SECTION 4
FUTURE "WITHOUT PLAN" CONDITION

This section provides a definition as to what is meant by the future "without plan" condition and how and why it is developed. In the context of the Restudy, the term "plan" refers to alternative comprehensive plans and not to the existing C&SF Project (although Project modifications will be important parts of the alternative plans).

4.1 "WITH AND WITHOUT" COMPARISONS

The U.S. Water Resources Council's *Principles and Guidelines* provides the instructions and rules for Federal water resources planning (USWRC, 1983). One *Principles and Guidelines* requirement is to evaluate the effects of alternative plans based on a comparison of the most likely future conditions with and without those plans. In order to make this kind of comparison, descriptions - often called forecasts - must be developed for two different future conditions: the future without plan condition, and the future with-plan condition.

The future without plan condition describes what is assumed to be in place if none of a study's alternative plans are implemented. The without-plan condition is the same as the alternative of "no action" that is required to be considered by the Federal regulations implementing the *National Environmental Policy Act of 1969 (NEPA).*

Future "with plan" conditions describe what is expected to occur as a result of implementing each alternative plan that is being considered in a study. With plan conditions are developed for each alternative plan; therefore, there are as many with plan conditions as there are alternative plans.

The differences between the "without plan" condition and the "with plan" condition are the effects or impacts of the plan. Note that the plan referred to in this context is any one of the alternative plans that have been considered in the Restudy. The formulation of alternative plans is described fully in ***Section 7***.

4.1.1 "With-and-Without" Versus "Before-and-After"

Many people typically think about the effects of alternative plans in terms of "before and after"; that is, they compare the condition that exists now, before it is changed by a plan, to the condition they expect to exist in the future after it has been changed by a plan. For example, if a proposed levee were to cover four acres of

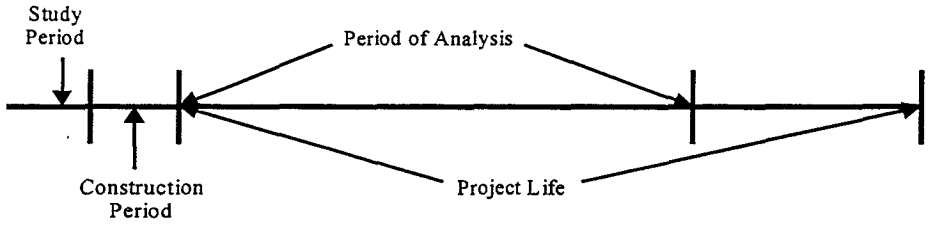
an existing 10-acre wildlife habitat, then, using a before-and-after comparison, the levee could be said to result in a loss of four acres of that habitat.

Another way to think about effects is to compare the conditions that are expected to exist in the future if no alternative plan is implemented, the without plan condition, to the conditions that are expected to exist in the future if a particular plan is implemented. Returning to the example, let's say that the 10-acre wildlife habitat is already included in a residential development plan that would convert three of its acres to residential sites. Now suppose that a proposed levee would cover four acres of the 10-acre site, including the same three acres that would be converted to residential sites. Using a "with-and-without" comparison, the levee would be said to result in a loss of only one acre since three of the four acres would be affected even if the levee were never constructed. With-and-without comparison recognizes that the future is often different from the existing condition; and, unlike before-and-after comparisons, accounts for future changes in the comparison.

4.2 PLANNING HORIZON

The planning horizon encompasses the feasibility study period, the construction period, the economic analysis period, and the effective life of the project. How long a time period should be used when forecasting future without-project and with-project conditions, and considering the impacts of alternative plans? This time frame is called the period of economic analysis, and is also known as the period of analysis. It is the period of time over which we think it is important to extend our analysis of plan impacts. This time period is frequently confused with the planning horizon, which is a longer and more encompassing concept. ***Figure 4-1*** shows that the period of analysis is part of the planning horizon.

Figure 4-1: Planning Horizon



The period of analysis for water resources projects is usually 50 years and never over 100 years. Forecasting conditions and impacts beyond 100 years is pure guessing, even if some structural projects may last more than 100 years.

If significant impacts do not last 50 years, the period of analysis should be restricted to the duration of the significant impacts. One of the most common measures of impacts has to do with the time value of money. Future dollar values, whether benefits or costs, are worth less than current dollar values. Discounting is the process used to place dollar values incurred at different times on an equivalent time basis. After 50 years, the discount factor alone reduces monetary values to a mere fraction of their former value. Unless the future dollar values being discounted are large there is no apparent point to continue to include these values among project impacts. Therefore, the period of economic analysis for the purposes of this study will be 50 years.

4.3 CLIMATE

The hydrologic data used for modeling in this study are based on a 31-year period of record. For the modeling effort, the climatic record from 1965 to 1995, was used for both the existing (1995) condition, and the future (2050) without plan condition. This climatic record is considered appropriate in that it includes wet, dry and average years which are and have been typical of conditions in south Florida. The wet years are considered to be 1969-1970, 1982-1983 and 1994-1995, the dry or drought years are 1971, 1975, 1981, 1985 and 1989 and a typical, average year is 1984. Rainfall and potential evapotranspiration are the key climatic inputs. This same record was used in the evaluation of plan alternatives. For the purpose of this study, it is assumed that the 31-year period of record used for the hydrologic modeling is representative of conditions that are expected to occur in the study area in the future.

4.4 SEA LEVEL RISE

The U.S. Environmental Protection Agency (EPA) completed a study of the probability of sea level rise in 1995 (USEPA, 1995). Some conclusions from this study follow. "Many climatologists believe that increasing atmospheric concentrations of carbon dioxide and other gases released by human activities are warming the Earth by a mechanism commonly known as the 'greenhouse effect". The Earth's average surface temperature has risen approximately 0.6° C (1° F) in the last century, and the nine warmest years have all occurred since 1980. Global warming is most likely to raise sea level 15 cm (0.48 ft) by the year 2050 and 34 cm (1.09 ft) by the year 2100." The report estimates that *"along most of the U.S. Atlantic and Gulf coasts, there is a 50 percent chance that sea level will rise at least one foot by the year 2050, and two feet by the year 2100."*

The Environmental Protection Agency published historic rates of sea level rise at various locations in the United States. Those of interest to the study area

are shown in ***Table 4-1***. Estimates of sea level rise in future years for specific locations within the study area are shown ***Table 4-2***. These normalized projections estimate the extent to which future sea level rise will exceed what would have happened if current (historic) trends in ***Table 4-1*** simply continued.

TABLE 4-1
HISTORIC RATE OF SEA LEVEL RISE

Atlantic Coast		Gulf Coast	
Mayport, FL	2.2 mm/yr	Key West	2.2 mm/yr
Miami Beach, FL	2.3 mm/yr	St. Petersburg	2.3 mm/yr

Source: Sea Level Variations for the United States1855-1986, National Oceanic and Atmospheric Administration, National Ocean Service, Rockville, MD., Lyles, S.D., Hickman, L. E., Debaugh, H. A., 1987

TABLE 4-2
ESTIMATING SEA LEVEL RISE AT SPECIFIC LOCATION
Normalized Sea Level Projections, Compared with 1990 Levels (cm)

Cumulative Probability	Year 2025	Year 2050	Year 2100
10	-	-	1
20	1	3	10
30	3	6	16
40	4	8	20
50	5	10	25
60	6	13	30
70	8	15	36
80	9	18	44
90	12	23	55
95	14	27	66
97.5	17	31	78
99	19	38	92
Mean	5	11	27
Standard Deviation	6	10	23

To estimate sea level rise at a particular location, the historic sea level rise is added to the projected rise that would occur if current trends were to continue. For example, the historic rate of sea level rise at Miami Beach is 2.3 mm per year (***Table 4-1***). Under current trends, sea level will rise 14 cm between 1990 and 2050. Adding 14 cm to the normalized values in ***Table 4-2***, the median estimate for 2050 is 25 cm, with a one percent chance of a 52 cm rise, and a 50 percent chance that sea level will rise at least 24 cm.

Most coastal areas of the United States are moving vertically as the result of tectonic forces, glacial rebound, the consolidation of sediments, or the extraction of water, gas and oil. Therefore, the evaluation of the impacts of sea level change

require the development of sea level projections that are relative to the land motion. Rates of land elevation change for the study area are shown in ***Table 4-3***.

TABLE 4-3
RATES OF LAND ELEVATION CHANGE

	Trend		
Location	mm/yr	cm/yr	ft/yr
Mayport, FL	+1.0	+0.10	+0.0032
Miami Beach, FL	+1.1	+0.11	+0.0035
Key West, FL	+1.0	+0.10	+0.0032
St. Petersburg, FL	+0.8	+0.08	+0.0026

Source: Sea Level Variations for the United States1855-1980, National Oceanic and Atmospheric Administration, National Ocean Service, Rockville, MD., Lyles, S.D., Hickman, L. E. Jr., Debaugh, H. A., 1983

To estimate relative sea level rise at a particular location, the rate of land elevation change is added to the sea level rise that would occur if current trends and future projections were true. For example, at Miami Beach, land elevation change is estimated to be +6.6 cm by the year 2050. Therefore, the median relative sea level rise estimate at Miami Beach for 2050 is 18.4 cm (0.59 ft), with a one percent chance of an 45.4 cm (1.46 ft) relative rise, and a 50 percent chance that sea level will rise at least 17.4 cm (0.56 ft).

To determine the sensitivity of the C&SF Project to sea level rise a modeling scenario was completed for the future without plan condition utilizing a 15 cm rise in sea level so that the impacts of such a change on the performance of the water management system can be assessed. The sea level rise changes the boundary conditions of the South Florida Water Management Model in the Lower East Coast. The South Florida Water Management Model assumptions for the rise are as follows: specific coastal canals were maintained higher, flood control releases were delayed to allow a higher maintenance level, but the water level at which maximum releases were made was not altered, and trigger levels for water supply cutbacks were also raised by 15 cm with the exception of one interior trigger in Palm Beach County. Analysis of this scenario showed that the sea level rise had the most impact on the coastal canals and communities with loss of flood protection and salt water intrusion being the primary impacts. Lower East Coast water supply cutbacks are expected to increase significantly as well as deliveries to Lower East Coast service area. Coastal ecosystems and estuaries were adversely affected and would require additional deliveries of fresh water. The performance measures for the interior of south Florida did not appear to be influenced by the sea level rise. This was probably due to the higher ground elevations than those found along the coast. A detailed description of this modeling scenario can be found in ***Appendix B.***

4.5 POPULATION AND SOCIO-ECONOMIC CONDITIONS

The south Florida 16-county study area is characterized by higher average incomes, and greater economic and population growth than the rest of the State and the Nation. This is particularly true of the Lower East Coast (Palm Beach, Broward, and Miami-Dade Counties), and while true in average terms for the study area as a whole, some localities do not share in this overall trend. The important features of the economic landscape are agricultural activity, construction, fishing, tourism, and recreation. This picture is expected to continue to be the case for 2050.

The south Florida study area is home to just over six million people, about half of Florida's population. This relationship between the study area's population and that of the state has been so for some time and is likely to continue. Population growth tends to exceed the national rate of growth, a trend expected to continue, although at a declining rate from that of the past.

The Lower East Coast population is expected to grow by 72 percent from just over four million in 1990 to nearly seven million by 2050 (G.E.C., 1996). The 16-country study area counties are expected to experience population growth during this period from 6.3 million to 11 million. The Monroe County population is projected to grow from 78,000 in 1990 to 126,000 by 2050.

Florida's economy is characterized by strong wholesale and retail trade, government and service sectors. Florida's warm weather and extensive coastline attracts vacationers and other visitors and helps to make the state a significant retirement destination for people from all over the country. Agricultural production and fisheries are also important sectors of the state's economy, and are especially significant to portions of the study area. While compared to the national economy, the manufacturing sector has played less of a role in Florida, but high technology manufacturing has begun to emerge as a significant sector in the State over the last decade. Total employment in the study area is expected to grow from about three million in 1990 to about five million by 2050. Lower East Coast employment by 2050 is projected to be about 2.7 million.

Most of the population and economic activity in the study area is concentrated along the Lower East Coast (Miami-Dade, Broward, and Palm Beach Counties). Per capita income for the study area as a whole is above that for the State. The three-county area's per capita income is even higher. These relationships will likely continue to 2050.

The Lower East Coast three-county area comprises about 9.5 percent of the State's land area but is home to 31 percent of Florida's population. Population growth is fueled by in-migration, as it continues to be both a leading location for retirement as well as a haven for refugees from such places as Cuba and Haiti. By contrast, the

group of primarily agrarian counties bordering the shores of Lake Okeechobee (Glades, Highlands, Martin, Okeechobee, St. Lucie, and Hendry Counties, but excluding Palm Beach County), while similar in size to Lower East Coast counties, comprise only about three percent of the study area's population.

The Big Cypress and Caloosahatchee River regions (Lee, most of Collier and Hendry, and part of Charlotte and Glades Counties) are two of the fastest growing regions in the nation. The estimated total population of these counties for 1990 was 632,000. The total population is projected to increase 63 percent to 1,032,000 by the year 2010. It is expected to continue to increase through 2050 at a lower rate to 1,401,000.

Population in the Upper East Coast region, Martin and St. Lucie Counties, is expected to more than double by 2050. Despite this anticipated population growth, the region is not expected to have the large population like its neighboring counties to the south. The population in 2050 will be 529,000 or five percent of the study area.

Although there is population growth anticipated in the Big Cypress, Caloosahatchee, and Upper East Coast regions by the year 2050, the Restudy modeling effort was not sensitive to changes in these regions. These regions are outside of the modeling domain of the South Florida Water Management Model.

The population growth rate for the south Florida study area is expected to continue to exceed the national rate, but this trend is expected to lessen. By the year 2050, the population of the study area is estimated to still be about half of the state's population of 23 million people. Over 60 percent of this population are expected to inhabit the three southeast coast counties of Palm Beach, Broward, and Miami-Dade. To accommodate this growth, urban development will continue.

4.6 LAND USE AND LAND COVER

Land use in the future without plan condition is expected to be characterized by the continued urbanization of the developable lands which lie east of the Water Conservation Areas in the Lower East Coast, and continued urbanization of the Osceola and southern Orange County area associated with the development of Disney's properties. Southwest Florida is currently experiencing a very rapid rate of population growth; this trend is expected to continue.

For the coastal basins, 2050 land use projections were based on local government Comprehensive Plans. The Florida Legislature adopted the Local Government Comprehensive Planning Act in 1975 requiring each local governmental jurisdiction to prepare and adopt a local Comprehensive Plan. The

Future Land Use Element is a major component of the local plan designed to guide the future disposition of land use. Urban land use coverage in the future without plan condition was developed from the 2010 Comprehensive Plans and modified to include estimated decreases in agriculture, increases in golf course coverages, and other changes, such as identifying areas approved for development.

The urban portion of Palm Beach County to the east is home to a fast growing population. Palm Beach County is expected to become much denser as the population grows by over 600,000 people by 2050. This represents an almost doubling of the 1995 population. The amount of land available is somewhat limited since the other land-uses, agriculture, water conservation areas and publicly owned lands compete for space with urban development. Conversion of vacant, agricultural and low-density areas to higher density land use is expected throughout the county. North Palm Beach County may experience greater expansion into vacant or open areas since this portion of the county is not associated with the large population centers of West Palm Beach or Boca Raton, yet is expected to grow more rapidly.

In Palm Beach County, the majority of the agricultural areas is inland, and includes most of the Everglades Agricultural Area. The size of the Everglades Agricultural Area has been projected to decline somewhat as areas have been identified and scheduled to be used for Stormwater Treatment Areas by 2006. A total of approximately 44,000 acres will be shifted to that use. Another agricultural area, namely the Agricultural Reserve, is located adjacent to the urbanized eastern areas. The amount of land available for agriculture is limited and under high pressure to be developed in the future. The Agricultural Reserve is not expected to expand in the future.

In Broward County, suitable land for any type of development is limited. Almost all of the conversion from open or vacant land to urbanized development has already taken place. It is expected that most of the development to accommodate an additional projection of 800,000 persons will either infill small vacant parcels east of the levee or significantly increase the density in highly attractive areas adjacent to the coast. Greenhouse and nursery operations accounted for approximately 3,000 acres in 1995 and are expected to remain somewhat constant. The Water Preserve Areas project may accelerate the rate of infill and increases in density as the only remaining significant tracts of land are purchased.

Miami-Dade County is expected to continue to urbanize and become more dense within its urban development boundary as the greatest increase in the number of persons within the study area are expected to live here. Miami-Dade County's population will grow by approximately 1.1 million by 2050. Much of the growth will be accommodated on already developed lands; however, expansion into south Miami-Dade County and its agricultural areas as well as into areas west of the existing urban core will also occur. Urban development in south Miami-Dade

County and the strip west of the urban core will entail conversion of agricultural lands and wetlands. Increased flood protection, loss of storage in the surficial aquifer and the addition of pollutants associated with urban development will affect the hydrology of these areas.

Land use in the Upper East Coast, Martin and St. Lucie Counties, has been predominately agricultural and is expected to remain so in the future. However, the percentage of agricultural land use in Martin and St. Lucie Counties is anticipated to decrease while urban land uses increase as a result of anticipated population growth. Urban growth will cause conversion of some of the geographically desirable agricultural areas as well as expansion into vacant or natural areas.

Citrus is by far the dominant irrigated crop in this area and occupies over four-fifths of the irrigated agricultural acreage in the region. Irrigated citrus in this area is projected to grow by 32 percent in just the first 25 years of the planning horizon, from 134,000 acres in 1990 to 176,000 acres in 2020. Agricultural water demand is not projected to grow as rapidly although citrus, a high water use crop, is expected to remain the dominant crop.

Land use in the Big Cypress and Caloosahatchee River regions is projected to intensify to accommodate the growing population and demands on water resources will increase proportionately. However, agricultural demand is projected to remain the single largest category of land use in Big Cypress and Caloosahatchee River regions. In addition, agriculture is expected to remain the largest type of demand for water in southwest Florida over the planning horizon.

Citrus is the largest category of agricultural land use in the Big Cypress and Caloosahatchee River regions, and has been the fastest growing citrus acreage of any area in Florida. Recently, sugarcane acreage has begun to increase significantly as well. The initial clearing, draining, and planting and subsequent water withdrawals required to establish agricultural operations replaces natural habitats and modifies the natural hydrology of the area. Urban growth in Lee and Collier Counties also has the potential to impact the region's environmental and water resources. Drainage of wetlands for urban expansion, loss of natural surface water storage areas and contamination from urban land use are the major water related issues in urban areas.

Agriculture, predominately citrus and sugarcane, is expected to expand in the Lake Okeechobee Service Area, but at a slower rate than in the Big Cypress and Caloosahatchee River region. The expected increase in population and resulting urban development are not expected to significantly alter the current land uses. Much of the growth may not be centralized and will be more rural in nature.

Land cover (vegetation classes and spatial distribution) within the Everglades Protection Area in the future without plan condition is not expected to be greatly different at regional scales, from the vegetation patterns for the existing (1995) condition. Changes that could occur are expected to be local, and could include the continued invasion by exotic and native woody species into overdrained marl prairies and the northern portions of the Water Conservation Areas, and the continued loss of natural marsh communities in overponded portions of the Water Conservation Areas.

4.7 WATER QUALITY

The future without plan condition assumes no further hydrologic restoration actions beyond the presently planned/approved construction or maintenance actions in the study area, including those contained within the 1992 Settlement Agreement to the Federal lawsuit (United States et al v. South Florida Water Management District et al, Case No. 88-1886-CIV-Hoeveler) and the State of Florida's 1994 Everglades Forever Act (Stormwater Treatment Areas, Everglades Agricultural Area Best Management Practices and Phase 2 water quality technology).

The following subsections describe the projects by region that affect water quality and that are assumed to be in place in the future without plan condition.

4.7.1 Kissimmee River Region

Several planned and ongoing environmental restoration projects are expected to be completed which would beneficially affect water quality in the Kissimmee River watershed. Of particular importance is the Kissimmee River Restoration Project (including the Headwaters Revitalization and Modified Level II Backfilling projects). The Kissimmee River Restoration Project is expected to result in the restoration of approximately 26,500 acres of former wetlands in the vicinity of the Kissimmee Chain of Lakes (USACE, 1996) and at least 24,000 acres of former (drained) wetlands south of Lake Kissimmee (USACE, 1991).

4.7.2 Lake Okeechobee

Several watershed and in-lake cleanup projects are currently proposed (flow diversion projects for four Florida Statutes Chapter 298 Water Control Districts, diversion of flows from the 715 Farms area, and a critical project authorized pursuant to Section 528 of the Water Resources Development Act of 1996 – the Lake Okeechobee Water Retention/Phosphorus Removal Critical Project) to incrementally reduce inputs of nutrients to the lake. However, to sustain water quality improvements brought about by in-lake cleanup projects, pollutant source reduction programs (e.g., agricultural land acquisition, and implementation of best

management practices) in the lake watershed must be implemented concurrently. The Florida Department of Environmental Protection is at present developing a Total Daily Maximum Load pollutant loading program which is expected to result in additional pollutant load reduction activities in watersheds flowing to Lake Okeechobee.

4.7.3 Upper East Coast

Several ongoing watershed management/planning programs in the Upper East Coast and Indian River Lagoon area are expected to be completed which would beneficially affect water quality conditions in the St. Lucie River and estuary, Indian River Lagoon and other freshwater waterbodies in the area. The South Florida Water Management Districts' Indian River Lagoon Surface Water Improvement and Management Plan has developed numerous programs and objectives to improve water quality conditions in the area. Many of the water quality remediation activities being implemented by the Surface Water Improvement and Management Plan focus on reducing agricultural pollutant loads in the Indian River Lagoon watershed and urban/suburban pollutant loads in the rapidly developing coastal region surrounding the St. Lucie Estuary and Indian River Lagoon. Implementation of more environmentally sensitive Lake Okeechobee regulation schedules should also reduce pollutant loading to the St. Lucie Estuary/ Indian River Lagoon systems. The Indian River Lagoon National Estuary Program, jointly administered by the U.S. Environmental Protection Agency and the State of Florida will also result in water quality improvement activities and a reduction of pollutant loads to the Indian River Lagoon in the future. In summary, as a result of these ongoing watershed management programs, water quality in the Upper East Coast is expected to improve in the future.

4.7.4 Everglades Agricultural Area

Recent monitoring results indicate that phosphorus loads in Everglades Agricultural Area runoff have declined approximately 51 percent (three year average, SFWMD, 1997b). The current average concentration of total phosphorus contained in Everglades Agricultural Area runoff is approximately 100 parts per billion (Havens, 1997). Construction of the Everglades Construction Project involves converting approximately 44,000 acres of existing agricultural land. The construction project is explained in more detail below.

4.7.4.1 Everglades Forever Act

The Everglades Forever Act's principal water quality treatment strategy for improving water quality in the Everglades Protection Area which includes the Water Conservation Areas 1 (Loxahatchee National Wildlife Refuge), 2A and 3A; the Rotenberger Wildlife Management Area and the Holey Land Wildlife

Management Area centers around five requirements: The Everglades Construction Project, Everglades Agricultural Area Best Management Practice programs, Everglades research and monitoring program, evaluation of water quality standards and long-term compliance permits. Each element is further examined below.

The Everglades Construction Project consists of six large wetlands treatment facilities deemed Stormwater Treatment Areas containing approximately 44,000 acres of land previously used for agricultural purposes. These areas are designed to treat Everglades Agricultural Area runoff prior to discharge into the Everglades Protection Areas (***Figure 4-2***).

The Everglades Construction Project is designed to treat Everglades Agricultural Area runoff to meet an interim phosphorus concentration target of 50 parts per billion in discharges to the Everglades Protection Area (Burns and McDonnell, 1994). Stormwater Treatment Areas 1 East and 1 West will discharge into the L-7 and L-40 borrow canals in the Loxahatchee National Wildlife Refuge (WCA-1). Stormwater Treatment Area 2 will discharge to Water Conservation Area 2A via the L-6 borrow canal. Stormwater Treatment Area 3/4 will discharge to Water Conservation Area 3A via the L-5 borrow canal. Stormwater Treat Area 5 will discharge to Rotenberger and Holey Land Wildlife Management Areas and Water Conservation Area 3A along the L-4 borrow canal. Stormwater Treatment Area 6 discharges to Water Conservation Area 3A through the L-4 borrow canal. Stormwater Treatment Area 6 Section 2 will discharge to Rotenberger Wildlife Management Area. The future base condition assumes all of the treatment areas are completed and operational with the exception of Stormwater Treatment Area 6 Section 2. Stormwater Treatment Area 6 Section 2 was not included in hydrologic regional modeling since the conceptual design for the Stormwater Treatment Area did not include this element (Burns and McDonnell, 1994).

Another component of the Everglades Construction Project targeted for completion in 2003 is the diversion of runoff from five special districts (four chapter 298 districts and the 715 Farms area established under Florida Statutes). These special districts are located adjacent to Lake Okeechobee north of the Everglades Agricultural Area. Currently, the districts discharge directly to Lake Okeechobee. According to the Everglades Forever Act, approximately 80 percent of the historic flow volumes and total phosphorus loads are to be diverted away from the lake. The future base condition assumes that the diversion of flows and loads has been completed.

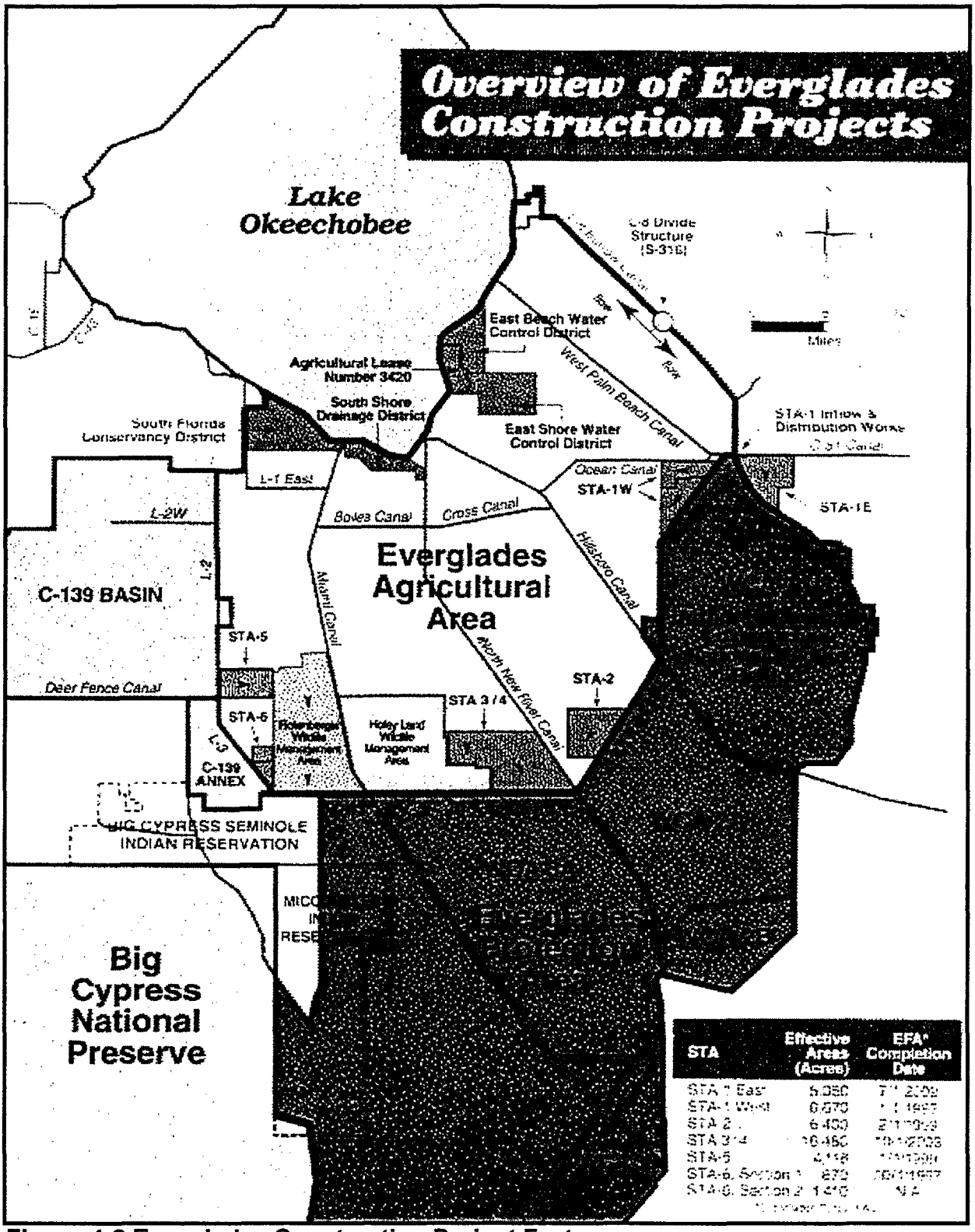


Figure 4-2 Everglades Construction Project Features

According to the Everglades Forever Act, based upon research, field-tests and expert review, the Everglades Agricultural Area Best Management Practices are determined to be the most effective and practicable on-farm means of improving water quality to a level that balances water quality improvements and agricultural productivity. The act establishes monitoring programs, permit requirements, research, field-testing and evaluation programs designed to improve water quality prior to discharge into conveyance canals in the Everglades Agricultural Area. The act provides a tax incentive for phosphorus concentration reductions of 25 percent or more. As a consequence, the future base condition assumes a 25 percent phosphorus concentration reduction from best management practices.

In addition to the Everglades Construction Project and best management practices, the Everglades Forever Act directs that an Everglades Research and Modeling program shall seek means of optimizing the design and operation of the Stormwater Treatment Areas. This program shall include research to reduce outflow concentrations and identify other treatment and management methods and regulatory programs that are superior to Stormwater Treatment Areas in achieving the intent and purposes of the act. The research and monitoring program is also directed toward development of a permanent (threshold) phosphorus criterion in the Everglades Protection Area by the Florida Department of Environmental Protection and evaluation of existing state water quality standards applicable to the Everglades area. The criterion is to be adopted by December 31, 2003 or a default criterion of 10 parts per billion total phosphorus will be established. Currently, research efforts have not drawn any conclusions that affect treatment area designs, planned operations or the threshold phosphorus criterion. Research to determine superior or supplemental technologies and the threshold phosphorus standard is on going.

The Everglades Forever Act does specify that compliance with water quality standards shall be based upon a long-term geometric mean of concentration levels to be measured at sampling stations reasonably representative of receiving waters in the Everglades Protection Area. Discharges to the Everglades Protection Area from outside the Everglades Agricultural Area (non-Everglades Construction Project structures) also require evaluation to determine appropriate strategies. The act requires the South Florida Water Management District and the Florida Department of Environmental Protection to take such action as may be necessary so that water meets state water quality standards in all parts of the Everglades Protection Area.

The Everglades Forever Act further directs that long-term compliance permit requirements shall be modified to achieve compliance with the phosphorus criterion cited in the paragraph above. If the Florida Department of Environmental Protection has not adopted this criterion by rule prior to December 31, 2003, then

the phosphorus criterion shall be 10 parts per billion in the Everglades Protection Area. This default criterion or the criterion adopted by the Department (phase II) is to be imposed by 2006. The act specifies that as of December 31, 2006, no permittee's discharges shall cause or contribute to any violation of water quality standards in the Everglades Protection Area. In view of the fact that the phase II phosphorus criterion has not been established, the future base condition assumes that the default standard of 10 parts per billion has been attained.

Design of the Everglades Construction Project was initiated in 1995 and construction in 1997. Stormwater Treatment Area 6 Section 1 was completed in October 1997 and operation was initiated in December 1997. Construction is currently underway at Stormwater Treatment Areas 1 West, 2 and 5 with completion scheduled on or before September, November and July 1999, respectively. Scheduled construction completion for Stormwater Treatment Area 1 East and 3/4 is set for July 1, 2002 and October 1, 2003, respectively.

A demonstration-scale wetlands treatment area project of nearly 3,800 acres has been operating adjacent to Water Conservation Area 1 (Loxahatchee National Wildlife Preserve) on the same site as future Stormwater Treatment Area 1 West since 1994. Stormwater Treatment Area 1 West will encompass the demonstration project when completed. The Everglades Nutrient Removal project was designed to reduce phosphorus from an inflow concentration of 190 parts per billion to an outflow concentration of 50 parts per billion. The settling rate constant for the demonstration project was set at 10.2 meters per year. These were the same parameters established for the Everglades Construction Project Stormwater Treatment Area design. Three years cumulative data from the demonstration project reflects that these criteria have been significantly exceeded. Additionally, on-farm best management practices have averaged 51 percent, considerably higher than the projected 25 percent contained in the future base condition for the Everglades Agricultural Area.

It is too early to predict what conclusions research and analyses will drive with regard to the findings outlined above. An optimistic one is that the best management practices reduction in phosphorus concentrations will increase Stormwater Treatment Area operations such that concentrations lower than the interim criterion will be achieved. Also, the higher settling rate constant and low phosphorus concentration outflows could significantly improve performance of the Stormwater Treatment Areas; thus, reduce phase II treatment needs. Only time and further operations of the treatment areas will judge whether the long-term findings will be supportive of the optimism suggested by current best management practices and Everglades Nutrient Removal findings. The current findings certainly should affect the research into what supplemental technologies may be necessary to achieve the phase II phosphorus criterion.

During the alternative development and evaluation phase of the Restudy, a preliminary study was conducted by Walker (Walker, 1998) to evaluate the performance of the Stormwater Treatment Areas based upon Restudy generated flows from the South Florida Water Management Model in the future base condition and the preferred alternative. A phosphorus removal model developed by Walker was used in the study. Modeling results indicated that some of the Stormwater Treatment Areas did not meet the interim phosphorus criteria of the Everglades Forever Act under either the future base condition or the preferred alternative. A closer examination reveals some of the reasons for the apparent underachievement. First, the periods of records differ. The Everglades Construction Project used a 10-year period of record from 1979 to 1988. The Restudy uses the 31-year period from 1965 to 1995. Second, the operational concepts differ. The Restudy uses rain-driven operational procedures whereas the Everglades Construction Project uses the current calendar-based regulation schedule. Third, because Stormwater Treatment Area 6 Section 2 was not modeled in the Restudy, the treatment area was not considered in the phosphorus modeling. Therefore, a treatment area totaling nearly 2,000 acres was not considered and the inflows scheduled for this area were all routed through Stormwater Treatment Area 5. Finally, although the period of record was changed from ten years to 31 years, the fixed parameters of the settling rate of 10.2 meters per year and targeted outflow concentration of 50 parts per billion remained unchanged from the Everglades Construction Project.

These two parameters (settling rate constant and outflow phosphorus concentration target) are two of the three most significant factors in determining the required area of treatment cells. Walker's study did indicate that when the 51 per cent best management practice phosphorus reduction rate experienced over a three-year period was used in lieu of the 25 percent estimate, all Stormwater Treatment Areas met or bettered the interim phosphorus criterion with the exception of Stormwater Treatment Area 5. Stormwater Treatment Area 5 did not meet the criteria in the modeling outcome due to the third reason cited in the preceding paragraph.

At first blush, the reasons cited above appear to mitigate the Walker findings of Stormwater Treatment Area underachievement. Although only time and continued operation of the treatment areas will provide proof, the findings should, in any case, direct research efforts toward ensuring that phase II treatment technologies are sufficient to meet the adopted threshold standard. Regardless of the Walker study or the demonstration project findings, the fact remains that the phase II (threshold) phosphorus standard must be met by 2006. The default criterion of 10 parts per billion is the target assumed in the 2050 future base condition. At that point, the interim standard becomes obsolete. When research efforts determine the optimal method of operation and supplemental technologies needed to meet the Everglades Forever Act permanent (phase II) phosphorus criterion, both the Everglades Construction Project and treatment elements of the

Restudy components must be modified to attain the designated water quality standard.

4.7.5 Natural Areas

The natural areas of the study area include the Rotenberger and Holey Land Wildlife Management Areas, the Loxahatchee National Wildlife Refuge, Water Conservation Areas 2 and 3, Big Cypress National Preserve, and Everglades National Park. The Rotenberger and Holey Land Wildlife Management Areas are adjacent to the Everglades Agricultural Area and are contained within the same hydrologic basin. The Everglades Construction Project, which is part of the future without plan condition, is designed to achieve hydrologic restoration objectives for the Rotenberger and Holey Land tracts by redirecting Everglades Agricultural Area runoff through Stormwater Treatment Areas into those areas to create preferred hydropatterns.

A fundamental underlying assumption for the Restudy is the full implementation of the State of Florida's Everglades Program contained in the Everglades Forever Act (F.S. 373.4592) by December 31, 2006. Implementation of the Everglades Forever Act includes completion of construction of the Stormwater Treatment Areas as described in the conceptual design for the Everglades Construction Project (Burns and McDonnell, 1994; scheduled to be completed in 2003), setting of a numeric phosphorus criterion for the Everglades Protection Area, by December 31, 2003, and compliance with that criterion by December 31, 2006.

In addition to the Everglades Construction Project and water quality treatment facilities developed as a result of the non-Everglades Construction Project requirements of the Everglades Forever Act, the currently authorized C-111 Project and the Modified Water Deliveries to Everglades National Park Project are assumed to be implemented in 2050.

4.7.6 Lower East Coast and Biscayne Bay

The major watershed management/planning program ongoing in the Lower East Coast region that will beneficially effect future water quality conditions is the State's Biscayne Bay Surface Water Improvement and Management Plan (SFWMD, 1995). The Biscayne Bay Surface Water Improvement and Management Plan has developed numerous water quality improvement related strategies and projects to reduce pollutant loading in Biscayne Bay and its tributaries. The extent to which this program is implemented, however, is limited due to funding constraints. Also, the Lake Worth Lagoon Management Plan will result in water quality improvement projects being implemented in the Lake Worth Lagoon area. Although implementation of these water quality improvement activities will result in beneficial effects to Lower East Coast waterbodies, the net future condition of

waterbodies in this region is not expected to improve due to the dramatic additional urban development, and associated additional pollutant loads, projected to occur in this region.

4.7.7 Florida Bay

Both the Modified Water Deliveries to Everglades National Park and C-111 Projects are assumed to be completed in the future without plan condition. The first project to be implemented is the C-111 Project. Notably, the C-111 spoil (dredged material) mounds in the marsh on the southern leg of the C-111 Canal were removed in 1997. The purpose of that project was to promote overland flow out of the canal into the marshes in the northeastern part of Florida Bay. In addition, two other features of the C-111 Project are scheduled to be completed in the near future which would beneficially affect water quality in Florida Bay. A new pump station, S-332D, is scheduled to begin pumping operations to deliver increase stages in the L-31W borrow canal, preventing seepage from Everglades National Park from draining east into the canal network and downstream to tide. Operation of S-332D is intended to promote overland flow during high water conditions. Also, the existing single-span bridge over Taylor Slough in Everglades National Park is to be replaced with two longer-span bridges and two box culverts. Removing sections of an existing fill road (Ingraham Highway) across Taylor Slough will augment the bridge replacement project.

Furthermore, agricultural non-point pollution sources in the C-111 Basin are currently being investigated as required by the non-Everglades Construction Project structures requirements of the Everglades Forever Act and the C-111 / Modified Water Deliveries projects implementation process.

4.7.8 Florida Keys

The major ongoing water quality improvement program in the Florida Keys, which is expected to result in improved water quality conditions in the future, is the Water Quality Protection Program of the Florida Keys National Marine Sanctuary Program. The U.S. Environmental Protection Agency and the Florida Department of Environmental Protection are jointly responsible for implementing water quality improvement activities throughout the Florida Keys region as part of the Water Quality Protection Program. Implementation of these activities will result in improved water quality conditions in the Florida Keys in the future.

4.7.9 Big Cypress Basin

The South Florida Water Management District has identified the S-190 water control structure (a gated culvert at the confluence of the North Feeder and West Feeder Canals) as a structure discharging into the Everglades Protection Area

that requires an assessment of pollution loads and the development of a water quality improvement strategy in accordance with the non-Everglades Construction Project structures requirement of the Everglades Forever Act. South Florida Water Management District water quality data (SFWMD, 1998a) indicate that agricultural areas upstream of the Seminole Reservation contribute significant nutrient loads (particularly phosphorus) into the canal system that drains into the North and West Feeder Canals and ultimately across the northeast corner of Big Cypress National Preserve. Water quality improvements required under the Everglades Forever Act are to be completed by December 31, 2006, to assure that all water quality standards are met in the Everglades Protection Area.

4.7.10 Caloosahatchee River Region

The South Florida Water Management District's Caloosahatchee River Water Management Plan is the main ongoing watershed management program that is likely to result in water quality improvement activities in the basin. In the future, although implementation of new Lake Okeechobee regulation schedules and the Caloosahatchee River Water Management Plan will reduce pollutant loading to the Caloosahatchee River/estuary, in general, water quality conditions throughout the basin in the future without plan condition are expected to be similar to current water quality conditions

4.8 URBAN AND AGRICULTURAL WATER SUPPLY DEMANDS

Future water supply demands for urban and agricultural areas that utilize the C&SF Project for water supply were projected for the study area.

4.8.1 Lower East Coast Region

The urban area of the Lower East Coast has been subdivided into four service areas. The North Palm Beach Service Area includes northeastern Palm Beach County east of the L-8 Canal and north of the C-51 Canal. Service Area 1 includes central and southern Palm Beach County as well as portion of northern Broward County. Service Area 2 includes central and southern Broward county and a small portion of northern Miami-Dade County. Service Area 3 is made up of the remainder of northern, central and southern Miami-Dade County and Monroe County. For the urban areas of the Lower East Coast projections are based on the use of the IWR-MAIN water demand forecasting software; underlying population and economic growth assumptions are a combination of the University of Florida Bureau of Economic and Business Research (short term) and Bureau of Economic Analysis, U.S. Department of Commerce (long term) growth projections. For Service Area 3 public water supply demands have been increased to reflect Miami-Dade

County's estimation of its future population growth as influenced by recent immigration legislation and other factors.

Two projections of future water consumption for the year 2050 have been made for the Lower East Coast study area. The two scenarios differ in terms of the assumed level of water use conservation. The higher estimate, Projection A (***Table 4-4***), is based on the same percentage distribution and usage of conservation flow devices, and irrigation restrictions, in effect in 2050 as in 1990. The lower estimate, Projection B (***Table 4-5***), is based on the full implementation of existing South Florida Water Management District mandatory regulations and programs.

The higher Projection A estimate for the year 2050 is about 1,450 millions of gallons per day. The lower Projection B estimate is about 1,200 millions of gallons per day, approximately 18 percent less than Projection A. In this study, the 2050 base condition (the without plan condition) assumes a more moderate application of conservation practices and effectiveness, representing a level of consumption about 12 percent below the 2050 Projection A estimate.

The Projection A average daily Municipal and Industrial demand for water use in the year 2050 is summarized in ***Table 4-4***. The table shows that water use is fairly evenly distributed among the Lower East Coast counties. The Service Areas that coincide mainly with the developed portion of Palm Beach County account for 30 percent of total forecast Municipal and Industrial use. Service Area 2, which roughly coincides with Broward County accounts for a little over 29 percent of use. Service Area 3 use, representing demand in most of Miami-Dade County and the Florida Keys (Monroe County), is somewhat higher in terms of its share of the total.

TABLE 4-4
SUMMARY 2050 MUNICIPAL AND INDUSTRIAL DEMANDS BY SERVICE AREA – PROJECTION A

Area	Million Gallons Per Day (MGD)	Percent of Total
North Palm Beach Service Area	101.25	7
Service Area 1	349.20	24
Service Area 2	422.24	29
Service Area 3	577.00	40
Total	1449.69	100

As stated above these 2050 Projection A estimates reflect a level of conservation practices that is the same as estimated to be in place in 1990. That is, the same percentage distribution of the use of restrictive flow devices among all

uses in place in 1990 is assumed to be in place for the 2050 usage, and therefore probably can be viewed safely as an upper bound forecast estimate.

Another set of forecast use estimates, full implementation of the South Florida Water Management District's mandatory water conservation program for all consumers by 2050, was also made. The 2050 summary results of this conservation Projection B scenario, which can be viewed as a lower bound forecast estimate, are shown in ***Table 4-5***.

TABLE 4-5
SUMMARY 2050 MUNICIPAL AND INDUSTRIAL DEMANDS BY SERVICE AREA – CONSERVATION PROJECTION B

Area	Million Gallons Per Day (MGD)	Percent Reduction [1/]
North Palm Beach Service Area	83.66	17.37
Service Area 1	294.18	15.76
Service Area 2	345.72	18.12
Service Area 3	474.80	17.71
Total	1198.36	17.34

[1/]From Projection A

The IWR-MAIN forecasts have been categorized by residential, commercial, industrial, public administration, and unaccounted-for uses. The following percentage breakdown (***Table 4-6***) provides a profile of these uses in the study area for 2050 for Projection A. As the tabulation shows, this profile is generally similar throughout the study area, although residential use is more heavily weighted in southern areas.

TABLE 4-6
PERCENTAGE DISTRIBUTION OF 2050 DEMAND BY END USE AND BY SERVICE AREA

End Use	NPB	SA1	SA2	SA3	Total
Residential	47	49	56	58	54
Commercial & Industrial	36	37	28	22	29
Public & Other	17	14	16	20	17
Total	100	100	100	100	100

The demand projections made using IWR-MAIN are made by large areas because the projections are driven by economic and demographic projections, which have been made at the county-wide level. But the South Florida Water Management Model input requires that the demand input be in the form of well withdrawals, by month, in millions of gallons per day, spatially identified by grid-cell location. This information has been developed for existing well pumpages. The conversion of the above projected service area water use into grid-cell based well

withdrawal data has been developed using known existing well field locations, and the likelihood of future locations and operations.

The IWR-MAIN estimates excluded golf courses and landscape irrigation (estimated by the South Florida Water Management Model simulation as a part of the evapotranspiration simulation calculation runs), deep well withdrawals from the brackish Floridan aquifer, and some other uses which are not consumptive. For example, water is used in rock mining operations, but it is returned immediately after use (consisting mainly of washing rock cuttings), and therefore such use is not really a consumptive use. Instead, it is more representative of moving water from one place to another in the system. Floridan aquifer withdrawals do not represent a withdrawal from the water system modeled by the South Florida Water Management Model and are outside of the Everglades system.

Total irrigation demands for the Lower East Coast areas are projected to increase by 21 percent by the year 2050 to a total annual average demand of 707,800 acre-feet. Irrigation demands have been divided into three general categories; landscape, golf course and agriculture.

Landscape irrigation demands are supplied by either public water supply utilities or self-supplied sources such as wells or canals. Those demands provided by public water supply utilities have been included in the IWR-MAIN estimates. Self-supplied landscape irrigation demand estimates are based on future land use maps developed for local government comprehensive plans. Future self-supplied landscape irrigation is estimated to increase by 48 percent with average annual demands of 499,000 acre-feet.

Golf course irrigation that uses self-supplied sources for irrigation is estimated to increase by 31 percent with average annual demand of 71,800 acre-feet.

Agricultural irrigation in the Lower East Coast area includes irrigation for row crops, citrus, tropical fruits and nurseries. Overall, most agricultural irrigation is expected to decline in the future with the exception of nursery irrigation, which is expected to increase. Total agricultural irrigation demands for the Lower East Coast are estimated to decline by 28 percent to a total annual average demand of 136,600 acre-feet. Nursery irrigation is estimated to increase by 164 percent to a total annual average demand of 52,900 acre-feet.

4.8.2 Everglades Agricultural Area Region

The only source for irrigation water in the Everglades Agricultural Area is surface water. Irrigation demands for the Everglades Agricultural Area are not

expected to increase in the future. The demand of the Everglades Agricultural Area is estimated to be 430,000 acre-feet per year on an average annual basis.

4.8.3 Upper East Coast Region

The Upper East Coast region is approximately 1,200 square miles and includes most of Martin and St. Lucie Counties and a small part of Okeechobee County. There is a transition in land use in the region from urban in the east to agricultural in the west.

The Upper East Coast Region municipal and industrial water demand forecast by sector is shown in ***Table 4-7***. Figures are based on University of Florida Bureau of Economic and Business Research population and employment projections. A range of projected water supply usage is provided to reflect water usage based on implementation of the South Florida Water Management District mandatory regulations and programs. The data is shown for both restricted and unrestricted water usage for the Upper East Coast region for 1990 and 2050. Overall, municipal and industrial water supply demands are projected to increase up to as much as 125.8 million gallons per day by the year 2050 from 53.6 million gallons per day in 1990. This is a 135 percent increase over the 60-year period. In the Upper East Coast Region groundwater is the predominant source of water for municipal and industrial uses. This trend is expected to continue in the future.

TABLE 4-7
UPPER EAST COAST MUNICIPAL AND INDUSTRIAL DEMANDS
(MILLION OF GALLONS PER DAY)

End Use	2050 Range of Unrestricted to Restricted Demand
Residential	83.6 –70.1
Commercial & Industrial	33.5 – 31
Public & Other	8.7 - 7.9
Total	125.8 – 108.9

Agriculture is the predominate land use of the Upper East Coast region, accounting for 85 percent of the overall water demand. Currently, citrus crops occupy four-fifths of the irrigated agricultural acreage in the region (Gulf South Research Corp. & G.E.C. Inc, 1998). St Lucie Canal (C-44) Basin demands are estimated to be approximately 28,000 acre-feet on an average annual basis; these demands are not expected to increase in the future (Gilpin-Hudson et al., 1998a). The same trend is expected for the remainder of the Upper East Coast Region with irrigation demands remaining stable in the future (Gilpin-Hudson et al., 1998b).

The primary source of water for agriculture in the Upper East Coast Region is surface water however, in some areas the Floridan Aquifer System is an important source of water (SFWMD, 1998c).

4.8.4 Big Cypress and Caloosahatchee River Regions

The Big Cypress and Caloosahatchee River regions extend across approximately 4,300 square miles in southwest Florida. The regions include all of Lee county and portions of Charlotte, Collier, Glades, Hendry, Miami-Dade and Monroe Counties. Total water demand in these regions is estimated to increase by approximately 26 percent over the next 20 years. Urban demand is projected to increase by 84 percent, while agricultural demand is projected to increase by 13 percent (SFWMD, 1998b). In the Big Cypress and Caloosahatchee Regions groundwater is the predominant source of water for municipal and industrial uses with the exception of the City of Ft. Myers and Lee County Utilities, which withdraw water from the Caloosahatchee River. Lee County estimates that future demand for this source of water will be 50 cubic feet per second. The predominant source of water for agriculture in these regions is ground water and with the exception of the Caloosahatchee River Region have not been included in the modeling analysis for this plan.

In the Caloosahatchee River Region surface water from the Caloosahatchee River is the primary source of irrigation and has been included in the modeling analysis for the future without plan condition. The Caloosahatchee River Region demands are estimated to increase by 40 percent by 2050 to a total average annual demand of 125,000 acre-feet. (Gilpin-Hudson et al., 1997) These demand estimates are based on analysis of the suitability of land for growth in irrigation and land ownership (Mazzotti et al., 1992).

4.9 PHYSICAL FACILITIES AND OPERATIONS

This section discusses the physical facilities operational changes that are planned for the study area and are assumed to be in place for the future without plan condition.

4.9.1 C&SF Project Modifications

The C&SF Project was authorized by the Flood Control Act of 1948 and modified by subsequent acts, as a plan of improvement for flood control, drainage, and other purposes covering a 18,000 square mile area of both central and southern Florida. A number of efforts are currently underway by the Corps of Engineers to modify the project for environmental improvement. The following is an inventory of C&SF Project modifications either in the planning, design, or construction phase.

For the purpose of evaluating effects of alternative plans, they are included in the future without plan condition.

4.9.1.1 Kissimmee River Restoration

In the future without plan condition, the Kissimmee River restoration project will be in place and functioning. The restoration project, authorized by the Water Resources Development Act of 1992, will create a more natural physical environment in the lower Kissimmee River Basin. The major components of the project include: (1) reestablishment of inflows from Lake Kissimmee that will be similar to historical discharge characteristics (headwaters component), (2) acquisition of approximately 85,000 acres of land in the lower Kissimmee Chain of Lakes and river valley, (3) continuous backfilling of 22 miles of canal, (4) removal of two water control structures, and (5) recarving of nine miles of former river channel. The Kissimmee River Basin contributes about 30 percent of the water input to Lake Okeechobee. The supply of water to Lake Okeechobee is anticipated to be reduced by about 1.60 percent due to the implementation of this project.

As a component to the Kissimmee River Restoration project, the modification of the Upper Chain of Lakes regulation schedules and associated canal and water control structure modifications, known as the Headwaters Revitalization Project, will restore the ability to simulate the historic seasonal flow from Lake Kissimmee to the Lower Basin, and provide higher fluctuations of water levels in the lakes. The project will result in the expansion of the lakes' littoral zones by up to 18,500 acres, and improved habitat to fish and wildlife on Lakes Kissimmee, Hatchineha, Cypress, Tiger, and Jackson. The project will also increase spatial and temporal dynamics produced through long-term fluctuations of seasonal water levels.

The Headwaters Revitalization Project will meet two hydrologic conditions (criteria) that must be reestablished to restore the Lower Basin ecosystem. These conditions are; the reestablishment of continuous flow with duration and variability characteristics comparable to prechannelization records; and reestablishment of stage hydrographs that result in flood plain inundation frequencies comparable to prechannelization hydroperiods, including seasonal and long-term variability characteristics.

4.9.1.2 C-111 Project

Plan 6a, recommended in the Corps' General Reevaluation Report dated May 1994, will create the operational capability and flexibility to provide restoration of the ecological integrity of Taylor Slough and the eastern panhandle areas of the Everglades and maintain flood protection to the agricultural interests adjacent to C-111.

In the future without plan condition, C-111 Plan 6a will protect the natural values of a portion of Everglades National Park, and will maintain flood damage prevention within the C-111 Basin, east of L-31N and C-111. The project, which consists of both structural and non-structural modifications to the existing project works within the C-111 Basin, will restore the hydrology in 128 square miles of Taylor Slough and its headwaters in the Rocky Glades. In addition, the hydroperiod and depths in 1,027 square miles of Shark River Slough are beneficially impacted by the higher stages in the Rocky Glades, resulting in a net increase in water volume within Shark River Slough. The project will provide adequate operational flexibility to incorporate management strategies that will evolve as a result of continued monitoring and studies.

4.9.1.3 Modified Water Deliveries to Everglades National Park

The Modified Water Deliveries to Everglades National Park Project was authorized by the Everglades National Park Protection and Expansion Act (Public Law 101-229). The purpose of the project is to provide for structural modifications to the C&SF Project to enable the restoration of more natural water flows to Shark River Slough in Everglades National Park. The project is being implemented by the Corps in conjunction with the acquisition of about 107,600 acres of land by the Department of Interior. Land acquisition for the levee, canal, and pump station for the flood mitigation system in the 8.5-square-mile area is underway.

This project is presently in the design and construction phase. Project construction is scheduled for completion in 2003. In the future without plan condition, the Modified Water Deliveries Project will provide more natural flows to Shark River Slough in Everglades National Park. Water flows will be spread across a broader section of Shark River Slough to include the East Everglades between L-67 Extension and L-31N.

The addition of water control structures and culverts will help to reestablish the natural distribution of water from Water Conservation Area 3A into Water Conservation Area 3B. Outlets from Water Conservation Area 3B (S-355A & B) will be constructed to discharge into Northeast Shark River Slough. An existing levee and canal (L-67 Extension) along the eastern edge of the existing Everglades National Park boundary will also be removed. A Miccosukee Indian camp has been flood-proofed to avoid periodic flooding that would otherwise be caused by the project.

In order to prevent adverse flood impacts to the 8.5-square-mile residential area, the authorized project includes the construction of a seepage levee and canal around the western and northern edges of the area and a pump station (S-357) to remove excess seepage water. These project features are designed to maintain the existing level of flood protection in the residential area after the Modified Water

Deliveries to Everglades National Park project returns water levels in Northeast Shark Slough to higher levels. A second pump station (S-356) will be constructed to pump excess seepage water from the L-31N borrow canal and residential area into the L-29 borrow canal. This water will then flow through culverts under US Highway 41 into Northeast Shark River Slough. A locally preferred option which would modify the project features in the 8.5-square mile area is currently under consideration.

The structural modifications were designed to provide for maximum operational flexibility so that as more is learned through the continued iterative testing program, the operation of the project can be adjusted accordingly.

4.9.1.4 C-51 Project

The current Design Memorandum was completed in February 1998 and submitted for review and approval and contains the same National Economic Development plan as the June 1992 Detailed Design Memorandum but references an "authorized" plan, which includes the replacement of the 2.5-square-mile detention area with Stormwater Treatment Area 1E from the Everglades Construction Project. The "authorized" plan is also a product of the Technical Mediated Plan, which has been agreed to by Department of Justice, Department of Interior, Department of Army, the State of Florida, and the South Florida Water Management District. The State of Florida's Everglades Forever Act is based, in part, on the Technical Mediated Plan. The current "authorized" plan was authorized by the Water Resources and Development Act of 1996. The Act included language for the western C-51 project that additional work, as described in the "Everglades Construction Project", shall be accomplished at full Federal cost.

The authorized plan is recommended in the C-51 Design Memorandum and has many of the same physical features proposed in the 1992 Detailed Design Memorandum. It is described below. The project will provide 10-year flood protection for the western basin of C-51. The major physical difference between the 1992 Detailed Design Memorandum National Economic Development plan and the authorized plan is the replacement of the 1,600 acre detention area with the 5,350 acre "locally preferred" Stormwater Treatment Area 1 East. The most significant modification will be the reduction of discharges to Lake Worth, with C-51 West Basin runoff directed instead to Water Conservation Area 1 (Arthur R. Marshall Loxahatchee Wildlife Refuge). Runoff from the C-51 West Basin will pass through Stormwater Treatment Area 1 East for water quality improvement prior to its discharge to Water Conservation Area 1. In addition to the flood damage reduction benefits provided by the 1992 plan, the authorized plan would provide water quality improvement, reduction of damaging freshwater discharges to Lake Worth, and increased water supply for the Everglades and other users.

4.9.1.5 Manatee Protection

The West Indian manatee (*Trichechus manatus*) is listed as a Federally endangered species and is one of the most endangered species in Florida. As a response to recent manatee mortality trends associated with water control structures, this project will provide operational changes and implement the installation of a manatee protection system at seven sector gates at navigational locks near Lake Okeechobee. The beneficial outcome of this project will be the reduction of risk, injury, and mortality of the manatee. The seven sector gates include S-193 at Okeechobee and S-310 at Clewiston on Lake Okeechobee; St. Lucie Lock and Port Mayaca Lock on the St. Lucie Canal; and Moore Haven Lock, Ortona Lock, and W. P. Franklin Lock on the Caloosahatchee River.

The mechanism proposed would use hydroacoustic and pressure sensitive devices that will immediately stop the gates when an object is detected between the closing gates. These systems will transmit an alarm and signal to stop the gate movement when a manatee is detected. When an object or manatee activates the gate sensors, the gate will stop and open approximately six inches to release a manatee. As a result, a manatee will be able to travel between the open gates. After the gate opens, the operator can fully close the gate unless an object remains between the gates. Then the opening process will repeat the cycle as the sensors are activated again. Due to these structural modification, manatees will be at a significantly less risk as they encounter locks with sector gate.

The future without plan condition assumes that the automatic gate sensor devices are installed these lock sector gates.

4.9.1.6 Emergency Interim Plan

Legislation known as the Emergency Interim Plan for Florida Bay (Chapter 373.4593 FS) was passed by the Florida Legislature in May of 1994. Its purpose was to *"...provide for the release of water into Taylor Slough and Florida Bay by up to 800 cfs, in order to optimize the quantity, timing, distribution & quality of fresh water, and promote sheet flow into Taylor Slough."*

Section 2(e) called for acquisition of the western three sections of the agricultural area known as the Frog Pond in Miami-Dade County. The South Florida Water Management District took title to all eight sections of the Frog Pond in February of 1995. This effectively became phase 1 of the Emergency Interim Plan, as acquisition of this land eliminated land use conflicts between Everglades National Park and farming taking place in the Frog Pond. Elimination of these conflicts prevented the unnatural reduction in canal stages that had previously taken place each year in the fall to facilitate those farming activities. In addition, it allows greater flexibility in implementation of a rainfall driven plan for water levels in L-31W.

Phase 2 of the Emergency Interim Plan was designed to provide additional pumping capability into the L-31W canal, which formed the western boundary of the Frog Pond. Pump Station S-332D (C-111 Project and Experimental Program of Water Deliveries to Everglades National Park) was built for this need and expanded to 500 cfs.

4.9.1.7 Lake Okeechobee Regulation Schedule

Lake Okeechobee has undergone numerous changes since the initial construction of Herbert Hoover Dike. Today, the Lake Okeechobee's water level is managed to provide a range of desired purposes including, flood protection, water supply and environmental protection using "regulation schedules." In 1995, the South Florida Water Management District requested the Corps of Engineers to study a range of regulation schedules intended to be more responsive to lake ecosystem, down stream users and receiving water bodies. Those studies are currently underway. Due to the uncertainty of the recommendation that will result from that study, the Restudy assumed the current schedule, known as Run 25, for hydrologic modeling of the future without plan condition.

4.9.2 Critical Projects

The Water Resources Development Act (WRDA) of 1996 authorizes the Secretary of the Army to expeditiously implement restoration projects that are deemed critical to the restoration of the south Florida ecosystem. These projects are referred to as "Critical Projects." This authority resulted in an expedited study to identify projects that would meet the criteria set forth in the authorizing legislation. A total of 35 projects were nominated as Critical Projects under this authority by the Working Group of the South Florida Ecosystem Restoration Task Force (***Section 11***). This nomination process involved considerable input from the Governor's Commission for a Sustainable South Florida (***Section 11***) and the public. Based on the priorities developed during the nomination process, the U.S. Army Corps of Engineers conducts an abbreviated study and produces a letter report that is transmitted to the Secretary of the Army to obtain approval for construction of the project.

For the Critical Projects, the future without plan condition is defined as those Critical Projects that have Secretary of the Army approval and are anticipated to be funded under the Critical Projects program. To date, the following twelve Critical Projects have received approval:

- East Coast Canal Structures
- Tamiami Trail Culverts
- Melaleuca Eradication Project – New Facility

- Florida Keys Carrying Capacity Study
- Western C-11 Water Quality Treatment
- Seminole Tribe Big Cypress Water Conservation Plan (west)
- Southern Golden Gate Hydrologic Restoration
- Southern Crew Project Addition/Imperial River Flowways
- Lake Okeechobee Water Retention/Phosphorous Removal
- Ten Mile Creek Water Preserve Area
- Lake Trafford Restoration
- L31-East Flow Redistribution

Of these twelve approved projects, it is anticipated that the top five will be funded through the Critical Projects program:

- East Coast Canal Structures
- Tamiami Trail Culverts
- Melaleuca Eradication Project – New Facility
- Florida Keys Carrying Capacity Study
- Western C-11 Water Quality Improvements

Furthermore, it is anticipated that the North Fork of the New River Restoration Critical Project will receive approval and can be funded through the remainder of the Critical Projects program funds. Accordingly, the following seven Critical Projects are included in the without plan condition:

- East Coast Canal Structures
- Tamiami Trail Culverts
- Melaleuca Eradication Project – New Facility
- Florida Keys Carrying Capacity Study
- Western C-11 Water Quality treatment
- L31-East Flow Redistribution
- North Fork of the New River Restoration

Appendix A5 contains additional information about the Critical Projects Program.

4.9.3 Interim Plan for Lower East Coast Regional Water Supply

The Interim Plan for Lower East Coast Regional Water Supply, produced by the South Florida Water Management District, identified water resources and water supply development projects, both structural and non-structural, that should be initiated before 2000 to help meet the growing needs of the region (SFWMD, 1998d). The Interim Plan also identified local basin planning and other analytical programs to support the Lower East Coast 2020 Plan development and the Restudy.

The analyses conducted during the Lower East Coast Regional Water supply planning process demonstrated the need for increased storage capabilities throughout the system to help meet the increasing agricultural, environmental and urban demands.

The following components of the interim plan are included in the future without plan condition.

4.9.3.1 Wellfield Expansion in Service Areas 1 and 2

This component provides for relocation of future and some existing withdrawals from existing (1995) wellfields. Demands of the following utilities were evaluated assuming new wellfield locations: Lake Worth, Manalapan, Lantana, Boca Raton, Fort Lauderdale, Hollywood and Hallandale. The evaluations assumed that, for these utilities, demands shifted to new wellfields were the same as those identified in the Draft Lower East Coast Regional Water Supply Plan (SFWMD, 1997g). Generally this means that 1995 levels of demands continued to be met from existing facilities while the portion of new demands beyond 1995 levels were met from the newly expanded wellfields. The new wellfields were generally evaluated as being located along the western boundary of each utility's service area.

4.9.3.2 Northeastern Broward Secondary Canal Recharge Network

This component includes pump stations and structures that would maintain higher levels in secondary canals in eastern Broward County between the Hillsboro and the North New River Canals during the dry season. The control of seasonally higher canal elevations along the coast could help recharge the aquifers being used by local public water supply wellfields, and further reduce saline encroachment into the coastal fresh water aquifers. The selected canals are located where recharge from the canals would help to hold back the salt water front and protect the production capability of wellfields to the east.

4.9.3.3 Miami-Dade County Utility Aquifer Storage and Recovery

This component includes aquifer storage and recovery wells and related facilities that would be installed associated with wellfields of the Miami-Dade Water and Sewer Authority Department. These facilities would be operated to store water in the Floridan Aquifer in the wet season and recover this water in the dry season. For the future without project condition, the evaluations were for a daily injection and recovery capacity of approximately 150 million gallons per day, a maximum recovery percentage of injected water of 90 percent, an annual injection period of seven months and an annual recovery period of five months.

4.9.3.4 Selected Elements of L-8 Project

The goal of the selected elements of the L-8 project is to redirect runoff from the southern L-8 Basin away from Water Conservation Area 1 and the C-51 canal to the West Palm Beach Water Catchment Area and the Loxahatchee Slough via the M Canal and the C-18 Canal. Subsequently, this water may be used to meet urban water supply demands for West Palm Beach, to meet environmental water demands of the Catchment Area and Loxahatchee Slough, and may provide recharge for the Jupiter and Seacoast Utilities Authority wellfields. In addition, this project would be expected to reduce the incident and volume of harmful freshwater releases into Lake Worth lagoon via the C-51 Canal. The project includes: an improved structural connection from the West Palm Beach Water Catchment Area to the Loxahatchee Slough aquifer storage and recovery wells at the West Palm Beach Water Catchment Area or the Indian Trails Improvement District impoundment and a coastal recharge delivery system.

4.9.3.5 Minimum Flows and Levels

This component involves operational adjustments associated with the establishment of minimum flows and levels for the Biscayne Aquifer and the Everglades. Minimum levels for the Biscayne Aquifer involves maintaining water levels in coastal canals to prevent saltwater intrusion. Minimum flows and levels for the Everglades focuses on preservation of hydric soils. No net outflow from Water Conservation Areas are allowed if water levels are less than minimum level marsh triggers or less than minimum operating criteria in the canals of the Loxahatchee National Wildlife Refuge (Water Conservation Area 1): 14 feet, Water Conservation Area 2A: 10.5 feet, Water Conservation Area 3A: 7.5 feet. Marsh level triggers will be those used in the Interim Plan for Lower East Coast Regional Water Supply.

4.9.3.6 Modify Pump Station G-404

This component involves increasing the capacity of proposed pump station G-404 as part of the Everglades Construction Project to increase its capacity from 570 cfs to 1,000 cfs. This will provide the ability to deliver more water from L-5 to L-4, which will in turn improve Everglades hydropatterns in the northwest corner of Water Conservation Area 3A.

4.9.3.7 Water Conservation Areas and Everglades National Park Rainfall-Based Rainfall Water Delivery Plans

In the future without plan condition, the rainfall delivery plan is based on antecedent rainfall and natural system hydropatterns for Water Conservation Area

2A and 3A and Everglades National Park, with quantities to approximate Best Management Practices Replacement water quantities.

4.9.4 Northwest Dade Lake Belt Area

This component assumes that the conditions caused by the currently permitted mining exist and that the affects of any future mining are fully mitigated by the mining industry.

4.9.5 East Cape and Homestead Canals

The East Cape and Homestead Canals, located within Everglades National Park, were constructed by local interests in the early 1900s to assist in the drainage of the Everglades prior to authorization of the park in 1936. After the Everglades National Park was established, the canals were plugged to prevent overdrainage of upstream fresh water systems and saltwater intrusion during high tides in the dry season. The passage of Hurricane Andrew resulted in extensive damage to both plugs. The project repaired the plugs in August 1997.

4.10 LAND ACQUISITION PROGRAMS

Besides land acquisition for ongoing C&SF Project Modifications, the State of Florida, the South Florida Water Management District, Miami-Dade County, and the Federal government have land acquisition programs or are funding land acquisitions within south Florida through a variety of funding sources or programs. Lands within the study area have been acquired and will continue to be acquired by these entities for a variety of purposes.

4.10.1 Save Our Rivers Program, Preservation 2000 and Conservation and Recreation Lands

In 1981, the State of Florida enacted the Resource Rivers Act, also known as the Save Our Rivers Program, Florida Statutes section 373.59. The Act created the Water Management Lands Trust fund. The program uses bond proceeds, supported by the general revenue portion of the State's Documentary Stamp Tax, to acquire lands for the purposes of water management, water supply, and the conservation and protection of the State's water resources. Manageability, surface and ground water systems, and the formation of corridors for the critical interaction of wildlife populations are major considerations in the land acquisition process. Prime requisites in managing these public lands are to ensure that the water resources, fish and wildlife populations, and native plant communities are maintained in an environmentally acceptable manner, and made available for appropriate outdoor recreational activities consistent with their environmental sensitivity. The

Preservation 2000 Act (Florida Statutes 375.045) enacted by the State of Florida in 1990 also added land acquisition funds to the Save Our Rivers Program. The South Florida Water Management District is allocated 30 percent of the yearly moneys in the Water Management Lands Trust Fund. To date the District has acquired more than 330,000 acres with the Save Our Rivers Program funding.

Florida Statutes section 259.032 entitled Conservation and Recreation Lands Trust Fund, established within the Department of Environmental Protection a nonlapsing, revolving fund to fund the Land Acquisition Trust Fund for the Save Our Rivers Program and to purchase other lands for state-designated parks, recreation areas, preserves, reserves, historic or archaeological sites, geologic or botanical sites, recreational trails, forests, wilderness areas, wildlife management areas, urban open space, or other state-designated recreation or conservation lands.

All of the above programs assume that the lands can be purchased from willing sellers.

The South Florida Water Management District's P-2000 needs and priority study, identified an additional 491,000 acres of priority projects; however, available funding from P-2000, plus funds from other federal, state and local programs will allow for the purchase of 316,000 acres. The South Florida Water Management District has other 50 identified projects.

One of the projects directly related to the Restudy is the East Coast Buffer. The East Coast Buffer consists of approximately 66,400 acres in Palm Beach, Broward and Miami-Dade Counties and was approved for acquisition under Save Our Rivers by the South Florida Water Management District Governing Board in June 1995 with the understanding that the concept would be incorporated into the Restudy. In July 1997 the Board approved an expansion of the buffer by 5,657 acres. To date, approximately 16,000 acres have been acquired. The East Coast Buffer, as evaluated during the South Florida Water Management District's Lower East Coast Regional Water Supply planning process and incorporated into the Restudy process as the Water Preserve Areas, is a series of marshes, reservoirs, and groundwater recharge areas along the east side of the Water Conservation Areas. The function of the buffer, once constructed, is to reduce the impacts of development on the Everglades, reduce levee seepage from the Everglades, increase ground water recharge, capture stormwater discharged to tide, and enhance wetland areas east of the conservation areas. The Without Plan Condition assumes that a portion of the lands for the East Coast Buffer are in public ownership; however, the Without Plan Condition does not assume that all the lands needed for the East Coast Buffer are in public ownership or that the physical facilities necessary for the operation of the storage of water on these land are constructed.

Another of the projects directly related to the Restudy Project is the Model Lands Basin. This land acquisition project is located in southern Miami-Dade County. The project includes the acquisition of approximately 42,000 acres, of which only 1,270 acres have been acquired. These lands form a contiguous habitat corridor with the Everglades National Park, the Southern Glades Save Our River project, Biscayne National Park, Crocodile Lakes National Wildlife Refuge, John Pennekamp State Park, and the existing National Marine Sanctuary.

4.10.2 Miami-Dade County Environmentally Endangered Lands Program

In 1990, Miami-Dade County approved a program to fund the acquisition, protection and maintenance of environmentally endangered lands. The Miami-Dade County Environmentally Endangered Lands Program specifically established an Environmentally Endangered Lands Management Trust Fund in Chapter 24A of the Code of Miami-Dade County, providing for:

> *" ...the preservation, enhancement, restoration, conservation and maintenance of environmentally endangered lands which either have been purchased with monies from the EEL Acquisition Trust Funds, or have otherwise been approved for management pursuant to Section 24A-8(2)." (Appendix X, Chapter 24A, Code of Miami-Dade County)."*

The Environmentally Endangered Lands program considers acquisition of sites proposed by the public and by other government agencies. Sites are inspected and then recommended for acquisition. Once approved for acquisition, the seller must be willing to sell the land to Miami-Dade County. No land is acquired from those landowners unwilling to sell. For the Without Plan condition, it is assumed that lands purchased through this program will be managed in accordance with Chapter 24A of the Miami-Dade County code.

4.10.3 Farm Bill

The U.S. Congress on April 4, 1996 enacted the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127). Section 390 entitled Everglades Ecosystem Restoration, provides the Secretary of the Interior with $200,000,000 to: conduct restoration activities in the Everglades ecosystem in south Florida, which shall include the acquisition of real property and interests in real property located within the Everglades ecosystem; and to fund resource protection and resource maintenance activities in the Everglades ecosystem. The Secretary of Interior can also transfer funds to the State of Florida, the Army Corps of Engineers or the South Florida Water Management District. The Secretary of Interior has executed Grant Agreements with the South Florida Water Management District designed to provide land acquisition funds for the purchase of lands within the East Coast Buffer and in the Everglades Agricultural Area. The Secretary of Interior has also executed a Grant Agreements with the State of Florida Department of

Environmental Protection for the purchase of lands within Southern Golden Glades Estates. The Department of Interior is also providing funds to purchase the Talisman Property in the Everglades Agricultural Area.

4.11 RECREATION

South Florida's climate and unique ecosystem offer a wide variety of recreational opportunities. Due to the region's high population growth rate, more recreational facilities and opportunities will be needed in the future. Without the plan, hunting, fishing, boating and wildlife viewing will continue; however, the quality of these recreational activities can be expected to decline concurrent with ecosystem decline. Given the likelihood of an increased demand in these activities occurring in direct proportion to the growth in population in the south Florida area, the impacts of the potential loss of recreational opportunities due to ecosystem decline is predictable.