J. Everglades Protection Area

1. Overview

The Everglades Protection Area (EPA) lies south of the EAA, west of the Atlantic Coastal Ridge and east of the Big Cypress Preserve. It is comprised of a number of different management areas that have different operational needs and priorities, including the Water Conservation Areas (WCA); the Holey Land and Rotenberger Wildlife Management Areas (WMAs); and Everglades National Park, which also includes Florida Bay.

The Everglades is an internationally recognized ecosystem that covers approximately two million acres in South Florida and represents the largest subtropical wetland in the United States. Prior to drainage and development, this area consisted largely of vast sawgrass plains, dotted with tree islands and interspersed with wet prairies and aquatic sloughs covering most of southeastern Florida. (Davis, 1943). Everglades National Park and the WCAs are the surviving remnants of the historical Everglades, which extended over an area approximately 40 miles wide by 100 miles long, from the south shore of Lake Okeechobee to the mangrove estuaries of Florida Bay. This remaining area provides significant ecological, water storage, flood control and recreational benefits to the region, as well as important habitat for wildlife of national significance. The pre-drainage Everglades had three essential characteristics: 1) it was largely a rainfall driven ecosystem, 2) it contained large spatial scale and extent, and 3) its hydrologic regime featured dynamic storage and sheetflow.

Construction of canals, levees and water control structures as part of the C&SF Project has compartmentalized the WCAs into five separate reservoirs. These five WCAs contain the last remnants of the tall sawgrass, wet prairie, deep water slough and tree island landscapes that remain intact outside of Everglades National Park. The primary purposes for the WCAs and their levees, canals, structures and pump stations include flood control, water conservation, prevention of saltwater intrusion, recreation, preservation of fish and wildlife and water supply for ENP. The WCAs are completely contained by levees, except for about seven miles on the west side of WCA-3A, which has a tieback levee. Additional levees on the east side of the east Everglades protect adjacent agricultural and industrial areas. This whole region is managed with a system of canals, pump stations, and control structures.

2. Drainage Basin Breakouts

a. S-8 Drainage Basin

Background

Land Use

The land use in the S-8 Basin consists of agriculture (52.4%), wetlands (46%), barren land (0.8%), water (0.6%), transportation communications and utility (0.2%), rangeland (0.03%) and urban/built-up (0.017%).

Drainage Features

Water Quality Summary

The S-8 was on the 1998 303(d) list for dissolved oxygen, mercury and nutrients. The development of TMDLs for these parameters is scheduled for the year 2006, with special TMDL development for mercury in the year 2011.

1. L-3

L-3 was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

2. Holey Land

Holey Land was on the 1998 303(d) list for nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

b. S-7 Drainage Basin

Background

Land Use

The land use in the S-7 Basin consists of agriculture (86%), wetlands (10%), transportation communications and utility (1.5%), barren land (0.9%), upland forests (0.35%), urban/built-up (0.3%) and water (0.4%),

Drainage Features

Water Quality Summary

The S-7 was on the 1998 303(d) list for dissolved oxygen, mercury, nutrients and turbidity. The development of TMDLs for these parameters is scheduled for the year 2006, with special TMDL development in the year 2011 for mercury.

1. Holey Lands

The segment of the Holey Lands that runs through this basin was on the 1998 303(d) list for nutrients. The development of TMDLs for this parameter is scheduled for the year2011, according to the Consent Decree with the USEPA.

c. Water Conservation Area 1

Background

Water Conservation Area 1 (WCA1), also known as the Arthur R Marshall - Loxahatchee National Wildlife Refuge, is located approximately 19.9 miles to the southeast of Lake Okeechobee, in Palm Beach County. The area is 15 miles west of the Atlantic Ocean. WCA 1 is teardrop shaped and covers an area of 221 square miles, of which 145,2800 acres are Everglades wetland habitat. The western boundary of WCA 1 borders the Everglades Agricultural Area (EAA), while the eastern boundary borders expanding urban communities from Lake Worth to Boca Raton. WCA 1 represents a remnant of the northern Everglades.

Land Use

145,280 acres of Everglades wetland habitat.

Drainage Features

The Hillsboro Canal separates WCA 1 from WCA 2. The L-7, L-39, & L-40 canals form an interior perimeter which encircles WCA 1. Construction of these perimeter L canals caused peat formations in proximity to the canals to subside; thus WCA 1's interior ground levels are slightly higher than these perimeter marsh wetlands. Most of the inflows from the perimeter L canals impact the perimeter wetlands. The WCA 1 has higher water holding capacity than that of the deeper WCA 2, because peat soils can retain large volumes of surface water. Water within WCA 1 is largely rainfall and is kept isolated from more mineralized groundwater. Several structures along the southern boundary (S-10A, 10C, 10D, 10E and 39) allow water from WCA 1 to drain into Hillsboro Canal. The largest sources of nutrients entering the WCAs originate from waters draining the Everglades Agricultural Area. Excessive nutrient loading (particularly phosphorus) resulting from agricultural drainage into the system has severely altered ecological structure and function of approximately 6000 acres in WCA 1

Water Quality Summary

1. **Knights Farm Field 3**
   Knights Farm Field 3 was on the 1998 303(d) list for nutrients. The development of TMDLs for this parameter is scheduled for the year 2006.

2. **Knights Farm Field 1**
   Knights Farm Field 1 was on the 1998 303(d) list for nutrients. The development of TMDLs for this parameter is scheduled for the year 2006.

3. **North Sector WCA 1**
   The North Sector of WCA1 was on the 1998 303(d) list for dissolved oxygen, coliforms, nutrients and total suspended solids. The development of TMDLs for this parameter is scheduled for the year 2006.

4. **West Sector WCA 1**
   The West Sector of WCA1 was on the 1998 303(d) list for dissolved oxygen. The development of TMDLs for this parameter is scheduled for the year 2011, according to the Consent Decree with the USEPA.

5. **Center Sector WCA 1**
   The Center Sector of WCA1 was on the 1998 303(d) list for dissolved oxygen, nutrients and mercury. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

6. **East Sector WCA 1**
   The East Sector of WCA1 was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

7. **South Sector WCA 1**
   The South Sector of WCA1 was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

d. Water Conservation Area 2A

Background

Water Conservation Area 2A (WCA 2) is located south of Lake Okeechobee, below WCA 1, in southern Palm Beach and northern Broward Counties. WCA 2 is an extensive wetland dominated by sawgrass covering 210 square miles. This area, WCA 2, is totally enveloped by levees and it is divided in two cells by a levee constructed in 1961. The north cell, WCA-2A, covers 173 square miles. The ground elevation of WCA 2A ranges form 11-12 feet mean sea level, north to south.

Land use

The land use in the Conservation Area 2-A Basin consists of wetlands (98.7%), water (0.7%), barren land (0.58%), and transportation communications and utility (0.02%).

Drainage Features

Discharges are made through the S-10 structures and the S-7 pump station. The major outflow structures from WCA 2A are the S-11C, B and A which direct water into WCA 3 and S-144, 145 and 146 which are used to provide water to WCA 3B. Structure S-38 provides discharge to the east from WCA 2 for water supply purposes during drought into coastal Broward County, and in some cases for regulatory purposes.

Water Quality Summary

1. **Southwest Perimeter WCA2A**

The Southwest Perimeter of WCA2A was on the 1998 303(d) list for dissolved oxygen, coliforms, nutrients and cadmium. The development of TMDLs for these parameters is scheduled for the year 2006, according to the Consent Decree with the USEPA.

2. **S-10 Perimeter WCA2A**
   The S-10 Perimeter of WCA2A was on the 1998 303(d) list for dissolved oxygen, coliforms, un-ionized ammonia and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

3. **Center Sector WCA2A**
   The Center Sector of WCA2A was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

4. **East Section WCA2A**
   The East Section of WCA2A was on the 1998 303(d) list for dissolved oxygen, nutrients and mercury. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

5. **L-35B Perimeter WCA2A**
   The L-35B Perimeter of WCA2A was on the 1998 303(d) list for dissolved oxygen, cadmium and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

e. Water Conservation Area 2B

Background

Land Use

WCA 2B primarily recharges and maintains ground water levels in the coastal area to the east.

Drainage Features

Water Quality Summary

The WCA2B was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

f. Water Conservation Area 3A

Background

WCA-3, the largest of the WCAs covers an area of 915 square miles Water Conservation Area 3 (WCA3) was subdivided into 3A and 3B by building the L-67 canals and levees. WCA 3A consists of 786 square mile and is the only WCA not entirely enclosed by levees. The L-67 canals and levees were constructed to divert water from WCA 2B to WCA 3B for seepage protection in the Aquifer. These canals later became important for transporting water through WCA 3A into Everglades National Park (ENP).

Land Use
The land use of Conservation Area 3-A consists of wetlands (98.7%), barren land (0.3%), transportation communications and utility (0.6%) and water (0.3%).
Drainage Features

Water Quality Summary

1. **North Sector WCA 3A**
   The North Sector of WCA3A was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

2. **US27 Perimeter WCA 3A**
   The US27 Perimeter of WCA3A was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

3. **Center Sector WCA 3A**
   The Center Sector of WCA3A was on the 1998 303(d) list for dissolved oxygen, nutrients and mercury. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

g. Water Conservation Area 3B
Background
WCA-3, the largest of the WCAs covers an area of 915 square miles Water Conservation Area 3 (WCA3) was subdivided into 3A and 3B by building the L-67 canals and levees. Water Conservation Area 3B covers an area of 128 square miles in the southeast corner of WCA 3, directly north of Everglades National Park and East of the City of Miami. The L-67 canals and levees were constructed to divert water from WCA 2B to WCA 3B for seepage protection in the Aquifer.

Land Use
The land use of the WCA3B consists of wetlands (99%) and barren land (0.6%).

Drainage Features

The Miami Canal slices through the northern tip of WCA 3B. Two gated plugs in the Miami Canal, S-339 and S-340, redirect water from the canal into the marsh. Much of the Miami Canal water that flows from WCA 3A into WCA 3B is forced southward across the WCA 3B marsh because the S-31 structure is usually closed. Introduction of high nutrient water into the northern end of WCA 3B from the Miami Canal has replaced natural sawgrass communities with invasive cattail stands.

Water Quality Summary
The WCA 3B was on the 1998 303(d) list for dissolved oxygen and mercury. The development of TMDLs for these parameters is scheduled for the year 2006, according to the Consent Decree with USEPA.

1. **S-333 WCA 3B**
   The S-333 was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

2. **Miami Canal WCA 3B**
   The Miami Canal was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

g. Everglades National Park
Background
Everglades National Park covers over 2,000 square miles at the southern tip of the Florida Peninsula. It is bounded on the west by the Gulf of Mexico, and on the north by Big Cypress National Preserve and Water Conservation Areas (WCAs) 3A and 3B. On the east it is bounded by residential suburbs of Miami and farmlands of Homestead and Florida City. The Park's southern boundary encloses about 85 % of Florida Bay.

Everglades National Park is the largest remaining sub-tropical wilderness in the continental United States and has extensive fresh and saltwater areas, open Everglades prairies and mangrove forests. Abundant wildlife includes rare and colorful birds, and this is the only place in the world where alligators and crocodiles exist side by side. The park is 1,506,539 acres (606,688 hectares) in size.

Water management strategies have caused reduced reproductive effort, increased frequencies of nest flooding and increased rates of juvenile mortality for the American alligator, one of the most ecologically significant of the larger vertebrates in the Everglades. The continuing and possibly accelerating loss of species diversity of both flora and fauna from upland communities is of great concern. Invasion of the natural vegetation communities by exotic pest plants, especially melaleuca and Brazilian pepper, is one of the most serious problems in ENP. It is possible these and

other invasive species may modify the water table and hasten extinction of native species.

ENP is presently subject to intense disruptions of historic geochemical processes due to human activities along its margins and, to some extent, from atmospheric transport. With the advent of intense land-use change, notably artificial drainage and cultivation within the EAA and development of the Atlantic Coastal Ridge, phosphorus and other substances are delivered to the Everglades in quantities significantly above historic levels. One consequence of such enrichment is extensive development of cattail stands in phosphorus-enriched areas formerly dominated by sawgrass.

Land Use
ENP is a World Heritage Site, an International Biosphere Reserve and a Wetland of International Importance. ENP is the second largest national park in the continental United States.

Drainage Features
Its aquatic environment is dependent on seasonal rainfall and sheet flow of water from the north. Historically, about half of the park's water came from Everglades and Big Cypress Swamp to the north and half from rainfall. Water management facilities and activities have radically altered the natural volume, distribution, timing and quality of freshwater flows into the Park and Florida Bay.

Changes in the natural hydrologic cycle in the Everglades National Park include water levels, surface-water inundation and water flow. Completion of the Tamiami Trail in 1928, the first east-west road across the basin, altered and interrupted water patterns and blocked all natural sheetflow. Present flow patterns in ENP are limited and controlled by management of the WCAs to the north, extensive agricultural and urban pumping, and drainage canals to urban areas to the north and east. Unnatural hydroperiods and hydropatterns throughout ENP are now typical, resulting in sharp reductions of seasonal water levels and large discharges for flood control purposes. These have been both ecologically significant and deleterious. Ground water from the Biscayne Aquifer flows into Biscayne Bay modifying salinity and possibly carrying pollutants into the bay waters.

1. L-67 Culvert US41
The L-67 was on the 1998 303(d) list for dissolved oxygen and iron. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

2. Shark Slough
Background
Shark River Slough is a broad southwesterly trending arc of continuous wetland, interspersed with numerous tree islands. The area of freshwater wetlands to the west

of Shark River Slough between the Everglades trough and the Big Cypress Basin is known as the Broad River / Lostmans River Drainage (Schomer and Drew, 1982).

Expansive transitional areas of slightly higher bedrock elevation distinguish its northwestern and southeastern boundaries. The slough is defined by the center of the Everglades trough which is a wide, slightly concave depression in the underlying limestone (White, 1970).

Drainage Features
Historically, natural water movement in Shark Slough depended on the timing, duration and magnitude of regional and local meteorological events particularly flood and drought conditions. Currently water movement is primarily controlled by the operations of the C&SF Project. Recent isotopic data suggests that groundwater underlying Everglades National Park is derived primarily from recent surface waters, and is heavily affected by recent rainfall recharge.

Water Quality Summary
Shark Slough was on the 1998 303(d) list for dissolved oxygen, iron, mercury and nutrients. The development of TMDLs for these parameters is scheduled for the year 2007, according to the Consent Decree with the USEPA.

3. ENP Taylor Slough
Background
Taylor Slough is located east of Shark River Slough. It encompasses more than 158 sq. miles of freshwater marsh and extends approximately 20 miles, from its northern source in the rocky glades to Florida Bay (Van Lent, *et a*l. 1993).

Puri and Vernon (1964) distinguish two physiographic provinces lying within the Taylor Slough drainage basin. The first of these provinces refers to the series of lagoons from Seven Palm Lake to West Lake. A broad continuous strip of land covered by coastal prairie occupies the area north of these lagoons, running southeast to the mangroves bordering Madeira Bay. The northern border of these lagoons roughly corresponds to a partial barrier between fresh and saline waters known as the Buttonwood Embankment (Craighead, 1971).

A distinct band of pioneer red mangrove *(Rhizophora mangl*e) occurs 2 to 5 miles (3 to 8 kilometers) inland of this barrier (Schomer and Drew 1982). The second physiographic province corresponds to black *(Avicennia germinan*s) and white *(Laguncularia racemos*a) mangrove communities that occur in the areas south to Florida Bay. This second region is known as Reticulate Coastal Swamps (Schomer and Drew, 1982). On the eastern side of Taylor Slough the coastal lagoons are less prominent and the surface drainage is better defined. This hydrologic structuring leads to a land and vegetation pattern that radiates out from the surface drainage pattern (Schomer and Drew, 1982).

Drainage Features

The limestone ridges, Long Pine Key and Everglades Keys, that run west/southwest from upper Taylor Slough form a barrier inhibiting sheet flow from Shark River and the lower Rocky Glades.

Water quality summary
Taylor Slough was on the 1998 303(d) list for dissolved oxygen and iron. The development of TMDLs for these parameters is scheduled for the year 2007, according to the Consent Decree with the USEPA.

h. C-111 Drainage Basin
Background
The C- 111 Basin is near the bottom of the existing C&SF Project and provides flood protection to agriculture in south Dade County and water supplies to Taylor Slough and the eastern panhandle of the Everglades National Park. Construction of the C-111 Canal was completed in 1968. One of the key goals of the current Everglades Restoration efforts is to restore the environmental health of the region south of the C-111 Canal, which is known as the "Panhandle area" of Everglades National Park. The restoration of the Panhandle area is also expected to have a positive effect on Florida Bay, which lies less than 10 km south of the C-111 Canal.

A high percentage of the C-111 area wetlands, which are east of Everglades National Park, are undeveloped. Some of the other C-111 wetlands generally are areas that have a low to moderate level of disturbance. The C-111 wetlands provide habitat for several endangered species. Land cover includes pineland remnant, tropical hardwood hammocks and sawgrass glades. Restoration of sheetflow to Florida Bay through the C-111 area is in the planning stages.

According to our basin boundaries, the C-111 has been divided into three sections.

Land Use

Drainage Features

Water Quality Summary
The C-111 was on the 1998 303(d) list for dissolved oxygen and mercury. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

1. C-113
The C-113 was on the 1998 303(d) list for dissolved oxygen and nutrients. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA.

2. Transect T3

Transect T3 was on the 1998 303(d) list for dissolved oxygen. The development of TMDLs for these parameters is scheduled for the year 2011, according to the Consent Decree with the USEPA

h. Model Land Drainage Basin

Background

The Model Land Drainage basin has an area of approximately 18,000 acres.

Land Use

The land use in the Model Land Basin consists of wetlands (77.3%), upland forests (13.3%), agriculture (7.7%), water (0.8%), communications and utility (0.45%), transportation urban and built-up (0.21%) and barren land (.04%).

Drainage Features

Land within the Model Land basin drains to the west borrow canal of L-31E. Water in the west borrow canal of L-31E is passed through L-31E by way of S-20. The water is routed to the south around the cooling basin for the Florida Power and Light Turkey Point Power Plant and is discharged to Biscayne Bay.

Water Quality Summary

The Model Land Drainage Basin does not contain any 1998 303(d) listed waterbodies.

The following water quality summary was taken directly from Chapters 3 and 4 of the Everglades Consolidated Report, September 1, 2000.

Everglades Protection Area

The purpose of this section is to provide an update concerning the water quality status for each region of the EPA for WY2000 (*i.e.*, May 1, 1999 through April 30, 2000). This report builds on the water quality analyses previously presented in past Interim and Consolidated Reports and includes a simplified analysis of the water quality parameters not meeting the water quality criteria specified in Section 62-302.530, F.A.C., and a discussion of any temporal or spatial trends observed for the parameters identified as Concerns or Potential Concerns. Unlike previous reports, this chapter also provides a discussion of the factors contributing to excursions from applicable water quality criteria and an evaluation of the natural background condition where existing standards are not applicable. Although much of the data from the Non-ECP structures is used in the regional analysis of water quality conditions in the EPA, the Non-ECP structures are required by the permit to be analyzed individually. This individual analysis of the Non-ECP structures data as well as all other permit required analyses and data presentations are provided in Chapter 11 of this report to simplify and improve the readability of this chapter.

Excursion Analysis Methods
An approach similar to the regional synoptic approach used in the 1999 Everglades Interim and 2000 Consolidated Reports was applied to the WY2000 data to provide an overview of the status of compliance with water quality criteria in the EPA. The consolidation of water quality data on a regional basis provides for analysis over time, but limits spatial analyses within each region. However, spatial analyses can be made between regions because the majority of inflow and pollutants enter the northern one-third of the EPA and the net water flow is from north to south.

Water Quality Data Sources
The large majority of the water quality data evaluated in this section were retrieved from the SFWMD's DBHYDRO database. Before water quality data are entered into the database, the SFWMD follows strict Quality Assurance/Quality Control (QA/QC) procedures approved by the Department for both data collection and analytical methods. These methods are documented in the SFWMD Comprehensive Quality Assurance Plan #870166G (SFWMD, 1999), which is annually reviewed, updated and approved by the Department. Contract laboratories used by the SFWMD must also have their comprehensive QA/QC plans approved by the Department. Water quality data from the nutrient gradient sampling stations monitored by the Everglades Systems Research Division in the northern part of Water Conservation Area 2A (WCA-2A) and the southwestern part Loxahatchee National Wildlife Refuge (Refuge) were obtained from the Everglades Research Database.

EPA Water Quality Sampling Stations
Water quality sampling stations in each region of the EPA were classified as inflow, interior, or outflow sites, in order to provide a more detailed analysis of each region for compliance with Class III water quality criteria and to assist in the evaluation of potential causes for observed excursions. There are several interior structures that convey water between EPA regions. Based on the current classification system, it was necessary to classify these structures conveying water from one region to another within the EPA as inflow stations. Thus, the S-10 structures were added as inflow sites to WCA-2, the S-11 structures as inflow sites to WCA-3, and the S-12 structures and S-333 as inflow sites to Everglades National Park (Park). The interior sites of each region consist of marsh and canal stations in addition to structures that convey water within the area. In contrast to the other regions, the Refuge has four components for analysis (inflow sites, rim canal sites, outflow sites and interior marsh sites) to account for inflows being conveyed in rim canals that border the east and west refuge levees and discharge into outflow structures in the south levee. Most of the water entering the Refuge through the S-5A and S-6 structures bypasses the marsh via the L-7 rim canal and is discharged to WCA-2A through the S-10 structures.

EPA Data Analysis Period
Water quality data collected from monitoring stations within EPA regions during WY2000 (May 1, 1999 to April 30, 2000) are evaluated and discussed in this section. Additionally, pesticide data presented herein were collected during four quarterly

sampling events (April, August, November 1999, and February 2000). The pesticides period of record was selected as an update to data presented in the 2000 Consolidated Report, rather than reflecting a water year.

Method Detection Limit

Each water quality constituent has a Method Detection Limit (MDL) that defines the minimum concentration or level at which the constituent can be identified. The MDL is usually statistically above the background noise level associated with a test and constituent concentrations at or near the MDL may not be quantified within established limits of accuracy or precision. The Practical Quantitation Limit (PQL) represents a practical and routinely achievable quantification level with a relatively good certainty that a reported value is reliable (APHA, 1995). For the analyses presented in this section, data reported to be less than the MDL were assigned a value of the MDL unless otherwise noted.

Excursion Categories

To evaluate compliance with water quality criteria in WY2000, constituent concentrations were compared to their respective Class III criteria provided in Chapter 62-302, F.A.C. In addition to Class III criteria, pesticides were evaluated based on chronic toxicity values. An excursion was recorded when a parameter exceeded the applicable numeric criteria or was chronically toxic. The excursions for each EPA region were tabulated providing both the total number of samples and percent of samples not in compliance with the criteria.

The three-category system previously employed in the 1999 Interim and 2000 Consolidated Reports (Bechtel *et al*, 1999 and 2000) was utilized to rank the severity of excursion from water quality criteria. Parameters were categorized by region and class (*i.e.*, inflow, outflow, rim, interior) as being Concerns, Potential Concerns, or of No Concern according to the frequency of excursions as specified in **Table .** Pesticides were additionally categorized based on detection frequency (>MDL). The excursion categories are meant to provide some guidance in the interpretation of monitoring results. The categories provide a loose test of the hypothesis that the parameter concentrations and excursion rates are below levels, which adversely affect the designated uses. Use of the 5% break point between parameters classified as Potential Concerns and those identified as Concerns follows the common scientific practice of allowing a 5% rejection limit. Furthermore, the categories provide a means to rank the severity of excursions from water quality criteria and allow tracking of temporal and spatial trends.

Definitions of excursion categories for water quality constituents that had excursions in the EPA.

Excursion Category	Class III Waters	Pesticides
Concern	> 5% excursions	Class III criterion and/or toxicity levels exceeded
Potential Concern	Up to 5% excursions	>MDL[1]
No Concern	No excursions	≤MDL

MDL[1] = Method Detection Limit

Since there is no numeric criterion for phosphorus at this time, total phosphorus (TP) data were divided into three categories based on the frequency of measurements above 10 µg/L (parts per billion, ppb) and above 50 µg/L. This approach is consistent with the Settlement Agreement (1991), which requires the SFWMD's Stormwater Treatment Areas (STA) to achieve a long term TP discharge concentration average of 50 µg/L, and also requires long term TP averages of approximately 10 µg/L in the Refuge interior marshes and in the inflows to the Park. Furthermore, 10 µg/L is the default phosphorus criterion specified by the EFA. This classification of measured phosphorus concentrations may be modified in future years once the nutrient threshold research is completed and a numeric nutrient criterion for TP is established.

Summary of Prior Report Findings

1999 Interim Report

Chapter 4 of the 1999 Interim Report was prepared in compliance with the EFA requirement that by January 1, 1999, a report summarizing the results of water quality monitoring efforts in the Everglades be submitted to the Governor, the President of the Senate, and the Speaker of the House of Representatives. The report provided a review of compliance with state water quality criteria in the EPA as of April 1998. Water quality data were divided into a baseline period (October 1, 1978 through September 30, 1988) and into individual recent water years (1990 through 1998) to determine if any changes in water quality were evident during the 1990s when compared to the baseline period. With a few exceptions, water quality during the 1990s was in compliance with existing state water quality standards and numeric criteria. For parameters, which exceeded state standards, as previously discussed, excursion categories were presented to rank the relative severity of excursions in the EPA regions. Dissolved oxygen, specific conductance, alkalinity, pH, un-ionized ammonia, iron, beryllium, chlorpyrifos ethyl, endosulfan, ethion, and parathion methyl were placed in the most severe excursion category (Concern) for one or more EPA areas. Of the parameters classified as Concerns, dissolved oxygen stood out as the most pervasive, being a Concern in every basin. However, a majority of the dissolved oxygen excursions were due to natural conditions within the marsh and therefore did not necessarily constitute violations of state water quality standards. The remaining parameters of Concern were localized to specific areas or sub-areas. Alkalinity and pH excursions were associated with natural rain-driven soft-

water conditions within the interior of the Refuge. Conductivity excursions occurred in the inflows and canals associated with the Refuge and WCA-2, likely due to ground water intrusion.

Changes in TP loads and median concentrations were also analyzed following the direction of water flow from north to south through the EPA. When TP loads discharging into the EPA between the baseline (1978-1988) and recent water years (1990-1998) were compared, it appeared that the Refuge was the only region to receive a higher load in recent years. For inflows to WCA-2 and WCA-3, TP concentrations and loads differed relatively little from the baseline period, while average TP loads into the Park since WY90 decreased. Based on a 10µg/L default standard and a 50 µg/L interim criteria specified in the EFA, TP was placed in the Concern category in all EPA regions except for the Park and interior marsh sites in the Refuge, where it was placed in the Potential Concern category.

2000 Consolidated Report

The 2000 Consolidated Report provided an update to the Interim Report with the addition of WY99 data. Additionally, it presented an analysis of water quality constituent data at Non-Everglades Construction Project (Non-ECP) structures during the second year of monitoring consistent with reporting requirements stated in Specific Conditions 5 and 12 of the Non-ECP Permit (FDEP No. 06,5025907098). The same categorical system used in the Interim Report, to rank excursions, was employed in the 2000 Consolidated Report. As in WY98, dissolved oxygen, specific conductance, alkalinity, pH, un-ionized ammonia, iron, and total beryllium were placed in the Concern category in one or more areas within the EPA. Additionally, the pesticide diazinon was classified as a Concern for inflows to WCA-2. Dissolved oxygen continued to have high rates of excursions from the State criterion of 5.0 mg/L for all regions of the EPA. Similarly, the patterns noted in the Interim Report for alkalinity, pH, and conductivity largely persisted during WY99.

Total phosphorus loads and median concentrations in the inflows to each EPA region during WY99 were within the ranges observed in the previous nine water years. Concentrations of TP at non-ECP structures show no trends in comparison with previous periods with the exception of structures ACME1DS and G94D, where an increasing concentration trend was evident. As in WY98, TP was placed in the Concern category (>50 µg/L) in all EPA regions except for the Park and interior marsh sites in the Refuge, where it was placed in the Potential Concern (>10 µg/L) category.

Water Year 2000 Results

Comparison of the water quality data with applicable Class III water quality criteria found excursions for only eight parameters, out of the approximately 109 parameters measured during WY2000. These excursions were localized to specific EPA areas, with the exception of dissolved oxygen, which exhibited excursions in all areas. For at least one EPA region; alkalinity, conductivity, dissolved oxygen, iron, pH, and turbidity were classified as parameters of Concern. Alkalinity, conductivity, iron, pH and turbidity were additionally classified as Potential Concerns in one or more other areas. Due to

excursion rates less than five percent, lead and unionized ammonia were designated as parameters of Potential Concern, in specific EPA regions. Additionally, the pesticides DDT, DDE, DDD, endosulfan (total alpha and beta), and diazinon each exceeded either Class III criteria or chronic toxicity values on one occasion. No other parameters exceeded state water quality standards during WY2000 and therefore will not be discussed within this section, with the exception of cadmium and beryllium. Cadmium and beryllium are addressed because excursion rates reported for WY99 have been recalculated.

Parameters placed in the Concern or Potential Concern categories in previous reports or for WY2000 are presented in Table ____ by three time periods (*i.e.*, historical period encompassing WY79 through WY98, WY99, and the current WY2000) to evaluate any temporal trends present. Generally, excursion results for WY2000 were similar to WY99 and the historic period with a few exceptions. During WY2000 dissolved oxygen excursions declined slightly (2 - 31%), relative to one or both of the historic periods in all regions of the EPA except the interior of WCA-3. Additionally, in contrast to previous periods, no cadmium and beryllium measurements exceeded state standards during WY2000. Turbidity excursions increased in frequency for some areas in the northern Everglades (Refuge inflow, outflow and rim-canal, WCA-2 inflow).

Parameters exhibiting excursions during either WY99 or WY2000 are reviewed in greater detail below. The review will include discussions concerning the environmental significance associated with the observed excursions, potential causes of the excursions, and any actions taken to resolve the associated concerns including the evaluation of the applicable criteria and natural background conditions within the EPA.

Summary of water quality data and excursions from applicable criteria in the EPA for WY2000. Only parameters with excursions in the given region and class are listed. Excursion Categories of Concern and Potential Concern are denoted by "C" and "PC", respectively.

Region	Class	Parameter	Class III Criteria	N	Mean	Std. Deviation	Min.	Max.	Excursion	
									Category	%
Refu	Inflow	Conductivity (µmho/cm)	<1275[1]	246	953	282	52	1603	C	13
		DO (mg/L)	≥5.0	246	4.27	2.23	0.16	13.10	C	63
		Iron (mg/L)	≤1.0	49	0.39	0.76	0.01	4.12	C	6.1
		Turbidity (NTU)	≤29[2]	104	13.4	21.2	0.51	136.5	C	12
	Interior	Alkalinity (mg/L)	≥20	206	109	94	9.5	359	C	25
		Conductivity (µmho/cm)	<1275[1]	344	340	317	50	1279	PC	0.3
		DO (mg/L)	≥5.0	235	3.55	1.87	0.03	9.64	C	77

		PH	≥6.0, ≤8.5	240	6.66	0.53	5.20	7.87	C	15
	Outflow	Conductivity (µmho/cm)	<1275[1]	63	821	281	301	1396	C	7.9
		DO (mg/L)	≥5.0	63	3.49	2.26	0.30	8.86	C	70
		Un-ionized NH_3 (mg/L)	≤0.02	63	0.002	0.004	<0.0001	0.027	PC	1.6
		PH	≥6.0, ≤8.5	63	7.35	0.42	5.52	8.44	PC	1.6
		Turbidity (NTU)	≤29[2]	64	7.5	8.4	1.01	50.0	PC	3.1
	Rim	Alkalinity (mg/L)	≥20	50	225	81	2.5	387	PC	2.0
		Conductivity (µmho/cm)	<1275[1]	66	906	324	392	1564	C	15
		DO (mg/L)	≥5.0	43	4.38	2.30	0.32	8.40	C	54
		Turbidity (NTU)	≤29[2]	25	11.2	17.5	0.05	78.0	C	8.0
WCA-2	Inflow	Conductivity (µmho/cm)	<1275[1]	57	907	279	301	1396	C	8.8
		DO (mg/L)	≥5.0	57	3.73	2.26	0.33	8.86	C	68
		NH_3 (mg/L)	≤0.02	57	0.003	0.005	<0.0001	0.027	PC	1.8
		Turbidity (NTU)	≤29[2]	57	8.9	8.7	1.11	50.0	PC	3.5
	Interior	Conductivity (µmho/cm)	<1275[1]	348	793	248	60	1437	PC	1.1
		DO (mg/L)	≥5.0	294	3.62	2.10	0.13	11.28	C	76
		Un-ionized NH_3 (mg/L)	≤0.02	199	0.001	0.005	<0.0001	0.055	PC	1.0
		PH	≥6.0, ≤8.5	293	7.31	0.31	5.58	9.27	PC	0.7
	Outflow	DO (mg/L)	≥5.0	72	3.56	1.95	0.70	7.72	C	76
W	Inflow	DO (mg/L)	≥5.0	257	3.46	2.28	0.12	11.94	C	77
		Iron (mg/L)	≤1.0	44	0.20	0.22	<0.003	1.15	PC	2.3
		PH	≥6.0, ≤8.5	257	7.33	0.38	5.89	8.60	PC	0.8

	Interior	DO (mg/L)	≥5.0	194	3.15	1.52	0.29	12.03	C	92
	Outflow	DO (mg/L)	≥5.0	181	3.58	1.39	0.42	6.70	C	82
ENP	Inflow	DO (mg/L)	≥5.0	286	3.46	1.57	0.09	6.70	C	80
	Interior	DO (mg/L)	≥5.0	100	5.87	2.67	0.97	12.87	C	42
		Iron (mg/L)	≤1.0	94	0.27	0.40	<0.003	2.28	C	5.3
		Lead (µg/L)	Hardness Based[3]	98	0.84	0.16	<0.8	2.26	PC	1.0
		PH	≥6.0, ≤8.5	100	7.82	0.29	7.02	8.56	PC	1.0

1. Specific conductance shall not be increased 50% above background or to 1275 µmho/cm, which ever is greater.
2. Turbidity ≤ 29 NTU above natural background conditions.
3. Total lead standard is ≤ $e^{(1.273[Hardness]-4.705)}$.

Summary of excursions from Class III criteria in the Everglades Protection Area for WY2000, WY99, and historic data (1979-1998). Note: Number in front of parenthesis gives number of excursions while number within parenthesis specifies total number of samples collected.

Region	Class	Parameter	Historic (1978-1998)		1999 Water Year		2000 Water Year	
			Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions
Refu	Inflow	Beryllium	25	1 (4)	100	1 (1)/1 (1)	0	0 (0)/ 0 (0)
		Conductivity	29	424 (1453)	17	37 (223)	13	32 (246)
		DO	78	1134 (1457)	73	161 (222)	63	156 (246)
		Iron	3.3	12 (361)	3.3	2 (61)	6.1	3 (49)
		Turbidity	2.4	39 (1641)	2.6	3 (114)	12	12 (104)

Region	Class		Historic (1978-1998)		1999 Water Year		2000 Water Year	
			Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions
	Interior		32	351 (1103)	15	21 (144)	25	51 (206)
			0.5	5 (932)	0	0 (200)	0.3	1 (344)
			74	640 (862)	83	164 (197)	77	182 (235)
			11	110 (984)	6.1	12 (198)	15	35 (240)
			0	0 (375)	1.1	1 (91)	0	0 (91)
	Outflow	Parameter	15	129 (872)	0	0 (63)	7.9	5 (63)
			66	576 (868)	76	48 (63)	70	44 (63)
			0.2	2 (852)	0	0 (63)	1.6	1 (63)
			0.8	7 (893)	1.6	1 (63)	3.1	2 (64)
			1.1	9 (822)	1.6	1 (63)	1.6	1 (63)
	Rim		0	0 (370)	0	0 (67)	2	1 (50)
			0	0 (4)	100	1 (1)/1 (1)	0	0 (1)/ 0 (1)
			20	95 (478)	17	4 (98)	15	10 (66)
			73	345 (474)	85	83 (98)	53	23 (43)
			0	0 (467)	1	1 (96)	0	0 (45)
			2	6 (306)	0	0 (43)	8	2 (25)
		un-ionized NH3	0.3	1 (345)	1.4	1 (72)	0	0 (22)
WCA	Inflow	Conductivity	17	162 (951)	0	0 (54)	8.8	5 (57)
		DO	70	661 (946)	72	39 (54)	68	39 (57)

Region	Class	Parameter	Historic (1978-1998)		1999 Water Year		2000 Water Year	
			Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions
			0.9	10 (1090)	1.9	1 (53)	3.5	2 (57)
			0.8	7 (902)	1.9	1 (54)	1.8	1 (57)
	Interior		9	191 (2113)	1.7	2 (233)	1.1	4 (348)
			78	1579 (2033)	84	184 (219)	76	224 (294)
			0.7	15 (2123)	1.4	3 (214)	0.7	2 (293)
			1.5	25 (1657)	0.6	1 (159)	1	2 (199)
	Outflow	DO	66	750 (1134)	80	52 (65)	76	55 (72)

Summary of excursions from Class III criteria in the Everglades Protection Area for WY2000, WY99, and historic data (1979-1998). Note: Number in front of parenthesis gives number of excursions while number within parenthesis specifies total number of samples collected. (Continued)

Region	Class	Parameter	Historic (1978-1998)		1999 Water Year		2000 Water Year	
			Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions
WCA-3	Inflow	Beryllium	0	0 (1)	25	1 (1)/ 0 (1)	0	0 (4)/ 0 (4)
		DO	68	1937 (2830)	86	204 (237)	77	199 (257)
		Iron	1.2	6 (496)	2.4	1 (42)	2.3	1 (44)
		pH	0.6	17 (2800)	0	0 (239)	0.8	2 (257)
		Turbidity	1.8	52 (2841)	0.7	1 (137)	0	0 (168)
		un-ionized NH3	0.2	4 (2589)	0.65	1 (155)	0	0 (178)
	Interior	DO	81	904 (1117)	87	138 (158)	92	178 (194)
		Turbidity	0.4	5 (1297)	0.9	1 (111)	0	0 (161)
	Outflow	DO	72	2105 (2915)	86	163 (191)	82	148 (181)
		pH	1.3	37 (2874)	1.6	3 (192)	0	0 (180)
		un-ionized NH3	0	1 (2169)	1.5	2 (134)	0	0 (131)
ENP	Inflow	DO	70	2446 (3484)	81	183 (226)	80	228 (286)
		pH	1.4	47 (3447)	3	7 (230)	0	0 (285)
		un-ionized NH3	0.2	6 (2705)	7.1	11 (154)	0	0 (225)
	Interior	Cadmium	0.3	3 (1025)	1.2	1 (81)	0	0 (98)

Region	Class	Parameter	Historic (1978-1998)		1999 Water Year		2000 Water Year	
			Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions	Percent Excursions	Number of Excursions
			45	464 (1032)	60	49 (81)	42	42 (100)
			8.7	92 (1053)	8.6	7 (81)	5.3	5 (94)
			0.4	4 (1025)	0	0 (81)	1	1 (98)
		pH	2	18 (905)	1.2	1 (81)	1	1 (100)

Dissolved Oxygen

As in previous water years, dissolved oxygen (DO) was classified as a parameter of Concern for all EPA regions and classes during WY2000. Overall, 75% of the 2,028 DO measurements collected during WY2000 were below the 5.0 mg/L Class III criterion. The frequency of DO measurements falling below 5.0 mg/L ranged from 42 to 92% among the EPA regions. The highest oxygen concentrations and consequently lowest excursion frequency (42%) were observed in the relatively minimally impacted interior of the Everglades National Park. The highest excursion rate occurred in the interior of WCA-3. Dissolved oxygen concentrations and excursion frequencies observed during WY2000 were generally within the ranges determined for the historical period and WY99. However, temporal trends were apparent for a few regions. Excursion frequencies declined (9.1-31.2%) in Refuge inflow and rim canal samples. Conversely, excursions in WCA-2 outflows and all regions of WCA-3 increased (9.6-10.8%) during WY2000, relative to the historic period, but not WY99.

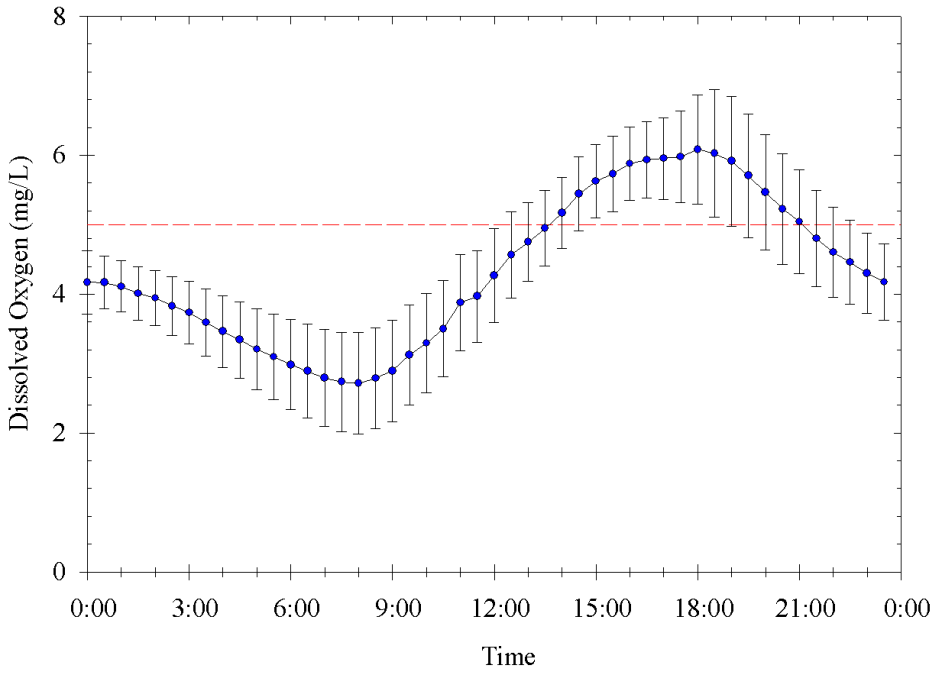
It is widely accepted that DO concentrations are normally low in macrophyte dominated marsh environments such as the Everglades due to natural processes of photosynthesis and respiration (Belanger and Platko 1986, McCormick *et al.,* 1997). Since the low DO concentrations often measured in the Everglades represent the natural variability in this type of ecosystem, the Department does not consider these excursions violations of the DO standard. Therefore, the Class III criterion of 5.0 mg/L is not believed to be appropriate for the Everglades. This stance is supported by Paragraph 62-302.500(1)(f), F.A.C., which states that "*dissolved oxygen levels that are attributable to natural background conditions or man-induced conditions which cannot be controlled or abated may be established as alternative dissolved oxygen criteria for a water body or portion of a water body*."

Pursuant to Section 62-302.800, F.A.C., the Department has undertaken the development of a Site Specific Alternative Criterion (SSAC) for dissolved oxygen in the Everglades that formally recognizes the natural background DO regime. The SSAC will also allow a more accurate assessment of which sites are adversely impacted with respect to DO level. More detail concerning the Department's efforts in establishing a dissolved oxygen

SSAC is provided in a technical report documenting the development of the SSAC (Weaver, 2000) which is provided as Appendix 4-II. The development and application of the proposed SSAC is outlined below.

Development of DO SSAC

Oxygen is a necessity for most life on Earth and all aerobic life, including plants and animals. Due to oxygen's importance to life, it is important to understand the processes which influence DO concentrations in the Everglades. In any aquatic system, water column DO concentrations are regulated by a variety of sources and sinks. These controlling factors are balanced in healthy systems. The primary oxygen sinks include chemical oxidation and aerobic respiration by vegetation, periphyton, and other organisms in both the water column and sediments. Photosynthesis and atmospheric exchange are the primary oxygen sources. In a marsh habitat, the principal photosynthetic contributors are periphyton and submerged aquatic vegetation (P/SAV) in open water sloughs with some minor contribution from phytoplankton. Additionally, DO concentrations within background areas fluctuate widely on a daily basis (diel) in



Average (mean ± 95% C.I.) diel dissolved oxygen fluctuation at a typical interior marsh station in the EPA. Data were taken from diel measurements collected at site E5 in WCA-2A during five sampling periods (4/24/95-4/29/95, 8/28/95-9/1/95, 9/3/96-9/6/95, 10/27/97-10/31/97, and 2/24/98-2/27/98). The dashed line shows the current Class III criterion at 5.0 mg/L.

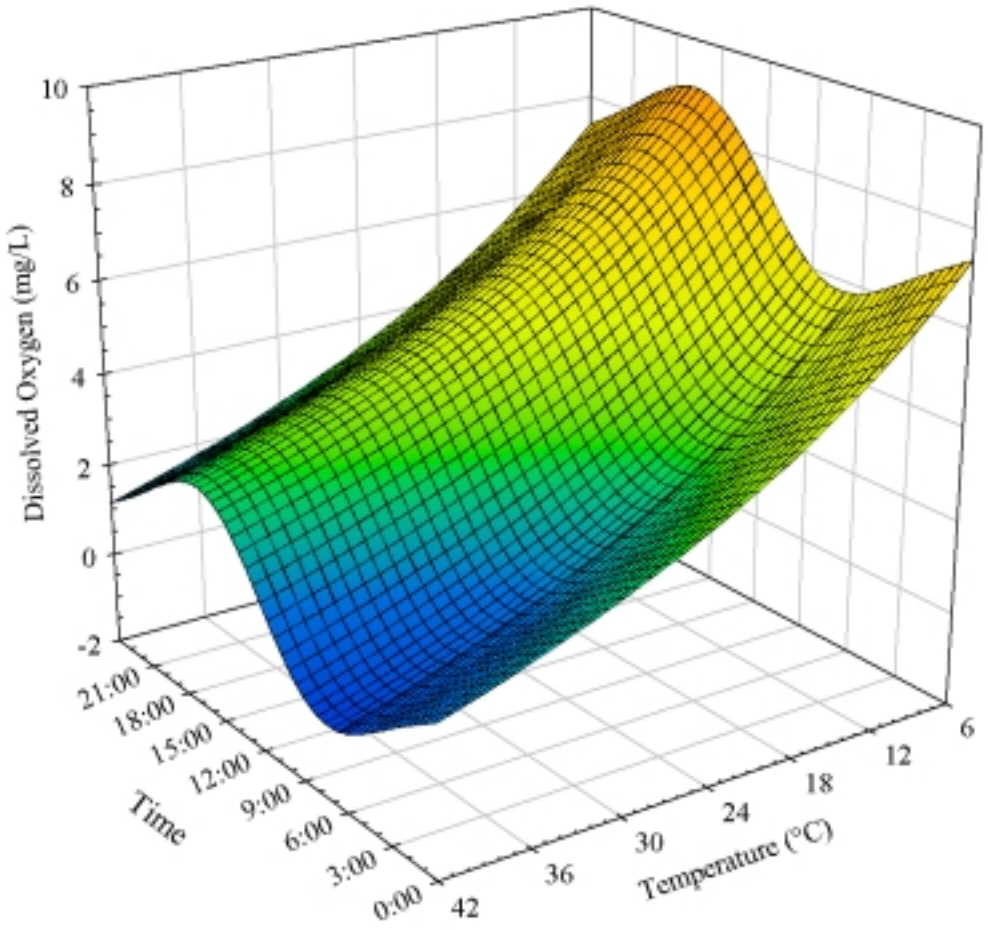
response to varied respiration and photosynthetic rates (Figure). These variations represent the normal diel variability typical for this type of ecosystem and therefore, must be maintained by any SSAC developed by the Department as specified by Section 62-302.800, F.A.C.

Although conditions in background areas of the Everglades represent natural variability, evaluation of DO concentrations along nutrient gradients in WCA-2A and the Refuge and mesocosm data in WCA-2A, indicate that phosphorus enriched areas of the marsh have DO concentrations which are significantly depressed (McCormick *et al*., 2000, Chapter 3, this Report). The normal daily DO fluctuations are also depressed, in fact, nutrient-enriched sites barely exhibit any diurnal DO fluctuations (Belanger *et al*, 1989). Significant depression of DO concentrations and suppression of the normal daily and seasonal variability at nutrient-enriched sites do constitute violations of the Class III dissolved oxygen criterion.

In recognition of the natural background condition and to allow differentiation between impacted and background conditions, the Department is developing a SSAC for Everglades marsh DO. The proposed SSAC utilizes a mathematical model that describes the relationship between DO and time of day and temperature to define the compliance limit. This approach takes into consideration the wide daily variations. In contrast, a single number SSAC would not be representative of background conditions across all times and temperature ranges and would at times be either under-protective or over-protective. Compliance with the SSAC is to be based on an annual average concentration. Annual average DO, at any given station, must be maintained above an annual limit calculated from an equation defined by sample collection time and temperature (Figure). The period of one year provides a characterization of the DO regime at a site and accounts for the infrequent occurrence of naturally low values. It should be noted that the SSAC has not yet been formally adopted. Establishment of the SSAC requires further peer review, public notice and hearing, and finally approval by the Secretary of the Department.

The proposed SSAC was applied to WY2000 DO data from interior, rim canal, inflow, and outflow stations in the EPA. Although the SSAC was developed for interior marsh stations, water discharging to the Everglades should meet the SSAC in order to prevent violations in receiving waters of the marsh. The Class III standard would still be applicable to canal waters that do not immediately discharge to the marsh. Utilizing the proposed SSAC on data from the previous water year yields a far lower excursion rate than did the analysis based upon the 5.0 mg/L criterion (Table). The percentage of stations categorized as Concern declined sharply in most cases. Stations that failed to meet the SSAC generally fell into two groups. A high percentage of water control structures (*i.e*., inflow, outflow) failed the SSAC test. This high rate of non-compliance is likely due to disturbance of bottom sediments and the intrusion of low DO ground water into the surface water at these structures. Sediments are commonly mixed with canal surface waters during pumping events. These sediments typically increase oxygen demand within the water column and subsequently result in reduced DO concentrations (Environmental Services & Permitting, Inc., 1992). Ground water intrusion is a common occurrence at Everglades pumping stations and canals dug below the water table. The influence of ground water on DO at these structures potentially represents a "man-induced condition which cannot be "controlled or abated" and will need to be addressed separately. The second group of stations failing the SSAC are interior marsh stations known to be impaired due to phosphorus enrichment (*e.g*., E1, E2, Z1, CA28).

Conditions at these stations are expected to remain impaired until sediment phosphorus concentrations are reduced and the biological communities recover.



Annual dissolved oxygen compliance limit for interior mash stations in the EPA. The curve is a function of temperature and sample collection time.

Comparison between the number of stations categorized as Concern using the current Class III Standard and the proposed SSAC for WY2000.

Region	Class	Number of Stations	Class III Criterion	SSAC
			Percent/(Number)	Percent/(Number)
Refuge	Inflow	6	100 (6)	0 (0)
	Interior	23	100 (23)	26 (6)
	Outflow	6	100 (6)	17 (1)
	Rim	4	100 (4)	0 (0)
WCA-2	Inflow	6	100 (6)	0 (0)
	Interior	22	100 (22)	27 (6)
	Outflow	5	100 (5)	60 (3)
WCA-3	Inflow	14	100 (14)	36 (5)
	Interior	10	100 (10)	20 (2)
	Outflow	9	100 (9)	11 (1)
Park	Inflow	9	100 (9)	0 (0)
	Interior	9	67 (6)	0 (0)

Turbidity

Turbidity is a measure of water clarity or cloudiness and thus is an indirect measure of particulates, water color and dissolved substances. It can be increased by soil erosion, waste discharge, urban runoff, bottom feeders like carp that stir up sediments, wind-induced resuspension of sediments, and algal growth. Turbid water can have ecological effects (USEPA, 1976). Turbid waters become warmer as suspended particles absorb heat from sunlight, causing oxygen levels to fall. Reflection and absorption of light on suspended particles can reduce light penetration through the water resulting in a decrease in photosynthesis and subsequent lowering of oxygen levels. Suspended solids in turbid water can clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. Settled particles smother eggs of fish and aquatic insects. Dependent upon particle composition, high turbidity can be indicative of elevated total phosphorus and total nitrogen concentrations.

The current state criterion for turbidity is $\leq$29 NTU above natural background conditions. For the Everglades, where natural marsh turbidities tend to be low (<1.0 NTU), natural background has been assumed to be 0 NTU for the purpose of this evaluation. There were 19 excursions above this standard in WY2000. Because station S10E is classified as both an outflow from the Refuge and inflow to WCA-2, two excursion events were counted twice, thus there were actually only 17 unique excursion events in WY2000. As

a result of these excursions, turbidity was categorized as a Concern for the rim canal and inflow structures of the Refuge. Additionally, turbidity was classified as a Potential Concern for the outflows from the Refuge and inflows to WCA-2. The frequency of turbidity excursions in the regions of the EPA during WY2000 occurred at frequencies at or above those for the historic period and WY99.

Excursions in WY2000 occurred in the vicinity of the S-5A, S-6 and S-10E pumping stations, with the majority occurring in December and January. The excursions are most likely explained by construction near these stations. Canal construction was being conducted on the Hillsboro and West Palm Beach Canals during this period, which would have had a substantial influence on the water quality at sites S6 and S5A, respectively. Additionally, work on the Inflow and Diversion Work of STA-2 was conducted in the L-7 canal in the vicinity of the S-10E structure. Although during WY2000 turbidity levels exceeding the state standard occurred in some areas of the EPA at frequencies exceeding those historically observed, many of the exceedances can be tracked to temporary events that will not be repeated and ultimately contribute to the restoration of the Everglades and net improvement in water quality.

Total Phosphorus and Total Nitrogen

Even though phosphorus and nitrogen do not have numeric criteria, the concentration of these nutrients in Class III waters is regulated by a narrative criterion that specifies that nutrient concentrations in a water body can not be altered so as to cause an imbalance in the natural populations of flora or fauna and shall be limited to prevent violations of other water quality standards. In an attempt to prevent further adverse biological impacts resulting from nutrient enrichment within the EPA, the Department is currently in the process of developing a numeric phosphorus criterion for the Everglades based on the interpretation of the narrative standard. Due to the importance of nutrient levels within the EPA, the concentrations of nitrogen and phosphorus measured during the 2000 water year are discussed below and compared to results from previous monitoring years.

Total Phosphorus

Since no numeric standard currently exists, phosphorus concentrations are summarized to provide an overview of the current nutrient status of the Everglades and demonstrate temporal and spatial patterns. No excursion analysis can be performed at this time, however, the 10 µg/L EFA default phosphorus criterion and the 50 µg/L long-term limit for the STAs is used as a basis for comparison. Total phosphorus (TP) concentrations observed in WY2000, WY99, and the historic period (WY79-WY98) are summarized in Table___. Data for the current water year are presented against historical data for comparative purposes.

Median inflow TP concentrations were within the range of the two historic periods, with the exception of WCA-3 where inflow concentrations were slightly higher during WY2000. Overall, inflow concentrations decreased from north to south with the highest concentrations entering the Refuge (median = 68 µg/L) and the lowest flowing into the Park (median = 8 µg/L). Similar to previous periods, median interior marsh concentrations were low in WY2000 and ranged by area from 5 to 13 µg/L. The lowest

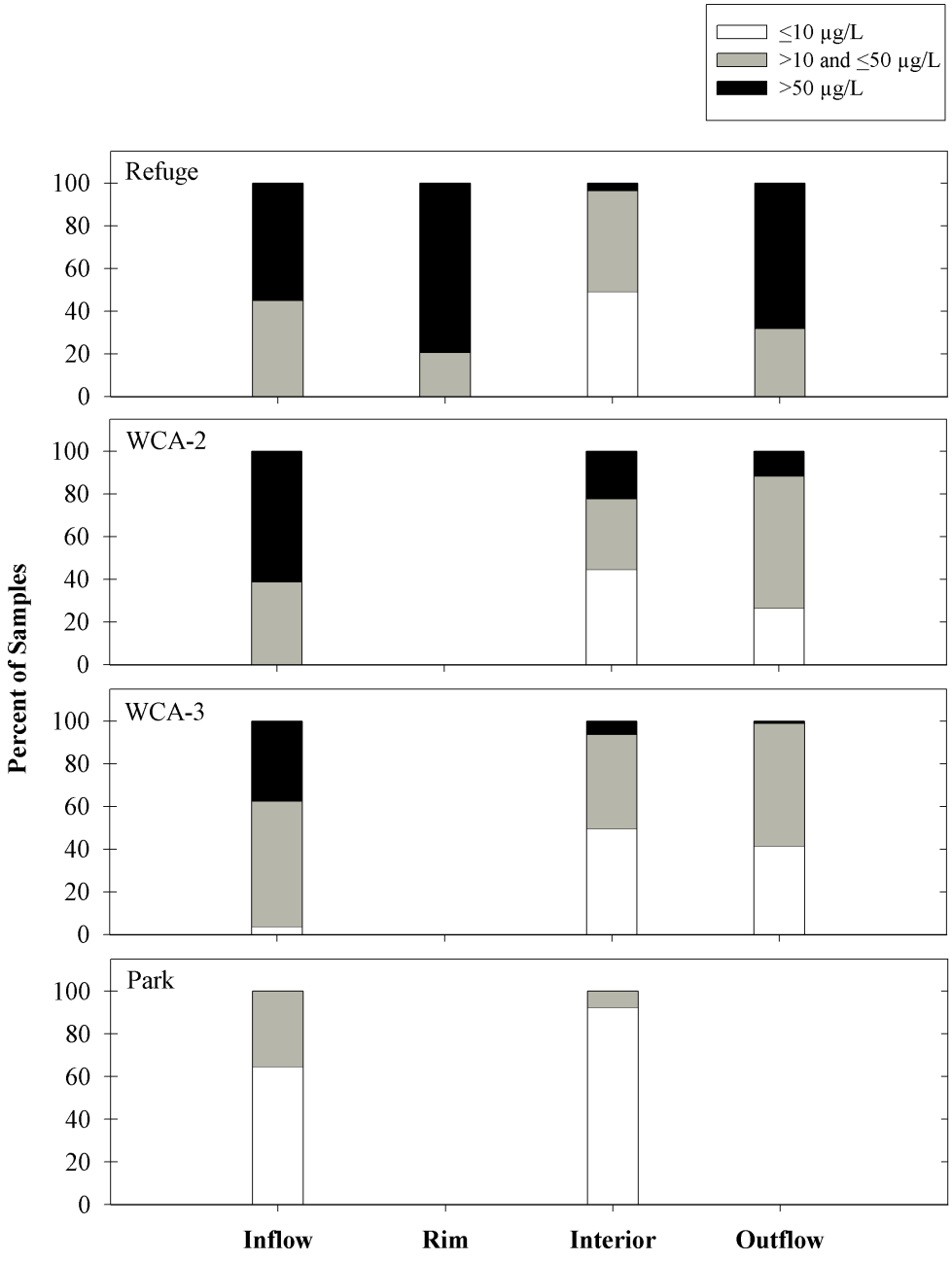
interior marsh concentrations were observed in the Park, where a substantial proportion (22%) of the samples were less than the 4 µg/L MDL.

The distribution of TP concentrations in all EPA regions for WY2000 is presented in Figure ____. Over the entire EPA, 87% of TP measurements were below 50 µg/L with 45% at or below 10 µg/L. As with previous years, a decreasing north to south gradient, indicative of settling, sorptive (both adsorptive and absorptive), assimilative (biological) and other biogeochemical processes in the marsh, was apparent. Inflow stations to the Refuge and Water Conservation Areas had the highest percent of measurements above 50 µg/L (38 - 61%). In contrast, no values above 50 µg/L were observed in inflows to the Park and most values (92%) within the Park interior were less than 10 µg/L. High concentrations in the north are related to canal discharges composed primarily of agricultural runoff originating in the EAA. Water Conservation Area 2 is the most directly affected region and thus has the greatest occurrence of inflow and interior marsh concentrations above 50 µg/L. Although the Refuge also receives EAA discharges similar to WCA-2, hydrologic patterns within the Refuge substantially reduce the influence of canal inputs on interior marsh stations. Drainage from the EAA also enters the Refuge through the S-5A and S-6 structures, but largely circumvents the Refuge interior via the L-7 canal and enters WCA-2A instead through the S-10 structures.

Summary of total phosphorus concentrations (µg/L) in the Everglades Protection Area for WY2000, WY99, and WY79-WY98.

Region	Class	Period	N	Mean (Arithmetic)	Std. Deviation	Minimum	Median	Maximum
Refuge	Inflow	WY78-WY98	2256	105	95.5	<4	79	1415
		WY99	329	69	52.2	13	58	295
		WY2000	359	83	71.1	10	68	418
	Rim	WY78-WY98	518	80	57.4	<4	66	564
		WY99	100	61	38.4	22	48	198
		WY2000	50	91	56.8	34	72	290
	Interior	WY78-WY98	1294	14	26.3	<4	8.5	494
		WY99	254	16	19.4	<4	9	200
		WY2000	273	16	18.7	5	11	140
	Outflow	WY78-WY98	903	81	136.5	6	56	3435
		WY99	62	64	39.8	12	51	159
		WY2000	64	76	43.5	24	62	210

Region	Class	Period	N	Mean (Arithmetic)	Std. Deviation	Minimum	Median	Maximum
WCA-2	Inflow	WY78-WY98	1337	83	118.3	7	62	3435
		WY99	66	66	44.7	10	54	254
		WY2000	83	74	51.0	14	59	319
	Interior	WY78-WY98	2645	36	65.1	<4	14	1253
		WY99	304	55	168.2	<4	16	2200
		WY2000	321	34	47.0	<4	13	380
	Outflow	WY78-WY98	1150	35	44.2	<4	21	556
		WY99	66	27	21.8	4	18	91
		WY2000	73	28	38.1	6	15	199
WCA-3	Inflow	WY78-WY98	3389	63	75.4	<4	41	933
		WY99	366	53	48.7	<4	39	263
		WY2000	398	67	65.1	4	48	347
	Interior	WY78-WY98	1524	20	31.6	<4	10	438
		WY99	144	19	30.8	<4	8	192
		WY2000	190	17	17.6	<4	11	103
	Outflow	WY78-WY98	3075	15	23.6	<4	10	593
		WY99	192	15	16.9	5	11	217
		WY2000	179	15	14.3	4	12	171
Park	Inflow	WY78-WY98	3653	14	21.6	<4	9	593
		WY99	233	12	15.0	<4	9	217
		WY2000	306	11	7.0	<4	8	51
	Interior	WY78-WY98	1048	13	47.4	<4	6	1137
		WY99	81	7	8.0	<4	5	75
		WY2000	94	7	4.4	<4	5	38



Distribution of total phosphorus concentrations in samples collected in the EPA during WY2000.

Total Nitrogen

No State numeric water quality standard exists for total nitrogen (TN), although the narrative nutrient standard does apply. Most areas of the EPA are known to be phosphorus limited. There is no evidence that the Everglades is greatly affected by nitrogen enrichment. It is however still an important plant nutrient and component of agricultural discharge and was previously reported in the Interim and 2000 Consolidated Reports. Total nitrogen concentrations for WY2000, WY99 and WY79-WY98 are summarized in Table ___. Water Year 2000 TN concentrations fell within the range of the historic periods with small declines in most regions. As with TP, a north to south gradient is apparent in the TN data and likely reflects agricultural discharges in the north and assimilative processes within the marsh as water flows southward. The highest median concentrations were observed in the inflows to the Refuge (3.0 mg/L) and WCA-2 (2.7 mg/L). While the lowest median concentrations were observed in the inflows to and interior of the Park (0.7-0.8 mg/L).

Summary of total nitrogen concentrations (mg/L) in the Everglades Protection Area for WY2000, WY99, and historic period (WY79-WY98).

Region	Class	Period	N	Mean	Std. Deviation	Minimum	Median	Maximum
Refuge	Inflow	WY78-WY98	2330	4.2	27.11	0.2	3.0	1303
		WY99	265	2.5	1.63	<0.5	2.0	13.1
		WY2000	235	2.6	1.31	<0.5	2.2	9.4
	Rim	WY78-WY98	527	2.8	1.49	0.5	2.4	10.9
		WY99	93	2.4	1.47	<0.5	1.9	9.7
		WY2000	50	2.5	1.29	<0.5	2.0	7.7
	Interior	WY78-WY98	1124	1.7	1.59	0.5	1.3	36.7
		WY99	144	1.4	0.77	0.5	1.2	4.7
		WY2000	206	1.5	0.73	<0.5	1.3	6.6
	Outflow	WY78-WY98	914	2.8	1.76	0.5	2.4	22.8
		WY99	63	2.3	1.21	0.8	1.8	5.1
		WY2000	64	2.3	1.07	0.9	1.9	4.9
WCA-2	Inflow	WY78-WY98	1359	3.0	1.68	0.5	2.7	22.8
		WY99	66	2.5	1.18	1.1	2.3	5.1
		WY2000	81	2.5	1.00	0.8	2.2	4.9

Region	Class	Period	N	Mean	Std. Deviation	Minimum	Median	Maximum
	Interior	WY78-WY98	2515	2.5	1.58	0.2	2.3	37.2
		WY99	214	2.0	0.78	<0.5	2.0	5.0
		WY2000	285	2.0	0.68	<0.5	1.9	5.0
	Outflow	WY78-WY98	1173	2.2	0.91	0.5	2.1	7.7
		WY99	66	1.6	0.47	1.0	1.5	3.7
		WY2000	74	1.6	0.71	<0.5	1.4	4.4
WCA-3	Inflow	WY78-WY98	3283	2.2	1.17	0.5	1.9	10.8
		WY99	246	1.7	0.61	0.8	1.6	4.7
		WY2000	278	1.8	0.92	0.7	1.5	6.4
	Interior	WY78-WY98	1567	1.7	0.94	0.2	1.5	10.0
		WY99	113	1.1	0.41	<0.5	1.0	2.3
		WY2000	161	1.2	0.43	<0.5	1.2	3.3
	Outflow	WY78-WY98	2381	1.5	0.70	0.3	1.4	14.9
		WY99	137	1.1	0.26	0.6	1.1	1.7
		WY2000	144	0.9	0.28	<0.5	0.9	2.0
Park	Inflow	WY78-WY98	2967	1.4	0.70	0.2	1.3	14.9
		WY99	157	1.0	0.27	<0.5	0.9	1.7
		WY2000	244	0.8	0.22	<0.5	0.7	1.4
	Interior	WY78-WY98	1075	1.5	1.68	0.05	1.3	40.8
		WY99	81	1.2	0.54	0.6	1.1	4.9
		WY2000	98	0.9	0.46	<0.5	0.8	2.7

Summary

The focus of this section is to provide an update concerning the water quality status for each region of the EPA for WY2000 (*i.e.*, May 1, 1999 through April 30, 2000). This report builds on the water quality analyses previously presented in the Interim and Consolidated Reports. An analysis of the water quality parameters not meeting the water quality criteria specified in Section 62-302.530, F.A.C. and a discussion of any temporal or spatial trends observed for the parameters identified as concerns or potential concerns is also provided. Annual excursion rates were summarized in a manner consistent with methods employed in the Interim and 2000 Consolidated Reports with parameters not meeting existing standards being classified into two categories based on excursion frequencies. Unlike previous reports, this section also provides a discussion of the factors contributing to excursions from applicable water quality standards and an evaluation of the natural background condition where existing standards are not appropriate. The results of the evaluation detailed in this section are summarized below.

- Dissolved Oxygen (DO) was placed in the Category of Concern for all EPA regions and classes due to ubiquitous concentrations below the current 5.0 mg/L criterion. However, a draft SSAC is being developed by the Department to recognize the naturally low DO regime characteristic of macrophyte dominated wetlands such as the Everglades. Application of the proposed SSAC to the DO data collected during WY2000 resulted in a reduction in the number on monitoring stations at which DO was identified as being a Concern from 120 to 24. Most of the remaining 24 sites can be shown to be influenced by either nutrient enrichment or groundwater infiltration and are accurately designated as not being in compliance with the SSAC.
- Turbidity was categorized as a Concern for the rim canal and inflow structures of the Refuge. Additionally, turbidity was classified as a Potential Concern for the outflows from the Refuge and inflows to WCA-2. Most of the turbidity excursions can likely be related to construction activities near these stations. Although during WY2000 turbidity levels exceeding the State standard occurred in some areas of the EPA at frequencies exceeding those historically observed, many of the exceedances can be tracked to temporary events that will not be repeated and will ultimately contribute to the restoration of the Everglades and net improvement in water quality.
- In the interior of the Park, lead was placed in the Potential Concern category due to a single value above the state criterion and likely results from sample contamination.

The Department, with assistance from the SFWMD, intends to continue evaluation of background water quality in the EPA as it relates to current standards. Where current standards prove to be inappropriate, means of formally recognizing the unique nature of the Everglades will be pursued. For example, natural conditions within the Refuge lead to frequent excursion from alkalinity and pH criteria. The Department recognizes these conditions to be natural characteristics of the Refuge, and thus, does not consider the excursions to be violations of State standards. Formal recognition (e.*g.*, SSAC) of these

conditions within the marsh would eliminate the necessity of investigating, documenting and reporting naturally occurring low pH and alkalinity values in the Refuge, an Outstanding Florida Water. Other parameters that may require further evaluation include conductivity and iron. Evaluation of existing water quality standards is being pursued in order of relevance, that is, parameters with the most persistent and pervasive (*e.g.*, dissolved oxygen, alkalinity and pH) excursion frequency being addressed first.