream of Lake Okeechobee and undesirable high lake levels are projected to occur or anticipated to occur based on any combination of planned water management operations, weather forecasts, and historical information/data, NTO may be considered for implementation. The NTO would be implemented to lower the lake level in advance of planned activities and/or prevent undesirable high lake levels. Determination of an undesirable lake level can be influenced by many issues including, but not limited to, season, watershed conditions, lake ecology conditions, projected lake levels, as well as weather, and can be determined on a daily basis, as needed. An example that could result in a NTO is planned muck removal operation involving a lake drawdown in the Kissimmee River

Basin that could result in the need to create storage in Lake Okeechobee prior to the planned Kissimmee River Basin drawdown.

(3) Weather Conditions

In the event that weather conditions or forecasted weather conditions including but not limited to, El Nino, La Nina, and/or active hurricane season forecasts are projected to create or continue undesirable high lake levels, NTO may be considered for implementation. The NTO would be implemented to prevent and/or lower undesirable high lake levels. Determination of an undesirable lake level can be influenced by many issues including, but not limited to, season, watershed conditions, lake ecology conditions, projected lake levels, as well as weather, and can be determined on a daily basis, as needed. The 2004 wet spring (normally the dry season) and an overly active hurricane season provide conditions that could be addressed by this NTO.

(4) Managed Lake Recessions

The hurricanes of 2004 and 2005 devastated the submerged aquatic vegetation (SAV) community in Lake Okeechobee. Experience from the managed recession of 2000 and scientific literature suggest that managed recessions are beneficial to stimulate growth of SAV and improve overall health of Lake Okeechobee. In the event that there is a need to facilitate periodic managed recessions of Lake Okeechobee to benefit the lake's ecosystem, NTO may be considered for implementation. The NTO would be conducted to improve lake water clarity and to benefit the lake's (SAV) as well as other lake ecology reasons. Refer to Appendix F (managed recession paper), that describes implementation of periodic managed recessions, and associated impacts of the 2000 managed recession.

(5) Low Volume Releases

In the event that the lake level is above 12.5 ft., NGVD and there are conditions that would require low volume releases, NTO may be considered for implementation. The NTO would be implemented to address conditions including, but not limited to the following: to prevent and/or to lower undesirable lake levels, to address algae blooms, to disperse saltwater, or improve other conditions related to the congressionally authorized project purposes. The proposed NTO would provide the ability to implement a pulse release with an average daily release of up to a 1600 cfs/day and up to a 730 cfs/day from Lake Okeechobee to the Caloosahatchee Estuary and the St. Lucie Estuary, respectively. In 2004, a temporary deviation that enabled the ability to implement an "Up to Level 1 Pulse Release" (a ten-day pulse release that averaged up to 1600 cfs to the Caloosahatchee Estuary and up to 730 cfs to the St. Lucie Estuary) benefited spawning in the estuaries by making low volume releases prior to spawning in the estuaries while eliminating releases when there was actual spawning in the estuaries.

This type of release has been implemented several times since the WSE regulation schedule was approved. In 2004 and 2005, this tool allowed the lake to be dropped by 0.8 feet by discharging water to the estuaries at a time of year that was acceptable

(outside the spawning times for fish and oysters). This usually occurs during the November to March timeframe on average.

3.3. NON TYPICAL TEMPORARY OPERATIONS AND ENVIRONMENTAL EFFECTS

The environmental effects (both positive and negative) of each of the NTO have been considered in the preparation of this document. As described below, each NTO can be placed in one of two groups relative to the environmental effects to be expected from the NTO. These two groups would have operational effects that are bounded by the modeled effects described in Section 5, Environmental Effects, for the Preferred Alternative (1bS2-m) and Alternative 2a-m. These represent the best case and worst case scenarios (or bookends) for environmental effects of all of the alternatives considered in this study. These two extremes are used to bracket the discussion of environmental effects expected when operating under the Preferred Alternative as modeled and under the NTOs, which were not modeled, that are described above in Section 3.

The two groups of NTO are: (1) NTO with environmental effects similar to the Preferred Alternative (1bS2-m) modeled effects; and (2) NTO with effects similar to the 2a-m modeled effects. Operations outside the NTO operations would most likely be subject to a deviation request and supporting National Environmental Policy Act (NEPA) documentation. There are currently five NTO incorporated into this plan as described in Section 3.2.2.

The NTO have been organized into two groups as follows: (1) NTO from Section 3.2.2 numbered 1 and 3, if put into operation could have environmental effects similar to the effects described under the 2a-m model impacts. In actual operations, the water managers would stay within those modeled impacts and would probably be able to minimize the full realization of those effects through proactive lake management. Again, it is important to remember that these effects are the “bookends” or extremes and actual operational decisions should result in effects that are within those extremes. Since the SFWMM projects the extremes, the actual operations are expected to be less than the extremes projected by the model. (2) NTO 2, 4 and 5, if put into operation could have effects similar to the effects described under the Preferred Alternative (1bS2-m). In actual operations, the water managers would stay as close to the projected 1bS2-m performance as practical. Since these are all planned events or dry weather events, it is very probable that these effects would be at least as good as those projected by the model for Alternative 1bS2-m, would be far removed from the projected impacts of wet weather NTO and are expected to perform better than the current WSE. In particular, NTO Number 5, allowed the use of a tool called a pulse release to discharge lake water in times of the year when the estuaries can accommodate freshwater pulses with minimal to no adverse effects to the estuaries.

Conditions that may trigger a decision not to use a planned low level pulse release include, but may not be limited to: (1) a rate of recession in the Lake stage that may pose risks to water supply, (2) spawning conditions in the St Lucie Estuary and

(3) spawning conditions in the Caloosahatchee Estuary. It should be noted that had the past pulse deviations not been implemented, estuary releases of water from Lake Okeechobee would have resulted in higher constant discharges to the estuaries. Also, given the risks projected by a positional analysis model run for those past temporary pulse releases, there is a 10% risk of operating in the Supply Side Management band versus higher bands so the impact to water supply of implementing these low level pulse releases is minimal. The impacts of temporary use of this water management NTO have been previously assessed in the WSE FEIS dated June 1999. This SEIS, a supplement to that 1999 FEIS, merely makes this a permanent tool of the new Water Control Plan.

4. AFFECTED ENVIRONMENT

The Affected Environment section succinctly describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision to be made. It does not describe the entire existing environment, but only those environmental resources that would affect or that would be affected by the alternatives if they were implemented. This section, in conjunction with the description of the "No-Action" alternative forms the base line conditions for determining the environmental effects of the proposed action and reasonable alternatives.

4.1. GENERAL ENVIRONMENTAL SETTING

Lake Okeechobee is a subtropical lake in south Florida with a surface area of 730 square miles and an average depth of nine feet. As a result of this shallow depth, wind is a major influence on the lake. Prior to construction of a perimeter dike system, Lake Okeechobee was much larger than it is now, with an extensive wetland littoral zone along the shoreline. Today, Lake Okeechobee is constrained within the HHD, and the littoral zone is much smaller. As a result, when water levels are above 17 ft., NGVD, the entire littoral zone is flooded; leaving minimal habitat for wildlife that requires exposed ground. When water levels are below 11 ft., NGVD, the entire marsh is dry, and not available as habitat for fish or other aquatic life. Lake Okeechobee's littoral zone is characterized by emergent and submerged vegetation covering an area of approximately 150 square miles (25 percent of the lake's surface area), and is primarily located along the western shore of the lake (Havens et al., 1996) (Figure 4-1). The littoral zone is sensitive to nutrient loading and light availability (Havens, et al., 1999). The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. At present, the littoral zone vegetation consists of many native plant species but also consists of many less desirable and invasive and/or exotic species. The invasion of exotic vegetation has impacted the health and productivity of the littoral zone plant community. Anthropogenic disturbances such as altered hydrology and pollution, along with nutrients, can directly and indirectly affect the health of Lake Okeechobee.

The Caloosahatchee Estuary is a large system where the Caloosahatchee River freshwater mixes with the Gulf of Mexico (Figure 4-2). The westernmost structure, Franklin Lock and Dam (S-79), demarcates the beginning of the estuary, and acts as a barrier to salinity and tidal action. A shallow bay supporting seagrass beds with mud and sand flats throughout characterizes the lower region closest to the Gulf of Mexico. Mangroves are a dominant species occurring on undeveloped shorelines. An important upper estuarine plant species is the fresh water-brackish submerged grass,

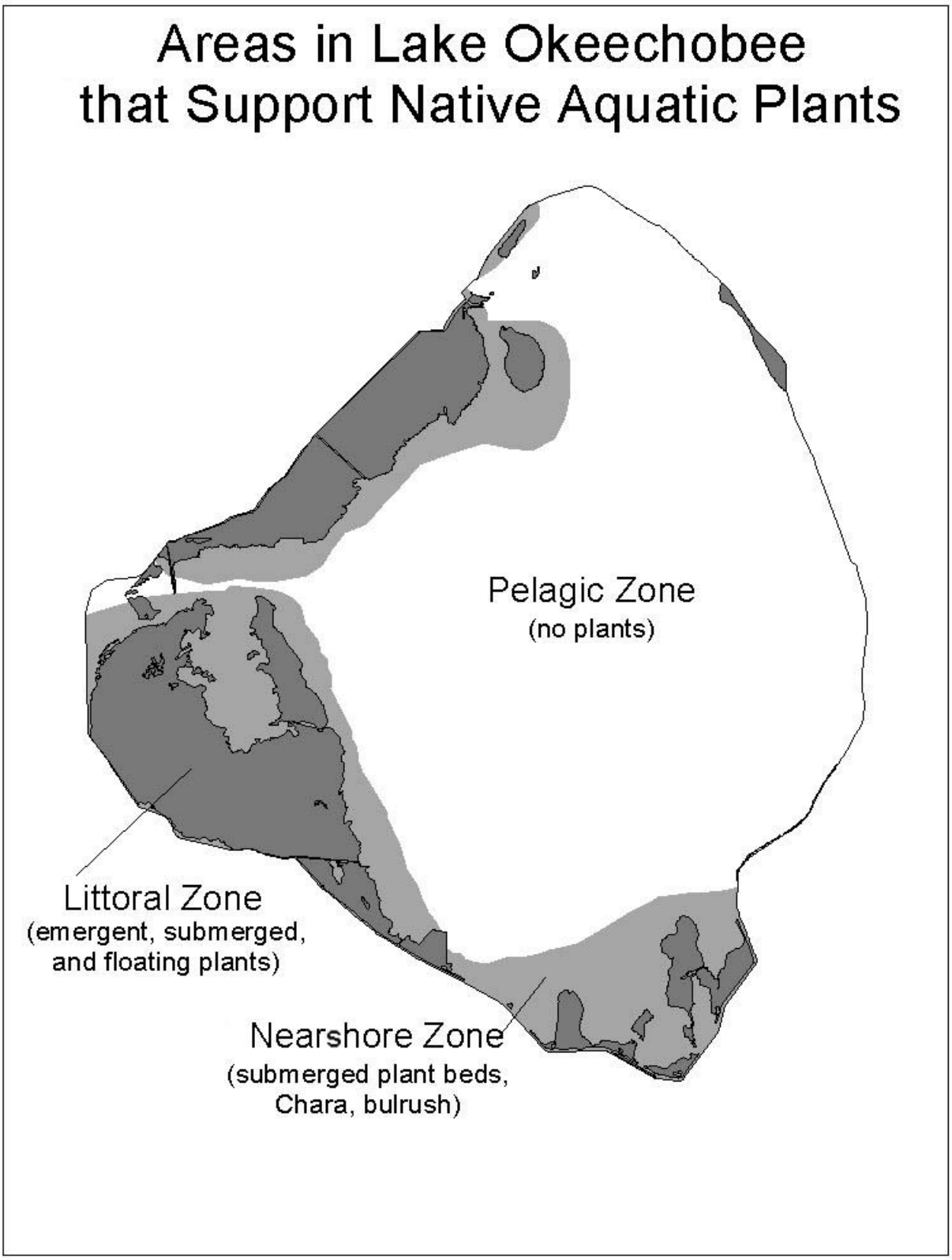


FIGURE 4-1: LAKE OKEECHOBEE ZONES

Vallisneria americana (tape grass). Downstream, beds of seagrass, *Halodule wrightii*, (shoal grass) extend from San Carlos Bay to near the Cape Coral Bridge. Oysters are also present in the estuary, in particular near the mouth of Shell Point.

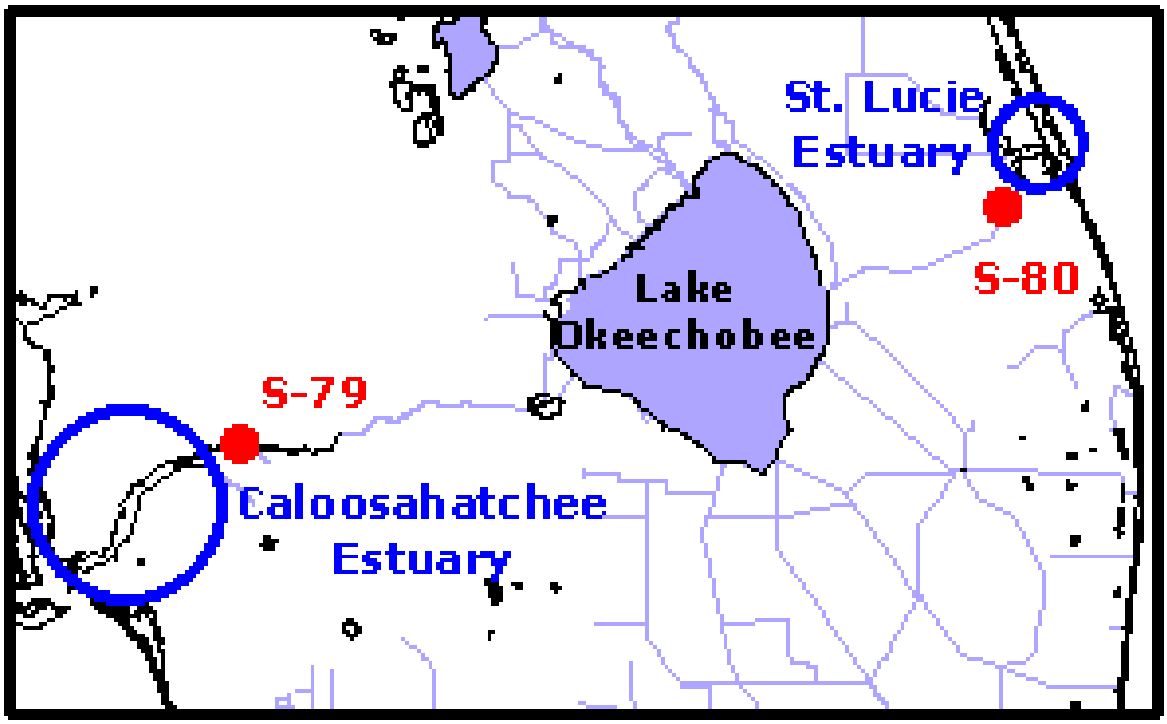


FIGURE 4-2: LOCATION OF ESTUARIES AND STRUCTURES

The St. Lucie Estuary, which is part of the IRL ecosystem, is located on the East Coast of Florida (Figure 4-2). There are two forks of the St. Lucie Estuary, the North and the South that flow together and then eastward to the IRL and Atlantic Ocean at the St. Lucie Inlet. The C-44 Canal connects Lake Okeechobee to the St. Lucie River. The easternmost structure S-80 releases fresh water to the estuary. Both the Caloosahatchee and St. Lucie Estuaries attract a variety of commercial, recreational and educational activities such as fishing, boating, ecotourism, and sightseeing.

4.2. VEGETATION

The discussion of vegetation occurring within the study area is organized by physiographic area, beginning with Lake Okeechobee, the estuaries, EAA and concluding with the WCAs.

4.2.1. LAKE OKEECHOBEE BASIN

The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, pond apple forests, and pine flatwoods. The freshwater marshes were the predominant cover type throughout, especially along the southern portion of the lake where it flowed into the Everglades.

These marshes were vegetated primarily with sawgrass (*Cladium jamaicense*) and scattered clumps of carolina willow (*Salix caroliniana*), sweetbay (*Magnolia virginiana*), and cypress (*Taxodium* sp.). Hardwood swamps dominated by red maple (*Acer rubrum*), sweetbay, and sweet gum (*Liquidambar styraciflua*) occurred in riverine areas feeding the lake, while cypress swamps were found in depressional areas throughout the region. Pine flatwoods composed of slash pine (*Pinus elliottii*), cabbage palm (*Sabal palmetto*), and saw palmetto (*Serenoa repens*) were prevalent in upland areas especially to the north.

Lake Okeechobee has an extensive littoral zone that occupies approximately 150 square miles (about 25 percent) of the lake's surface (Milleson, 1987). Littoral vegetation occurs along much of the lake's perimeter, but is most extensive along the southern and western borders (Milleson 1987). The littoral zone plant community is composed of a mosaic of emergent, submergent and natant plant species. Richardson and Harris (1995) refer to a total of 30 distinguishable vegetative community types in their digital cover map study. Emergent vegetation within the littoral zone is dominated by herbaceous species such as cattail (*Typha* spp.), spike rush (*Eleocharis cellulosa*), and torpedo grass (*Panicum repens*) which is an invasive exotic species. Other emergent vegetation observed includes bulrush (*Scirpus californicus*), sawgrass, pickerelweed (*Pontederia cordata*), duck potato (*Sagittaria* spp.), beakrush (*Rhynchospora tracyi*), wild rice (*Zizania aquatica*), arrowhead (*Sagittaria latifolia*), button bush (*Cephalanthus occidentalis*), sand cordgrass (*Spartina bakeri*), fuirena (*Fuirena scirpoidea*), rush (*Scirpus cubensis),* southern cutgrass (*Leersia hexandra*), maidencane (*Panicum hemitomon*) white-vine (*Sarcostemma clausum*), dogfennel (*Eupatorium capillifolium*), mikania (*Mikania scandens*). Woody vegetation consist of primrose willow (*Ludwigia peruviana*), Carolina willow, and melaleuca (*Melaleuca quiquenervia*) an invasive exotic species. Over the years, there has been an on-going multi-agency effort to eradicate melaleuca. The eradication effort of melaleuca has been extremely effect.

The submerged vegetation is composed almost entirely of hydrilla (*Hydrilla verticillata*) which is an invasive exotic species, pondweed (*Potamogeton illinoensis*), bladderwort (*Utricularia* spp.), Chara (*Chara spp*.) and vallisneria, also known as wildcelery, eel grass, or tape grass (*Vallisneria americana*).

The natant, or floating, component of the littoral zone consists of lotus lily (*Nelumbo lutea*), fragrant water lily (*Nymphaea odorata* and *N. mexicana*), water hyacinth (*Eichhornia crassipes*) which is an invasive exotic species, water lettuce (*Pistia stratiotes*), duckweed (*Lemna* sp.), coinwort (H*ydrocotyle umbellata*), and ludwigia (*Ludwigia leptocarpa*).

Hydrilla is one of several problem species which occur on Lake Okeechobee. Although it provides good fish habitat, its prolific growth, as evidenced in Fisheating Bay in the mid 1990's, causes navigation and water quality problems. A significant expansion of cattail in the littoral zone has also been observed.

Melaleuca, a resilient species found in a variety of habitats, is one of the principal species of concern on Lake Okeechobee. Melaleuca is capable of displacing native vegetation, including sawgrass marsh (Laroche and Ferriter, 1992), and has been observed to displace native species in other marsh types, cypress-hardwood forests, and pine savanna (Schmitz and Hofstetter, 1994). Ewel (1990) described melaleuca sites in south Florida as having hydroperiods of six to nine months. Shomer and Drew (1982) noted that melaleuca colonization rates appeared to be inversely proportional to the length of the hydroperiod. Melaleuca may be observed adjacent to the rim canal, on spoil islands peripheral to the HHD, in wetland pockets behind the dike, and in the western littoral zone, where it has penetrated into the marsh over a mile from the rim canal near Moore Haven.

Brazilian pepper (*Schinus terebinthifolius*), an invasive exotic species, is frequently associated with ditch banks (Barber 1994) and is commonly found along canal banks within Lake Okeechobee. Very little is known about its hydroperiod requirements, but Duever et al. (1986) found that it thrives in areas with three to four month hydroperiods, while Doren and Jones (1994) stated that it rarely grows on sites flooded longer than three to six months, and is absent from deeper wetland communities.

Australian pine (*Casurina* spp.), an invasive exotic species, is a major invader of short hydroperiod areas where it can be found in dense stands, which preclude establishment of native species. One of the species (*C. quinquenervia*) is intolerant of extended inundation, but another (*C. glauca*) invades sawgrass marsh and burned hardwood hammocks in the Everglades (Doren and Jones 1994). Australian pine is commonly found along the rim canal and in monotypic stands on the berm of the HHD and in areas behind the dike.

Another exotic that continues to plague resource managers throughout Lake Okeechobee is torpedograss, which is spreading rapidly into areas of spike rush, where it forms dense rooted mats and appears to be tolerant of a wide variety of hydroperiods. Other species include water hyacinth (native to South America) and water lettuce, which clog waterways and are found primarily in canals and backwater areas as well as in the lake, and both may root in wet soil. These latter two species, along with hydrilla, pose navigation problems for boaters and fisherman, flood control and water supply challenges for water managers, and are among the principal species targeted by aquatic plant control efforts by the Corps.

4.2.2. ESTUARINE VEGETATION

Seagrasses are undoubtedly among the most important vegetation of the Caloosahatchee Estuary. Seagrasses were once common in the St. Lucie Estuary, but virtually disappeared over the years. Seagrasses are more common in the IRL. Seagrass meadows improve water quality by removing nutrients, dissipating the effects of waves and currents, and by stabilizing bottom habitats, thereby reducing suspended solids. Seagrass beds support some of the most abundant fish populations in the IRL, with large species diversity. Seagrass and macroalgae (collectively referred to as SAV) are highly productive areas and are perhaps the most important habitat of the IRL (IRL

CCMP, 1996). Pinfish (*Lagodon rhomboides*) and several species of mojarra (Gerreidae) are very abundant in the seagrass habitat. These species are known to feed on seagrasses and on the epiphytes and epifauna of the seagrasses, providing a critical link in the food chain between the primary producers and the higher level consumers such as the common snook (*Centropomus undecimalis*) and spotted seatrout (*Cynoscion nebulosus*).

The natural shoreline and inter-tidal areas of the St. Lucie Estuary were once populated by mangroves and other detritus producing vegetation, but now due to shoreline alterations supports very little vegetation. In many areas, seawalls and docks have replaced mangroves and seagrasses. Massive freshwater basin and Lake Okeechobee releases have caused SAV to virtually disappear from the St. Lucie Estuary as well as some areas of the IRL South closest to the St. Lucie Estuary (USACE, 2004). Most SAV coverage in the St. Lucie Estuary is now found near the IRL. Those species known to occur there are shoal grass (*Halodule wrightii*), wigeongrass (*Ruppia maritime*), and Johnson's seagrass (*Halophila johnsonii*).

In the Caloosahatchee River the primary species of importance is Vallisneria (*Vallisneria americana*), also known as tape grass and commonly found in still and fast flowing waters. Like the seagrasses of the St. Lucie Estuary and IRL, Vallisneria is used extensively as an indicator species as it has proven to be an excellent ecological representative for a wide variety of other biota for this area. Although Vallisneria is salt tolerant, it is a freshwater plant species. During times of extended low inflow conditions, when salinity is too high in the upper estuary, this grass becomes very sparse and can disappear completely (Doering et al., 2002). When growing conditions are favorable, the most extensive beds are found in the 640 acre area between Beautiful Island and the Ft. Myers Bridge which constitutes about 60 percent of the reported areal coverage of the species in the Caloosahatchee (SFWMD, 2002). Vallisneria is a valuable waterfowl food and is considered an excellent plant for fish spawning areas along the river margin. The seagrasses which occur in the Caloosahatchee Estuary are shoal grass, which is downstream in the estuary and extends beyond Shell Point; shoal grass and turtle grass are in San Carlos Bay and the lower Charlotte Harbor.

4.2.3. EVERGLADES AGRICULTURAL AREA

Lake Okeechobee provides water south to the EAA (Figure 4-3) through three structures, S-351, S-354, and S-352. The EAA, covering 1,122 square miles south of Lake Okeechobee is the largest contiguous area of historic Everglades cover that has been converted by land use practices. The EAA historically consisted of several different plant communities. A dense swamp of pond apple, willow and elderberry

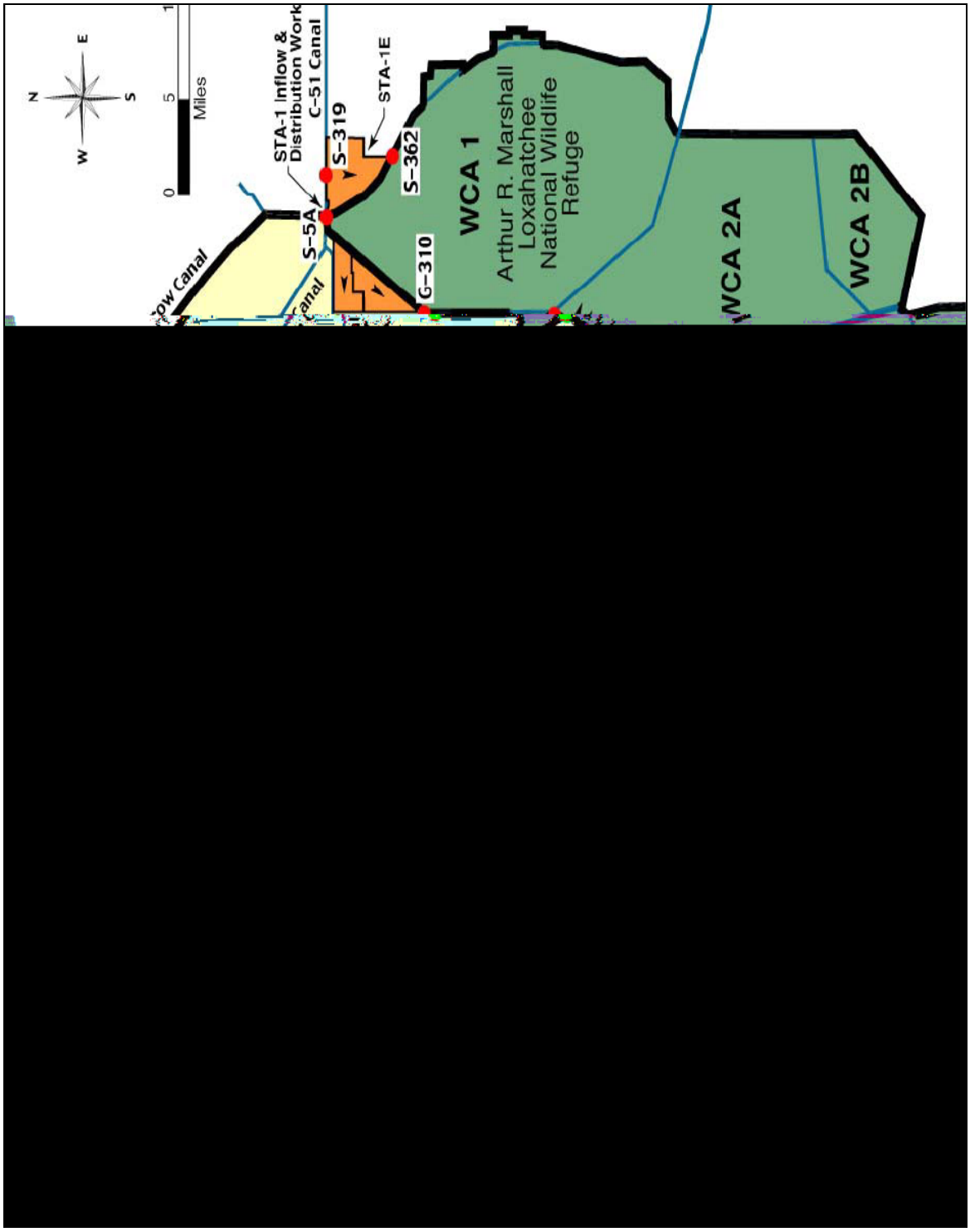


Figure 4-3: Location of EAA and WCAs

formed broad bands along the southern rim of Lake Okeechobee. The remainder of what is now the EAA was dominated by sawgrass marshes. The present EAA contains primarily agricultural cropland.

Several large tracts of land at the south end of the EAA were never directly converted to agricultural lands, although seasonal water patterns have been greatly altered by water management practices. These areas are known as the Holey Land and Rotenberger Wildlife Management Areas (WMAs), and the former Brown's Farm WMA (now converted to STA 2). These three areas comprise approximately 18 percent of the EAA and retain much of their historic sawgrass marsh and associated plant communities, although the plant cover has been altered by hydroperiod changes, fires, soil subsidence and invasion of exotic plant species and cattail. It is not expected that these areas will experience any modification to their existing in-flows under the LORS alternatives and are thus not further discussed.

4.2.4. WATER CONSERVATION AREAS (GREATER EVERGLADES)

Nearly all of the WCAs (Figure 4-3) are a patterned peatland, consisting of long, linear sawgrass ridges interspersed with teardrop-shaped tree islands (hammocks) and willow strands. Tree islands are a unique feature of the Everglades ecosystem. Tropical hardwoods are found on some of the relatively unaltered tree islands in the southern portion of the area. The landscape pattern of Ridge and Slough has been altered significantly but appears largely intact in portions of the Water Conservation Areas and into Everglades National Park (Science Coordinating Team 2003).

The Ridge and Slough patterns developed in broad, shallow to intermediate depth basins with peat substrate in response to the original hydrologic flow regimes of the Everglades. The dominant plant cover is sawgrass and/or buttonbush and/or mixed emergents. In general, there are now three recognizable types of basin wetland communities present:

1. Sawgrass ridges now interspersed, composed of sawgrass, with cattail, maidencane, arrowhead, pickerelweed, willow, button bush, wax myrtle (*Myrica cerifera*), and saltbush (*Baccharis glomeruliflora*).

2. Wet prairie, composed of beak rush, spike rush, maidencane, string lily (*Crinum americanum*), and white water lily.

3. Aquatic slough, composed of white water lily, floating heart (*Nymphoides aquatica*), spatterdock (*Nuphar luteum*), bacopa (*Bacopa caroliniana*), and bladderwort.

The following species are associated with some portions of this community: pond cypress (*Taxodium ascendens*), bald cypress (*Taxodium distichum*), willow, buttonbush, wax myrtle, sawgrass, and royal fern (*Osmunda regalis*).

A hydric hammock is a wetland forest community that occurs in lowlands over sandy, clay organic soil, often over limestone. Its water regime is mesic to hydric; climate is subtropical or temperate; and fire is rare or not a major factor. The following species are associated with this community: sweet bay (*Magnolia virginiana*), red bay (*Persea borbonia*), cocoplum (*Chrysobalanus icaco*), strangler fig (*Ficus aurea*), wax myrtle, willow, elderberry (*Sambucus simpsonii*), hackberry, cabbage palm (*Sabal palmetto*), red maple (*Acer rubrum*), false nettle (*Boehmeria cylindrica*), water oak (*Quercus nigra*), hornbeam, and needle palm (*Rhapidophyllum hystrix*).

Vegetation within the WCA 1 consists of a matrix of wet prairies, sawgrass prairies, and aquatic slough communities with some Ridge and Slough patterning. Tree islands are interspersed throughout the area. Plant community cover within WCA 1 has shifted as a result of impoundment of the marsh by perimeter levees and alteration of hydroperiods by operation of the C&SF Project. The southern, lower elevation areas of WCA 1 have been flooded for long periods of time, while the northern portions of the area have experienced more frequent drying. Areas which have experienced shortened hydroperiods have experienced shifts to woody vegetation (wax myrtle and willow), while lower elevations have experienced shifts to more aquatic flora. In addition, WCA 1 currently includes approximately 6,000 acres (four percent total cover) of cattail marsh that was not present prior to the early 1960's. A number of factors influence establishment of cattails in the Everglades. These include physical disturbance of underlying soil profile by canal construction activities, proximity to seed sources, fire, hydrologic changes and the availability of nutrients. Exotic vegetation that was uncommon prior to 1965 is a growing problem. Melaleuca and Brazilian pepper are both rapidly spreading along the perimeter and into the interior marsh. Old World climbing fern (*Lygodium microphyllum*) is also a major invasive exotic species in WCA 1.

Major plant communities in WCA 2A now consist of remnant drowned tree islands, open water sloughs and large expanses of sawgrass, and sawgrass intermixed with dense cattail (*T. domingensis*) stands. Some remnant Ridge and Slough patterning remains. Remaining tree islands are found primarily at higher ground level elevations, located in the northwest corner of WCA 2A. Remnant (drowned) tree islands, dominated primarily by willow, are found scattered throughout the central and southern sections of WCA 2A.

Several studies conducted within WCA 2A show that cattails out-compete sawgrass in their ability to absorb nutrients. There is increased cattail production during years of high nutrient inflows (Toth, 1988; Davis, 1991). Cattails are considered a high nutrient status species that is opportunistic and highly competitive, relative to sawgrass, in nutrient-enriched situations (Toth, 1988; Davis, 1991). Davis (1991) concluded that both sawgrass and cattail increased annual production in response to elevated nutrient concentrations, but that cattail differed in its ability to increase plant production during years of high nutrient supply.

The community structure and species diversity of Everglades vegetation located north of I-75 (WCA 3A North) is very different from the wetland plant communities found south

of I-75 (WCA 3A South). Improvements made to the Miami Canal and impoundment of WCA 3A by levees during the early to mid-1900s have over-drained the north end of WCA 3A and shortened its natural hydroperiod. These hydrological changes have increased the frequency of severe peat fires that have resulted in loss of tree islands, sawgrass ridges, aquatic slough, and wet prairie habitat that were once characteristic of the area. Today, northern WCA 3A is largely dominated by sawgrass and lacks the natural structural diversity of plant communities seen in southern WCA 3A. Most of the Ridge and Slough patterning is severely degraded.

Over drainage of the northwestern portion of WCA 3A has allowed the invasion of a number of terrestrial species such as salt bush (*B. halmifolia*), dog fennel, and broom sedge (*Andropogon* spp.). Melaleuca has become well established in the southeastern corner of WCA 3A North, and is spreading to the north and west.

Everglades vegetation located in the central and southern portion of WCA 3A probably represents some of the best examples of original, undisturbed Everglades habitat left in south Florida. This region of the Everglades appears to have changed little since the 1940's, and contains a mosaic of tree islands, wet prairies, sawgrass stands, and aquatic sloughs similar to those reported by Loveless (1959). The existing Ridge and Slough patterning is largely intact spatially, although the vertical difference between ridge tops and slough bottoms has lessened.

The majority of vegetation within WCA 3A south can be described as typical Everglades habitat with some exceptions due largely to the canalization and construction of levees which compartmentalize the WCAs. Water depths in southern WCA 3A are deeper than they would be without levees and Tamiami Trail.

4.3. THREATENED AND ENDANGERED SPECIES

Federally endangered and threatened species known to occur within the project area include:

COMMON NAME	SCIENTIFIC NAME	STATUS
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E(CH)
Wood stork	*Mycteria americana*	E
West Indian manatee	*Trichechus manatus*	E(CH)
Bald eagle	*Haliaeetus leucocephalus*	T
Eastern indigo snake	*Drymarchon corais couperi*	T
Cape sable seaside sparrow	*Ammodramus maritimus mirabilis*	E
Okeechobee gourd	*Cucurbita okeechobeensis*	E
Small-toothed sawfish	*Pristis pectinata*	E
Johnson's seagrass	*Halophila johnsonii*	T

E=Endangered; T=Threatened; CH=Critical Habitat has been designated

4.3.1. EVERGLADE SNAIL KITE

The snail kite occupies the watersheds of the Everglades, Kissimmee River, Caloosahatchee River, the upper St. Johns River, and Lake Okeechobee. "Each of these watersheds has experienced, and continues to experience, pervasive degradation due to urban development and agricultural activities" (USFWS, 1999). Snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lakes where the apple snail (*Pomacea paludosa*), the kite's main food source, can be found. Snail kite populations in Florida are highly nomadic and mobile; tracking favorable hydrologic conditions and food supplies, and thus avoiding local droughts. Snail kites move widely throughout the primary wetlands of the central and southern portions of the State of Florida. Lake Okeechobee and surrounding wetlands are major nesting and foraging habitat, particularly the large marsh in the southwestern portion of Lake Okeechobee and the area southwest of the inflow of the Kissimmee River (USFWS, 1999). Critical habitat was designated for the snail kite in 1977. Critical habitat includes the entire littoral zone and western shore of Lake Okeechobee.

The snail kite has a highly specialized diet typically composed of Florida apple snails, which are found in palustrine, emergent, long-hydroperiod wetlands. As a result, the snail kite's survival is directly dependent on the hydrology and water quality of its habitat (USFWS, 1999). Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Suitable foraging habitat for the snail kite is typically a combination of low profile marsh and a mix of shallow open water. Shallow wetlands with emergent vegetation such as spike rush, bulrush, and other native emergent wetland plant species provide good snail kite foraging habitat as long as the vegetation is not too dense to locate apple snails. Dense growth of plants reduces the ability of the snail kite to locate apple snails. The degradation of water quality in Lake Okeechobee, due in part to runoff of phosphorous from agriculture lands, promotes dense growth of both native and exotic vegetation, in particular cattail, water lettuce (*Pistia stratiotes*) and water hyacinth (*Eichhornia crassipes*), which inhibits the ability of snail kites to find food. Bennetts and Kitchens (1997) noted that quality of habitat for kites is adversely influenced by changes in water quality and expansion of non-native plants. Lake Okeechobee has experienced high rates of phosphorus loading in recent decades due to altered land use in the watershed. At present, phosphorus loading is in excess of 500 metric tons per year (Havens & Gawlick, 2005), compared to the FDEP's recommended annual load of 140 metric tons (FDEP, 2001).

Snail kite nesting primarily occurs from December to July (peak in March-June), but can occur year-round. Nesting usually occurs over water, which deters predation. Nesting substrates include small trees such as willow and pond apple, and in herbaceous vegetation such as sawgrass, cattail, bulrush and reed. Kites appear to prefer woody vegetation when water levels are adequate to inundate the site (Rodgers, 1996). Nests are more frequently placed in herbaceous vegetation around Lake Okeechobee during periods of low water when dry conditions beneath willow stands (which tend to grow to the landward side of cattails, bulrushes and reeds) prevent snail kites from nesting in woody vegetation (USFWS, 1999). Nest collapse is rare in woody vegetation but common in non-woody vegetation, especially on lake margins (Rodgers, 1996).

Historically, Lake Okeechobee's littoral zone has provided one of South Florida's largest habitats for the snail kite (Bennetts and Kitchens, 1997). However, species experts have reported a decline in the overall Florida population estimate for the snail kite in recent years, as well as a lack of substantial numbers of snail kite nests in Lake Okeechobee. Observations since 1992 suggest a general degradation of nesting habitat in the littoral zone of Lake Okeechobee from the loss of willows in nesting areas (USFWS, 1999).

The south/central Florida region, including Lake Okeechobee, has experienced extreme weather events over the past few years. For instance, a regional drought occurred in 2000-2001, and above average rainfall in 2004 and 2005. Above average rainfall coupled with very active hurricane seasons in 2004 and 2005, has allowed less favorable conditions in the littoral zone of Lake Okeechobee. The major hurricanes of 2004 (Frances and Jeanne) caused major ecological damage inside the lake, uprooting much of the lake's submerged vegetation and causing suspension and transport of soft mud sediments from the center of the lake to the shallow shoreline areas (Havens, 2005b). As a result Lake Okeechobee remained highly turbid for months after the hurricanes. The combination of high turbidity and deep water blocked light penetration to the lake bottom in shoreline areas (Havens, 2005). Lack of suitable light penetration can adversely impact SAV in Lake Okeechobee.

During years 2000-2001, snail kite survival dropped substantially in response to the regional drought (Kitchens et al., 2006). Lake Okeechobee had a record low stage of 9.2 ft., NGVD, at which time much of the shoal area became dry (Havens, et. al., 2005). Droughts, such as the one that occurred in 2000-2001, can severely impact the snail kite's forage and nesting habitats. In particular, snail availability to kites is greatly reduced during droughts (Beissinger, 1995). When droughts lead to a drying out (dry-down) of a breeding site during breeding season, they have a negative effect on survival and reproduction of snail kites (Bennets and Kitchens, 2000). To date, the assumption has been that during a drought, snail kites move from areas most affected by drought toward areas least affected by drought (Martin, et al., 2006). In extreme droughts, Lake Okeechobee is sometimes the only major wetland habitat with adequate water levels which are suitable for foraging and nesting (Havens & Gawlick, 2005). Havens and Gawlick (2005) report that the prolonged period of extreme low stage in 2000-2001 appeared to have nearly eliminated the apple snail population from Lake Okeechobee's littoral zone. However, it is also important to note that dry-downs are not necessarily harmful to apple snail populations, as long as they do not coincide with the peak period of egg-production or last for many months (Havens & Gawlick, 2005).

Even though drought conditions have negative effects, it is also recognized that occasional droughts are necessary to maintain native emergent vegetation such as spike rush, which is favorable to snail kite foraging.

Regulation of water stages in Lake Okeechobee is particularly important to maintain the balance of vegetative communities required for snail kites and the apple snail. Fluctuation and timing of lake stages affect the distribution of vegetative communities,

and overall habitat quality (nesting sites, foraging habitat) for the snail kite. According to USFWS (1999), a water stage of 14.5-15.0 ft. NGVD on Lake Okeechobee is recommended near the beginning of the snail kite nesting season during most years, with a gradual recession in late winter to late spring. This water stage coincides with several ecological studies on the littoral system of Lake Okeechobee. These studies have shown that a spring recession of lake levels from near 15 ft. to 12 ft. NGVD (January through May) favors nesting birds and other wildlife in the littoral marsh and allows for re-invigoration of willow stands (Smith et al., 1995). It is the extreme prolonged high and low lake levels which can be damaging to the Lake Okeechobee ecosystem. Factors contributing to habitat loss in Lake Okeechobee include prolonged periods of deep water and expansion of exotic vegetation (during low lake levels) such as torpedograss (Havens and Gawlick, 2005).

4.3.2. BALD EAGLE

The bald eagle is currently listed as threatened by the USFWS and the Florida Fish and Wildlife Conservation Commission (FFWCC). The bald eagle occurs in various habitats near lakes, large rivers and coastlines. Most breeding eagles construct nests within several hundred yards of open water (USFWS, 1999). Shorelines, such as the shorelines around Lake Okeechobee, the Okeechobee Waterway, and estuaries provide fishing and loafing perches, nest trees, and open flight paths for the bald eagle (USFWS, 1999). The bald eagle primarily feeds on fish, but is known to occasionally prey on small mammals and will feed on carrion. Bald eagles are known to nest around the study area. Nesting season occurs from October through May. The bald eagle mates for life and uses the same nesting site year after year, if the territory is available. According to the FFWCC database, for the period of 2000-2004, two nests were reported in close proximity to Lake Okeechobee. One nest, located in Palm Beach County near Lake Harbor, was last listed as active in 2003. The second nest, located in Glades County northeast of Lake Port, was active in 2004.

4.3.3. WOOD STORK

The wood stork is listed as endangered by the USFWS and the FFWCC. Wood storks forage in freshwater marshes, seasonally flooded roadside or agriculture ditches, narrow tidal creeks, shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Wood storks typically feed on fish between 2 and 25 centimeters (cm) in length. Wood storks have nested in small numbers around Lake Okeechobee, and are regularly seen foraging in the area (Smith, et al., 1995). Data gathered by Smith, et al., (1995) indicate that wood storks are attracted to the lake in large numbers only when the stage is dropping below 15 ft., NGVD. A lake stage above 15 ft., NGVD eliminates most of the foraging habitat available to wading birds on the lake (Aumen and Gray, 1995), whereas a lake stage below 11.8 ft., NGVD reduces the diversity of available foraging habitats and the number of acceptable nesting colony sites (Smith et al., 1995). As Aumen and Gray (1995) discuss, a regulation schedule for Lake Okeechobee benefiting wading birds should include a moderately paced draw down in water level to below 15 ft., NGVD coincident with the dry season and the usual wading bird nesting season (January – June).

4.3.4. CAPE SABLE SEASIDE SPARROW

Cape Sable Seaside Sparrow (CSSS) are medium-sized sparrows restricted to the Florida peninsula. They are non-migratory residents of freshwater to brackish marshes (USFWS, 1999). CSSS have a very restricted range and occur only in the Everglades region of Miami-Dade and Monroe counties of South Florida (USFWS, 1999). Critical habitat for the sparrow was designated on August 11, 1977 under Title 50 of the Code of Federal Regulations Part 17.95 (50 CFR 17.95). A key constituent element for the CSSS should be a hydroperiod pattern that maintains the preferred vegetative communities for successful breeding. During the breeding season, surface water levels should be at or below the surface within the short-hydroperiod prairies, and should be achieved through adherence to a rainfall-driven operational schedule within its habitat (USFWS, 1999).

4.3.5. WEST INDIAN MANATEE

The West Indian manatee has been recognized as an endangered species since 1967. The manatee lives in freshwater, brackish, and marine habitats and prefers water depths of at least three to seven feet. Water temperature colder than 77 degrees Fahrenheit increases the manatee's susceptibility to cold stress and cold induced mortality. Primary threats to manatees today are attributed to collisions with watercraft, degradation of habitat, and accidents occurring at water control structures. Manatees feed on a variety of submerged, emergent and floating vegetations and usually forage in shallow grass beds adjacent to deeper channels. During the summer months, manatees range throughout water bodies of south Florida. In the winter months, manatees tend to congregate in warm water areas such as springs and power plant facilities. The utilization of Lake Okeechobee and the tributaries and canal systems in south Florida by the manatee is not uncommon. Manatees are often seen in the Caloosahatchee River, St. Lucie Canal and Lake Okeechobee. During winter, manatees congregate close to the Florida Power and Light power plant at Ft. Myers, adjacent to the Caloosahatchee River. A park has been established in this vicinity for manatee viewing. The manatee is known to move through the Okeechobee Waterway lock structures when traveling to and from the coast.

4.3.6. OKEECHOBEE GOURD

The Okeechobee gourd is an annual or perennial, fibrous-rooted, high-climbing vine with tendrils, belonging to the gourd family *Cucurbitaceae* (USFWS, 1999). Today, the Okeechobee gourd has an extremely limited distribution. Lake Okeechobee is one of two areas where the gourd is currently found. There are several localized sites along the southeastern and northeastern shore of Lake Okeechobee, where this vine plant is known to grow. Around Lake Okeechobee, the gourd relies on pond apple trees to support its vines above rising water levels during the wet season. Water management levels in Lake Okeechobee affecting the snail kite and wood stork are also likely to affect the Okeechobee gourd. Fluctuating lake levels are necessary for the continued survival and recovery of the gourd within and around Lake Okeechobee. The endangered Okeechobee gourd flourishes when suitable soils are exposed during low water levels (USFWS, 1999).

4.3.7. EASTERN INDIGO SNAKE

The Eastern indigo snake has been classified as a threatened species by the USFWS and the FFWCC. The Eastern indigo snake is a large, black, non-venomous snake in North America. The Eastern indigo prefers drier habitats, but may be found in a variety of habitats from xeric sand hills, to cabbage palm hammocks, to hydric hardwood hammocks (Schaefer and Junkin, 1990). This species is generally an upland species snake, occupying a wide variety of habitat. The main reason for the snakes decline is habitat loss due to development. Further, as habitats become fragmented by roads, indigo snakes become increasingly vulnerable to highway mortality as they travel through their large territories (Schaefer and Junkin, 1990). The HHD and other levees within the Lake Okeechobee project area would be the primary area the snake would utilize.

4.3.8. SMALLTOOTH SAWFISH

The endangered smalltooth sawfish (*Pristis pectinata*) is one of two species of sawfish that inhabit United States (U.S.) waters. The U.S. population of smalltooth sawfish experienced severe range reduction and decline over the last century. The biology and ecology of *P. pectinata* is poorly known and the species was thought to be close to extirpation from the U.S. waters before moderate numbers of individuals were recently documented in Florida, particularly south and southwest Florida. The smalltooth sawfish was listed as a Federally endangered species in 2003.

Smalltooth sawfish commonly reach 5.5 meters. Little is known about the life history of these animals, but they may live up to 25-30 years and mature after about 10 years. Like many elasmobranches (e.g. sharks), smalltooth sawfish are ovoviviparous, meaning the mother holds the eggs inside her until the young are ready to be born. Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world. Sawfish are most often found within a mile of land such as in estuaries, river mouths, bays, or inlets. They occur in a wide range of habitat types including seagrass flats, mud bottoms, oyster bars, sand bottoms, artificial reefs, cocral reefs, and mangrove shorelines. They can also be found miles up rivers in low salinity conditions. The smalltooth sawfish is found in the Caloosahatchee River, particularly in the lower parts of the river near the mouth (personal correspondence, G. Poulakis, FFWCC). This portion of the river is where the majority of sawfish are caught and tagged by FFWCC for research and monitoring purposes. Additionally, anglers most commonly report seeing and catching the species in the lower parts of the river near the mouth.

Smalltooth sawfish generally eat whatever small schooling fish may be abundant locally, such as mullet. They may also feed on crustaceans and other benthic organisms. The sawfish has been seen as “stirring the mud with its saw” to locate its prey, or attacking schools of small fish by slashing sideways with its saw and eating the wounded fish (NMFS, 2000).

4.3.9. JOHNSON’S SEAGRASS

The threatened Johnson’s seagrass (*Halophila johnsonii*) has been found growing only along approximately 200 kilometers (km) (approximately 125 miles) of the coastline in

southeastern Florida from Sebastian Inlet, Indian River County to northern Key Biscayne. This narrow range and apparent endemism indicates that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world.

Johnson's seagrass occurs in dynamic and disjunct patches throughout its range. Growth appears to be rapid and leaf pairs have short life spans while horizontally spreading from dense apical meristems (Kenworthy, 1997). Kenworthy suggested that horizontally spreading rapid growth patterns and a high biomass turnover could explain the dynamic patches observed in distribution studies. New information reviewed in Kenworthy (1999, 1997) confirms H. johnsonii's limited geographic distribution in patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay.

Johnson's seagrass occurs over varied depths, environmental conditions, sand substrates, and water quality. In tidal channels, H. johnsonii is found in coarse sand substrates, although it has been found growing on sandy shoals in soft mud near canals and rivers where salinity may fluctuate widely (Virnstein et al., 1997).

Areas of concern for this species include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into seagrass areas reduce the amount of sunlight available for photosynthesis.

4.3.10. STATE LISTED SPECIES

Additional State listed species present within the effected area, and which may be affected by regulation schedule alternatives are presented in Table 4-1.

TABLE 4-1: STATE LISTED SPECIES

Scientific Name	Common Name	USFWS	FFWCC
Trichechus manatus	West Indian manatee	E	E
Rostrhamus sociabilis plumbeus	snail kite	E	E
Mycteria americana	wood stork	E	E
Haliaeetus leucocephalus	bald eagle	T	T
Ammodramus maritimus mirabilis	Cape sable seaside sparrow	E	E
Drymarchon corais couperi	Eastern indigo snake	T	T
Alligator mississippiensis	American alligator		SSC
Ajaja ajaja	roseate spoonbill		SSC
Aramus guarauna	limpkin		SSC
Egretta caerulea	little blue heron		SSC
Egretta rufescens	reddish egret		SSC
Egretta thula	snowy egret		SSC
Egretta tricolor	tri-colored heron		SSC
Eudocimus albus	white ibis		SSC
Grus canadensis pratensis	Florida sandhill crane		T
Pelecanus occidentalis	brown pelican		SSC
Rhynchops niger	black skimmer		SSC
Centropomus undecimalis	common snook		SSC
Cucurbita okeechobeensis	Okeechobee gourd	E	E
Pituophis melanoleucus mugitus	Florida pine snake		SSC

4.4. FISH AND WILDLIFE RESOURCES

As with the above discussion of existing vegetation, the below discussion of fish and wildlife resources inhabiting the study area is organized by physiographic area, beginning with Lake Okeechobee itself, the estuaries, EAA and concluding with the WCAs.

4.4.1. LAKE OKEECHOBEE

The area around Lake Okeechobee includes a wide variety of habitat opportunities for wildlife, including wading and migratory birds, many mammals, amphibians, and reptiles, as well as prey species such as crayfish, prawns, apple snails (Pomacea paludosa), and aquatic insects. The U.S. Fish and Wildlife Service (USFWS) has designated six wildlife species as threatened or endangered and likely to occur in the vicinity of the Lake Okeechobee study area (Section 3.3). There are also State-listed species present within and around Lake Okeechobee, including several of the wading bird species that are not on the Federal list. The Corps conducted a two year wildlife survey within the western littoral zone of Lake Okeechobee, gathering baseline data for key habitat types for reptiles, amphibians, and migratory and resident birds (USACE, 1999). Much of the information below was gathered from the study.

Lake Okeechobee is home to a large number of fish species, some of which are valued as commercial and sportfish, and others serving as part of the cornerstone of the littoral zone food web. The USACE (1999) found numerous small fish species, including the Cyprinodontids such as the golden topminnow (*Fundulus chrysotus*), the least killifish (*Heterandria formosa*), and the Florida flagfish (*Jordanella floridae*) which are important food resources for wading birds, amphibians, and reptiles. Over a five year period (1987-1991), mean annual commercial harvest was 2,008 metric tons (Fox, et al., 1992, 1993). Commercially important fish species included white catfish, bluegill, and red-ear sunfish.

Additionally, Furse and Fox (1994) revealed that numerous sportfish occur in the littoral zone. The largemouth bass (*Micropterus salmoides*) is one of the most popular gamefish in the State of Florida, and is a major predator of small fish, amphibians, birds, and reptiles. Additionally, the black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), and redear sunfish (*L. microlophus*) are sportfish found in high numbers in the littoral zone.

Macroinvertebrate diversity in the western littoral zone provides yet another vital component to the food web. Macroinvertebrate species incidentally sampled during field investigations in the western littoral zone included the apple snail, an important food resource of the snail kite (*Rostrhamus sociabilis plumbeus*), crayfish (*Procambarus* spp.), grass shrimp (*Paleomonetus paludosus*), and Dytiscid beetles (Dytiscidae).

Significant changes in recent years have been observed on Lake Okeechobee. Valuable fish habitat including bulrush, spike rush and SAV has been lost and/or replaced by exotic species such as torpedograss and hydrilla. Reports of muddy, turbid water, and drowned vegetation are not uncommon among the public and fisherman. Fishing guides report fish spawning has been poor for the last five years. Others report that shiners (an important bait fish) are becoming increasingly difficult to find and more and more fisherman are forced to the same areas to fish for them.

A major area of concern to the life cycle of fish and wildlife species is the western littoral zone and marsh, thus the description below will focus on this area as a representative of similar littoral resources around the lake.

The western littoral zone provides tremendous foraging and nesting habit for a wide range of avifauna. Previous studies (Smith and Collopy, 1995; David, 1994) have documented birds including the endangered wood stork (*Mycteria americana*), the Federally and State endangered snail kite, great blue heron (*Ardea herodias*), white ibis (*Eudocimus albus*), pied-billed grebe (*Podilymbus podiceps*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), little blue heron (*E. caerulea*), tricolored heron (*E. tricolor*), and common moorhen (*Gallinula chloropus*) that have commonly been observed utilizing the study area.

Other birds that may utilize the littoral zone include the threatened bald eagle (*Haliaeetus leucocephalus*), black skimmer (*Rhyncops niger*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), and anhinga (*Anhinga anhinga*).

According to range maps presented in Conant and Collins (1991), reptile and amphibian diversity should be quite high in littoral and marsh areas of Lake Okeechobee. Studied species on Lake Okeechobee include the American alligator (*Alligator mississippiensis*) and the Florida soft-shelled turtle (*Apalone ferox*) (USACE, 1999). Currently, no published inventories are available on the diversity of reptiles and amphibians inhabiting the western littoral zone of Lake Okeechobee.

The Corps found large numbers of the greater siren (*Siren lacertina*) along with the green water snake (*Nerodia floridana*) and the banded water snake (*N. fasciata*). Additional common species sampled included frogs such as the southern leopard frog (*Rana utricularia*), the green tree frog (*Hyla cinerea*), and the squirrel tree frog (*H. squirrela*). The American alligator was the only listed species of reptile recorded by the Corps and there are no listed species of amphibians currently known to utilize the study area.

Of additional interest is the possibility of colonization of exotic amphibians and reptiles within Lake Okeechobee. Several reports from local residents have confirmed sightings of non-native species of lizards, such as the green iguana (*Iguana iguana*), the spiny-tailed iguana (*Ctenosaura pectinata*), and the brown basilisk (*Basiliscus vittatus*). Established populations of such species could be extremely harmful to native reptile and amphibian populations.

Lake Okeechobee also provides major resources for mammals. The Okeechobee Waterway, a designated channel that runs around the perimeter of the lake, as well as across the lake, provides habitat for the endangered West Indian manatee (*Trichechus manatus latirostris*). Additionally, river otters (*Lutra canadensis*), bobcats (*Felis rufus*), and the Florida water rat *(Neofiber alleni*), a species of special concern as listed by the

Florida Committee for Rare and Endangered Plants and Animals, have been observed within the lake.

4.4.2. NORTHERN ESTUARIES

The northern estuaries refer to the St. Lucie Estuary on the east coast of Florida (which flows into the IRL) and the Caloosahatchee Estuary on the west coast of Florida. The IRL system is a biogeographic transition zone, fed by the St. Lucie Estuary, rich in habitats and species, with the highest species diversity of any estuary in North America (Gilmore, 1977). Approximately 4,315 different plant and animal species have been identified in the lagoon system. Included are 2,965 species of animals, 1,350 species of plants, 700 species of fish and 310 species of birds (IRL CCMP, 1996). Species diversity is generally high near inlets and toward the south, and low near cities where nutrient input, freshwater input, sedimentation, and turbidity are high and where large areas of mangroves and seagrasses have been lost. For biological communities and fisheries, seagrass and mangrove habitats are extremely important (Virnstein and Campbell, 1987). Much of the habitat loss has occurred as the result of the direct effects of shoreline development, navigational improvements, and marsh management practices.

Most of the predominantly freshwater fishes recorded from the Lagoon system, such as minnows (Cyprinidae), bullhead catfishes (Ictaluridae), and sunfishes (Centrarchidae) are found mainly or exclusively in the tributary streams including the streams feeding the St. Lucie. Examples of other species in this habitat include all of the ubiquitous forms mentioned above as well as Florida gar; gizzard shad; flagfish; bluefin killifish (*Lucania goodei*); mosquitofish (*Gambusia affinis*); least killifish; sailfin molly (*Poecilia latipinna*); inland silverside (*Menidia beryllina*); gulf pipefish (*Syngnathus scovelli*); leatherjack (*Oligoplites saurus*); gray snapper (*Lutjanus griseus*); Irish pompano (*Diapterus auratus*); silver jenny (*Eucinostomus gula*); fat sleeper (*Dormitator maculatus*); bigmouth sleeper (*Gobiomorus dormitor*); and lined sole (*Achirus lineatus*). Fish species that specialize in creek-mouth habitats include yellowfin menhaden (*Brevoortia smithi*); gafftopsail catfish (*Bagre marinus*); timucu, a needlefish (*Strongylura timucu*); gulf killifish (*Fundulus grandis*); striped killifish (*F. majalis*); mosquitofish; sailfin molly; lined seahorse (*Hippocampus erectus*); chain pipefish (*S. louisianae*); gulf pipefish; tarpon snook (*Centropomus pectinatus*); Atlantic bumper (*Chloroscombrus chrysurus*); gray snapper; Irish pompano; silver jenny; great barracuda (Sphyraena barracuda); gobies, sleepers, puffers, filefish (*Monacanthus* spp.) and many others.

In addition to finfish, the estuaries and IRL support a variety of shellfish. Blue crabs, stone crabs, hard clams and oysters are important estuarine commercial species. The blue crab accounted for approximately 80 percent of shellfish landings in the IRL between 1958 and 1988 (IRL CCMP, 1996). Oysters are an important indicator organism and are known to be sensitive to salinity changes in their environment.

The Caloosahatchee Estuary starts at the W.P. Franklin Lock and continues downstream nearly 30 miles to San Carlos Bay. Although various changes have

historically occurred in the Caloosahatchee Estuary (channelization, shoreline hardening, point and non-point source pollution impacts), the estuary sustains numerous and diverse fish and wildlife populations. Important resources within the estuarine portions of the Caloosahatchee are SAV (i.e. seagrasses), oyster bars, open bottom community, and mangrove-lined shorelines. These communities provide important habitat supporting many wildlife species.

Manatees, waterfowl, and wading birds rely on seagrass communities as foraging area. SAV are an integral nursery area for commercially and recreationally important fish and shellfish. Seagrass communities provide critical refugia for juvenile fish such as redfish, grouper, snook, and spotted seatrout. In addition, the upper and middle portions of the Caloosahatchee River support a blue crab fishery. Oyster bars and open bottoms of sand, mud, shell, and bedrock provide important habitat and food for other estuarine species. They harbor a rich macro invertebrate community that is utilized by wading birds, as well as shorebirds and fish.

In the Caloosahatchee Estuary, mangroves support fish and macro invertebrate communities by providing a protected nursery area. Important marine and estuarine species that spend part of their life cycle in the mangrove community include snook, snapper, tarpon, jack, sheepshead, red drum, ladyfish, blue crab, and shrimp. Mangrove forests also provide important foraging and nesting habitat for diverse populations of birds.

During the dry season, inflows are too low and supplemental input from Lake Okeechobee is required to maintain a viable salinity gradient in the estuary. Mean monthly flows >2800 cfs have been known to cause mortality of marine seagrasses and other organisms near the mouth of the Caloosahatchee Estuary. Mean monthly flows >4500 cfs have been known to begin to cause mortality of seagrasses in the adjacent San Carlos Bay.

During the dry season salt water from the Gulf of Mexico can intrude up the estuary all the way to the Franklin Lock and Dam referred to as S-79. Too much salt in the upper estuary will significantly impact the brackish water organisms that normally inhabit this region. During the driest times, a mean monthly flow of 450 cfs at S-79 is required to maintain viable salinity conditions in the upper estuary.

Spring is a critical period in estuarine systems because many estuarine dependent organisms reproduce at this time. High flows, >2800 cfs in the Caloosahatchee and 2000 cfs in the St. Lucie, have been known to prevent the early life stages of fish, shellfish and other commercially and recreationally important species from utilizing estuarine habitat. Alternatives with the fewest number of mean monthly flows exceeding these limits are preferred.

4.4.3. EVERGLADES AGRICULTURAL AREA

Wildlife habitat within the EAA is mostly limited to the canal systems. Flooded and cultivated agricultural fields attract feeding birds, especially waders. The Holey Land and Rotenberger WMAs located at the south end of the EAA support populations of wading birds, deer, hogs and waterfowl. Wading birds and some raptors also frequent the flooded fields and canals. Raptors find abundant food sources in small mammals, snakes and other reptiles which often inhabit sugar cane fields. The extensive canal system supports fish species that normally would not be common inhabitants of the Everglades marshes, but are typically found in lakes. These fish include black crappie, catfish, and shad. Oscars (*Astronotus* spp.), spotted tilapia (*Tilapia mariae*), walking catfish (*Clarias batrachus*), and the black acara (*Cichlasoma bimaculatum*) are examples of exotic fish species that have become established within the region.

4.4.4. WATER CONSERVATION AREAS (GREATER EVERGLADES)

The WCAs as a whole contain a number of important species whose existence, population numbers and sustainability are markedly influenced by water levels. The American alligator, a keystone Everglades species, has rebounded in terms of population numbers since the 1960's when the reptile was placed on the endangered species list by the USFWS. Alligators, it is believed, play an important ecological function by maintaining "gator holes", or depressions, in the muck which are thought to provide refuge for aquatic organisms during times of drought and concentrates food sources for wading birds. High water during periods of nest construction which occurs from June to early July (Woodward et al., 1989) decreases the availability of nesting sites. If conditions become too dry, water levels may fall too low to maintain gator holes, forcing the animal to seek other areas to survive.

Other important reptile species commonly encountered within the study area include a number of species of turtles, lizards, and snakes. Turtle species include the snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*K. subruburm*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), and Florida softshell turtle (*Trionys ferox*). Lizards such as the green anole (*Anolis carolinensis*), are found in the central Everglades, and several species of skinks occur more commonly in terrestrial habitats. Numerous snakes inhabit the wetland and terrestrial environments. Drier habitats support such species as the Florida brown snake (*Storeria dekayi*), southern ringneck snake (*Diadophis punctatus*), southern black racer (*Coluber constrictor*), scarlet snake (*Cemophora coccinea*), and two rattlesnakes (*Sistrurus miliarius* and *Crotalus adamanteus*). The eastern indigo snake (*Drymarchon corais*), a Federally listed threatened species, and the Florida pine snake (*Pituophis melanoleucus mugitus*), a State species of special concern, may also exist in drier areas of the study area. Wetter habitats support more aquatic species such as the water snake (*Natrix sipedon*), the green water snake, mud snake (*Francia abacura*), eastern garter snake (*Thamnophis sirtalis*), ribbon snake (*T. sauritus*), rat snake (*Elaphe obsoleta*), and the Florida cottonmouth (*Agkistrodon piscivorus*) (McDiarmid and Pritchard, 1978).

Important amphibians, known to occur in south Florida, include the Everglades bullfrog, or pig frog (*R. grylio*), Florida cricket frog (*Acris gryllus*) and southern leopard frog, southern chorus frog *(Pseudacris nigrita*) and various tree frogs are common to tree islands and cypress forests. Salamanders inhabit the densely vegetated, still or slow-moving waters of the sawgrass marshes and wet prairies. They include the greater siren and the Everglades dwarf siren (*Pseudobranchus striatus*). Toads such as the eastern narrow-mouth toad (*Gastrophryne carolinensis*) also occur within the study area.

Colonial wading birds (*Ciconiformes*) are a conspicuous component of the wildlife communities that utilize the WCAs as both feeding and breeding habitat. These include 11 species of herons and egrets, two species of ibis, the wood stork, and the roseate spoonbill (Robertson and Kushlan, 1984). Historically, white ibis has been the most abundant colonial wading bird species within the WCAs. Surveys indicate that the great egret is the second most abundant species (Frederick and Collopy, 1988). The great blue heron, little blue heron, tricolored heron, green backed heron (*Butorides striatus*), snowy egret (*E. thula*), cattle egret (*Bubulcus ibis*), black crowned night heron (*Nycticorax nycticorax*), and yellow crowned night heron (*N. violacea*), are also common wading bird species found throughout the WCAs. The roseate spoonbill (*Ajaia ajaja*), a State listed species of special concern, and the wood stork, a Federally listed endangered species, both occur within the WCAs. The WCAs support additional aquatic avifauna, such as the limpkin (*Aramus guarauna*), two bitterns (*Ixobrycus exilis* and *Botarus lentiginosus*), the anhinga, as well as a number of resident and migratory waterfowl.

The Everglades fish community is composed of a variety of forage fish important in the diet of many wading birds, sport fish, native species and exotics introduced partly through aquacultural practices and the aquarium trade. Forage species include the Florida flagfish, bluefin killifish, least killifish, shiners, mosquito fish, and sailfin molly.

Generally, Everglades sport fish are harvested from the borrow canals that surround the marsh. As water levels in the canal and marsh rise, fish populations disperse into the interior marsh and reproduce with minimum competition and predation. As water levels recede, fish concentrate into the deeper waters of the surrounding canals, where they become available as prey for wildlife and fishermen. In some instances, the canal fishery has experienced major fish kills due to overcrowding and oxygen depletion. The WCAs provide a valuable sport fishery for south Florida. Many of the canals, notably along U.S. Highway 41, Interstate-75, and in the L-35B and L-67A provide valuable recreational fishing for largemouth bass, sunfish, oscar, gar, bowfin (*Amia calva*), catfish and other species.

Besides supporting a valuable recreational fishery for the region, fish communities in the WCAs 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. Consequently, fishing success by humans or wildlife is also

dependent on water levels (Dineen, 1974). For a more complete listing of common Everglades fishes reference Gunderson and Loftus (1993).

Several game and non-game wildlife species occur within the WCA system including: white-tailed deer (*Odocoileus virginianus*), common snipe (*Capella gallinago*), and marsh rabbit (*Sylvilagus palustris*). Blue-winged teal (*Anas discors*), mottled ducks (*A. fulvigula*) and other game waterfowl are found in the sloughs of the northeast corner. Feral hogs (*Sus scrofa*) may also be present in drier areas or on tree islands.

4.5. ESSENTIAL FISH HABITAT

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976 and the 1996 Sustainable Fisheries Act, an Essential Fish Habitat (EFH) Assessment is necessary for implementation of the Preferred Alternative. An EFH Assessment is a review of the proposed action and its potential impacts to EFH. The rules promulgated by the National Marine Fisheries Service (NMFS) in 1997 and 2002 further clarify EFH by definition as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." *Waters* include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include areas historically used by fish where appropriate. *Substrate* includes sediment, hardbottom, structures underlying the waters, and any associated biological communities. *Necessary* means the habitat required to support a sustainable fishery and managed species' contribution to a healthy ecosystem. *Spawning, breeding, feeding, or growth to maturity* covers all habitat types used by a species throughout its life cycle.

Only species managed under a federal fishery management plan (FMP) are covered under (50 CFR 600). The act requires federal agencies to consult on activities that may adversely influence EFH designated in the FMPs. The activities may have direct (e.g., physical disruption) or indirect (e.g., loss of prey species) effects on EFH and may be site-specific or habitat-wide. The adverse result(s) must be evaluated individually and cumulatively.

The St. Lucie Estuary and the Southern IRL are within the jurisdiction of the South Atlantic Fishery Management Council (SAFMC) and are located in areas designated as EFH for estuarine waters, mangroves, seagrasses, and live bottom communities. The estuary provides EFH for adult and juvenile red drum (*Sciaenops ocellatus*), shrimp, spiny lobster (*Panulirus argus*), and the snapper-grouper complex. In addition, the nearshore hardbottom habitat outside of the St. Lucie and Ft. Pierce Inlets is designated as EFH Areas of Special Concern for the snapper-grouper complex.

The Caloosahatchee Estuary is within the jurisdiction of the Gulf of Mexico Fishery Management Council (GMFMC). In the estuary, EFH is defined as all estuarine waters and substrates (mud, sand, shell, rock and associated biological communities), including the sub-tidal vegetation (seagrasses and algae) and the adjacent inter-tidal vegetation (marshes and mangroves). The estuary provides EFH for adult and juvenile brown shrimp (*Penaeus aztecus*), pink shrimp (*Panaeus duorarum*), white shrimp

(*Penaeus setiferus*), gray snapper (*Lutjanus griseus*), red drum (*Sciaenops ocellatus*), Spanish mackerel (*Scomberomorus maculates*), spiny lobster (*Panulirus argus*), stone crab (*Menippe mercenaria*), and gulf stone crab (*Menippe adina*).

In conformance with the 1996 amendment to the MSFCMA, the information provided in the SEIS will comprise the required EFH Assessment. The SEIS will be coordinated with the NMFS Habitat Conservation Division which will initiate consultation under the MSFCMA.

4.6. COASTAL BARRIER RESOURCES

There are no coastal barrier resources in the project study area.

4.7. FLOOD PROTECTION

One of the primary functions of the C&SF Project is to provide a highly-efficient flood control system designed to keep urban and agricultural areas dry in the wet season by discharging excess water to tide or into the WCAs and ENP. Flood control works on Lake Okeechobee consist of a system of about 1,000 miles of encircling levees designed to withstand a severe combination of flood stage and hurricane occurrence, plus the regulatory outlets of St. Lucie Canal and the Caloosahatchee River. The design discharge of Moore Haven Spillway is 9,300 cfs and St. Lucie Spillway is about 16,000 cfs (USACE, 1999). Following removal of local runoff from the agricultural areas south of the lake, an additional regulatory capability of several thousand cfs is available through the Miami, North New River, Hillsboro, and West Palm Beach Canals by pumping into the three WCAs. The crest elevation of the levee system surrounding the lake ranges from 32 to 45 ft., NGVD. The likelihood of overtopping the levees from excess storage is nearly non-existent. Possible flooding due to overtopping of levees within the HHD system is limited to short duration events involving wave runup in addition to hurricane-induced storm surge.

4.8. WATER SUPPLY

As one of its planned purposes, Lake Okeechobee supplies water for agricultural irrigation, municipalities, industry, and ENP, and for regional groundwater control and salinity control.

A primary use of Lake Okeechobee is to provide water supply for adjacent urban and agricultural lands and a backup water supply for lower east and west coast Florida counties. Currently, C-43 provides an important source of potable water for Lee County and the City of Ft. Myers and is also used as a source of water for irrigation by agriculture.

During years of normal rainfall, the WSE regulation schedule allows for an ample supply of water to be stored in Lake Okeechobee during wet periods for use during the dry season.

During dry periods, increased water usage and large dry season water losses due to evapotranspiration require an operational water allocation plan for Lake Okeechobee,

especially when regional water supplies become low and may not meet anticipated service area demands. The SFWMD has developed a water supply management plan that requires various actions to be taken according to the severity of the conditions exhibited in the lake regulation schedule. The basis of this plan is an allocation scheme which parcels out lake water based on estimated water use for the remainder of the dry season. A target water level in Lake Okeechobee is established for the beginning of the wet season (June 1st) and allotments are computed such that lake water levels will not fall below the critical target stage, assuming average climatic conditions. Operational flexibility is built into the plan to make available the special actions that proved successful during the 1981–1982 drought.

4.9. WATER QUALITY

Lake Okeechobee

Waters of Lake Okeechobee have been designated by the State of Florida as Class I Waters, suitable for potable water supplies, and Class III, recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife

Water quality data indicate that Lake Okeechobee is currently in a eutrophic condition, primarily due to excessive nutrient loads from the agricultural sources both north and south of the lake. Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or not supplying their designated uses. According to FDEP's 1998 303(d) list, the water quality of Lake Okeechobee is impaired due to phosphorus, dissolved oxygen, iron, un-ionized ammonia, coliforms and chlorides. High phosphorus concentrations resulting from human-induced hydrologic and land use modifications are the predominant reason for impairment (FDEP, 2001). The total phosphorus concentrations that currently exist in the lake are in excess of the amount needed for a healthy ecosystem. The in-lake total phosphorus concentrations have doubled over the last 50-years as a result of increased inputs from the watershed (FDEP, 2001). From 1995 to 2000, the average concentration of total phosphorus in the pelagic region of Lake Okeechobee was approximately 100 parts per billion (ppb) (FDEP, 2001). In September 2004, hurricanes Frances and Jeanne passed just to the northeast of Lake Okeechobee producing winds in the 70 to 80 miles per hour (mph) range to the lake. Due to the lake's average shallow depth, wind easily affects sediment suspension. Total phosphorus concentrations climbed to levels as much as four to five times higher than normal as a result of the 2004 hurricanes (SFWMD, 2005). The EPA and the FDEP have prepared and approved a Total Maximum Daily Load (TMDL) for phosphorus for the Lake (FDEP, 2001) which is hereby incorporated by reference. The purpose of this TMDL is to attain acceptable phosphorus loads in the lake.

Caloosahatchee River Basin

Water quality conditions are degraded in the upper and lower areas of the Caloosahatchee River Basin due to agricultural and urban runoff, respectively. The channelized section of the river also shows degraded water quality conditions, due to agricultural inputs, as compared to tributaries lying in less developed areas of the basin. Problems associated with the degraded areas are typified by low dissolved

oxygen levels, elevated conductivity, and decreased biodiversity. Conditions in the urbanized sections of the basin are influenced by non-point stormwater flows, and are manifested in the river by elevated chlorophyll levels, algal blooms, periodic fish kills, and low dissolved oxygen levels. Although wastewater discharges remain a problem, the estuary is presently more seriously affected by high-nutrient waters from the river and tributaries, and stormwater runoff from cities. Nutrient and chlorophyll levels are high, and small algal blooms occur regularly. When there are discharges of fresh water from Lake Okeechobee to the Caloosahatchee River, the ambient water quality and the salinity of the river can be affected. Salinity effects are only experienced downstream of the W.P. Franklin Lock (S-79) since the river is freshwater downstream of the lake to that point and usually only a concern when discharge events exceed 2800 cfs at the S-79 structure for longer than 14 consecutive days. Water quality effects may be experienced all the way down the river from elevated nutrient concentrations in the lake water relative to the river water. These effects would be of concern during any discharge of water, even those falling within the optimum flow range of 450-2800 cfs. These discharges of lake water are just a piece of the puzzle of water quality conditions in the Caloosahatchee River and estuary.

St. Lucie River Basin

Water quality conditions along the St. Lucie River are rated as good in less developed areas of the basin. However, conditions are degraded in urbanized areas along the extensive network of canals that drain this area. High volume discharges from Lake Okeechobee also contribute to degraded water quality conditions in the St. Lucie River Basin.

4.10. HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

A preliminary assessment indicated no evidence of HTRW affecting this action.

4.11. AIR QUALITY

No significant sources of air quality pollutants are located in the Lake Okeechobee and waterway vicinity.

4.12. NOISE

Ambient noise levels are low to moderate in the Lake Okeechobee region. The major noise producing sources are vehicular and boat traffic.

4.13. AESTHETIC RESOURCES

Lake Okeechobee, the Caloosahatchee River Basin and the St. Lucie Estuary have several landscape features that are aesthetically appealing to tourists and local communities.

4.14. RECREATION RESOURCES

Lake Okeechobee and the St. Lucie and Caloosahatchee estuaries are considered popular recreational resources in South Florida. Fishing, recreational boating, sightseeing, wildlife watching, camping and swimming are just a few of the recreational activities residents and visitors participate in. Lake Okeechobee is host to more than

500 permitted bass fishing tournaments annually and ranks as the top bass fishing lake in the U.S. (Havens, et al., 2004a).

4.15. NAVIGATION

A navigable waterway exists from the Intracoastal Waterway at St. Lucie Inlet on the Atlantic Coast across the State by way of St. Lucie Canal, Lake Okeechobee, and Caloosahatchee River to the Gulf of Mexico. The Caloosahatchee River is the western navigational channel for the Okeechobee Waterway. When the Lake Okeechobee stage is below 12.56 ft., NGVD, the authorized project depth is not maintained. The waterway consists of 154 miles of navigation channel, including the lake itself. Commercial and recreational navigation via the Okeechobee Waterway takes advantage of this shortcut across the Florida peninsula.

4.16. HISTORIC PROPERTIES

This action was coordinated in accordance with Section 106 of the *National Historic Preservation Act* (NHPA) of 1966, as amended, and 36 CFR, Part 800: *Protection of Historic Properties*. The State Historic Preservation Officer (SHPO) advises and assists the Corps in identifying historic properties (archaeological, architectural, and historical) listed, or eligible for listing, in the *National Register of Historic Places*, assessing the project's effects, and considering alternatives to avoid or minimize effects.

5. ENVIRONMENTAL EFFECTS

This section is the scientific and analytic basis for the comparisons of the alternatives. See Table 2-1 in Section 2.0 Alternatives, for summary of impacts. The following includes anticipated changes to the existing environment including direct, indirect, and cumulative effects.

5.1. GENERAL ENVIRONMENTAL EFFECTS

5.2. VEGETATION

Vegetative species within the study area are site specific and it is highly probable that there will be effects to plant communities due to the Preferred Alternative and other alternatives. These effects are expected to be largely beneficial, but in certain areas may be locally detrimental due to Lake Okeechobee's existing water quality.

5.2.1. LAKE OKEECHOBEE

RECOVER (Restoration Coordination and Verification) is an arm of the Comprehensive Plan (CERP) responsible for linking science and the tools of science to a set of system-wide planning, evaluation and assessment tasks. The most current (as of March 2006) RECOVER performance measures for Lake Okeechobee extreme low lake stage (<10 feet), Lake Okeechobee extreme high lake stage (>17 feet), and Lake Okeechobee stage envelope (within [%], above [SS], below [SS]) were utilized to evaluate the alternatives of the LORSS effort. In-depth documentation and rationale for these performance measures is available through the RECOVER performance measure documentation and is available for review in the draft RECOVER Comprehensive Everglades Restoration Plan System-wide Performance Measures report (RECOVER, 2006), at the following web address:
www.evergladesplan.org/pm/recover/eval_team_perf_measures.cfm.

High Lake Stage

As stated throughout this document, all the alternatives lower the top stage of the schedule from 18.5 feet (WSE) to 17.25 feet. All alternatives would produce lower lake stages and fewer occurrences of prolonged high and extreme high lake stage events.

At the extreme high stage (>17 feet), it has been documented that wind driven waves can cause large-scale loss of submerged and emergent plants by physical uprooting (Havens et al., 2004c). Reduction in the duration and severity of high water stages is expected to be more favorable for maintenance of more diverse vegetative communities in the littoral zone, which in turn should provide for more favorable habitat conditions for fish and wildlife. The anticipated overall increase in diversity of littoral vegetation is expected to include larger areas vegetated by willow, which has been adversely impacted through the years by prolonged high water elevations. Willow is important nesting substrate for wading birds and the endangered snail kite. More extreme high water stages >17 feet would be significantly reduced under 1bS2-m, or any of the alternatives, compared to WSE, thereby decreasing the likelihood of erosion

of bulrush from the deep water edge of the littoral zone, and encouraging healthy growth and vegetative recruitment.

Even prolonged periods of moderately high lake levels are known to impact marsh vegetation. When lake stages exceed 15 feet for long periods, especially when light penetration is inhibited by turbid water, adverse impacts to SAV can occur. The percent of time in the simulation when lake stages exceed 15 feet would decrease from approximately 31 percent under WSE to about 16 percent under the Preferred Alternative, 1bS2-m. Modeling simulations indicated that the base had two events of lake stage >15 feet for 365 days. All other alternatives have zero events. As the past has shown, even moderate high lake levels (>15 feet) of prolonged (>12 months) duration, may cause significant harm to the lake's ecosystem. All of the alternatives did equally well with reducing lake stages >17 feet. The base performed the worst for this PM.

Low Lake Stage

The extreme low stage PM used in this study identifies a critical stage of 10 feet, a depth at which substantial adverse effects on the lake may occur. It is at this depth where detailed field observations during the 2000-2001 drought indicated that adverse effects such as rapid spread of terrestrial weedy plants, severe loss of SAV, loss of apple snail population, occurred. Even when the lake stage falls below 11 feet, the entire littoral zone is dry (Havens and Gawlik, 2005). However, there are a number of benefits to the ecosystem that occur at low levels, such as drying and oxidation of accumulated organic detritus in the littoral zone, favorable conditions for marsh fires that burn away cattail and torpedograss thatch, and exposure of moist soil for plant germination (Havens et al., 2004c).

As would be expected, alternatives that did the best in reducing extreme high lake stage occurrences did worse on reducing extreme low lake stage occurrences. The base, however, has fewer low lake stage events than the other alternatives, as would be expected since it has more high lake stage events. The remainder of the alternatives scored relatively the same for lake stages <10 feet. All of the alternatives will have more low stage events compared to the base. Alternative 2a-m performed the worst with number of days the lake stage is <10 feet. However, the positive ecological effect of these alternatives lowering the lake stage to reduce the high extreme events potentially out weights the possible adverse ecological effects of occasional extreme low water events.

Stage Envelope

Although the stage envelope is optimal for the lake, it is also necessary for the system to occasionally experience the extreme highs, and particularly the extreme lows, which would mimic more natural conditions. In Lake Okeechobee, water level management that mimics natural conditions will have the greatest benefits to plant communities (FFWCC, 2003).

A water management regime similar to the Lake Okeechobee Stage Envelope PM, where water levels are between 12.5 feet (June-July low) and 15.5 feet (November-January high), is the target range for the preferred Alternative, 1bS2-m. A wide body of published research documents the benefits of variable water levels within this range (Havens & Gawlick, 2005; FFWCC, 2003; Smith, et al., 1995; Aumen and Gray, 1995). A January to June stage recession would provide benefits for wading birds nesting and foraging, development of good submerged and emergent vegetation habitat for fish and wildlife, and in general, benefits the littoral wetland by providing a range of water depths that subject most of that area to wetting and drying (Havens et al, 2003c). Although these conditions are beneficial, they should not be repeated every year. Lake Okeechobee experts recognize that there also should be years of extreme stage, especially stages below 11 feet that are needed to periodically dry out lower elevation littoral areas so they can benefit from detritus oxidation and fires (Aumen and Gray, 1995; Havens et al., 2004c).

All alternatives performed basically the same for the percentage of time within the stage envelope. The differences within the stage envelope were minor with Alternative 1bS2 falling within the stage envelope 27.3 percent of the time and Alternative 2a falling within the envelope 32 percent of the time (Figure 5-1). The remaining alternatives fell somewhere in between these scores

Due to the small differences in the performance of the alternatives based on modeling simulations, it is unclear whether one alternative is significantly better for lake vegetation or lake ecology in general. The differences are indistinguishable from each other in their potential ecological effect.

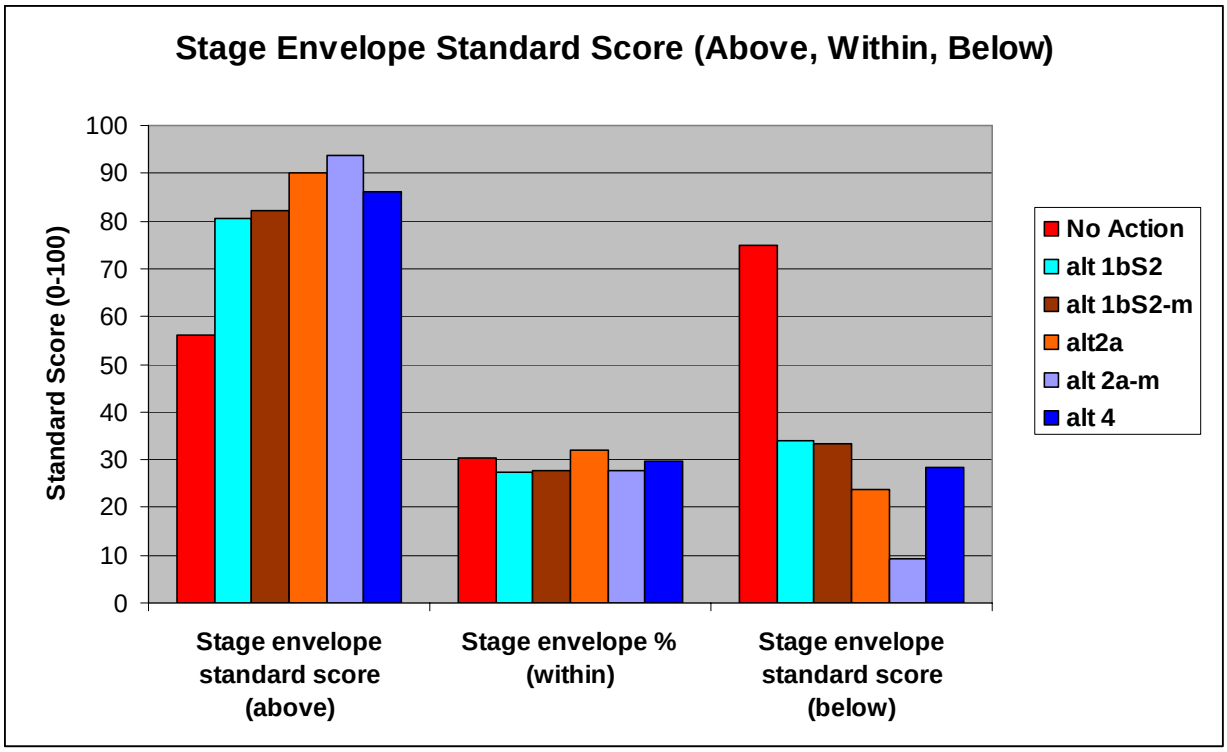


FIGURE 5-1: STAGE ENVELOPE STANDARD SCORE FOR LAKE OKEECHOBEE FOR ALTERNATIVES

5.2.2. ESTUARINE VEGETATION

The PMs used to evaluate the impacts to the St. Lucie and Caloosahatchee estuaries, and the results of the evaluation can be found in Section 5.5.2, and are not repeated in this section. The discussion of impacts on vegetation can be found below.

St. Lucie Estuary

The natural shoreline and inter-tidal areas of the estuary were once populated by mangroves and other detritus producing vegetation, but now due to shoreline alterations supports very little vegetation. In many areas, seawalls and docks have replaced mangroves and seagrasses. Large volumes of freshwater basin and Lake Okeechobee releases have caused SAV to virtually disappear from the St. Lucie Estuary as well as some areas of the IRL South closest to the St. Lucie Estuary (USACE, 2004). Most SAV coverage in the St. Lucie Estuary is now found near the IRL. Those species known to occur there are shoal grass (*Halodule wrightii*), wigeongrass (*Ruppia maritime*), and Johnson's seagrass (*Halophila johnsonii*). Maintaining the correct salinity in the estuary would provide benefits for these aquatic plants requiring specific salinity ranges. Light availability is also an important factor for SAV colonization. The depth to which the required quantity of light may penetrate the water is inversely proportional to turbidity and water color. Other water quality parameters that affect light attenuation include nitrogen and phosphorus. Increasing water clarity and stabilizing

the salinity regime in the estuary would increase light penetration and expand the area of suitable habitat for aquatic plant colonization.

Alternatives 1bS2, 1bS2-m and 4, all improve the overall performance for the St. Lucie Estuary. These three alternatives show similar results, but Alternative 1bS2-m performs somewhat better than the others in reducing flows >2000 cfs (Figure 5-2). Alternative 1bS2-m had the fewest (65) mean monthly flows >2000 cfs. That translates to approximately nine less events (compared to WSE) over the 36 year POR where the estuary suffers from flows >2000 cfs. To the extent that the Preferred Alternative, 1bS2-m, is able to reduce damaging regulatory discharges to the estuary and IRL system, it will benefit SAV, including seagrasses which are currently in a declining state from sediment and nutrient deposition from upstream sources. Clearer water and more stable salinity are expected to foster re-colonization of the bottom by benthic plants, especially shoal grass.

Minimizing flows >2000 cfs would provide a salinity range more favorable to SAV. However, Alternatives 2a and 2a-m do not reduce damaging flows >2000 cfs to the estuary. Alternatives 2a and 2a-m performed similar to the base, WSE, regarding mean monthly flows >2000 cfs. The base and Alternative 2a had 74 events, whereas Alternative 2a-m had 73. As such, these alternatives would not provide improvements in flow ranges >2000 cfs, or provide more suitable conditions for SAV re-colonization.

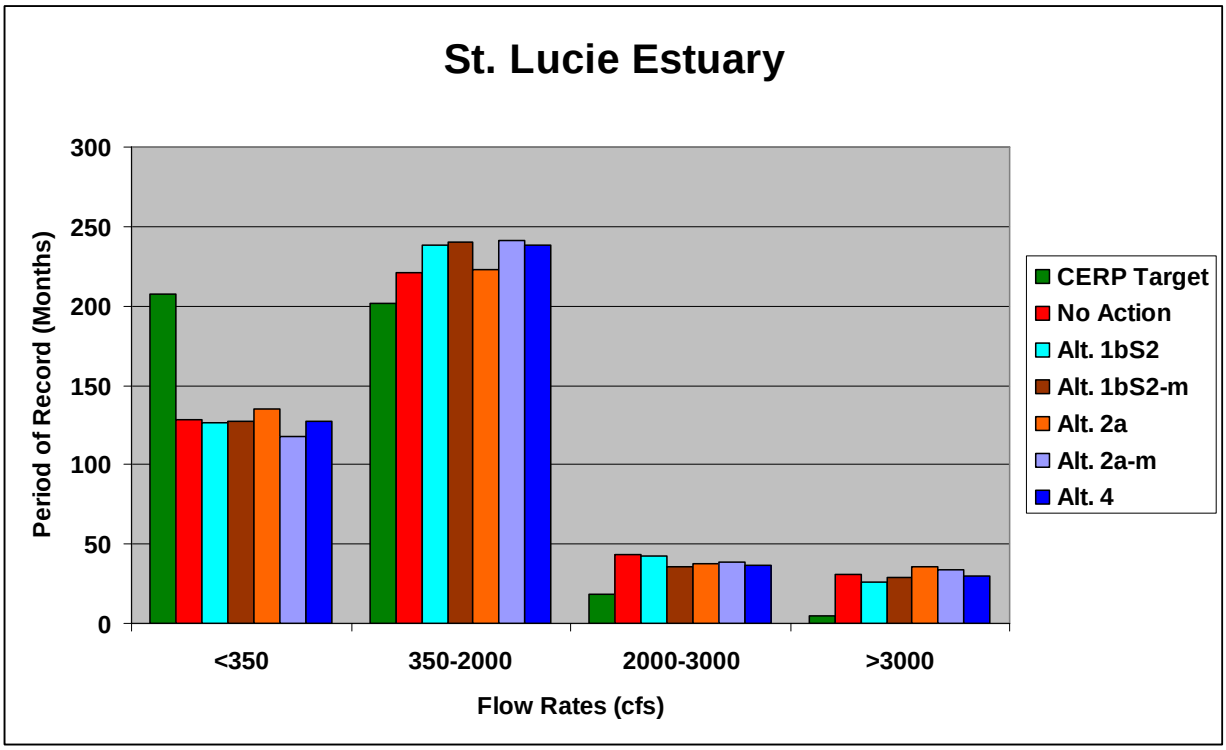


FIGURE 5-2: ST. LUCIE FLOW RATES FOR ALTERNATIVES

Caloosahatchee Estuary

At times, the Caloosahatchee receives high volume inflows during the wet season. During the dry season inflows may be too low and supplemental input from Lake Okeechobee is required to maintain a viable salinity gradient in the estuary. Mean monthly flows >2800 cfs may cause mortality of marine seagrasses and other organisms near the mouth of the Caloosahatchee Estuary. Mean monthly flows >4500 cfs may begin to cause mortality of seagrasses in the adjacent San Carlos Bay.

Performance for the Caloosahatchee Estuary is somewhat mixed. All of the alternatives did better than the base at maintaining the preferred flows between 450 to 2800 cfs. Additionally, all of the alternatives did better than the base at reducing the number of large volume flows between 2800 and 4500 cfs. However, none of the alternatives did better than the base, WSE, at reducing large volume flows >4500 cfs (Figure 5-3). Only Alternative 2a-m did a better job at reducing durations of flows >4500 for >5 weeks.

All of the alternatives, except the No Action Alternative, would provide environmental base flow releases to the Caloosahatchee Estuary. This feature was included to address the dry season inflows that may be too low to maintain a viable salinity gradient in the estuary. During times of extended low inflow conditions, when salinity is too high in the upper estuary, tape grass (*Vallisneria americana*), which is a salt tolerant, fresh water species, becomes very sparse and can disappear completely (Doering et al., 2002). When growing conditions are favorable, the most extensive beds are found in the 640 acre area between Beautiful Island and the Ft. Myers Bridge.

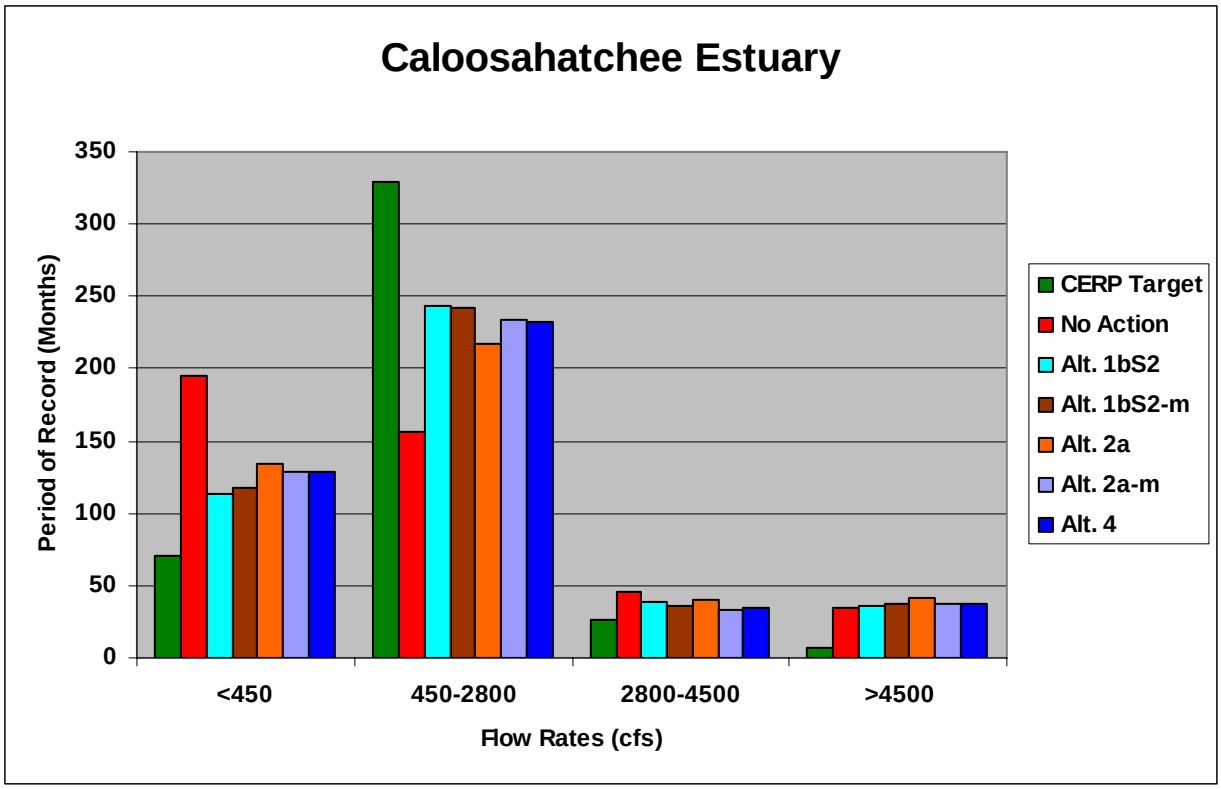


FIGURE 5-3: CALOOSAHATCHEE ESTUARY FLOW RATES FOR ALTERNATIVES.

5.2.3. EVERGLADES AGRICULTURE AREA

Under any of the alternatives, regulatory discharges from Lake Okeechobee will be confined to existing canal systems and flow through the EAA without impacting existing vegetation. Furthermore, native vegetation, within remnant wetlands and within the Rotenberger and Holey Land WMAs will not be impacted.

5.2.4. WATER CONSERVATION AREAS (GREATER EVERGLADES)

For simplicity, the impacts to the greater Everglades as they relate to vegetation (Section 5.2) and fish and wildlife resources (Section 5.5) are discussed completely in this Section, 5.2.

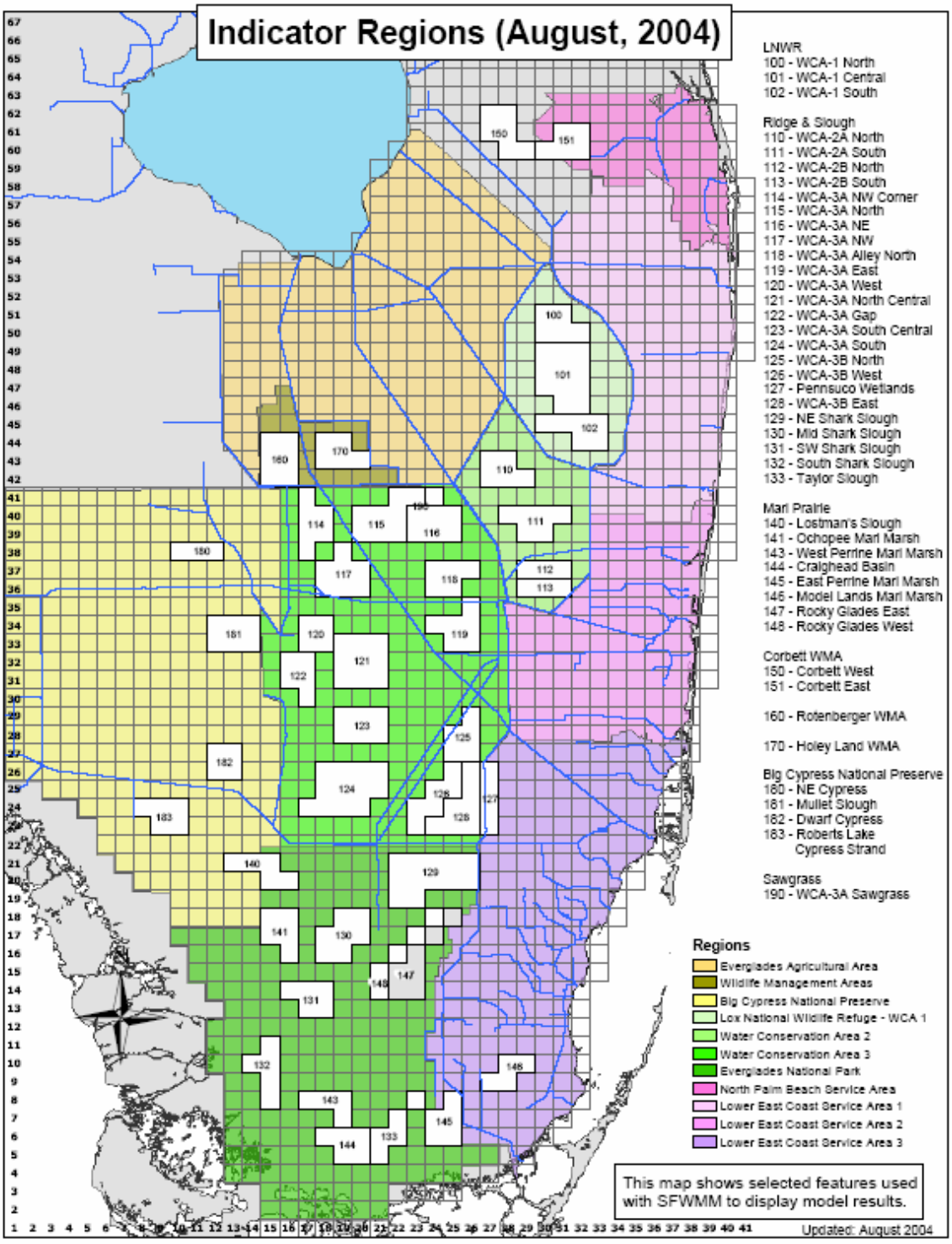


FIGURE 5-4: GREATER EVERGLADES INDICATOR REGIONS

Indicator Regions (Figure 5- 4) representing a variety of habitat types in the Everglades were used to evaluate the alternatives. A subset of the total number of Indicator Regions was selected to represent the range of hydrologic conditions in the WCAs, northern dry areas, southern wet areas, and several middle regions. The Indicator Regions used for the WCAs were 100, 102, 110, 113, 115, 121, 124, 125, and 128, and for northern Shark River Slough 129. The Indicator Regions used for snail kites were 101, 112, 115, 117, 118, and 119.

A subset of Hydrologic PMs was used in these analyses to evaluate impacts of the Alternatives on the Everglades. Only hydrologic conditions, not water quality, were evaluated. These hydrologic PMs were peat dry-out, tree island inundation, wading bird breeding season water recession rates and reversals, and snail kite breeding and apple snail reproduction.

Peat dry-out, total weeks: Evaluation is based upon the number of weeks that water depths fell below one foot or lower below the surface. Peat dry-out increases the frequency and severity of peat fires, which can severely damage wetland ecosystems. The target is to reduce the weeks of very low water tables. Lower numbers are preferred. All of the alternatives increase the number of weeks of peat dry-out.

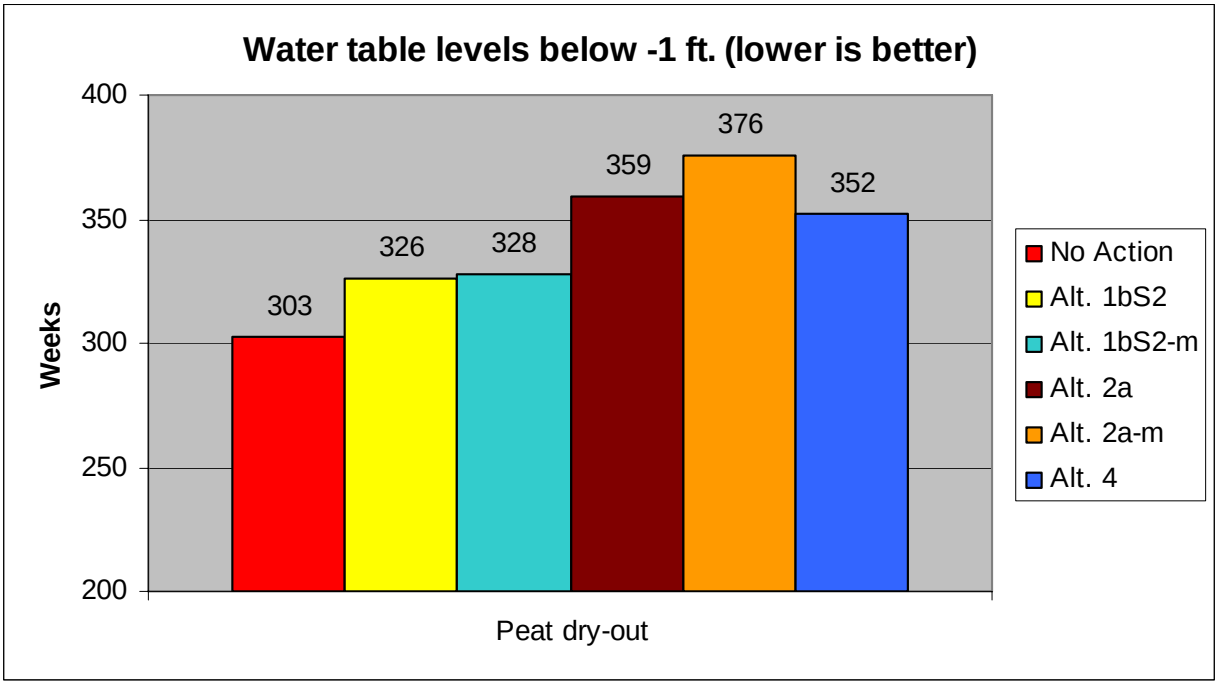


FIGURE 5-5: PEAT DRY-OUT

Wading Bird Nesting Success: Wading birds nest from January through May in the Everglades. The two PMs that target wading birds are recession rates and reversals.

Recession rates describe the declines in water depths, and reversals are defined as rapid increases in water depths.

Recessions: As water depths decline in the dry season, wading bird food species are concentrated in the shallower water, increasing the wading birds' feeding efficiency. Optimal water depths for wading birds vary with the species, and move across the landscape as water depths decrease. The concentrated prey allows the parent birds to feed their hatchlings and to successfully fledge the year's young. The months that are important for this PM are January through May each year.

Target recession rates are -0.1 foot per week. This measure reports the number of weeks that recession rates fall into the "good" category (declining water depths between 0.16 and 0.05 feet per week). The goal is to increase the percent of weekly recession rates falling into the "good" category during the wading bird breeding season. Higher numbers are better. The Alternatives are ecologically similar.

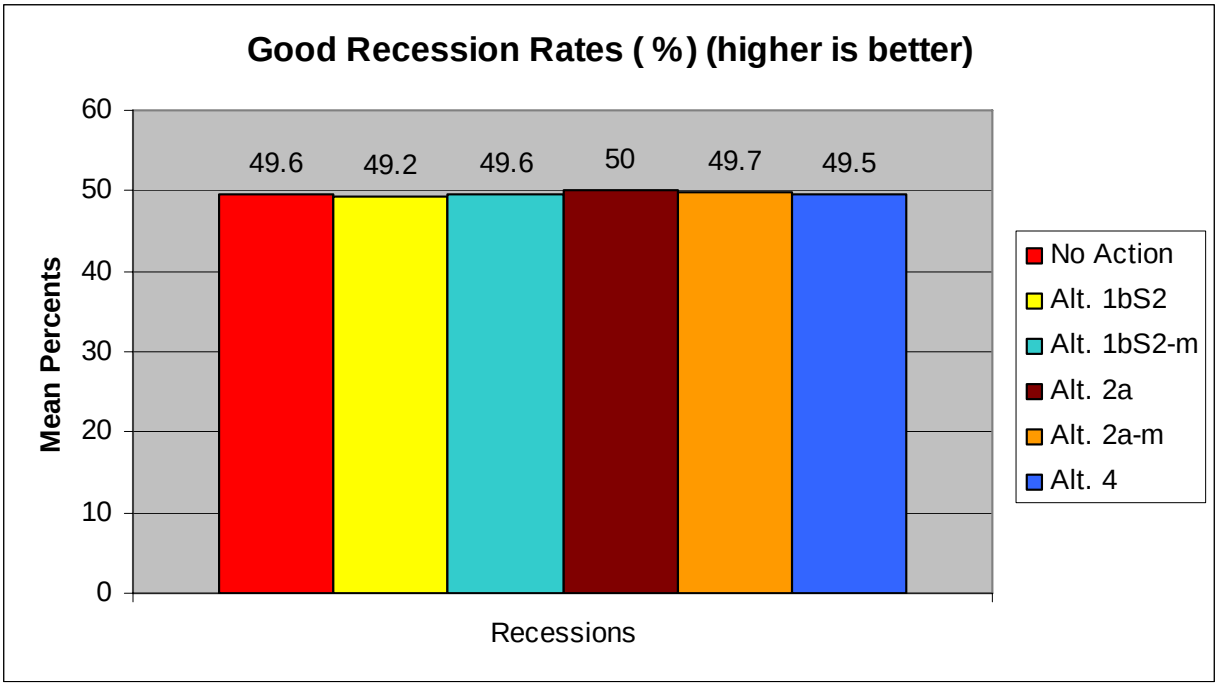


FIGURE 5-6: RECESSIONS

Reversals: When water depths increase during the breeding bird season (January through May), food prey concentrated in shallower pools disperse, reducing feeding efficiencies of the parent birds. Reduction in feeding reduces nesting success of wading birds, so reversals should be avoided during this period of the year. This PM summarizes the percent of weeks of reversals (when recession rates are above the desired recession rates and increasing). Lower numbers are better. For this PM, reversals are similar for all alternatives.

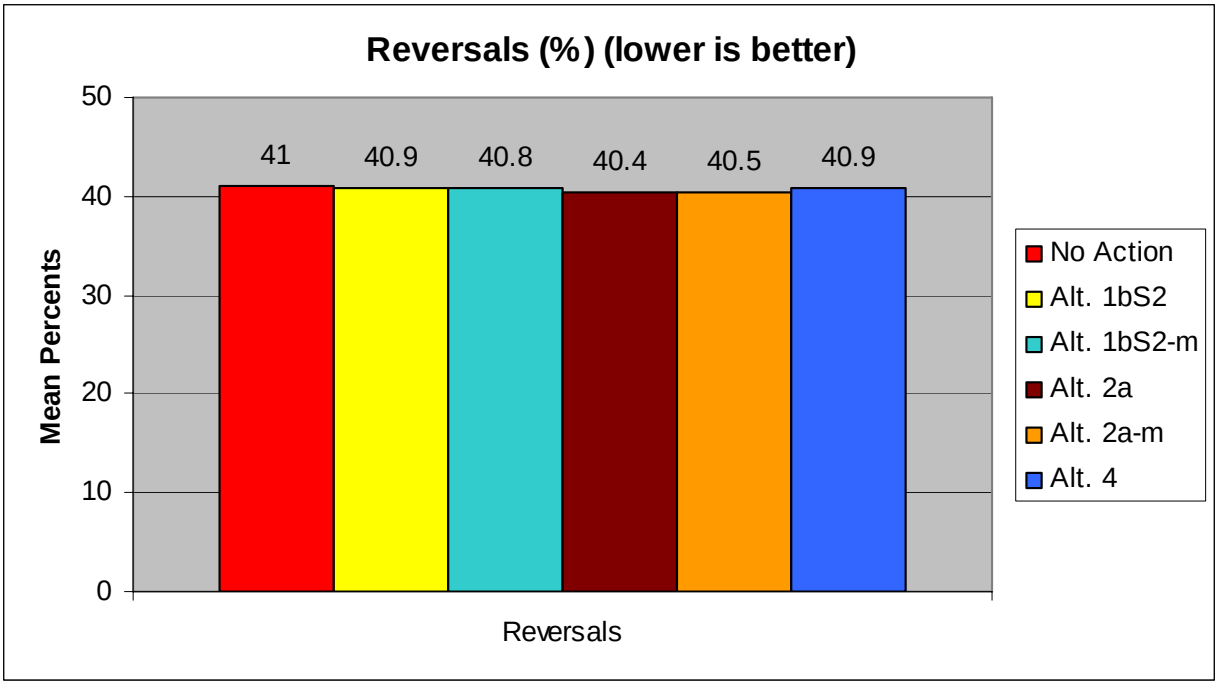


FIGURE 5-7: REVERSALS

Tree island inundation: Tree species on tree islands are adapted to a period of inundation. However, excessive periods of long-term inundation can reduce the survival of tree species when one year, or a succession of years, exceed the tree species tolerances. The Tree Island Inundation PM records the duration, in weeks, of water depths above two and a half feet. The preferred number of weeks should not exceed 17 per year. Although the total number of weeks (events * duration) varies, none of these differences is significant.

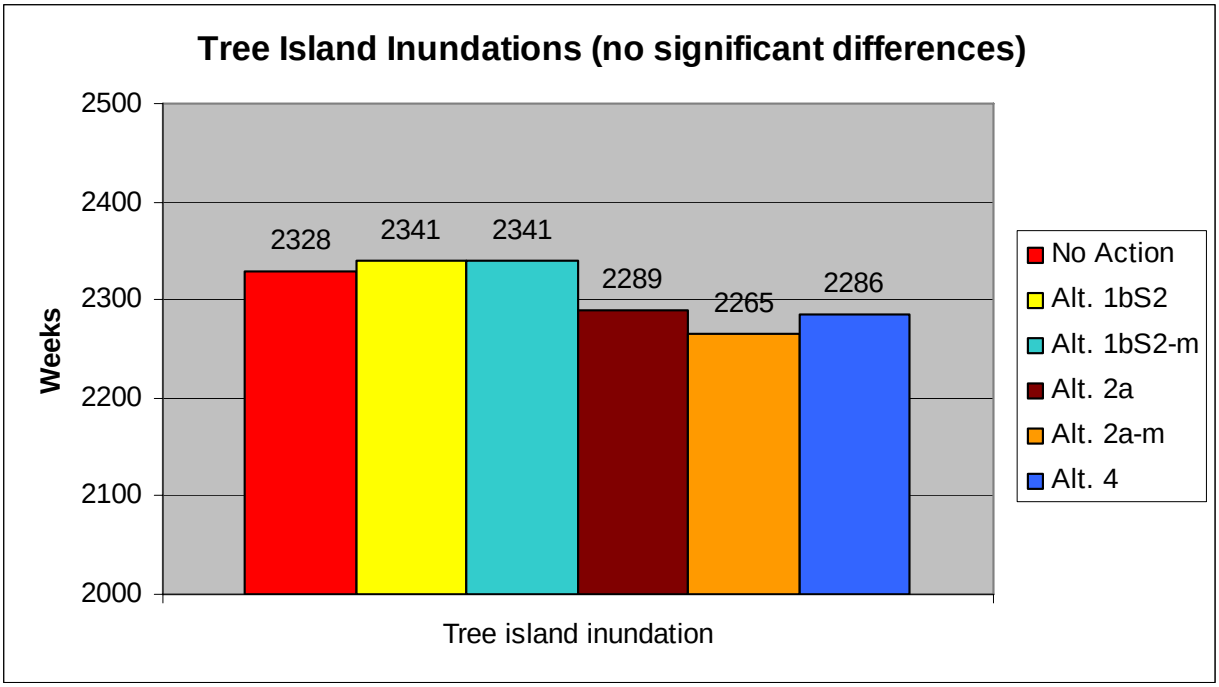


FIGURE 5-8: TREE ISLAND INUNDATION

Greater Everglades Snail Kite: Like the wading birds, snail kites also reproduce during the early part of the year and feed upon apple snails. Rapid water depth reversals are harmful to apple snail reproduction, and loss of a year's cohort of apple snail eggs impacts snail populations for two to three years. Lack of prey inhibits snail kite reproduction and survival and therefore conditions that decrease apple snail populations negatively impact snail kites.

The PM for the snail kites indicates "Optimal" (O) conditions, "Marginal" (M) conditions, and "Unsustainable" (U) for snail kites. For the select Indicator Regions, ratings of "Unsustainable" were valued at 0, "Marginal" at 5, and "Optimal" at 10. These values are summed over the selected Indicator Regions. All the alternatives except for 2a-m are better than the current schedule.

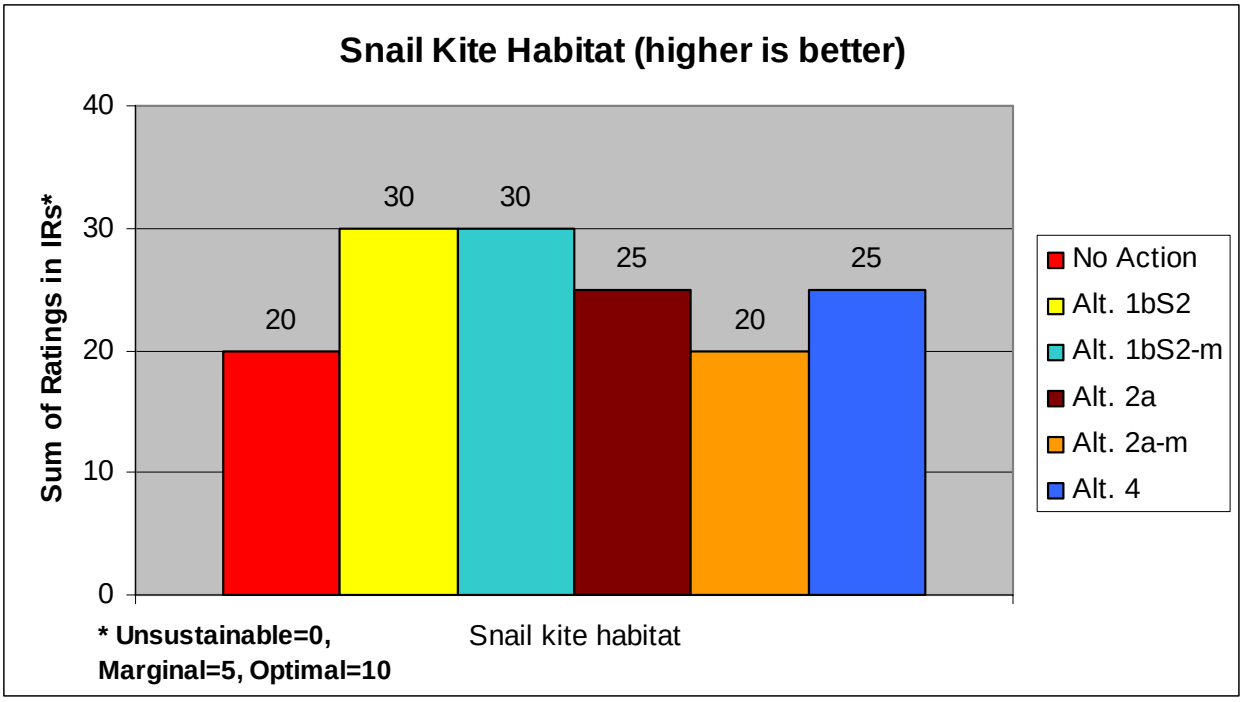


FIGURE 5-9: SNAIL KITE HABITAT

5.3. THREATENED AND ENDANGERED SPECIES

Formal consultation in accordance with the Endangered Species Act (ESA) included submittal of a Biological Assessment on June 30, 2006. Additional information on ESA consultation is found in Appendix C.

5.3.1. EVERGLADE SNAIL KITE

No Action Alternative or Base (WSE)

The issue of high water levels and the detrimental effects on the littoral zone of Lake Okeechobee has been a major concern since the 1990's, and a major focus of the LORSS. The littoral zone of Lake Okeechobee provides one of the largest habitats in south Florida for the snail kite (Bennetts and Kitchens, 1997) and it supports large populations of wading birds (Smith et al., 1995). High water effects result in declines of submerged plants, as well as loss of bulrush and other emergent vegetation, where apple snails (main food source for the snail kite) lay their eggs.

Under the No Action Alternative, during abnormally wet periods of heavy rainfall and runoff, Lake Okeechobee would continue to experience high stages >16 feet, NGVD, and extreme high lake stages >17 feet, NGVD. During periods of extreme high lake levels (>17 feet), wind and erosion cause emergent and submerged plants to be torn loose from their substrate, resulting in a loss of important fish and wildlife habitat When compared to the other alternatives, WSE ranks the worst for high lake stage events, and is the only alternative with prolonged periods of moderately high lake stages (>15 feet for 365 days). Prolonged inundation of the littoral zone by stages >15 feet under the

WSE schedule reduces diversity of marsh vegetation on which that species depends. This alternative would continue to allow high lake stages which could adversely affect the Everglade snail kite.

Alternatives 1bS2 and 1bS2-m
All of the alternatives perform basically the same for percent of time within the stage envelope of 12.5 feet (June-July low) and 15.5 feet (November –January high). A wide body of published research documents the benefits of seasonally variable water levels within this range for the benefit of many plants and animal communities on Lake Okeechobee. Habitat for the snail kite is expected to improve with a water management regime that mimics more natural hydrologic variability. Both alternatives 1bS2 and 1bS2-m are designed to manage the lake at lower elevations. However, while both alternatives produce comparable benefits for the lake's littoral zone, 1bS2 allows the lake stage to exceed >16 ft., NGVD, more often (approximately 150 days more over the 36-year simulated POR) than Alternative 1bS2-m.

According to Bennetts and Kitchens (1997), snail kites nest primarily in willow and other woody vegetation types. Two factors contributing to loss of this habitat in Lake Okeechobee include prolonged periods of deep water and the expansion of exotic vegetation such as torpedograss. Torpedograss expansion is more likely during extreme low water periods. Both alternatives perform well for reducing high lake stages and limiting extreme low lake stages. Extreme low lake stage is defined by the technical experts to be a depth below 10 feet. It is at this level that detailed field observations during the 2000-2001 drought indicated that negative effects (rapid spread of terrestrial weedy plants, loss of nearly all the submerged vegetation habitat, loss of the lake's apple snail population) occurred. The modeling results of Alternatives 1bS2 and 1bS2-m indicate that lake levels below 10 feet occurred approximately four percent of the time during the 36 year POR. The positive effect of these two alternatives lowering the lake stage to reduce the high extreme events clearly outweighs the potential negative effect of occasional extreme low water events. Either alternative may affect the snail kite and its critical habitat. Even though the extreme lows may be adverse, it is expected that the effects overall from these two alternatives would be beneficial to the species.

Alternatives 2a and 2a-m
All of the alternatives were developed to reduce the frequency of high lake stages on Lake Okeechobee. Alternatives 2a and 2a-m perform slightly better than 1bS2, 1bS2-m and 4 for reducing high lake stages above 16 ft., NGVD. However, all of the alternatives perform nearly the same for the percent of time inside the stage envelope. The only discernable difference for lake performance with these two alternatives is their performance for extreme low lake stages <10 feet. Compared to all alternatives, including the No Action, Alternatives 2a and 2a-m performed slightly worse. The effects of 2a and 2a-m would be relatively the same as those effects described for Alternatives 1bS2 and 1bS2-m. However, it is expected that the negative effects from increased extreme low water events would be more substantial from Alternatives 2a and 2a-m. These extreme low conditions could impact nesting and foraging habitat for the snail kite. Macro-invertebrates such as the apple snail are impacted by extreme low water

levels due to effects on plant habitat. A prolonged period of extreme low stage in 2000-2001 appeared to have nearly eliminated the apple snail population from the littoral zone. Alternatives 2a and 2a-m may have some negative effects to the snail kite and its critical habitat due to extreme low lake stage occurrences however, it is expected that the overall effects would be beneficial to the species. The occurrences of extreme low levels may directly impact the apple snail.

Alternative 4

Alternative 4 would provide some of the same hydrologic improvements and have similar effects on the snail kite as Alternatives 1bS2, 1bS2-m, 2a and 2a-m. Alternative 4 is comparable to the other alternatives for reducing high lake stages, and for the percent of time in the stage envelope. However, Alternative 4 has less extreme low events than 2a or 2a-m. Alternative 4 compares to 1bS2 and 1bS2-m for percent of time below 10 feet. As such, the effects as described above for IbS2, 1bS2-m, 2a and 2a-m would apply to Alternative 4. Alternative 4 may have some negative effects on the snail kite and its critical habitat due to low lake stage occurrences; however, it is expected that the overall effects would be beneficial to the species.

5.3.2. WOOD STORK

The description above for the snail kite, favors littoral zone/marsh communities supported by wading birds. The quality of foraging habitat within Lake Okeechobee is expected to improve as a result of lower lake levels and a more natural hydrologic variability (moderately declining water levels during the wading bird nesting season) achieved by all alternatives compared to the base. Alternatives 1bS2, 1bS2-m, 2a, 2a-m, and 4 may affect the wood stork, but beneficial effects would be expected for this species. The No Action Alternative would continue to allow high lake levels, adversely impacting Lake Okeechobee's littoral zone that the wood stork utilizes.

5.3.3. WEST INDIAN MANATEE

As described above for the snail kite, all alternatives, except the base, would be beneficial for Lake Okeechobee's littoral zone plant and animal communities. All alternatives, except the base, would reduce the frequency of high water levels that have been detrimental over the years to the lake's resources. If littoral zone improvements are achieved, then there is the potential for an increase in the vegetative community on which the manatee feeds. There would be no significant adverse effect on habitat conditions for the manatee within the lake as a result of any of the alternatives.

5.3.4. BALD EAGLE

The potential improvement to conditions of Lake Okeechobee's littoral zone may result in enhanced productivity of fish in the lake. Foraging conditions may be slightly improved for the eagle for all alternatives compared to the base. It is determined that implementation of either alternative would have no effect on the bald eagle.

5.3.5. EASTERN INDIGO SNAKE

The Eastern indigo snake occurs primarily on uplands. Implementation of any of the alternatives, including the base, would not affect the indigo snake.

5.3.6. CAPE SABLE SEASIDE SPARROW

The modeling simulations indicate that the hydrology of the indicator regions of the Everglades corresponding to occupied CSSS habitat is not adversely affected by the base or Alternatives 1bS2 or 1bS2-m. Therefore, neither the species nor its designated critical habitat would likely be affected by these alternatives. Modeling simulations for Alternatives 2a, 2a-m, and 4 performed slightly worse as these alternatives indicated a flow decrease to the ENP by -6,000 acre ft./year, -13,000 acre ft./year, and -10,000 acre ft./year, respectively.

5.3.7. OKEECHOBEE GOURD

The Okeechobee gourd would benefit from any of the alternatives, except the base, as all of the alternatives lower the high lake stages. By decreasing the high stage events, the alternatives would allow for more low lake stage events. As such, there would be a potential benefit to listed species, such as the Okeechobee gourd, where a lower lake stage is crucial for its survival. Low lake stages allow for suitable habitat areas within the littoral zone that are able to dry out and allow for seed germination. Implementation of the Preferred Alternative or any of the described alternatives may effect the gourd, however, the reduction of extreme high water under these alternatives should benefit this species overall.

5.3.8. SMALLTOOTH SAWFISH

Since the Florida smalltooth sawfish population is currently restricted to waters of southwest Florida, especially along the coastal fringe of ENP and north to Charlotte Harbor, releases from Lake Okeechobee to the St. Lucie Estuary will not affect this species. It would be more common for the smalltooth sawfish to be found along the coastal areas of the Caloosahatchee Estuary, or near the mouth of the Calooshatchee River. Some research and monitoring in the Charlotte Harbor estuarine system is currently being conducted by the FFWCC. In studies documenting occurrences of sawfish along the southwest coast of Florida, anglers have reported encountering sawfish on a regular basis in the Charlotte Harbor area, and near the mouth of the Caloosahatchee River (Seitz and Poulakis, 2002). As part of the Charlotte Harbor study, the FFWCC is currently conducting monthly random sampling for sawfish in the Caloosahatchee River (FFWCC, 2005).

It has been documented that juvenile sawfish use shallow habitats with a lot of vegetation, such as mangrove forests and SAV, as important nursery areas. A more stable salinity regime may result in increased SAV coverage, and therefore increase the population of small fish and benthic organisms, which are a food source for the sawfish.

As discussed in Sections 5.2.2 and 5.5.2, performance for the Caloosahatchee Estuary is somewhat mixed. All of the alternatives did better than the base at maintaining the preferred flows between 450 to 2800 cfs. Additionally, all of the alternatives did better than the base at reducing the number of damaging flows between 2800 and 4500 cfs. However, none of the alternatives did better than the base, WSE, at reducing high damaging flows >4500 cfs. Only Alternative 2a-m did a better job at reducing durations of flows >4500 for >5 weeks.

Implementation of the Preferred Alternative (1bS2-m) is likely to increase the preferred flow range between 450 to 2800 cfs, and reduce damaging flows between 2800 and 4500 cfs. Even though damaging flows above 4500 cfs may increase (three months over the 36 year POR), it is not a substantial difference over the current WSE schedule. The preferred regulation schedule (1bS2-m) is not likely to directly affect the sawfish. However, there is the potential for indirect effects to the habitat (i.e. seagrasses) that the sawfish occupies at the mouth of the Caloosahatchee River when releases are greater than 4500 cfs, for long durations. The Corps has determined that the proposed alternative regulation schedule "may affect" but is not likely to adversely affect the sawfish.

5.3.9. JOHNSON'S SEAGRASS

One of the objectives of this study is to reduce high regulatory releases to the St. Lucie Estuary, and thereby improve the salinity regime to the area. Modeling results indicate that Alternatives 2a and 2a-m decrease mean monthly flows between 2000 cfs and 3000 cfs, but do not decrease damaging flows >3000 cfs. Results indicate that Alternatives 1bS2, 1bS2-m (Preferred Alternative) and 4, all decrease the mean monthly flows >2000 cfs to the St. Lucie Estuary. The decreased freshwater discharges from the Lake would cause less stress to seagrasses, including Johnson's seagrass, in the IRL. As such, the Corps has determined that the preferred Alternative, 1bS2-m, is not likely to adversely affect Johnson's seagrass.

5.3.10. STATE LISTED SPECIES

Of the State listed species not evaluated above, the American alligator, brown pelican, and black skimmer (species of special concern) may slightly benefit from the preferred Alternative, 1bS2-m by the improved fish production in Lake Okeechobee, which those species consume. The wading birds, roseate spoonbill, limpkin, little blue heron, reddish egret, snowy egret, tricolored heron, and white ibis, may benefit by the improved spring water recession regime under 1bS2-m.

5.4. HARDGROUNDS

Hardgrounds would not be affected by any of the alternatives.

5.5. FISH AND WILDLIFE RESOURCES

As was the case with vegetation (Section 4.2), the study area is site specific with regard to fish and wildlife resources and it is highly probable that there will be affects on these resources due to the recommended alternative, or any other alternative discussed. These effects are expected to be largely beneficial, but in certain areas may be locally adverse due to the lake's existing water quality problem.

5.5.1. LAKE OKEECHOBEE

Although the pelagic zone of Lake Okeechobee is important in supporting commercial and recreational fisheries, the littoral zone of the lake is highly productive, sustains a greater diversity of fish and wildlife, and is the area most affected by changes to the lake's regulations schedule. Lake Okeechobee's littoral zone provides critical habitat for

fish and wildlife, including Federal listed species as described in Section 3. A general understanding of how fish and wildlife respond to changes in habitat structure and resource availability leads to a consensus among experts that Lake Okeechobee's fish and wildlife may be harmed by extreme high and low stage events (Havens et al., 2004c; FFWCC, 2003).

These extreme water levels can completely dry out or inundate Lake Okeechobee's entire littoral zone. However the issue of high water levels and the detrimental effects on the ecology of Lake Okeechobee has been a major concern since the 1990's, and a major focus of the LORSS. Scientists observed a large-scale loss of aquatic vegetation and impacts to fisheries in Lake Okeechobee when high water conditions persisted from 1995 to 1999 (Havens, et al., 2001). Greater water depths have devastated woody plants, and submerged and emergent macrophytes, resulting in habitat destruction and alteration of primary production in the Lake Okeechobee ecosystem (FFWCC, 2003).

In Lake Okeechobee, water level management that mimics natural conditions will have the greatest benefits to plant communities (FFWCC, 2003). The water management regime would be similar to the Lake Okeechobee Stage Envelope PM (LO-3), 12.5 feet (June-July low) and 15.5 feet (November-January high). The ideal pattern for foraging by wading birds is considered to be an uninterrupted decline in lake stage from approximately 15 feet in January to approximately 12 feet by June without reversals (rising water stages) of >0.5 feet (USFWS, 1999). This type of spring recession would not only provide benefits for wading birds nesting and foraging, but would also provide development of good submerged and emergent vegetation habitat for fish and wildlife, and in general, benefits the littoral wetland by providing a range of water depths that subject most of that area to wetting and drying (Havens et al, 2003c).

As stated throughout this document, all the alternatives lower the top stage of the schedule from 18.5 feet (WSE) to 17.25 feet. All alternatives would produce lower lake stages and fewer occurrences of prolonged high and extreme high lake stage events. There is no observable difference in higher stages among the alternatives. In addition, all alternatives performed basically the same for the percentage of time within the stage envelope. The differences within the stage envelope were minor with Alternative 1bS2 falling within the stage envelope 27.3 percent of the time and Alternative 2a falling within the envelope 32 percent of the time. The remaining alternatives fell somewhere in between these scores. All alternatives minimized prolonged duration of high stages except for the base, WSE. Modeling simulations indicated that the base had two events of lake stage >15 feet for 365 days. All other alternatives had zero events. All of the alternatives did equally well with reducing lake stages >17 feet. The base performed the worst for this PM.

The base, however, has fewer low lake stage events than the other alternatives, as would be expected since it has more high lake stage events. The remainder of the alternatives scored relatively the same for lake stage occurrences <10 feet. However, Alternative 2a-m performed slightly worse than any other alternatives. All of the alternatives will have more low stage events compared to the base. However, the

positive effect of these alternatives lowering the lake stage to reduce the high extreme events clearly outweighs the potential negative effect of occasional extreme low water events. Lake Okeechobee can benefit from low level occurrences, but the key for benefits is based on duration. Extended periods of low lake stages may have more adverse effects to fish and wildlife.

Maintaining the heterogeneous native plant communities which are intrinsic to a healthy lake littoral zone may also facilitate an improvement in fish stocks and wading birds under conditions brought about by the Preferred Alternative, 1bS2-m, or any other alternative compared to the base. By improving lake hydroperiods, including a lowering of overall lake stages and reductions in both prolonged high and extreme high lake stages, conditions for both emergent and SAV, as well as for wading bird foraging, nesting and spawning and feeding habitat for fish should be improved. When low-to-moderate water levels occur in Lake Okeechobee, resulting in dense plants such as bulrush and peppergrass, the biomass and taxonomic diversity of macro-invertebrates is maximal (Warren and Vogel, 1991). Many of these animals, including grass shrimp, amphipods, and a variety of larvae are integral to the diets of largemouth bass, black crappie, redear sunfish, and bluegill sunfish (Havens and Gawlick, 2005).

Lake stages, as predicted by stage hydrographs, will differ substantially between the Preferred Alternative and WSE. A key difference between the No Action (WSE) Alternative and the proposed action (1bS2-m) is the lake regulation schedule elevation below which no regulatory discharges are made (line between zones D and E for WSE, and the operational band No Flow for 1bS2-m (reference Figure 3-1). For WSE, the low end of the regulation schedule allows Lake Okeechobee to recede to 13.5 ft., NGVD. Under Alternative 1bS2-m, the low end of the regulation schedule is at 11.5 ft., NGVD. The proposed action therefore allows for more frequent lower lake levels than would occur under WSE. Periodic dry downs have been shown to be important for the marsh and littoral plant communities to regenerate, providing optimal habitat for fish and wildlife, enhancing foraging conditions for wading birds and reducing nutrient and sediment influxes into the littoral zone from the open waters of Lake Okeechobee. However, during extended extreme low stages, there are many negative effects on wetland fauna. Bulrush stands become too dry for fish spawning or shelter, and smaller fish may face mortality due to predation in Lake Okeechobee's open waters. Wading birds and waterfowl have restricted foraging and nesting habitat. Wetland dependent organisms including turtles, frogs, snakes, marsh rabbits, muskrats, and others may suffer population declines. Extreme low lake levels with durations of three months or longer may impact the productivity of the apple snail, the snail kite's main food source.

There should be minimal adverse effects on lake fish and wildlife, including macro-invertebrates, upon which wading birds and fishes depend for food, as a result of the preferred Alternative, 1bS2-m, or Alternatives 1bS2 and 4. Alternatives 2a and 2a-m as modeled would result in some adverse effects to the lake's fish and wildlife, as described above. Adverse effects are based on more occurrences of extreme low lake levels, compared to the other alternatives.

Water levels in the rim canal or principal navigation canals should not be significantly affected during low water occurrences, and will continue to offer refuge to animals such as manatees, alligators, turtles and predator fish known to use this habitat.

5.5.2. NORTHERN ESTUARIES

Water that needs to be released from Lake Okeechobee for flood protection is termed a "regulatory release" and although these releases can go south to the Everglades or east and west to the estuaries, the largest volume goes to the estuaries. During the dry season (mid-November to mid-May) large regulatory flows are minimal to the estuaries. Higher volumes of flows to the estuaries generally occur during the wet season.

To evaluate the various alternatives, three PMs were examined: The number of mean monthly flows in various flow ranges over the 36 year POR (POR equates to 432 months), a duration measure based on the weekly moving average discharge at S-79 for the Caloosahatchee; and the two-week moving average total discharge to the St. Lucie; and finally the number of mean monthly flows in various flow ranges during the critical spring spawning period.

Spring is an important period in the Caloosahatchee and St. Lucie estuaries as many biotic groups often begin to increase their productivity and dependency on the estuary. An indicator species used during this critical time is the American oyster (*Crassostrea virginica*). Adult oysters are bottom dwellers. However, their life cycle starts in the water column. Adults release (spawn) eggs and sperm into the water column. Once eggs are fertilized a two to three week larval period begins. The larval period occurs entirely in the water column and culminates in settlement on the bottom. It is during the spring time that freshwater flows to the estuaries should be monitored closely and possibly reduced, so larvae are retained in the system and not flushed out by excessive freshwater flows. Freshwater releases should also be monitored to allow for appropriate salinity conditions for oyster reproduction. Optimal salinity for spawning is 10-30 parts per thousand (ppt) (Mazzotti, et al. 2003).

Oysters are commonly used as an indication of spawning season, but many other species of saltwater fish begin spawning in late winter/early spring. Without optimum salinity, because of excessive freshwater, other fish species may be affected too by fresh water releases.

Performance Measures

In the tables below, a color scheme has been used to indicate the relative performance of the alternatives (green identifies the best performer). The discussion of each estuary present results for each PM.

It is important to note that the hydrologic model output assumes maximum practicable releases from the Lake within each decision tree band, with consideration of downstream operational constraints. This provides a very useful means for comparing the effects of all alternatives. However, the decision making process to determine quantity, timing, and duration of the potential release considers estuary conditions/needs, potential impacts from lake releases, local runoff, and dry weather conditions. Although modeled and represented in the modeling output, maximum releases are not always necessary or recommended.

High discharges of freshwater from Lake Okeechobee can adversely affect the St. Lucie Estuary. During dry periods, supplemental water from Lake Okeechobee is generally not required. Ground water inflow and runoff from other basins supply a sufficient base flow to the estuary. Mean monthly flows >2000 cfs may lower salinity in the St. Lucie Estuary sufficiently and may cause mortality of oysters and other estuarine organisms. Flows >3000 cfs may cause significant mortality of these organisma in both the estuary and adjacent IRL. The longer these high flows last in either estuary, the higher the potential for adverse effects. So, in general, those alternatives with fewer high discharges of shorter duration are preferred.

At times, the Caloosahatchee may receive high volume inflows of freshwater from Lake Okeechobee during the wet season. During the dry season inflows are too low and supplemental input from Lake Okeechobee is required to maintain a viable salinity gradient in the estuary. Mean monthly flows >2800 cfs may cause mortality of marine seagrasses and other organisms near the mouth of the Caloosahatchee Estuary. Mean monthly flows >4500 cfs may begin to cause mortality of seagrasses in the adjacent San Carlos Bay.

During the dry season, salt water from the Gulf of Mexico can intrude up the estuary to the Franklin Lock and Dam (S-79). Too much salt in the upper estuary may adversely impact the brackish water organisms that normally inhabit this region. During the driest times, a mean monthly flow of 450 cfs at S-79 is required to maintain viable salinity conditions in the upper estuary.

Spring time is a critical period in estuarine systems because many estuarine dependent organisms reproduce at this time. High flows >2800 cfs in the Caloosahatchee and >2000 cfs in the St. Lucie, may prevent the early life stages of fish, shellfish and other commercially and recreationally important species from utilizing estuarine habitat. Alternatives with the fewest number of mean monthly flows exceeding these limits are to be preferred.

St. Lucie Estuary

Mean Monthly Total Inflow: The Preferred Alternative, 1bS2-M, had the fewest (65) mean monthly flows >2000 cfs and therefore is preferred over the other alternatives. The difference in the distribution of high flows between those >3000 cfs and those between 2000 and 3000 cfs was not large enough to distinguish one from the other. Alternative 4 had (67 events) and Alternative 1bS2 had (68 events) which are rated second and third respectively, although the difference between them was minimal. Having fewer flows >3000 cfs, Alternative 1bS2 had 26 events and therefore would be expected to do relatively less damage to the IRL. On the other hand, Alternative 1bS2 would be expected to do relatively more damage to the St. Lucie Estuary because it had more (42 events) flows in the 2000 – 3000 cfs range than Alternative 4 which had 37.

TABLE 5-1: ST. LUCIE MEAN MONTHLY TOTAL FLOWS				
		CFS		
Alternative	<350	350-2000	2000-3000	>3000
No Action (WSE)	128	230	43	31
Alt1bS2	126	238	42	26
Alt1bS2-M	127	240	36	29
Alt 2a	135	223	38	36
Alt 2a-M	118	241	39	34
Alt 4	127	238	37	30

Duration: Alternative 1bS2 had the fewest occurrences of 14-day moving average flows exceeding 3000 cfs for more than a month (two week periods, Table 5-2). At no time did the flow exceed 3000 cfs for more than ten weeks (five two-week periods). The No Action (WSE) Alternative ranked second. In general the remaining alternatives performed somewhat worse with occurrence of high flows for over ten weeks (five two-week periods). Alternative 1bS2-M had fewer occurrences of 14-day moving average flows exceeding 3000 cfs for more than a month than WSE, but eight of these lasted for more than 10 weeks. By contrast Alternative 2a-M had no high flows exceeding 3000 cfs for more than ten weeks but rated poorly because of a relatively high number that lasted for more than a month (46).

TABLE 5-2: ST. LUCIE ESTUARY: DURATION OF HIGH FLOWS				
	2 week Moving Avg >3000 cfs			
	>5 periods	4-5 periods	2-3 periods	Sum
No Action (WSE)	0	13	25	38
Alt1bS2	0	12	11	23
Alt1bS2-M	8	16	9	33
Alt2a	8	28	15	51
Alt2a-M	0	28	18	46
Alt 4	14	9	12	35

Critical Period: Based on mean monthly flows >2000 cfs, Alternatives 4 and 1bS2-M tied for best performance with 17. Alternative 1bS2 was ranked next best with 18 (Table 5-3).

TABLE 5-3: ST. LUCIE ESTUARY			
Mean Monthly Flows: Mar-Jun			
CFS:	<350	350-2000	>2000
No Action (WSE)	60	61	23
Alt1bS2	61	65	18
Alt1bS2-M	62	65	17
Alt2a	62	61	21
Alt2a-M	58	66	20
Alt4	60	67	17

Caloosahatchee Estuary

Mean Monthly Flows: With respect to high flows, no alternative out performed the No Action Alternative (WSE). The No Action Alternative had 34 occurrences of high flows >4500, whereas Alternative 1bS2 ranked second with 36 occurrences, and Alternatives 1bS2-m, 2a-m and 4 with 37 occurrences each (Table 5-4). With respect to high flows between 2800 and 4500 cfs, all the alternatives showed improvements over the base, WSE. Alternatives 2a-m and 4 ranked best in this flow range.

TABLE 5-4: CALOOSAHATCHEE MEAN MONTHLY FLOWS				
		CFS		
	<450	450-2800	2800-4500	>4500
No Action (WSE)	195	157	46	34
Alt1bS2	114	243	39	36
Alt1bS2-M	117	242	36	37
Alt2a	134	218	40	41
Alt2a-M	128	234	33	37
Alt4	128	233	34	37

Duration: Alternatives No Action and Alternative 2a-m performed the best with respect to duration of high flows (Table 5-5). While the No Action Alternative had more occurrences of high flows lasting more than five weeks than Alternative 2a-m, it was rated higher because 2a-m had so many in the 10-12 week range. This ranking is based on the total number of times that moving weekly average flows exceeded 4500 cfs for six or more weeks.

TABLE 5-5: CALOOSAHATCHEE ESTUARY: DURATION					
	Weekly Moving Avg >4500 cfs				
	13-16 wk	10-12wk	8-9 wk	6-7 wks	Sum
No Action (WSE)	0	10	26	12	48
Alt1bS2	0	33	9	26	68
Alt1bS2-M	13	31	16	12	72
Alt2a	14	22	0	20	56
Alt2a-M	0	20	0	26	46
Alt4	13	21	9	14	57

Critical Period: During the critical spawning period (Table 5-6), Alternatives 4, 2a-m, 1bS2 and 1bS2-m all performed close to the same with fewest number of mean monthly flows >2800 cfs. Alternatives 1bS2 and 1bS2-M performed the best for flows in the preferred range (73).

TABLE 5-6: CALOOSAHATCHEE ESTUARY			
Mean Monthly Flows: Mar-Jun			
CFS:	<450	450-2800	>2800
No Action (WSE)	73	44	27
Alt1bS2	53	73	18
Alt1bS2-M	53	73	18
Alt2a	59	61	24
Alt2a-M	55	72	17
Alt 4	58	71	15

5.5.3. EVERGLADES AGRICULTURE AREA

Under any of the alternatives, regulatory discharges from Lake Okeechobee will be confined to existing canal systems and flow through the EAA without impacting agricultural fields or remnant wetlands where wildlife may occur. Although canal stages may be slightly higher at certain times of the year, this is not expected to be at any level that may affect existing fish and wildlife habitat.

5.5.4. WATER CONSERVATION AREAS (GREATER EVERGLADES)

For impact discussion on fish and wildlife resources, refer to Section 5.2.4.

5.6. ESSENTIAL FISH HABITAT ASSESSMENT

5.6.1. PROPOSED ACTION, 1BS2-M

In addition to this section, further evaluation of estuary effects for the Preferred Alternative can be found in Sections 4.2.2 and 4.5.2.

Excess storm water that is discharged from Lake Okeechobee to the Atlantic Ocean through the St. Lucie Canal can be very damaging to the St. Lucie Estuary, and to a lesser extent the IRL Estuary. Likewise, excess stormwater discharges to the Gulf of Mexico through the Caloosahatchee River can be damaging to the Caloosahatchee Estuary.

The proposed action, Alternative 1bS2-m regulation schedule, will reduce the amount of high flows to the St. Lucie Estuary, thereby reducing the frequency and severity of flushing events, algal blooms, turbid water and fish kills. Although improvements are not substantial, improved conditions for sensitive estuarine biota, such as species dependent on this habitat for egg, larval, and juvenile stages, may be seen. The Preferred Alternative will reduce the number of flows >2000 cfs from Lake Okeechobee to the St. Lucie Estuary. This reduction in high regulatory flows may provide improvement for the St. Lucie Estuary. Improved conditions within estuarine communities may result in improvements to SAV, oysters, fish, such as redfish, grouper, snook and spotted seatrout, and other fauna in the estuary.

Based on the information provided in this SEIS, the Corps has determined that the proposed operational changes to the water regulation schedule would have no anticipated adverse impact in the St. Lucie Estuary, and conditions may improve slightly with implementation of the Alternative 1bS2-m schedule.

The modeling results for the Caloosahatchee Estuary are somewhat mixed. The proposed action, Alternative 1bS2-m, improves mean monthly flows to the Caloosahatchee Estuary in the preferred cfs range of 450 cfs to 2800 cfs by 54 percent. Modeling simulations also indicated improvements in reducing mean monthly flows between 2800 cfs and 4500 cfs. Mean monthly flows in this range can cause adverse impacts to marine seagrasess and other organisms near the mouth of the Caloosahatchee Estuary. This flow range was reduced by ten months under the Preferred Alternative.

However, modeling simulations indicate no improvements in the high flow >4500 cfs range to the estuary. The Preferred Alternative allows a base flow to the Caloosahatchee Estuary during dry periods in order to meet low salinity conditions for SAV, primarily tape grass. This is a positive effect, and not a component built into the current WSE regulation schedule.

Based on the information provided in this SEIS, the Corps has determined that the proposed operational changes to the water regulation schedule would provide some benefits to the Caloosahatchee Estuary, particularly for flows in the preferred salinity range, reducing damaging flows between 2800-4500 cfs, and adding a base flow during dry periods. Even though some benefits for the Caloosahatchee Estuary would occur as described above, due to the increase in high flows >4500 cfs, the Corps has determined that the proposed action would provide minimal benefits overall to essential fish habitat in the Caloosahatchee Estuary.

5.6.2. ALTERNATIVES 1BS2, 2A, 2A-M, AND 4.

Refer to discussions in Section 4.2.2 and 4.5.2.

5.7. HISTORIC PROPERTIES

Historic properties would not be affected by any of the alternatives.

5.8. SOCIO-ECONOMIC

The following discussion of socio-economic existing conditions focuses on the principal social and economic forces of the Lake Okeechobee region. They include: commercial navigation via the Okeechobee Waterway, agriculture in the area immediately surrounding the lake, urban municipalities, recreation and sport fishing, and commercial fishing. More detailed information on the socio-economic conditions within the study area are presented in Appendix D.

Commercial Navigation

The Lake Okeechobee Waterway connects Stuart on the Atlantic Ocean with Ft. Meyers on the Gulf of Mexico. It includes 154 miles of navigation channel and five lock and dam structures. The Port Mayaca and Moore Haven locks connect Lake Okeechobee to the St. Lucie Canal and Caloosahatchee River respectively. Commercial navigation on this waterway has been stable over the past ten years, with sustained year to year variation (USACE 1998). The Lake Okeechobee Waterway was used to transport 430,000 tons of freight in 1995. Petroleum products were the predominant commodities transported (USACE 1998). There are no commercial shipping lines that regularly pass through the waterway, rather traffic consists primarily of special barge traffic which takes advantage of the shortcut across the Florida peninsula, saving about three to five days of travel.

Agriculture

The immediate area surrounding Lake Okeechobee is largely rural, with agriculture being critical to the local and regional economy. There are estimated to be over 700,000 irrigated acres of farm land in the LOSA, which includes the EAA. The EAA alone, accounted for over $750 million in agricultural production, and provided employment for over 20,000 full time workers in 1989 (Snyder and Davidson, 1994). Agricultural production consists predominantly of sugarcane, as well as rice, row crops, and sod. There is also extensive improved and unimproved pastureland, particularly west and north of Lake Okeechobee. The St. Lucie and Caloosahatchee basins, which also receive irrigation water from the lake, also contain an estimated 138,000 and 49,000 acres, respectively of citrus crops, sugarcane, vegetables, sod, and ornamentals (USACE 1998). During prolonged droughts, significant volumes of water are required by the agricultural community in the LEC. Row crops such as truck vegetables, are the predominant crop type in the LEC.

Urban

The urban landscape surrounding Lake Okeechobee includes the incorporated municipalities of Belle Glade, Clewiston, Moore Haven, Okeechobee City, Pahokee, and South Bay. These communities range in population from approximately 1,635 (Moore Haven) to 14,906 (Belle Glade). Residential and commercial water users depend on Lake Okeechobee's water supply for well field recharge, drinking water, and industrial processes.

In addition to the area immediately surrounding the lake, the populations of the Caloosahatchee and St. Lucie Basins, and of the LEC, can be affected by Lake Okeechobee operations. The 2000 population of the affected 16 county region was approximately 8.5 million. The combined population of these areas, along with the rural areas adjacent to the lake, accounts for just under 40 percent of the State's population. The economy of South Florida is based on services, agriculture, and tourism. The LEC

counties' economies are strongly oriented to the services industry, while the counties surrounding Lake Okeechobee are heavily agricultural.

Recreation and Sport Fishing

Lake Okeechobee is the largest recreational resource in the region and provides a wide variety of water based recreation including fishing, boating, picnicking, sightseeing, camping, swimming, hunting, airboating, and hiking. The littoral zone, along the lake's western shore, provides valuable habitat for the lake's popular sport fishery. Lake Okeechobee is recognized as supporting one of the best recreational fisheries in the nation. A variety and abundance of sport fish, including largemouth bass, black crappie, bluegill, and redear sunfish are targeted by sport fishermen from around the country. Consequently, sport fishing is a major activity on the lake. There is also several major sport fishing tournaments held on Lake Okeechobee annually, which bring significant revenues to the marinas, fishing guides, hotels, and support industries along the lake. It should be noted that Lake Okeechobee supports several commercial finfishing endeavors, including fisheries for bullhead catfish, gizzard shad, striped mullet (*Mugilcephcalus*), and gar (*Lepisosteus spp*).

Heavy seasonal waterfowl utilization of the lake attracts tourists and recreational enthusiasts, such as hunters. Common waterfowl species include ring-necked duck (*Aythya collaris*), American wigeon (*Anas americana*), Northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), blue-winged teal (Anas discors), lesser scaup (*Aythya affinis*), and Florida duck (*Anas fulvigula*).

Lake Okeechobee has been a historic tourist destination for purely aesthetic reasons. Airboat rides are popular tourist activities on the lake. Recreation levels in 1996 at Lake Okeechobee were estimated at over 64,000 visitor-hours, with an annual value of over $78,000,000 (USACE 1998).

Commercial Fishing

The commercial fishing industry in Lake Okeechobee utilizes primarily haul seines to catch bluegill, redear sunfish, and catfish. Catfish are also caught by trot lines, and wire traps. Bullhead, shad, gar, mullet, and tilapia are also caught, although since the net ban, mullet are no longer considered a commercial species. There are reports of commercial mullet trapping on the lake, mostly in the canals (FFWCC pexs. corn.). The annual wholesale value of the commercial fishery was estimated in 1998 (USACE) to be approximately $2,326,932, employing about 210 fisherman and landside workers.

There are also commercial fisheries on Lake Okeechobee, which harvest the American alligator and the Florida soft-shell turtle (Diemer and Moler, 1995). Alligators are harvested from the lake population to supplement the stock in alligator tanning operations. Soft-shell turtles are harvested by commercial fishermen, with some individual yields in excess of 13,640 kilograms (30,000 pounds) annually. The majority

of the harvest is prepared for shipment to Japan, or sold locally, primarily to the Miccosukee Tribe of Indians of Florida.

Land Use

The following section will address the general land use within the vicinity of Lake Okeechobee. The area is rural in character with most lands dedicated to agriculture. In general, sugar cane is the predominant crop in the south, row crops and sugar cane in the east, and pastureland with dairy production in the north. Urban areas, which are generally few and modest in population, service the agriculture sector, as well as the tourists who come to the lake to fish, hunt, and enjoy other recreational pursuits.

Agriculture

There is an abundance of agricultural lands surrounding Lake Okeechobee and throughout the affected area. The section below discusses the existing agricultural conditions by physiographic region, beginning with the largest area, the EAA, immediately south and east of the lake.

Everglades Agricultural Area

More than 600,000 acres are farmed in Palm Beach County (UFBEBR, 1995), and sugarcane was harvested in about half of that acreage in 1996 (FASS, 1996d). Much of this acreage is likely categorized as unique farmland based upon its location, growing season, and high value crops, including sugarcane and vegetables. Sugarcane receipts accounted for 68 percent of total field crop sales in Florida in 1996 (FASS, 1996c). The EAA is known for its sugarcane production and sugar processing, but Palm Beach County also ranks 15th among Florida counties for acres of citrus PASS, 1996b). This region is characterized by mid-size farms averaging 690 acres each with high productivity of more than $1300 per acre (UFBEBR, 1995). More than 18,000 people are employed in agricultural production and services representing a payroll of more than $26 million (UFBEBR, 1995). Total market value of agricultural products in Palm Beach County is approximately $900 million, ranking it first among counties in the State of Florida (UFBEBR, 1995) and third among U.S. counties (FDACS, 1994).

The EAA is highly dependent upon the system of canals running through the region to provide necessary drainage of excess water during the wet season as well as supplemental water supplies for irrigation during the dry season. Approximately two thirds of the land farmed in the EAA is irrigated, totaling more than 400,000 acres (UFBEBR, 1995). The EAA has traditionally relied upon Lake Okeechobee for its water supply during drier periods, and looked to the WCAs to the south to receive their excess drainage.

Continued agricultural production in the EAA has become increasingly controversial. Some of the factors that may affect the EAA agriculture include water quality concerns, soil subsidence, and urban encroachment. The water quality concerns, particularly

phosphorus loading, are being addressed through best management practices, STAs, and growing use of organic farming practices and rice cultivation in rotation with sugarcane production. Although sugarcane cultivation in the EAA has come under some sharp criticism in recent years, sugarcane is recognized as the most appropriate crop for this region. Sugarcane requires less phosphorus fertilizer than other crops grown in the EAA (Sanchez, 1990), and sugarcane has been found to remove 1-79 times more phosphorus than was applied as fertilizer (Coale et al., 1993). Florida sugarcane only requires small amounts of pesticides due to disease resistant and tolerant cultivars, and uses cultivation instead of herbicides for weed control. Sugarcane also tolerates greater variability in water table levels, allowing for more flexible water management strategies (Glaz, 1995).

Soil subsidence has become a potential threat to long-term crop production in the EAA. The average historic rate of subsidence of one inch per year has slowed to 0.56 inches per year since 1978 (Shih et al., 1997). The lower rate was attributed to several factors including higher water tables and an increased proportion of land planted to sugarcane. Surveys conducted by Shih et al. (1997) found an average of 1.62 feet to 4.36 feet of soil remaining over I1 transects. Prevention of continued soil subsidence will depend on maintaining high ground water levels to prevent further oxidation of the soil profile. This, in turn, will require development of more water-tolerant sugarcane varieties and/or increased rice cultivation. This research is currently underway and showing promising results (Glaz, 1997). A strong agricultural economy in the EAA based on profitable crop production is the best defense against conversion of agricultural land to urban land.

Kissimmee River Basin

Immediately north of Lake Okeechobee, Osceola, Polk, Highlands, and Okeechobee Counties surround the Kissimmee River Basin. More than two million acres in these counties are farmed, with more than half of this area devoted to pastureland (UFBEBR, 1995). Much of this acreage is likely categorized as unique farmland based upon its location, growing season, and high value crops, including citrus. Approximately a quarter of a million acres in the Kissimmee River Basin are irrigated (UFBEBR, 19951), requiring a dependable water supply. This region is characterized by large farms with relatively low productivity per acre. These four counties are among the top five counties in Florida for cattle production, both beef and dairy (FASS, 1996a). More than 200,000 acres are used for citrus production. Approximately 11,000 people are employed in agricultural production and services representing a payroll of approximately $21 million. The market value of all agricultural products in this region totals approximately $575 million (UFBEBR, 1995).

Martin and St. Lucie Counties (Upper East Coast)

At present, the dominant land use in the basin is agriculture (covering approximately 45 percent of the basin). Agricultural activities include 228,000 acres of citrus, 211,000 acres in range and citrus, and 9,500 acres of vegetable crops (SCS, 1994). The present urban land use (17 percent of the basin) is concentrated along the coast and

the lagoon shorelines. Urban growth is rapidly extending westward, replacing agricultural land. Future land use patterns indicate that this trend will continue as urbanization intensifies along the coast, especially in the southern counties (Swain and Bolohassen, 1987). Present forested uplands and wetlands comprise 11 and 18.8 percent of the basin, respectively.

Caloosahatchee River Basin

Approximately one half million acres are farmed in the Caloosahatchee River Basin, and approximately three-fourths of that area is pastureland. The region is characterized by large farms averaging 1,800 acres, with relatively low productivity per acre (UFBEBR, 1995). Glades County ranks eighth in the State of Florida for cattle production (FASS, 1996a). Citrus production in the Caloosahatchee River Basin covers more than 20,000 acres (FASS, 1996b) and is currently increasing. Much of this acreage is likely categorized as unique farmland based upon its location, growing season, and high value citrus crops. Approximately 5,000 people are employed in agricultural production and services, and the payroll totals approximately $5 million. Agricultural products in this region have a total market value of more than $135 million (UFBEBR, 1995).

More than 77,000 acres of farmland are irrigated in the Caloosahatchee River Basin (UFBEBR, 1995). Reliable water supply is a big concern in this region which has traditionally relied upon water deliveries through the Caloosahatchee River from Lake Okeechobee. Irrigation demands can be expected to increase as additional land is used for citrus production.

Urban Land Use

A significant use of land outside the agricultural context is for urban development. Six incorporated communities are situated around the lake and range in population from approximately 1,400 to 16,000.

TABLE 5-7: 2000 POPULATION ESTIMATES, COMMUNITIES SURROUNDING LAKE OKEECHOBEE (2000 CENSUS)

COMMUNITY	POPOULATION	COUNTY
Belle Glade	14,906	Palm Beach
Clewiston	6,460	Hendry
Moore Haven	1,635	Glades
Okeechobee City	5,784	Okeechobee
Pahokee	5,985	Palm Beach

The Brighton Seminole Indian Reservation occupies a large area of land west of Lake Okeechobee in Glades County. The southern end of this reservation is near the HHD just north of Lakeport. Major transportation corridors around the perimeter of Lake

Okeechobee Include several highways and railroads. County Road (CR) 78 parallels the lake along its western and northern shores from Moore Haven to Okeechobee.

From Okeechobee, State Highway 98 follows the northern and eastern portion of the lake to Pahokee. CR 715 then follows the HHD from Pahokee to Belle Glade, where State Highway 27 follows the southern lake area back to Moore Haven and CR 78.

The municipalities of Stuart at the mouth of the St. Lucie Estuary, Fort Pierce, to the north of Stuart, and Jupiter to the south, are the three principal urban centers nearest the outlet of the C-44 within Martin and St. Lucie Counties.

On the west side of the lake, along the Caloosahatchee River and on Charlotte Harbor, urban areas include the cities of LaBelle, Alva, Olga, Fort Myers, and Cape Coral. Land use adjacent to the Caloosahatchee Estuary is largely residential and urban with the city of Cape Coral on its northern bank and the highly urbanized City of Fort Myers on its south bank. Both of these communities have experienced rapid growth with even more growth anticipated in the near future (SFWMD, 1997).

Recreation Resources

Recreation resources in the Lake Okeechobee region are primarily water based within Lake Okeechobee and include boating, fishing, and nature interpretation. Lake Okeechobee provides approximately 40 miles of navigable waterway for commercial navigation and many more for recreational boating. Twenty-five USACE built land and water-based recreational facilities are located along the lake. The Florida National Scenic Trail encompasses Lake Okeechobee atop the HHD (approximately 140 miles long). Approximately 94 percent of the recreation lands available to the public in this region are owned by the State or Federal government (SCOW, 1994). Bike riding, hiking, picnicking, camping, and nature interpretation are popular land based recreation activities in the region. Substantially altered water deliveries to this region could result in flooding and have a detrimental affect on many natural and recreation resources in the area. The ample water based recreation resources in the Lake Okeechobee region receive extensive use and future demand is anticipated to increase. The St. Lucie Canal provides approximately 34 miles of navigable waterway with four USACE/County recreation facilities that include boating, fishing, camping and day use facilities (USACE, 1991). The approximately 44 miles of Intracoastal Waterway, within the Upper East Coast, provides many coastal recreational navigation opportunities.

Public beaches in the Upper East Coast are the most popular forms of recreation in the region. Four State of Florida Aquatic Preserves, and four State Parks and Recreation Areas are within the Upper East Coast. Five artificial coastal reefs provide popular diving and fishing spots. The region also includes high quality recreation opportunities within the Dupuis Reserve State Forest and Wildlife and Environmental Area and the St. Lucie Inlet Preserve. Overall, existing recreation resources in the region receive heavy annual usage that is expected to increase in the future.

Recreation resources in the WCA region are inland water and upland resources that include the Arthur R. Marshall Loxahatchee National Wildlife Refuge, and Rotenberger and Holey Land WMAs (SCOW, 2000). These areas provide high quality boating, fishing, and nature interpretation activities. The Miccosukee State Indian Reservation is within the WCA region boundary. Hunting, boating, and fishing occur within the Everglades WMA, including the Miccosukee State Indian Reservation.

The Caloosahatchee River provides approximately 67 miles of navigable waterway with ten Corps recreation facilities that include boating, fishing, picnicking, and camping. The J.N. "Ding" Darling National Wildlife Refuge, a popular birding area, administers Caloosahatchee, Matlacha Pass, Island Bay National Wilderness area and Pine Island National Wildlife Refuge, all located near the region's western edge. Boca Grande Pass is world renowned for record tarpon, and Sanibel and Captiva Islands are reported among the top shelling destinations in the Western Hemisphere.

Caloosahatchee State Park and Recreation Area is located near Alva on the Caloosahatchee River. Estero River and Hickory Creek State Canoe Trails are within the region and provide excellent recreation resources. Cayo Costa State Park, Sanibel Island State Park, and State Aquatic Preserves are located in the region.

5.9. AESTHETICS

Aesthetics within the study area will probably not be affected in the short-term. Since there will not be any structural modifications to the existing operations system, no visible impediments to existing landscapes will be present. While plant communities may change over time through varying water management practices, succession, and competition, among other factors, significant (observable) changes to plant communities *usually* require a few to several years to occur. Over the longer term, improved hydroperiods within Lake Okeechobee and the St. Lucie Estuary are expected to benefit native plant communities which should support enhanced numbers of native fish and wildlife. A reduction in the occurrence of prolonged and extreme high lake stages within Lake Okeechobee for instance should reduce excessive turbidity, and enhance wading and foraging conditions and nesting success for wading birds, two components of the ecosystem which contribute greatly to the visual aesthetic/appeal. Healthier seagrass beds in the St. Lucie and IRL will provide better habitat for fish stocks which, although not easily seen by the casual observer, also act as food sources and support bald eagles and other fish eating raptors whose presence may enhance the wilderness aesthetic of the estuary.

There are not expected to be any affects on existing or future aesthetics within the EAA, nor to the Caloosahatchee River. Neither area benefit greatly from the proposed action in terms of improved hydroperiods and flows through these areas will not affect related resources, existing land use or other variables that may enhance or detract from current appearances.

5.10. RECREATION

Improvements to Lake Okeechobee's hydroperiod should reduce the occurrence of prolonged high lake stage events in particular, that have adversely impacted native aquatic and marsh vegetation around the lake over the past several years. The littoral and marsh habitat provides important nesting, breeding and feeding areas for fish and wildlife and the health and sustainability of these vegetation communities is crucial to the recreation resources, particularly fishing, hunting, and wildlife viewing. The Preferred Alternative (1bS2-m), by allowing for lower lake levels, would protect and enhance fish and wildlife habitat within Lake Okeechobee, to a certain degree, by reducing over inundation of emergent and floating vegetation and improving light penetration to SAV, components of which are important habitat throughout the life cycle of fishes, wading birds, raptors, waterfowl, and other animals which make up the food chain. Moreover, lower lake levels may also contribute to a reduction in sediment and nutrient transport into the back water marsh areas and littoral zone and reduce resuspension of nutrients which contribute to algae bloom production. These improvements to hydroperiod, aquatic vegetation, and water quality should translate into better opportunities for fish and wildlife reproduction, foraging and cover, and allow for larger, more sustainable populations for fishing, hunting, and wildlife observation.

The slightly reduced freshwater flows >2000 cfs to the St. Lucie Estuary in particular may improve fish and wildlife habitat and improve conditions for the fishery. Although high regulatory releases would still be necessary on occasion, the reduced volume of lake water sent to the estuary would improve overall salinity regimes, water clarity and color, reduce turbidity and probably reduce the oxygen demand of deposited silts. Any conditions which favor growth and expansion of seagrasses and improved water quality, will enhance the fishery and opportunities for commercial and sport fishing. Wildlife viewing may also be enhanced with healthy and sustainable seagrass beds. Habitat for prey species such as invertebrates and forage fishes which are food sources for eagles, wading birds, marine mammals and other watchable species will enhance opportunities to view these animals. Manatees, which feed directly on seagrasses will also benefit through improved conditions for their primary food source

All of the proposed alternatives, including 1bS2-m, would have more occurrences of low water stages, and extreme low water stages, than the WSE schedule. Low water events would impact recreational boat users navigating Lake Okeechobee, and accessing the lake from local boat ramps. Some boat ramps and marinas may be inaccessible during low water events below >11 feet.

5.11. NAVIGATION

Boating access to Lake Okeechobee is affected by water levels. At lake stages below 12.56 ft., NGVD, the authorized project depth cannot be maintained. During low lake level, navigational access to much of the fishing area is reduced. The rim canal and boat trails also become inaccessible during low water periods. Boat ramp access and marina access is also impacted in certain areas around Lake Okeechobee when water levels fall below 12 feet. Table 5-8 below gives lake conditions at a glance for Route 1.

TABLE 5-8: NAVIGATION DEPTHS ON LAKE OKEECHOBEE, ROUTE 1 (SOURCE: WWW.SAJ.USACE.ARMY.MIL)

Lake Level (ft., NGVD)	Available Navigation Depth (ft.)
13.12	7.06
12.62	6.56
12.12	6.06

The hydrologic PM used for navigation was based on the 1965-2000 simulation POR. The performance of each alternative was measured by the number of times in the POR that lake stage is below 12.56 feet (Table 5-9). In summary, all of the alternatives performed worse than the base for days below 12.56 feet. Adverse effects to navigation would occur under any alternative, including the preferred Alternative 1bS2-m.

TABLE 5-9: DAYS BELOW 12.56 FT.

Alternative	Days lake stage below 12.56 ft., NGVD
No Action (WSE)	2577
1bS2	4809
1bS2-m	4842
2a	5141
2a-m	5776
4	4841

5.12. COASTAL BARRIER RESOURCES

There are no coastal barrier resources located in the project area.

5.13. WATER SUPPLY

The water supply performance measures used in the LORSS are located in Table 5-10. The Preferred Alternative, 1bS2-m, allows for the water supply requirements to be satisfied nearly as effectively as the current operational schedule, WSE. Alternative 1bS2 performs close to the Preferred Alternative. The performance of Alternatives 2a and 4 are close and show minor effects compared to the No Action Alternative. Alternative 2a-m would indicate more minor effects with respect to water supply than the other alternatives.

5.14. FLOOD PROTECTION

One of the goals of the LORSS is to reduce the frequency of high lake stages that may be stressful to the HHD levee system surrounding Lake Okeechobee, which provides flood protection for the surrounding area. Lake Okeechobee water levels are managed to minimize risks for each hurricane season. Because the Corps recognizes that the HHD is more stable when water in Lake Okeechobee is maintained below 18.5 feet, the LORSS only focused on alternatives that would allow the lake to be managed at a lower average level year-round. The final array of alternatives analyzed were developed to achieve zero or close-to-zero days above lake elevation 17.25 feet, NGVD. Any alternative not meeting the high lake constraint of 17.25 feet, NGVD was eliminated from further analysis in the SEIS. The 17.25 feet constraint was based on the schedule's ability to store rainfall and runoff anticipated from a storm event comparable to Hurricane Wilma in 2005 without having HHD integrity issues.

The Corps evaluated all alternatives that included lake elevations beginning at 16 feet, NGVD to 17.25 feet, NGVD (Figure 5-9). Evaluating stage elevation at and above 16 feet, NGVD, allowed consideration of the trends in duration of days within this high lake band. Based on this evaluation, Alternatives 2a and 2a-m performed the best, followed by Alternatives 1bS2, 1bS2-m and 4. The No Action (WSE) alternative was the least effective at maintaining lower lake levels.

TABLE 5-10: EVALUATION OF ALTERNATIVES FOR WATER SUPPLY PERFORMANCE MEASURES

Water Supply Performance Measures	Weight	Alt. No Action	Alt. 1bS2			Alt. 2a			Alt. 4			Alt. 1bS2-m			Alt. 2a-m		
		Data	Data	Dif from Base	Rating	Data	Dif from Base	Rating	Data	Dif from Base	Rating	Data	Dif from Base	Rating	Data	Dif from Base	Rating
Additional Supply Side Management Cutback (acre-feet)	1	0	37,870		0	326,530		-3	214,890		-2	89,660		-1	597,100		-3
Frequency of Water Shortages (years)	2	7	7	100%	0	8	114%	-1	8	114%	-1	7	100%	0	9	129%	-1
Duration of Water Shortages (months)	2	15	14	93%	0	18	120%	-1	16	107%	0	14	93%	0	22	147%	-2
Severity of Water Shortages Score	2	9	10	111%	0	12	133%	-1	11	122%	-1	10	111%	0	14	156%	-2
Water Years with Supply Side Management Cutbacks >100,000 acre-feet	0.5	4	3	75%	1	3	75%	1	3	75%	1	3	75%	1	4	100%	0
Water Years with Supply Side Management Cutbacks >200,000 acre-feet	1.5	0	0		0	2		-2	2		-2	1		0	2		-2
EAA Percent of Demands not Met	1	4	6	150%	-1	7	175%	-3	7	175%	-3	6	150%	-1	9	225%	-3
Other LOSA Percent of Demands not Met	1	4	4	100%	0	5	125%	-1	5	125%	-1	4	100%	0	6	150%	-2
Coastal Basin Supply Side Management Water Shortages	2	4	4	100%	0	4	100%	0	4	100%	0	4	100%	0	4	100%	0
Weighted Rating	13				-0.038			-1.192			-0.962			-0.115			-1.615

Scale System:
(3) = Much Better
(2) =Better
(1) = Slightly Better
(0) = No Difference
(-1) = Slightly Worse
(-2) = Worse
(-3) = Much Worse

5.15. WATER QUALITY

The Corps has engaged FDEP (K. Shugar, personal communication, July 2006) in discussions on the Lake's TMDL and the proposed water management change for the Lake to ensure that there is no conflict between our water management change and the TMDL goals set forth in the FDEP TMDL. This discussion will be on-going. It is not anticipated that the Preferred Alternative will have an adverse effect on TMDL goals for the lake. If the littoral zone vegetation rebounds from damages experienced from the 2004 and 2005 hurricane seasons, the vegetation may actually assist in the attainment of TMDL goals set by FDEP.

No measurable impact to Lake Okeechobee water quality is anticipated from the proposed alternatives due to the limitations of operational only regulation schedule adjustments. There are minor positive effects to the St. Lucie Estuary due to the reduction in the number of undesired high regulatory discharges from Lake Okeechobee under the Preferred Alternative. The Caloosahatchee River and Estuary will have more discharges in the optimum flow range (450-2800 cfs) as a result of the new schedule. The model results also indicate very minor increases of heavy discharges. Additionally, there are very minor adverse effects from any alternative to the receiving marsh areas in the WCAs. These are primarily due to the STAs water quality treatment capacity (currently 64,000 acre-feet annual average, based on a lake water phosphorus level) constraint on regulatory discharges from Lake Okeechobee to the WCAs. As phosphorus levels decline in the lake more water can be treated in these STAs and delivered south to the WCAs.

5.16. HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

A preliminary assessment indicated no evidence of HTRW affecting this action

5.17. AIR QUALITY

Air quality would not be impacted by any of the alternatives.

5.18. NOISE

With implementation of any of the alternatives, there would be no affect on existing or future noise levels.

5.19. PUBLIC SAFETY

Public health and safety was a major factor in the development of the alternatives. One of the goals of the LORSS is to reduce the frequency of high lake stages. Florida has experienced back to back active hurricane seasons during the last two years, which produced significant rain and raised lake elevations. Lake Okeechobee water levels are managed to minimize risks for each hurricane season. The LORSS only focused on alternatives that would allow Lake Okeechobee to be managed at a lower average level year-round. The final array of alternatives were developed to achieve zero or close-to-zero days above lake elevation 17.25 ft., NGVD. Any alternative not meeting the high lake constraint of 17.25 ft., NGVD was eliminated from further analysis in the SEIS.

The Corps only evaluated alternatives with maximum high lake stages beginning at 16 ft., NGVD to 17.25 ft., NGVD (Figure 5-10). Evaluating stage elevation at and above 16 ft., NGVD allowed consideration of the trends in duration of days within this high lake band. Based on this evaluation, Alternatives 2a and 2a-m performed the best, followed by Alternatives 1bS2, 1bS2-m and 4. The No Action (WSE) alternative had the poorest performance.

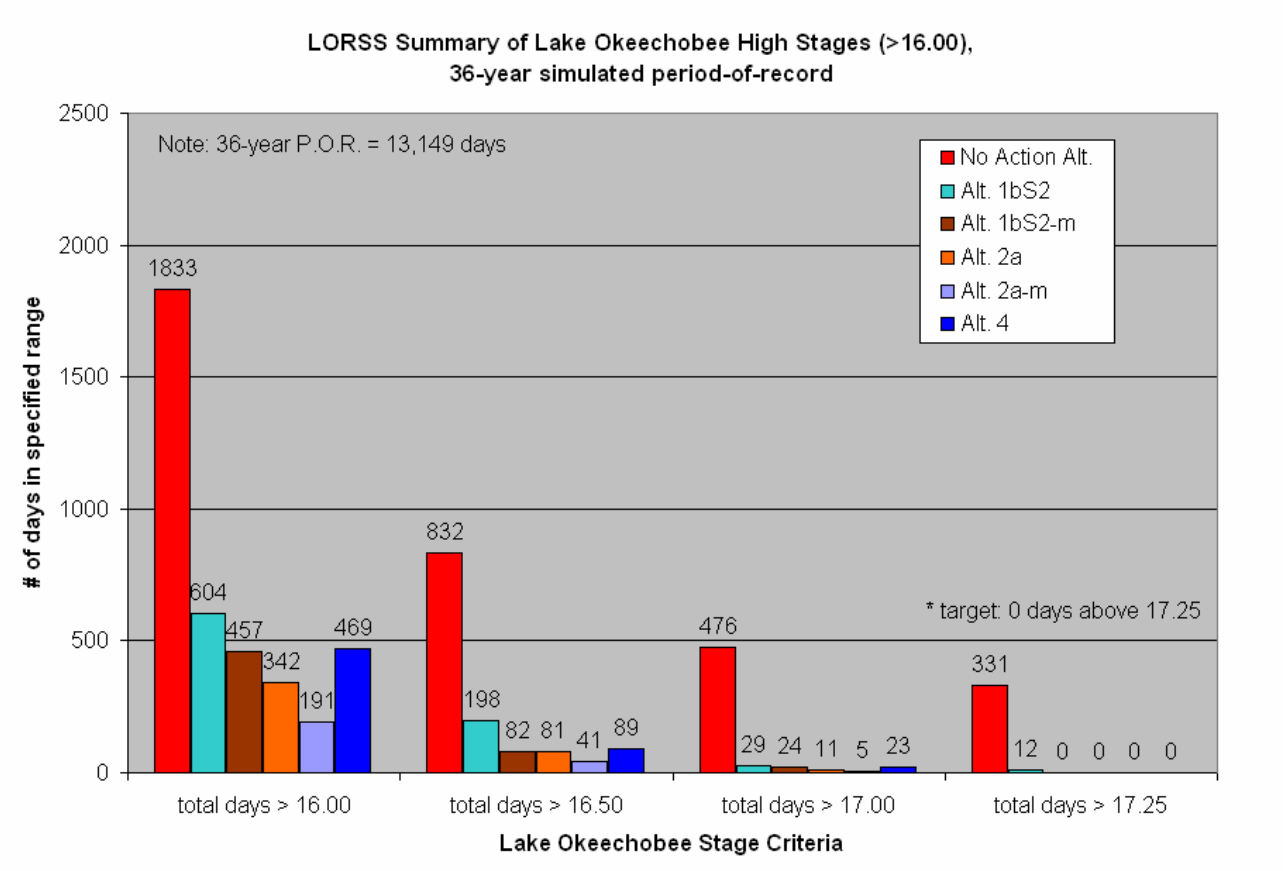


FIGURE 5-10: LAKE OKEECHOBEE STAGE CRITERIA

5.20. NATIVE AMERICANS

There would be no impact to Native American resources.

5.21. DRINKING WATER

Implementation of any of the alternatives would not adversely impact drinking water consumption for the surrounding communities.

5.22. CUMULATIVE EFFECTS

Cumulative impacts are impacts likely to occur due to the proposed action or alternatives in combination with other past, present and reasonably foreseeable future actions. As stated previously, this study has been designed to identify a lake regulation

schedule which would be in effect until a more comprehensive solution to the water regulation and management challenges is implemented by the CERP. A key feature to restoring the lake and the estuaries under the CERP is the construction of several large storage reservoirs, reservoir assisted STAs and STAs which would attenuate and treat flows to the lake and downstream receiving water bodies. These are the type of structural features which will likely be necessary to fully resolve the environmental problems inherent in the present system.

5.23. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

5.23.1. IRREVERSIBLE

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. One example of an irreversible commitment might be the mining of a mineral resource. As there are no proposed construction activities or alteration of existing features or landscape, there should be no irreversible commitment of resources as a result of this action.

5.23.2. IRRETRIEVABLE

An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. An example of an irretrievable loss might be where a type of vegetation is lost due to road construction. As there are no proposed construction activities or alteration of existing features or landscape, there should be no irreversible commitment of resources as a result of this action.

5.24. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

As the proposed action is completely operational, and does not contain any physical features, construction, or addition or removal of structures, and the action is designed to enhance conditions to the natural environment, there are minimal adverse effects anticipated to the natural and human environment.

Conditions within the Caloosahatchee Estuary are not predicted to be improved substantially. Although the Preferred Alternative increased the mean monthly flows >4500 cfs by 3 months, it did reduce the flows between 2800 cfs and 4500 cfs by 10 months. Flow range >2800 can be significantly damaging to the estuary. On the more positive side, the number of mean monthly flows in the preferred range of 450 cfs to 2800 cfs increased by 85 months over the WSE schedule. The number of months in the SFWMM simulation POR is 432.

5.25. COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES

Alternatives evaluated are compatible with Federal, State, and local objectives.

5.26. CONFLICTS AND CONTROVERSY

There will always be a level of controversy with any issue related to water management is south Florida. Few issues remain unresolved with various commenting agencies and other non-governmental groups. However, stakeholder input obtained during the

Planning phase of the study indicates much concern over the health of the Caloosahatchee Estuary. Stakeholders representing the Caloosahatchee Estuary have concerns that the alternatives analyzed show minimal benefits for the estuary. As described in section 4.24, conditions in the Caloosahatchee Estuary are not predicted to improve substantially. However, modeling simulations indicated slight improvement in the preferred flow range, and improvements in reducing mean monthly flows between 2800 cfs and 4500 cfs. Mean monthly flows in this range may cause adverse impacts to marine seagrasess and other organisms near the mouth of the Caloosahatchee Estuary. This flow range was reduced by 10 months under the Preferred Alternative.

5.27. ENVIRONMENTAL COMMITMENTS

The Corps will continue consulting with scientists during weekly operations meetings to determine the status of the individual ecosystems in the study area. Spring season is critical for all ecosystems in the area. Allowing spring recessions in the lake with limited reversals is critical to plants and animals, including nesting and foraging habitat for the endangered snail kite. Additionally, springtime is critical for the estuaries. So, maintaining certain flow ranges for the salinity envelopes is desirable during lake discharges.

5.28. COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

5.28.1. NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the action has been compiled and this draft SEIS has been prepared. The project is in compliance with the NEPA.

5.28.2. ENDANGERED SPECIES ACT OF 1973

A species list was requested from NMFS on September 15, 2005. No threatened or endangered species under the jurisdiction of NMFS would be affected by this action. A species list was requested from USFWS on August 29, 2005, and received on September 30, 2005. Informal consultation was initiated with USFWS by letter dated March 8, 2006. Formal consultation was initiated with USFWS by letter dated June 30, 2006, which included a Biological Assessment of effects on endangered and threatened species. This action will be fully coordinated under the Endangered Species Act and will be in full compliance with the Act.

5.28.3. FISH AND WILDLIFE COORDINATION ACT of 1958

This action has been coordinated with the U.S. Fish and Wildlife Service (USFWS). A Coordination Act Report (CAR) is forthcoming from the USFWS. This project will be in full compliance with the Act.

5.28.4. NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

The action is in compliance with the act.

5.28.5. CLEAN WATER ACT OF 1972

The proposed action is in compliance with this act. As the proposed action is strictly of an operational nature, and does not involve any construction activity, water quality

certification from the State of Florida is not required. Furthermore, as there are no structural components contained in the proposed action and no dredge and fill operations being considered, a Section 404(b) Evaluation is not appropriate.

5.28.6. CLEAN AIR ACT OF 1972

No air quality permits will be required for this action.

5.28.7. COASTAL ZONE MANAGEMENT ACT OF 1972

A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as *Appendix B*. State consistency review will be performed during the coordination of the draft EIS and the State will determine if the action is consistent with the Florida Coastal Zone Management (CZM) Program.

5.28.8. FARMLAND PROTECTION POLICY ACT OF 1981

No prime or unique farmland would be impacted by implementation of this action. This act is not applicable.

5.28.9. WILD AND SCENIC RIVER ACT OF 1968

The Northwest Fork of the Loxahatchee River is designated a Wild and Scenic River. This resource is not expected to be adversely impacted by the proposed action. The study is in full compliance with this act.

5.28.10. MARINE MAMMAL PROTECTION ACT OF 1972

The proposed action is operational and does not involve construction activities; there would not be any adverse impact to marine mammals in the area. Therefore, this action is in compliance with the Act.

5.28.11. ESTUARY PROTECTION ACT OF 1968

The IRL and Charlotte Harbor are part of the National Estuary Program established by Section 320 of the Clean Water Act. This action would not adversely affect these estuaries. As such, the action is in compliance with this Act.

5.28.12. FEDERAL WATER PROJECT RECREATION ACT

The effects of the proposed action on outdoor recreation have been considered. Benefits to fishing, boating and wildlife viewing should be accrued by implementation of the proposed action. Therefore, the action is in compliance with this act.

5.28.13. FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

This action is being coordinated with the National Marine Fisheries Service (NMFS) and will be in compliance with the act.

5.28.14. SUBMERGED LANDS ACT OF 1953

The action would occur on submerged lands of the State of Florida. The project has been coordinated with the State and is in compliance with the act.

5.28.15. COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

There are no designated coastal barrier resources in the project area that would be affected by this action. These acts are not applicable

5.28.16. RIVERS AND HARBORS ACT OF 1899

The proposed action will not obstruct navigable waters of the United States. The action is in full compliance.

5.28.17. ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species will not be affected. The action has been coordinated with the NMFS and is in compliance with the act.

5.28.18. MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

No migratory birds will be affected by the action. The action is in compliance with these acts.

5.28.19. MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The term "dumping" as defined in the Act (3[33 U.S.C. 1402](f)) does not apply to the action proposed. Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this action.

5.28.20. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

This act requires the preparation of an EFH Assessment and coordination with the NMFS. The EFH Assessment within the draft SEIS will be coordinated with the NMFS during the normal NEPA coordination process. This action is in compliance with the act.

5.28.21. E.O. 11990, PROTECTION OF WETLANDS

No wetlands will be affected by the action. This action is in compliance with the goals of this E.O.

5.28.22. E.O. 11988, FLOOD PLAIN MANAGEMENT

The project area is in the base flood plain (100-year flood) and has been evaluated in accordance with this E.O. The action is in compliance.

5.28.23. E.O. 12898, ENVIRONMENTAL JUSTICE

The proposed action will not result in adverse health or environmental effects. Any impacts of this action will not be disproportionate toward any minority. The activity does not (a) exclude persons from participation in, (b) deny persons the benefits of, or (c) subject persons to discrimination because of their race, color, or national origin. The activity would not impact “subsistence consumption of fish and wildlife”.

5.28.24. E.O. 13089, CORAL REEF PROTECTION

The proposed action will not result in adverse impacts to coral reef ecosystems. No coral reef habitats exist within or near the project area. This act is not applicable.

5.28.25. E.O. 13112, INVASIVE SPECIES

This action does not authorize, fund, or carry out action that might spread or introduce invasive species.

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6. LIST OF PREPARERS

6.1. PREPARERS AND REVIEWERS

NAME	DISCIPLINE	ROLE/RESPONSIBILITY
Yvonne Haberer	Biologist, Corps	NEPA Impact Analysis and Coordination, Document Prepare
Dave Apple	Engineer, Corps	Plan Formulation
Jeff Trulick	Biologist, Corps	Plan Formulation and Impact Analysis
Dan Crawford	Engineer, Corps	Hydrologic Modeling
Richard Punnett	Corps Contractor	Hydrologic Modeling
John Zediak	Engineer, Corps	Operational Guidelines Paper
Kamili Hitchmom	Hydraulic Engineer, Corps	Document Review
Andrew Geller	Hydraulic Engineer, Corps	Operational Guidelines Paper
Christopher Graham	Economist, Corps	Economic Report
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Peter Doering	Sr. Supervising Environmental Scientist, SFWMD	Evaluator of Estuary Performance Measures
Martha Nungesser	Sr. Environmental Scientist, SFWMD	Evaluator of Greater Everglades Performance Measures
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Cynthia Ivin	Environmental Engineer, Corps	Document Review

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7. PUBLIC INVOLVEMENT

7.1. SCOPING AND DRAFT SEIS

A Notice of Intent (NOI) to prepare a draft of this SEIS appeared in the Federal Register on August 3, 2005. In addition, a scoping letter, dated July 21, 2005, was sent out by the Corps to agencies and interested parties soliciting views, comments, and information about environmental and cultural resources, study objectives and important issues within the study area. During the 60-day comment period, many written responses were received and represented several issues. These issues were subsequently compiled and infused into the plan formulation process. A sampling of issues resulting from the scoping process are included in Section 1.7. A copy of the Corps' scoping letter and NOI can be found in Appendix C. It should be noted that the 60-day scoping comment period was extended through November 2005 due to the impact of Hurricane Wilma on the South Florida regional communities.

Four public scoping meetings were conducted at the following locations:

- •Clewiston October 11, 2005
- •Ft. Myers November 14, 2005
- •Okeechobee November 15, 2005
- •Stuart November 17, 2005

In addition to the scoping meetings, public workshops were held during the planning phase of the regulation schedule development. The first workshop was held at the Okeechobee Civic Center in Okeechobee, Florida on February 22, 2006. The purpose of the public workshop was to present the LORS alternatives under consideration. Interested individuals, groups, and agencies were invited to attend and were given an opportunity to comment and ask questions. The workshop was video taped and can be found on the Corps' Jacksonville District webpage at: **www.saj.usace.army.mil**. A second round of workshops was held on the following dates: July 11, 2006 at John Boy Auditorium in Clewiston, Florida; July 12, 2006 at the Lee County Commission Chambers in Fort Myers, Florida; and July 13, 2006 at Indian River Community College in Stuart, Florida. The purpose of the public workshops was to inform the public of the tentative selected plan (or Preferred Alternative regulation schedule). Numerous presentations to the Water Resources Advisory Commission (WRAC)/Lake Okeechobee Committee were also conducted throughout the study process.

7.2. AGENCY COORDINATION

Coordination with local, state and federal agencies was achieved by inviting staff of those agencies to participate as team members. Team members were invited to participate in weekly team meetings via teleconference and video conference throughout the Planning process of the study. The EPA, USFWS, NMFS, FDEP, FFWCC, SFWMD, Seminole Tribe of Florida, Lake Worth Drainage District, city governments of Lee County, City of Sanibel, Broward County, and Miami-Dade County Office of Water Management, all contributed one or more staff as active participants of

the study team. The issues and concerns of these agencies and governments were continuously a part of study team activities.

7.3. LIST OF STATEMENT RECIPIENTS (DRAFT SEIS)

Copies of the draft SEIS were sent to local, state, and federal agencies, interested parties and individuals for review and comment in accordance with the Council on Environmental Quality's NEPA regulations and related Corps guidance. A complete mailing list can be found in Appendix C. In addition, the draft SEIS can be found at the following Corps website:
http://planning.saj.usace.army.mil/envdocs/envdocsb.htm.

7.4. COMMENTS RECEIVED AND RESPONSE

A period of time for comments will be set aside in accordance with the NEPA to provide all interested parties an opportunity to comment on the contents of the SEIS. Letters and comments received on the draft SEIS will be included in the final SEIS.

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APPENDIX B

COASTAL ZONE MANAGEMENT ACT

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APPENDIX C

PERTINTENT CORRESPONDENCE

APPENDIX D

ECONOMICS

APPENDIX E

SIMULATION OF OPERATIONAL ALTERNATIVES

APPENDIX F

PERIODIC MANAGED RECESSION