Chapter 1: Introduction to the 2003 Everglades Consolidated Report

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This introduction provides the reader with a basic understanding of the governmental, scientific and legal context to the *2003 Everglades Consolidated Report* (Report). First, an overview of the Everglades resource is given so the reader can appreciate the challenges that are faced in the environmental management of South Florida. The chapter then addresses the interim and long-term water quality goals for the Everglades and the many steps and hurdles necessary to reach these goals. Next, the objectives and content of this document are highlighted, followed by a discussion of the legal reporting requirements being fulfilled by the Report. Finally, the process used to create the Report is summarized. The 2003 Report is similar to earlier versions in having an intensive external peer review, including two days of public workshops with a panel of outside experts.

GEOGRAPHIC FEATURES OF THE EVERGLADES PROTECTION AREA AND SURROUNDINGS

AREAS WITHIN THE EVERGLADES PROTECTION AREA

The Everglades is an internationally recognized ecosystem that covers approximately 9000 square kilometers (3480 square miles) in South Florida and represents the largest subtropical wetland in the United States. The historic Everglades extended 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 (EAA) located south of Lake Okeechobee. Today's remaining Everglades, generally referred to throughout this Report as the Everglades Protection Area (EPA), are comprised of Everglades National Park (Park), including Florida Bay, and the Water Conservation Areas (WCAs), which include WCA-1, WCA-2A, WCA-2B, WCA-3A and WCA-3B (**Figure 1-1**).

Water Conservation Areas 1, 2 and 3

The three WCAs, including the entire Arthur R. Marshall Loxahatchee National Wildlife Refuge, are major components of the Everglades Protection Area (**Figure 1-1**) and provide a valued suite of ecological and hydrological functions for the region. Located south of Lake Okeechobee and west of the heavily urbanized areas of Miami-Dade, Broward, and Palm Beach counties, the WCAs comprise an area of about 3,497 square kilometers. These vast wetlands serve as detention areas for excess water discharged from Lake Okeechobee, the Everglades Agricultural Area and portions of the lower East Coast. In that regard, they serve as a critical source of water for the Park and also serve as a water supply source for lower East Coast region

by recharging the Biscayne Aquifer and retarding saltwater intrusion in coastal wellfields. In addition, the WCAs are an important habitat for Everglades wildlife and provide areas for public recreation.

Water Conservation Area 1 (WCA-1) is within the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) and is managed by the U.S. Fish and Wildlife Service (USFWS). WCA-1 covers an area of 566 square kilometers (221 square miles) and provides storage for excess rainfall and runoff from the Everglades Agricultural Area (SFWMD, 1992b). The Refuge is included in the Everglades Protection Area in its entirety, and receives agricultural drainage water from the West Palm Beach Canal at the north end. This area has been the subject of extensive monitoring and research, and data and findings for this important resource are summarized primarily in Chapters 2, 5, and 6.

Water Conservation Area 2 (WCA-2) is an extensive sawgrass wetland and the smallest of the three WCAs. It was divided into two smaller units, WCA-2A (442 square kilometers or 173 square miles) and WCA-2B (95 square kilometers or 37 square miles) (**Figure 1-1**), to reduce water seepage losses to the south and improve the water storage capabilities of WCA-2A. More than half the inflow water entering WCA-2A originates from the EAA. Canal inflow waters contain high concentrations of nitrogen and phosphorus, resulting from agricultural and urban land use within the EAA (SFWMD, 1992b). WCA-2A has been the site of intensive research and monitoring; data and findings for this conservation area are primarily in Chapters 2, 5, and 6.

Water Conservation Area 3 (WCA-3) is the largest WCA, with an area of 2,339 square kilometers (915 square miles) (**Figure 1-1**). The area is predominantly 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. Like WCA-2, WCA-3 was divided into WCA-3A (2,012 square kilometers or 786 square miles) and WCA-3B (327 square kilometers or 128 square miles) by two interior levees so water losses due to levee seepage could be reduced. WCA-3A is the only WCA 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 basins to the west (SFWMD, 1992b). Less information is available on this area than WCA-1 or -2, but there is substantial new information (e.g., tree islands, water quality, mercury) being generated and reported in Chapters 2, 5 and 6.

Everglades National Park

Everglades National Park encompasses 5,569 square kilometers (2150 square miles) of freshwater sloughs, sawgrass prairies, marl-forming wet prairies, mangrove forests and saline tidal areas 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 United Nations designated it as a World Heritage Site in 1979 and it is also 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 10 most endangered parks (SFWMD, 1992b).

The Park contains three dominant wetland habitat types: 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 stands, 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 and 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). Information on the Park is scattered throughout this Report, with specific data and findings included in Chapters 2, 5 and 6.

FLORIDA BAY

Florida Bay is at the extreme southern tip of mainland Florida and includes the body of water that lies between the mainland peninsula and the Florida Keys (SFWMD, 1992b). The Bay covers a total area of about 2,200 square kilometers (860 square miles), of which approximately 1,800 square kilometers (700 square miles) 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, sea trout 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 and diversity of Florida Bay is dependent on mangroves and seagrasses, and the die-off of seagrasses in the late 1980s was 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, urban development and other natural areas. The effects of long-term variations in rainfall patterns and sea level rise are unknown, but may also be significant (Chapter 6, SFWMD, 1992b). Inputs of both nitrogen and phosphorus are also a concern for Florida Bay (Rudnick et al., 1999). Nutrient sources include the atmosphere, the Gulf of Mexico and the Southern Everglades; the impact of nutrient movement from the Florida Keys and from hydrological changes associated with Everglades restoration are of potential significance to the long-term management of the Florida Bay ecosystem.

AREAS SURROUNDING THE EVERGLADES PROTECTION AREA

Several areas adjacent to the modern Everglades Protection Area are significant because they were once a part of the historical system. They serve as contributory basins to the EPA and, as such, add to its water management problems. They also provide wildlife corridors and habitat. The areas include the Holey Land and Rotenberger Wildlife Management Areas, Everglades Agricultural Area (EAA), the C-139 Basin, Big Cypress National Preserve, and the Seminole and Miccosukee Indian Reservations (**Figure 1-1**).

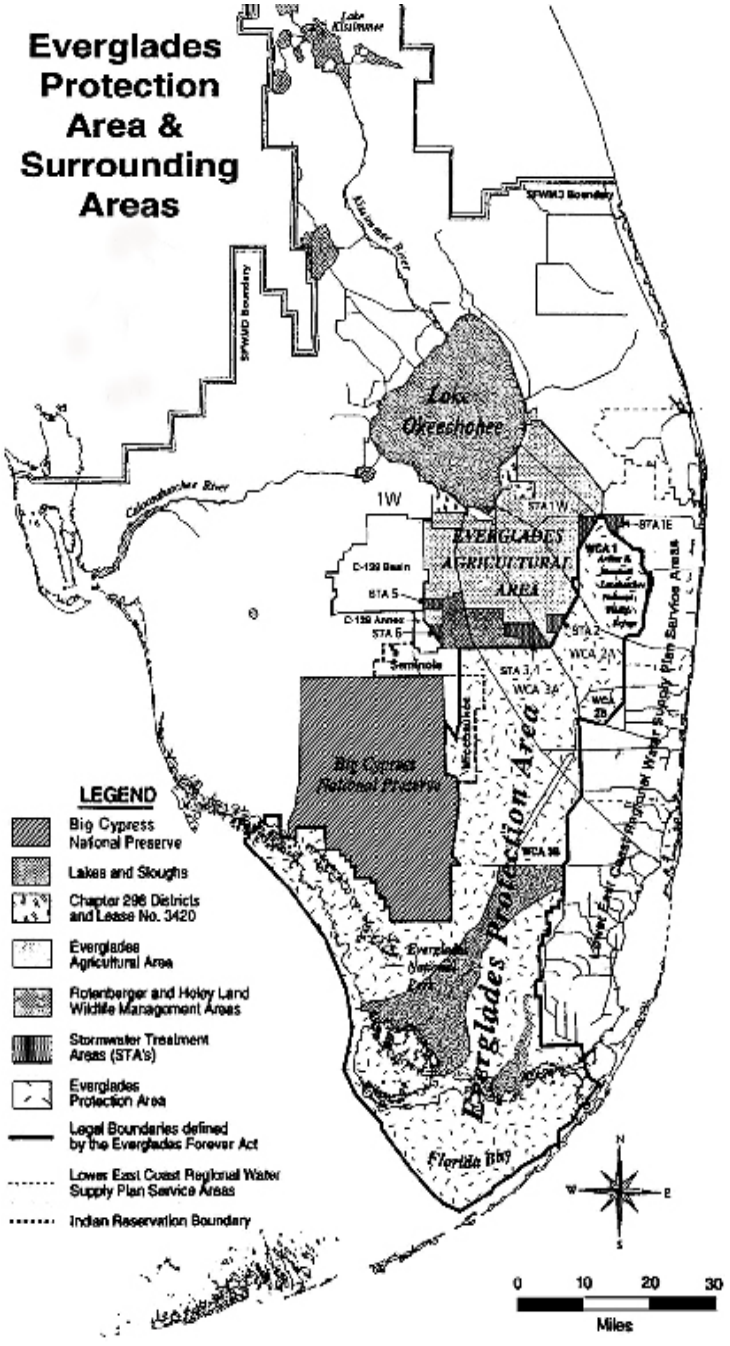

Figure 1-1. Major features of the Everglades Protection Area in South Florida

Everglades Agricultural Area

The EAA 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 (**Figure 1-1**). It incorporates approximately 2,872 square kilometers (1,122 square miles) of highly productive agricultural land with rich organic peat or muck soils. Approximately 77 percent of the EAA, or 2,212 square kilometers (864 square miles), is in agricultural production. Nitrogen-rich organic (peat) soils and a warm subtropical climate permit the year-round farming. The major crops in the EAA include sugar cane, vegetables and sod, and smaller amounts of rice and citrus. Nutrient-laden water from the EAA is now recognized as a major contributor to enrichment of the Everglades (refer to subsection on *Environmental Challenges and Restoration Strategies*), and nutrient control is the primary focus of programs under the Everglades Forever Act. Information on the EAA is provided primarily in Chapters 2, 3, and 8 of this Report.

The Holey Land Wildlife Management Area is a 140 square-kilometer (55-square mile) tract that is state-owned and managed by the Florida Fish and Wildlife Conservation Commission (FWC). The area is used for hunting of white-tailed deer and hogs. The Rotenberger Wildlife Management Area, which consists of 96 square kilometers (37 square miles) of state-owned land (roughly 40 percent of its total acreage), is also managed by the FWC for deer and hog hunting. Both of these areas lie at the southern boundary of the EAA and drain into the WCAs. The District and other agencies have agreed to restore the Holey Land/Rotenberger tracts and to establish water regulation schedules that will simulate a natural hydroperiod. In July 2001, treated water from Stormwater Treatment Area 5 (STA-5) began discharging into the Rotenberger parcel to restore a more natural hydroperiod.

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

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

The areas immediately west of WCA-3 include reservations of 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 native rangelands or for improved pasture. The basins west of WCA-3A are undergoing rapid agricultural development.

The 2,280 square-kilometer (891 square-mile) Big Cypress National Preserve was established in 1974 to protect natural and recreational values of the Big Cypress Watershed, while allowing continued hunting, fishing and oil and gas production. The Preserve also provides an ecological buffer zone and water supply for Everglades National Park. 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 provide local drainage from lands in the Seminole Indian Reservation, C-139 Basin and C-139 Annex.

THE DISTRICT, OTHER GOVERNMENTAL AGENCIES AND THE EVERGLADES RESTORATION PROGRAM

Originally known as the Central and Southern Florida Flood Control District, the South Florida Water Management District (District or SFWMD) was renamed in response to a broadened mission. Although the District's initial responsibility was to operate and maintain canals, levees, and dikes forming the Central and Southern Florida Project, it is now responsible for environmental resources management of approximately 17,000 square miles in South Florida, with an agency mission that includes water supply, flood protection, water quality protection and environmental enhancement.

The District's partner in many of its responsibilities is the Florida Department of Environmental Protection (FDEP or Department). Created by statute, the District operates under the general supervisory authority of the Department, and many of the District's programs rely on close cooperation between the agencies. The Department issues permits to the District for the operation of its water control structures. The District and Department are specifically named as partners in the Everglades Forever Act (EFA), with shared responsibility for various activities in the Everglades restoration program, including the production of this 2002 Report (**Table 1-1**). The Department has taken the lead in developing Chapters 2 and 5 in this Report on water quality and phosphorus effects.

Information in this Everglades Consolidated Report and earlier versions is primarily a product of District programs and projects associated with the Everglades Forever Act, Florida Statute §373.4592. **Table 1-1** outlines the seven primary components of the Everglades restoration program as set forth in the Everglades Forever Act, and cross-reference the EFA's various research and reporting requirements to the chapters in this Report. Particularly important components of the Everglades restoration program include: construction of Stormwater Treatment Areas (STAs) to treat water flowing from the EAA into the EPA (the Everglades Construction Project) (Chapters 4 and 8), implementing agricultural Best Management Practices (BMPs) (Chapter 3), the development of a revised water quality standard for phosphorus (Chapter 5), and research on Advanced Treatment Technologies (ATTs) for treating stormwater (Chapter 4). Another major component of the Everglades restoration program, the Everglades Stormwater Program (Chapter 8), includes developing the means to ensure water quality compliance for structures discharging into, from or within the Everglades Protection Area. The Everglades Stormwater Program moves beyond the Everglades Construction Project (ECP) to ensure water quality standards will be met for areas of the EPA that are not directly involved in the ECP and are beyond the scope of the settlement entered in *United States vs. South Florida Water Management District,* Case No. 88-1886-CIV (S.D. Fla.). The hydrological needs of the Everglades are the subject of Chapter 6 (this information provides an important foundation for Everglades management and restoration). The Comprehensive Everglades Restoration Plan (CERP) jointly led by the U.S. Army Corps of Engineers (Corps or USACE) and the District, is discussed in Chapter 7. The CERP will provide the basis for reconstructing the drainage network within the District so the regional ecosystem can be managed in a more sustainable manner.

Table 1-1. Component projects of the Everglades restoration program as authorized through the 1994 Everglades Forever Act, Section 373.4592, Florida Statutes

Project		Completion Dates	Chapter Coverage in 2002 Everglades Consolidated Report
1. Everglades Construction Project			
Everglades Construction contains 18 projects including 5 Stormwater Treatment Areas and 3 hydropattern restorations.		All projects completed by 12/3l06	Construction projects are not discussed specifically in the Consolidated Report, but the ECP is mentioned in Chapters 1, 4 and 8.
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 6 hydropattern issues, Chapter 8 Lower East Coast Water Supply Plan and Chapter 7 hydropattern restoration in the Comprehensive Ecosystem Restoration Plan.
3. Research and Monitoring (RAM)			
RAM-1	Describe Water Quality in EPA and Tributary Waters	01/31/96	Chapter 2 covers EPA water quality in detail and Chapter 8 includes issues in tributary basins.
RAM-2	Evaluate Best Management Practices Effectiveness	12/31/01	Chapter 3 is devoted to the EAA BMP implementation. BMPs for tirbutaries are considered in Chapter 8.
RAM-3	Evaluate Existing Water Quality Standards for the EPA	12/31/01	Chapter 2 covers water quality in detail.
RAM-4	Evaluate WQ Standards and Classifications of EAA Canals	12/31/01	Chapters 1 and 2; canal evaluations not completed to date.
RAM-5	Optimize Stormwater Treatment Area Operation	Ongoing	Chapter 4 disusses this work and STA performance to date.
RAM-6	Interpret Class III Phosphorus Criterion Research	12/31/01	Chapter 5 provides a detailed review; there is a discussion of scheduling in Chapter 8.
RAM-7	Peer-Reviewed Interim Report	01/01/99	Product of RAM 7 is the 1999 Everglades Interim Report.
RAM-8	Peer-Reviewed Annual Report	01/01/00 and yearly to 2006	RAM 8 provides updates; to date, 2000, 2001 and this 2002 Everglades Consolidated Reports are published.
RAM-9	Monitor C-139 Basin Water Quality	05/01/95, in progress	Covered in Chapter 2 of this Report.
RAM-10	Hydrological Needs of the Ecosystem	12/31/01	Detailed in Chapter 6 and mentioned throughout the Report, particularly Chapters 4, 5 and 7.
RAM-11	Mercury Monitoring and Research	12/31/01	Covered in detail in Chapter 2.
RAM-12	Identify Advanced Treatment Technologies	Ongoing	Covered in detail in Chapter 4 and mentioned in Chapters 1 and 8.
RAM-13	Best Management Practice Strategies for other Water Quality Parameters	12/31/06	Not covered directly in Report; relevant information is in Chapters 2, 3, 4 and 8.
4. Regulation Projects			
This element includes 10 projects; three are now completed.		All projects 12/ 31/06	Projects are mentioned in Chapters 1, 3, 5 and 8.
5. Exotic Species Control		Ongoing	Covered in Chapter 8 and mentioned in Chapters 5, 6 and others.
6. Funding Projects		Ongoing	Covered in Chapter 8.
7. Everglades Annual Reports		Ongoing	This Everglades Consolidated Report encompasses annual reporting requirements and Exectuve Summary provides all information required in the Annual Report.

ENVIRONMENTAL ALTERATION AND RESTORATION OF THE EPA

ENVIRONMENTAL CHALLENGES TO THE EVERGLADES

Landscape development is changing ecosystems dramatically around the world. Hydrological alterations are recognized as a major threat to public lands and other ecosystems (Pringle, 2000; Rosenberg et al., 2000). Dams and other changes to flowing waters associated with development have resulted in huge modifications to the hydrology and chemistry of large aquatic ecosystems, including the oceans (Dynesius and Nilsson, 1994; Chao, 1995; Justic et al., 1995; Humborg et al., 2000). Unfortunately, the Everglades is no exception to these trends: the ecosystem has been altered fundamentally by changes in spatial extent, hydrology and water quality.

With regard to spatial extent, the historic Everglades system once extended from the south shore of Lake Okeechobee to the mangrove estuaries of Florida Bay and covered more than 10,000 square kilometers. Urban and agricultural development during this century, however, have reduced the present-day Everglades to 50 percent of its original size (Mitsch and Gosselink, 2000), of which 3,400 square kilometers have been impounded within the WCAs (SFWMD, 1992a & b; Light and Dineen, 1994). 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).

The loss of spatial extent has been accompanied by altered flow regimes and water quality, thereby endangering the overall biotic integrity of the remaining Everglades (Davis and Ogden, 1994). Hydrology of the ecosystem is a major focus of the Comprehensive Everglades Restoration Plan (CERP, Chapter 7) that will undertake major projects addressing water supply for man and nature spanning at least three decades. The combined influence of changes in water quality and quality has produced a suite of undesirable impacts. These include: establishment of pronounced nutrient gradients in the WCAs downstream of major discharge structures; replacement, with cattail, of large areas once dominated by sawgrass and periphyton; decline in wading bird populations (recent increases are reported in Chapter 6); and species changes in periphyton and macroinvertebrate communities (Davis and Ogden, 1994; SFWMD, 1992a and b). 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 square-kilometer Everglades Agricultural Area (SFWMD 1992a, b, c; Chapters 2 and 3 in 2000 and 2001 Everglades Consolidated Reports). 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). Such impacts from agricultural drainage are not unique to South Florida and are often severe (Lemly et al., 2000).

Since the late 1980s the heavy metal mercury has been identified as an environmental and potential human health risk in the Everglades ecosystem. Over the past decade, research and monitoring conducted by many agencies and organizations has provided a much better understanding of mercury cycling and bioaccumulation in wetlands. It is now recognized that mercury is delivered to the Everglades almost entirely from the atmosphere, but is transformed into the toxic methyl-mercury species through wetland microbes fueled by local resources, such as sulfur, and suitable habitat, such as periphyton mats or aquatic sediments. As detailed in

Chapter 2B, recent dramatic reduction in atmospheric sources appears to be reducing the mercury problem in the Everglades.

THE EVERGLADES RESTORATION STRATEGY

Restoration of the Everglades ecosystem is a national, even international, imperative. The Florida Legislature stated the mandate succinctly:

> …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])

The international importance of the restoration activities in the Everglades was made clear in the recently completed *IV Inter-American Dialogue on Water Management* (Iguazu Falls, Brazil, September 2–6, 2001). A special session was held during the conference on the Everglades-Pantanal Initiative, and the final report from that session concluded:

> The South Florida Water Management District and the U.S. Army Corps of Engineers are implementing a comprehensive restoration program in the Everglades region -- the largest undertaking of this nature ever attempted. The experience gained in this endeavor will overtime provide areas such as the Pantanal not only a wealth of data on water quality parameters, management of exotic species, and public involvement processes, but will also assist those with wetlands management responsibilities to avoid problems encountered in this process over the long-term. (IV Inter-American Dialogue on Water Management, Final Draft Report, Inter-American Water Resources Network, Washington, D.C. September 2001.)

Although this massive undertaking is unique in scale and complexity, it follows a well-worn path of environmental management addressing the manifestations of excess nutrient inputs (Carpenter et al., 1998; Smith et al., 1999). The restoration strategies described below are guided by prior successes in reversing problems associated with nutrient enrichment in aquatic ecosystems around the world. Classic restoration case histories include: Lago Maggiore, Italy (de Bernardi et al., 1996), Lake Washington, U.S.A. (Edmondson, 1991), the Chesapeake Bay, U.S.A. (Malone et al., 1996) and the Thames River and Estuary, England (Gameson and Wheeler, 1977).

While the cited success cases provide evidence that large-scale restorations are feasible, the spatial extent and unique ecology of the Everglades pose a suite of challenges to restoration that are being met by the strategies and programs described below. Central to its restoration will be control of non-point source phosphorus inputs to the EPA. The application of constructed wetlands for phosphorus interception (Chapter 4) and agricultural Best Management Practices (BMPs, Chapter 3) are the two fundamental approaches presently being used to reverse enrichment of Everglades marshes.

Stormwater Treatment Areas

The initial management plan for the Everglades (SFWMD, 1992a) proposed the construction of three large treatment wetlands encompassing approximately 14,500 hectares (about 35,000 acres). Subsequent amendments increased the total acreage of these constructed treatment

wetlands to 42,000 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 EFA was enacted by the Florida Legislature in 1994, and established the funding mechanisms and construction timetable for a more comprehensive program of six STAs, as well as other restoration projects (**Figure 1-1** shows the location of STAs). The EFA 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 in Chapter 4 of this Report, is intended to provide the District with the information necessary to achieve this mandate, particularly with regard to ways to optimize performance.

Best Management Practices

While the STAs provide treatment of phosphorus for waters flowing into the Everglades, the source reduction of P discharged from farms, towns and other land uses within the Everglades Agricultural Area has been approached through BMPs. An EAA-wide target of 25 percent load reduction, compared to the May 1979 through April 1988 pre-BMP period, was established by District rulemaking (Chapter 3). The P concentrations have also been reduced significantly from the pre-BMP period; while this is a positive improvement, additional P reduction downstream in the STAs is necessary to achieve the EFA's interim goal of 50 ppb. The agricultural industry, with support from state and federal agencies, is continually investigating additional measures to enhance the existing BMP programs. If proven cost-effective, additional BMPs could be implemented to reduce the overall costs and scale of the long-term water quality solutions. Additional details on the BMP programs are provided in Chapter 3 of this Report.

ACHIEVING LONG-TERM WATER QUALITY GOALS

The implementation of STAs and BMPs is merely a part of the mandates of the EFA. The long-term water quality goal of the EFA is to implement the optimal combination of enhanced BMPs, STAs, ATTs and/or regulatory programs to ensure that waters discharged to the EPA achieve water quality standards no later than December 31, 2006. If the ECP and other discharges to the EPA are not in compliance with state water quality standards, the EFA requires that the District submit an integrated water quality plan by December 31, 2003, designed to achieve compliance with state standards by December 31, 2006. A tremendous amount of research, data analyses, rulemaking, planning and basin-specific evaluations must be completed and integrated in a short time to develop integrated water quality plans and long-term permit applications by December 31, 2003.

The interrelationship between these steps, and the anticipated timeframes for each step, are summarized in the following paragraphs. Excellent progress is being made toward water quality goals. Technical analyses in support of the phosphorus criterion for the Everglades Protection Area, treatment technology research, planning for the CERP and water quality strategies of the Everglades Stormwater Program are all progressing rapidly. The STAs continue to perform very well, and BMPs continue to reduce phosphorus exports from the Everglades Agricultural Area more than the mandated 25-percent level. As encouraging as this progress may be, significant challenges remain ahead in the complex and interrelated steps leading to ultimate water quality goals for the Everglades Protection Area.

Phosphorus Research and Rulemaking

Achieving compliance with Florida's phosphorus standard by 2006 includes more than building STAs or creating new phosphorus-reducing technologies; in this case it includes researching and promulgating the criterion and a compliance methodology. Presently, Florida has only a vague narrative phosphorus water standard (which also applies to all other nutrients): nutrients may not be at a level that causes an imbalance in flora and fauna.

The EFA mandates that the state must undertake research necessary to translate the narrative standard into a numeric criterion and must do so by December 31, 2003. In the event it fails to adopt a standard, a default 10-ppb phosphorus limit will be imposed. The EFA further requires the state to adopt a compliance methodology to assure phosphorus in the EPA meets the criterion and, in those areas already impacted, to assure net improvement towards that goal. To make matters more complex, any compliance methodology to be used in the Refuge and Park must be consistent with the method adopted in the settlement of *United States vs. SFWMD,* Case No. 88-1866 (S.D. Fla.).

The Department has proposed a 10 ppb phosphorus criterion and that number, along with alternative criterions proposed by agriculture interests, are being considered by Florida's water standard-setting board, the Environmental Regulation Commission (ERC). The Department has also set forth its initial concept for a compliance methodology, which is the subject of pending ERC review.

STA Optimization

Virtually all the STA designs have been refined according to standard engineering practice to incorporate new information that was not available during the earlier design phase. This adaptive management will continue throughout implementation of the ECP. A combination of field research, evaluation of available data for similar systems and application of appropriate wetland water quality models is being used to identify ways to optimize the nutrient removal performance of the STAs (Chapter 4). Research has been underway in the large treatment cells of STA-1 west. In addition, activities are underway in two sets of test cells where greater water control and statistical replication are available. The results will include recommendations for enhancing the nutrient-removal performance of STAs through refining system operations (e.g., water depths and hydraulic retention times). Also, as the early STAs come online, their operations will be continuously evaluated, with valuable feedback incorporated into other STA operations. Additional details on STA performance and STA optimization research are provided in Chapter 4.

Advanced Treatment Technologies Research

In 1996, the District completed a comprehensive evaluation of promising P reduction technologies, ranging from low-intensity management of constructed wetlands to full-scale chemical treatment (PEER Consultants, P.C./Brown and Caldwell, 1996). Various combinations of the highest ranked technologies were evaluated on the basis of nutrient removal performance, implementation costs and environmental criteria. This evaluation confirmed that STAs are indeed the best interim step toward achieving the long-term water quality and hydropattern restoration goals of the Everglades. In addition, the most promising P removal technologies were identified, and the remaining technological uncertainties were documented to guide future research. Completion of ATT research is in the critical path for determining and implementing long-term solutions by December 31, 2006. Acceleration of this research has been difficult because

biological research inherently requires one or more growing seasons to evaluate performance. Additional details on the ATT research are discussed in Chapter 4 of this Report.

Comprehensive Everglades Restoration Plan (CERP)

The objectives of CERP are stated in the Water Resources Development Act 2000, Title VI, Sec. 601, (h),(1): "IN GENERAL - The overarching objective of the Plan is the restoration, preservation, and protection of the South Florida Ecosystem while providing for other water-related needs of the region, including water supply and flood protection. The Plan shall be implemented to ensure the protection of water quality in, the reduction of the loss of fresh water from, the improvement of the environment of the South Florida Ecosystem and to achieve and maintain the benefits to the natural system and human environment described in the Plan, and required pursuant to this section, for as long as the project is authorized." CERP will restore the ecological integrity of the South Florida ecosystem, while continuing to provide flood protection, agricultural and urban water supply and other project purposes.

The CERP analyses yielded hydropattern design targets for the long-term solutions and potential restoration approaches. It is anticipated that the CERP will: (1) determine the total water storage capacity required to achieve the hydropattern restoration goals for the Everglades, and (2) define requirements for temporal and spatial distribution of flows to the Everglades. Data and findings on hydrological needs of the ecosystem used to develop CERP targets are provided in Chapter 6. Interim and final results from the CERP will be integrated into long-term implementation activities subject to funding and timing constraints. More information on the water quality and hydrological aspects of the CERP is provided in Chapter 7 of this Report. This chapter has been expanded for the 2003 Report to provide more complete coverage of CERP project implementation.

Many other restoration and water management projects are being conducted through federal-state partnerships not included directly in CERP. Many examples, such as the Kissimmee River Restoration Project, multiple land acquisitions for water management projects, and ENP/Modified Water Deliveries, are described on the District's Website for Major Projects at www.sfwmd.gov.

Everglades Stormwater Program

The Everglades Construction Project covers seven of the 15 major basins that discharge into the Everglades Protection Area. The water quality strategies for the remaining eight basins and the interior waters of the Everglades were identified in the permit issued in April 1998, which is referred to as the "non-ECP" permit. These schedules and strategies are being implemented through the District's Everglades Stormwater Program. The Everglades Stormwater Program includes a combination of regulatory analyses, water quality evaluations and water quality improvement measures. The Everglades Stormwater Program is described more fully in Chapter 8.

CHALLENGES TO ACHIEVING LONG-TERM WATER QUALITY GOALS

Florida's EFA establishes an orderly process of research and rulemaking to develop a sound foundation for making long-term water quality decisions. If critical decisions on long-term water quality solutions are made without sufficient time to assess the current water quality program, establish appropriate discharge limits and investigate alternative measures, they carry associated

environmental and economic risks. Potential environmental risks include not achieving the long-term water quality targets, causing unintended adverse impacts to the Everglades or generating problematic by-products. Potential economic risks of early selection of solutions include greater capital and annual costs and acquisition of additional or legal challenges to the sufficiency of science and engineering information used in the decision process.

The orderly process of research and rulemaking, established by the EFA, was designed to provide sufficient science and engineering information to reduce the uncertainty and minimize risks associated with long-term water quality solutions. To meet the ambitious timeframes in the EFA, the District may be required to recommend long-term solutions based on incomplete information. The key gaps in the information base for the long-term decisions and other challenges of the mandated timeframe are described in Chapter 8 of this Report. Considering the number and complexity of the many activities required to achieve the long-term water quality goals, the 2006 timeframe for compliance with all water quality standards, as established by the EFA, is ambitious.

Information is needed from analyses of BMP, STA optimization, ATT research and regulatory action strategy efforts to support basin-specific feasibility studies. These studies and associated conceptual designs will be completed by the Everglades Stormwater Program to determine the optimal combination of water quality measures required to achieve the long-term water quality goals. The basin-specific feasibility studies and conceptual engineering designs are scheduled for completion by December 31, 2003.

Funds need to be appropriated for implementation of long-term solutions (refer to Chapter 8D for financial information). The EFA allocated several state sources for funding the implementation of the ECP, and federal funds have been appropriated for STA-1 East. However, funding for implementation of long-term solutions has not been appropriated, though research designed to support these decisions is already underway. Because the costs of the long-term solutions will be dependent on the basin-specific combination management actions taken (Chapters 8A and 8B), the District cannot develop a firm estimate of the total costs.

By December 31, 2003, the District must submit to the Department permit modifications and/or permit applications for the long-term water quality measures, as needed. The final water quality plans are due in December 2003 and will contain the most cost-effective combination of enhanced BMPs, STAs and ATTs for each basin discharging into the Everglades Protection Area. In addition to the information in the basin-specific feasibility studies, the integrated water quality plans will include proposed funding mechanisms and implementation schedules.

CONTENT OF THE 2003 EVERGLADES CONSOLIDATED REPORT

REPORT OBJECTIVES

The first and foremost objective of this Report is to update and summarize available data and findings relating to the Everglades restoration effort. Information in this Report will be used by the District and the Department for making decisions affecting implementation of the Everglades Construction Project (ECP) and other restoration and management activities. This year's edition builds on and updates information in earlier versions of the Report, without repeating detailed technical information. The Report is part of an ongoing process to provide information for

decisions and updates on important programs. In addition, the Report satisfies, or partially satisfies, the reporting requirements and specifications of multiple permits, including: the U.S. Army Corps of Engineers (Corps) Section 404 permit for the ECP; Department permits for the ECP; and the non-ECP permit issued by the Department. District authors also provide information needed for resource management, even if a specific requirement for reporting is not required.

This *2003 Everglades Consolidated Report* has been produced pursuant to section 373.4592(4)(d) 6 F.S., which requires the District to submit an annual peer-reviewed report to state officials; this requirement is RAM 8 of the Everglades Program (**Table 1-1**). The scientific workshops and public hearing are part of the peer review process and were held September 24 through 26, 2002. Through that review process, numerous other agencies or organizations contributed information and focus to this Report. However, peer review is not required to include a public hearing with public access to the review panel. The District and the Department elect to hold a public hearing and to conduct an open panel review for this Report because the issues being communicated are very important to local resource agencies and the public, and the issues deserve open deliberation before a panel of objective experts. This review process is described later in this chapter.

The contents of this *2003 Everglades Consolidated Report* are the same as those of earlier Reports and are set forth in the EFA (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 about July 1, 2001. In most cases, by this date, authors had access to all data from the 2002 "water year" (WY02), the period from May 1, 2001 through April 30, 2002, and most data summaries in this Report use this WY02 period. This period is convenient for South Florida since it generally follows the overall wet/dry cycles of this subtropical environment and is consistent with calculations done in the Everglades Regulatory Program described in Chapter 3.

LEGAL AND REPORTING REQUIREMENTS

The District's Everglades restoration efforts entail numerous reporting mandates. These legal requirements include the following:

- An Everglades Forever Act Annual Report, required by §373.4592(12), submitted to the Department of Environmental Protection, the Governor's office and the leaders of the Florida Legislature. That report must include a summary of the water conditions in the Everglades Protection Area, the status of the impacted areas, the status of the construction of the STAs, the implementation of the BMPs and actions taken to monitor and control exotic species.

- An annual peer-reviewed report, required by §373.4592(4)(d)6., F.S., also submitted to the Department, the Governor and legislative leaders regarding the research and monitoring program that summarizes all data and findings as an update on topics included in the 1999 Everglades Interim Report, required by §373.4592(4)(d)5., F.S.
- A Joint Legislative Committee on Everglades Oversight (JLCEO) Report, required by §11.80(4), Florida Statute, submitted to the legislative committee and addressing changes to the Everglades Construction Project, and analyzing costs and revenues.
- A Non-Everglades Construction Project permit annual report, required by §373.4592(9)(k) and (l), F.S., and by DEP Permit No. 06, 502590709, to be submitted to the Department and address water quality at structures associated with the Everglades Protection Area that are not included in the Everglades Construction Project. This report also addresses schedules and strategies to improve that water quality.
- A 404 permit report(s), required by Permit No. 199404532, submitted to the U.S. Army Corps of Engineers and addressing the District's strategy for achieving water quality standards and updating the Corps on the activities authorized or otherwise regulated by the permit.
- A series of reports on the Stormwater Treatment Areas from National Pollutant Discharge Elimination System permits and Everglades Forever Act permits and to be submitted to the Department and the U.S. Environmental Protection Agency. These permits require information on the quality of water discharged from the treatment systems, as well as the progress of the treatment systems at improving water quality.
- An annual report on the Everglades Comprehensive Restoration Plan (CERP) required under Section 373.470(7) Florida Statutes is also included in this 2003 Report. This requirement was met by stand-alone reports titled CERP 470 Reports for the last two years. As a result, Chapter 7 has been expanded to accommodate this reporting requirement and to provide more complete coverage of CERP as its many projects are implemented.

This *2003 Everglades Consolidated Report* is submitted in compliance with all these reporting requirements. By consolidating all the requirements into a single document, the District ensures that its evaluation of annual data on the Everglades is both comprehensive and cost-effective. Furthermore, the Consolidated Report is intended to ease the review process for other agencies, organizations and interested persons and provide a single source of information on the Everglades for use in decision-making.

REPORT DEVELOPMENT AND FORMAT

This Report consists of a set of chapters with varying levels of technical detail and synthesis, including an executive summary with major findings and the technical report in eight chapters. The Executive Summary of the Report is written for a diverse readership and provides an abstract of the key facts and supporting information. This section of the Report is intended as 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 Executive Summary fulfills all the information needs formerly addressed through the Everglades Annual Report.

The eight-chapter technical document conveying data and findings in each topic area is the main product of this reporting effort. This technical document is targeted at individuals who seek detailed information on topics mentioned in the EFA, along with technical interpretation and supporting information. Another product of the reporting effort is a volume of appended documentation referred to in the main body of the Report. These appendices give interested readers data summaries and detailed analyses for the special interest reader. Appendices include data tables required for compliance with various permits.

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 topics being addressed. Chapters reflect the writing style of the authors and the level of detail appropriate to the topics. The order of authors on each chapter indicates their contributions to the Report in accordance with common practice in science and engineering. An editorial team provided technical review and integration of the Report. A production team at the District formatted and assembled the Report.

CONSTRAINTS ON CHAPTER CONTENT AND INTERPRETATION

There are several important factors that influence the interpretation of chapters in all Everglades Consolidated Reports. First, detailed discussion of methods and quality assurance/quality control (QA/QC) or complex interpretative (statistical) issues cannot be dealt with through the Report. However, authors have attempted to summarize the data and findings comprehensively, 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 data that are readily available and quality assured as of about July 1, 2002 for the Water Year ending April 30, 2002.

Publications used for the Report must be complete 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 to ensure authors can include it in their evaluations. The level of detail varies in accordance with information available and the opinion of the author on what data should be presented to address issues of interest to decision makers. Finally, the reader should recognize that the Report is not a formal part of any legal or administrative process. Interpretation of wording in this Report must be done from a technical, not a legal, perspective.

CHAPTER ORGANIZATION

The 2003 Report is comprised of eight chapters and an Executive Summary. The Report contains the same basic information as earlier versions, but the number of chapters has been reduced in an effort to simplify the Report's organization. This chapter, the Introduction, provides background for the Report and a basic outline integrating projects and programs described in the Report. Chapters 2 through 8 each contain a summary, background on topics, technical discussion of data, findings, strategies for obtaining additional information and references cited in the chapter. The Executive Summary attempts to summarize information about important issues and

guide the reader to sources of additional information in the Report. It is written as an abstract of critical information and conclusions for decision makers.

Water quality status and trends for standard Class III parameters in the EPA are the subjects of Chapter 2. This chapter also covers issues concerning mercury in the EPA and includes an update on mercury research and monitoring in support of risk analysis for mercury contamination associated with the Everglades Construction Project. A history and summary of actions taken under the Everglades Regulatory Program, a BMP Program in the Everglades Agricultural Area, are provided in Chapter 3. Chapter 4 provides a detailed account of information gathered on the performance of the STAs and STA optimization research. Chapter 4 also describes techniques being investigated as means for removing phosphorus from water down to the planning level of 10 parts per billion (ppb) default concentration specified in the EFA.

Effects of phosphorus on the Everglades are discussed in Chapter 5, which provides information on the intricate effects of nutrients and associated factors on Everglades ecology. The hydrological needs of the Everglades Protection Area and supporting technical information are the subject of Chapter 6. Chapter 7 summarizes the ongoing planning and implementation of the Comprehensive Everglades Restoration Plan (CERP). Chapter 8 is a composite of sections concerning other Everglades programs. This chapter describes the strategy for achieving water quality goals, including a detailed update on the Everglades Stormwater Program. Chapter 8 also gives a status report on land acquisition, fiscal resources and control of exotic species.

PEER REVIEW OF THE EVERGLADES CONSOLIDATED REPORT

The 2003 Everglades Consolidated Report was developed through a two-step review and revision process described previously. Following internal review and revision during July and August 2002, an updated and revised draft of the Report was distributed for external public review on the District's Internet site. A scientific review panel also received the Report during September (see below). The requirement for **peer review** is specified by narrative from the EFA (373.4592(4)(d) 6):

> "*Beginning January 1, 2000, the District and the Department shall annually issue a peer-reviewed report regarding the research and monitoring program that summarizes all data and findings.*"

The District organized the external 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 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 over a Web Board and through public hearings conducted **September 24 through 26, 2002**. The panel collaborated in providing recommendations and a final report to the District. The breadth of this Report and the need for interaction with reviewers require that the Everglades Consolidated Report be reviewed by such a group of experts, as described below.

A general Statement of Work was developed for the review process and was modified to fit the specific role of each panelist. Panelists were given a Purchase Order and Statement of Work by the District to provide the following review services on the Everglades Report:

- **Read selected chapters of earlier Everglades Consolidated Reports**. Panelists were asked to focus attention on assigned chapters closest to their areas of expertise. Broad reading of the 2002 Report was encouraged as general background for the *2003 Everglades Consolidated Report* and associated public hearings. Earlier Everglades Consolidated Reports were available through the District's Website and should be read as necessary on specific issues during the review.
- **Read assigned chapters of the *2003 Everglades Consolidated Report***. Prior to the public hearing, panelists reviewed assigned chapters of the 2003 Report and prepared a preliminary written review, including questions to be addressed by District staff. All communications between the panelists were done "in the sunshine" through a Web Board linked to the District's Website (www.sfwmd.gov).
- **Participate in the public hearings as a panelist from September 24 through 26, 2002 in West Palm Beach**. The Panel participated in public workshops, noticed as public meetings in accordance with "government in the sunshine" statutes. One day was devoted to water quality, STAs and ATTs. The second workshop day concentrated on the scientific basis for a phosphorus criterion for the Everglades Protection Area and on the status of CERP and other Everglades programs. These workshops were organized in cooperation with the Department.
- **Develop a draft Panel Report with conclusions and recommendations**. During a working session on **September 26, 2002**, following the public workshops, the panel developed their conclusions and recommendations on the 2003 Everglades Consolidated Report and provided these to the District and Department before leaving West Palm Beach. This step gave the authors review comments so revisions could be made within the time constraints of the Report deadline.
- **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 the Panel deemed appropriate for each chapter. Public comments contributed before, during and one week after the hearings were considered by the Panel. The Final Report was delivered to the District on **October 17, 2002** and is provided in **Appendix 1-1** of this Report.
- **Panel Chairperson, additional responsibilities**. Additional duties of the Chairperson included: communicating with the panelists prior to the panel receiving materials; assisting panelists as needed to ensure consistent interpretation of the Statement of Work and assumptions and policies associated with the document; assisting panelists as necessary in the use of the WWW site for posting reviews and ensuring that panelists used this site for all communication; while in West Palm Beach, conducting organizational meetings as needed to keep the review process well focused; chairing the workshops and working session, September 24 through 26, 2002; organizing the panel's preparation of draft and final reports to the District; and ensuring that the final report was well edited and delivered to the District on schedule.

This intensive public and panel review resulted in extensive written comments and suggestions to the Report authors; the panel report is provided verbatim in **Appendix 1-1**. The Report authors benefited from the thorough 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 2001. A summary of the responses of authors to reviewer comments is also provided in **Appendix 1-1**.

PANELISTS REVIEWING THE 2003 REPORT

Selection of panelists for the 2003 review was based on the success of previous reviews. Authors and interested parties felt strongly that having panelists serve more than once improves their review comments by allowing more time for deliberation of relevant technical matters while requiring less time for getting up-to-speed on the details of Everglades issues. The District and the Department received many favorable comments on the Panel's performance in grappling with difficult Everglades issues and in providing thoughtful and constructive comments to both agencies in their review report. As a result of these considerations, panelists from last year's review process reviewed the 2003 Report, with one exception. The District contacted six of last year's panelists, who were all available to participate in the 2002 review. Dr. Yuch Ping Hsieh from Florida Agricultural and Mechanical University will provide expertise in wetland science and chemistry, following in the niche vacated by Dr. Donald Kent. Five of seven panelists are in the District's Expert Assistance Pool.

In accordance with earlier ECR reviews and routine practice in scientific peer review, professional expertise and experience in the major subject areas covered by the Report were the primary criteria used for selecting panelists for the 2003 process described below. Knowledge of environmental management and decision-making was also important for these well-qualified panelists, and to ensure independence they continued to be free of any professional connection to interests or organizations in South Florida. Biographical sketches for the panelists are provided below, along with chapter assignments and specific strengths they brought to the 2003 ECR review process.

Expert #1: Chairperson Dr. Jeffrey L. Jordan, Professor, Department of Agricultural and Applied Economics, University of Georgia, Griffin, Georgia

Through extensive post-doctoral experience in agricultural economics and water resource policy, Dr. Jeffery Jordan is recognized for his work in modeling water demand and allocation, conservation planning, survey design and other aspects of water resource analysis. This diverse experience in water-related economic and policy analyses is demonstrated in over 35 peer reviewed articles, 45 miscellaneous publications, one book and several book chapters authored during his productive career with the University of Georgia. He is well acquainted with general environmental and water quality issues being faced in South Florida. He fulfilled all contract requirements very effectively as Panel chairperson for the peer review of the 2000, 2001 and 2002 Consolidated Reports. Earlier, he served on the peer review panel for the Lake Okeechobee minimum flows and levels, the Spalding County Water Authority, and the Georgia Water Wise Council. This background and record of accomplishment proved to be invaluable for dealing effectively with the wide range of topics and issues associated with the earlier reviews. Together, these qualities made him ideally suited as chair of the Peer Review Panel for the *2003 Everglades Consolidated Report*. He also acted as a reviewer for chapters on other Everglades programs

(Chapter 8), the CERP (Chapter 7), and hydrological aspects of the Everglades (Chapter 6), and he commented on the Introduction (Chapter 1).

Expert #2: Dr. Richard A. Meganck, Director, Sustainable Development and Environment, Organization of American States, Washington, D.C.

Dr. Richard Meganck is highly experienced in planning for development and natural resource management internationally. Since receiving a doctorate in natural resource management in 1975, he has authored dozens of refereed articles and papers in conference proceedings on park planning, international development, ecological restoration and sustainable development. Dr. Meganck is experienced in dealing with diverse audiences and interests through his work with the Organization of American States, the United Nations Environment Program, and as a private consultant in environmental management. His resource-planning experience is exceptionally diversified and unique, particularly his extensive work on park management and sustainability. He participated in peer review of the 2000, 2001 and 2002 Consolidated Reports and proved to be very thoughtful and innovative in his review comments. His expertise was well matched to the needs of the 2003 Report review panel for issues dealing with environmental restoration (Chapter 1), other Everglades programs (Chapter 8), the CERP (Chapter 7), and phosphorus criterion (Chapter 5).

Expert #3: Dr. Rebecca R. Sharitz, Professor, Department of Botany and Savannah River Ecology Laboratory, University of Georgia, Aiken, South Carolina

Dr. Rebecca Sharitz is highly experienced in management-related science of wetlands through her work on southern forests, swamps and marshes. Trained as a botanical ecologist, she has worked on the effects of disturbance and water level on forested wetlands and marsh plant communities and has researched the interactive effects of many factors on these biological communities. She has mentored many graduate students over the course of her career and has served in a variety of administrative and professional service positions, including many national panels and boards. The ecological principles used throughout this distinguished career are the same suite of scientific concepts underlying issues in the Everglades ecosystem, especially concerning the effects of eutrophication and hydroperiod alterations on South Florida vegetation communities. With over 90 publications in the international scientific literature, and dozens of presentations at scientific meetings, Dr. Sharitz made a major contribution to the 2000, 2001 and 2002 Everglades Consolidated Report reviews. As a panelist for this year's peer review, she provided specific comments on wetland hydrology (Chapter 6), nutrient issues (Chapter 5), the CERP (Chapter 7), and exotic species (Chapter 8).

Expert #4: Dr. Robert C. Ward, Professor and Director, Colorado Water Resources Research Institute, 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. Dr. Ward is well acquainted with peer review, having served on many panels and review committees. He is also familiar with South Florida technical issues

and science through his participation in panels that reviewed the phosphorus control program in the Lake Okeechobee watershed, the 1999 *Everglades Interim Report* and the 2000, 2001 and 2002 Everglades Consolidated Reports. In addition, he is experienced in dealing with diverse audiences through his work with students, educational initiatives and professional societies. His quantitative experience with water quality monitoring data is extensive, and his knowledge of monitoring program design is exceptional. Dr. Ward was well matched to the needs of the 2003 Report review panel, particularly for issues dealing with water quality and interpretation of monitoring data for regulatory purposes. His participation was valuable for aspects related to water quality monitoring and compliance contained primarily in chapters concerning water quality (Chapter 2), agricultural BMPs (Chapter 3), the RECOVER section of CERP (Chapter 7), and the phosphorus criterion (Chapter 5).

Expert #5: Dr. Yuch Ping Hsieh, Wetland Ecology Program, Florida A & M University, Tallahassee, Florida

After receiving a doctorate from Rutgers University in 1976, Dr. Hsieh has held a series of academic positions as a wetland chemist and soil scientist. From 1986 to the present, he has been a professor and program leader in Florida A & M's Wetland Ecology Program. Dr. Hsieh has been responsible for over 40 scientific publications concerning carbon and sulfur cycling, nitrogen and phosphorus dynamics and management practices for sustainable soils. He has served on many advisory and review teams and has attracted over $2.7 million in external support to the university. Dr. Hsieh has been involved in water quality issues over his career and is extremely well versed in state-of-the-science methods in environmental chemistry, particularly involving isotope techniques and advanced chemical analyses of environmental samples. His input on the 2003 Report will be particularly important for chapters on water quality (Chapter 2), constructed wetlands (Chapter 4), phosphorus criterion (Chapter 5) and Everglades hydrology (Chapter 6). Dr. Hsieh's unique knowledge of sulfur cycling is particularly valuable to aspects of the Report dealing with mercury dynamics in the Everglades.

Expert #6: Dr. Joanna Burger, Professor, Division of Life Sciences, Rutgers University, Piscataway, New Jersey

Dr. Joanna Burger has a distinguished research and teaching career that spans three decades. She has contributed greatly to the understanding of waterbird ecology and behavior and the effects of metals and other toxic substances on animals. Her research and scholarly activities have been extremely diverse and numerous and have recently included aspects of ecological risk assessment, a subject of emerging importance in South Florida. She is a highly productive research scientist, with over 70 books and book chapters and about four hundred refereed publications. The unusual depth and breadth of her experience as a biologist, ecologist and toxicologist allowed her to contribute greatly to the review of the 2001 and 2002 Everglades Consolidated Reports; her unique understanding of wading bird ecology was a valuable asset to this review. Dr. Burger acted as the lead reviewer on mercury in the Everglades (Chapter 2). She also commented on wetland science and hydrology (chapters 4 and 6).

Expert #7: Dr. E. Joseph Middlebrooks, Environmental Engineering Consultant, Lafayette, Colorado

Dr. Joseph Middlebrooks has a track record in science and engineering since 1966, involving a wide range of activities and responsibilities. He has extensive administrative experience at the University of Tulsa, Tennessee Technological University, and Utah State University,

demonstrating an excellent grasp of research and policy directions and needs in environmental engineering. He has been involved in a variety of consulting activities on water quality, wastewater treatment and industrial waste management. Dr. Middlebrooks has been active in professional societies and has a substantial list of accomplishments and honors as a professor of engineering. With 11 books, over 50 sole-authored papers and more than 200 jointly authored papers and reports, he has an outstanding record of contribution to wastewater and environmental engineering. He served on the review panels for the 2000, 2001 and 2002 Everglades Reports and provided useful, constructive criticism. His breadth of experience and accomplishments placed Dr. Middlebrooks in a unique position to contribute greatly to the review of the *2003 Everglades Consolidated Report*. His input was sought on agricultural BMPs (Chapter 3), Alternative Treatment Technologies (Chapter 4), Everglades hydrology (Chapter 6), and watershed management (Chapter 8).

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