# Chapter 1: Introduction to the Everglades Interim Report

Garth Redfield, Joel VanArman, Keith Rizzardi and Michael Chimney

This Introduction to the Everglades Interim Report (Report) provides essential background to help the reader understand the legal, scientific and governmental context of the document and supporting research efforts. An overview of the status of the Everglades and resources at stake is given so that the reader can appreciate the challenges that are faced in the environmental management of south Florida; they are discussed from many different vantage points in the Report. Next, the governmental context of the Report is described from the perspective of planning for environmental management over the next two to five decades. The objectives and content of the document are then highlighted, followed by a discussion of the legal and reporting requirements being addressed. The process used to create and review the Report is summarized because it is somewhat unique, particularly in the use of external peer review by the public and a panel of experts. Finally, the Introduction provides a review of constraints on report contents, so that the reader can know what authoritative sources of information were available for authors to discuss and analyze in the Report.

This chapter only provides a general introduction to the issues and content of the Report. The diversity of topics covered precludes a detailed introduction. Individual chapters give specific background needed to interpret information in each subject area. This Report is essentially an anthology of topical reports that describe the status of the Everglades ecosystem; the subjects were specified by Florida statute. Although it has been edited for grammar, format and consistency, the District has not attempted to create an integrated volume, such as might be expected for a more narrowly focused book on environmental management of the Everglades ecosystem.

## The Geographic Setting

### Major Features of the Everglades Protection Area and Surroundings

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. The historic Everglades 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. More than half of the original system has been lost to drainage and development (Davis and Ogden, 1994), including the Everglades Agricultural Area located south of Lake Okeechobee. Today's remaining Everglades, which are primarily included within the boundaries of the Everglades Protection Area (EPA), are comprised of Everglades National Park (Park) including Florida Bay, and the Water Conservation Areas (WCA-1, WCA-2A, WCA-2B, WCA-3A, and WCA-3B) (**Figure 1-1**).

Several areas adjacent to the modern Everglades are significant because they were part of the historical system, they provide significant wildlife corridors and habitat, and/or they contribute directly to management problems within the system. These include the Holey Land and Rotenberger Wildlife

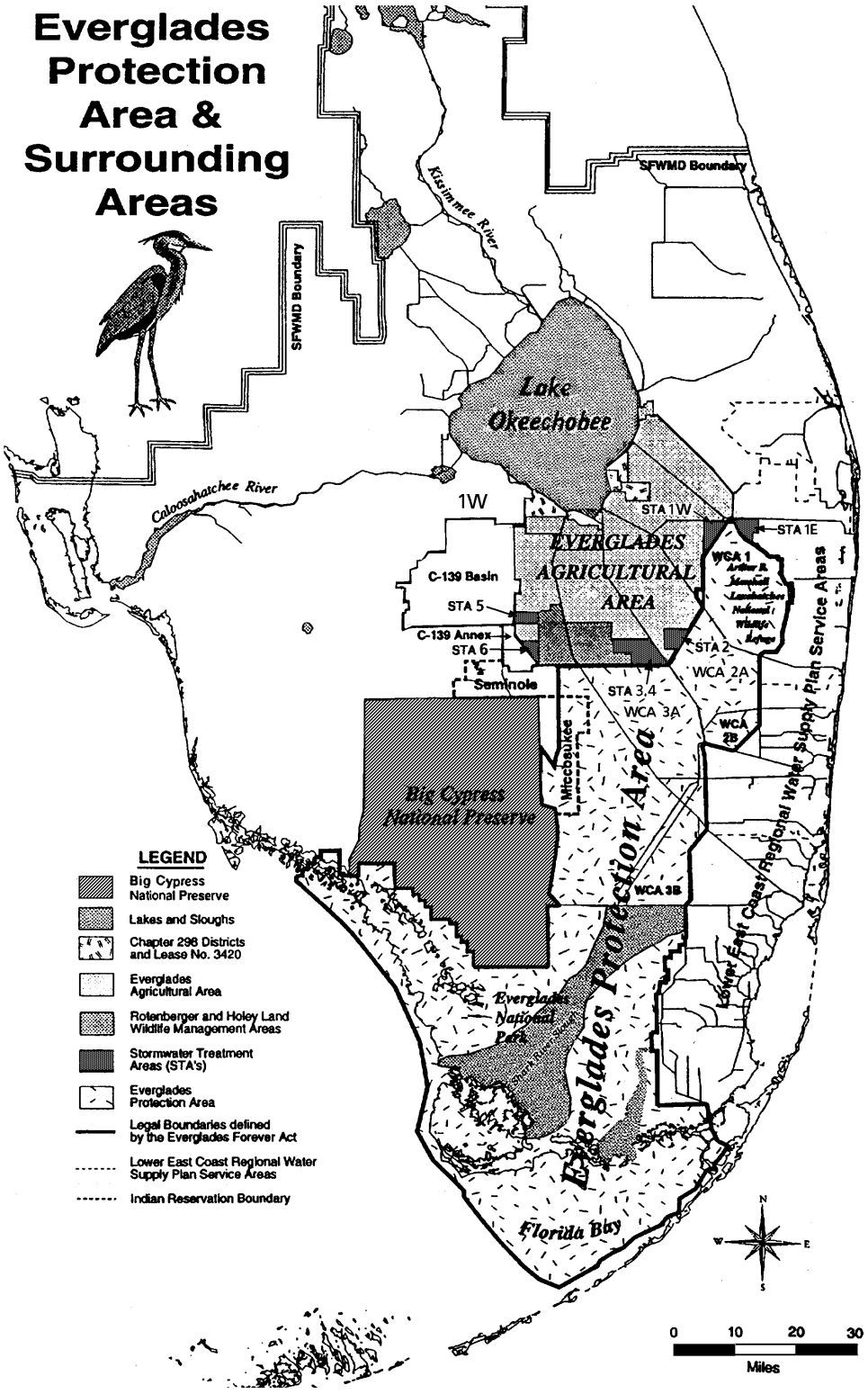


**Figure 1-1.** Major Features of the Everglades Protection Area in South Florida.

Management Areas, Everglades Agricultural Area (EAA), the C-139 Basin, Big Cypress National Preserve, and the Seminole and Miccosukee Indian Reservations.

## Areas within the Everglades Protection Area

### Everglades National Park

Everglades National Park (the **Park**) encompasses 2,150 sq. mi. of freshwater sloughs, sawgrass prairies, marl-forming wet prairies, mangrove forests and saline tidal areas located at the southern end of the Florida peninsula (**Figure 1-1**). The Park was formally established by Congress in 1934 to preserve the unique ecology of the Everglades. The Park was designated by the United Nations as a World Heritage Site in 1979 and was named as a Federal Wilderness Area, an International Biosphere Reserve, and a Wetland of International Significance. Today, Everglades National Park is the second largest national park in the United States and is one of the nation's ten most endangered parks (SFWMD, 1992b).

The Park contains three dominant wetland systems -- sloughs, marl-forming marshes and mangroves. Sloughs comprise much of the central drainage of the park. Shark River Slough consists of a broad southwesterly arc of continuous wetlands, interspersed with sawgrass strands, open water sloughs, wet prairies, and tree islands extending from Tamiami Trial to the mangrove estuaries of Florida Bay. During wet periods, Taylor Slough (also called Taylor River) provides local flow of freshwater from the eastern side of the Park to Florida Bay. Southern marl-forming marshes are characterized by the formation of marl soils (also known as calcitic mud). Marl is formed by the precipitation of calcite by blue-green algae in submerged algal mats (periphyton) under shallow water/short hydroperiod conditions. Marl-forming marshes occur on the eastern and western margins of Shark River Slough, as well as in Taylor Slough and the Rocky Glades. These wetlands occur at a slightly higher elevation than Shark River Slough and exhibit corresponding shallow water depths and shorter hydroperiods. The third major wetland system, mangroves, occupies the southern and western borders of the Park where freshwater ecosystems merge with the brackish estuaries of Florida Bay (SFWMD, 1992b).

### Water Conservation Areas

The three Water Conservation Areas (WCAs) are a major component of the Everglades Protection Area and an important source of water supply for South Florida (SFWMD, 1992b). The WCAs, located south of Lake Okeechobee and east of the heavily urbanized Lower East Coast, comprise an area of about 1,350 square miles (**Figure 1-1**). These remaining Everglades wetlands today serve multiple purposes: a) detention areas for excess water discharged from Lake Okeechobee and flood control discharges from the Everglades Agricultural Area and portions of the lower east coast; b) sources of water supply for lower east coast agricultural lands and urban areas by recharging the Biscayne aquifer and retarding salt water intrusion in coastal wellfields; c) sources of water supply for Everglades National Park; d) important habitats for Everglades wildlife; and e) public recreational uses.

#### *Water Conservation Area 1*

Water Conservation Area 1 (WCA-1) is designated as the Arthur R. Marshal Loxahatchee National Wildlife Refuge (**Refuge**) and is managed by the U.S. Fish and Wildlife Service (USFWS). WCA-1 covers an area of 566 $km^2$ (221 sq. mi). within Palm Beach County. The West Palm Beach Canal discharges agricultural drainage water into the north end of WCA-1 and the Hillsboro canal discharges water into the southwestern portion. The area is enclosed by 93 km (58 mi.) of levees and provides storage for excess rainfall and runoff from the Everglades Agricultural Area (SFWMD, 1992b).

***Water Conservation Areas 2A and 2B***

Water Conservation Area 2 is an extensive sawgrass wetland that encompasses an area of 538 $km^2$ (210 sq. mi.). and is the smallest of the three Water Conservation Areas located within southern Palm Beach and northern Broward counties (**Figure 1-1**). In 1961 a levee (L-35B) was constructed across the southern portion of WCA-2, dividing the area into two smaller units, WCA-2A (442 $km^2$ or 173 sq. mi.) and WCA-2B (95 $km^2$ or 37 sq. mi.). The area was divided in an effort to reduce water seepage losses to the south and improve the water storage capabilities of WCA-2A. More than half of the inflow water entering WCA-2A originates from the EAA. Canal inflow waters are highly mineralized and contain high concentrations of nitrogen and phosphorus resulting from the oxidation of organic peat soils within the EAA (SFWMD, 1992b).

***Water Conservation Areas 3A and 3B***

The largest of the water conservation areas, WCA-3, covers an area of 2342 $km^2$ (915 sq. mi.) and is located in western Broward and Dade counties (**Figure 1-1**). The area is predominately a vast sawgrass marsh dotted with tree islands, wet prairies and aquatic sloughs. A cypress forest fringes its western border along the L-28 Gap and extends south to Tamiami Trail. In 1962, WCA-3 was divided into WCA-3A (2012 $km^2$ or 786 sq. mi.) and WCA-3B (327 $km^2$ or 128 sq. mi.) by construction of two interior levees so that water losses due to levee seepage could be reduced. WCA-3A is the only water conservation area that is not entirely enclosed by levees. The L-28 Gap allows overland flow to enter WCA-3A from the Big Cypress National Preserve and other western basins (SFWMD, 1992b).

**Florida Bay**

Florida Bay is located at the extreme southern tip of mainland Florida and includes the body of water that lies between the mainland peninsula and Florida Keys (SFWMD, 1992b). The Keys form the approximate east and southern boundaries of Florida Bay. The boundary on the west is generally considered to be the 30-foot depth contour line where the Bay adjoins the deeper waters of the Gulf of Mexico. The Bay covers a total area of about 2200 $km^2$ (860 square miles) of which approximately 1800 $km^2$ (700 sq. mi.) lie within Everglades National Park.

Florida Bay is a broad shallow expanse of brackish to salty water that contains numerous small islands, extensive sandbars and grass flats. Florida Bay historically supported important commercial and sport fisheries for invertebrates (lobster, shrimp, sponges) and fishes (snook, redfish, tarpon, seatrout and mullet). In addition, the warm shallow waters provide habitats for major populations of birds and endangered species such as crocodiles and manatees. Much of the productivity of Florida Bay is dependent on mangroves and seagrasses, which provide important sources of primary production and habitat for complex associations of other species. The die-off of seagrasses in the late 1980's was taken as an indication that Florida Bay was seriously threatened by water management practices in upstream basins (SFWMD, 1992b).

There has been great concern that surface water flows to Florida Bay have been reduced due to increasing competition for available fresh water from agriculture and urban development. Also, the available water has been partitioned to meet the needs of other natural areas such as Lake Okeechobee, the Water Conservation Areas, Everglades National Park, Biscayne National Park and the Big Cypress National Preserve. Another factor of unknown impact has been the reduction in groundwater flow. The

effects of long-term variations in rainfall patterns and sea level rise are unknown but may also be significant (SFWMD, 1992b).

## Areas Surrounding the Everglades Protection Area

### Holey Land and Rotenberger Wildlife Management Areas

The Holey Land Wildlife Management Area is a 140 $km^2$ (55 sq. mi.) tract lying in the S-7 and S-8 sub-basins. It is wholly state owned and managed by the Florida Game and Freshwater Fish Commission (FGFWFC). The area is heavily used for hunting of white-tailed deer and hogs. The Rotenberger Wildlife Management Area consists of 96 $km^2$ (37 sq. mi.) of state-owned and leased private land (roughly 40% of total acreage) that is separated from the Holey Land by the Miami Canal and managed by the FGFWFC for deer and hog hunting. In 1983, a Memorandum of Understanding was entered into by the District and other agencies to restore Everglades values associated with the Holey Land/Rotenberger Tract and establish water regulation schedules that will simulate the natural hydroperiod. In June 1990, the District and the FGFWFC agreed on operational schedules that improve hydroperiods in both the Holey Land and WCA-3A (SFWMD, 1998).

### Everglades Agricultural Area

The Everglades Agricultural Area (**EAA**), located south of Lake Okeechobee within eastern Hendry and western Palm Beach counties, encompasses approximately 2872 $km^2$ (1,122 sq. mi.) of highly productive agricultural land comprised of rich organic peat or muck soils. Small portions of EAA muck lands are also found in western Martin County. Approximately 77 percent of the EAA's 2212 $km^2$ (864 sq. mi.) is in agricultural production. The area is considered one of Florida's most important agricultural regions; it extends south from Lake Okeechobee to the northern levee of WCA-3A, from its eastern boundary at the L-8 Canal, to the western boundary along the L-1, L-2 and L-3 levees. Nitrogen-rich organic (peat) soils and a warm subtropical climate permit the year round farming of sugar cane, winter vegetables and rice, with a total economic impact estimated at more than $1 billion dollars per year (gross sales, Mulkey and Clouser, 1988). The major crops in the EAA include sugar cane, vegetables, and sod and smaller amounts of other crops such as rice, and citrus. In 1987, sugar cane production alone accounted for 1620 $km^2$ (633 sq. mi.) of land use within the EAA (Coale, 1987).

### C-139 Basin, Big Cypress National Preserve, and the Seminole and Miccosukee Indian Reservations

Basins located west and northwest of the WCAs discharge into WCA-3A via structures or gaps in the area's western levee. Agriculture is the dominant land use in the C-139, Feeder Canal and L-28 Interceptor basins. The remaining land cover in these three basins is predominately wetlands and forested uplands, while the L-28 Gap basin consists almost entirely of wetlands (98%) within the Big Cypress national preserve. Urban land uses occupies 4% of the C-139 Basin and less than 1% of the remaining Basins.

The areas immediately west of WCA-3 include the Seminole Indian Tribe of Florida and the Miccosukee Tribe of Indians of Florida. These areas include extensive private holdings that traditionally have been used for cattle operations on either native range lands or improved pasture. The basins west of WCA-3A are undergoing rapid intensification of agricultural development. During the 1980s, native range lands, improved and unimproved pastures have been undergoing conversion to citrus, sugar cane or other

agricultural use. Tribal lands within the WCA system should be restored and maintained as natural Everglades habitat for the benefit of the Tribes and the Everglades ecosystem.

The 2280 $km^2$ (891 sq. mi.) Big Cypress National Preserve was established by Public Law 93-440 in 1974 to protect natural and recreational values of the Big Cypress watershed, and to allow for continued traditional uses such as hunting, fishing, and oil and gas production. It was also established to provide an ecological buffer zone and protect Everglades National Park's water supply. In 1988, Congress added 584 $km^2$ (228 sq. mi.) to the preserve. Excessive drainage and the introduction of water of poor quality into Big Cypress National Preserve via the existing canal system are the most significant water management problems. The canals contributing pollutants into the Preserve are not part of the C&SF Project, but provide local drainage from agricultural lands in the Seminole Indian Reservation, C-139 Basin and C-139 Annex.

## Governmental Setting: the District, Other Agencies and the Everglades Program

Created originally as the Central and Southern Florida Flood Control District in 1949, the agency was renamed the South Florida Water Management District (**District** or SFWMD) in response to a broadened mission. The District is now responsible for environmental resources management of approximately 17,000 sq. miles in south Florida, with an agency mission that includes the following elements: water supply, flood protection, water quality protection, and environmental enhancement. The District's fundamental responsibility is to operate and maintain the Central and Southern Florida Project, a multipurpose water resources project first authorized by Congress in 1949.

The District's partner in many of its responsibilities is the Florida Department of Environmental Protection (DEP). The DEP is officially a cooperator on this Interim Report and has reviewed and contributed much of the content, particularly on aspects involving water quality. However, this Everglades Interim Report is primarily a product of District programs and projects associated with the Everglades Forever Act. Much of the information in this Report is based on planning, monitoring and research that has been funded or conducted by District staff and has been combined with information available by July 1, 1998 from peer-reviewed published literature, as well as from other organizations conducting research in the Everglades Protection Area.

The several elements of the **Everglades Program** are outlined in **Table 1-1**, along with Research and Monitoring (RAM) Projects that provided most of the information summarized in this Report. **Table 1-1** provides a summary of the 56 projects of the Everglades program and ties these activities to chapters in this Report. Descriptions of the projects can be found in the publication titled, "Everglades Program Implementation: Program Management Plan (revision 3)" (SFWMD, 1997). The RAM element encompasses many of the subjects that will be covered in this Interim Report, although individual authors may go beyond the original scope of these projects, if required to provide relevant and complete information concerning key topics mentioned in the Act.

The overall Everglades Program includes interpreting the water quality standard for phosphorus (background science in **Chapter 3**), agricultural Best Management Practices (**Chapter 5**), the Everglades

**Table 1-1.** Seven Elements and 56 projects of the Everglades Program as authorized through the 1994 Everglades Forever Act. This Interim Report is one of these projects (RAM 7).

| Element Titles (7) Project abbreviations and titles (56) | | Completion Dates | Chapter Coverage in Interim Report |
|---|---|---|---|
| **1. Everglades Construction** | | | |
| Everglades Construction contains 18 projects including 5 Stormwater Treatment Areas and 3 hydropattern restorations. | | All projects completed by 12/31/06 | Construction projects are not discussed specifically in the Interim Report, but the ECP is covered in **Chapters 2**, **4**, **5**, **6**, **11** and **12**. |
| **2. Hydropattern Restoration** | | | |
| Of the seven projects in this element, four are complete as of 12/31/98. | | Most projects by 12/31/99, all by 10/01/03 | **Chapter 2** hydropattern issues, **Chapter 9** LEC Water Supply Plan and **Chapter 10** hydropattern restoration in the Restudy. |
| **3. Research and Monitoring (RAM)** | | | |
| RAM - 1 | Describe Water Quality in EPA and Tributary Waters | 01/31/96 | **Chapter 4** covers water quality in detail. |
| RAM - 2 | Evaluate Best Management Practices Effectiveness | 12/31/01 | **Chapter 5** is devoted to the EAA and BMP implementation. |
| RAM - 3 | Evaluate Existing Water Quality Standards for the EPA | 12/31/01 | **Chapter 4** covers water quality in detail. |
| RAM - 4 | Evaluate WQ Standards and Classifications of EAA Canals | 12/31/01 | **Chapters 4** and **7** (see also **12**), canal evaluations not completed to date |
| RAM - 5 | Optimize Stormwater Treatment Area Operation | 12/31/06 | **Chapter 6** with annual updates through 2006 |
| RAM - 6 | Interpret Class III Phosphorus Criterion Research | 12/31/02 | **Chapter 3** with discussion of scheduling in **Chapter 12** |
| RAM - 7 | Peer-Review Interim Report | 01/01/99 | Product of RAM 7 is this Everglades Interim Report |
| RAM - 8 | Peer-Review Annual Report | 01/01/00 and yearly to 2006 | RAM 8 will provide updates to Everglades Interim Report |
| RAM - 9 | Monitor C-139 Basin Water Quality | 05/01/95, in progress | Covered in **Chapter 4** of this report |
| RAM - 10 | Hydrological Needs of the Ecosystem | 12/31/01 | Covered in detail in **Chapter 2** and mentioned throughout the Report |
| RAM - 11 | Mercury Monitoring and Research | 12/31/01 | Covered in detail in **Chapter 7** |
| RAM - 12 | Identify Supplemental Technologies | 01/01/01 | Covered in detail in **Chapter 8** and mentioned in **Chapters 11** and **12** |
| RAM - 13 | Best Management Practice Strategies for other Water Quality Parameters | 12/31/06 | Not covered in detail in Report; **Chapter 5** is closest to topic (see also **Chapters 11** and **12**) |
| **4. Regulation Projects** | | | |
| This element includes 10 projects; three are now completed. | | All projects 12/31/06 | Projects are mentioned in **Chapters 5**, **10**, **11** and **12** |
| **5. Exotic Species Control** | | On-going | Mentioned in **Chapters 2**, **3**, **9** & **10** |
| **6. Funding Projects** | | On-going | Mentioned in **Chapters 9**, **10**, **11** & **12** |
| **7. Everglades Annual Reports** | | On-going | Reports contain summaries of Interim Report and annual updates |

Construction Project (**Chapters 6** & **12**), and supplemental technologies for treating stormwater (**Chapter 8**). A major component of the Everglades Program, the Everglades Stormwater Program (**Chapter 11**), includes developing the means to assure water quality compliance for structures discharging into, from or within the Everglades Protection Area. The Everglades Stormwater Program moves beyond the Everglades Construction Project to assure water quality standards will be met for areas of the EPA that are not directly involved in the ECP. All of these elements of the Everglades Program are integrated in **Chapter 12** as it highlights successes, linkages and potential setbacks that may occur as these diverse programs are implemented. A general goal of the Everglades Interim Report is to improve public understanding of these programs and the science that supports decisions derived from the programs.

The District, other agencies, local governments and private interests, have worked cooperatively to develop a Lower East Coast Water Supply Plan (LEC Plan), which is described in detail in **Chapter 9**. This Plan, completed in March 1998, is an *interim plan* because it provides for immediate steps within the framework of a larger, longer-term planning process. This regional planning process, the Central and Southern Florida Comprehensive Review Study (Restudy) is being led by the U.S. Army Corps of Engineers (USACE) and is the subject of **Chapter 10**. The Restudy will provide the basis for reconstructing the drainage network within the District so that the regional ecosystem can be managed in a more sustainable manner. The Restudy is linked to the Everglades Construction Project because the Restudy planning process assumes the Everglades Construction Project is completed and functioning fully as a condition of new regional plans.

## Regional Environmental Issues

As mentioned above, the Everglades Protection Area (EPA) includes the Water Conservation Areas, the Arthur R. Marshall Loxahatchee National Wildlife Refuge and Everglades National Park, and encompasses what remains of a once larger Everglades ecosystem. This larger system extended from the south shore of Lake Okeechobee to the mangrove estuaries of Florida Bay and covered more than 10,000 $km^2$ (Davis, 1987; Light and Dineen, 1994). Urban and agricultural development during this century have reduced the present-day Everglades to 50% of its original size (Mitsch and Gosselink, 1993), of which 3,400 $km^2$ have been impounded within the WCAs (SFWMD, 1992a; **Chapter 2**). The remaining wetland still contains a variety of habitats (e.g., tree islands, wet prairies and aquatic sloughs) that support unique biotic communities, and is widely recognized as an ecosystem of immense regional and international importance (SFWMD, 1992a; Lodge, 1994; Maltby and Dugan, 1994; **Chapters 2**, **3** and **4**). Everglades National Park was designated an International Biosphere Reserve in 1976, an Outstanding Florida Water in 1978 and United Nations World Heritage Site in 1979.

There is concern in the regulatory, scientific and environmental communities that the biotic integrity of the remaining Everglades is endangered. This position is based, in part, on undesirable changes observed in water quality, flora and fauna in portions of the EPA during the last several decades. These changes include establishment of pronounced nutrient gradients in the WCAs downstream of major discharge structures, replacement of large areas once dominated by sawgrass and periphyton with cattail, decline in wading bird populations and species changes in periphyton and macroinvertebrate communities (Belanger et al., 1989; Davis, 1987, 1991, 1994; Grimshaw et al., 1993; Nearhoof, 1992; Ogden, 1994; Rutchey and Vilchek, 1994; SFWMD, 1992a, 1992b; Swift and Nicholas, 1987; Walker, 1991). These

environmental impacts have been attributed to urban and agricultural development, a disruption of the system's natural hydroperiod and an introduction of nutrient-rich runoff to the EPA from the 2,800 $km^2$ Everglades Agricultural Area (EAA) (see SFWMD 1992a, 1992b, 1992c; **Chapters 2**, **3** and **4**). The Florida Legislature has stated that:

> "... the Everglades ecological system not only contributes to South Florida's water supply, flood control, and recreation, but serves as the habitat for diverse species of wildlife and plant life. The system is unique in the world and one of Florida's great treasures. The Everglades ecological system is endangered as a result of adverse changes... and, therefore, must be restored and protected." (Everglades Forever Act [Act; Section 373.4592, F.S. as amended])

Phosphorus has been identified as the nutrient most responsible for changes in periphyton and plant communities within the EPA (Koch and Reddy, 1992; McCormick and O'Dell, 1996; McCormick et al., 1998; **Chapter 3**). Reducing P loading to the EPA is central to the District's strategy for restoring and preserving the Everglades (SFWMD, 1992a). Agricultural Best Management Practices (**Chapter 5**) and the application of constructed wetlands for phosphorus assimilation (**Chapter 6**) are the two fundamental approaches being used to reverse enrichment of Everglades marshes. Best Management Practices have been installed in the Everglades Agricultural Area and have proven successful at reducing P loading from that basin. Wetlands for stormwater treatment are being constructed as the second line of nutrient cleansing for the Everglades Protection Area.

## Stormwater Treatment Areas

Concern over environmental conditions in the Everglades prompted the Florida Legislature to enact the Everglades Protection Act in 1991 (Section 373.4592, F.S.). This act was intended to help resolve long-standing litigation related to Everglades restoration, require the District to adopt a Surface Water Improvement and Management Plan for the Everglades that included programs and projects for stormwater management systems, and bring all facilities into compliance with applicable water quality standards. The resulting plan (SFWMD, 1992a) proposed the construction of three large treatment wetlands encompassing approximately 16,000 ha (~ 40,000 acres). These constructed wetlands are now referred to as **Stormwater Treatment Areas (STAs)** and are designed to serve as biological traps to reduce the P concentration in agricultural runoff entering the EPA.

The basis of design for the STAs is provided in conceptual design documents by Burns and McDonnell (1992), Kadlec and Newman (1992), and Walker (1995). The Everglades Forever Act was enacted by the Florida Legislature in 1994 and established the funding mechanisms and construction timetable for a more comprehensive program of five STAs, as well as other restoration projects (see **Figure 1-1** for location of STAs). Furthermore, the Act requires the District to initiate research and monitoring programs that, among other things, will seek to optimize the operation of the STAs to achieve optimum water quality for the benefit of the Everglades. The research and monitoring program described primarily in **Chapter 6** of the Interim Report is intended to provide the District with the information necessary to achieve this mandate, particularly with regard to the need to construct the largest unit, STA-3/4. However, the scientific concepts underlying the effectiveness of STAs are also examined in **Chapters 2**, **3**, **4**, **5**, **7** and **8**.

## Objectives and Content of the Interim Report

The overall objective of this Report is to summarize available data and findings relating to the Everglades restoration effort. Information from this Report will be used by the South Florida Water Management District (SFWMD or District) and Florida Department of Environmental Protection (DEP) for making decisions affecting implementation of the Everglades Construction Project (ECP). In addition, information contained in this Report will be used for the District's multiple permits, including: the U.S. Army Corps of Engineers (USACE) Section 404 permit for the ECP; DEP permits for the ECP; the Non-ECP permit issued by DEP; and the DEP Long-Term Compliance Permit, which the District will apply for in December 2003.

This Everglades Interim Report is an interagency product of the District and DEP, and has been produced pursuant to section 373.4592(4)(d) F.S., which requires the District to submit a peer-reviewed interim report to state officials after conducting a scientific peer review and two public hearings. The scientific-review workshop and the two public meetings were held in September 1998. Through that review process, numerous other agencies or organizations contributed information to this report.

The contents of the Report will be used for decisions regarding the implementation of the ECP, and are set forth in the Act (Section 373.4592(4)(d)5. F.S.) as follows:

> "The interim report shall summarize all data and findings available as of July 1, 1998, on the effectiveness of STAs and BMPs in improving water quality. The interim report shall also include a summary of the then-available data and findings related to the following: the Lower East Coast Water Supply Plan of the district, the United States Environmental Protection Agency Everglades Mercury Study, the United States Army Corps of Engineers South Florida Ecosystem Restoration Study, the results of research and monitoring of water quality and quantity in the Everglades region, the degree of phosphorus discharge reductions achieved by BMPs and agricultural operations in the region, the current information on the ecological and hydrological needs of the Everglades, and the costs and benefits of phosphorus reduction alternatives".

For purposes of this Report, "available data and findings" and "then-available data and findings" are interpreted as data that were subjected to quality control and complete technical interpretation by **July 1, 1998**. It is important to note that samples collected in the field take several months to analyze and process through quality assurance. Therefore, data available to authors in most cases would only include samples taken before March 1, 1998. Although existing data sets are extensive, they yield an incomplete picture for virtually all the issues in the Everglades. The timeframe for acquiring information specified in the Act varies with each program, and most information is being derived from ongoing projects. This limitation is the reason this document is an 'interim' report. The status of monitoring and research in each area is discussed in detail within each chapter.

## Other Legal and Reporting Requirements

Information from this Everglades Interim Report will be updated annually beginning in January 1, 2000 in peer-reviewed reports required under 373.4592(4)(d)6, F.S. These reports will represent an important step in the process of reviewing technical information on the Everglades Protection Area (EPA) and communicating progress on the review and evaluation activities required in the Act under 373.4592(4)(d)1&2, F. S., concerning Everglades research and monitoring. In addition to the Interim Report and its subsequent updates, the District is also required to submit two other reports. An Annual Report must be developed in accordance with Section 13 of the Act, and must incorporate: a summary of the water conditions in the Everglades Protection Area; status of the impacted areas; status of the construction of STAs; implementation of the BMPs; and actions taken to monitor and control exotic species. Each year, an Everglades Status Report must be submitted to the Joint Legislative Committee on Everglades Oversight, in accordance with ß11.80(4), F. S. This report to the Joint Legislative Committee on Everglades Oversight concerns the status of the implementation of the Everglades Forever Act. It includes progress on and changes to the ECP, an analysis of revenues, an evaluation of the costs of acquisition, construction, operation and maintenance, and projected revenues over the succeeding five years.

The requirements of those two reports and a summary of the contents of this Interim Report have been consolidated into the 1998 **Everglades Annual Report**, prepared in coordination with federal and state agencies. This integration avoids a duplication of effort while providing a more complete and relevant set of products for decision-makers. This Report also contains information of direct interest to other agencies, particularly the USACE and the Florida DEP. Before any ECP facilities could be constructed, the District was required to obtain a 404 permit from the USACE. Although that permit has not been formally accepted by the District, the District is operating in accordance with its requirements. Design features of the ECP have been developed with USACE oversight to ensure compliance with the permit. The USACE will also conduct on-site inspections during the construction process, and a monitoring program will be implemented to ensure that the systems are functioning according to design specifications.

The permit for structures not included in the ECP, known as the Non-ECP Permit, was issued by the DEP April 21, 1998, following the approval of an Administrative Law Judge after two years of litigation. The District submitted a series of schedules and strategies relating to the Everglades restoration to DEP as part of the permitting process. Specific Condition 9 of that permit, issued in accordance with Section 9(k) and (l) of the Act, requires the District to update those schedules and strategies through this Interim Report. It is anticipated that many of these same water quality and environmental issues will also be relevant to the long-term compliance permit to be issued by DEP in accordance with Section 10 of the EFA.

The Act specifies that the Report is to be a resource for decision-making: “The Interim Report shall be used by the Department and District in making any decisions regarding the implementation of the Everglades Construction Project subsequent to the completion of the Interim Report. The construction of the STA-3/4 shall not be commenced until 90 days after the Interim Report has been submitted to the Governor and the Legislature.” In light of this mandate, the Report has been written to highlight information on key issues, concepts, assumptions and parameters underlying the implementation decisions for the ECP and associated projects. Authors have strived to make information and findings relatively easy

to understand while providing enough detail to support findings and make them credible for decision-making. The list of **major findings** and the **summary** have been developed to guide readers to fundamental conclusions and findings. The goal is to make data and findings readily available as a resource for all technically-based decisions without actually directing information toward any particular decision or recommending a course of action on a specific project.

The Act, Section 373.4592 (4) (d) 1., F. S., has specific requirements for water quality analysis; **Chapter 4** of this Report responds most directly to these mandates by summarizing data and findings on water quality in the Everglades Protection Area. The Act requires an evaluation of available water quality data for the Everglades Protection Area and tributary waters, and identification of any additional information necessary to adequately describe water quality. A research and monitoring program is also required to generate such additional information and to evaluate the effectiveness of the BMPs and STAs for improving water quality and maintaining beneficial uses of the Everglades Protection Area and tributary waters. As part of the program, the District must monitor all discharges into the Everglades Protection Area to determine compliance with state water quality standards. In addition, Section 373.4592 (4) (d) 2 & 4 and (4) (e) 1 & 4, F. S, further requires a classification of EAA canals towards their protection as an integral part of the water management system. This requirement includes any additional research necessary to "evaluate existing water quality standards applicable to the Everglades Protection Area and EAA canals" no later than December 31, 2001.

## Layout and Format of the Interim Report

This Interim Report consists of a coordinated set of products with varying levels of technical detail and synthesis, including a list of **major findings and implications**, **summary**, the technical report in twelve chapters and appendices with responses to public comment. The list of **major findings and implications** highlight major conclusions of the report for the public and other interested parties with only a brief summary of supporting analyses. The **summary** of the Report is written for a diverse readership and provides an abstract of the key facts and supporting information. The findings are also published in the 1998 Everglades Annual Report. This report is a stand-alone document designed to communicate findings to a broad audience and to contain minimal technical discussion and data presentation. It has been developed to highlight findings of relevance to environmental decision-makers, particularly with regard to decisions on the ECP and associated projects.

The main product is the full-length Everglades Interim Report, a technical document conveying data and findings in each topic area. This technical document is targeted at individuals who seek detailed information on topics mentioned in the Act, along with technical interpretation and supporting information. Another product of the reporting effort is a volume of supporting documentation referred to in the main body of the Report. These appendices are designed to give interested readers pivotal data summaries and detailed analyses of interest as background for the special interest reader. A summary of responses to reviewer comments on the Report is also included in the appendices.

This Interim Report presented an opportunity for open communication of progress on technical areas described in the Act and for data sharing on key technical issues. Through the required peer review of the report, programs, projects and products were evaluated critically by scientists outside of the agencies

involved in Everglades information gathering. Subsequently, this report will provide the District with an opportunity to identify strategies for filling information gaps on these important topics.

## Process Used to Develop the Report

This Report was developed through a four-step review and revision process. Authors and project staff associated with the research and monitoring programs required by the Act submitted rough drafts of chapters for technical review in the early spring of 1998. After this initial review, each chapter was revised by the author and submitted to a technical editor on District staff. The edited draft was of sufficient quality after these two reviews to be given to the document assembly team, which formatted chapters into the first working draft of the entire Report. At this point (early July), the draft was sent out for internal agency review within the District and DEP.

Authors responded to comments from the internal review as they updated the chapters to include all data and findings available as of July 1, 1998. Second, updated drafts were distributed to the public, the District's Governing Board and a scientific panel for review in September. This intensive review resulted in many substantive and helpful comments on the chapters, and guided the authors as they revised the chapters into the final draft, which was submitted to the District's Governing Board for acceptance on November 13, 1998. All comments received during Report development were given directly to chapter authors. Their responses to these comments are summarized in an appendix to the Report.

The technical body of this Report has been developed in a manner often used for scientific volumes compiling information on diverse issues. Chapters were written independently by authors with expertise in the topic being addressed. Chapters reflect the writing style of the authors and the level of detail appropriate to the topic. The order of authors on each chapter indicates their contributions to the report in accordance with common practice in science and engineering. Technical review and integration was provided by the report editor Garth Redfield, and the Report was formatted and assembled by Kimberly Jacobs and Victor Mullen. Technical and grammatical editing was done by Marian Heitzman and Ginger Brooks, and the Report was reviewed extensively by a peer review panel and other reviewers outside the agency.

## Constraints on Chapter Content and Interpretation

There are several important factors that influence the interpretation of chapters in this report. First, detailed discussion of methods and quality assurance (QA/QC) or complex interpretative (statistical) issues cannot be dealt with through the Report, due to time and space limitations and the broad target audience for the Report. Many issues covered in the Report are complex and do not lend themselves to simple answers free of caveats. Authors have attempted to summarize the data and findings as definitely as possible, arriving at discrete conclusions whenever possible. Second, for the most part, authors do not repeat technical discussions that have been published in the peer reviewed literature; they are expected to provide readers with appropriate citations to the primary information source. Third, authors can only report information that is readily available as of July 1, 1998, and interpretable by standard scientific norms. In

practical terms, this means that information from other agencies must be in the form of formal agency reports or literature publications in order to ensure that authors can include it in their evaluations.

The mid-stream status of most projects required by the Act should also be kept in mind. Each chapter will detail the overview status of research and monitoring activities on the specified topics, but it must be recognized that the vast majority of information-generating projects are still in progress. Thus, to varying extents, all chapters are truly interim in nature. The level of detail varies in accordance with the magnitude of information available and the opinion of the author on what data should be presented to address issues of interest to decision-makers. For example, **Chapter 7** on the mercury problem contains dozens of literature citations and findings from research in south Florida, while **Chapter 8** on Supplemental Technologies is more focused on project descriptions and current status.

The Report is not a formal part of any legal or administrative process, such as setting the criteria and standards for phosphorus in the EPA. Any interpretation of wording in this Report must be done from a technical, not a legal perspective. For example, the official process of setting the standard for surface water quality is primarily the responsibility of the Environmental Regulation Commission, working in concert with DEP. Any use of "imbalance" or other similar terms in this Report is done to describe ecological evidence and must not be considered as any official interpretation of Class III criteria by the District or the DEP.

## Report Organization

There are 12 chapters, a list of **major findings** and a **summary** in the Report. **Chapters 2 – 12** each contain a summary, background on the topic, technical discussion of data, findings, strategies for obtaining additional information, and references cited in the chapter. The list of **major findings** and **summary** of the Report attempt to summarize information about important issues and guide the reader to sources of additional information in the Report. They are written as an abstract of critical information and conclusions for decision-makers. **Chapter 1** provides background for the Report, an overview of the process used to develop the Report and an outline of its organization, as well as factors affecting the nature and interpretation of data and findings. A glossary of technical terms and lists of authors and acronyms are provided at the end of this introductory chapter, along with a guide to units of measure.

The hydrological needs of the Everglades Protection Area and supporting technical information is the subject of **Chapter 2**. This chapter also provides a unique synthesis of important information on the history and development of water management and resultant ecosystem alterations in south Florida. The ecological needs of the Everglades is discussed in **Chapter 3**. This detailed account provides up-to-date information on the intricate effects of nutrients and associated factors on Everglades ecology. Water quality status and trends for standard Class III parameters are the subjects of **Chapter 4** (although issues concerning mercury in the EPA are covered in **Chapter 7**). A history and summary of actions taken under the Best Management Practices Program in the Everglades Agricultural Area are provided in **Chapter 5**, while **Chapter 6** provides a detailed account of information gathered to date on the performance of the Stormwater Treatment Areas, particularly the Everglades Nutrient Removal (ENR) Project. **Chapter 7**, as mentioned, discusses mercury issues and analyzes the risk of mercury contamination associated with the Everglades Construction Project.

**Chapter 8** describes techniques being investigated as means for removing phosphorus from water down to the planning level of 10 parts per billion, the default concentration specified in the Act. This eighth chapter reflects the fact that the studies of Supplemental Technologies are in their early stages as this report is written, and most information on the relative costs and effectiveness of technologies will not be available for several years. Nevertheless, the chapter does provide a preliminary understanding of the relative costs and benefits of each technology. **Chapter 9** describes the status of the Lower East Coast Water Supply Plan, as required by the Act, and **Chapter 10** summarizes the ongoing planning effort on the Restudy of the Central and South Florida Project. The Restudy has resulted in a preferred alternative plan to restore the greater Everglades ecosystem; key elements of the planning process are given in **Chapter 10**. The Everglades Stormwater Program, which is the subject of **Chapter 11**, is being implemented to assure that water quality standards will be met in areas not encompassed by the Everglades Construction Project, particularly along the lower east coast of Florida. The final chapter (**12**) is an integration of projects and programs described in the Report. This final segment of the Report explains complementarities in planning and construction activities and overall organization of the Everglades restoration effort.

## Peer Review of the Everglades Interim Report

The Interim Report was developed through a four-step review and revision process, described earlier in this chapter. Following internal review and revision, an updated and revised September 9, 1998 draft of the Report was distributed for external review by the public (via hardcopy and the District's internet site) and a scientific review panel. The requirement for **peer review** is suggested by the title of the Report in the Act, 'peer reviewed interim report,' and other narrative from the Act (373.4592(4)(d)5:

> "*Prior to finalizing the Interim Report, the District shall conduct at least one scientific workshop and two public hearings on its proposed Interim Report."*

The District organized the review of the Report in accordance with typical scientific review practices, the independent panel review process required by Florida Statute for evaluating Minimum Flows and Levels (F.S. 373.042 (4)) and 'government in the sunshine' provisions of Florida Statutes. '**Independence**' in the context of this review process means that panelists should have no substantial personal or professional relationship with the District or any other organization involved in environmental management in South Florida. Maintaining such independence provides reasonable assurance that reviewers will be objective in evaluating materials presented in the Report - such objectivity is the cornerstone of a bonafide review process. The panel reviewed the Report independently, then interacted with each other and the public at a scientific workshop and public hearing. The panel collaborated in authoring recommendations and a final report to the District. The breadth of this Report and the need for interaction with reviewers require that the Interim Report be reviewed by such a group of experts, as described below.

A **Statement of Work** was developed for the review process. Each panelist was given a Purchase Order by the District to provide the following review services on the Everglades Interim Report:

- **Read the Everglades Interim Report**. Each panelist was asked to focus attention on chapters closest to their areas of expertise, although comments or questions on any aspect or chapter of the Report were encouraged.
- **Read two reports contributed by the Sugar Cane Growers Cooperative of Florida**. Two reports with data and findings on the Everglades system were submitted to the District in time to be considered in the Report: 'Ecological Risks to Wading Birds of the Everglades in Relation to Phosphorus Reductions in Water and Mercury Bioaccumulation in Fishes,' by Exponent, Incorporated; and 'Data and Analysis Report – Status and Trends in the Everglades, June 1998,' by Tetra Tech, Incorporated. The Panel was not asked to provide a separate peer review of these reports, but was requested to evaluate the merit of their data, findings and conclusions in relation to those in the Everglades Interim Report.
- **Prepare a preliminary written review of the Everglades Interim Report**. Prior to the workshop and public hearing, panelists prepared a preliminary written review of the Everglades Interim Report, including questions to be addressed by District Staff at the scientific workshop and public hearing.
- **Participate in the scientific workshop and public hearing as a panelist September 28 and 29, 1998 at District headquarters.** The Panel participated in the first public hearing which was held in association with the scientific workshop, September 28 and 29, 1998 at District headquarters in West Palm Beach.
- **Develop a draft Panel Report with conclusions and recommendations**. During an executive session following the public workshop on September 30, 1998, the panel developed their conclusions and recommendations on the Interim Report, and provided these to the District before leaving District headquarters.
- **Collaborate with the other panelists in writing the Final Report**. The panel's final report summarized conclusions and recommendations, and included a narrative with details to the extent that the Panel deemed appropriate for each chapter. The Final Report was delivered to the District on October 22, 1998 and is provided in **Appendix 1** of this Report.

**Panelists** were selected from the District's Expert Assistance Pool which contains over four hundred pre-qualified technical experts. Professional expertise and experience in the major areas covered by the Report were the primary criteria for selection. Knowledge of environmental management and decision-making was also considered in potential panelists. Candidate panelists from the Pool were screened for any professional connection to interests or organizations in south Florida to ensure independence. Seven expert panelists were selected to conduct an independent scientific peer review of the Everglades Interim Report. Their experience and credentials are summarized below:

1. **Chairperson**: Dr. Clifford S. Russell, Professor of Economics and Public Policy, and Director, Vanderbilt Institute for Public Policy Studies, Vanderbilt University, Nashville, Tennessee. With 30 years of post-doctoral experience in environmental economics and public policy, Prof. Clifford Russell is recognized internationally for his work in industrial economics, pollution control, decision-making for environmental policies, analysis of non-point source pollution, modeling of environmental economics, integration of ecology and economics, and water quality economics. This diverse experience in water-related economic and policy analyses is demonstrated in over 50 peer reviewed articles, approximately 100 miscellaneous

publications, and 6 books authored during his productive career.

2. **Expert on Water Quality:** Dr. Robert C. Ward, Director, Colorado Water Resources Research Institute and Professor, Dept. of Chemical and Bioresource Engineering, Colorado State University, Fort Collins, Colorado. Dr. Robert Ward is highly experienced in the science of water quality assessment, including the design of information systems and water quality monitoring networks, application of data to decision-making and communication with the public, and wastewater treatment. Since receiving a doctorate in Agricultural Engineering in 1970, he has authored dozens of refereed articles and papers in conference proceedings. His quantitative experience with water quality data is exceptionally diverse and extensive.

3. **Expert on nutrient effects and wetland ecology:** Dr. J. Court Stevenson, Professor, University of Maryland Center for Environmental Sciences, Cambridge, Maryland. Dr. Court Stevenson is highly experienced in management-related science through his work on the restoration of Chesapeake Bay and its watershed. He has worked on the effects of nutrients and water level on marsh and sea grass plant communities, and has researched the effects of sea-level rise and non-point source pollution on coastal wetlands and shoreline biological communities. The ecological principles used in these investigations are the same suite of scientific concepts underlying issues in the Everglades ecosystem. Dr. Stevenson has over 60 publications in the international scientific literature, dozens of presentations at scientific meetings, and a wide-range of activities in environmental management.

4. **Expert on wetland ecology, policy and management:** Dr. Barbara L. Bedford, Senior Research Associate, Department of Natural Resources, Cornell University, Ithaca, New York. Dr. Barbara Bedford is a senior scientist specializing in the ecology of wetland plants, responses of wetland biota to disturbances, conservation of biodiversity and application of scientific information to environmental management. Her research track record touches on many of the key issues being faced in south Florida, such as the cumulative effects of humans on wetland structure and function, and the trade-off between the effects of nutrient enrichment and hydroperiod modification. This combined experience in wetland ecology and public policy is unique and well-suited to an evaluation of the Interim Report.

5. **Expert on agricultural Best Management Practices:** Dr. J. Wendell Gilliam, Professor of Soil Science, North Carolina State University, Raleigh, North Carolina. After receiving a doctorate from Mississippi State University in 1965, Dr. Gilliam worked as a laboratory manager conducting research on soils until he became a full-time researcher in 1972. From that point to the present time, he has continued to work on agricultural soil science as related to water quality, nutrient cycling and Best Management Practices. His research on riparian or buffer strip management is known internationally, and he has worked extensively on nutrient related issues and management. He acted as a technical consultant to the State of Florida to assist the State in designing the BMP program for the Everglades Agricultural Area and provided technical peer review to the District on BMP issues in the Lake Okeechobee watershed.

6. **Expert on the effectiveness of constructed wetlands for treating stormwater:** Dr. Danuta Leszczynska, Associate Professor of Environmental Engineering, Florida Agricultural and Mechanical University, Tallahassee, Florida. Dr. Danuta Leszcsynska is trained as an environmental engineer specializing in environmental chemistry, wastewater treatment, water quality enhancement and water reuse. She has conducted several research projects involving

constructed wetlands for treating wastewater and stormwater, and has investigated mechanisms involved in the transformation of contaminants in natural systems. Dr. Leszcsynska has worked with industrial clients on waste management problems. She has presented papers on these industrial projects and more basic research efforts on over three dozen occasions in the last 5 years.

7. **Expert on metal contaminants and ecosystem modeling:** Dr. Joseph V. DePinto, Professor and Director Great Lakes Program, State University of New York at Buffalo. Dr. Joseph DePinto has a research and teaching career that spans over two decades. Trained as an environmental engineer, he has contributed greatly to modeling fate and transport of pollutants in aquatic systems, ecosystem models of nutrient cycling and food web interactions, lake eutrophication and its control, and the use of geographic information systems in water quality modeling. His professional and scholarly activities have been extremely diverse and numerous, and he is very experienced in peer review of scientific material. His research and consulting activities have produced several hundred reports, papers, presentations and seminars, primarily involving the use of models in analyzing aquatic ecosystems.

This intensive public and panel review resulted in over 100 pages of written comments and suggestions to the authors of the Report; all written reviews and the panel report are provided *verbatim* in **Appendix 1**. Although all reviews were helpful to authors, the Report benefited most extensively from the throughtful and incisive suggestions of the expert panel. The advice of reviewers and the panel guided the authors through a major revision of the Report during October and November 1998. A summary of the responses of authors to reviewer comments is also given in **Appendix 1**.

## Literature Cited

Belanger, T.V., D. J. Scheidt, and J.R. Platko II. 1989. Effects of nutrient enrichment on the Florida Everglades. Lake and Reservoir Management 5: 101-111.

Burns & McDonnell. 1992. Everglades Protection Project: Conceptual Design Stormwater Treatment Areas. Report prepared for the South Florida Water Management District, West Palm Beach, FL.

Coale, F.J. 1987. Sugarcane. In: Izuno, F.T. and A.B. Bottcher, editors. The effects of on-farm agricultural practices in the organic soils of the EAA on nitrogen and phosphorus transport: Phase II (Draft Report). Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

Davis, S.M. 1987. Investigation of periphyton and water quality relationships in the Everglades Water Conservation Areas, 1978-1982. Technical Publication 87-2, South Florida Water Management District, West Palm Beach, FL.

Davis, S.M. 1991. Growth, decomposition, and nutrient retention of Cladium jamaicense Crantz and Typha dominensis Pers. in Florida Everglades. Aquatic Botany 40: 203-224.

Davis, S.M. 1994. Phosphorus inputs and vegetation sensitivity in the Everglades. Pages 357-378 in S.M. Davis and J.C. Ogden, editors. Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL.

Davis, S.M. and J.C. Ogden, 1994. Toward Ecosystem Restoration. Pages 769-796 in S.M. Davis and J.C. Ogden, editors. Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL.

Grimshaw, H.J., M. Rosen, D.R. Swift, K. Rodberg, and J.M. Noel. 1993. Marsh phosphorus concentrations, phosphorus content and species composition of Everglades periphyton communities. Archives for Hydrobiology 128: 257-276.

Kadlec, R.H., and S. Newman, 1992. Phosphorus removal in wetland treatment areas. DOR 106. Report prepared for South Florida Water Management District, West Palm Beach, FL.

Koch, M.S., and K.R. Reddy. 1992. Distribution of soil and plant nutrients along a trophic gradient in the Florida Everglades. Soil Science Society of America Journal 56: 1492-1499.

Light, S.S., and J.W. Dineen. 1994. Water control in the Everglades: A historical perspective. Pages 47-84 in S.M. Davis and J.C. Ogden, editors. Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL.

Lodge, T.E. 1994. The Everglades Handbook - Understanding the Ecosystem. St. Lucie Press, Delray Beach, FL.

Maltby, E., and P.J. Dugan, 1994. Wetland ecosystem protection, management, and restoration: an international perspective. Pages 29-46 in S.M. Davis and J.C. Ogden, editors. Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL.

McCormick, P.V., and M.B. O'Dell. 1996. Quantifying periphyton responses to phosphorus in the Florida Everglades: a synoptic experimental approach. Journal of the North American Benthological Society 15: 450-468.

McCormick, P.V., R.B.E. Shuford III, J.G. Backus, and W.C. Kennedy. 1998. Spatial and seasonal patterns of periphyton biomass and productivity in the northern Everglades, Florida, U.S.A. Hydrobiologia 362: 185-208.

Mitsch, W.J., and J.G. Gosselink. 1993. Wetlands-2nd edition. Van Nostrand Reinhold, New York, New York.

Nearhoof, F.L. 1992. Nutrient-induced impacts and water quality violations in the Florida Everglades. Florida Department of Environmental Protection, Water Quality Technical Series Vol. 3, No. 4.

Ogden, J.C. 1994. A comparison of wading bird nesting colony dynamics (1931-1946 and 1974-1989) as an indication of ecosystem conditions in the southern Everglades. Pages 533-570 in S.M. Davis and J.C. Ogden, editors. Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL.

Rutchey K., and L. Vilchek. 1994. Development of an Everglades vegetation map using a SPOT image and the global positioning system. Photogrammetric Engineering and Remote Sensing 6: 767-775.

SFWMD. 1992a. Surface Water Improvement and Management Plan for the Everglades - Planning Document. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 1992b. Surface Water Improvement and Management Plan for the Everglades - Supporting Information Document. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 1992c. Surface Water Improvement and Management Plan for the Everglades - Appendices. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 1997. Everglades Program Implementation: Program Management Plan. Revision 3. South Florida Water Management District, West Palm Beach, FL.

SFWMD, 1998. DRAFT -- Proposed Minimum Water Level Criteria for Lake Okeechobee, the Everglades, and the Biscayne Aquifer within the South Florida Water Management District. South Florida Water Management District, West Palm Beach, FL. July, 1988, 93pp.

Swift, D.R., and R.B. Nicholas. 1987. Periphyton and water quality relationships in the Everglades Water Conservation Areas. Technical Publication 87-2, South Florida Water Management District, West Palm Beach, FL.

Walker, W.W., Jr. 1991. Water quality trends at inflows to Everglades National Park. Water Resources Bulletin 27: 59-72.

Walker, W.W., Jr. 1995. Design basis for Everglades stormwater treatment areas. Water Resources Bulletin 31: 671-685.

## Acronyms Used in the Everglades Interim Report

| | |
|---|---|
| Act | 1994 Everglades Forever Act |
| ATLSS | Across-Trophic Level System Simulation (model) |
| BAF | Biological accumulation factor |
| BCR | Big Cypress Seminole Indian Reservation |
| BMP | Best Management Practice |
| C&SFP | Central and Southern Florida Flood Control Project |
| cfs | cubic feet per second |
| Corps | United States Army Corps of Engineers |
| DEP | Florida Department of Environmental Protection |
| District | South Florida Water Management District |
| DO | dissolved oxygen |
| DOI | (United States) Department of the Interior |
| EAA | Everglades Agricultural Area |
| ECP | Everglades Construction Project |
| EIS | Environmental Impact Statement |
| ELM | Everglades Landscape Model |
| ELVM | Everglades Landscape Vegetation Model |
| EMAP | Environmental Monitoring and Assessment Program |
| EMCM | Everglades Mercury Cycling Model |
| ENP | Everglades National Park |
| ENR | Everglades Nutrient Removal (Project) |
| EPA | Everglades Protection Area comprised of Water Conservation Areas 1, 2A & B, 3A & B and Everglades National Park |
| EPH | Everglades Phosphorus and Hydrology Model |
| EPGM | Everglades Phosphorus Gradient Model |
| ERC | (Florida) Environmental Regulatory Commission |
| ET | evapotranspiration |
| ETAC | Everglades Technical Advisory Committee |
| EWQM | Everglades Water Quality Model |
| F.A.C. | Florida Administrative Code |
| F.S. | Florida Statutes |
| FGFWFC | Florida Game and Freshwater Fish Commission |
| FY | Fiscal year for District (October 1 to September 30) |
| GIS | Geographic Information System |
| HR | Hydropattern restoration |
| HLT | Hydraulic Loading Rate |
| HRT | Hydraulic Residence (or Retention) Time |
| JLCEO | Joint Legislative Committee on Everglades Oversight |
| LEC | Lower East Coast |
| LECRWSP | Lower East Coast Regional Water Supply Plan |
| LOWQM | Lake Okeechobee Water Quality Model |
| MeHg | methylmercury |

| | |
|---|---|
| mg/L | milligrams per liter |
| MGD | million gallons per day |
| MOA | Memorandum of Agreement |
| MOU | Memorandum of Understanding |
| msl | mean sea level |
| mt | metric ton (1000 kg) |
| NEPA | National Environmental Policy Act |
| NGVD | National Geodetic Vertical Datum |
| NPDES | National Pollution Discharge Elimination System |
| NSM | Natural Systems Model |
| OFW | Outstanding Florida Waters |
| Park | Everglades National Park (ENP) |
| PEIS | Programmatic Environmental Impact Statement |
| ppb | parts per billion |
| ppm | parts per million |
| QA/QC | Quality Assurance/Quality Control |
| RAM | Research and Monitoring element of the Everglades Forever Act |
| Refuge | Loxahatchee National Wildlife Refuge |
| Restudy | C&SF Comprehensive Review Study |
| SAWCAT | Sawgrass-Cattail Model |
| SERA | Southern Everglades Restoration Alliance |
| SFWMD | South Florida Water Management District |
| SFWMM | South Florida Water Management Model |
| STA | Stormwater Treatment Area |
| SWIM | Surface Water Improvement and Management Act |
| THg | Total mercury |
| TOC | Technical Oversight Committee |
| TP | total phosphorus |
| USACE | United States Army Corps of Engineers |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service (under DOI) |
| USGS | United States Geological Survey (under DOI) |
| WCA | Water Conservation Area |
| WPA | Water Preserve Area |
| WQ | Water Quality |

## Units of Measurement in the Everglades Interim Report

| Metric Unit | Symbol | U.S. Unit | U.S. Equivalents |
|---|---|---|---|
| Meter | m | yard | 1.094 yards |
| Kilometer | km | mile | 0.6214 miles |
| Microgram | µg | none | none |
| Milligram | mg | none | none in use |
| Gram | g | ounce | 0.035 ounces |
| Kilogram | kg | pound | 2.205 pounds |
| Metric Ton (1000 kg) | mt | ton | 2,205 pounds |
| Milliliter | ml | fluid ounce | 0.0338 ounces |
| Liter | L | quart | 1.057 quarts |
| Cubic meter | $m^3$ | cubic yard | 1.308 cubic yards |
| Hectare | ha | acres | 2.477 acres |
| Square kilometer | $km^2$ | square mile | 0.386 square mile |
| Acre-feet* | ac.ft. | cubic meters | 1234 $m^3$ |
| Milligram/liter | mg/L | part per million | none |
| Microgram/liter | µg/L † | part per billion | none |

* Not a metric unit, but used commonly to express large volumes of water.

† Note: 1 µg P/L = 1/4 teaspoon of phosphorus in an olympic-size pool.

## Glossary of Technical Terms in the Everglades Interim Report

**Accretion:** The gradual addition of new material on top of older sediments or soils.

**Accuracy:** The closeness of a measured value to the true value (as opposed to precision).

**Acre-foot:** The volume of liquid required to cover one acre to a depth of one foot.

**Analyte:** A chemical species measured in a water sample.

**Apple Snails:** The Florida Apple Snail (Pomacea paludosa) is a gastropod mollusk found commonly in shallow wetland environments in south Florida. It is the primary food of the endangered Everglades Snail Kite.

**Aquifer:** A porous layer in the ground where water can be stored.

**Benthic:** Bottom dwelling organisms (e.g., benthic insects).

**Best Management Practices:** Land, industrial and waste management techniques that reduce pollutant loading from an industry or land use.

**Biogeochemistry:** The study of the form, fate and movement of elements through biological, geological and chemical materials.

**Biomass:** The weight of living material, usually as dry mass.

**Bulk density:** The mass of soil in a given volume.

**Chlorophyll:** green pigments found in plants and essential for photosynthesis.

**Conductance:** The ability of an aqueous solution to carry an electric current; used as a measure of total dissolved solids.

**Decomposition:** The action of microorganisms causing the breakdown of organic compounds into simpler ones and the release of energy.

**Discharge:** The rate of water movement, as volume per unit time (cubic feet per second).

**Dissolved organic carbon:** The organic fraction of carbon in water that is dissolved (not filterable).

**Emergent macrophytes:** Rooted vascular plants in inundated areas that extend above the water surface.

**Eutrophication:** The natural or cultural enrichment of an aquatic environment with plant nutrients leading to rapid ecological changes and high productivity (adj. eutrophic).

**Evapotranspiration:** The process by which water is released to the atmosphere by evaporation from the water surface or movement from a vegetated surface (transpiration).

**Excursion in water quality data:** A constituent concentration that is of potential concern as an apparent violation of a water quality criterion. 'Excursion' indicates some uncertainty in the interpretation of the reported value that must be evaluated by examination of background conditions, ancillary data, quality assurance and historic data before the datum is considered a 'violation' of a water quality criterion. DEP is responsible for data review to determine violations of water quality criteria and standards.

**Exotic or Invasive Species:** Exotic species are kinds of plants and animals not normally found in an area. Often such species are highly invasive and dominating to native forms. Examples of exotic species in South Florida include cichlid fishes, melaleuca trees, Brazilian pepper, Australian pine and torpedograss

**Flow-Weighted Mean Concentration:** The average concentration of a substance in water corrected for the volume of water flow at the time of sampling; samples taken when flow is high are given greater weight in the average, and flow-weighted concentrations can be used to calculate mass loading at a particular location.

**Hectare:** A unit of measure in the metric system equal to 10,000 square meters (2.47 acres).

**Hydraulic residence time:** The length of time that water resides in a body of water or specified area.

**Hydropattern:** Water depth and duration, along with the quantity, timing and distribution of surface water to a specific area; critical for maintaining various ecological communities in wetlands.

**Hydroperiod:** Depth and duration of inundation in a particular wetland area.

**Invertebrates:** Small animals, such as insects, crayfish, mollusks, and annelids, that do not have a backbone. These animals are often important components of ecosystem food webs and can be indicators of ecosystem status.

**Loading (Mass loading):** The mass of a material entering an area per unit time (e.g., phosphorus loading into Water Conservation Area 2A as metric tons per year).

**Macrophytes:** Visible plants found in aquatic environments; sawgrass, cattails, sedges and lilies are examples of macrophytes.

**Moving average:** The arithematic average of a sequence of data within a data set moved and calculated sequentially to smooth the data and reveal trends (e.g., 12-month moving average TP concentration).

**Muck soil:** Dark, organic soil derived from the decay of plant biomass.

**Nutrients:** Elements essential as raw materials for the growth of an organism. For aquatic environments, nitrogen and phosphorus are important as nutrients affecting the growth rate of plants.

**Oligotrophic:** Refers to an environment low in plant nutrients and productivity; unenriched.

**Periphyton:** The biological community of microscopic plants and animals attached to surfaces in aquatic environments. Algae are the primary component in these assemblages and periphyton can be very important in aquatic food webs, such as those of the Everglades.

**Parts per billion:** ppb, equivalent to one microgram per liter.

**Parts per million:** ppm, equivalent to one milligram per liter.

**Phosphorus:** An element that is essential for life and limits the growth of plants in the Everglades ecosystem.

**Precision:** The reproducability of measurements (low precision yields high scatter in data).

**Quality assurance:** A program to provide a means for a product to meet a defined set of quality standards at a specified level of confidence.

**Quality control:** Steps to ensure that quality standards are met.

**Sheet flow:** Water movement as a broad front with shallow, uniform depth.

**Species richness:** The number of species occuring in a particular area for a specified sampling period.

**Parts per billion:** ppb, equivalent to one microgram per liter.

**Parts per million:** ppm, equivalent to one milligram per liter.

**Soil or peat subsidence:** The loss of organic soil and associated elevation due to decomposition, compaction and burning. This process occurs at a high rate when peat soils of the Everglades region are drained.

**Supplemental Technologies:** Advanced wastewater treatment techniques that have the potential to supplement STAs and reduce phosphorus to levels of about 10 ppb.

**Trophic level:** Groups of organisms using or producing energy at a definable level in nature. Plants are lowest trophic level and are the primary producers of biological energy. Grazing and detritus feeding animals are intermediate, and predators, such as bass, wading birds and raccoons, are in the higher trophic level. Metals like mercury accumulate at higher trophic levels, while most energy in nature is stored in lower trophic levels.

**Water quality criteria:** Constituent concentrations, levels or narrative statements representing a quality of water that supports the most beneficial use of the resource.

**Water quality standard:** Standards are composed of the most beneficial use of water, water quality criteria applied to that use, and the Florida antidegradation policy (see **Chapter 4**).

The Interim Report describes, however, the framework of design considerations, identified by countries in favour of introducing interim measures, which should be taken into account when considering introducing such measures.Â  14. In recent years, we have also seen the introduction by some countries of a range of uncoordinated and unilateral measures, which appear to reflect a discontent among some countries with the outcomes produced by certain aspects of the current international tax system. Towards a Global, Consensus-Based Solution.Â  24. The interim report is a key milestone to developing a durable, long-term solution to the tax challenges posed by the digitalisation of the economy. Interim (or progress) reports present the interim, preliminary, or initial evaluation findings. They are scheduled according to the specific needs of your evaluation users, often halfway through the execution of a project. The interim report is necessary to let a projectâ€™s stakeholders know how an intervention is going. It provides information that will help the funders and other decision-makers determine whether to continue with the current direction, where to make adjustments if necessary, revise goals, add more resources or in the worst case scenario, to shut it down.Â  Any delays or deviations to the plan are included and explained, as well as any comparison between actual compared to expected results.