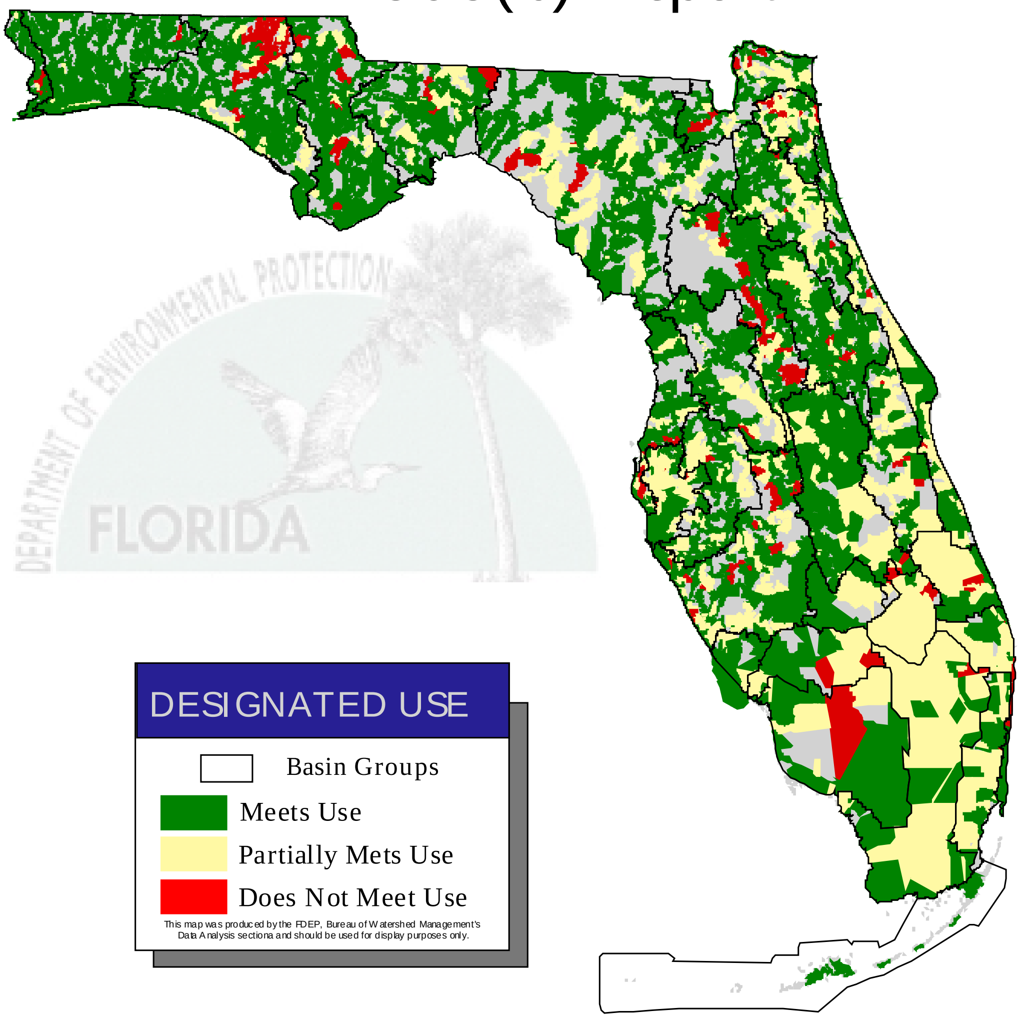
2000 Florida Water Quality Assessment:
305(b) Report



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Executive Summary/Overview

Water is Florida's most precious resource. We depend on a clean, reliable supply not only when we turn on the faucet, but as the foundation of our economy. The state's 50,000 miles of streams, 3,000 square miles of lakes, and 4,000 square miles of estuaries support diverse habitats, plants, and animals as well as food crops, industry, and recreation.

Currently the fourth most populated state in the United States, Florida continues to grow rapidly, and the pressures of population growth and development are serious threats to our water resources. Although issues of water quality and quantity are usually considered separately, they are inextricably linked, and maintaining both is critical to our future well being.

Recognizing the value of our water resources, Florida has acted to protect them. Chapters 403 and 373, Florida Statutes (F.S.), define the authority for preventing pollution and managing water resources. Both the Water Quality Assurance Act and Surface Water Improvement and Management (SWIM) Act address water resource planning and the restoration of degraded waters, respectively. Legislation in the mid-1980s required domestic wastewater discharges from Tampa Bay to Sarasota Bay to receive advanced treatment. In 1990 legislation also mandated the removal of all surface discharges of wastewater from the Indian River Lagoon, effective April 1, 1996.

Previously, a Department initiative introduced Ecosystem Management, the place-based management of watersheds. This approach allowed the state to evaluate impacts to a watershed in a comprehensive, integrated way, rather than simply reviewing individual permit requests. The Division of Water Resource Management implemented a Watershed Approach on July 1, 2000 through the Bureau of Watershed Management. This Bureau will build and expand on the concept of place-based management. Using a five-year basin management cycle, participants and stakeholders in each basin statewide will assess their individual basin, reach a consensus on its most important water quality problems, and cooperate in finding and implementing management solutions.

This report provides an overview of Florida's surface and ground water quality, trends, and protection efforts. It first discusses the federal water quality reporting requirements (the 305(b) report), presents significant water quality findings, and summarizes support for designated use. Next, it summarizes the major pollution problems in the state and assesses the primary causes and sources for water bodies that do not support their designated use. Water quality trends are summarized. Current monitoring efforts are briefly discussed, as are public health and aquatic life concerns. Wetlands protection is summarized, as are pollution regulation efforts and restoration and protection programs. Finally, ground water quality is summarized.

Assessing Florida's Surface Water Quality

The Clean Water Act requires each state, including Florida, to conduct water quality surveys to determine whether its waterways are healthy enough and of sufficient quality to meet their designated use. The EPA uses this information to prepare a biennial report to Congress, the National Water Quality Inventory. This is the principal means by which the EPA, Congress, and the public can evaluate existing water quality and track progress in cleaning up pollution. The section of the Clean Water Act requiring this process is 305(b), and the state reports are commonly referred to as 305(b) reports.

This 305(b) report, the *2000 Water Quality Assessment for Florida,* summarizes the quality of the state's water resources, regulatory developments, impacts to surface water and ground water, water quality trends, and current restoration and protection programs.[1]

For each 305(b) reporting cycle since 1976, FDEP has refined and improved its ability to assess Florida's surface water quality. The 2000 report moves further toward a comprehensive assessment.

For this report, 5,126 watersheds were evaluated. Of that number, sufficient data were available to fully assess 2,625, first using a Water Quality Index or Trophic State Index to calculate water quality on a broad scale. Next, when available, FDEP's quantitative biological data, exceedances of state criteria for conventional pollutants and toxics, and a calculated fish consumption rating was evaluated. Each water body was assigned a water quality rating for each of the four categories. The final rating for each waterbody as it supported its aquatic life use support was calculated by averaging ratings from the chemistry, biological, and exceedances as well as it supported its use a for the consumption of fish.

Significant Findings

The map on this report's cover graphically displays two important conclusions on Florida's surface water quality: first, most surface water is good quality and, second, most problems are found in highly urbanized Central and South Florida.

Water quality in the sparsely populated Northwest and West-Central sections of the state is better than in other areas. Problems are evident around the densely populated, major urban centers, including Jacksonville, Orlando, Tampa, Pensacola, Cape Kennedy, and the southeastern Florida coast. Poor water quality not associated with a large population is also found in basins with intense agricultural and industrial use.

[1]Note: Because the EPA mandates the content and structure of the 305(b) report, including the tables, to facilitate water quality reporting from all fifty states, many of the tables contain categories that do not apply to Florida or "zero" entries in some columns.

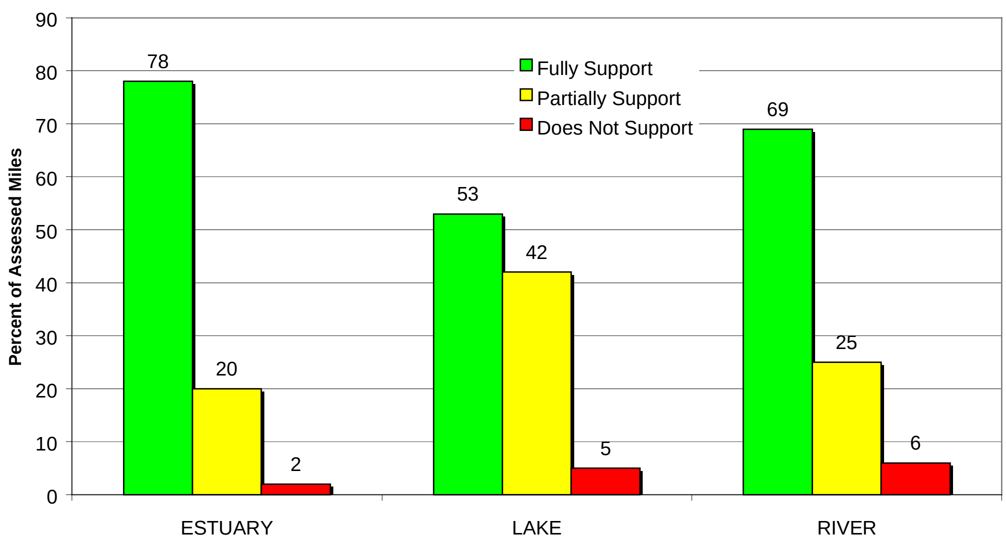
Support for Designated Use

The process of determining support for designated use continually evolves. Designated use is the functional classification given to each Florida water body, as follows:

Class I	*Potable water supplies*
Class II	*Shellfish propagation or harvesting*
Class III	*Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife*
Class IV	*Agricultural water supplies*
Class V	*Navigation, utility, and industrial use*

For this report, water quality was summarized by determining the degree of support for designated use for the state's different waterbody types. FDEP assessed 10,158 miles of rivers and streams, 2,624 square miles of lakes, and 4,037 square miles of estuaries. Of the assessed miles, 69 percent of total river miles, 53 percent of total lake areas, and 78 percent of total estuarine areas fully supported their designated use (Figure 1). Another 25 percent of river miles, 42 percent of lake areas, and 20 percent of estuarine areas only partially supported their designated use.

Figure 1: Percent of Florida Waters which Fully, Partially, Does Not Support their Designated Uses



Pollution Problems

Pollution problems in Florida vary. In the past, most water quality problems came from domestic and industrial point sources. These are specific, identifiable sources of pollution discharged to surface waters. By implementing new technologies, treating wastes better, and putting into place regulatory controls, point source pollution has diminished. While the state does not have extensive industrialization, localized concentrations of heavy industry that contribute point source pollution are centered mostly in urban areas.

Nonpoint sources now account for most water quality problems. Nonpoint pollution is caused when stormwater flows over large areas, collecting many different kinds of contaminants (including nutrients, pesticides, and oil and grease) from multiple sources. Because Florida is so populous and has grown so rapidly — especially over the last two decades — much nonpoint pollution in urban areas is caused by runoff from residential development and suburban sprawl. In addition, silviculture, agriculture, and various kinds of animal farming, all of which are a large part of the state's current and historical economy, also generate significant nonpoint pollution (Figure 2).

Causes

The main causes of water bodies not fully supporting their designated use vary. Nutrients and subsequent eutrophication were major causes of impairment for all waterbody types. For rivers, significant causes include nutrients, organic matter/low dissolved oxygen levels, siltation, and bacterial contamination (Figure 3).

Sources

Florida's major surface water problems fall into five general categories, as follows:

> ***1. Urban stormwater.*** *Stormwater carries many different pollutants, from nutrients to toxic pollutants, and adds biochemical oxygen demand. As a major nutrient source, it accelerates eutrophication. Urban stormwater and siltation and turbidity from construction activities are major sources of impairment for all waterbody types. Problems concentrate around the state's urban centers, mimicking the population map. Although current stormwater rules and growth management laws restrict pollution from new sources, regulations are difficult to monitor and enforce.*
>
> ***2. Agricultural runoff.*** *Major agricultural pollutants include nutrients, sediments (increased turbidity), biochemical oxygen demand, bacteria, and pesticides. These pollutants generally have the greatest impact on lakes, slowly moving rivers and canals, and sometimes receiving estuaries. Agriculture is an important source of impairment for all waterbody types. Problems are concentrated in the central and southern portions of the state and in several rivers entering Florida from Georgia and Alabama. Although agricultural operations have traditionally been largely exempt from regulation, the need has increasingly been recognized for improved treatment of runoff and better implementation of BMPs. Significant restoration projects to treat stormwater by marsh filtration or retention are under way in the Everglades, Upper St. Johns River Basin, and Upper Oklawaha River Basin.*

Figure 2: Miles of River, Lakes and Estuaries within the State Affected by Various forms of Pollution - Sources

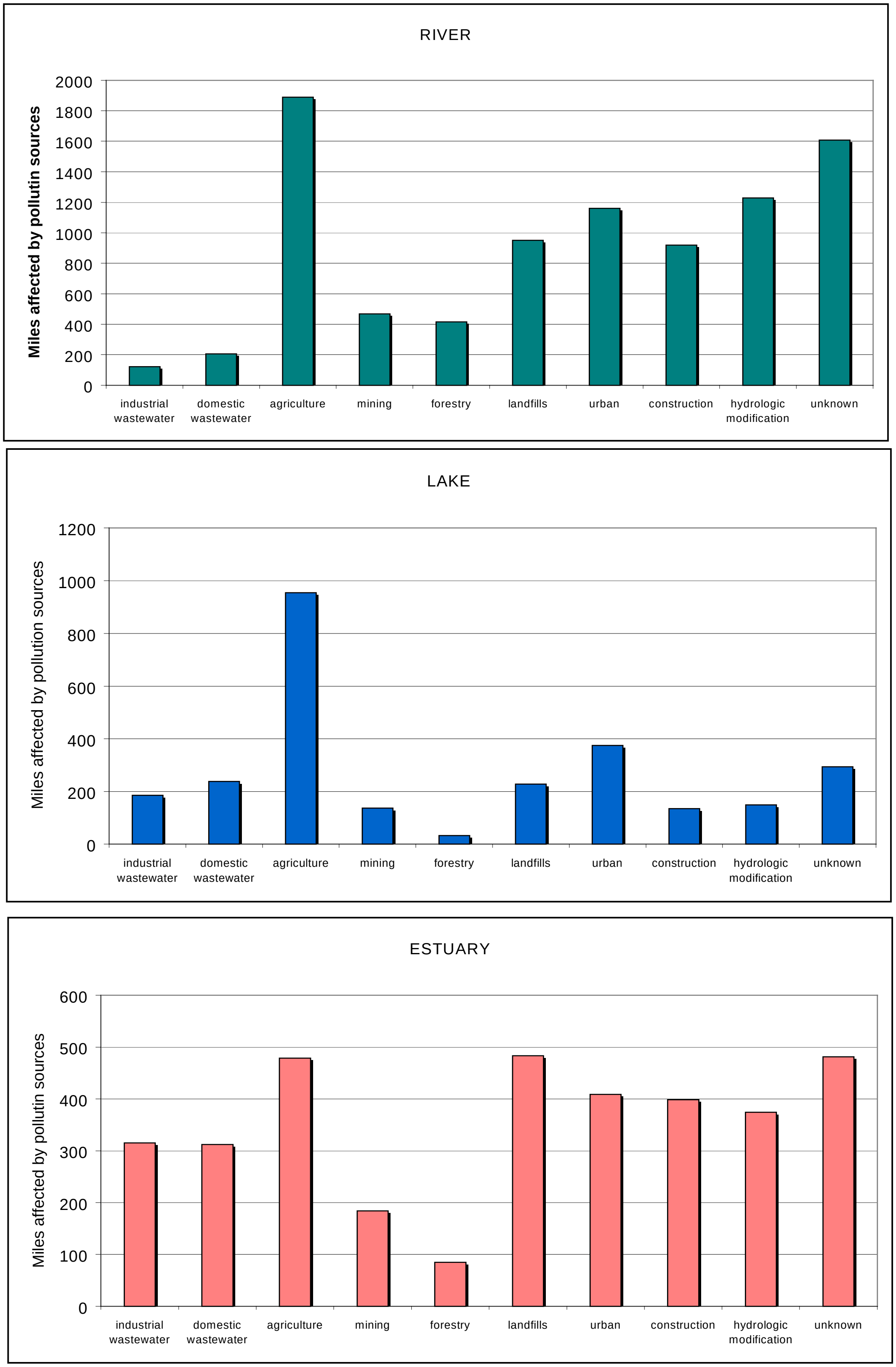
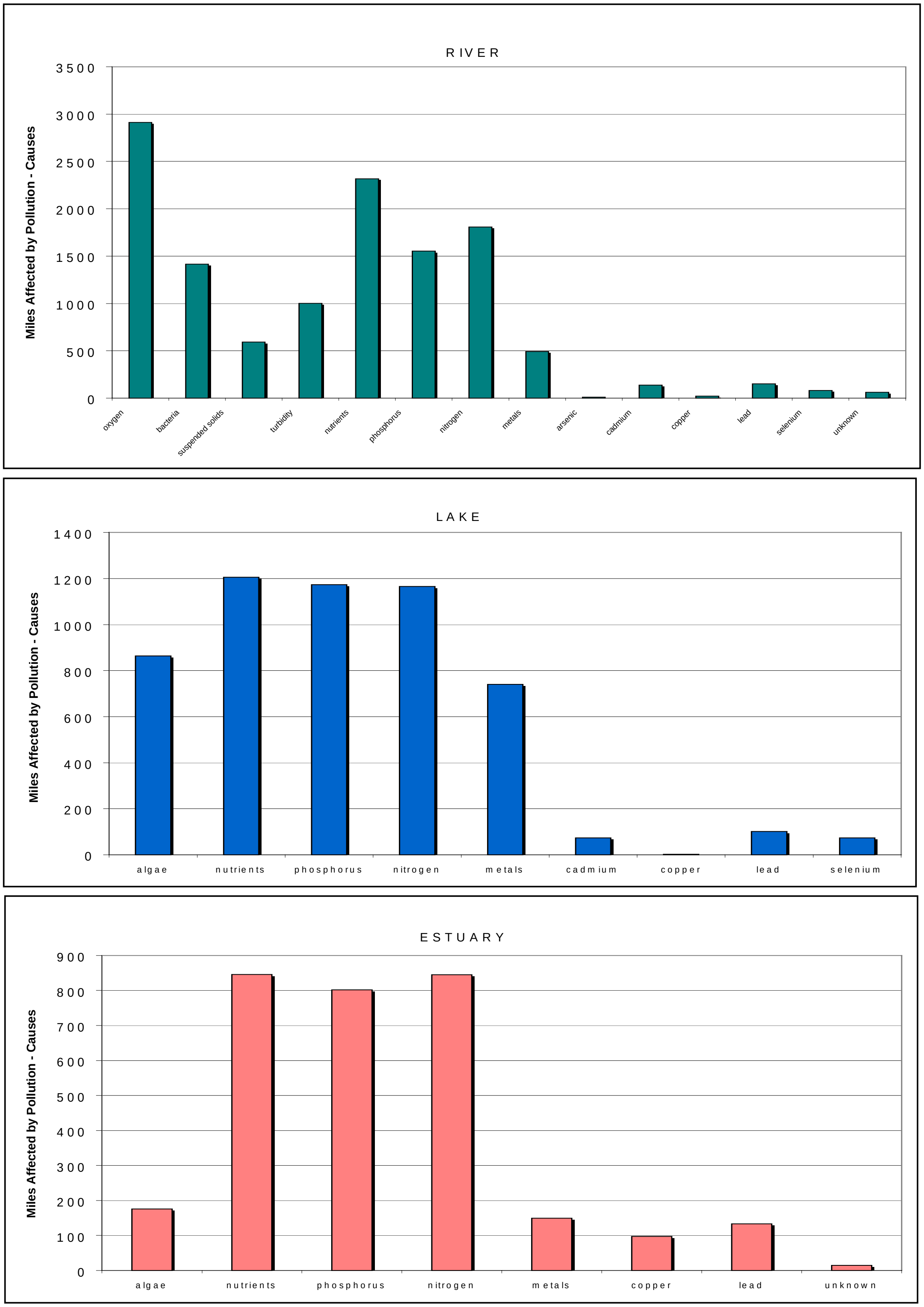


Figure 3: Miles of River, Lakes and Estuaries within the State Affected by Various forms of Pollution - Causes



3. Domestic wastewater. *Domestic wastewater mainly contributes nutrients and pathogens but can also be a source of toxics. Sources include municipal wastewater treatment plants, package plants, septic tanks, and runoff from land application sites. Controls in domestic wastewater plants have improved significantly in the last decade. In fact, most improving water quality trends can be traced to plant upgrades. Further advancements are being encouraged using design innovations such as wastewater discharges to wetlands, water reuse, and advanced treatment. A problem still exists in rural areas, however, where financial and technological resources are limited and where several poorly operating facilities continue to pollute relatively pristine waters.*

4. Industrial wastewater. *Major industrial wastewater sources in Florida include phosphate mines, fertilizer manufactures, pulp and paper mills. Because of the volume and nature of their discharges, pulp and paper mills operating in the state have historically had significant impacts on their receiving waters. Several mills have greatly improved their treatment facilities, and some are exploring the possibility of pipelines to relocate their discharges to areas with greater water flows. The phosphate and fertilizer industries are also major sources of point and nonpoint pollutants (nutrients) in several basins, and phosphate mining also creates hydrologic modifications in surface waters and on land. Industrial discharges contribute about 10 percent to the total miles of impaired waters.*

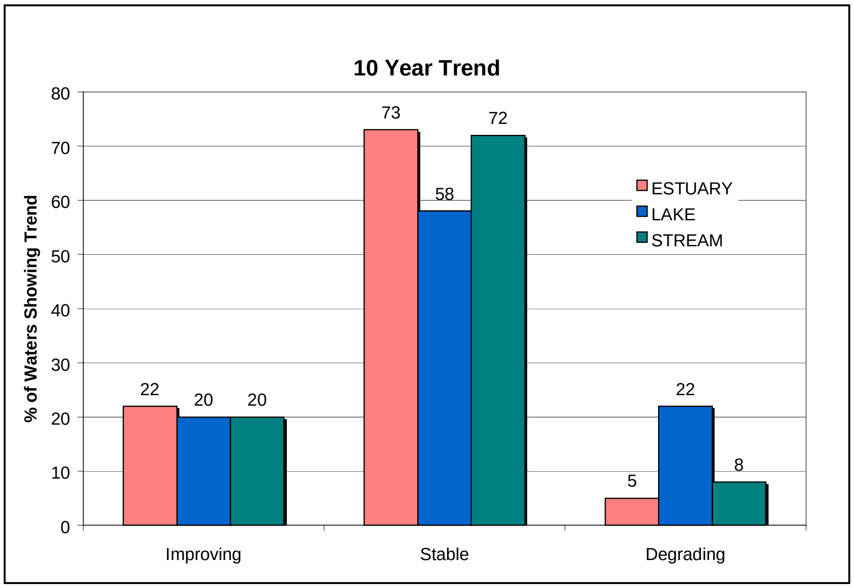
5. Hydrologic modifications. *These include damming running waters; channeling slowly moving waters; or dredging, draining, and filling wetlands for flood control, agriculture, drinking water supplies, and urban development. While such modifications are not strictly pollution sources, in most cases where natural hydrologic regimes are modified, water quality problems ensue. Rating the effects of hydrologic modifications is difficult. Dredging and filling destroy habitats. Disrupting wetlands and causing a net loss in their areas reduces buffering and filtering capacities and biological potential. This is a particularly important problem in estuaries. Losses of seagrasses, which provide crucial juvenile habitat for many commercial and recreational species, and other marine habitat losses can seriously affect the long-term viability of fisheries.*

Water Quality Trends

Changes in water quality are an important indicator of the health of surface waters. Enough data were available to evaluate long-term trends (over ten years) in water quality for 945 water bodies. Most (about 72 percent) showed no significant trends, while 20 percent improved and 8 percent worsened. The improvements generally resulted from wastewater treatment plant upgrades or new regional wastewater plants and nonpoint source controls in Tampa, Orlando, and several other cities. Twenty water bodies showed worsening trends caused by both point and nonpoint sources. Possible causes include silviculture and increased land development.

Of 321 lakes assessed, 20 percent showed an improving trend, 22 percent showed a declining trend, and 58 percent remained the same. Water quality declines were generally attributed to nonpoint source pollution. Water quality improved when wastewater discharges were removed (Figure 4).

Figure 4: Assessment of Long-term Trends (10 years)



Monitoring

FDEP has been working to revise and expand its Ambient Monitoring Program, including the development of its bioassessment program and the integration of its surface and ground water monitoring activities (referred to as Integrated Water Resources Monitoring, or IWRM). This probability-based approach will allow FDEP to statistically assess 100 percent of the waters of the state.

Six years of work have culminated in the development of final protocols (procedures) for biological assessments of streams and the implementation of a new biological-monitoring program. Bioassessment focuses on assessing the impacts of nonpoint sources. This type of monitoring should not only increase Florida's ability to monitor more water bodies but will also allow more comprehensive assessments.

A revitalized water quality trend-monitoring program will allow water quality changes over a five-year period to be detected with an 80 percent statistical confidence level. The five-year cycle will allow the results to be incorporated into future 305(b) reports. The network, which to date includes eighty stations, is a collaborative effort with the Water Management Districts (WMDs) and local programs.

Public Health/Aquatic Life Concerns

An assessment of public health and aquatic life impacts found several concerns, many of which are persistent in nature.

- *The Gulf marine fishery has been hurt by extended red tide blooms and an outbreak of disease in hardhead catfish.*

- *During 1994 and 1995, statewide, shellfish beds were closed for 2,111 days because of red tide.*

- *Fish with ulcerative disease syndrome are still seen in the Lower St. Johns River, a problem first identified in the early to mid-1980s.*

- *In the Miami River, chronic and acute bacterial contamination in the water and toxins in sediments threaten Biscayne Bay. The bacteria come from illegal sewer connections to the stormwater system, leaking or broken sewer lines, and direct discharges of raw sewage when pumping stations exceed capacity. When sewage is directly discharged, coliform bacteria counts in the Miami River and the adjoining waters of Biscayne Bay are hundreds of times higher than state criteria, periodically closing bathing beaches along the bay and Atlantic Ocean.*

- *Sediments in many urban estuaries such as Tampa Bay, the St. Johns River Estuary, and Pensacola Bay contain heavy metals and organic contaminants. Continued habitat losses from dredging and filling and construction also threaten the viability of the fisheries in these areas.*

- *In Florida Bay, algal blooms and extensive mangrove and seagrass dieoffs are important concerns. They likely stem from extensive channeling and hydrologic modifications in the watershed that have reduced freshwater flows to the bay. The problems have been exacerbated in recent years by a lack of flushing from hurricanes, high water temperatures, and high salinity.*

- *High concentrations of mercury in largemouth bass were first discovered in the 1980s, and advisories recommending limited consumption of largemouth bass have now been issued for two million acres of fresh waters. Advisories have also been issued for several marine species in estuaries and for shark and king mackerel statewide. A no-consumption advisory has been issued for the Fenholloway River, where elevated dioxin levels have been found in fish. A disturbing event is the decline of juvenile alligator populations in Lake Apopka. Egg viability has diminished and the numbers of deformed embryos have risen. The problem may stem from a 1980 spill of kelthane, a pesticide that contains DDT, but the evidence is not conclusive. It is not known whether Lake Apopka is an isolated occurrence or an indicator of problems in other surface waters.*

Wetlands Protection

Urban and agricultural growth threatens Florida's eleven million acres of wetlands. To address the problem, surface water and wetlands permitting have undergone major revisions. A new Environmental Resource Permit implemented in October 1995 merges with and replaces FDEP's dredge-and-fill Wetland Resource Permits and the WMDs' Management and Storage of Surface Water (MSSW) permits. FDEP shares responsibility for the program with four of the state's five WMDs. In Northwest Florida, the district continues to operate a limited MSSW permitting process for agriculture and silviculture, and FDEP administers a Wetland Resource Permit program.

Florida does not use the federal methodology to define or delineate wetlands, but has adopted rules for determining wetlands jurisdiction. The landward extent of a wetland is defined by the dominance of plant species, soils, and hydrologic evidence of regular or periodic inundation with water. This approach is required by all local, state, and regional agencies.

Regulating Pollution

All facilities that discharge wastes into waters of the state or are reasonably expected to be a source of water pollution are regulated under FDEP's Wastewater Permitting Program. Permits issued under this program for discharges to surface waters also serve as the National Pollutant Discharge Elimination System (NPDES) permit for the facility. Permits containing effluent limitations must be obtained to build, operate, and modify domestic and industrial wastewater facilities.

Florida contains 5,111 permitted facilities. Of these, 641 are permitted to discharge to surface waters, and an additional 255 discharge to surface waters under general permits. To improve water quality further, FDEP is encouraging the reuse of treated wastewater (primarily for irrigation) and wetlands discharge. Currently, eighteen wetlands treatment systems are operating in the state.

The state also has an active Nonpoint Source Program. At the core of this program is FDEP's Stormwater Rule and supporting stormwater legislation enacted in 1989. The regulations require all new developments to retain the first inch of runoff in ponds that are designed to remove 80 to 90 percent of pollutants before they enter surface waters. The program is also integrated with the state's SWIM Act as well as the Comprehensive Planning Act. The program actively supports, via 319 Program grants, the development of BMPs to control nonpoint source pollution. Current contracts focus on the development of BMPs for other nonpoint sources such as agriculture, septic tanks, landfills, mining, and hydrologic modifications.

- *Regulatory actions in the 1980s and recent efforts through the National Estuary Program and Florida's SWIM Act have improved water quality in Tampa Bay. The Grizzle-Figg legislation of the mid-1980s required that all discharges of domestic wastewater to an estuary be given advanced treatment. With improved water quality, seagrass acreages have increased. Nitrogen contributions to the bay are about half what they were in the 1970s. Nitrogen is the critical nutrient fueling algal blooms in the estuary.*

- *Similar regulatory actions have also helped to improve water quality in northern and central Sarasota Bay. The city of Sarasota has reduced its nitrogen contribution to the bay by 80 to 90 percent with advanced wastewater treatment, amounting to a 14 percent baywide reduction. Manatee County has removed wastewater discharges by switching to deep well injection. The county also reduced stormwater runoff into the bay by diverting reclaimed water to a gladiolus farm.*

Restoration and Protection Programs

Florida has very active programs to restore and protect surface waters. The state has been buying environmentally sensitive lands since 1963, and at least eleven different programs actively purchase land. The two primary programs are the Conservation and Recreation Lands Program, administered by FDEP, and the Save Our Rivers Program, administered by the WMDs.

Most current restoration work is aimed at correcting problems caused by excess nutrients. Restoration projects under way in the Everglades, Upper St. Johns River, Lake Griffin, and Lake Apopka includes the construction of large marsh flow-ways to filter nutrients and other pollutants. Early results from Lake Apopka indicate that the marshes improve water clarity by removing suspended particles, and they may remove as much as thirty-three tons of phosphorus a year.

Programs to Restore Water Quality

Florida's well-established point source permitting process was modified in 1995 with the delegation of the NPDES Program to Florida, but does not include stormwater permitting. While NPDES only regulates discharges to surface waters, the state wastewater program issues permits for facilities that discharge to either surface or ground water. The state permit for surface water dischargers now serves as the NPDES permit. Florida permits about 4,794 ground water and surface water discharge facilities. The state also encourages the reuse of treated wastewater (primarily for irrigation) and the use of constructed and natural wetlands for wastewater treatment as alternatives to direct discharge.

Florida has established several programs focused on the restoration or preservation of state waters. The 1987 SWIM requires management and restoration plans for preserving or restoring priority water bodies and setting Pollutant Load Reduction Goals (PLRGs) for those water bodies. PLRGs are estimated reductions in pollutant loading needed to preserve or restore beneficial use to a water body. The 1999 Florida legislature enacted the Florida Watershed Restoration Act, which provides a process for restoring waters through the establishment and implementation of Total Management of Daily Loads (TMDLs) for pollutants of impaired waters. TMDLs establish the maximum amount of a given pollutant that a particular basin can assimilate without exceeding surface water standards that protect natural system function and human health.

The state has also purchased environmentally sensitive lands for protection since 1963. The most notable program was Preservation 2000, a ten-year land acquisition program that the legislature extended in 1999 as the Florida Forever Act.

Programs to Assess Water Quality

Florida's tiered Integrated Water Resources Monitoring (IWRM) Network, which includes sampling of both surface and ground waters, will be used to assess state waters. Tier 1 answers questions on a statewide or regional scale. Tier II addresses basin specific or waterbody-specific questions. Tier III includes monitoring associated with regulatory permits and evaluations of TMDLs and Best Management Practices (BMPs).

Ground Water Quality

Because ground water supplies about 87 percent of Florida's drinking water, ground water protection programs traditionally focused on monitoring wells for contamination. Under the 1983 Water Quality Assurance Act, the state began monitoring existing ground water quality. Data from over 2,900 monitoring wells and 1,300 private water supply wells that monitor all the state' aquifer systems are collected and stored in a database. Although a preliminary analysis indicates generally good ground water quality, particularly in the Floridan Aquifer underlying all but the westernmost and southernmost parts of the state, threats and sources of contaminants do exist.

The major sources of contamination include underground petroleum storage tanks, agriculture, landfills, urban stormwater runoff, and septic tanks. Several hundred leaking tanks are being investigated. Agriculture uses large quantities of pesticides and fertilizers that can contaminate ground water supplies. Several chemicals — including aldicarb, alachlor, bromacil, simazine, and ethylene dibromide (EDB) — have caused local problems. With EDB, the contamination is regional. Other sources that create threats to stormwater include runoff laden with pesticides and fertilizers, leachate from hazardous waste sites and landfills, nitrates from dairies and other animal farms, and chemicals from drycleaning operations. Ground water contamination in highly permeable sandy soils in aquifer recharge areas is a particular concern.

Florida has many programs, either established or being developed, to protect ground water quality. These range from discharge permitting programs, to the development of standards and criteria, to aquifer mapping and characterization.

As part of the Watershed Approach, Florida will assess regional ground water quality, and future 305(b) reports will provide additional information as the assessment process expands.

Background[2]

Florida's 58,560 square miles support abundant, diverse natural resources. Some of these — for example, the Everglades — is found nowhere else. Florida also contains the only emergent coral reef in the continental United States.

Ranking twenty-second in the country in total land area, Florida is rapidly growing and developing. Water is the state's most critical resource. Florida depends on water resources in many ways — for example, for its $7 billion fishing and $32 billion tourism industries. The pressures of population growth and its accompanying development present serious problems. Maintaining overall good water quality and an adequate, reliable water supply; protecting public health; and ensuring healthy populations of fish and wildlife are important challenges for the state and FDEP.

Of these challenges, water quality and quantity have emerged as the most critical issues for the next century. In 1950, the state's population of 2.8 million used about 2.9 billion gallons per day. By contrast, in 1990, its 13 million people used 7.5 billion gallons of fresh water daily, of which ground water provided about two-thirds. Although the state has extensive water resources, most Floridians live in coastal areas where less fresh water is available. As population grows along with development, different users vie for water resources. The challenge is to satisfy competing and rapidly increasing demands for finite quantities of water and minimize damage to future reserves.

This chapter provides background information about Florida's population, climate, and physical features. The state's total waters are summarized in terms of river and stream miles and lake and estuary areas. Florida's comprehensive Water Pollution Control Program is described, along with the costs and benefits of attaining the objectives of the 1972 federal Clean Water Act. Finally, special state concerns and recommendations are listed.

Atlas

This section provides an overview of the state's population, water resources, climate, and hydrogeology *(see Table 1 for a summary of basic information on the state and its surface waters).*

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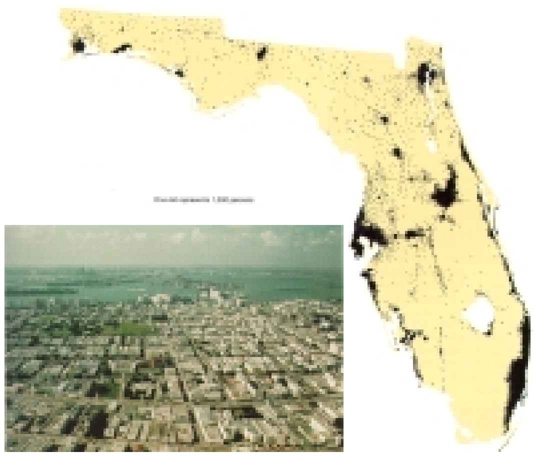
[2] This section is based on the information in the following publications:

Atlas of Florida, Edward A. Fernald, ed., 1981, Florida State University, Institute of Science and Public Affairs.
Hydrologic Almanac of Florida, R.O. Heath and C.S. Conniver, 1981, U.S. Geological Survey Open File Report B1-1107.
Water Resources Atlas of Florida, Edward A. Fernald and Elizabeth D. Purdom, eds., 1998, Florida State University, Institute of Science and Public Affairs.
U.S. Census Bureau Web site: http://www.census.gov/

Population

In 1999, Florida had an estimated population of over 19.1 million, growing at a rate of 1.4 percent from 1998. Currently the fourth most populous state in the country, by 2025 it is projected to be the third most populated in the nation. Within the next three decades, the state's total population is expected to increase by 6.5 million people — the third largest net gain in the United States. This rate of population change, at 46.2 percent, ranks as the ninth largest in the country. Florida is also expected to gain 1.9 million people through international migration between 1995 and 2025, the third largest net gain in the country.



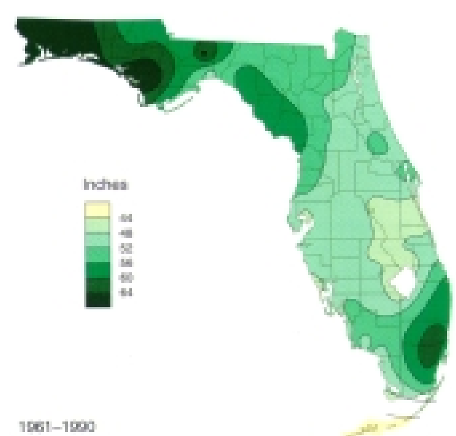
Florida Population, 1990
Source: *Water Resources Atlas of Florida,* 1998
Photo: Florida Department of Commerce

As the baby-boom generation (those born between 1946 and 1964) reaches retirement age, the numbers of elderly residents (65 and over) are expected to accelerate rapidly in all states. In Florida the proportion of elderly is projected to expand from 18.6 percent of the population in 1995 to 26.3 percent in 2025. Florida had the country's highest proportion of elderly in 1995 and is also projected to have the highest proportion in 2025.

The state has several large, expanding population centers, including southeastern Florida (Dade, Broward, and Palm Beach counties), Jacksonville, Tampa–St. Petersburg, and Orlando. In contrast, other relatively large areas of Florida are sparsely populated.

Water Resources

Florida has 51,858 miles of streams and rivers (about half of which are ditches and canals). It contains more than 7,700 lakes (greater than ten acres in area) with a total surface area of 2,799 square miles and 4,437 square miles of estuaries. The state also has an extensive coastline. A line running from the northeast corner of the state to Key West and back up to the northwest corner along the Gulf Coast would extend 1,300 miles. If the distance around barrier islands and estuaries were included, the line would stretch 8,460 miles.



Average Annual Rainfall, 1961-1990
Source: *Water Resources Atlas of Florida,* 1998

The state has more than 1,700 streams and rivers. Differences in climate, hydrogeology, and location all affect their water quality. The longest river entirely in the state is the St. Johns, which flows north as a recognizable stream about 273 miles from the St. Johns Marsh in North St. Lucie County to its mouth at Jacksonville. The river drains a land area equal to about one-sixth of Florida's surface. The Apalachicola River, in the Florida Panhandle, has the greatest discharge. Its basin, draining over 19,000 square miles, extends to North Georgia's southern Appalachian Mountains.

Lakes occupy close to 6 percent of Florida's surface. The largest, Lake Okeechobee, is the ninth largest lake in surface area in the United States. Most of the state's lakes are shallow, averaging seven to twenty feet deep, although many sinkhole lakes and parts of other lakes can be much deeper.

Table 1: 2000 Atlas of Florida

2000 estimated population	15,233,000
Ranking by population among 50 states	4th largest
Ranking by land area among 50 states	22nd in size
Surface area	58,560 square miles
Number of U.S. Geological Survey (USGS) hydrologic units	51
Total number of river/stream miles	51,858 miles
*Border river miles – total	191 miles
Chattahoochee River	26 miles
Perdido River	65 miles
St. Marys River	100 miles
Total density of rivers/streams	0.89 miles/square mile
Perennial streams	19,620 miles
Density of perennial streams	0.39 miles/square mile
Intermittent streams	2,956 miles
Density of intermittent streams	0.05 miles/square mile
Ditches and canals	25,909 miles
Density of ditches and canals	0.44 miles/square mile
Number of lakes/reservoirs/ponds	7,712 (area > than or equal to ten acres)
Area of lakes/reservoirs/ponds	2,799 square miles
Area of estuaries/bays	4,437 square miles
Coastal miles	8,460 miles
Freshwater and tidal wetlands	17,830 square miles
Area of islands greater than ten acres	1,314 square miles
Number of first-order magnitude springs	27
Largest lake	Lake Okeechobee
Longest river (entirely in Florida)	St. Johns River
Prominent wetlands systems	Everglades and Big Cypress Swamp, Green Swamp, Okefenokee Swamp, Big Bend coastal marshes

Climate

The state's climate ranges from a transitional zone between temperate and subtropical in the north and northwest to tropical in the Keys. As a result, Florida's plants and animals are a mix of those from more temperate northern climates and those from the tropical Caribbean. Three hundred native trees and 3,500 vascular plants have been recorded. More than 425 bird species, about half the known species in the United States, can be seen in Florida.

Summers are long, with periods of very warm, humid air. Maximum temperatures average about 90° F., although temperatures of 100° F. or greater can occur in some areas. Winters are generally mild, except when cold fronts move across the state. Frosts and freezes are possible, but typically temperatures do not remain low during the day, and cold weather usually lasts no more than two or three days at a time.

Rainfall across the state varies with location and season. On average more than sixty inches per year can fall in the far northwest and southeast, while the Keys receive about forty inches annually. This variability because of location can create local water shortages. The heaviest rainfall occurs in Northwest Florida and in a strip ten to fifteen miles inland along the southeast coast.

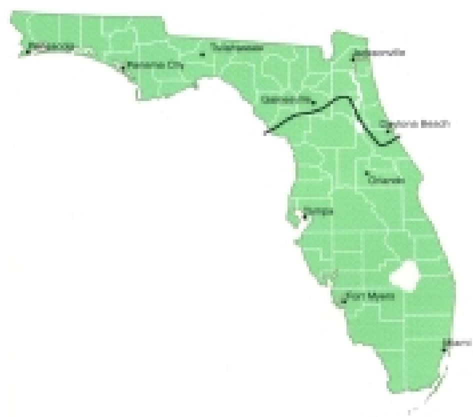
Except for the northwestern part of the state, the year contains a rainy season and a relatively long dry season. In the peninsula, half the average annual rainfall usually falls between June and September. In northwestern Florida, a secondary rainy season occurs in late winter to early spring. The lowest rainfall for most of the state occurs in fall (October and November) and spring (April and May). The varying patterns of rainfall create differences in the timing of high and low discharges from surface waters.

An approximate diagonal line drawn from the mouth of the St. Johns River at the Atlantic Ocean to the boundary of Levy and Dixie counties on the Gulf of Mexico depicts a climatic river basin divide. North and northwest of the divide, streams have high discharges in spring and late winter (March and April) and low discharges in the fall and early winter (October and November). A second low-water period occurs from May to June. South of the climatic divide, high stream discharges occur in September and October and low discharges occur from May to June.

Hydrogeology

A hydrologic divide interrupts the movement of Florida's ground water and surface water. The divide is represented by an approximate line extending from near Cedar Key on the Gulf Coast to New Smyrna Beach on the Atlantic Coast. Little, if any, surface water or ground water moves across this barrier. Most major rivers north of the line receive part of their discharges from outside Florida, in addition to rain. South of the divide, rain is the sole water source. Hydrologically, the half of Florida south of the divide is an island. About 75 percent of the state's population live in this area in peninsular Florida.

Most of Florida is relatively flat. The highest elevation, 345 feet, is near Lakewood, in Walton County in the Panhandle. The longest river, the St. Johns on Florida's east-coast, only falls about a tenth of a foot per mile from the headwaters to the mouth. Farther south, below Lake Okeechobee, land relief is less than six feet. Surface drainage and topographic relief are greatest in the streams and rivers entering North and Northwest Florida from Alabama and Georgia. Most of these streams are classified as alluvial, or sediment carrying. As the land flattens farther south, surface drainage becomes less distinct. Rivers and streams are typically slower moving, noneroding, and nonalluvial.



Hydrologic Divide
Source: *Water Resources Atlas of Florida,* 1998

Many rivers have their headwaters in wetlands. The Green Swamp in Central Florida is the headwater for three major river systems: the Withlacoochee, Ocklawaha, and Hillsborough. In North Florida, the Suwannee and St. Marys rivers originate in the Okefenokee Swamp. Throughout the state, smaller streams often disappear into wetlands and later re-emerge as channeled flows.

Many wetlands were drained for agriculture and urban development, and numerous rivers were channeled for navigation. The modifications were most intense in South Florida where, beginning in the 1920s, canals and levees were built to control flooding and drain wetlands. These modifications resulted in the loss of much of the original Everglades wetlands from Lake Okeechobee south and the channeling of the Kissimmee River.

Low relief coupled with Florida's geological history have created unique hydrogeological features. Large areas are characterized by karst topography, which forms when ground water dissolves limestone. Landforms in these areas include streams that disappear underground, springs, sinkholes, and caves.

The state has about 320 springs, whose combined discharges are estimated at over eight billion gallons a day. The largest springs by discharge are the Spring Creek Springs in Wakulla County and the Crystal River Springs group in Citrus County. The United States has only seventy-eight first-order magnitude springs, which discharge on average at least 64.6 million gallons per day. Florida has thrity-six such springs.

Because of Florida's porous karst terrain, ground water and surface water often interact closely. Most lakes and streams receive at least some water from base flows, springs, or seeps. By the same mechanisms, surface waters can recharge underground aquifers.

Surface water commonly drains through sinks and caverns into ground water and can later reappear as springs and seeps, sometimes in a completely different basin from where it entered the ground. For example, drainage from a large karst area in Marion County provides water for Silver Springs, which discharges to the Ocklawaha River and then to the St. Johns River and the Atlantic Ocean.

The same area also provides water for Rainbow Springs, which discharges to the Withlacoochee River and then the Gulf of Mexico.

Total Waters

For the purposes of this assessment, there are two different types of total waters: total waters in the state and total waters monitored. The estimates of Florida's total river and stream miles in the Florida atlas (*Table 1)* are based on the U.S. Environmental Protection Agency's (EPA's) River REACH File 3 (RF3) maps. These are derived from U.S. Geological Survey (USGS) hydrologic maps on a 1:100,000 scale. However, RF3 maps of lake and estuary areas were not available from the EPA. Areas of lakes and estuaries in the table are based on REACH File 2 (RF2) estimates. Florida has also estimated lake and estuarine areas with a new waterbody delineation approach that uses the EPA's RF3 files and geographic information system (GIS) techniques.

Table 2 identifies the number of Florida waters assessed, including monitored miles (using recent STORET data (1994 to 1998)), evaluated miles (based on older data, professional judgment, or other qualitative information), and unknown miles. The total assessed areas for lakes and estuaries represent state rather than EPA estimates. As stated above, Florida and the EPA estimate the total areas of Florida lakes and estuaries using different approaches, with Florida using the higher resolution RF3 files. All estimates of lake and estuary areas that support or do not support designated use are based on Florida's calculations.

Table 2: Miles of waters assessed

Waterbody type	*Monitored (based on 1994 - 1998 STORET data)*	*Evaluated (based on older data, professional judgment, other information)*	*Total**
River (miles)	4,704	5,453	51,858
Lake (square miles)	1,698	926	3,258
Estuary (square miles)	1,336	2,702	4,298

* From Table 1

Florida's Water Pollution Control Program

Florida's comprehensive Water Pollution Control Program, discussed in this section, is a multi-pronged effort that comprises a number of activities and tools. These include the Florida Water Plan as well as FDEP's Watershed Approach, and Water Quality Standards Program for point source permitting and nonpoint source pollution.

The monitoring of ground water and surface water, an important FDEP tool for controlling water pollution, was integrated in 1996 under the Ambient Monitoring Program. The Water Pollution Control Program also includes extensive FDEP coordination with other agencies, the WMDs' SWIM Program, and Pollutant Load Reduction Goals (PLRGs) developed for SWIM water bodies.

Florida Water Plan

In 1972, the Florida legislature, recognizing the importance of the state's water resources, passed the Water Resources Act, Chapter 373, F.S., and the Florida Air and Water Pollution Control Act, Chapter 403, F.S. Many goals and policies in the State Comprehensive Plan, Chapter 187, F.S., also address water resources and natural systems protection. Section 373.036 outlines the requirements for developing a Comprehensive State Water Use Plan. Section 373.039 stipulates that the water use plan, together with state water quality standards, constitutes the Florida Water Plan.

Under Florida's water management system, FDEP oversees five regional WMDs, an approach that balances the need for consistent statewide regulations with regional flexibility. As the primary stewards of the state's water resources, FDEP and the districts often must address competing public demands for water supplies, flood protection, water quality, and the protection of natural systems. To accomplish this, they have developed comprehensive water management plans for each region.

The Florida Water Plan builds on these regional plans to manage water resources. Its overall goal is to assure the long-term sustainability of Florida's water resources to benefit the state's economy, natural systems, and quality of life. The most recent version of the plan identifies sixteen issues as priorities, discusses strategies to address those issues, and sets specific goals. The issues are categorized into general issues, water supply, flood protection, water quality, natural systems protection, and intergovernmental coordination.

Two fundamental principles guide the plan. First, water resources must be managed to meet people's water needs while maintaining, protecting, and improving natural systems. Second, these resources can be effectively managed only if all those affected collaborate and cooperate.

The plan emphasizes the need for interagency coordination in achieving statewide water management goals. The Florida Water Plan supports the State Comprehensive Plan and is intended to coordinate and be mutually compatible with the Florida Transportation Plan and the Florida Land Development Plan. *Table 3a* lists the primary state local, and regional coordination mechanisms for managing water resources, *Table 3b* shows the federal and interstate coordination mechanisms, while *Figure 5* shows the agencies responsible for water resources coordination and management.

The Florida Water Plan is not self-executing. Its provisions guide FDEP and the WMDs' future actions but are not binding unless adopted by rule.

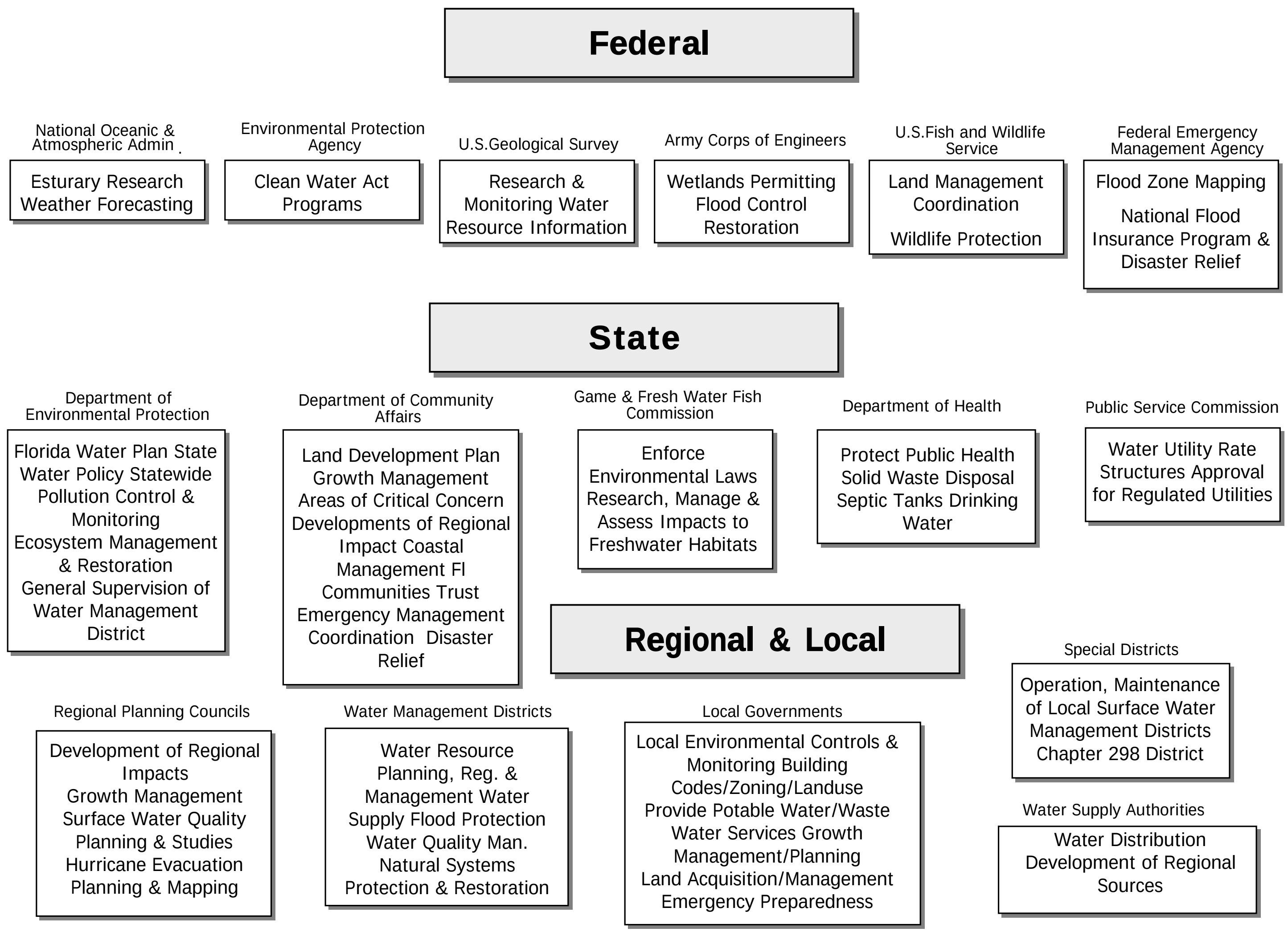
Table 3a: Primary Coordination Mechanisms For Managing Water Resources: State, Regional, And Local

Function/entity	Primary mechanisms
FDEP's general supervision over WMDs (policies, plans, and programs)	a. Water Resources Coordinating Commission b. Meetings of the WMDs' executive directors c. State Water Policy (Chapter 62-40, Florida Administrative Code [F.A.C.]) d. FDEP liaisons to the WMDs e. Florida Water Plan/District Water Management Plan (DWMP) work group f. Issue-specific work groups (policy and rule development) g. Reuse Coordinating Committee h. Memoranda of understanding (delegation of programs and authorities) i. Permit streamlining, mitigation banking j. FDEP review of WMD rules and budgets, auditing
Statewide Watershed Management initiative (FDEP)	a. Watershed Management Areas b. Adaptive management
State Comprehensive Plan (Governor's Office)	Overall coordination by Governor's Office
State Land Development Plan (Florida Department of Consumer Affairs)	Interagency Planning Committees
Florida Transportation Plan (Florida Department of Transportation)	Interagency plan review process
Strategic regional policy plans (Regional Planning Councils)	a. Florida Water Plan/DWMP work group b. Plan review process (Chapter 186.507[2], F.S., and Chapter 27E-5, F.A.C.)
Agricultural interests (Florida Department of Agriculture and Consumer Services)	Agricultural Water Policy Committee
Local comprehensive plans	Plan review process (Chapter 9J-5, F.A.C)
Local government water supply planning, wastewater management, stormwater management, solid waste management	FDEP and WMD programs for technical and financial assistance
Reuse of reclaimed water	Reuse Coordinating Committee

Table3b: Primary Coordination Mechanisms For Managing Water Resources: Federal And Interstate

Function/entity	Primary mechanisms
U.S. Army Corps of Engineers	a. Public works program b. State clearinghouse review process c. Quarterly meetings between FDEP and the Corps d. Joint FDEP/Corps permit application process (Clean Water Act, Section 404) e. Memoranda of understanding f. Potential delegation of Section 404 permitting to FDEP
U.S. Environmental Protection Agency	a. EPA/FDEP yearly work plans and grants b. EPA technical assistance and special projects c. Delegation of EPA/Clean Water Act programs to FDEP
National Oceanic and Atmospheric Administration	a. Grants b. Cooperative agreements and special projects
U.S. Geological Survey	a. Contracts for technical services and data b. Cooperative agreements
U.S. Natural Resource Conservation Service (formerly Soil Conservation Service)	Contracts for technical services and data
U.S. Forest Service	Ecosystem Management teams
U.S. Fish and Wildlife Service	a. Acquisition programs b. Ecosystem Management teams c. Special projects
National Park Service	a. Acquisition programs b. Ecosystem Management teams
Alabama and Georgia	a. Memorandum of Agreement for Apalachicola–Chattahoochee–Flint/Alabama–Coosa–Tallapoosa Rivers Comprehensive Study b. Suwannee River Coordinating Committee c. St. Marys River Management Committee d. Florida–Alabama Water Resources Coordinating Council

Figure 5: Agencies responsible for water resource coordination and management



Watershed Approach

The Watershed Approach is a comprehensive approach to managing water resources on the basis of hydrologic units — which are natural boundaries such as river basins — rather than arbitrary political or regulatory boundaries. On a simple level, the Watershed Approach provides a mechanism to focus resources on specific units (river or estuary basins) rather than trying to work on all state waters at one time. An important feature is the involvement of all the stakeholders who have an interest in the basin in a cooperative effort to define, prioritize, and resolve the basin's problems. Existing programs are coordinated to manage basin resources without duplicated effort.

Currently, FDEP's Division of Water Resource Management is developing a Watershed Management Program to apply the Watershed Approach to its division's responsibilities. A Framework Document for implementing this approach has been developed and is under review. Key components include the following:

- *The **basin management unit,** or geographic or spatial unit used to divide the state into smaller areas for assessment — generally groups of Hydrologic Unit Codes (HUCs). HUCs are a nationwide cataloging system commonly used for watershed assessment and management. They provide a common framework for delineating watersheds and their boundaries at different geographic scales.*

- *A five-year **basin management cycle** began on July 1, 2000. The cycle provides a set schedule that both organizes work activities and helps to ensure that all waters are addressed in a timely manner. At the conclusion of the cycle, the process begins anew, allowing the basin managers and stakeholders to respond to changing conditions or adjust strategies that have not performed as anticipated.*

- *A **Management Action Plan (MAP),** developed for each basin in cooperation with stakeholders and local communities, to coordinate and guide management actions. These MAPs may include the development of Total Maximum Daily Loads (TMDLs) for impaired waters and watershed restoration, where needed. TMDLs establish the maximum amount of a given pollutant that a particular basin can assimilate without exceeding surface water standards that protect natural system function and human health.*

- ***Forums and communication networks** that help participants collect information, fill data gaps, and reach a consensus on solutions to the basin's problems.*

- *A statewide **basin management schedule** to ensure that each of the state's fifty-one basins will be assessed every five years.*

To implement the Watershed Approach, each FDEP district has been divided into five parts with roughly equivalent workloads. These parts, or assessment groups, are made up of one or more EMAs. The order and specific time frame for evaluating each part within each district is based on a number of priority factors, including watersheds that contain surface water sources of drinking water, watersheds requiring TMDL development, and watersheds where SWIM plans are proposed or under way.

Water Quality Standards Program

Florida's water quality standards and criteria are intended to maintain the designated beneficial uses of waters of the state. All surface waters of the state have been classified according to their designated use, as follows:

Class I: ***Potable water supplies***
Class II: ***Shellfish propagation or harvesting***
Class III: ***Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife***
Class IV: ***Agricultural water supplies***
Class V: ***Navigation, utility, and industrial use***

Table 4 lists the extent of Florida waters that must meet federal Clean Water Act goals for fishable and swimmable waters. These numbers should not be interpreted, however, as miles or areas of water bodies that actually support designated use.

Table 4: Waters Classified For Uses Consistent With Clean Water Act Goals

Type of water	*Fishable*	*Swimmable*
Estuaries (square miles)	4,437	4,437
Lakes (square miles)	2,799	2,799
Rivers (miles)	19,620	19,620

Note: The table includes only waters assigned a Florida waterbody number. They do not include about 25,909 miles of ditches and canals to which numbers could not be assigned.

A water body with exceptional recreational or ecological significance may also be designated an Outstanding Florida Water (OFW). OFWs include waters in state and national parks, preserves, and sanctuaries, rivers designated as wild and scenic at federal or state levels, and "special" waters that have been designated OFW based on their exceptional environmental or recreational significance. OFWs are listed in Section 62-302.700, F.A.C. *Table 5* lists the water bodies designated since January 1, 1996.

Table 5: Ofws Designated from 1996 - 2000

Hillsborough River
Wiggins Pass and Cocohatchee River

Point Source Permitting

***Facility permitting*.** Florida's well-established permitting process for point source pollution was recently revised when the EPA authorized FDEP to administer a partial National Pollutant Discharge Elimination System (NPDES) Program, beginning in May 1995. While the federal program only regulates discharges to surface waters, the state wastewater program issues permits for facilities that discharge to either surface water or ground water. Of 5,111 facilities in Florida, 641 are permitted to discharge to surface water. An additional 255 discharge to surface water under a general permit.

FDEP's district offices handle most of the permitting process, with the Tallahassee office overseeing the program, providing technical assistance, and coordinating with the EPA. The Tallahassee office also oversees the relief mechanisms for applicants allowed under Florida law, as well as permits for steam electric–generating power plants that discharge to waters of the state. Wastewater permits, issued for up to five years, set effluent limits and monitoring requirements to provide reasonable assurance that water quality criteria will be met. A permit may allow a mixing zone when there is enough dilution to ensure that a water body's designated use will not be affected. In other special cases, a variance or exemption allows certain water quality standards to be exceeded. Facilities that cannot comply with new requirements may be issued or reissued a permit containing the effluent limitations to be met and an administrative order setting out the steps required. This procedure applies only to facilities complying with an existing permit, though, and is not used in lieu of enforcement when a permittee is out of compliance with an existing permit or without a required permit.

All facilities must meet, at a minimum, appropriate technology-based effluent limitations. In many cases, water quality–based effluent limitations may also be necessary. Two types are used (as defined in Rule 62-650, F.A.C.). Level I limitations are generally more simplified evaluations for streams and for permit renewals. In Level II limitations, which apply to more complicated situations, a water body is generally sampled intensively and computer models used to predict its response to the facility's discharge.

In the past few years, FDEP's permitting staff has emphasized three main issues. First, since chlorine is toxic to aquatic life, domestic dischargers have been required either to dechlorinate their effluent or to disinfect it by alternative methods that do not use chlorine. Second, many recently renewed permits provide for whole effluent toxicity testing to determine the effluent's toxicity on aquatic species. Third, with an emphasis on reusing treated effluent, the total number of discharges to surface waters has been decreasing.

Permit Compliance. FDEP's objective in permit compliance is to protect the quality of Florida's surface water and ground water by identifying pollution sources that do not meet water quality standards or specific permit conditions. To manage the state's wastewater facilities safely and adequately, the agency's compliance evaluation strategy, established as part of the annual state program plan, is based on its wastewater facilities compliance strategy *(see Table 6).* Staff in the Division of Water Resource Management schedule the plan based on each facility's permit expiration date (permits are issued for five years).

While the type and frequency of inspections are based on the staff available in each district office, all major facilities (as defined by the EPA) will be inspected each year with at least a Compliance Evaluation Inspection.

Table 6: Wastewater Facilities Compliance Strategy

Permit year	Inspection type
1	Performance Audit Inspection (PAI)
2	Compliance Evaluation Inspection (CEI)
3	Compliance Evaluation Inspection (CEI)
4	Compliance Evaluation Inspection (CEI)
5	Compliance Sampling Inspection (CSI)
5	Toxic Sampling Inspection (XSI)
5	Compliance Biomonitoring Inspection (CBI)
5	Impact Bioassessment Inspection (IBI)
5	Water Quality Inspection (WQI)

District compliance and enforcement staff makes every effort to work with a permittee to resolve minor problems before beginning formal enforcement action. During inspections to determine compliance with, or violations of, compliance schedules and permit conditions, staff verifies the accuracy of facility records and reports, plant operation and maintenance logs, and effluent quality data; they also evaluate the general reliability of the self-monitoring program under the permit.

Enforcement. FDEP enforces Florida's water quality standards under a formal Memorandum of Agreement with the EPA. The state follows the EPA's Enforcement Management System and the guidelines set out in the EPA document, *Technical Review Criteria and Enforcement Response Guide***.** Using this structure, FDEP has a training program for district staff who investigate and document all violations, issue noncompliance and warning letters, conduct informal conferences, prepare case reports, and testify at administrative and judicial hearings.

When formal enforcement is necessary, staff attempts to negotiate a consent order — a type of administrative order in which civil penalties (such as fines) for noncompliance can be assessed. Consent orders also establish step-by-step schedules for complying with permit conditions and Florida law.

When consent orders cannot be negotiated, FDEP seeks compliance through civil court proceedings, with the assistance of the agency's Office of General Counsel. When a serious violation endangers human health or welfare or the environment, FDEP issues a complaint for injunctive relief or takes other legal action, including an immediate final order for corrective action.

Nonpoint Source Program

Florida established its first stormwater rules in 1979 and its first stormwater permitting program in 1982 (Chapter 17- 25, F.A.C.). FDEP, which administers the stormwater rule, delegated permitting authority to the WMDs. New developments, except for single-family dwellings, and modifications to existing discharges must obtain stormwater permits. Projects must include a stormwater management system that provides flood controls. BMPs such as retention, detention, or wetland filtration must remove 80 percent of average pollutants. For OFWs, some other sensitive waters (such as shellfish-harvesting areas), and waters that are below standards, 90 percent of pollutants must be removed.

A 1989 stormwater law directed FDEP to establish statewide goals for treatment and to oversee the implementation of regulatory programs, which were also delegated to the WMDs. Delegation allows minor design adjustments for Florida's diverse landscape. In 1993, the legislature modified portions of Chapters 373 and 403, F.S., to allow streamlined permitting. The Wetlands Resource Permit and the Management and Storage of Surface Water (MSSW) Permit were unified into a single Environmental Resource Permit to increase statewide consistency in managing stormwater.

For federal fiscal years 1995 and 1996, Florida received nearly $6.9 million in nonpoint source grant funds (Section 319[H]) from the EPA. As in previous years, nearly all these monies were used for the following:

1. *To support continuing research on the effectiveness of stormwater systems and the relationship between design, BMPs, and the efficiency of pollution removal.*

2. *To reduce pollution from older stormwater systems and establish goals for reducing pollutants in watersheds.*

3. *To improve the effectiveness of BMPs, especially for controlling erosion and sedimentation.*

4. *To educate the public on the importance of stormwater management.*

Coordination with Other Agencies

Carrying out Florida's Water Pollution Control Program to protect water resources requires coordination between governments and agencies across state lines and in Florida. Section 403.60, F.S., authorizes the governor to enter into interstate environmental agreements or compacts.

Interstate Coordination. The following coordinated efforts are currently under way:

- *As part of a formal Memorandum of Agreement to stop an interstate civil lawsuit, Florida is participating with the U.S. Army Corps of Engineers, Georgia, and Alabama in the Apalachicola-Chattahoochee-Flint/Alabama-Coosa-Tallapoosa Comprehensive Study.*

- *In 1993 Nassau and Baker counties in Florida and Charlton and Camden counties in Georgia formed the St. Marys River Management Committee to identify water quality issues and protect the long-term environmental and economic resources of the St. Marys River.*

- *Several years ago the Florida and Alabama legislatures created the Florida–Alabama Water Resources Coordinating Council to collaborate in managing a shared resource, the Perdido River. FDEP and the Alabama Department of Environmental Management cochair the council.*

- *The Suwannee Basin Interagency Alliance coordinates interstate natural resource management in that basin. Florida and Georgia cochair the alliance, and a variety of federal, state, and regional agencies participate.*

Interagency Coordination. FDEP, in cooperation with the WMDs, is generally responsible for protecting the state's water resources. Sections 373.016 and 373.026, F.S., give FDEP authority to oversee the WMDs, while the districts have authority over managing water quantity for flood control and protecting natural resources. In many cases FDEP has formally delegated pollution control and prevention to other agencies (see *Table 7* for details of interagency coordination agreements). The following describes some of the agencies and major coordinated activities:

1. *Many FDEP regulatory programs share responsibilities with the WMDs and local governments or have delegated responsibilities to them under Chapters 253, 373, 376, and 403, F.S., and Chapter 62, F.A.C. Local governments include counties and municipalities. Chapter 62-101 and Section 62-113.100, F.A.C, describe the delegations. FDEP coordinates and delegates pollution-control programs to the WMDs and local governments.*

2. *The Florida Fish and Wildlife Conservation Commission conducts research into freshwater and anadromous fish, endangered species, and game and nongame animals. It also manages the state's freshwater fisheries and identifies regionally significant freshwater habitats. FDEP delegates enforcement of Chapter 403, F.S., Florida's Air and Water Pollution Control Act, to the commission. FDEP may in turn report violations of Chapter 372, which authorizes wildlife management and regulation, to the commission.*

3. *The Florida Department of Community Affairs is responsible for developing the State Land Development Plan, which must be consistent with the State*

Comprehensive Plan and compatible with the Florida Water Plan. The agency also reviews and certifies local government comprehensive plans for conformity with state planning requirements.

4. *The Florida Department of Health manages statewide programs to protect public health. FDEP has delegated authority to the department to issue permits for individual domestic wastewater disposal facilities up to 10,000 gallons and without a discharge to surface waters, and to authorize the application of pesticides to waters of the state for insect control. FDEP also delegates authority for drinking water distribution systems to some county public health units.*

5. *The Florida Department of Transportation prepares the Florida Transportation Plan, which has significant implications for protecting water resources and must be compatible with the Florida Water Plan.*

6. *FDEP delegates permitting and enforcement of open burning rules, as well as the testing and certification of gasoline tank trucks and storage tanks, to the Florida Department of Agriculture and Consumer Services.*

Surface Water Improvement and Management (SWIM) Program

In 1987, the Florida legislature passed the SWIM Act, Sections 373.451-373.4595, F.S. The act directed the state to develop management and restoration plans for preserving or restoring priority water bodies. The legislation designated a number of SWIM water bodies, including Lake Apopka, Tampa Bay, Indian River Lagoon, Biscayne Bay, St. Johns River, Lake Okeechobee, and the Everglades. *Table 8* lists the water bodies currently on the SWIM list.

The SWIM program's goals are protecting water quality and natural systems, creating governmental and other partnerships, and managing watersheds. While FDEP oversees and funds the program, the five WMDs are responsible for its implementation — including developing lists of additional high-priority water bodies and waterbody plans (outlined under Chapter 62-43, F.A.C.). The districts also provide matching funds for state revenues. In a collaborative effort, other federal and state agencies, local governments, and the private sector provide funds or in-kind services.

SWIM plans must contain the following:

1. *A description of the water body.*
2. *A list of governmental agencies with jurisdiction.*
3. *A description of land uses.*
4. *A list of point and nonpoint source discharges.*
5. *Restoration strategies.*
6. *Research or feasibility studies needed to support restoration strategies.*
7. *A restoration schedule.*
8. *An estimate of costs.*
9. *Plans for interagency coordination and environmental education.*

Table 7: Interagency Coordination Agreements

	Specific operating agreements for air	Drinking water	Pre-1985 general operating agreements for wastewater	Specific operating agreements for wastewater	Tank Inspection	Solid waste management facilities	Mangroves	Aquatic plant management	Beaches and coastal systems	Sewage collection lines	Water distribution
County Programs											
All 67 Counties					X						
Broward	X	X	X	Pending		X	X				
Palm Beach	X	X		X		X		X			
Dade	X	X	X	Pending		Pending	X				
Hillsborough	X	X	X	X				X			
Pinellas	Pending	X					X				
Sarasota	Pending	X		Pending							
Orange	X										
Duval	X	X	X	Pending							
Manatee	Pending	X									
Volusia		X	X								
Lee		X									
Polk		X									
Collier			X								
Escambia											
Hernando										X	X
Pasco											X
Lake			X					X		X	X
Brevard								X			
Citrus								X			
Highlands								X			
City programs											
Gainesville										X	X
Tallahassee										X	X
Tampa										X	
Sanibel							X				
Indian River Shores							X				
Jupiter Island							X				
Vero Beach									X		
Water Management District programs											
St. Johns River											
Southwest Florida								X			
South Florida								X			

Table 8: Priority SWIM Water Bodies (by WMD)

NORTHWEST FLORIDA
1. Apalachicola River and Bay
2. Lake Jackson
3. Deer Point Lake
4. Pensacola River and Bay
5. St. Marks/Wakulla rivers
6. Choctawhatchee River and Bay
7. Santa Rosa Sound
8. St. Joseph Bay
9. St. Andrews Bay
10. Lake Munson
11. Ochlockonee River and Bay
12. Lake Iamonia
13. Lake Lafayette
14. Lake Miccosukee
15. Sandhill lakes

SUWANNEE RIVER
1. Suwannee River
2. Santa Fe River
3. Coastal rivers
4. Alligator Lake
5. Aucilla River
6. Waccasassa River

ST. JOHNS RIVER
*1. Indian River Lagoon (middle and upper sections)
2. Lower St. Johns River
3. Lake Apopka
4. Upper Oklawaha River
5. Middle St. Johns River
6. Lake George Basin

ST. JOHNS RIVER (continued)
7. Halifax River
8. Nassau River
9. St. Mary's River
10. Palatlakaha River
11. Lower Oklawaha River
12. St. Augustine
13. Florida Ridge
14. Wekiva River
15. Orange Creek
16. Upper St. Johns River Basin

SOUTHWEST FLORIDA
1. Tampa Bay
2. Rainbow River
3. Crystal River/Kings Bay
4. Lake Panasoffkee
5. Charlotte Harbor
6. Lake Tarpon
7. Lake Thonotosassa
8. Winter Haven Chain of Lakes
9. Sarasota Bay

SOUTH FLORIDA
*1. Lake Okeechobee/Kissimmee River
*2. Biscayne Bay
*3. Indian River Lagoon
*4. Everglades/East Everglades/Holey Land/Rotenberger
5. Upper Kissimmee Chain of Lakes
6. Florida Keys

**Named in the SWIM statute as a priority water body.*

Pollutant Load Reduction Goals. The 1987 SWIM legislation required that Pollutant Load Reduction Goals (PLRGs) be established for SWIM priority water bodies. A PLRG is an estimated reduction in pollutant concentrations needed to preserve or restore beneficial uses in receiving waters. Both point source and nonpoint source contributions must be considered. Ultimately, water quality in a receiving water should meet state water quality standards, and PLRGs provide benchmarks toward which specific strategies can be directed. Interim PLRGs are best judgment estimates of the pollution reductions from specific corrective actions. Final PLRGs are goals needed to maintain water quality standards.

A joint work group from FDEP and the WMDs produced recommendations, guidelines, and a schedule to develop regional water management plans that included PLRGs. The recommendations were incorporated into the revised State Water Policy (Chapter 62-40, F.A.C.) effective July 1995.

Cost/Benefit Assessment

This section documents the costs and attainable benefits of achieving the federal Clean Water Act's objectives for controlling water pollution since 1972.[3]

Costs

These include capital investment in municipal and industrial facilities, investment in nonpoint source controls, and facilities operation and maintenance. Costs are shown as they are available for tracking through FDEP databases or from private sector data (see Table 9).

Table 9: Summary Of Costs For Controlling Water Pollution

Report	Total projects	Amount
Federal construction grants in Florida (federal fiscal years 1972 - 1988)	1,245	$1,966,391,714
State grants (federal fiscal years 1985 - 1988)	66	$103,723,873
State legislative appropriations (1987 - 1992)	14	$7,851,184
State bond loans	38 municipalities	$485,420,000
State small community preconstruction loans (1994 - 1995)	17	$22,598,178
State revolving fund construction loans (1989 - 1995)	51	$519,772,061
Private sector: Florida's electric power companies (since 1980)		$750,000,000

Federal Grants Program. Federal funding began with the Water Pollution Control Act of 1956 (Public Law 84-660). Initially, the federal share was 30 percent of eligible project costs, and funding was limited to $250,000 per project. In 1966, legislation increased the federal funding share to 55 percent.

[3] FDEP's Office of General Counsel, Economic Analysis Section, Tallahassee, provided the information in this section. Sources: Grants Information Control System database, FDEP; Local Government Wastewater Financial Assistance, Bureau Report, Federal and State Monies Awarded for the Construction of Wastewater Treatment Facilities in Florida; Florida Phosphate Council; and Report of the Chairman, Florida Electric Power Coordinating Group.

The 1972 Water Pollution Control Act (Public Law 92-500) further increased funding and raised the federal share to 75 percent of eligible costs for structural improvements such as treatment facilities, collection systems, or sewer line rehabilitation through planning, design, and construction grants. The 1977 Clean Water Act (Public Law 95-217) maintained the 75 percent funding for planning, design, and construction. In addition, a public works bill provided appropriations for building wastewater treatment works.

The 1981 Municipal Wastewater Construction Grants Act Amendments (Public Law 97-117), however, reversed the trend. Congress reduced annual appropriations and eliminated planning and design grants. States were ordered to reduce the federal share. Beginning in fiscal year 1983, Florida cut grants to 55 percent of eligible project costs, except for innovative and alternative technology projects.

The new amendments also restricted the funding eligibility of reserve capacity for population growth, advanced treatment facilities, major sewer rehabilitation, and collection sewers as of 1984. They encouraged the delegation of administrative responsibility to the states by the EPA. Funds for state administrative expenses were allocated from annual appropriations. *Table 10* shows federal construction grants in Florida for fiscal years 1972 to 1988.

Benefits

Because our environment and economy are intertwined, environmental damage harms the economy, as exemplified by the Everglades and Florida Bay. The value of protecting Florida's environment, however, cannot be readily measured in dollars, because the benefits of a functioning environment are not adequately valued under our current method of economic accounting. Many benefits of environmental protection are intangible or aesthetic.

Tourism, recreation, and fisheries are important contributors to Florida's economic well-being, and are dependent on a healthy environment. In 1996 visitors to Florida spent over $48 billion.[4] Between 11 million and 12 million people visit Florida's parks and recreational areas every year.[5] Florida ranks number three in the nation in the number of boats registered annually.[6] In 1997, Floridians spent $1.2 billion on boating equipment and registered 755,278 boats.[7] About 100 new boats are registered in Florida every day.[8] The recreational marine industry, including manufacturing and the activities of marinas and boat yards, is a $3.5 billion business in Florida.[9] On average, out of forty million tourists who visit Florida annually,[10] more than 75 percent spend more than two weeks here.[11] The vitality of Florida tourism, and the state's economy, depends upon effective management of the state's water resources.

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4 http://infoplease.lycos.com/ce5/CE018714.html

5 1995 Florida Statistical Abstract, Bureau of Economic and Business Research, College of Business Administration Gainesville, Florida: University Press of Florida, 1995).

6 http://www.nmma.org/facts/boatingstats/statistic98.html#population

7 Florida Keys and Key West Area of Critical State Concern, Report to the Administration Commission (Tallahassee: Florida Department of Environmental Protection, 1993).

8 Fernald et al., 1992

9 http://www.ficus.usf.edu/temp/1000fof-new-web/pubs/sand/apala.htm

10 Fernald et al., 1992

11 The 1996 Florida Almanac

Table 10: Federal Construction Grants Awarded In Florida, federal fiscal years 1972 to 1988

Federal fiscal year	Amount
1972	$1,904,020
1973	$58,403,418
1974	$132,311,874
1975	$231,753,781
1976	$126,566,806
1977	$199,190,080
1978	$89,899,946
1979	$176,116,401
1980	$119,958,364
1981	$169,685,272
1982	$81,061,710
1983	$111,789,002
1984	$117,003,023
1985	$64,349,837
1986	$72,882,748
1987	$106,898,937
1988	$106,616,685
Total	$1,966,391,714
Projects	1,245

Note: The facilities funded include publicly owned wastewater treatment facilities, reclaimed water reuse facilities, major sewer rehabilitation transmission facilities, and collection sewers.

Florida's coastal environments are a particularly important asset. Based on 1985 data, as much as 62 percent or $158 billion of the Gross State Product is generated in coastal areas.[12] Losses of wetland habitats and beaches and declines in water quality from stormwater runoff and point source discharges decrease the value of our natural resources. For example, when a swimming beach is closed because sewage contaminates the water, the state loses revenue.

Environmental protection is not cheap. The Tampa Bay National Estuary Program, for instance, estimates that $260 million is spent each year for regulatory controls on pollution, restoration, and stormwater management in the Tampa Bay area. One important change was upgrading wastewater discharges to advanced treatment or reusing wastewater. As a result, water quality has improved, seagrass acreages have increased, and nutrient contributions have declined. For the first time in several decades, it may be possible for bay scallops to thrive. All these changes benefit the bay's fishery and recreational users.

Changes in the state's approach to environmental protection from permitting to managing watersheds or ecosystems will benefit both the environment and the economy in the long run. Ecosystem Management improves the protection of natural resources, encourages the people of Florida to

[12] Draft State of Florida Coastal Nonpoint Source Pollution Control Program Environmental Assessment, (Washington, D.C.: National Oceanic and Atmospheric Administration, September 1996).

practice a conservation ethic and sustainable life-style, and stimulates a healthy economy. Sustainable development and environmental stewardship are two cornerstones of a healthy economy.

Finally, the probabilistic design of the Tier I monitoring network, described in *Table 12* in the next chapter, provides one specific benefit to Florida by allowing FDEP to make statistical statements about conditions in 100 percent of the hydrologic units of the state.

Special State Concerns

This section addresses special Florida concerns or strategic issues that are not specifically discussed or identified as special concerns in other parts of this report.

The state recognizes the integrity of the following ecosystems as special state concerns: the Everglades, Florida Bay, Florida Keys, and Apalachicola River and Bay. The importance of these ecosystems to Florida is discussed in the following pages.

Other issues of special concern include maintenance of the quality of surface and ground water by preventing pollution, widespread mercury contamination in both marine and freshwater fish, protection of coastal areas and estuaries because of their ecological importance and significant contribution to Florida's economy, and integration of water quantity and quality decisions.

1. Although a few ecosystems stand out in their significance and importance, all Florida's rivers, lakes, and estuaries are special state concerns because of their environmental and economic value to the people of the state.

Everglades

Before the 1940s, the Everglades ecosystem covered most of southern Florida, from its headwaters in the Kissimmee River Basin to the coral reefs of Florida Bay. Because of human alterations, however, the once-vast “River of Grass” has deteriorated and become fragmented, threatening not only wildlife but also the water supply, economy, and quality of life for Florida residents.[13]

Water quality in the Everglades is a special concern. FDEP's review of data shows that nutrients are the biggest water quality problem; they have caused or contributed to at least four major violations of Class III criteria (for wildlife and recreational use): imbalances of aquatic flora or fauna, dominance of nuisance species, biological integrity, and dissolved oxygen levels.

The state spent five years embroiled in a lawsuit with the U.S. Department of Justice for allowing water quality violations in Everglades National Park and Loxahatchee National Wildlife Refuge. The lawsuit was settled in 1992.

The Everglades bill passed by the Florida legislature and signed by Governor Lawton Chiles ended a lawsuit brought by the sugar industry against the original Everglades SWIM Plan. The bill authorizes immediate commencement of the Everglades Construction Project to clean up and restore the

[13] Senator Patrick Leahy, Congressional Record, March 29, 1996.

Everglades Protection Area, which includes the Loxahatchee Wildlife Refuge, Everglades National Park, and the three Water Conservation Areas.

Florida Bay. Florida Bay is the last link in the Kissimmee River–Lake Okeechobee–Everglades chain. Its problems reflect extensive habitat and hydrologic modifications throughout the system. The Everglades restoration will play an important role in revitalizing the bay. In turn, the bay's health is critical to maintaining the viability of the Florida Keys, the country's only emergent coral reef ecosystem.

The bay, a valuable recreational and fisheries resource, provides critical nursery habitat for juvenile fish. Tourism, an important revenue source for Florida, is also vital to the area. Both fisheries and recreation, however, are threatened by continued dieoffs of mangroves, seagrasses, and coral reefs — as well as by year-round algal blooms in Florida Bay and around the Keys.

The immediate causes include hydrologic modifications in the watershed, lack of flushing of organic-rich sediments from the bay by hurricanes, high water temperatures, high salinity levels, and nutrient pollution. Historically, the sheets of fresh water flowing slowly across the Everglades eventually reached the bay. When channels were dug and fresh water diverted to agriculture, much less fresh water flowed to the bay. This reduction is believed to be causing the high salinity and water temperatures.

Florida Keys

The Florida Keys are a state Area of Critical State Concern and an OFW. Congress also designated the Keys a National Marine Sanctuary to protect and preserve special marine resources. Because the Keys' water quality is so important, Congress required the development of a separate Water Quality Protection Plan along with a comprehensive management plan.

During the 1960s and 1970s, more than 700 canals and access channels were dredged and other areas filled, altering mangrove shorelines. Coral reefs on the east side of the Keys have been plagued by bleaching and dieoffs. In addition, seagrass beds have been lost to nutrient pollution.[14]

Apalachicola River and Bay

The Apalachicola River and Bay system are an Area of Critical State Concern, an OFW, a SWIM water body, and a National Estuarine Research Reserve. The WMD is working to acquire large areas of the river's floodplain. The river and its floodplain contain varied habitats that shelter many different kinds of rare, endangered, and endemic plants and animals. Detritus and nutrients from the floodplain nourish the bay's diverse and rich fisheries. Apalachicola Bay is best known for its oysters and other seafood.

Although the system is currently in good condition, threats come from development, dredging for navigation, barge pollution, urban and agricultural runoff, and industrial activities. Water demands outside Florida's boundaries create periodic shortages, since 90 percent of the river basin lies in Georgia and Alabama.

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[14] FDEP, 1993.

2. Maintaining the quality of surface water and ground water by preventing pollution is an important state concern.

Significant pollution sources include urban stormwater, agricultural runoff, dairies, septic tank leachate, and point source discharges. Widespread ground water contamination by the pesticide ethylene dibromide has already occurred. Although point source controls have successfully controlled much pollution, greater attention needs to be given to nonpoint pollution, especially stormwater.

Because Florida's limestone topography (called karst) is porous and much of the state contains porous, sandy soils, surface water and ground water interact. Surface waters receive part of their discharges from ground water, either directly from springs or through seepage and base flows. Conversely, aquifers recharge when surface water flows underground. Protecting surface water indirectly protects ground water, and vice versa.

Most Floridians depend on ground water for their drinking water. In a disturbing trend, increased nitrate levels in spring discharges in several parts of Florida indicate not just ground water contamination but also the potential for additional nutrient pollution in surface waters. The contamination is a particular concern in waters of the state whose productivity is nitrogen limited (based on low nitrogen levels) and receive substantial quantities of ground water.

3. Mercury contamination in marine and freshwater fish is a state concern because it affects residents' health and socioeconomic status and has a major economic impact on the fishing industry.

Consumption advisories have been issued for a large number of water bodies, including fresh and marine waters. Most major fresh surface waters have been inventoried to determine mercury levels in fish tissues. Estuarine and coastal waters have been sampled to a lesser extent, although monitoring in several large estuarine systems is complete.

Priorities have shifted from defining the extent of the problem to understanding why it exists. Addressing unusually high levels of mercury in Everglades fish is especially important, since the metal accumulates in wildlife that eat the contaminated fish — including the endangered Florida panther. Numerous studies are under way, including monitoring trends in fisheries resources, investigating atmospheric fluxes of mercury, and assessing aquatic systems and wetlands.

4. Florida's coastal areas and estuaries and their associated wetlands (both fresh water and salt water) are a state concern because they comprise important economic and recreational resources. Because about three-fourths of the state's population live and work near the coast, demands on these systems are enormous.

Coastal ecosystems comprise many different habitats, including seagrass beds, mangrove swamps, salt marshes, and hardbottom. Each habitat harbors different plants and animals, and each is important in maintaining an entire ecosystem's function. Habitat losses directly threaten valuable resources — for example, both freshwater and saltwater habitat losses affect fisheries. Changes in hydrology are a major threat, since hydrology and habitat are linked. To remain healthy, these systems must maintain a delicate balance between salt water and fresh water.

Most estuarine system in Florida has lost some habitat from declining water quality (caused by point and nonpoint pollution), dredging and filling for development, the effects of recreational activities, and altered hydrology. As a result, color and turbidity increase, and nutrients fuel algal blooms. Seagrasses in particular have been drastically affected, a problem exemplified by Florida Bay.

Because estuaries are at the downstream end of their watersheds, any upstream hydrologic changes that remove or divert water — such as dredging, channeling, or stormwater runoff — degrade water quality. Stormwater not only carries excess water but also brings pollutants. Altered hydrology has affected many coastal systems. For example, Florida Bay has periodically been too saline because freshwater flows from the Everglades were reduced. The Indian River Lagoon should have the salinity of seawater, but at times it receives too much fresh water diverted from other basins and stormwater runoff. To help regulate Lake Okeechobee's levels, water is discharged to the Caloosahatchee River, which delivers excess fresh water to Charlotte Harbor.

Intense use has created other water quality problems. A number of estuaries have heavy metals and/or organic contaminants in their sediments, including Tampa Bay, the North Fork of the St. Lucie River, Miami River, Lower St. Johns River, and Pensacola Bay. High coliform counts are a problem in the Miami River, where problems with broken sewer lines or overloaded sewer systems have increased coliform bacteria and repeatedly closed swimming beaches. The river's polluted discharge threatens Biscayne Bay. In other estuaries, recreational houseboats illegally discharge wastewater.

Many estuarine systems are being studied to determine the extent of existing problems and plan rehabilitation work. An integrated watershed or system approach allows the development of partnerships between government and private citizens and the integration of scientific knowledge and management practices. Examples of this approach include the National Estuary Program, the National Marine Sanctuary Act, state aquatic preserves, Florida's SWIM Program, and Watershed Management.

5. As Florida's population increases, so will water demands. Integrating water quantity and water quality decisions is an important state concern.

Many of the environmental problems discussed in this report result from poorly timed or wrong quantities of water. Managing and protecting water quality must be linked to resource management and planning. For example, as Florida's population grows, so will drinking water demands, and surface waters will increasingly be used to supplement potable ground water supplies. Water is already being diverted from the Peace River, a tributary to Charlotte Harbor, but if too much water is withdrawn, it will affect the estuary.

Neighboring states will also demand more water. Florida is currently participating in a study of the Apalachicola River as a result of the city of Atlanta's increasing water demands.

Some regions already face water supply problems. For example, in the Tampa area, saltwater intrusion into coastal aquifers is growing as more ground water is withdrawn.

Recommendations

The following recommendations describe Florida's goals in meeting the objectives of the federal Clean Water Act:

A. Continue to implement Watershed Management

The 1993 state Environmental Reorganization Act required FDEP to develop and implement measures to "protect the functions of entire ecological systems through enhanced coordination of public land acquisition, regulatory, and planning programs." In response, FDEP implemented Ecosystem Management, a holistic, integrated, flexible approach to Florida's environment that protects and manages resources based on watersheds. Ecosystem Management consciously redirects FDEP away from reacting to environmental crises toward exploring ways to prevent them, using tools such as planning, land acquisition, environmental education, regulation, and pollution prevention. In 1998, the Department of Environmental Protection renamed Ecosystem Management to Watershed Management.

B. Implement pollution prevention

Environmental integrity is best protected when pollution is not allowed to occur in the first place. In the past, FDEP controlled pollution by permitting, compliance monitoring, and enforcement. A broader strategy includes market incentives and source controls that minimize the generation of pollutants. Source controls, for example, can minimize impervious surface areas to reduce stormwater runoff, encourage reuse rather than discharge of pollutants through more efficient industrial operations, encourage wastewater reuse, and lower fertilizer and pesticide use through integrated pest management and BMPs.

Florida has made a tremendous effort to eliminate point source pollution. Threats to surface water and ground water still exist, however, from septic tanks, waste materials discharged from boats, and domestic package plants.

C. Manage both water quality and water quantity

Although programs to control water quality have emphasized controlling or eliminating discharges, many problems stem from water withdrawals or altered hydrology. Water quality and water quantity can no longer be viewed independently. On occasion, regulations to protect water quality may actually impede the management of water quantity. Programs to protect water quality and manage water resources need to be better coordinated and linked.

By taking a watershed approach, the Florida Water Plan and State Water Policy provide a mechanism to link quantity and quality. The state needs better, more comprehensives long-range planning for water resources, and existing regulatory programs need to be applied to water resource planning.

D. Obtain good water quality data

Assessing surface waters and supporting the Watershed Approach through FDEP's Ecosystem Management initiative cannot be accomplished without good, comprehensive water quality information. The 1983 Water Quality Assurance Act and State Water Policy, as revised in 1995, appointed FDEP the lead agency for water quality issues and the central data repository. Data are stored in the EPA's STORET database.

Traditional water chemistry, assessments of biological communities and habitats, and analyses of contaminants in tissues and sediments form the backbone of a strong, interdisciplinary approach to assessing environmental integrity. FDEP has identified a network of stations to monitor water chemistry trends, the bioassessment program has developed procedures to assess ecological integrity, and techniques to analyze trends are being developed. By linking different types of information on a particular surface water, the use of geographical information system (GIS) is key to developing the Surface Water Ambient Monitoring Program.

FDEP's Strategic Plan and the Florida Water Plan identify several strategies to collect and integrate data for decision making. The agency needs to support monitoring and assessment to the fullest extent possible, which includes adequate staffing and funding. Because the State Water Policy report identifies the 305(b) report as the first source of information for a water body, continued support for this report is also essential.

Many other federal, state, and local governments and WMDs have active monitoring programs. By continuing its collaboration with these programs, FDEP can expand its data assessment capabilities for more complete coverage of the state. Greater coordination with the EPA on monitoring and assessment is needed to transfer information to the state and provide mutual benefits.

Surface Water Assessment

This chapter describes the plan for and status of Florida's current efforts to achieve comprehensive assessments, FDEP's monitoring program, the methodology used to assess Florida's surface waters, a comprehensive assessment by waterbody type (rivers and streams, lakes, estuaries and coasts, and wetlands), and summary data for the state's surface waters.

Monitoring Program

The Watershed Approach will be complemented by FDEP's recently developed umbrella monitoring plan, the Integrated Water Resource Monitoring (IWRM) network. This probability-based sampling approach will allow FDEP to statistically assess all of the waters of the state. In mid-1996, FDEP's Division of Water Facilities (now the Division of Water Resource Management) restructured its monitoring efforts to better integrate the state's ground and surface water Ambient Monitoring Program. In response to this restructuring, an IWRM design was developed,[15] that uses a three-tiered approach to statewide monitoring *(see Table 11).*

Table 11: FDEP's Integrated Water Resources Monitoring network

- ***Tier I*** *(Status Network) uses a probability-based monitoring design to characterize statewide, regional, and specific basinwide conditions of Florida's water resources and determine if those conditions are changing over time. It can provide a statewide reference for comparing similar water resource types. The information from sampled stations can be used to make statistically significant statements on water quality for the entire state. Sampling is performed over five years but begins one year before the implementation of the Watershed Approach's basin management cycle, so that the information can be incorporated into the basin assessments. Information collected will be used to generate the Plan of Study in Phase 1 of the cycle. The monitoring began in October 1999.*

- ***Tier II*** *(Assessment Network) monitoring will be conducted to assess, in detail, targeted water bodies in each of the fifty-one hydrologic units or major watersheds of Florida. This tier of monitoring will identify specific water resource problems and determine the extent and severity of the problems. It will collect the additional data identified in the Plan of Study and will comprise Phase 2 of the basin management cycle. An important component will be the redesigned VISA ground water network. Originally designed to measure the general effects of broad categories of land use on ground water quality, this network will be modified to address specific issues of ground water quality and the interaction of ground water and surface water.*

- ***Tier III*** *(Compliance Monitoring Network) monitoring will determine if permitted facilities are in compliance with their permits. This monitoring will provide a basis for evaluating the effectiveness of management options.*

[15] The full scope of the design is described in Copeland *et al.*, 1998, *Overview of the Florida Department of Environmental Protection's Integrated Water Resource Monitoring Efforts and the Design Plan of the Status Network.*

Table 11: (continued)FDEP's Integrated Water Resources Monitoring network

• *The **Temporal Variability Network** for surface water is a fixed station network, assessed at the scale of the state's fifty-one eight-digit HUCs and consisting of water quantity, water quality, and biological monitoring. Sampling locations are major rivers entering Florida, downstream discharges of major rivers to estuaries, and a number of stream and lake locations. The network will provide loading information for estuaries and the state, and measure seasonal variations in support of Tier I sampling. A second Temporal Variability Network for ground water is under development.*

Achieving Comprehensive Assessments: Plan and Status

As discussed in the previous chapter, Florida is working towards the implementation of the Watershed Approach, which provides a structure that allows entire systems to be managed comprehensively, rather than on the basis of their separate parts and by watershed boundaries, rather than by political or regulatory boundaries.

This approach will allow FDEP to address more effectively the nonpoint source issues and adverse environmental impacts resulting from population growth and development, while continuing to address its historical responsibilities via a more efficient use of resources. FDEP anticipates that the implementation of the Watershed Approach will lead to a watershed-based permitting process. The environmental health of individual basins in the state will improve because activities are more likely to be coordinated and less likely to create cumulative impacts. In addition, this focusing of resources will allow Florida's water resource issues to be addressed more efficiently.

The Watershed Approach is designed to complement and integrate other watershed management programs in the state, including the Surface Water Improvement and Management (SWIM) Program of the WMDs. The framework it provides can eventually serve as a basis for achieving broader, ecosystem-level objectives and will establish mechanisms to define priorities, improve coordination, integrate program goals, and allocate finite resources within these geographic areas.

Methodology

This section summarizes the methodology used in preparing the 2000 305(b) report.[16] The approach is organized into the following four major activities:

- Watershed assignment and classification
- Database development
- Data analysis
- Designated Use Determination

[16] Hand *et al.*, 1996.

Watershed assignment and classification

Dividing the state into watersheds. For the 1994 report, we subdivided Florida into 4,400 watersheds based on the Environmental Protection Agency's River Reach File 3 (RF3) and U.S. Geological Survey watershed delineations. We contracted with the USGS to identify smaller watersheds (about five square miles each) using the watershed boundaries on USGS topological maps and ARC/INFO geographic information system (GIS) techniques.

The U.S. Geological Survey completed 75 percent of the state but unfortunately did not delineate South Florida's watersheds (Subregion 0309), which were adapted from a much coarser delineation developed by the South Florida Water Management District. As a result, these watersheds are each about 50 square miles, ten times larger than those in the rest of the state. For the 1996 report, we subdivided the USGS (Foose polygons) into smaller units (4,534 watersheds) based on the locations of the sample sites and the homogeneity of the data (step 2). Although the units may not be topologically accurate, they are a more reasonable size for assessment. In 1998, the State was subdivided into 4,934 watersheds, where in 2000, 5,126 watersheds were delineated.

A watershed, defined as a waterbody and the feeder streams that flow to it, is the analytic unit for assessing surface water quality; each watershed is named for the major waterbody located within it. Data from all water quality monitoring stations located within a given watershed are used to assess that watershed.

Identifying the type of waterbody. We identify the major water body—which usually encompass one major or one minor named water body—in each watershed. Each water body is identified as a stream, black water stream, lake, estuary, or spring. This water body identification is important because it determines which water-quality index will be applied in the assessment. *Table 12* shows the types of Florida water bodies, their characteristics, and the assessment techniques used.

Table 12 - Waterbody Characterization And Assessment Techniques

Waterbody Type	Number of Waterbodies	Characteristics	Assessment Technique
Stream	3,366		Water Quality Index (WQI)
Stream-black water	73	Color > 275 platinum color units, pH<6	Water Quality Index
Lake	1,114		Tropic State Index (TSI)
Spring	100	Low dissolved oxygen	Water Quality Index
Estuary	473	Conductivity >5000 uhmos, chloride >1500 ppm	Trophic State Index

Knowing the length of each stream and the area of each lake and estuary were essential in reporting the results to EPA. Stream lengths were determined by GIS measurements of RF3 (or assigned a length of five miles if no RF3 delineation was available). We determined lake and estuary areas using rough GIS aerial measurement techniques (if estuaries had no RF3 delineation, their areas were set at five square miles, while we assigned lakes whose areas were unknown an area of one square mile).

Each watershed is further identified by the predominant type of waterbody located within it. Identification of each waterbody as a stream, black water stream, lake, estuary, or spring is important because it determines which water-quality index will be applied in the data analysis.

The water quality is assumed to be homogeneous in each waterbody. If visual inspection of the data proves this wrong, or if GIS mapping shows more than one waterbody located within a watershed, the watershed is subdivided. GIS techniques were used to assign STORET sites to their respective watersheds. If more than one waterbody showed up in a watershed, the watershed was subdivided.

Identifying each water body's designated use. Functional classifications (Class I through V) have been applied to all Florida surface waters. Standards and water quality criteria have been established for each class of waterbody under Chapter 62-302 of the Florida Administrative Code (Table 13).

Table 13 - Florida Waterbody Classifications And Designated Uses

Class	Designation	# Watersheds	Water Body Type	Characteristics
I	Drinking Water	46	Usually lakes or reservoirs	
II	Shellfish harvesting	124	Estuarine	
III – Freshwater	Wildlife and recreation	4,567		
III – Marine	Wildlife and recreation	388		Chloride >1500 ppm
IV	Agriculture*	1		
V	Industrial	0**		

* Everglades area
** Fenholloway River changed to Class III in 1997

Database Development

Three (3) sources of data are inventoried for the water quality assessment: STORET data, biological data, and fish consumption advisory data.

Inventory Chemical Data (STORET). All data present in the STORET database (1.2 million samples) were inventoried for 16,393 STORET stations. Data for each station was divided into 5-year periods from the 1940's to the present (labeled as 1995 = 1994-1998; 1990 = 1990 - 1993; 1985 = 1985 - 1989; etc.) Data from 1994-1998 is considered current data; In 1998, an annual median water quality for each station, minimum 2 samples per year required -- once during the colder months (October through February) and once during the warmer months (March through September) was used. No minimum number of parameters were required except for lakes and estuaries where data must be available for 2 out 3 parameters (nitrogen and phosphorus). In 2000, seasonal medians were calculated (spring = sampled in April, May, and/or June; Fall = sampled in October, November, and/or December, etc.); sampling stations located within the influence of a point source effluent stream are not selected

For the 2000 305(b) report, 56 STORET parameter codes representing 23 different water quality constituents were inventoried. Since water quality constituents can be analyzed in different ways, the different STORET codes (Table 14) indicate the method of analysis for a given water quality parameter. When the value for a parameter is flagged with a code indicating that the reported value is too low to be accurately reported, the value is adjusted for use in the 305(b) data set by multiplying by 0.5. In those cases where the data code indicates that the reported value is too high, it is dropped from the data set.

Table 14:STORET Water Quality Assessment Parameters And Codes

Category	STORET parameter	Name	STORET code
Coliform	Fecal Coliform	MPN-FCBR/100ml	31616
Coliform	Fecal Coliform	MPNECMED/100ml	31615
Coliform	Fecal Coliform	M-FCAGAD/100ml	31625
Coliform	Total Coliform	MGIMENDO/100 ml	31501
Coliform	Total Coliform	MPN CONG/100 ml	31505
Conductivity	Conductivity	At 25c micromho	95
Conductivity	Conductivity	Field micromho	94
Dissolved oxygen	Dissolved oxygen	% saturation	Calculated
Dissolved oxygen	Dissolved oxygen	Mg/l	300
Dissolved oxygen	Dissolved oxygen	Probe mg/l	299
Diversity Index	Biotic Index	BI	61450, 82256
Diversity Index	Diversity Index	Artificial substrate	82251
Diversity Index	Diversity Index	Natural substrate	61453, 82246
Flow	Stream Flow	Cfs	60
Flow	Stream Flow	Inst.-cfs	61
Oxygen Demand	BOD 5 day	Mg/l	310
Oxygen Demand	COD Low Level	Mg/l	335
Oxygen Demand	COD High Level	Mg/l	340
Oxygen Demand	TOC	C mg/l	680
PH-Alkalinity	PH SU		400
PH-Alkalinity	PH SU	Lab	403
PH-Alkalinity	Total Alkalinity	CaCO3mg/l	410
Temperature	Temperature	Cent	10
Trophic Status	Chlorophyll A	Mg/l	32230
Trophic Status	Chlorophyll A	Mg/l	32217
Trophic Status	Chlorophyll A	Mg/l	32210
Trophic Status	Chlorophyll A	Mg/l corrected	32211
Trophic Status	Chlorophyll Total	Mg/l	32234
Trophic Status	Chlorophyll	Total ug/l	32216
Trophic Status	Nitrogen ammonia	TOT-NH4 mg/l	71845
Trophic Status	Nitrogen ammonia	Diss-NO2 mg/l	71846
Trophic Status	Nitrogen NH3+NH4-	N Diss mg/l	608
Trophic Status	Nitrogen NH3+NH4-	N total mg/l	610
Trophic Status	Nitrogen Nitrate	Diss-NO3 mg/l	71851
Trophic Status	Nitrogen Nitrate	Total-NO3 mg/l	71850
Trophic Status	Nitrogen NO2&NO3	N-Diss mg/l	631
Trophic Status	Nitrogen NO2&NO3	N-Total mg/l	630
Trophic Status	Nitrogen NO3-N	Diss mg/l	618
Trophic Status	Nitrogen NO3-N	Total mg/l	620
Trophic Status	Nitrogen Org N	Diss-N mg/l	607
Trophic Status	Nitrogen Org N	N mg/l	605
Trophic Status	Nitrogen Kjeldahl	Diss-N mg/l	623
Trophic Status	Nitrogen Total Kjeldahl	N mg/l	625
Trophic Status	Nitrogen Total N	N mg/l	Calculated
Trophic Status	Phosphorus	Total-PO4 mg/l	650
Trophic Status	Phosphorus Total	As PO4 mg/l	71886
Trophic Status	Phosphorus Dissolved	Mg/l P	666
Trophic Status	Phosphorus Total	Mg/l P	665
Trophic Status	Transparency	Secchi inches	77
Trophic Status	Transparency	Secchi meters	78
Water Clarity	Color	PT-CO Units	80
Water Clarity	Color-AP	PT-CO Units	81
Water Clarity	Residue Suspended	Mg/l	70299
Water Clarity	Residue Total NFLT	Mg/l	530
Water Clarity	Turbidity	JKSN JTU	70
Water Clarity	Turbidity	TRBIDMTR HACH FTU	76

Inventory biological data (statewide biologic database). In 1996 historic data was used to develop good, fair, and poor rankings of biological quality for streams, lakes, and estuaries. For each of the three types of water bodies, percentile distributions of the annual average values were prepared for the diversity index and for the number of taxa. The lower (20th percentile and below) portion of the data represents "poor" water quality, while the upper (70th percentile and above) represents "good" water quality. These percentile ranges were chosen empirically, based on "best professional judgment."

In the 1998 305(b) Report, a new biological-sampling program (which follows the Environmental Protection Agency's Rapid Biological Assessment protocols) developed in Florida was used for the assessment in lieu of the above technique. The sampling program technique uses dip-net sweeps of streams to collect aquatic insects. Based on regional and seasonal variation in the State, a series of metrics were developed to analyze the data. A new index, the Stream Condition Index, sums eight measures of the collected samples. The index accurately indicates water quality at the site. In the 2000 305(b) Report, the same technique was used. Approximately 1800 samples from the FDEP Biological database were available for use in the assessment of streams and lakes.

Inventory fish consumption advisory data. Elevated mercury levels have been found in the tissue of fish taken from surface waters across Florida. In 1989, the Florida Game and Fresh Water Fish Commission, the Florida Department of Health, Environmental Health Section, and FDEP began a joint project to sample mercury levels in fish tissue. As a result, a number of advisories have been issued recommending no or limited consumption of fish based on mercury concentrations.

About one million acres of fresh waters, mainly in the Everglades, are "no consumption" areas. These waters do not support their designated use. Limited consumption advisories have been issued for approximately another million acres of fresh waters. These waters are distributed throughout Florida and no pattern has been found for their distribution. These waters are considered for 305(b) reporting purposes to partially support their designated use. Generally, waters with good water quality and low pH, and low alkalinity have a greater potential for mercury contamination.

The following table indicates the concentration of mercury in fish tissue and its corresponding advisory used in the 2000 305(b) Report.

Table 15: Fish Consumption Advisories

Advisory	Concentration of Mercury
Unlimited Consumption	< 0.5 mg/kg
Limited Consumption*	0.5 mg/kg – 1.5 mg/kg
No Consumption**	> 1.5 mg/kg

** Limited consumption advisory means that adults should not eat fish from the contaminated waterbody more than once per week, while pregnant and nursing women and children under 15 years of age should not eat fish from the contaminated waterbody more than once per month.*

*** No consumption means fish from that waterbody should not be eaten by anyone at all.*

In the 2000 305(b) Report, data from 450 waterbodies were used in the assessment.

Data Analysis

Calculate water quality index (WQI). For streams, black water streams and springs; five (5) measures - water clarity (turbidity and total suspended solids), dissolved oxygen, oxygen demanding substances (biochemical oxygen demand, chemical oxygen demand, and total organic carbon), nutrients (total nitrogen, nitrate, and total phosphorous), and bacteria (total coliform and fecal coliform).

The Florida Water Quality Index (WQI) was developed and first used in the 1988 305(b) report. The WQI is a single numeric value condensed from several individual water quality parameters. Seasonal median water quality values, derived from the initial screening of the STORET chemical data, are used to calculate the WQI.

Table 16: Water Quality Index (WQI) Parameters

Category	Parameter	Unit
Water clarity	Turbidity	JTU
	Total Suspended Solids	mg/l
Dissolved oxygen	Dissolved oxygen	mg/l
Oxygen demand	Biological Oxygen Demand	mg/l
	Chemical Oxygen Demand	mg/l
	Total Organic Carbon	mg/l
Nutrients	Total nitrogen	mg/l as N
	Nitrate plus nitrite	mg/l as N
	Total phosphorous	mg/l as P
Bacteria	Total Coliform	# /100 ml
	Fecal Coliform	# /100 ml

Each parameter is assigned a value between 0 and 99 based on the percentile distribution of water quality in Florida, as determined in the Typical Water Quality Values (Friedemann and Hand,1989). The values are averaged to obtain an overall index value for each category and the categories are averaged to obtain the final WQI rating (good, fair, or poor). Due to the unique natural chemical and biological conditions that typify springs and black water streams, the index was modified to address these differences (Table 17).

Essential to the 305(b) assessment process is the comparison of the water quality in any waterbody to the values which are typical for the State of Florida. These typical values are contained in a single report: Typical Water Quality Values for Florida's Streams, Lakes, and Estuaries (Friedemann and Hand, 1989). In this report, water quality data for approximately 1,700 estuary stations, 1,000 lake sites, and 2,700 stream stations were inventoried for the period 1970 to 1987. Median water quality values and percentile distributions were determined for 23 different water quality parameters in estuaries, lakes and streams.

Table 17: Modified Water-Quality Index

	Used in the following indices		
Water quality parameter	Streams	Black waters	Springs
Turbidity	X	X	X
Total Suspended Solid	X	X	X
Dissolved oxygen	X		
Biochemical oxygen demand	X	X	X
Chemical oxygen demand	X	X	X
Total organic carbon	X		X
Total nitrogen	X		
Nitrate		X	X
Total phosphorus	X	X	X
Total coliform	X	X	X
Fecal coliform	X	X	X

To determine the range of values corresponding to good, fair, and poor water quality ratings, the overall index value was correlated with the USEPA National Profiles Water Quality Index for Florida (Peterson, EPA Region 10, 1984) data using standard statistical techniques (linear regression analysis). Based on this correlation, the cutoff values are as follows: 0 to less than 45 represented good quality; 45 to less than 60, fair quality; and 60 to 99, poor quality.

Calculate Trophic State Index (TSI). Lakes and estuaries; potential for algal or aquatic weed growth - total nitrogen, total phosphorous, and chlorophyll

The Trophic State Index effectively classifies lakes based on their chlorophyll levels and nitrogen and phosphorous concentrations. The index measures the potential for algal or aquatic weed growth. A ten-unit change in the index represents a halving or doubling of algal biomass. The Trophic State Index for lakes is based on:

- chlorophyll - Florida lake index value for chlorophyll, developed from a regression analysis of data collected from 313 Florida lakes in the 1970's - early 1980's, and
- nutrients - the Nutrient Trophic State Index value, based on phosphorous and nitrogen concentrations and the limiting nutrient concept. The limiting nutrient concept identifies a lake as phosphorous limited if the nitrogen-to-phosphorous concentration ratio is greater than 30, nitrogen limited if the ratio is less than 10, and balanced is the ratio is between 10 and 30.

The overall Trophic State Index is based on the average of the chlorophyll and nutrient indices.

The Trophic State Index can also be applied to estuaries to describe water quality. The rating scale for estuaries is lower for each category, which reflects a lower desirable upper limit for chlorophyll in estuaries than in lakes.

Table 18: Trophic State Index (Tsi) For Lakes And Estuaries

Trophic State Index (score)	Chlorophyll CHLA/micrograms per liter (ug/l)	Total Phosphorus TP/milligrams of phosphorus per liter (mg/l)	Total Nitrogen TN/milligrams of nitrogen per liter (mg/l)
0	0.3	0.003	0.06
10	0.6	0.005	0.10
20	1.3	0.009	0.16
30	2.5	0.01	0.27
40	5.0	0.02	0.45
50	10	0.04	0.70
60	20	0.07	1.2
70	40	0.12	2.0
80	80	0.20	3.4
90	160	0.34	5.6
100	320	0.58	9.3

For lakes: Good = 0 - 59; Fair = 60 - 69; Poor = 70 - 100

For estuaries: Good = 0 - 49; Fair = 50 - 59; Poor = 60 - 100

Identify exceedences of water-quality standards (pollutants and metals). Conventional pollutants (DO, total/fecal coliform) and metals (arsenic, aluminum, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, zinc); based on percent of violations in last 5 years

Florida's surface water quality standards are used to assess whether a pollutant level in a waterbody is high enough to preclude the designated use of the water body. Exceedences of metals and of conventional pollutants are determined using chemical water quality data taken from STORET.

Table 19: Determining Support For Designated Use

(based on exceeded standards over a Five year period)

Parameter	Fully	Partial	Not
Conventional pollutants	< 10%	11-25%	> 25%
Metals, Pesticides	< = 1 sample	≤ 10%	> 10%
Bacteria	0	≤ 10%	> 10%

Determining Designated Use, Trend, Sources, and Causes

Status Determination. The result of the Water Quality analysis is an assessment of each watershed in the state of Florida for which sufficient data exists. The analysis generates four (4) assessment values:

1) Water Quality Index (for streams) or the Trophic State Index (for lakes or estuaries), depending upon type of water body,
2) biological data,
3) exceeded standards for conventional pollutants, and
4) exceeded standards for metals.

To derive a single, over-all water quality rating for a watershed, a simple averaging technique is used. Each assessment value is given a score of 1 for good water-quality, 3 for fair water-quality, and 5 for poor water-quality. An overall average is calculated, with the break points set at 1 to 2 for good, 2 to 4 for fair, and 4 to 5 for poor. The result is a good, fair, poor rating representing the current status for each watershed with sufficient data for assessment. The Status ranking for Florida watersheds is an overall water quality ranking to be used for management purposes only. The Status ranking in conjunction with trend information is used by the Department to guide monitoring efforts.

Apply confidence filters for use determination. The 305(b) Use Determinations are of increasing regulatory significance because they are the basis for the state's 303(d) list of waters requiring TMDL development. In the 1998 305(b) Report, to enhance the confidence in making these determinations, the Department applied the following criteria for the 1998 assessment:

- A minimum of three "samples" (a sample is defined as two sampling events: one summer and one winter) will be required for each watershed instead of only one sample. (Note the 3 samples could be taken in 1 year from 3 different stations or from 1 station sampled over 3 years.)
- Data from three or more Water Quality Index (WQI) categories (water clarity, DO, oxygen demanding substances, nutrients, and bacteria) are required to determine a WQI.
- For the oxygen demanding substances category of the WQI, if BOD data are available, COD and/or TOC will not be used.

In the 2000 305(b), two measures of confidence are used:

- **Confidence in the amount of data collected during a 5 year period** (e.g. If we collected a lot of chemistry data during the five year period of 1985-1989, we have a "high" degree of confidence in the chemistry data for this period). We define low confidence for chemistry data to be less than 15% of possible data collected, while greater than 60% of the necessary data is "high" confidence. For biology, 1 sample is "low" confidence, 2 samples are "medium" confidence and 3 or more samples are "high" confidence.

- **Confidence in the assessment call for a waterbody** (e.g. If the most recent data for a waterbody is the 1985 time period chemistry water quality index information, and we have other more recent chemistry data, metals violation information or biology data, then we have "low" confidence in our overall assessment call for this waterbody). Generally, if we have 1995 time period data we have “high” confidence, 1990 data is “medium” confidence and 1985 data is “low” confidence”. Any data before 1985 is “insufficient”.

- We also used a **trumping logic**: which states that high confidence, recent biology assessments override all other assessments, and that we prefer to use high confidence biology and chemical water quality index information over low confidence conventional and metal violation information.

Use Designation Determination. Rankings of fully, partially, and does not meet use designations. Again the resulting rating represents the present use designation for each watershed with sufficient data for assessment. In cases where both biological and chemical data indicate the watershed does not meet its designated use, then this is the final rating for the watershed, *i.e.* no other evaluation parameters can alter that rating,

Trend Determination. Analyze trends - water quality trends are analyzed using water quality measurements for individual parameters and the overall Stream Water Quality Index (for streams) or the Trophic State Index (for lakes and estuaries) for watersheds with available data. Trends are only determined for those watersheds with at least 5 years of data collected between 1989 and 1998; a total of 1443 watersheds statewide.

The overall trend for water quality is determined by comparing improved and degraded water quality measurements (Spearman Ranked Correlation, at a 90% confidence level. Annual median values for sampling stations are analyzed for changes. At least two positive or two negative trend assessment indicators are required before classifying a water body as showing a trend. If a water body shows no trends, or if just one indicator shows a trend, then the trend is classified as "Stable."

Source Determination. EPA requires a listing of sources of pollutants for all waters which Partially or Do Not Meet their designated use. These sources (such as nutrient problems) come from comparing the water quality parameters with its percentile criteria for fair water quality as it relates to the water body type. The table identifies the screening levels used, the typical values measured, and the Florida criteria for streams, lakes, and estuaries.

- **Inventory nonpoint source pollution data** - 1994 update of 1988 survey

For water bodies that exhibit water quality problems due to the sources listed above, EPA requires the identification of the causes (e.g. agricultural runoff) of poor water quality. As in 1998, the 2000 305(b) Report utilized the results from the 1994 survey only used to assist in the determination of sources of pollution (e.g. agricultural runoff).

> *In 1988, FDEP qualitatively assessed the effect of nonpoint pollution on Florida's waters in a questionnaire sent to all major state agencies (water management districts, regional planning councils, Division of Forestry, Game and Fresh Water Fish Commission), city and county offices, US Soil Conservation Service, US Forestry Service, local Soil and Water Conservation*

Districts, environmental groups, and professional outdoor guides. The respondents (about 150 agencies and 300 to 400 participants) identified nonpoint sources of pollution, pollutants, symptoms such as fish kills and algal blooms, and degree of water body impairment. This survey was updated in 1994.

Table 20: Water Quality Assessment Parameters For Florida Streams, Lakes, And Estuaries

Parameter	Units	Screening Level	Typical Values 10%	Median	90%	Florida Criteria (Chapter 62.302) Class III
Waterbody type: STREAM						
Alkalinity	$CaCO^3$ mg/l		13	75	150	20.0 mg/l min.
Beck's Biotic Index	Index #		4	14	32	
BOD 5 day	mg/l	>1.4	0.8	1.5	5.1	Not cause DO<5 mg/l
Chlorophyll	µg/l		1	6	30	
COD	Mg/l	>42	16	46	146	
Coliform-fecal	# /100ml	>65	10	75	960	200/100ml
Coliform-total	# /100ml	>512	100	600	7600	1000/100ml
Color	Platinum Color Units		21	71	235	No nuisance conditions
Conductivity	micromho		100	335	1300	1275 or 50% above background
Dissolved oxygen	Mg/l	<6.1	3.1	5.8	8.0	5.0 mg/l
Diversity artificial sub	Index		1.4	2.9	3.6	Min. 75% of DI
Diversity natural sub	Index		1.2	2.4	3.5	Min. 75% of DI
DO % saturation	%		36	68	90	
Fecal strep	#/100ml		20	15	1700	
Fluoride	Mg/l		0.1	0.2	0.8	10.0mg/l
Nitrate nitrogen	Mg/l	0.09	0.01	0.1	0.64	Not cause imbalance
Nitrogen-total	Mg/l as N	>1.1	0.5	1.2	2.7	Not cause imbalance
PH	Standard units		6.1	7.1	7.9	<6.0 >8.5
Phosphorus-total	Mg/l as P	>0.08	0.02	0.09	0.89	Not cause imbalance
Secchi disc depth	Meters		0.4	0.8	1.7	Min. 90% background
Temperature	Centigrade		19	23	28	No nuisance conditions
Total organic carbon	Mg/l	>13	5	14	37	
Total suspended solids	Mg/l	>6.0	2	7	26	
Turbidity	JTU FTU	>4.9	1.5	5	21	29 NTUs above background
Waterbody type: LAKE						
Alkalinity	$CaCO^3$ mg/l		2	28	116	20.0 mg/l min.
Chlorophyll	µg/l	>40	1	12	70	
Nitrogen-total	mg/l as N	>2.0	0.4	1.1	2.5	Not cause imbalance
Phosphorus-total	mg/l as P	>0.12	0.01	0.05	0.29	Not cause imbalance
Waterbody type: ESTUARY						
Chlorophyll	µg/l	>20	1	9	36	
Nitrogen-total	mg/l as N	>1.22	0.3	0.8	1.6	Not cause imbalance
Phosphorus-total	mg/l as P	>0.07	0.01	0.07	0.20	Not cause imbalance

River and Stream Assessment

Florida has over 50,000 miles of rivers *(see Table 1).* Half of those miles are canals.

Major dams have been built on the Apalachicola, Oklawaha, Ochlockonee, and Withlacoochee rivers. The most extreme alterations were damming the Oklawaha to create the Cross-Florida Barge Canal and channeling the Kissimmee River.

The southern third of Florida's peninsula has been so hydrologically altered that few naturally flowing streams and rivers remain. Most water bodies in South Florida are canals, which usually support plants and animals more typical of lakes than rivers.

Still, Florida does have several types of natural river systems. In fact, most Florida rivers exhibit characteristics of more than one type of river system, either at different places along their length or at different times of the year. The links between surface water and ground water can also affect natural systems. A good example is the Suwannee River, which originates in the Okefenokee Swamp as a blackwater stream and becomes spring-fed south of Ellaville. During periods of high flow, it carries sand and sediments, behaving like a true alluvial stream. During low flow, however, the river's base flow comes from underground springs. These variations in flow affect the river downstream and the receiving estuary. Ground water has higher nitrate concentrations that can affect animals and plants downstream, while the sand and sediments carried by the river during periods of high flow have a different effect on biological life.

In North and Northwest Florida, many rivers are alluvial. These are best represented by the Choctawhatchee, Apalachicola, and Escambia rivers. Common features include a well-developed floodplain, levees, terraces, oxbows, and remnant channels (sloughs) that parallel the active riverbed. Typically, because flows fluctuate more than with other types of rivers, habitats are more diverse.

Blackwater rivers usually have acidic, highly colored, slowly moving waters containing few sediments. These systems typically drain acidic flatwoods or swamps and are low in biological productivity. The Upper Suwannee River is a good example.

Many major river systems that originate as springs are found in Central and North Florida, the Big Bend area of the Gulf Coast, and the southern portion of the Tallahassee Hills. Chemically, these rivers are clear, alkaline, and well buffered, with little temperature variation. They have relatively constant flows and few sediments. Their clear water encourages the growth of submerged plants that provide habitat for diverse animal species. Many spring-fed rivers flow directly into estuaries; the constant temperatures protect species acclimated to warmer waters, including estuarine fish such as spotted seatrout and red drum, as well as manatees.

Support for Designated Use

The determination of whether each water body supported its designated use was made by evaluating many different kinds of information, including a WQI (discussed in the preceding methodology), biological data, whether standards were violated for conventional pollutants and trace metals, and whether fish consumption advisories were posted.

Table 21 summarizes overall support for designated use of Florida's rivers and streams. A classification of threatened means although that a watershed currently supports its designated use, activities in that watershed may lower water quality in the near future. The impaired category includes watersheds that either partially support or do not support their designated use.

Table 21: Summary Of Fully Supporting, Threatened, And Impaired Rivers And Streams (Miles)

	Evaluated	*Monitored*	*Not specified*
Fully supporting	3150	3310	0
Threatened	142	410	0
Impaired	2162	985	0
Not attainable			

Table 22 lists river miles that support or fail to support specific uses such as protecting aquatic life, swimming, and fishing.[17] Florida's standards and criteria do not distinguish between protecting aquatic life, secondary contact,[18] and other recreational activities; these are all included in Class III water quality standards. Class I and Class II waters must also protect aquatic life and allow swimming, fishing, and other recreational uses.

Support of Aquatic Life

For this report, the EPA asks states to show how individual rivers and streams support aquatic life. To do so, they must contain healthy biological communities. The decision on whether these water bodies supported aquatic life was based on biology and/or chemical data. If a river or stream met its designated use, it was considered to have met aquatic use. If its designated use was impaired, then it did not meet aquatic use.

[17] The EPA supplied the categories in Table 14, which was prepared by first identifying miles of support or nonsupport for each of Florida's water quality standards. A total mileage was obtained for protecting aquatic life, fish consumption, swimming, and secondary contact by adding miles for Classes I, II, and III. Because Florida does not distinguish between these four uses within state standards, the same total mileage was used for each category; the numbers listed in Table 14 should not be summed for column totals.

[18] The EPA defines secondary contact as activities where the possibility of total immersion in water is small.

Table 22: Individual Use Support In Rivers (miles)

	Aquatic life	Fish consumption	Swimming	Secondary contact	Drinking water	Agriculture
Fully supporting	5998	1002	5998	5998	289	
Threatened	552	0	552	552	0	
Partially supporting	2345	2538	2345	2345	67	
Not supporting	629	231	629	629	2	
Not attainable						

Causes and Sources of Nonsupport of Designated Use

For each water body that does not fully support its designated use, both causes (such as nutrients and dissolved oxygen) and sources (such as municipal point sources and agricultural runoff) of the problem were identified. A cause is what prevents a water body from meeting its designated use, while a source is the activity that may have created the problem. Information on causes came mainly from exceeded water quality screening levels and professional judgement. Information on point and nonpoint sources came from professional judgment.

Causes and sources were classified as having major, moderate, or minor impacts. Impacts were major when a source or cause was responsible for, or a large contributor to, nonsupport of designated use. Impacts were moderate when a source or cause was either solely responsible for partial support of designated use, or one of several equally important reasons. Impacts were minor when a source or cause was only one of many reasons and its contribution small compared with other sources or causes. In contrast, previous 305(b) reports identified single sources and causes as major impacts, and multiple sources and causes (regardless of their impact) as moderate/minor.

Assessing causes. *Table 23* identifies, by specific causes, the miles of rivers and streams not fully supporting their designated use. All causes are moderate to minor. At least 1,000 river miles are affected by nutrients, siltation, bacteria or other pathogens, organic enrichment, and low dissolved oxygen.

Tables 24a and 24b identify sources such as types of facilities or activities that contribute to rivers and streams not fully supporting their designated use. Most water quality problems stem from agricultural and construction activities, urban runoff, hydrologic modifications, and land disposal. Land disposal includes septic tanks, landfills, and land application of wastewater effluent, all of which affect about 30 percent of the total miles assessed. Municipal and industrial point sources were relatively small contributors, affecting 200 out of 3,147 miles, or about 6 percent.

Table 23:Leading Pollutants And Processes Impairing Rivers And Streams (miles)

Pollutant/process	Major	Moderate/minor	Not specified
Cause unknown			
Unknown toxicity			
Pesticides			
Priority organics			
Nonpriority organics		492	
PCBs			
Dioxins			
Metals	0	492	0
Arsenic	0	9	0
Cadmium	0	137	0
Copper	0	21	0
Chromium	0	0	0
Lead	0	157	151
Mercury	0	0	0
Selenium		82	
Zinc	0	0	0
Ammonia (un-ionized)			
Chlorine			
Cyanide			
Sulfates			
Other inorganics			
Nutrients	0	2319	0
Phosphorus	0	1552	0
Nitrogen	0	1808	0
Other			
pH			
Siltation			
Organic enrichment/low DO)	0	2911	0
Salinity/TDS/chlorides			
Thermal modifications			
Flow alterations			
Habitat alterations (nonflow)			
Pathogens	0	1416	0
Radiation			
Oil and grease			
Taste and odor			
Suspended solids	0	592	0
Noxious aquatic plants			
Algae/chlorophyll *a*			
Total toxics			
Turbidity	0	1001	0
Exotic species			

Table 24a: Leading Sources Impairing Rivers And Streams — Part I (miles)

Source	Major	Moderate/minor	Not specified
Industrial PS	0	123	0
Major industrial PS			
Minor industrial PS			
Municipal PS	0	206	0
Major municipal PS – dry/wet			
Major municipal PS – dry			
Major municipal PS - wet			
Minor municipal PS - dry/wet			
Minor municipal PS - dry			
Minor municipal PS - wet			
Package plants			
CSO			
Collection system failure			
Domestic wastewater lagoon			
Agriculture	0	1,890	0
Crop-related sources			
Nonirrigated crop production			
Irrigated crop production			
Specialty crop production			
Grazing-related sources			
Pasture - riparian/upland			
Pasture – riparian			
Pasture – upland			
Range – riparian/upland			
Range – riparian			
Range – upland			
Intensive animal feed operations			
CAFO, permitted PS			
CAFO, NPS			
Aquaculture			
Silviculture	0	416	0
Harvesting, restoration			
Forest management			
Logging road construction/maintenance			
Silvicultural PS			
Construction	0	918	0
Highway/road/bridge construction			
Land development			

Table 24b: Leading Sources Impairing Rivers And Streams — Part II (miles)

Source	Major	Moderate/minor	Not specified
Urban runoff/storm sewers	0	1,161	0
Nonindustrial permitted			
Industrial permitted			
Other urban runoff			
Illicit connections/illegal hookups			
Highway/road/bridge runoff			
Erosion and sedimentation			
Resource extraction	0	468	0
Surface mining			
Subsurface mining			
Placer mining			
Dredge mining			
Petroleum activities			
Mill tailings			
Mine tailings			
Acid mine drainage			
Abandoned mining			
Inactive mining			
Land disposal	0	951	0
Sludge			
Wastewater			
Landfills			
Inappropriate waste disposal			
Onsite wastewater systems (septic)			
Hazardous waste			
Septic disposal			
Hydromodification	0	1228	0
Channelization			
Dredging			
Dam construction			
Upstream impoundment			
Flow regulations/modification			
Habitat modification (nonhydrological)			
Removal of riparian vegetation			
Bank or shoreline modification			
Drainage/filling of wetlands			
Marinas and recreational boating			
In-water releases			
On-land releases			
Erosion from derelict land			
Atmospheric deposition			
Waste storage/storage tank leak			
Leaking underground storage tanks			
Highway maintenance and runoff			
Spills (accidental)			
Contaminated sediments			
Debris and bottom deposits			
Internal nutrient cycling			
Sediment resuspension			
Industrial land treatment			
Natural sources			

Table 24b:(continued)
Leading Sources Impairing Rivers And Streams — Part II (miles)

Source	Major	Moderate/minor	Not specified
Recreational and tourism activities			
Golf courses			
Salt storage sites			
Ground water loadings			
Ground water withdrawal			
Other	0	1608	0
Unknown source			
Source outside state border			

Lake Assessment

Florida has 7,712 public lakes with a surface area greater than or equal to ten acres. Of these, 969 had water-monitoring data, representing a total of 2,624 square miles *(Table 25)*. FDEP does not collect water quality data for private lakes.

Support for Designated Use

Florida lakes are functionally designated as either Class I (public drinking water supply) or Class III (wildlife and/or recreational use). Although this report assesses a relatively small number of lakes, they represent close to 80 percent of the state's lake surface area. In deciding whether individual lakes supported their designated use, many different kinds of information were evaluated, including the TSI and biological data. Consideration was also given to whether standards were violated for conventional pollutants and trace metals and whether fish consumption advisories had been issued.

Table 25: Total Lake Waters (acres)

Total lake acres	2,085,120
Significant public acres	2,085,120
Number of lakes greater than ten acres	7,712
Surveyed acres	1,679,360

Note: It was assumed that all lakes are public access, by definition.

Table 26 summarizes support for designated use of Florida's lakes. The *impaired* category included lakes that either partially met or did not support their designated use. Although this category included better than half the total lake area, the information should not be interpreted to mean that a large number of lakes did not support their designated use. The main reason was that Lakes Okeechobee, George, and Apopka — very large lakes with water quality problems — dominated the total area.

Table 26: Summary Of Fully Supporting And Impaired Lakes (acres)

Monitored	Evaluated	Monitored	Not specified
Fully supporting	437,120	334,720	0
Threatened	29,440	80,640	0
Impaired	126,720	674,360	0
Not attainable			

Impaired = partially or not supporting designated use

Table 27 lists the total lake areas that met different degrees of support for designated use, as specified by the EPA. Examples of designated use include aquatic life support (healthy plant and animal life), swimming, and fishing.

Florida's standards and criteria do not distinguish between protecting aquatic life, secondary contact, and other recreational activities — all of which are included in Florida's Class III standard. Similarly, Class I waters must also protect aquatic life and allow swimming, fishing, and other recreation.

Table 27 was generated by identifying the acres of support or nonsupport for each Florida water quality standard. The acreage listed for aquatic life, fish consumption, swimming, and secondary contact was obtained for the areas for Classe III. Because Florida standards do not distinguish between these uses, the same total acreage was used for each. Slightly more than half the total lake area assessed fully supported Class III use. The acreage only partially supporting Class I use is very large because Lake Okeechobee dominated the total acreage.

Table 27: Individual Use Support In Lakes (acres)

	Aquatic life (Class III)	Fish consumption	Swimming (Class III)	Secondary contact (Class III)	Drinking water (Class I)	Agriculture (Class IV)
Fully supporting	760,960	654,720	760,960	760,960	10,880	
Threatened	110,080	0	110,080	110,080	0	
Partially supporting	304,000	229,120	304,000	304,000	407,680	
Not supporting	85,760	0	85,760	85,760	640	
Not attainable						

Causes and Sources of Nonsupport of Designated Use

The determination of causes based on whether each water body exceeded water quality–screening levels and on professional judgment. Conclusions on sources were based on professional judgment for point sources and the results of the Nonpoint Source Pollution Survey. As with rivers and streams, it was also determined whether causes and sources had major or moderate/minor impacts.

Relative Assessment of Causes. *Table 28* lists the causes of nonsupport of designated use and the total areas affected. The major causes were nutrients and algae. The data were biased, however, because they reflected a relatively small number of lakes with large areas.

Relative Assessment of Sources. *Tables 29a and 29b* list the sources of nonsupport of designated use and the total areas affected. Most water quality problems stemmed from agricultural and urban runoff, as well as municipal and industrial point sources. Again, because many sources contributed to impairment, all impacts were classified as moderate/minor.

Trophic Status/Impaired and Threatened Lakes

The TSI, discussed in the previous section on methodology, was used to determine individual lakes' trophic status and to indicate support for designated use: a very high TSI (above 80) was considered hypereutrophic and a high TSI (between 70-79) was considered eutrophic and not supporting use, 60 to 69 was considered mesotrophic and partially supporting use, and below 60 was considered oligotrophic and fully supporting use. These approximated poor, fair, and good water quality classifications, respectively, compared with those expected without human impacts. *Table 30* shows the trophic status of the state's significant publicly owned lakes.

Lake Protection, Management, and Restoration in Florida. Many different levels of government address lake water quality, restoration and rehabilitation, and management. The EPA's Clean Lakes Program, Florida's SWIM Program, the Florida Game and Fresh Water Fish Commission's lake restoration program, FDEP's Aquatic Plant Management Program, the WMDs, local governments, and volunteers are all important participants. Work often proceeds as a partnership of local, federal, and state governments, with the costs shared by all.

Trends in Lake Water Quality

Trends in Florida lakes between 1989 and 1998 were analyzed. Of 969 lakes, only 541 had sufficient data for analysis. Of these 541, 109 were improving, 119 were declining, and 313 showed no trend *(see Table 31).*

Water quality improved in most lakes after new regulations removed the majority of point source discharges — mainly wastewater effluent — in the 1970s and 1980s. The change was most obvious in the Orlando area when effluent was eliminated from the headwaters of Lakes Howell, Jesup, and Harney, which had serious water quality problems.

Table 28: Leading Pollutants And Processes Impairing Lakes (acres)

Pollutant/process	Major	Moderate/minor	Not specified
Cause unknown			
Unknown toxicity			
Pesticides			
Priority organics			
Nonpriority organics			
PCBs			
Dioxins			
Metals	0	473,600	0
Arsenic			
Cadmium		47,360	
Copper		1,280	
Chromium			
Lead		64,640	
Mercury			
Selenium		47,360	
Zinc			
Ammonia (un-ionized)			
Chlorine			
Cyanide			
Sulfates			
Other inorganics			
Nutrients	0	771,840	0
Phosphorus	0	750,720	0
Nitrogen	0	745,600	0
Other			
pH			
Siltation			
Organic enrichment/low DO			
Salinity/TDS/chlorides			
Thermal modifications			
Flow alterations			
Habitat alteration (nonflow)			
Pathogens			
Radiation			
Oil and grease			
Taste and odor			
Suspended solids			
Noxious aquatic plants			
Algae/chlorophyll *a*	0	552,320	0
Total toxics			
Turbidity			
Exotic species			

Table 29a: Leading Sources Impairing Lakes — Part I (acres)

Source	Major	Moderate/minor	Not specified
Industrial PS	0	119,040	0
Major industrial PS			
Minor industrial PS			
Municipal PS	0	152,320	0
Major municipal PS – dry/wet			
Major municipal PS – dry			
Major municipal PS - wet			
Minor municipal PS - dry/wet			
Minor municipal PS - dry			
Minor municipal PS - wet			
Package plants			
CSO			
Collection system failure			
Domestic wastewater lagoon			
Agriculture	0	610,560	0
Crop-related sources			
Nonirrigated crop production			
Irrigated crop production			
Specialty crop production			
Grazing-related sources			
Pasture - riparian/upland			
Pasture – riparian			
Pasture – upland			
Range - riparian/upland			
Range – riparian			
Range – upland			
Intensive animal feed operations			
CAFO, permitted PS			
CAFO, NPS			
Aquaculture			
Silviculture	0	21,120	0
Harvesting, restoration			
Forest management			
Logging road construction/maintenance			
Silvicultural PS			
Construction	0	86,400	0
Highway/road/bridge construction			
Land development			

Table 29b: Leading Sources Impairing Lakes — Part II (acres)

Source	Major	Moderate/minor	Not specified
Urban runoff/storm sewers	0	240,000	0
Nonindustrial permitted			
Industrial permitted			
Other urban runoff			
Illicit connections/illegal hookups			
Highway/road/bridge runoff			
Erosion and sedimentation			
Resource extraction	0	87,680	0
Surface mining			
Subsurface mining			
Placer mining			
Dredge mining			
Petroleum activities			
Mill tailings			
Mine tailings			
Acid mine drainage			
Abandoned mining			
Inactive mining			
Land disposal	0	145,920	0
Sludge			
Wastewater			
Landfills			
Inappropriate waste disposal			
Onsite wastewater systems (septic)			
Hazardous waste			
Sewage disposal			
Hydromodification	0	95,360	0
Channelization			
Dredging			
Dam construction			
Upstream impoundment			
Flow regulations/modification			
Habitat modification (nonhydrological)			
Removal of riparian vegetation			
Bank or shoreline modification			
Drainage/filling of wetlands			
Marinas and recreational boating			
In-water releases			
On-land releases			
Erosion from derelict land			
Atmospheric deposition			
Waste storage/storage tank leak			
Leaking underground storage tanks			
Highway maintenance and runoff			
Spills (accidental)			
Contaminated sediments			
Debris and bottom deposits			
Internal nutrient cycling			
Sediment resuspension			
Industrial land treatment			
Natural sources			

Table 29b: (continued)
Leading Sources Impairing Lakes — Part II (acres)

Source	Major	Moderate/minor	Not specified
Recreation and tourism activities			
Golf courses			
Salt storage sites			
Ground water loadings			
Ground water withdrawal			
Other	0	187,520	0
Unknown source			
Source outside state border			

Lakes with declining trends generally supported their designated use and had good water quality. Increased nonpoint pollution such as agricultural runoff, urban runoff, and septic tank leachate caused most degradation.

It is anticipated that, as SWIM restorations bear fruit and BMPs for nonpoint sources are more fully implemented, the number of improving trends in lake-water quality will increase.

Table 30: Trophic Status Of Significant Publicly Owned Lakes

	Number	Acreage
Surveyed	969	1,679,360
Oligotrophic	775	881,280
Mesotrophic	168	711,680
Eutrophic	22	62,080
Hypereutrophic	4	24,320
Dystrophic		

Table 31: Trends In Significant Publicly Owned Lakes

	Number	Acreage
Surveyed	541	1,310,080
Improving	109	184,960
Stable	313	688,000
Degrading	119	437,120

Estuary and Coastal Assessment

With over 8,000 coastal miles on three sides, Florida is second only to Alaska in amount of coastline. The state's west-coast alone contains almost 22 percent of the Gulf Coast estuarine acreage in the United States. *Table 32* shows the state's total estuarine and ocean shore waters.

Florida's estuaries are some of the nation's most diverse and productive. They include embayments, low- and high-energy tidal salt marshes, lagoons or sounds behind barrier islands, vast mangrove swamps, coral reefs, oyster bars, and tidal segments of large river mouths.

The Atlantic coast of Florida from the mouth of the St. Mary's River to Biscayne Bay is a high-energy shoreline bordered by long stretches of barrier islands, behind which lie highly saline lagoons. This 350-mile stretch of coast contains only eighteen river mouths and inlets. Biscayne Bay spans the transition from high- to low-energy shorelines, which are more typical of Florida's west coast.

At the southern end of the state lie Florida Bay and the Ten Thousand Islands, dominated by mangrove islands fronting expansive freshwater marshes on the mainland. Many tidal creeks and natural passes connect the islands and marshes. Historically, the area's fresh water came mainly from sheet flows across the Everglades.

Florida's west coast has low relief, since the continental shelf extends seaward for many miles. Unlike the east coast, numerous rivers, creeks, and springs contribute to estuarine habitats. Generally, the west coast's estuaries are well-mixed systems with classically broad variations in salinity. They often lie behind low-energy barrier islands or at the mouths of rivers that discharge into salt marshes or mangrove-fringed bays.

The Big Bend from the Anclote Keys north to Apalachee Bay is low-energy marsh shoreline. It does not conform to the classical definition of an estuary, although its flora and fauna are typically estuarine. Many freshwater rivers and streams feeding the shoreline here are either spring runs or receive significant quantities of spring water.

The Florida Panhandle from Apalachee Bay west to Pensacola Bay comprises high-energy barrier islands, with sand beaches fronting the Gulf of Mexico.

Major coastal and estuarine habitats vary from northern to southern Florida. Salt marshes dominate from Apalachicola Bay to Tampa Bay and from the Indian River Lagoon north to the Georgia state line. West of Apalachicola Bay, estuaries have few salt marshes. Mangrove swamps dominate the southern Florida coast. There are about 6,000 coral reefs between the city of Stuart on the Atlantic Coast south and west to the Dry Tortugas, while seagrasses are most abundant from Tarpon Springs to Charlotte Harbor, and from Florida Bay to Biscayne Bay.

Unfortunately, human activities have affected many estuaries, even though they are an important ecological and economic resource. Population growth and associated development pressures have contributed to their deterioration, since about three-fourths of new Florida residents choose coastal locations for their new homes.

Table 32: Total Estuarine And Ocean Shore Waters

Total estuarine square miles	4,437
Surveyed square miles	4,038
Coastal shoreline miles	8,460
Surveyed shoreline miles	0

Support for Designated Use

Florida's estuarine and coastal areas are either Class II waters (shellfish harvesting or propagation) or Class III waters (recreational and wildlife use). *Table 33* lists the total areas and support for designated use of estuaries. The "impaired" category includes estuaries that partially met or did not meet their designated use.

Table 33: Summary of fully supporting, threatened, and impaired estuaries (square miles)

	Evaluated	Monitored	Not specified
Fully supporting	2390	665	0
Threatened	42	79	0
Impaired	270	591	0
Not attainable			

Decisions on whether individual estuaries supported their designated use were based on the TSI, biological data, exceedances of water quality criteria for conventional pollutants and trace metals. The earlier section on methodology discusses the weighting method used.

Almost 80% of the state's estuaries fully supported their designated use. *Table 34* identifies the total estuarine areas that met different levels of designated use specified by the EPA. Examples of designated use include aquatic life support, swimming, and fishing.

Table 34: Individual use support in estuaries (square miles)

	Aquatic life (Class III)	Fish consumption	Shellfishing (Class II)	Swimming (Class III)	Secondary contact (Class III)
Fully supporting	1652	88	1398	1652	1652
Threatened	10	0	111	10	10
Partially supporting	538	261	256	538	538
Not supporting	68	18	0	68	68
Not attainable					

Impaired = partially or not supporting designated use

Florida's standards and criteria do not distinguish between protecting aquatic life, secondary contact, and other recreational uses, all of which are included in Class III standards.

Table 34 was generated by identifying the square miles of support or nonsupport for designated use for each of Florida's water quality standards. The areas for aquatic life, swimming, and secondary contact were obtained for Class III waters. The same total area was used for each of these categories. The square miles listed for shellfishing are different because Class II areas were combined to identify the shellfish-harvesting areas.

Seventy-three percent of the estuarine watershed area classified for recreational use fully supported that designation. Twenty percent of estuaries only partially supported their designated use. Conversely, only about 2 percent or less did not support designated use.

Causes and Sources of Nonsupport for Designated Use

The causes of nonsupport of designated use were assessed based on exceeded water quality screening levels for each water body and professional judgment.

Relative Assessment of Causes. *Table 35* identifies the main causes of nonsupport for areas not fully supporting their designated use. All causes were classified as having moderate/minor impacts because the same estuarine area had multiple causes. The biggest problem affecting estuaries was nutrient enrichment.

Relative Assessment of Sources. *Tables 36a and 36b* identify the main sources of nonsupport for areas not fully supporting their designated use. The most important sources were agriculture, municipal and industrial point sources, urban areas, and land disposal (including septic tanks).

Table 35: Leading Pollutants And Processes Impairing Estuaries (square miles)

Pollutant/process	Major	Moderate/minor	Not specified
Cause unknown			
Unknown toxicity			
Pesticides			
Priority organics			
Nonpriority organics			
PCBs			
Dioxins			
Metals	0	149	0
Arsenic	0	0	0
Cadmium	0	0	0
Copper	0	97	0
Chromium			
Lead	0	133	0
Mercury			
Selenium	0	0	0
Zinc	0	0	0
Ammonia (un-ionized)			
Chlorine			
Cyanide			
Sulfates			
Other inorganics			
Nutrients	0	845	0
Phosphorus	0	1552	0
Nitrogen	0	1808	0
Other			
pH			
Siltation			
Organic enrichment/low DO			
Salinity/TDS/chlorides			
Thermal modifications			
Flow alterations			
Habitat alteration (nonflow)			
Pathogens			
Radiation			
Oil and grease			
Taste and odor			
Suspended solids			
Noxious aquatic plants			
Algae/chlorophyll *a*	0	175	0
Total toxics			
Turbidity			
Exotic species			

Table 36a: Leading Sources Impairing Estuaries — Part I (square miles)

Source	Major	Moderate/minor	Not specified
Industrial PS	0	315	0
Major industrial PS			
Minor industrial PS			
Municipal PS	0	311	0
Major municipal PS – dry/wet			
Major municipal PS – dry			
Major municipal PS - wet			
Minor municipal PS - dry/wet			
Minor municipal PS - dry			
Minor municipal PS - wet			
Package plants			
CSO			
Collection system failure			
Domestic wastewater lagoon			
Agriculture	0	478	0
Crop-related sources			
Nonirrigated crop production			
Irrigated crop production			
Specialty crop production			
Grazing-related sources			
Pasture - riparian/upland			
Pasture – riparian			
Pasture – upland			
Range - riparian/upland			
Range – riparian			
Range – upland			
Intensive animal feed operations			
CAFO, permitted PS			
CAFO, NPS			
Aquaculture			
Silviculture	0	85	0
Harvesting, restoration			
Forest management			
Logging road construction/maintenance			
Silvicultural PS			
Construction	0	398	0
Highway/road/bridge construction			
Land development			

Table 36b: Leading Sources Impairing Estuaries — Part II (square miles)

Source	Major	Moderate/minor	Not specified
Urban runoff/storm sewers	0	409	0
Nonindustrial permitted			
Industrial permitted			
Other urban runoff			
Illicit connections/illegal hookups			
Highway/road/bridge runoff			
Erosion and sedimentation			
Resource extraction	0	184	0
Surface mining			
Subsurface mining			
Placer mining			
Dredge mining			
Petroleum activities			
Mill tailings			
Mine tailings			
Acid mine drainage			
Abandoned mining			
Inactive mining			
Land disposal	0	483	0
Sludge			
Wastewater			
Landfills			
Inappropriate waste disposal			
Onsite wastewater systems (septic)			
Hazardous waste			
Sewage disposal			
Hydromodification	0	374	0
Channelization			
Dredging			
Dam construction			
Upstream impoundment			
Flow regulations/modification			
Habitat modification (nonhydrological)			
Removal of riparian vegetation			
Bank or shoreline modification			
Drainage/filling of wetlands			
Marinas and recreational boating			
In-water releases			
On-land releases			
Erosion from derelict land			
Atmospheric deposition			
Waste storage/storage tank leak			
Leaking underground storage tank			
Highway maintenance and runoff			
Spills (accidental)			
Contaminated sediments			
Debris and bottom deposits			
Internal nutrient cycling			
Sediment resuspension			
Industrial land treatment			
Natural sources			

Table 36b: (continued)
Leading Sources Impairing Estuaries — Part II (square miles)

Source	Major	Moderate/minor	Not specified
Recreation and tourism activities			
Golf courses			
Salt storage sites			
Ground water loadings			
Ground water withdrawal			
Other	0	481	0
Unknown source			
Source outside state border			

Wetlands Assessment

Because of its low elevation and peninsular nature, Florida has many varied types of wetlands, including estuarine spartina and mangrove marshes, as well as freshwater sawgrass marshes, cypress swamps, and floodplain marshes. Wetlands comprise almost one-third of the state. The following are the largest and most important:

1. *The Everglades and the adjacent Big Cypress Swamp. Including the Water Conservation Areas (diked portions of the original Everglades system) and excluding the developed coastal ridge, this system extends from about twenty miles south of Lake Okeechobee to Florida Bay.*

2. *The Green Swamp in the state's central plateau.*

3. *The Big Bend coast from the St. Marks River to the Withlacoochee River.*

4. *Vast expanses of spartina marsh between the Nassau and St. Marys rivers.*

5. *The headwaters and floodplains of many rivers throughout the state, especially the Apalachicola, Suwannee, St. Johns, Oklawaha, Kissimmee, and Peace rivers.*

Although information on the historical extent of Florida's wetlands is limited, one researcher estimates that the state lost as many as 46 percent of its original wetlands between the 1780s and the 1980s *(see Table 37 for estimates of Florida's historical wetlands).*

Table 37: Historical Estimates Of Wetlands In Florida

Period	Wetlands acreage	Source
circa 1780	20,325,013	*Dahl*
mid-1950s	12,779,000	*Hefner*
mid-1970s	11,334,000	*Hefner*
mid-1970s	11,298,600	*Frayer and Hefner*
1979 - 1980	11,854,822	*National Wetlands Inventory*
circa 1980	11,038,300	*Dahl*

Sources:

Dahl, Thomas E., *Wetland Losses in the United States, 1780s to 1980s* (U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., 1990).

Frayer, W.E. and J.M. Hefner, *Florida Wetlands Status and Trends, 1970s to 1980s* (U.S. Department of the Interior, Fish and Wildlife Service, Atlanta, September 1991).

Hefner, John M., *Wetlands of Florida, 1950s to 1970s* (in *Managing Cumulative Effects in Florida Wetlands* [Conference Proceedings, October 17-19, 1985], New College, Sarasota, 1986).

National Wetlands Inventory, Florida Wetland Acreage (U.S. Fish and Wildlife Service, St. Petersburg, January 1984).

Wetlands Management and Protection. While no formal, statewide wetlands conservation plan exists, the state's wetlands protection programs are well established in Florida's statutes, regulations, and policies. The 1984 Warren S. Henderson Wetlands Protection Act formally recognized the value of the state's wetlands in protecting water quality and biological resources. The act regulated permitting and required the tracking of affected wetlands and the creation of a wetlands inventory.[19] Wetlands protection was amended in 1993 to provide a unified statewide approach to defining wetlands and to streamline permitting into a single Environmental Resource Permitting Program for regulating point and nonpoint pollution as well as water quantity.

Enforcing the Environmental Resource Permit relies heavily on public awareness. Although each district has its own enforcement officers, the public reports many violations. Public education occurs through several state pamphlets and documents, technical and regulatory workshops, and newspaper coverage. The press has done a good job of reporting on wetlands issues.

Instead of using the federal methodology for defining wetlands, FDEP's rules address the extent of its wetlands jurisdiction (Chapter 62-340, F.A.C.). This approach, designed specifically for Florida wetlands communities, determines the landward extent of wetlands and other surface waters. It applies to both isolated and contiguous wetlands, with some exceptions in Northwest Florida, and must be used by all local, state, and regional governments.

Under the rule, the landward extent of a wetland is defined by the dominance of plants, soils, and other evidence of regular or periodic inundation or saturation with water. Florida's approach compares with the federal in scope but differs in its use of soils and the vegetative index. As part of the process of expanding the Army Corps of Engineers' state programmatic general permit, field testing is under way to refine the differences between the state and federal approaches.

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[19]Because of a variety of funding and contract problems, the inventory has not yet been created.

Numerous programs are working to restore both freshwater and estuarine wetlands — most notably, the Everglades system. Over 40,000 acres of filtration marshes known as Stormwater Treatment Areas are being built to reduce the phosphorus in agricultural runoff entering the Everglades. Filtration marshes are also being used in the Oklawaha River and Upper St. Johns River basins.

Comprehensive mapping is essential to assessing the extent of Florida's wetlands and how human activities affect them. Both the U.S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission have mapped wetlands. Local governments have also carried out mapping to comply with local comprehensive land-use plans. Several programs to map estuarine seagrasses have begun under the National Estuary Program and the state SWIM Program in the Indian River Lagoon, Tampa Bay, and Sarasota Bay. In addition, FDEP continues to develop its GIS work to track the wetlands management program.

Land acquisition is crucial to wetlands preservation. The state has bought wetlands and other environmentally sensitive lands since 1963, mainly through the Conservation and Recreation Lands Program, administered by FDEP, and the Save Our Rivers Program, administered by the WMDs. Both are funded primarily by the documentary stamp tax on the transfer of property. Additional funding comes from the Preservation 2000 Trust Fund. In addition to outright land purchases, the state and WMDs can enter into agreements where the owner retains use of the property with certain restrictions such as conservation easements, the purchase of development rights, leasebacks, and sale with reserved life estates.

Integrity of Wetlands Resources. *Table 38* summarizes the acreage of affected wetlands (regulated by FDEP and the WMDs) from 1985 to 1993. Implementing the Environmental Resource Permit Program, adopting a unified approach to defining wetlands, and sharing information between FDEP and the WMDs will substantially reduce problems in future reports. In comparing the numbers, the following should be considered:

1. *The numbers reflected only wetlands permits and did not measure overall trends. Wetlands lost to nonpermitted or exempt activities were not tracked.*

2. *Some minimal overlap occurred where FDEP and the WMDs both issued permits.*

3. *The WMDs used different measurements to determine jurisdictional wetlands during this period.*

4. *Not all figures were verified by field inspections or remote-sensing techniques.*

Table 38: Wetlands Acreage Affected By Permitted Activities, 1985 - 1993

Agency	Wetlands acreage			
	Lost	Created	Preserved	Improved
FDEP	7,827	39,272	20,900	123,843
WMDs				
Northwest Florida	187	170	1,986	0
Suwannee River	188	45	7,343	0
St. Johns River	4,351	8,719	65,256	14,028
Southwest Florida	4,293	3,409	30,549	1,254
South Florida	13,658	11,532	73,135	20,893
Totals	30,504	63,147	199,169	160,018

Lost — Wetlands destroyed.
Created — Wetlands created from uplands or nonjurisdictional wetlands connected to jurisdictional wetlands.
Preserved — Jurisdictional wetlands legally entered into some type of conservation easement.
Improved — Poor-quality jurisdictional wetlands enhanced by activities such as improved flow and the removal of exotic species.

Florida does not assess support for designated use for wetlands as it does for other surface waters. Although some background data are collected for issuing permits (particularly for wastewater discharged to wetlands) and restoration programs may require water quality data, no comprehensive wetlands-monitoring network exists.

Development of Wetlands Water Quality Standards. The state's policy for preventing wetlands degradation is set out in Section 403.918, F.S., and in Section 62-302.300 and 62-4.242, F.A.C. Proposed permits that may degrade wetlands must be clearly in the public interest. More stringent tests apply to activities that may degrade wetlands in OFWs. Finally, an extremely rigorous nondegradation policy covers Outstanding National Resource Waters.[20]

Since wetlands are considered waters of the state, they are regulated under the same standards as other surface waters *(Table 39 summarizes the development of wetlands and surface water standards),* and the same five functional classifications described earlier also apply.

Florida's rules already contain qualitative and quantitative biological criteria such as dominance of nuisance species and biological integrity. The state has spent the past six years developing procedures for assessing biological communities in streams, defining stream ecoregions, and identifying relatively pristine stream reference sites. Similar work on lakes is nearing completion, and procedures for wetlands are under early development.

[20]Although this last designation, created in 1989, applies to Everglades and Biscayne national parks, it has not been confirmed by the Florida legislature.

Table 39: Development Of State Wetlands Water Quality Standards

	In place	Under development	Proposed
Use classification	X		
Narrative (qualitative) biocriteria	X	X	X
Numeric (quantitative) biocriteria	X	X	X
Antidegradation	X		
Implementation method	X		

Additional Wetlands Protection. Florida's five WMDs regulate agriculture and silviculture under Chapter 373, F.S. Permit applicants must show that they will not harm wetlands (including isolated wetlands) of five acres or larger. A state committee advises the districts on silvicultural BMPs in hardwood forested wetlands. The districts also administer permits for surface water and ground water withdrawals (consumptive use permitting) under Part II, Chapter 373, F.S.

FDEP, the Florida Department of Agricultural and Consumer Services, and the WMDs are reviewing regulations that affect agriculture and consolidating permitting. The review is part of a larger multiagency effort, Florida's Private Lands Initiative, to promote stewardship of private lands — particularly agricultural lands. The initiative will integrate regulations with stewardship activities, such as whole farm planning, and one-stop permitting will provide an incentive for stewardship. A pilot project has begun in northern Charlotte County.

Mitigation is often used to offset otherwise unpermittable wetlands impacts. Accepted by rule since 1984 under Part III, Chapter 62-312, F.A.C., mitigation includes the restoration, enhancement, creation, or preservation of wetlands, other surface waters, or uplands. The amount of land to be mitigated, called the mitigation ratio (mitigation ratio = land mitigated/land affected) is based on the quality of the area affected, its function, and the ability of mitigation to replace those functions. Ratios generally range from 1.5:1 to 4:1 for created or restored marshes, 2:1 to 5:1 for created or restored swamps, 4:1 to 20:1 for wetlands enhancement, 10:1 to 60:1 for wetlands preservation, and 3:1 to 20:1 for uplands preservation.

FDEP adopted rules governing mitigation banks in February 1994 under Chapter 62-342, F.A.C. A mitigation bank is a large area set aside for preservation or restoration. Permit applicants can, for a fee, withdraw mitigation credits to offset damage to wetlands functions. Mitigation credits are the increase in ecological value from restoring, creating, enhancing, or preserving wetlands.

Summary Data

This chapter brings together information from many different programs in FDEP and numerous other state, local, regional, and federal agencies. Topics include environmental contamination problems, consumption advisories, and closed surface water drinking supplies and bathing areas.

Public Health/Aquatic Life Impacts and Concerns

Table 40 shows the total size of the surface waters monitored for toxicants and the size of the waters found to contain elevated levels of toxicants.

Table 40: Surface Waters Monitored For Toxicants

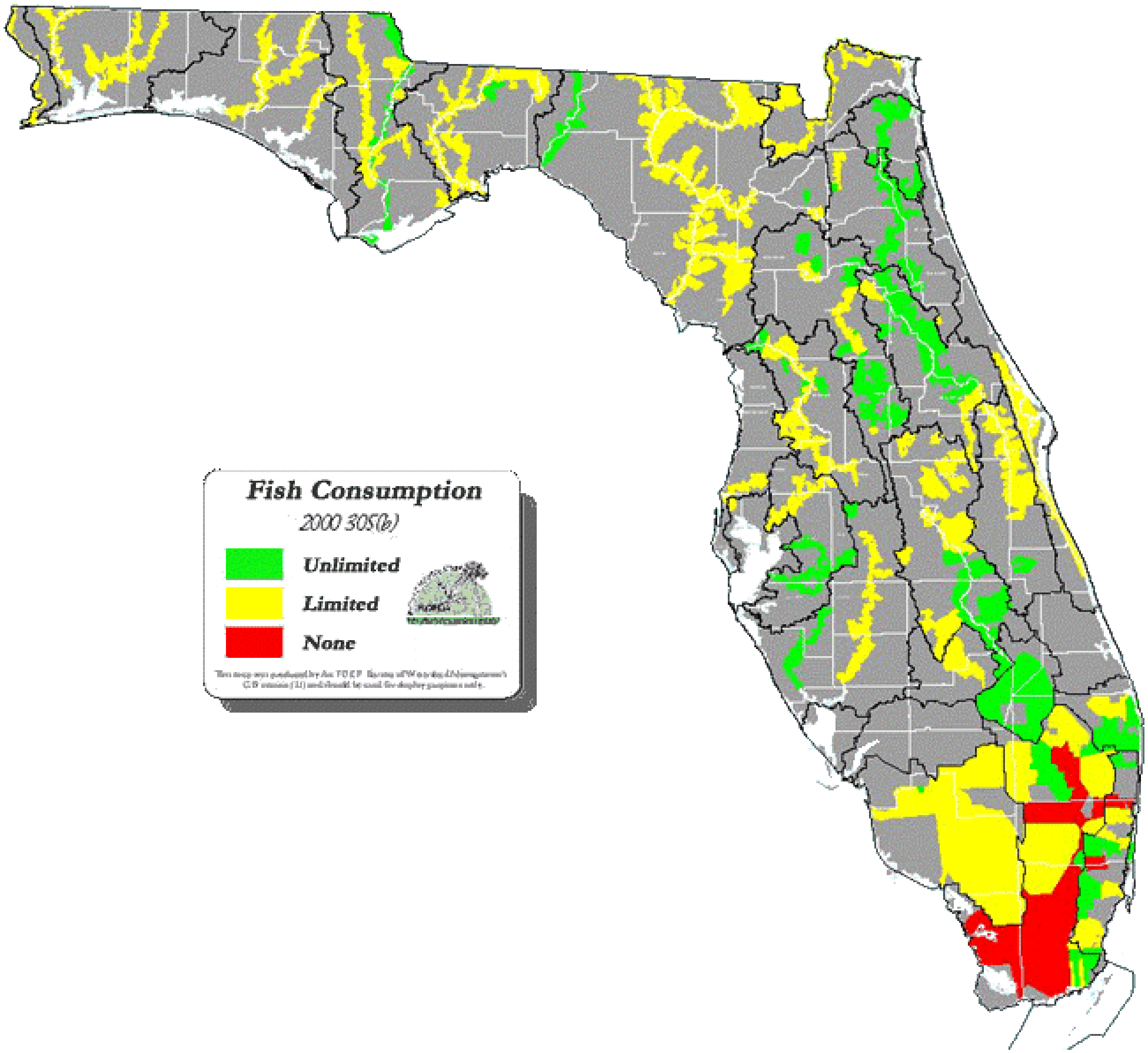
Water body	Size monitored for toxicants	Size with elevated levels of toxicants
Rivers (miles)	3,445	1,973
Lakes (acres)	873,600	739,840
Estuaries (square miles)	743	283
Coastal waters (miles)		
Freshwater wetlands (acres)		
Tidal wetlands (acres)		

Fish Consumption Advisories. In many parts of the state, no-consumption and limited consumption fish advisories have been issued for mercury in both fresh waters and coastal waters. A dioxin advisory has also been issued for fish from the Fenholloway River (Figure 6).

Sediment Contamination. Florida's unique geologic and hydrologic features make surface water and ground water relatively vulnerable to contamination. Sediment and soil contamination is particularly important to water quality because surface and subsurface sediments, ground water, and surface water interact extensively. Sediment contamination is also crucial because of the state's extensive estuaries and their use as fisheries.

Although Florida currently has no criteria for heavy metals or toxic organics in sediments, FDEP's Intergovernmental Programs Section studied estuarine sediments to assess current conditions, develop tools to identify contaminated areas, and provide background information to develop future sediment criteria.

Figure: 6 Fish Consumption Advisories



The initial study collected and interpreted data on natural background concentrations of selected metals, including arsenic, cadmium, chromium, copper, mercury, lead, zinc, cadmium, barium, iron, lithium, manganese, silver, titanium, and vanadium.[21] The study was later expanded to include five classes of organic contaminants: chlorinated hydrocarbons (pesticides), polycyclic aromatic hydrocarbons, polychlorinated biphenyls, phenolic hydrocarbons, and aliphatic hydrocarbons.[22]

A sediment database contains information collected from 700 sites by FDEP, 42 sites by the National Oceanic and Atmospheric Administration's National Status and Trends Program, and 33 sites in the St. Johns River by Mote Marine Laboratory (a private marine research facility in Sarasota). The data came from three different surveys. From 1983 to 1984, sediments were collected as part of the Deepwater Ports Project from sites near dense population centers and close to commercial channels and ship berths. A second survey, from 1985 to 1991, assessed sites where contamination was expected because of flows from tributaries and local land use practices. The third survey examined sites in relatively remote or unimpacted areas.

Once the data were collected, the group developed tools using metal-to-aluminum ratios to identify estuarine and marine sites contaminated with cadmium, lead, arsenic, zinc, lead, nickel, chromium, and copper. Ratios greater than one indicate potential contamination. Mercury was evaluated against a maximum concentration associated with uncontaminated estuarine sediments. Metal contamination above background levels was most often seen for cadmium, mercury, lead, and zinc. Polyaromatic hydrocarbons were found in about 70 percent of the samples tested for organic chemicals. Of this group, fluoranthene and pyrene were found in more than 50 percent of the samples. Not surprisingly, more contaminants were found in urban watersheds than in rural or undeveloped watersheds.

While contaminant levels in estuarine and marine sediments can be measured, the effects of specific concentrations of metals or organic chemicals on aquatic life are not completely understood. Because of the difficulty of interpreting the data, FDEP developed guidelines for assessing sediment quality rather than sediment criteria. They provide ranges of concentrations that could cause a specific level or intensity of biological effects.

Using data from twenty different areas of Florida, FDEP developed preliminary guidelines for thirty-four priority contaminants in coastal and marine sediments.[23] Data from acute toxicity tests were used mainly because little information exists on chronic effects. Three ranges of effects were defined for each contaminant: probable, possible, and minimal. These are interpreted, respectively, as concentrations that always have an effect, frequently have an effect, and rarely or never have an effect. The guidelines for twenty-eight substances have a high or moderate degree of reliability. The guidelines for all thirty-four substances, used collectively, predict the potential effects of contaminated marine and estuarine sediments on biological communities.[24]

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[21] This effort culminated in the release of the document A Guide to Interpretation of Metal Concentrations in Estuarine Sediments, Florida Department of Environmental Regulation, Coastal Zone Management Section, April 1988.

[22] The expanded database is summarized in Florida Coastal Sediment Contaminants Atlas, FDEP, 1994.

[23] This approach was adapted from recommendations by Long and Morgan, National Oceanic and Atmospheric Administration National Status and Trends Approach, 1990.

[24] For a complete discussion of methodology, see the report, Approach to the Assessment of Sediment Quality in Florida Coastal Waters, D.D. MacDonald, McDonald Environmental Sciences Ltd., 1994.

Although the guidelines are a valuable tool, it is recommended that they be used with other tools and procedures. Direct cause and effect should not be inferred. They also do not replace dredging disposal criteria or formal procedures, nor are they meant to be sediment quality criteria or numerical attainment levels for cleaning up Superfund sites.

Public Bathing Closures. The Florida Department of Health regulates public bathing places (swimming and water recreation areas in both fresh and salt water bodies), under Sections 381.0011, 381.006, F.S. Each county's public health unit permits and monitors in accordance with Section 10D-5, F.A.C.

Because only permitted bathing places are typically monitored, many lakes and rivers used for swimming are unmonitored, or monitoring is left to municipal agencies where available. In addition, most saltwater beaches are not routinely monitored.

Public Health: Drinking Water. Surface waters supply about 13 percent of Florida's drinking water. Of 7,200 public drinking water systems, nineteen obtain their water from surface water. An additional twenty-six wholly or partially purchase water from these nineteen systems. Because it is expensive to operate a surface water system (given that filtration and advanced disinfection are costly), most are large.

Support for Drinking Water Use

To determine support for drinking water use, the data for all class I rivers and lakes in the state were examined.

Summary of support for designated use as drinking water: rivers, streams, and reservoirs

Tables 41 and 42 summarize the causes and acreage's of water bodies not fully supporting drinking water use.

Table 41:Summary Of Assessments For Drinking Water Use: Rivers And Streams

Total miles assessed for drinking water use — 358				
Miles fully supporting drinking water use	289	Percent fully supporting drinking water use	80	Major causes
Miles fully supporting but threatened for drinking water use		Percent fully supporting but threatened for drinking water use		
Miles partially supporting drinking water use	67	Percent partially supporting drinking water use	29	
Miles not supporting drinking water use	2	Percent not supporting drinking water use	1	
Total miles assessed for drinking water use 100%	358		100%	

Table 42: Summary Of Assessments For Drinking Water Use: Lakes And Reservoirs

Total area assessed for drinking water use — 419,200 acres				
Acres fully supporting drinking water use	10,880	Percent fully supporting drinking water use	3	Major causes
Acres fully supporting but threatened for drinking water use		Percent fully supporting but threatened for drinking water use		
Acres partially supporting drinking water use	407,680	Percent partially supporting drinking water use	97	
Acres not supporting drinking water use	640	Percent not supporting drinking water use	0	
Total acres assessed for drinking water use	419,200		100%	

Ground Water Assessment

Ground water — that is, water under the land's surface — is one of our most valuable natural resources. Naturally, any assessment of drinking water is also an assessment of ground water, since drinking water for 87 percent of Florida's fourteen million people comes from ground water. Ground water is also used for irrigation and many other essential commercial, industrial, and domestic activities.

Most of the state's drinking water comes from the Floridan Aquifer system, one of the world's largest aquifers. (An aquifer is a geologic formation capable of yielding a significant amount of ground water, while an aquifer system is a group of one or more aquifers and/or confining beds — impermeable or less permeable layers of soil or rock adjacent to an aquifer.) In some areas the Floridan, largely a limestone and dolomite aquifer, is unconfined and close to the surface, while in other areas it is deep and artesian (confined and under pressure). Much of the water is high quality — that is, it contains less than 500 milligrams per liter of total dissolved solids.

Two substantial surficial aquifers — water table aquifers lying close to the surface — at opposite ends of the state supply some local drinking, industrial, and irrigation water. The Biscayne Aquifer supplies the Miami metropolis, while the Florida Sand and Gravel Aquifer provides water for the Pensacola area.

Intermediate aquifers, also called secondary artesian aquifers, are composed of confined limestone and shell beds interspersed with some layers of clay and sand. These aquifers provide important public drinking water sources for Sarasota and Lee counties. A geologic formation, the Hawthorn Group sediments, separates the surficial and intermediate aquifers.

Ground water is the source of springs and a significant source for streams. Florida contains thrity-six of the seventy-eight highest volume (first-magnitude) springs in the United States. Ground water also seeps upward to maintain water levels in most of the state's lakes.[25]

This chapter discusses Florida's current and historical ground water monitoring network and provides an overview of ground water contamination sources and protection programs.

Florida's Ground Water Monitoring Network

The 1983 Water Quality Assurance Act (Section 403.063, F.S.) required the state to establish a ground water monitoring program to provide scientifically defensible information on the important chemical and physical characteristics of water from three major aquifer systems: the deep Floridan Aquifer, the intermediate aquifer, and the shallow surficial aquifer.

The Florida Ground Water Monitoring Program continued until the fall of 1999, when it was replaced with the Integrated Water Resources Monitoring Program (IWRM). The section on FDEP's

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[25]White, W.A., *Geomorphology of the Florida Peninsula,* Florida Department of Natural Resources, Florida Geological Survey Bulletin No. 51, 1970.

monitoring program in the previous chapter provides details of IWRM. As Florida implements the Watershed Approach for the management of water resources, IWRM will meet the requirements of this approach to monitoring. The original ground water program met its program objective of providing information on the background quality of Florida's ground water.

FDEP managed the Florida Ground Water Quality Monitoring Program through contracts with the state's five WMDs and six (out of a total of sixty-seven) county governments. The program's objectives were to collect information on background ground water quality for the state, determine significant trends, detect and predict changes from various land uses and potential sources of contamination, and disseminate information to the public.

Historical Ground Water Quality Monitoring Networks

The Florida Ground Water Quality Monitoring Network, comprising more than 2,900 wells statewide, contained two sub-networks: the Background Network and the Very Intense Study Area (VISA) Network. Each has unique monitoring priorities. The Florida Department of Health also operated a third network, the Private Well Survey, between 1986 and 1997. It analyzed ground water quality from fifty private drinking water wells in each county. Although sampling was completed in thirty-four counties, the project was not finished because of budget cuts and altered priorities. It is no longer part of the active monitoring network.

The Background Network, first sampled in 1984, consists of a statewide grid of over 2,000 wells that tap into the state's three major aquifer systems *(Figures 7a and 7b show Background Network wells by location and type)*. Background water quality is defined as existing water quality where land uses are unlikely to have widespread effects. (In this sense, background water quality differs from pristine water, that is, water unaffected by human activity.)[26] A third of the background wells are sampled annually, so that all wells are sampled every three years. Both the procedures for collecting data and the data themselves are checked for accuracy.

The VISA Network, consisting of about 400 wells, began operating in 1990 *(Figure 8).* Monitored the effects of various land uses on ground water quality in specific aquifers in selected areas. The major land uses are intensive agriculture, mixed urban/suburban, industrial, and low impact. The VISAs are chosen based on their relative susceptibility to contamination. Florida has complete data sets for twenty-three VISAs.

Wells in the VISA and Background Networks are sampled in the same year. *Table 43* lists the various water chemistry indicators and groups of pollutants monitored in both networks. Because of budget constraints, complete statewide testing for trace metals, pesticides, volatile organic chemicals, and synthetic organic chemicals (base neutral acid extractables) was reduced to once every nine years.

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[26]For further discussion of background water quality in Florida aquifers, see Maddox, G.L., *et al.* (editors), *Florida Ground Water Quality Monitoring Program — Volume 2, Background Hydrogeochemistry,* Florida Geological Survey, Special Publication No. 34, 1992.

During the first VISA and background sampling, all wells were tested for the standard analytes and trace metals. During the second sweep, they were sampled for the standard list and pesticides, but not metals. For the final sweep, all wells were sampled for the standard list and volatile organic chemicals and base neutral acid extractables, but not metals or pesticides.

The Temporal Variability Network, a subset of about fifty wells across the state, is also monitored monthly to assess how ground water quality varies over time in the three aquifer systems *(Figure 9).*

By comparing VISA and background results in the same aquifer system, FDEP can develop lists of pollutants commonly found in different kinds of land uses. This process helps the state plan for and regulate those land uses. It is essential, however, to understand local geology and hydrology as well as the limits of monitoring to interpret the study results correctly.**[27]**

Statewide Ground Water Contamination

Thin soils, a high water table, porous limestone formations, high levels of rainfall, and a high potential for saltwater intrusion leave Florida's ground water vulnerable to pollution. Surficial aquifers are especially at risk because they are the first ground water layer where pollutants enter from land and air.

Table 44 lists the most common sources and causes of ground water contamination. Sources were identified as highest priority if specific programs, staff, and resources have been appointed to address those sources of contamination. The table, however, does not imply specific priorities. Two additional sources are noted with asterisks: cattle dip vats, which are unique to Florida, and pesticide applications. While these are issues of concern, there are no specific programs to address them. Agricultural activities rate particularly high.

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[27]To date, aquifer sizes and natural ground water conditions such as elevated levels of iron and manganese have been characterized in two publications of FDEP's Ground Water Quality Monitoring Program: *Hydrogeologic Framework* in Scott, T.M., *The Lithostratigraphy of the Hawthorn Group (Miocene) of Florida,* Florida Department of Natural Resources, Florida Geological Survey Bulletin No. 59, 1988; and *Background Hydrogeochemistry* (Maddox *et al*., 1992).

Figure 7a: Location Of Background Network Monitoring Wells

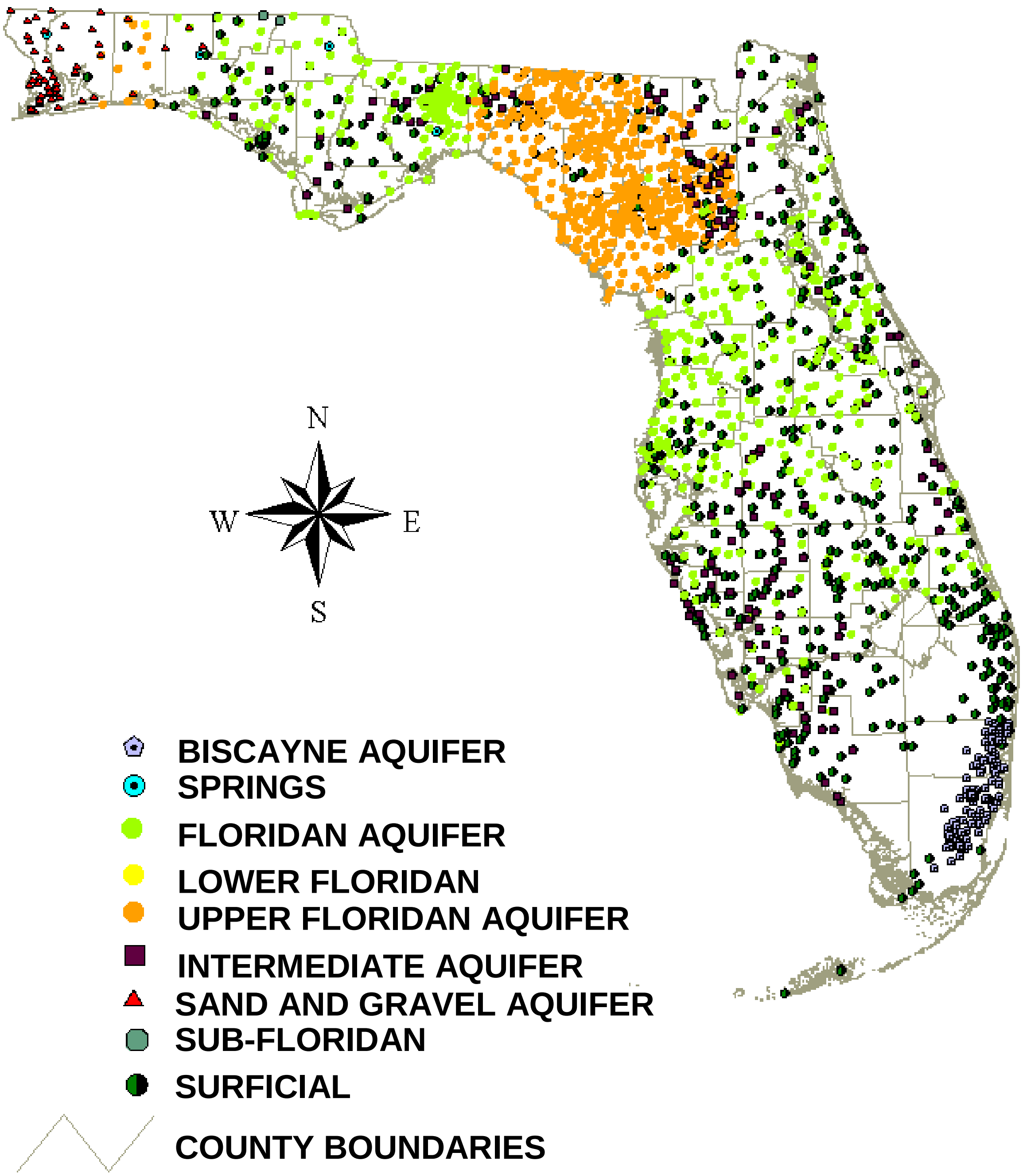

Figure 7b: Location Of Background Network Wells By Type

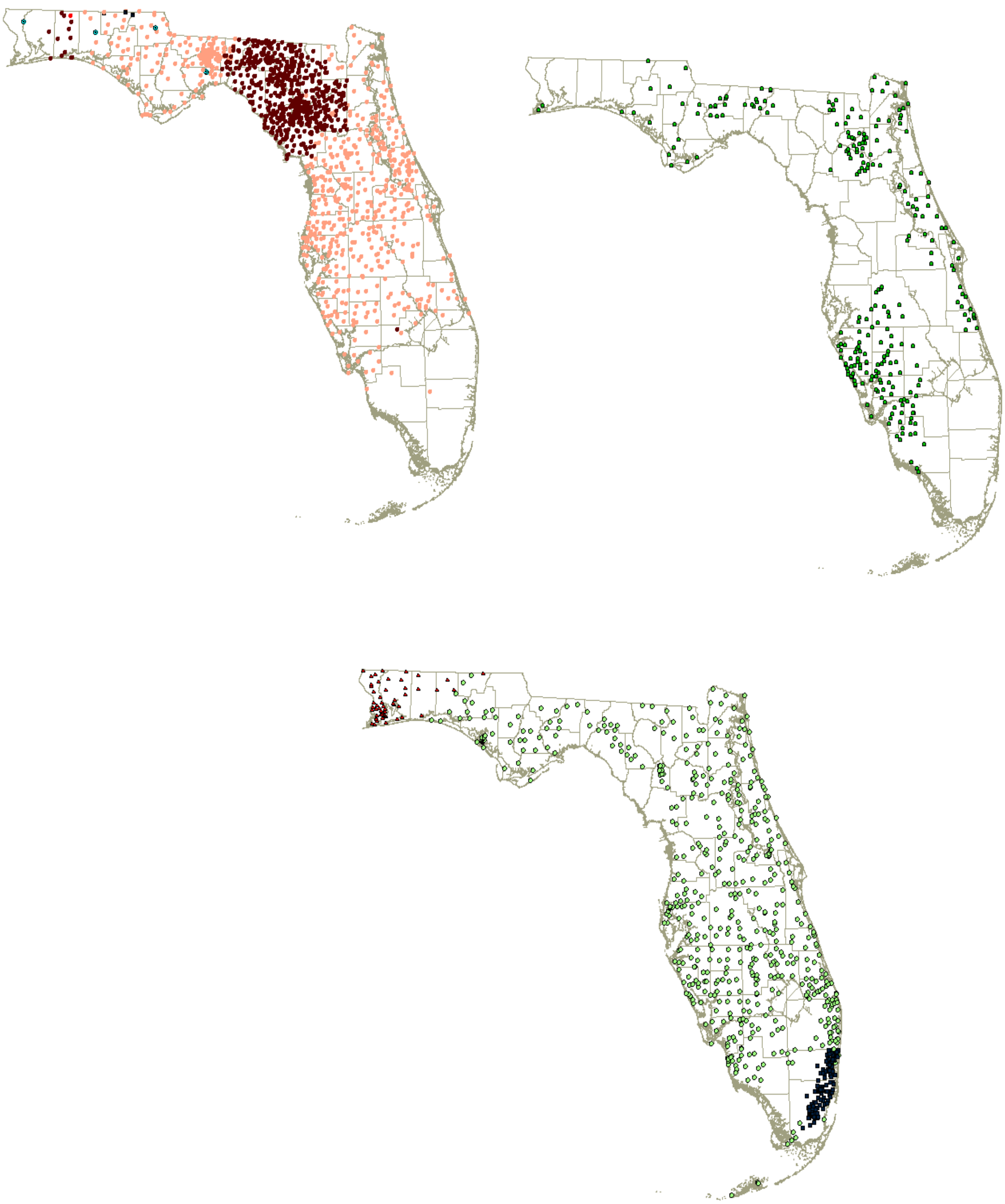

Figure 8: Location of VISA Network Monitoring Wells

FDEP Groundwater Quality Monitoring Program VISA Network

VISA Location	Aquifer	Predominant Land Use
NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT:		
1) Pensacola	Sand & Gravel	Heavy Industrial
2) Gulf Breeze	Sand & Gravel	Mixed Urban/Suburban
3) Panama City	Surficial	Mixed Urban/Suburban
4) NE Jackson County	Floridan	Cropland Agricultural
5) South Tallahassee	Floridan	Light Industrial
SUWANNEE RIVER WATER MANAGEMENT DISTRICT:		
6) Live Oak	Floridan	Mixed Urban/Industrial
7) Lafayette County	Floridan	Agricultural/Dairies
ALACHUA COUNTY:		
8) West Gainesville	Floridan	Mixed Urban/Suburban
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT:		
9) Talleyrand	Surficial	Heavy Industrial
10) Putnam/Volusia	Floridan	Agricultural/Ferneries
11) Ocala	Floridan	Urban/Suburban
12) North Lake Apopka	Surficial	Cropland/Agricultural
13) Palm Bay	Surficial	Single Family
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT:		
14) E. Polk County	Surficial	Orchards/Citrus
15) E. Polk County	Floridan	Orchards/Citrus
16) Hillsborough Co.	Surficial/Floridan	Single Family
17) Pinellas County	Surficial	Light Industrial
SOUTH FLORIDA WATER MANAGEMENT DISTRICT:		
18) S. Orange County	Surficial	Mixed Urban/Industrial
19) S. Lee County	Surficial	Single Family
20) Martin County	Surficial	Orchards/Citrus
21) Palm Beach Co.	Surficial	Sludge/Citrus
22) NE Broward Co.	Biscayne	Mixed Urban/Industrial
23) NE Dade Co.	Biscayne	Heavy Industrial

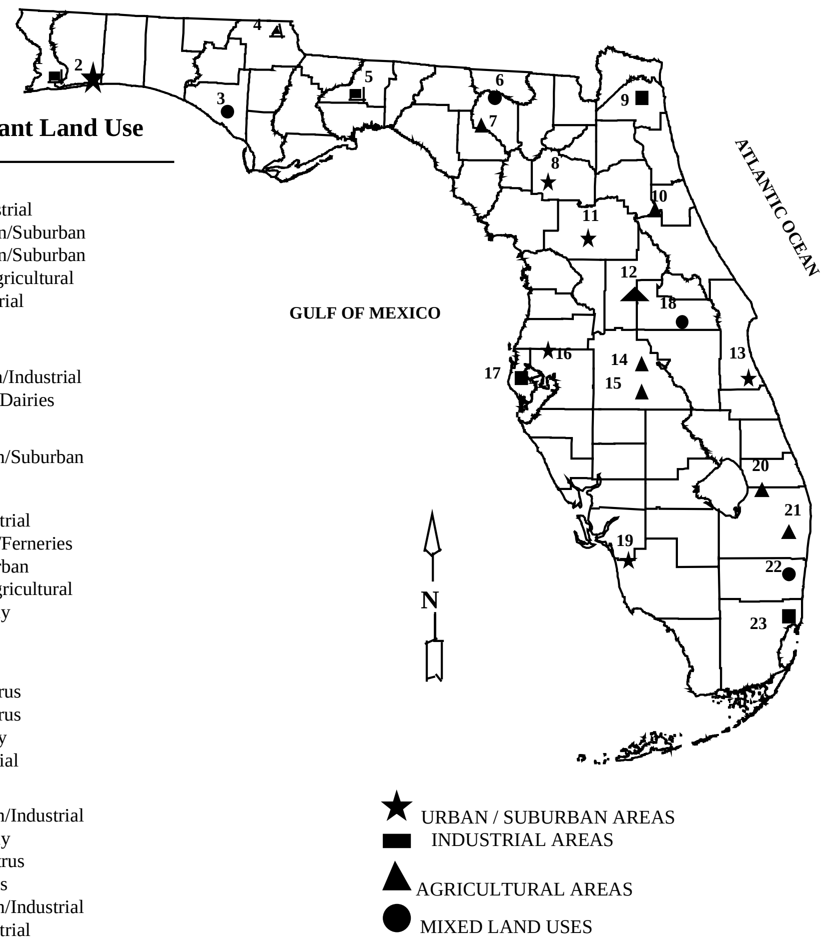

Figure 2. Location of Very Intense Study Area well networks

Table 43: Florida Ground Water Quality Monitoring Program Analyte List*

STANDARD ANALYTE LIST

Water level	Dissolved sodium	Dissolved iron	Nitrate + nitrite
Specific conductance	Dissolved potassium	Dissolved manganese	Ammonia
Temperature	Dissolved calcium	Dissolved strontium	Turbidity
Dissolved oxygen	Dissolved magnesium	Dissolved aluminum	Dissolved sulfate
Dissolved fluoride	Dissolved chloride	Sulfide	Orthophosphorus
pH (relative acidity or alkalinity)	Total Kjeldahl nitrogen	Dissolved alkalinity	
Eh (oxidation reduction or redox potential)			

TRACE METAL ANALYTE LIST

Total iron	Dissolved barium	Dissolved organic carbon	Total carbon
Total manganese	Dissolved silver	Total organic carbon	Total arsenic
Total strontium	Dissolved chromium	Dissolved copper	Total copper
Total aluminum	Dissolved nickel	Total barium	Total cadmium
Total mercury	Dissolved zinc	Dissolved lead	Total lead
Total selenium	Total nickel		

VOC/BNA ANALYTE LIST

VOCs — Volatile organic chemicals	BNAs — Base neutral acid extractables

PESTICIDE ANALYTE LIST

Carbamates	Chlorinated pesticides	Nitrogen/phosphorus pesticides	Herbicides	Urea

TEMPORAL VARIABILITY ANALYTE LIST

Water level	Temperature	pH	Eh	Dissolved oxygen	Specific conductance

**The Temporal Variability Network is only sampled for the Temporal Variability Analyte List, while the Background Network and the VISA Network are sampled for all these measures*

Table 44: Major Sources of Ground Water Contamination

Contaminant source	Highest priority sources (✓)	Factors considered in selecting a contaminant source	Contaminants
Agricultural activities			
Agricultural chemical facilities	✓	C,D,E	H,M(SO_4),F,I
Animal feedlots	✓	A,C,E,F	E,J,K,L
Drainage wells			
Agricultural mix/load sites	✓	F	A,B,D,E
Fertilizer applications*	✓	A,C,D,E,B,F	E
Pesticide applications	X	A,B,C	A,B,H
Cattle dip vats*	X	E	Arsenic, D
Storage and treatment activities			
Land application			
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	✓	B,D,A	D
Surface impoundments			
Waste piles			
Waste tailings			
Disposal activities			
Deep injection wells			
Landfills	✓	C,A,D,B,E	C,E,H,D,A,B,F,J
Septic systems	✓	D,C,B,A	E,L,K
Shallow injection wells			
Other			
Hazardous waste generators			
Hazardous waste sites	✓	A,D,C,E	C,A,B,H,D, phenols, PCBs
Industrial facilities	✓	A,D	C,H,D
Material transfer operations			
Mining and mine drainage			
Pipelines and sewer lines			
Saltwater intrusion	✓	C,E,B	M(SO_4,Cl,Na)
Spills			
Transportation of materials			
Urban runoff	✓	A,B,C	D,H,J,K,L
Other sources—drycleaning facilities	✓	A,B,C,D,E,F	C

Notes to Table 44:

* Includes irrigation practices.

X Indicates contaminant source of concern to state, but a specific program with funding and staff has not been allocated to address that source.

In Column 3: Factors used in selecting a contaminant source:

- A. Human health and/or environmental risk (toxicity)
- B. Size of population at risk
- C. Location of the sources relative to drinking water sources
- D. Number and/or size of contaminant sources
- E. Hydrologic sensitivity
- F. State findings, other findings
- G. Documented from mandatory reporting
- H. Geographic distribution/occurrence
- I. Other factors (described in text)

In Column 4: Contaminants associated with each contaminant source:

- A. Inorganic pesticides
- B. Organic pesticides
- C. Halogenated solvents
- D. Petroleum compounds
- E. Nitrate
- F. Fluoride
- G. Salinity/brine
- H. Metals
- I. Radionuclides
- J. Bacteria
- K. Protozoa
- L. Viruses
- M. Other contaminants (described in text)

Florida's Ground Water Protection Programs

Florida's goal is to protect all its ground water, in shallow, intermediate, and deep aquifers. Twenty-six programs — either established or under development — are in place to protect, manage, or assess ground water. *Table 45* lists the state's ground water programs or protection activities and their status in early 1999. The Wellhead Protection Program and the Core Comprehensive State Ground Water Protection Program will be developed after the EPA approves plans.

Florida is developing its Source Water Assessment and Protection (SWAP) Program. Created under the 1996 amendments to the Safe Drinking Water Act, which provides funding and focuses resources for the protection of drinking water sources, SWAP requires the states to identify public drinking water supplies, delineate assessment areas, identify potential sources of contamination, determine the susceptibility of drinking water supplies to the sources of contamination, and provide the assessments to the public.

A susceptibility determination will be made to assess the threat that the identified sources pose to drinking water systems which use ground water or surface water supplies. This determination will assess the threat posed from potential contamination sources in the delineated source water protection area. Florida has few surface water sources of drinking water, so to a large extent SWAP plans will address the protection of wellheads. To date, no plans have been prepared.

FDEP is preparing GIS databases for the different programs. The ability to assess data on compliance and to analyze specific sites will improve the quality of future reports.

Table 45: Summary of State Ground Water Protection Programs

Programs or activities	Check	Implementation status	Responsible state agency
Active SARA Title III Program	✓	Established	FDEP*/DCA
Ambient ground water monitoring system	✓	Established	FDEP*/WMD
Aquifer vulnerability assessment	✓	Continuing effort	FDEP*/WMD
Aquifer mapping	✓	Under development	WMD/FGS
Aquifer characterization	✓	Under development	FGS*/WMD
Comprehensive data management system	✓	Evolving	FDEP
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)		Not endorsed	FDEP
Ground water discharge permits	✓	Established	FDEP
Ground water BMPs	✓	Established	FDEP*/WMD/DACS
Ground water legislation	✓	Established	FDEP*/WMD
Ground water classification	✓	Established	FDEP
Ground water quality standards	✓	Established	FDEP
Interagency coordination for ground water protection initiatives	✓	Established	FDEP*/WMD
Nonpoint source controls	✓	Established	FDEP*/WMD
Pesticide State Management Plan		Not endorsed	DACS*/FDEP
Pollution Prevention Program	✓	Established	FDEP
Resource Conservation and Recovery Act (RCRA) Primacy	✓	Established	FDEP
Source Water Assessment Program (SWAP)	✓	Under development	FDEP
State Superfund	✓	Continuing effort	FDEP
State RCRA Program incorporating more stringent requirements than RCRA primacy	✓	Established	FDEP
State septic system regulations	✓	Established	FDEP
Underground storage tank installation requirements	✓	Established	FDEP
Underground Storage Tank Remediation Fund	✓	Established	FDEP
Underground Storage Tank Permit Program	✓	Established	FDEP
Underground Injection Control Program	✓	Established	FDEP
Vulnerability assessment for drinking water/wellhead protection	✓	Established	FDEP
Well abandonment regulations	✓	Established	WMD
Wellhead Protection Program (EPA-approved)		Not approved	FDEP
Well installation regulations	✓	Established	WMD*/FDEP

FDEP* — Agency with primary responsibility for this activity.
FDEP — Florida Department of Environmental Protection.
DCA — Florida Department of Community Affairs.
FGS — FDEP's Florida Geological Survey.
WMD — Water Management District.
DACS — Florida Department of Agriculture and Consumer Services.