SECTION 9

THE RECOMMENDED COMPREHENSIVE PLAN

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THE RECOMMENDED COMPREHENSIVE PLAN

The recommended Comprehensive Plan is the Initial Draft Plan, Alternative D-13R, together with the Other Project Elements. The plan consists of construction and operation features, real estate requirements, mitigation, a monitoring program, and operation and maintenance of the completed project. The individual features of the recommended Comprehensive Plan were designed at various levels of detail based on information available during the plan formulation and evaluation phase. The details of the recommended plan are conceptual and more site-specific analyses will be needed to optimize the design and operations of the plan. In addition, several studies are recommended to investigate additional improvements needed to support restoration, protection, and preservation of the south Florida ecosystem.

The following principles guided the development of the recommended Comprehensive Plan:

- The overarching objective of the Comprehensive Plan is the restoration, preservation and protection of the south Florida ecosystem while providing for other water related needs of the region;
- The Comprehensive Plan will be based on the best available science and independent scientific review will be an integral part of its development and implementation;
- The Comprehensive Plan will be developed through an inclusive and open process that engages all stakeholders;
- All applicable Federal, tribal, state, and local agencies will be full partners and their views will be considered fully; and
- The Comprehensive Plan must be a flexible plan that is based on the concept of adaptive assessment – recognizing that modifications will be made in the future based on new information.

9.1 CONSTRUCTION FEATURES

A large number of construction features have been identified in the recommended Comprehensive Plan. These features were designed at various levels of detail based on information available during the plan formulation and evaluation phase. As described in ***Section 7***, the engineering design of the Other Project Elements was very limited. Further, many of the design assumptions for components in the Initial Draft Plan were based solely on output from the South Florida Water Management Model (refer to ***Appendix B*** for more detailed description of this model), which averages hydrologic conditions across grid cells

totaling four square miles. Consequently, the engineering details of the construction features, including the size and location, are conceptual. Conceptual planning of many of the construction and operation features did not involve detailed planning and design work necessary to optimize features to achieve all ecosystem restoration performance objectives, particularly on a smaller, local scale. In particular, conceptual planning work completed to date is not adequate to determine construction design features necessary to achieve basin-specific water quality performance objectives. Furthermore, water quality benefits of conceptual features of the recommended plan could not be fully evaluated for all regions of the study area during alternative plan formulation and evaluation because modeling and other predictive tools were not available. More site-specific analyses of the recommended plan features will be needed to determine the optimum size, location, depth and configuration in subsequent phases of this project. Subsequent site-specific analyses performed during the implementation phase will include collecting necessary physical and water quality data, finalizing hydrologic and water quality performance targets, conducting refined modeling and pilot projects, and resolving regulatory issues. In a number of cases, construction features, such as reservoirs, were not specifically sited in the Comprehensive Plan. In these cases, a cooperative effort with landowners in the areas where these features are proposed will be used to identify suitable sites in subsequent phases of this project.

The construction features in the recommended Comprehensive Plan are described in the following sub-sections by study region. In some cases, the construction features include multiple components. These components were grouped based on their dependency upon one another. For example, outlet conveyance improvements to Water Conservation Area 3 from the Central Lake Belt component were combined with the Central Lake Belt Storage Reservoir component. The component designation that was used during plan formulation is included in parentheses, e.g. (A). Other Project Elements are identified as (OPE).

9.1.1 Kissimmee River Region

9.1.1.1 North of Lake Okeechobee Storage Reservoir (A)

This feature includes an above-ground reservoir and a 2,500-acre stormwater treatment area. The total storage capacity of the reservoir is approximately 200,000 acre-feet and is located in the Kissimmee River Region, north of Lake Okeechobee. The specific location of this facility has not been identified, however, it is anticipated that the facility will be located in Glades, Highlands, or Okeechobee Counties. The initial design of this feature assumed a 20,000-acre facility (17,500-acre reservoir and 2,500-acre treatment area) with water levels in the reservoir fluctuating up to 11.5 feet above grade. The final size, depth and configuration of this facility will be determined through more detailed planning, land suitability analyses, and design. Future detailed planning and design activities will also include an evaluation of degraded waterbodies within the watersheds of the

storage/treatment facility to determine appropriate pollution load reduction targets, and other water quality restoration targets for the watershed.

The purpose of this facility is to detain water during wet periods for later use during dry periods and reduce nutrient loads flowing to the lower Kissimmee River and Lake Okeechobee. This increased storage capacity will reduce the duration and frequency of both high and low water levels in Lake Okeechobee that are stressful to the Lake's littoral ecosystems, and cause large discharges from the Lake that are damaging to the downstream estuary ecosystems. Depending upon the proposed location(s) of this water storage/treatment facility and pollutant loading conditions in the watershed(s), the facility could be designed to achieve significant water quality improvements, consistent with appropriate pollution load reduction targets.

The operation of this feature assumes that water from Lake Okeechobee, the Kissimmee River or the S-65E drainage basin will be pumped into the storage reservoir/stormwater treatment area when the climate-based inflow model (see ***Appendix B***) forecasts that the Lake water levels will rise significantly above desirable levels for the Lake littoral zone. Water held in the reservoir and stormwater treatment area will not be released until the lake levels decline to ecologically acceptable levels.

9.1.1.2 Taylor Creek/Nubbin Slough Storage and Treatment Area (W)

This feature includes an above-ground reservoir with a total storage capacity of approximately 50,000 acre-feet and a stormwater treatment area with a capacity of approximately 20,000 acre-feet in the Taylor Creek/Nubbin Slough Basin. The initial design of this feature assumed a reservoir of 5,000 acres with water levels fluctuating up to 10 feet above grade and a stormwater treatment facility of approximately 5,000 acres. The final size, depth and configuration of this feature will be determined through more detailed planning, land suitability analysis and design.

The purpose of this feature is to attenuate flows to Lake Okeechobee and reduce the amount of nutrients flowing to the Lake. The feature is designed to capture, store, and treat basin runoff during periods when levels in Lake Okeechobee are high or increasing. The water quality treatment element of this feature is consistent with the recommendations of the South Florida Ecosystem Restoration Working Group's Lake Okeechobee Issue Team and the Pollution Load Reduction Goals for Lake Okeechobee developed for the Lake Okeechobee Surface Water Improvement and Management Plan (SFWMD, 1997f). The water held in the reservoir would be released to Lake Okeechobee when lake levels decline to ecologically acceptable levels.

9.1.1.3 Lake Okeechobee Watershed Water Quality Treatment Facilities (OPE)

This feature includes two reservoir-assisted stormwater treatment areas and plugging of select local drainage ditches. The initial design of these reservoir-assisted stormwater treatment areas assumes a 1,775-acre facility in the S-154 Basin in Okeechobee County and a 2,600-acre facility in the S-65D sub-basin of the Kissimmee River Basin in Highlands and Okeechobee Counties. The plugged drainage ditches will result in restoration of approximately 3,500 acres of wetlands throughout the Lake Okeechobee watershed basin. This feature is also consistent with the recommendations of the South Florida Ecosystem Restoration Working Group's Lake Okeechobee Issue Team for achieving water quality restoration objectives in the Lake and should provide significant long-term water quality benefits for the Lake.

The other portion of this feature includes the purchase of conservation easements within four key basins of Lake Okeechobee to restore the hydrology of isolated wetlands by plugging the connection to drainage ditches and the diversion of canal flows to adjacent wetlands. The sites range in size from an individual wetland to an entire sub-basin and are located within the lower Kissimmee River Basins (S-65D, S-65E, and S-154) and Taylor Creek/Nubbin Slough Basin (S-191).

The purpose of this feature is to attenuate peak flows and retain phosphorus before flowing into Lake Okeechobee. Further, many of the wetlands in the Lake Okeechobee watershed have been ditched and drained for agriculture water supply and flood control. This feature will restore the hydrology of selected isolated and riverine wetlands in the region by plugging these drainage ditches.

The South Florida Ecosystem Restoration Working Group's Lake Okeechobee Issue Team identified six primary tributary basins (C-41 Basin, Fisheating Creek, Taylor Creek/Nubbin Slough, S-154 Basin, S-65D (Pool D) Basin, S-65E (Pool E) Basin) contributing significant phosphorus loads to the Lake. In order to further reduce nutrient loading to Lake Okeechobee in support of the water quality goals for the Lake, articulated in the Lake Okeechobee Surface Water Improvement Management Plan, there are potentially other reservoir-assisted stormwater treatment area facilities needed in the Lake Okeechobee watershed (such as in the C-41 and Fisheating Creek Basins) that are not included in this construction feature. Therefore, it is proposed that a comprehensive plan for the Lake Okeechobee watershed be developed before the final configuration of this construction feature is implemented. A comprehensive Lake Okeechobee watershed plan would include elements of the Lake Okeechobee Surface Water Management Plan and remediation programs developed to achieve appropriate pollution reduction targets established for the Lake.

9.1.1.4 Lake Okeechobee Tributary Sediment Dredging (OPE)

This feature includes the dredging of sediments from 10 miles of primary canals within an 8-basin area in the northern watershed of Lake Okeechobee. The initial design assumes that the dredged material will contain approximately 150 tons of phosphorus.

The purpose of this feature is to remove phosphorous in canals located in areas of the most intense agriculture in the Lake Okeechobee watershed. These sediments presently contribute to the excessive phosphorus loading to Lake Okeechobee. A partnership with local landowners will be pursued for the disposal of the dredged material on uplands. The South Florida Water Management District has programmed a demonstration project to be implemented in 1999. Findings from this demonstration project will be used for detailed planning and design of this construction feature. This feature is also consistent with the water quality restoration goals for the Lake included in the Lake Okeechobee Surface Water Management Plan and subsequently developed by the Lake Okeechobee Issue Team. Implementation of this feature will also complement other activities associated with pollution reduction for the Lake.

9.1.1.5 Lake Istokpoga Regulation Schedule (OPE)

This feature includes development of a plan to address water resource problems in the Lake Istokpoga Basin. Lake Istokpoga is a natural lake located in Highlands County, a tributary of Lake Okeechobee and the Kissimmee River. The major focus of this plan is to create a balance between the environmental needs, water supply and flood control in the Lake Istokpoga drainage basin.

The purpose of this plan is to examine the Lake Istokpoga Basin with a view towards enhancing fish and wildlife benefits and developing a long-term comprehensive management plan. It has been noted that operation of S-68, beginning in 1962, reduced the maximum annual fluctuation of the Lake (SFWMD, 1978). While the littoral zone expanded, the amount of quality habitat was reduced by this formation of extensive floating tussocks and dense cattail communities. Persistently lowered lake levels have reduced the natural frequency of seasonal drying and inundation. Without natural dewatering events, germination of diverse aquatic plant seeds is reduced, consolidation and compaction of organic sediments cannot occur, and the formation and expansion of floating mats of water hyacinths and other species common to tussock communities are promoted. These mats reduce overall productivity and diversity of the marsh.

The plan will also address the need for flood protection to the perimeter and upstream tributaries, and downstream areas west and east of C-41A. Water supply needs for agriculture and the Seminole Tribe of Florida will also be addressed.

9.1.2 Lake Okeechobee Region

9.1.2.1 Lake Okeechobee Aquifer Storage and Recovery (GG)

This feature includes a series of aquifer storage and recovery wells adjacent to Lake Okeechobee with a capacity of 1-billion gallons per day and associated pre- and post- water quality treatment in Glades and Okeechobee Counties. The initial design assumes 200 wells, each with the capacity of 5 million gallons per day with 8-ultrafiltration water quality pre-treatment facilities and aeration for post-treatment. Based on information for existing aquifer storage and recovery facilities, it is assumed that recovery of aquifer-stored water would have no adverse effects on water quality conditions in Lake Okeechobee. In fact, some level of nutrient load reduction may occur as a result of aquifer storage, which would be a long-term benefit to in-lake water quality conditions. The level and extent of treatment and number of the aquifer storage and recovery wells may be modified based on findings from a proposed aquifer storage and recovery pilot project (U.S. Environmental Protection Agency, 1999). The pilot project would also investigate changes to water chemistry resulting from aquifer storage and identify post-retrieval water quality treatment requirements, if any, necessary to implement aquifer storage and recovery facilities. The Implementation Plan (Section 10) includes pilot studies to investigate the proposed facilities, including water quality changes associated with aquifer storage and recovery.

The purpose of this feature is to: (1) provide additional regional storage while reducing both evaporation losses and the amount of land removed from current land use (e.g. agriculture) that would normally be associated with construction and operation of above-ground storage reservoirs; (2) increase the Lake's water storage capability to better meet regional water supply demands for agriculture, Lower East Coast urban areas, and the Everglades; (3) manage a portion of regulatory releases from the Lake primarily to improve Everglades hydropatterns and to meet supplemental water supply demands of the Lower East Coast; (4) reduce harmful regulatory discharges to the St. Lucie and Caloosahatchee Estuaries; and (5) maintain and enhance the existing level of flood protection.

The operation of this feature assumes that after treatment, water from Lake Okeechobee will be injected into the upper Floridan Aquifer when the climate-based inflow model forecasts that the Lake water level will rise significantly above those levels that are desirable for the Lake littoral zone. During the dry season, water stored in the Floridan Aquifer will be returned to the Lake after aeration either when the Lake water level is projected to fall to within three quarters of a foot of the supply-side management line or below an established water level during the dry season.

9.1.3 Caloosahatchee River Region

9.1.3.1 C-43 Basin Storage Reservoir and Aquifer Storage and Recovery (D)

This feature includes above-ground reservoir(s) with a total storage capacity of approximately 160,000 acre-feet and aquifer storage and recovery wells with a capacity of approximately 220 million gallons per day and associated pre- and post-water quality treatment located in the C-43 Basin in Hendry, Glades, or Lee Counties. The initial design of the reservoir(s) assumed 20,000 acres with water levels fluctuating up to 8 feet above grade. The final size, depth and configuration of this facility will be determined through more detailed planning and design. The initial design of the wells assumed 44 wells, each with the capacity of 5 million gallons per day with chlorination for pre-treatment and aeration for post-treatment. The level and extent of treatment and number of the aquifer storage and recovery wells may be modified based on findings from a proposed aquifer storage and recovery pilot project (U.S. Environmental Protection Agency, 1999).

The purpose of this feature is to capture C-43 Basin runoff and releases from Lake Okeechobee. These facilities will be designed for water supply benefits, some flood attenuation, to provide environmental water supply deliveries to the Caloosahatchee Estuary, and water quality benefits to reduce salinity and nutrient impacts of runoff to the estuary. It is assumed that, depending upon the location of the facility and pollutant loading conditions in the watershed, the facility could be designed to achieve significant water quality improvements, consistent with appropriate pollution load reduction targets.

Excess runoff from the C-43 Basin and Lake Okeechobee flood control discharges will be pumped into the proposed reservoir. Water from the reservoir will be injected into the aquifer storage and recovery wellfield for long-term (multi-season) storage. Any estuarine demands, not met by basin runoff and the aquifer storage and recovery wells, will be met by Lake Okeechobee as long as the lake stage is above a pre-determined level. Lake water is also used to meet the remaining basin demands subject to supply-side management. The C-43 reservoir is operated in conjunction with the Caloosahatchee Backpumping feature, which includes a stormwater treatment area for water quality treatment. If the level of water in the reservoir exceeds 6.5 feet and Lake Okeechobee is below a pre-determined level, then water is released and sent to the backpumping facility.

9.1.3.2 Caloosahatchee Backpumping with Stormwater Treatment (DDD)

This feature includes pump stations and a stormwater treatment area with a total capacity of approximately 20,000 acre-feet located in the C-43 Basin in Hendry and Glades Counties. The initial design of the stormwater treatment area assumed 5,000 acres with the water level fluctuating up to 4 feet above grade. The final size,

depth and configuration of this facility will be determined through more detailed planning and design.

The purpose of this feature is to capture excess C-43 Basin runoff, which will be used to augment regional system water supply.

This feature operates after estuary and agricultural/urban demands have been met in the basin and when water levels in the C-43 storage reservoir exceed 6.5 feet above grade. Lake Okeechobee must also be considered to have available storage. When these conditions are met, a series of pump stations will backpump excess water from the reservoir and the C-43 Basin to Lake Okeechobee after treatment through a stormwater treatment area. The stormwater treatment area will be designed to meet Lake Okeechobee phosphorus and other pollutant loading reduction targets consistent with the Surface Water Improvement and Management Plan for the Lake and future appropriate pollution load reduction targets which may be developed for the Lake and the watershed in which the facility is to be located.

9.1.4 Upper East Coast

9.1.4.1 C-44 Basin Storage Reservoir (B)

This feature includes an above-ground reservoir with a total storage capacity of approximately 40,000 acre-feet located in the C-44 Basin in Martin County. The initial design of the reservoir assumed 10,000 acres with the water levels fluctuating up to 4 feet above grade. The final location, size, depth and configuration of this facility will be determined through more detailed analysis to be completed as a part of the ongoing Indian River Lagoon Feasibility Study.

The purpose of the feature is to capture local runoff from the C-44 Basin, then return the stored water to the C-44 when there is a water supply demand. The reservoir will be designed for flood flow attenuation to the estuary, water supply benefits including environmental water supply deliveries to the estuary, and water quality benefits to control salinity and reduce loading of nutrients, pesticides, and other pollutants contained in runoff presently discharged to the estuary.

9.1.4.2 C-23/C-24/C-25/Northfork and Southfork Storage Reservoirs (UU)

This feature includes above-ground reservoirs with a total storage capacity of approximately 349,400 acre-feet located in the C-23/C-24/C-25/Northfork and Southfork Basins in St. Lucie and Martin Counties. The initial design of the reservoirs assumed 39,000 acres with water levels fluctuating up to 8 feet above grade and 9,350 acres with water levels fluctuating up to 4 feet above grade. The final location, size, depth and configuration of these facilities will be determined through more detailed analysis to be completed as a part of the Indian River Lagoon

Feasibility Study. It is noted that experience from the Upper St. Johns Project reveals that greater variability of water levels are more desirable for the ecology and water quality.

The purpose of this feature is to capture local runoff from the C-23/C-24/C-25/Northfork and Southfork Basins for flood flow attenuation to the St. Lucie River Estuary. It is assumed that this feature can be designed to provide significant water quality improvement benefits to the Indian River Lagoon and St. Lucie River Estuary in terms of reduced loading of nutrients, pesticides, and suspended materials in stormwater runoff which is presently conveyed to those waterbodies. Interim Pollution Load Reduction Goals for total suspended material, total nitrogen, and total phosphorus have already been developed for the Indian River Lagoon Surface Water Improvement and Management Plan (SFWMD and SJRWMD, 1994). This water will then be used to provide both water supply and environmental water supply benefits.

9.1.5 Everglades Agricultural Area

9.1.5.1 Everglades Agricultural Storage Reservoirs (G)

This feature includes above-ground reservoir(s) with a total storage capacity of approximately 360,000 acre-feet located in the Everglades Agricultural Area in western Palm Beach County and conveyance capacity increases for the Miami, North New River, and Bolles and Cross Canals. The initial design for the reservoir(s) assumed 60,000 acres, divided into three, equally sized compartments (1, 2, and 3), with the water level fluctuating up to 6 feet above grade in each compartment. The final size, depth and configuration of this facility will be determined through more detailed planning and design.

The purpose of this feature is to improve the timing of environmental deliveries to the Water Conservation Areas, including reducing damaging flood releases from the Everglades Agricultural Area to the Water Conservation Areas, reducing Lake Okeechobee regulatory releases to the estuaries, meeting Everglades Agricultural Area irrigation and Everglades water demands, and increasing flood protection in the Everglades Agricultural Area.

Runoff from the Everglades Agricultural Area, Miami and North New River Canal Basins and regulatory releases from Lake Okeechobee will be pumped into the reservoirs. Compartment 1 discharges will be used to meet Everglades Agricultural Area irrigation demands only. Compartment 2 discharges will be used to meet environmental demands as a priority and can be used to supply a portion of agricultural demands if the environmental demands equal zero. Compartment 3 discharges will be used to meet environmental demands. The storage compartments can also be designed to provide a water quality treatment function, augmenting the performance of the Everglades Construction Project and ensuring protection of water

quality in the Everglades Protection Area. Design of this feature for water quality performance will be based on water quality targets for the Everglades Construction Project and other water quality targets developed to protect designated uses in Everglades Agricultural Area waters.

9.1.6 Big Cypress Region

9.1.6.1 Big Cypress/L-28 Interceptor Modifications (CCC)

This feature includes modification of levees and canals, water control structures, pumps, and stormwater treatment areas with a total storage capacity of 7,600 acre-feet located within and adjacent to the Miccosukee and Seminole Indian Reservations in Collier and Hendry Counties. The initial design of the stormwater treatment areas assumed a total acreage of 1,900 acres with the water level fluctuating up to 4 feet above grade. Conceptual sizes of the stormwater treatment areas were based on interim phosphorus concentration targets in the conceptual plan for the Everglades Construction Project. The final size, depth and configuration of this facility, including the stormwater treatment areas, will be determined through more detailed planning and design. Design of the stormwater treatment areas will be based on water quality criteria of the Seminole Tribe and criteria applicable to Big Cypress National Preserve, as appropriate.

The purpose of this feature is to reestablish sheetflow from the West Feeder Canal across the Big Cypress Reservation and into the Big Cypress National Preserve, maintain flood protection on Seminole Tribal lands, and ensure that inflows to the North and West Feeder Canals meet applicable water quality standards. Consistency with the Seminole Tribe's Conceptual Water Conservation System master plan will be maintained.

Upstream flows entering the West and North Feeder Canals will be routed through two stormwater treatment areas to be located at the upstream ends of the canals. Sheetflow will be reestablished south of the West Feeder Canal by a system to be developed consistent with the Seminole Tribe's Conceptual Water Conservation System master plan. After conversion to a pump station, S-190 will also push flows south into the L-28 Interceptor Canal where sheetflow to the southwest will also be reestablished with backfilling of and degradation of the southwest levee of the canal.

9.1.6.2 Seminole Tribe Big Cypress Water Conservation Plan (OPE)

This feature includes construction of water control, management, and treatment facilities in the Big Cypress Reservation. The construction elements include conveyance systems, major canal bypass structures, irrigation storage cells, and water resource areas.

The purpose of this feature is to improve the quality of water and runoff from phosphorus generating agricultural sources within the Reservation. The area is traversed by the L-28 and L-28I Borrow Canals and the North and West Feeder Canals, all of which were constructed as part of the C&SF Project. This comprehensive watershed management system is designed to achieve environmental restoration on the Reservation, the Big Cypress Preserve, and the Everglades Protection Area. In addition, the project will reduce flood damage and promote water conservation.

The removal of pollutants will be achieved using natural treatment processes in pretreatment cells and water storage areas. A phosphorus level of 50 ppb is the goal, which is the current level to be achieved by the stormwater treatment areas of the Everglades Construction Project. Should design performance levels for phosphorus become more stringent, this project has sufficient flexibility to incorporate additional alternative technology.

9.1.7 Water Conservation Areas

9.1.7.1 Flow to Northwest and Central Water Conservation Area 3A (II and RR)

This feature includes relocation and modifications to pump stations and development of a spreader canal system located in the northwest corner and west-central portions of Water Conservation Area 3A in western Broward County.

The purpose of this feature is to increase environmental water supply availability, increase depths and extend wetland hydropatterns in the northwest corner and west-central portions of Water Conservation Area 3A.

Additional flows will be directed to the northwest corner and west central portions of Water Conservation Area 3A by increasing the capacity of the G-404 pump station, currently a part of the Everglades Construction Project, and increasing the capacity and relocating the S-140 pump station. A spreader canal system at S-140 will reestablish sheetflow to the west-central portion of Water Conservation Area 3A. Water quality treatment of flows is assumed to be provided by the Everglades Construction Project and water quality treatment strategies developed to fulfill the Non-Everglades Construction Project requirements of the Everglades Forever Act. If additional treatment is determined to be required as a result of future detailed planning and design work, those existing facilities would be modified to provide the necessary treatment.

9.1.7.2 Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement (AA, QQ and SS)

These features include the construction of new water control structures and the modification or removal of levees, canals, and water control structures in Water Conservation Area 3A and B located in western Broward County.

The purpose of these features is to reestablish the ecological and hydrological connection between Water Conservation Areas 3A and 3B, the Everglades National Park, and Big Cypress National Preserve.

Sheetflow obstructions will be removed with the backfilling of the Miami Canal and southern 7.5 miles of L-67A Borrow Canal, removal of the L-68A, L-67C, L-29, L-28, and L-28 Tieback Levees and Borrow Canals, and elevating of Tamiami Trail. Water supply deliveries to Miami-Dade County, previously made through the Miami Canal, will be rerouted through an expanded North New River Canal and southern conveyance system. Eight passive weir structures to be located along the entire length of L-67A will also promote sheetflow from Water Conservation Area 3A to 3B during high flow conditions.

9.1.7.3 Loxahatchee National Wildlife Refuge Internal Canal Structures (KK)

This feature includes two water control structures in the northern ends of the perimeter canals encircling the Loxahatchee National Wildlife Refuge (Water Conservation Area 1) located in Palm Beach County.

The purpose of this feature is to improve the timing and location of water depths within the Refuge. It is assumed that these structures will remained closed except to pass Stormwater Treatment Area 1 East and Stormwater Treatment Area 1 West outflows and water supply deliveries to the coastal canals.

9.1.7.4 Miccosukee Tribe Water Management Plan (OPE)

This feature includes construction of a 900-acre wetland retention/detention area on the Miccosukee Tribe's Alligator Alley Reservation. The feature includes a pump station, levees, trenches and culverts to create the inflow and outflow facilities for the retention/detention area.

The purpose of this feature is to provide water storage capacity and water quality enhancement for tribal reservation waters which discharge from tribal lands and downstream into the Everglades Protection Area.

9.1.8 Lower East Coast Region

9.1.8.1 Pal-Mar and J.W. Corbett Wildlife Management Area Hydropattern Restoration (OPE)

This feature includes water control structures, canal modifications and the acquisition of 3,000 acres located between Pal-Mar and the J.W. Corbett Wildlife Management Area in Palm Beach County.

The purpose of this feature is to provide hydrologic connections between the Corbett Wildlife Management Area and: (1) the Moss Property, (2) the C-18 Canal, (3) the Indian Trail Improvement District, and (4) the L-8 Borrow Canal, in addition to extending the spatial extent of protected natural areas. These connections would relieve the detrimental effects on native vegetation frequently experienced during the wet season and form an unbroken 126,000-acre greenbelt extending from the Dupuis Reserve near Lake Okeechobee across the J.W. Corbett Wildlife Management Area and south to Jonathan Dickinson State Park.

9.1.8.2 Water Preserve Areas / L-8 Basin (K and GGG)

This feature includes a combination above-ground and in-ground reservoir with a total storage capacity of approximately 48,000 acre-feet located immediately west of the L-8 Borrow Canal and north of the C-51 Canal in Palm Beach County. Other construction features include aquifer storage and recovery wells with a capacity of 50 million gallons per day and associated pre- and post- water quality treatment to be constructed in the City of West Palm Beach (Lake Mangonia), a series of pumps, water control structures, and canal capacity improvements in the M Canal. The initial design for the reservoir assumed a 1,800-acre reservoir with 1,200 usable acres with the water level fluctuating from 10 feet above grade to 30 feet below grade. The final size, depth and configuration of this facility will be determined through more detailed planning and design. The initial design of the wells assumed 50 wells, each with a capacity of 5 million gallons per day with chlorination for pre-treatment and aeration for post-treatment. The level and extent of treatment and number of the aquifer storage and recovery wells may be modified based on findings from a proposed aquifer storage and recovery pilot project.

The purpose of this feature is to increase water supply availability and flood protection for northern Palm Beach County areas. It will also provide flows to enhance hydroperiods in the Loxahatchee Slough, increase base flows to the Northwest Fork of the Loxahatchee River, and reduce high discharges to the Lake Worth Lagoon.

Water will be pumped into the reservoir from the C-51 Canal and Southern L-8 Borrow Canal during the wet season, or periods when excess water is available, and returned to the C-51 and Southern L-8 during dry periods. Additional features will

also direct excess water into the West Palm Beach Water Catchment Area. During periods when the West Palm Beach Water Catchment Area is above desirable stages, 50 million gallons per day will be diverted to Lake Mangonia for storage in the aquifer storage and recovery wells. The reservoir portion of this component may be implemented under a previous authorization

9.1.8.3 Acme Basin B Discharge (OPE)

This feature includes the construction of a wetland or chemical treatment area and a storage reservoir with a combined total storage capacity of 3,800 acre-feet located adjacent to the Loxahatchee National Wildlife Refuge in Palm Beach County. The initial design for the treatment area and reservoir assumed 310 acres with the water level fluctuating up to 4 feet above grade and 620 acres with the water level fluctuating up to 8 feet above grade. The final size, depth and configuration of these facilities will be determined through more detailed planning and design.

The purpose of this feature is to provide water quality treatment and stormwater attenuation for runoff from Acme Basin "B" prior to discharge to the Loxahatchee National Wildlife Refuge or alternative locations described below. Excess available water may be used to meet water supply demands in central and southern Palm Beach County.

Stormwater runoff from Acme Basin "B" will be pumped into the wetland treatment area and then into the storage reservoir until such time as the water can be discharged into the Loxahatchee National Wildlife Refuge if water quality treatment criteria is met or into the one of two alternative locations: the Palm Beach County Agricultural Reserve Reservoir (VV) or the combination above-ground and in-ground reservoir area located adjacent to the L-8 Borrow Canal and north of the C-51 Canal(GGG).

9.1.8.4 Lake Worth Lagoon Restoration (OPE)

This feature includes sediment removal and trapping within the C-51 Canal and sediment removal or trapping within a 2.5 mile area downstream of the confluence of the C-51 Canal and the Lake Worth Lagoon located in Palm Beach County. A prototype project will be conducted to determine if the Lagoon sediments will either be removed or trapped.

The purpose of this feature is to improve water quality and allow for the reestablishment of sea grasses and benthic communities. The elimination of the organically enriched sediment from the C-51 Canal discharge will provide for long term improvements to the Lagoon and enable success for additional habitat restoration and enhancement projects planned by Palm Beach County.

9.1.8.5 Winsburg Farms Wetland Restoration (OPE)

This feature includes the construction of a 175-acre wetland east of Loxahatchee Wildlife Preserve in Palm Beach County. The feature will reduce the amount of treated water from the Southern Region Water Reclamation Facility wasted in deep injection wells by further treating and recycling the water.

The purpose of this facility is to create a wetland from water, which would be normally lost to deep well injection and any future beneficial use. The wetland will reuse a valuable resource, recharge the local aquifer system, create a new ecologically significant wildlife habitat and extend the function of the nearby Wakodahatchee Wetland.

9.1.8.6 C-17 Backpumping and Treatment (X)

This feature includes backpumping facilities and a stormwater treatment area with a total storage capacity of approximately 2,200 acre-feet located in northeastern Palm Beach County. The initial design for the stormwater treatment area assumed 550 acres with the water level fluctuating up to 4 feet above grade. The final size, depth and configuration of this facility will be determined through more detailed planning and design, and will address appropriate pollution load reduction targets necessary to protect receiving waters (West Palm Beach Water Catchment Area).

The purpose of this feature is to increase water supplies to the West Palm Beach Water Catchment Area and Loxahatchee Slough by capturing and storing excess flows currently discharged to the Lake Worth Lagoon from the C-17 Canal.

Excess C-17 Canal water will be backpumped through existing canals and proposed water control structures to the stormwater treatment area which will provide water quality treatment prior to discharge into the West Palm Beach Water Catchment Area.

9.1.8.7 C-51 Backpumping and Treatment (Y)

This feature includes backpumping facilities and a stormwater treatment area with a total storage capacity of approximately 2,400 acre-feet located in Palm Beach County. The initial design for the stormwater treatment area assumed 600 acres in size with the water level fluctuating up to 4 feet above grade. The final size, depth and configuration of this facility will be determined through more detailed planning and design, and will address appropriate pollution load reduction targets necessary to protect receiving waters (West Palm Beach Water Catchment Area).

The purpose of this feature is to increase water supplies to the West Palm Beach Water Catchment Area and Loxahatchee Slough by capturing and storing excess flows currently discharged to the Lake Worth Lagoon from the C-51 Canal.

Excess C-51 Canal water will be backpumped through existing and proposed water control structures and canals to the stormwater treatment area which will provide water quality treatment prior to discharge into the West Palm Beach Water Catchment Area.

9.1.8.8 C-51 Regional Groundwater Aquifer Storage and Recovery (LL)

This feature includes a series of aquifer storage and recovery wells with a capacity of 170 million gallons per day as well associated pre- and post- water quality treatment to be constructed along the C-51 Canal in Palm Beach County. The initial design of the wells assumed 34 well clusters, each with a capacity of 5 million gallons per day with chlorination for pre-treatment and aeration for post-treatment. The level and extent of treatment and number of the aquifer storage and recovery wells may be modified based on findings from a proposed aquifer storage and recovery pilot project.

The purpose of this feature is to capture and store excess flows from the C-51 Canal, currently discharged to the Lake Worth Lagoon, for later use during dry periods.

The aquifer storage and recovery facilities will be used to inject and store surficial aquifer ground water adjacent to the C-51 Canal into the upper Floridan Aquifer instead of discharging the canal water to tide. Water will be returned to the C-51 Canal to help maintain canal stages during the dry-season. If water is not available in the aquifer storage and recovery system, existing rules for water delivery to this region will be applied.

9.1.8.9 Palm Beach County Agricultural Reserve Reservoir and Aquifer Storage and Recovery (VV)

This feature includes an above-ground reservoir with a total storage capacity of approximately 20,000 acre-feet located in the western portion of the Palm Beach County Agricultural Reserve. Aquifer storage and recovery wells with a capacity of 75 million gallons per day and associated pre- and post- water quality treatment located adjacent to the reservoir will also be a part of this feature. The initial design for the reservoir assumed 1,660 acres with water levels fluctuating up to 12 feet above grade. The final size, depth and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study. The initial design of the wells assumed 15 well clusters, each with a capacity of 5 million gallons per day as well as chlorination for pre-treatment and aeration for post-treatment. The source of water to be injected is surficial ground

water adjacent to the reservoir. The level and extent of treatment and number of the aquifer storage and recovery wells may be modified based on findings from a proposed aquifer storage and recovery pilot project.

The purpose of this feature is to supplement water supplies for central and southern Palm Beach County by capturing and storing excess water currently discharged to the Lake Worth Lagoon. These supplemental deliveries will reduce demands on Lake Okeechobee and Loxahatchee National Wildlife Area. It is assumed that this facility could also be designed to achieve water quality improvements in downstream receiving waters, depending upon pollutant loading conditions in the watershed.

The facilities will be filled during the wet season with excess water from the western portions of the Lake Worth Drainage District and possibly from Acme Basin B. Water will be returned to the Lake Worth Drainage District Canals to help maintain canal stages during the dry-season. If water is not available in the reservoir or the aquifer storage and recovery wells, existing rules for water delivery to this region will be applied.

9.1.8.10 Protect and Enhance Existing Wetland Systems along Loxahatchee National Wildlife Refuge including the Strazzulla Tract (OPE)

This feature includes water control structures and the acquisition of 3,335 acres located in Palm Beach County.

The purpose of this feature is to provide a hydrological and ecological connection to the Loxahatchee National Wildlife Refuge and expand the spatial extent of protected natural areas. This land will act as a buffer between higher water stages to the west and lands to the east that must be drained. This increase in spatial extent will provide vital habitat connectivity for species that require large unfragmented tracts of land for survival. It also contains the only remaining cypress habitat in the eastern Everglades and one of the few remaining sawgrass marshes adjacent to the coastal ridge. This is a unique and endangered habitat that must be protected. This area provides an essential Everglades landscape heterogeneity function.

9.1.8.11 Site 1 Impoundment and Aquifer Storage and Recovery (M)

This feature includes an above-ground reservoir with a total storage capacity of approximately 15,000 acre-feet located in the Hillsboro Canal Basin in southern Palm Beach County. A series of aquifer storage and recovery wells with a total capacity of approximately 150 million gallons per day and associated pre- and post- water quality treatment will also be a part of this feature located adjacent to the reservoir or along the Hillsboro Canal. The initial design of the reservoir assumed 2,460 acres with water levels fluctuating up to 6 feet above grade. The final size, depth and

configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study. The initial design of the aquifer storage and recovery facility assumed 30 well clusters, each with a capacity of 5 million gallons per day with chlorination for pre-treatment and aeration for post-treatment. The source of water to be injected is in the surficial ground water adjacent to the reservoir. The location, extent of treatment and number of the aquifer storage and recovery wells may be modified based on findings from a proposed aquifer storage and recovery pilot project.

The purpose of this feature is to supplement water deliveries to the Hillsboro Canal during dry periods thereby reducing demands on Lake Okeechobee and the Loxahatchee National Wildlife Refuge.

Water from the Hillsboro Canal will be pumped into the reservoir during the wet season or periods when excess water is available. Water will be released back to the Hillsboro Canal to help maintain canal stages during the dry-season.

9.1.8.12 Broward County Secondary Canal System (CC)

This feature includes a series of water control structures, pumps, and canal improvements located in the C-9, C-12 and C-13 Canal Basins and east basin of the North New River Canal in central and southern Broward County.

The purpose of this feature is to reduce water shortages by recharging local wellfields and stabilizing the saltwater interface. Excess water in the basins will be pumped into the coastal canal systems to maintain canal stages at optimum levels. When basin water is not sufficient to maintain canal stages, the canals will be maintained from other construction features such as the Site 1 Impoundment and the North Lake Belt Storage Area and then from Lake Okeechobee and the Water Conservation Areas.

9.1.8.13 Western C-11 Diversion Impoundment and Canal and Water Conservation Areas 3A and 3B Levee Seepage Management (O and Q)

This feature includes canals, levees, water control structures, and a stormwater treatment area/impoundment with a total storage capacity of 6,400 acre-feet located in western Broward County. The initial design of the stormwater treatment area/impoundment assumed 1,600 acres with the water level fluctuating up to 4 feet above grade. The final size, depth and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study. Detailed design of this feature will address appropriate pollution load reduction targets necessary to protect receiving waters.

The purpose of this feature is to divert and treat runoff from the western C-11 Basin that is presently discharged into Water Conservation Area 3A, control seepage from Water Conservation Areas 3A and 3B by improving groundwater elevations, and provide flood protection for the western C-11 Basin.

Runoff in the western C-11 Canal Basin that was previously backpumped into Water Conservation Area 3A through the S-9 pump station will be diverted into the C-11 Stormwater Treatment Area/Impoundment and then into either the North Lake Belt Storage Area, the C-9 Stormwater Treatment Area/Impoundment, or Water Conservation Area 3A after treatment, as applicable.

9.1.8.14 C-9 Stormwater Treatment Area/Impoundment (R)

This feature includes canals, levees, water control structures and a stormwater treatment area/impoundment with a total capacity of approximately 10,000 acre-feet, located in the western C-9 Basin in Broward County. The initial design of the stormwater treatment area/impoundment assumed 2,500 acres with the water level fluctuating up to 4 feet above grade. The final size, depth and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study and will address appropriate pollution load reduction targets necessary to protect receiving waters.

The purpose of this feature is to provide treatment of runoff stored in the North Lake Belt Storage Area, enhance groundwater recharge within the basin, provide seepage control for Water Conservation Area 3 and buffer areas to the west, and provide flood protection for the western C-9 Basin.

Seepage from the C-9 Stormwater Treatment Area/Impoundment will be collected and returned to the impoundment.

9.1.8.15 North Lake Belt Storage Area (XX)

This feature includes canals, pumps, water control structures, and an in-ground storage reservoir with a total capacity of approximately 90,000 acre-feet located in Miami-Dade County. The initial design of the reservoir assumed 4,500 acres with the water level fluctuating from ground level to 20 feet below grade. A subterranean seepage barrier will be constructed around the perimeter to enable drawdown during dry periods, to prevent seepage losses, and to prevent water quality impact due to the high transmissivity of the Biscayne Aquifer in the area. The reservoir will be located within an area proposed for rock mining. A pilot test of this component will be conducted prior to final design to determine construction technologies, storage efficiencies, impacts upon local hydrology, and water quality effects. The water quality assessment will include a determination as to whether the in-ground reservoir with perimeter seepage barrier will allow storage of untreated runoff without concerns of groundwater contamination. The final size, depth and

configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study and will address appropriate pollution load reduction targets necessary to protect the adjacent surficial aquifer and downstream receiving surface waters.

The purpose of this feature is to capture and store a portion of the stormwater runoff from the C-6, western C-11 and C-9 Basins. The stored water will be used to maintain stages during the dry season in the C-9, C-6, C-7, C-4 and C-2 Canals and to provide water deliveries to Biscayne Bay to aid in meeting salinity targets.

Runoff is pumped and gravity fed into the in-ground reservoir from the C-6 (west of Florida's Turnpike), western C-11, and C-9 Basins. Outflows from the facility will be directed into the C-9 Stormwater Treatment Area/Impoundment for treatment prior to delivery to the C-9, C-7, C-6, C-4 and C-2 Canals. If necessary, additional stormwater treatment areas will be constructed adjacent to the in-ground reservoir.

9.1.8.16 Diverting Water Conservation Area 2 and 3 flows to Central Lake Belt Storage Area (YY and ZZ)

This feature includes pumps, water control structures, canals, and conveyance improvements located adjacent to Water Conservation Areas 2 and 3 in Broward County. The final size and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study.

The purpose of this feature is to attenuate high stages in Water Conservation Areas 2 and 3 and transport this excess water to the Central Lake Belt Storage Area where it will be stored to meet downstream demands in Shark River Slough, Water Conservation Area 3B or Biscayne Bay.

When stages in Water Conservation Areas 2B, 3A, and 3B exceed target depths, water will be diverted to the Central Lake Belt Storage Area through water control structures and conveyance features. Water supply deliveries will be made first to Northeast Shark River Slough, then to Water Conservation Area 3B, and, finally, to Biscayne Bay, if flows are available. It is assumed that the water to be diverted from Water Conservation Areas 2 and 3 is of adequate quality to return to the Everglades Protection Area and Biscayne Bay; however, the final size, depth and configuration of these facilities, including treatment requirements, will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study.

9.1.8.17 Central Lake Belt Storage Area (S and EEE)

This feature includes pumps, water control structures, a stormwater treatment area, and a combination above-ground and in-ground storage reservoir

with a total storage capacity of approximately 190,000 acre-feet located in Miami-Dade County. The initial design of the reservoir assumed 5,200 acres with the water level fluctuating from 16 feet above grade to 20 feet below grade. A subterranean seepage barrier will be constructed around the perimeter to enable drawdown during dry periods and to prevent seepage losses. A pilot test of this technology will be conducted prior to final design of this component to determine construction technologies, storage efficiencies, impacts upon local hydrology, and water quality effects. Since this facility is to be located within the protection area of Miami-Dade County's Northwest Wellfield, the pilot test will also be designed to identify and address potential impacts to the County's wellfield which may occur during construction and/or operation. The stormwater treatment area was assumed to be 640 acres with the water level fluctuating up to 4 feet above grade. The final size, depth and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study.

The purpose of the feature is to store excess water from Water Conservation Areas 2 and 3 and provide environmental water supply deliveries to: (1) Northeast Shark River Slough, (2) Water Conservation Area 3B, and (3) to Biscayne Bay, in that order, if available. Due to the source of the water (Water Conservation Areas 2 and 3), it is assumed that water stored in this facility is of adequate quality to return to the Everglades Protection Area and Biscayne Bay; however, the final size, depth and configuration of these facilities, including treatment requirements, will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study.

Excess water from Water Conservation Areas 2 and 3 will be diverted into the L-37, L-33, and L-30 Borrow Canals, which run along the eastern boundaries of the Water Conservation Areas, and pumped into the Central Lake Belt Storage Area. Water supply deliveries will be pumped through a stormwater treatment area prior to discharge to the Everglades via the L-30 Borrow Canal and a reconfigured L-31N Borrow Canal. If available, deliveries will be directed to Biscayne Bay through the Snapper Creek Canal at Florida's Turnpike. A structure will be provided on the Snapper Creek Canal to provide regional system deliveries when water from the Central Lake Belt Storage Area is not available.

9.1.8.18 Dade-Broward Levee/Pennsuco Wetlands (BB)

This feature includes water control structures and modifications to the Dade-Broward Levee and associated conveyance system located in Miami-Dade County. The final size and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study.

The purpose of this feature is to reduce seepage losses to the east from the

Pennsuco Wetlands and southern Water Conservation Area 3B, enhance hydroperiods in the Pennsuco Wetlands, and provide recharge to Miami-Dade County's Northwest Wellfield.

9.1.8.19 C-4 Control Structures (T)

This feature includes two water control structures located in the C-4 Canal in Miami-Dade County.

The purpose of this feature will be to enhance wetland hydroperiods and enhance recharge to Miami-Dade County's Northwest Wellfield.

The eastern structure will be operated to reduce regional system deliveries by diverting dry season stormwater flows to the C-2 Canal to provide salt water intrusion protection and recharge to downstream wellfields. A western structure, being implemented under the Critical Projects Program, will be operated to control water levels in the C-4 Canal at a higher elevation to reduce seepage losses from the Pennsuco Wetlands and areas to the west of the structure.

9.1.8.20 Bird Drive Recharge Area (U)

This feature includes pumps, water control structures, canals, and an above-ground recharge area with a total storage capacity of approximately 11,500 acre-feet located in western Miami-Dade County. The initial design of the recharge feature assumed 2,877 acres with the water level fluctuating up to 4 feet above grade. Final design will seek to enhance and maintain the continued viability of wetlands within the basin. The final size, depth and configuration of these facilities will be determined through more detailed planning and design to be completed as a part of the Water Preserve Areas Feasibility Study and will address appropriate pollution load reduction targets necessary to protect downstream receiving surface waters.

The purpose of the feature is to recharge groundwater and reduce seepage from the Everglades National Park buffer areas by increasing water table elevations east of Krome Avenue. The facility will also provide C-4 flood peak attenuation and water supply deliveries to the South Dade Conveyance System and Northeast Shark River Slough.

Inflows from the western C-4 Canal Basin and from the proposed West Miami-Dade Wastewater Treatment Plant will be pumped into the Recharge Area. Inflows from the wastewater treatment plant will stop when the Recharge Area depth exceeds 3 feet above-ground and will be diverted to a deep well injection disposal system. Recharge area outflows will be prioritized to meet: (1) groundwater recharge demands, (2) South Dade Conveyance System demands, and (3) Northeast Shark River Slough demands, when supply is available. Regional system deliveries will be

routed through the seepage collection canal system of the Bird Drive Recharge Area to the South Dade Conveyance system.

9.1.8.21 L-31N Improvements for Seepage Management and S-356 Structures (V and FF)

This feature includes relocating and enhancing L-31N, groundwater wells, and sheetflow delivery system adjacent to Everglades National Park located in Miami-Dade County. More detailed planning, design and pilot studies will be conducted to determine the appropriate technology to control seepage from Everglades National Park. These studies and tests will also determine the appropriate amount of wet season groundwater flow control that will minimize potential impacts to Miami-Dade County's West Wellfield and freshwater flows to Biscayne Bay.

The purpose of this feature is to improve water deliveries to Northeast Shark River Slough and restore wetland hydropatterns in Everglades National Park by reducing levee and groundwater seepage and increasing sheetflow.

This feature reduces levee seepage flow across L-31N adjacent to Everglades National Park via a levee cutoff wall (refer to ***Appendix C***). Groundwater flows during the wet season are captured by ground water wells adjacent to L-31N and pumped to Everglades National Park. Water from upstream natural areas will be diverted into a buffer area adjacent to Everglades National Park where sheetflow will be reestablished. Further, this feature includes relocation of the Modified Water Deliveries structure S-357 to provide more effective water deliveries to Everglades National Park. New discharges to Everglades National Park will be designed to meet applicable water quality criteria.

9.1.8.22 West Miami-Dade County Reuse (HHH)

This feature includes a wastewater treatment plant expansion to produce superior, advanced treatment of wastewater from a future West Miami-Dade Wastewater Treatment Plant to be located in the Bird Drive Basin in Miami-Dade County. The initial design assumed a potential discharge volume of 100 million gallons per day from the wastewater treatment plant. The final configuration of these facilities will be determined through more detailed planning and design to be completed in the ongoing West Dade Water Reuse Feasibility Study authorized in Section 413 of the Water Resources Development Act of 1996. Superior water quality treatment features will be based on appropriate pollution load reduction targets necessary to protect downstream receiving surface waters.

The purpose of the feature is to meet the demands for: (1) the Bird Drive Recharge Area; (2) the South Dade Conveyance System, and (3) the Northeast Shark River Slough. When all demands have been met, the plant will stop

treatment beyond secondary treatment standards and will dispose of the secondary treated effluent into deep injection wells.

9.1.8.23 Biscayne Bay Coastal Wetlands (FFF and OPE)

The feature includes pump stations, spreader swales, stormwater treatment areas, flowways, levees, culverts, and backfilling canals located in southeast Miami-Dade County and covers 13,600 acres from the Deering Estate at C-100C, south to the Florida Power and Light Turkey Point power plant, generally along L-31E.

The purpose of this feature is to rehydrate wetlands and reduce point source discharge to Biscayne Bay. The proposed project will replace lost overland flow and partially compensate for the reduction in groundwater seepage by redistributing, through a spreader system, available surface water entering the area from regional canals. The proposed redistribution of freshwater flow across a broad front is expected to restore or enhance freshwater wetlands, tidal wetlands, and nearshore bay habitat. Sustained lower-than-seawater salinities are required in tidal wetlands and the nearshore bay to provide nursery habitat for fish and shellfish. This project is expected to create conditions that will be conducive to the reestablishment of oysters and other components of the oyster reef community. Diversion of canal discharges into coastal wetlands is expected not only to reestablish productive nursery habitat all along the shoreline but also to reduce the abrupt freshwater discharges that are physiologically stressful to fish and benthic invertebrates in the bay near canal outlets.

More detailed analyses will be required to define target freshwater flows for Biscayne Bay and the wetlands within the redistribution system.. The target(s) will be based upon the quality, quantity, timing and distribution of flows needed to provide and maintain sustainable biological communities in Biscayne Bay, Biscayne National Park and the coastal wetlands. Additionally, potential sources of water for providing freshwater flows to Biscayne Bay will be identified and evaluated to determine their ability to provide the target flows.

The component Biscayne Bay Coastal Canals as modeled in D-13R and the Critical Project on the L-31E Flowway Redistribution are smaller components of the Biscayne Bay Coastal Wetlands feature described above.

9.1.8.24 South Miami-Dade County Reuse (BBB)

This feature includes a plant expansion to produce superior, advanced treatment of wastewater from the existing South District Wastewater Treatment Plant located north of the C-1 Canal in Miami-Dade County. The initial design of this feature assumed that the plant will have a capacity of 131 million gallons per day. More detailed analyses will be required to determine the quality and quantity of water needed to meet the ecological goals and objectives of Biscayne Bay.

Additionally, due to the water quality issues associated with discharging reclaimed water into Biscayne National Park, an Outstanding Florida Water, such as potential failures of the treatment system and the limited ability to control contaminant inputs to the sanitary sewer system serving the treatment facility, other potential sources of water to provide required freshwater flows to southern and central Biscayne Bay should be investigated before pursuing the reuse facility as a source. If it is determined that other, more appropriate sources are not available, the reuse project will be initiated by determining the parameters of concern, the necessary wastewater treatment requirements, and the appropriate treatment technology to be implemented.

The purpose of this feature is to provide additional water supply to the South Biscayne Bay and Coastal Wetlands Enhancement Project. In order to attain the superior level of treatment, construction of an add-on pretreatment and membrane treatment system to the existing secondary treatment facility will be necessary. Superior water quality treatment features will be based on appropriate pollution load reduction targets necessary to protect downstream receiving surface waters (Biscayne Bay).

9.1.8.25 Restoration of Pineland & Hardwood Hammocks in C-111 Basin (OPE)

This feature includes restoring south Florida slash pine and hardwood hammock species on a 200-foot wide strip on each side of two miles of SR 9336 from the C-111 Canal to the L-31W Borrow Canal (approximately 50 acres) and the establishment of 2, one-acre hammocks in low-lying areas on each side of the road located in Miami-Dade County.

The purpose of this feature is to restore hammocks to a portion of the Frog Pond which has been purchased by the South Florida Water Management District as part of the C-111 Project to restore the Taylor Slough portion of the Everglades. This feature will provide some water quality treatment for runoff passing through the hammocks and will demonstrate the techniques required to re-establish native conifer and hardwood forests on land that has been rock plowed.

9.1.8.26 C-111N Spreader Canal (WW)

This feature includes levees, canals, pumps, water control structures, and a stormwater treatment area to be constructed, modified or removed in the Model Lands and Southern Glades (C-111 Basin) area of Miami-Dade County. This feature enhances the C-111 Project design for the C-111N Spreader Canal with the construction of a stormwater treatment area, the enlarging of pump station S-332E and the extension of the canal under U.S. Highway 1 and Card Sound Road into the Model Lands. The initial design of this feature pumps water from the C-111 and the C-111E Canals into a stormwater treatment area prior to discharging to Southern Everglades and Model Lands. This features also calls for filling in the southern reach of the C-111 Canal and removal of structures S-18C and S-197. The

final size, depth, location and configuration of this feature will be determined through more detailed planning and design.

The purpose of this feature is to improve deliveries and enhance the connectivity and sheetflow in the Model Lands and Southern Glades areas, reduce wet season flows in C-111, and decrease potential flood risk in the lower south Miami-Dade County area.

9.1.9 Southwest Florida Region

9.1.9.1 Southern Golden Gate Estates Restoration (OPE)

This feature includes a combination of spreader channels, canal plugs, road removal and pump stations in the Western Basin and Big Cypress, Collier County, south of I-75 and north of U.S. 41 between the Belle Meade Area and the Fakahatchee Strand State Preserve.

The purpose of this feature is to restore and enhance the wetlands in Golden Gate Estates and in adjacent public lands by reducing over-drainage. Implementation of the restoration plan would also improve the water quality of coastal estuaries by moderating the large salinity fluctuations caused by freshwater point discharge of the Fahka Union Canal. The plan would also aid in protecting the City of Naples' eastern Golden Gate wellfield by improving groundwater recharge.

9.1.9.2 Southern Corkscrew Regional Ecosystem Watershed Project Addition (OPE)

This feature includes the acquisition and restoration of 4,670 acres of land, replacement of the Imperial Bonita Estates bridge on the Imperial River, and replacement of the Kehl Canal Weir in southern Lee County, adjacent to Corkscrew Sanctuary.

The purpose of this feature is to: (1) re-establish historic flow patterns and hydroperiods on the project lands, as well as Corkscrew Regional Ecosystem Watershed and Corkscrew Sanctuary wetlands to the east; (2) restore historical storage potential of the Southern Corkscrew Regional Ecosystem Watershed lands; (3) reduce excessive freshwater discharges to Estero Bay during the rainy season; (4) decrease saltwater intrusion during the dry season; (5) reduce loading of nutrients and other pollutants to the Imperial River and Estero Bay; (6) increase aquifer recharge and water supply for an area frequently facing water restrictions during dry years; and (7) reduce flooding of homes and private lands west of the project area.

Hydrologic restoration of this land will include the following modifications: removal of existing road beds, removal of single family homes, removal of junk debris, filling of ditches, and removal of agricultural canals and berms. Other components within the plan include: replacement of the Kehl Canal weir, clearing and snagging on Imperial River, Estero River and Halfway Creek, reconnection of Spring Creek and Halfway Creek under U.S. Interstate 75, and replacement of the Imperial Bonita Estates bridge.

9.1.9.3 Lake Trafford Restoration (OPE)

This feature includes a lake-wide organic sediment removal to Lake Trafford near Ft. Myers, Florida. Lake Trafford has poor water quality, extensive muck accumulations, loss of native submergent plant communities, periodic aquatic weed infestations, and numerous moderate fish kills. Poor water quality is attributed to internal nutrient cycling from extensive organic much deposits throughout the Lake's basin.

The purpose of this feature is to preserve the headwaters of the Corkscrew Swamp and Camp Keais Strand. The water quality of the Lake affects these wetland resources that have been targeted for protection. These wetlands drain into important estuarine systems such as Estero Bay and Cape Ramono. Lake Trafford is an integral contributor to the sheet flow that traverses such areas as the Corkscrew Regional Ecosystem Watershed and the Southern Golden Gates Estates area. The quality of the Lake and the associated watershed affects important wildlife species and offers a sanctuary for migrating birds. As the only major lake in southwest Florida, Lake Trafford provides a sanctuary during the dry season.

9.1.9.4 Henderson Creek/Belle Meade Restoration (OPE)

This feature combines multiple individual elements to complement each other to form a larger-scale combined effect. This feature includes a 10-acre stormwater lake/marsh filtering system; four culverts under State Road 951; hydrologic restoration around Manatee Basin including culverts, ditching, removal of some roadbed; invasive, exotic plant removal; a public access point and interpretive boardwalk; construction of a swale and spreader system; and removal of the Road-to-Nowhere. This southwest Florida feature is located in Collier County. The area known locally as Belle Meade is the primary drainage basin for the Henderson Creek Estuary, which drains into Rookery Bay.

The purpose of this feature is to restore historic sheetflow to the estuary, treatment of stormwater, improvement of water quality and increase in habitat value and wetland functions.

9.1.9.5 Lakes Park Restoration (OPE)

This feature includes the construction of a 40-acre marsh/flowway in an abandoned rock mine, removal of exotic vegetation, and planting native vegetation on 11 acres of uplands and 9 acres of littoral zone. This feature is located in the Lee County Lakes Regional Park, upstream of Estero Bay.

The purpose of this feature is to enhance surface water runoff quality by creating a meandering flowway with shallow littoral zones to enhance pollution removal and oxygen content, removing aquatic and upland exotic infestation while allowing public access into upland areas of improved native habitat. The restoration will provide immediate habitat and water quality benefits at Lakes Park and improve downstream conditions in Hendry County and the Estero Bay Aquatic Preserve.

9.1.10 Florida Bay and Keys

9.1.10.1 Florida Keys Tidal Restoration (OPE)

This feature includes the use of bridges or culverts to restore the tidal connection between Florida Bay and the Atlantic Ocean in Monroe County. The four locations are as follows: (1) Tarpon Creek, just south of Mile Marker 54 on Fat Deer Key (width 150 feet); (2) unnamed creek between Fat Deer Key and Long Point Key, south of Mile Marker 56 (width 450 feet); (3) tidal connection adjacent to Little Crawl Key (width 300 feet); and (4) tidal connection between Florida Bay and Atlantic Ocean at Mile Marker 57 (width 2,400 feet).

The purpose of this feature is to restore the tidal connection that was eliminated in the early 1900's during the construction of Flagler's railroad. Restoring the circulation to areas of surface water that have been impeded and stagnant for decades will significantly improve water quality, benthic floral and faunal communities, larval distribution of both recreational and commercial species (i.e. spiney lobster), and the overall hydrology of Florida Bay.

9.1.11 System-wide

9.1.11.1 Melaleuca Eradication Project and other Exotic Plants (OPE)

This feature includes: 1) upgrading and retrofitting the current quarantine facility in Gainesville, and 2) large-scale rearing of approved biological control organisms for release at multiple sites within the south Florida ecosystem.

The purpose of this feature is to increase the effectiveness of biological control technologies to manage Melaleuca and other invasive exotic species.

9.2 OPERATIONAL FEATURES

A number of operational components have been identified in the recommended Comprehensive Plan. These components have been evaluated on a regional scale using the South Florida Water Management Model, which as noted earlier is an effective tool for analyzing regional hydrologic effects. These operational components have been evaluated along with the construction components previously described. More detailed planning and analyses will be necessary to develop the optimum operational modifications that will be implemented for the Central and Southern Florida Project.

The costs to implement these operational features are not explicitly presented in this report. Most of the operational features will be implemented in association with related construction features described previously and, as such the costs are included in those features. However, in the case of Coastal Wellfield Operations (***Section 9.2.5.1***) the magnitude and uncertainties of implementing the feature have necessitated that no cost estimates be developed. Additionally, it is assumed that the costs will be borne by the appropriate affected utilities.

9.2.1 Lake Okeechobee Region

9.2.1.1 Lake Okeechobee Regulation Schedule (F)

The Lake Okeechobee Regulation Schedule will be modified in order to take advantage of the additional storage facilities identified in the construction features. Two additional zones will be added to the schedule. The first zone will trigger discharges to the north of Lake Okeechobee reservoir and the Everglades Agricultural Area reservoir. The second higher zone will trigger the Lake Okeechobee aquifer storage and recovery facilities to begin injecting water from the Lake. Climate based forecasting will be used to guide management decisions regarding releases to the storage facilities.

It is anticipated that all flood control releases through the C-43 and C-44 Canals will be eliminated with the exception of emergency zone A. Zone A levels are expected to be similar to the levels that occur in the current regulation schedule Run 25, however, the number of times that the Lake is above zone A is expected to be dramatically reduced.

9.2.2 Caloosahatchee Region

9.2.2.1 Environmental Water Supply Deliveries to the Caloosahatchee Estuary (E)

Freshwater deliveries to the Caloosahatchee Estuary will be provided to protect and restore more natural estuarine conditions. Minimum and maximum flows

were identified which would cause poor water quality conditions for the estuary. This feature includes the development of a series of operational rules for storage features in the C-43 Basin along with modifications to Lake Okeechobee operations in order to maintain the salinity conditions in the estuary to support a range of aquatic vegetation, seagrass, invertebrates, and fish communities.

9.2.3 Upper East Coast Region

9.2.3.1 Environmental Water Supply Deliveries to St. Lucie Estuary (C)

Freshwater deliveries to the St. Lucie Estuary will be provided to protect and restore more natural estuarine conditions. Minimum and maximum flows were identified which would cause poor water quality conditions for the estuary. This feature includes the development of a series of operational rules for storage features in the C-23, C-24, C-25, C-44, Northfork and Southfork Basins along with modifications to Lake Okeechobee operations in order to maintain the salinity conditions in the estuary to support a range of aquatic vegetation, seagrass, invertebrates, and fish communities.

9.2.4 Water Conservation Areas and Everglades Regions

9.2.4.1 Everglades Rain-Driven Operations (H)

Modifications to the regulation schedules for Water Conservation Areas 2A, 2B, 3A, 3B and the current Rainfall Delivery Formula for Everglades National Park will be made to implement rain-driven operations for all of these areas. These new operational rules are intended to improve timing and location of water depths in the Water Conservation Areas and Everglades National Park and to restore more natural hydropatterns.

The rain-driven operational concept is a basic shift from the current operational practice, which uses calendar-based regulation schedules for the Water Conservation Areas. Regulation schedules, also referred to as flood-control schedules, typically specify the release rules for a Water Conservation Area based on the water level at one or more key gages. Regulation schedules do not typically contain rules for importing water from an upstream source. The schedules also repeat every year and make no allowance for inter-annual variability. The rain-driven operational concept includes rules for importing and exporting water from the Water Conservation Areas in order to mimic a desired target stage hydrograph at key locations within the Everglades system. The target stage hydrographs mimic an estimate of the more natural (pre-drainage Everglades) water level response to rainfall.

9.2.4.2 Modified Holey Land Wildlife Management Area Operation Plan (DD)

Modification to the current operating plan for Holey Land Wildlife Management Area will be made to implement rain-driven operations for this area. Water deliveries are made to Holey Land from the Rotenberger Wildlife Management Area or from Stormwater Treatment Area 3 & 4 if Rotenberger flows are insufficient. The deliveries are assumed to be of acceptable water quality. These new operational rules are intended to improve the timing and location of water depths within the Holey Land Wildlife Management Area.

9.2.4.3 Modified Rotenberger Wildlife Management Area Operation Plan (EE)

Modification to the current operating plan for Rotenberger Wildlife Management Area will be made to implement rain-driven operations for this area. Water deliveries are made to Rotenberger from Stormwater Treatment Area 5. Discharges from Rotenberger are made to the Holey Land Wildlife Management Area. The deliveries are assumed to be of acceptable water quality. These new operational rules are intended to improve the timing and location of water depths within the Rotenberger Wildlife Management Area.

9.2.5 Lower East Coast Region

9.2.5.1 Change Coastal Wellfield Operations (L)

For coastal public water supply utilities in the Lower East Coast Service Area, which are expected to experience an increased threat of saltwater intrusion, demands will be shifted from eastern facilities to western facilities away from the saltwater interface. The following utilities have a portion of their demands shifted inland: Riviera Beach, Lake Worth, Lantana, Manapalan, Boca Raton, and Florida City. The volume shifted is dependent upon the degree of saltwater intrusion, but is generally proportional to the increase in demands between the 1995 existing conditions and the 2050 future without plan conditions. Eastern wellfields at Miramar, Hollywood, Broward County 3A, 3B and 3C, Dania and Hallandale are assumed to be on standby with the entire demand met from western facilities.

9.2.5.2 Lower East Coast Utility Water Conservation (AAA)

This feature reduces the Lower East Coast public water supply demands through the full implementation of the South Florida Water Management District's current mandatory water conservation program. Full implementation of the conservation program over the next 50 years is projected to decrease public water supply demand by approximately 6 percent more than conservation incorporated in the future without project public water supply demands.

The regional effect from the implementation of this additional conservation would be more efficient utilization of water resources by the public and a reduction of the volume of water delivered from Lake Okeechobee, the Water Conservation Areas, and other regional storage facilities to recharge coastal canals and wellfields.

9.2.5.3 Operational Modification to Southern Portion of L-31N and C-111 (OO)

Modifications to the operations of the C-111 Project, currently under construction, will be made to the southern portion of L-31N Borrow Canal and C-111. These operational modifications will be made to improve deliveries to Everglades National Park and decrease flood risk of adjacent agricultural areas in the Lower East Coast Service Area.

9.3 PILOT PROJECTS

In addition to the construction and operational features previously discussed, a series of pilot projects have been recommended. These pilot projects are needed to address uncertainties associated with some of the physical facilities that are proposed in the recommended plan. The pilot projects will be designed to determine the feasibility, as well as optimum design, of a facility prior to embarking upon full scale implementation of a new facility.

9.3.1 Lake Okeechobee Aquifer Storage and Recovery – Pilot Project (GG)

This feature is multi-purpose and provides benefit to environmental, urban and agricultural users (see ***Section 9.1.2.1***). The pilot project is necessary to identify the most suitable sites for the aquifer storage and recovery wells in the vicinity of Lake Okeechobee and to identify the optimum configuration of those wells. Additionally, the pilot project will determine the specific water quality characteristics of waters to be injected, the specific water quality characteristics and amount of water recovered from the aquifer, and the water quality characteristics of the receiving aquifer. Further information from the pilot project will provide the hydrogeological and geotechnical characteristics of the upper Floridan Aquifer System within the region, and the ability of the upper Floridan Aquifer System to maintain injected water for future recovery.

9.3.2 Caloosahatchee River (C-43) Basin Aquifer Storage and Recovery – Pilot Project (D)

Aquifer Storage and Recovery wells are proposed in order to maximize the benefits associated with the Caloosahatchee River Storage Reservoir (see ***Section 9.1.3.1***). A pilot project for these wells is necessary to identify the most suitable

sites for the aquifer storage and recovery wells in the vicinity of the reservoir and to determine the optimum configuration of those wells. The pilot project will provide information regarding the characteristics of the aquifer system within the Caloosahatchee River Basin as well as determine the hydrogeological and geotechnical characteristics of the upper Floridan Aquifer. The pilot project will also determine the specific water quality characteristics of waters to be injected, the specific water quality characteristics and the amount of water recovered from the aquifer, and the water quality characteristics of water within the receiving aquifer.

9.3.3 Site 1 Impoundment and Aquifer Storage and Recovery – Pilot Project (M)

The Site 1 above-ground impoundment is proposed to be operated in conjunction with multiple aquifer storage and recovery wells in order to maximize the benefits of the reservoir. A pilot project for these wells is necessary to determine the most suitable sites for the aquifer storage and recovery wells in the vicinity of the reservoir and to determine the optimum configuration of those wells. The identification of the hydrogeological and geotechnical characteristics of the soils and aquifer will also be determined. The pilot project will also determine the specific water quality characteristics of water within the aquifer as well as the quality of water proposed for injection and the water quality characteristics of water recovered from the aquifer.

9.3.4 In-Ground Reservoir Technology – Pilot Project

Several features recommend the use of areas where lime rock mining will have occurred (see ***Sections 9.1.8.2, 9.1.8.15 and 9.1.8.17***). The initial design of these reservoirs includes subterranean seepage barriers around their perimeter in order to enable drawdown during dry periods, prevent seepage losses, and prevent water quality impacts due to transmissivity of the aquifer in these areas.

The pilot project is required to determine construction technologies, storage efficiencies, impacts on local hydrology, and water quality effects. Water quality assessments will include a determination as to whether the in-ground reservoirs and seepage barriers will allow for storage of untreated waters without concerns of groundwater contamination.

9.3.5 L-31N Seepage Management – Pilot Project (V)

The purpose of this feature is to reduce levee seepage flow across L-31N adjacent to Everglades National Park via a levee cutoff wall (see ***Section 9.1.8.21***). Additionally, the feature was designed to reduce groundwater flows during the wet season by capturing groundwater flows with a series of groundwater wells adjacent to L-31N, then backpumping those flows to Everglades National Park. The pilot project is necessary to determine the appropriate technology to control seepage from Everglades National Park. The pilot project will also provide necessary information

to determine the appropriate amount of wet season groundwater flow to return that will minimize potential impacts to Miami-Dade County's West Wellfield and freshwater flows to Biscayne Bay.

9.3.6 Wastewater Reuse Technology – Pilot Project (HHH, BBB, and OPE)

Currently, two features involve the advanced treatment of wastewater (see ***Sections 9.1.8.22 and 9.1.8.24***). This pilot project will address water quality issues associated with discharging reclaimed water into natural areas such as the West Palm Beach Water Catchment Area, Biscayne National Park, and the Bird Drive Basin as well as determine the level of superior treatment and the appropriate methodologies for that treatment. A series of studies will be conducted to help determine the level of treatment needed.

Pilot facilities will be constructed to determine the ecological effects of using superior, advanced treated reuse water to replace and augment freshwater flows to Biscayne Bay and to determine the level of superior, advanced treatment required to prevent degradation of freshwater and estuarine wetlands and Biscayne Bay. The constituents of concern in wastewater will be identified and the ability of superior, advanced treatment to remove those constituents will be determined.

In addition, a pilot facility will be constructed to treat wastewater from the East Central Regional Wastewater Treatment Facility using advanced and superior wastewater treatment processes to remove nitrogen and phosphorus. After treatment, the wastewater will be used to restore 1500 acres of wetlands and to recharge wetlands surrounding the City of West Palm Beach's wellfield. A portion of the treated wastewater will be used to recharge a residential lake system surrounding the City's wellfield and a Palm Beach County wellfield.

Besides serving as a pilot project for wetlands based water reclamation this feature will reduce a portion of the City's dependence on surface water from Lake Okeechobee during dry or drought events. In addition, approximately 2,000 acres of wetlands would be created or restored. Other benefits include aquifer recharge and replenishment, reduction of water disposed in deep injection wells and a reduction of stormwater discharge to tide.

9.4 REAL ESTATE

The real estate requirements for the recommended Comprehensive Plan are discussed in ***Appendix F***. The land requirements are based on an analysis of the land that would be needed for the construction features described in ***Section 9.1***. Based on this analysis, an estimated cost for land acquisition was developed. More

detailed planning and analyses will be necessary to develop the optimum real estate requirements in the recommended Comprehensive Plan.

9.4.1 Land Acquisition

For the construction features identified in ***Section 9.1***, the total estimated land requirement is approximately 220,000 acres as displayed in ***Table 9-1***. These lands were estimated based on the engineering assumptions made during the formulation of alternative plans. For example, in the case of a storage reservoir north of Lake Okeechobee, the Restudy Team used a conceptual reservoir and treatment area design that encompassed approximately 20,000 acres located somewhere north of Lake Okeechobee. As discussed in ***Section 9.1***, the specific areal extent and location of this feature was not critical to analyzing the regional water resources effects of the Comprehensive Plan and that specific design criteria for the features will be addressed in subsequent planning phases of this project. Consequently, the estimated land requirements will likely change as the result of more detailed analysis. However, these assumptions were used for the purpose of estimating the total real estate requirements for the Comprehensive Plan. Further, contingency costs were escalated above normal levels to address this uncertainty.

A cooperative effort, with landowners in the areas where construction features are proposed, should be used to identify suitable sites in subsequent planning phases of this project.

9.4.2 Relocation Assistance (Public Law 91-646)

In accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Public Law 91-646), relocation assistance will be provided to affected residents and businesses. However, due to the magnitude of the study area and the uncertainty in the location of many of the construction features, the number of residences, farms, and businesses were not estimated. These will be determined during more detailed planning and design of the construction features. For this level of planning, the unknown relocation assistance cost estimate is covered in a higher than usual contingency cost added to each construction feature.

TABLE 9-1
ESTIMATED REAL ESTATE LAND REQUIREMENTS

Report Section	Real Estate Land Requirement	Estimated Acreage	Counties
9.1.1	**Kissimmee River Region**		
9.1.1.1	North of Lake Okeechobee Storage Reservoir	20,000	Glades, Highlands, and Okeechobee,
9.1.1.2	Taylor Creek/Nubbin Slough Storage and Treatment Area	10,000	Okeechobee and St Lucie
9.1.1.3	Lake Okeechobee Watershed Water Quality Treatment Facilities	4,515	Glades, Highlands and Okeechobee
9.1.1.4	Lake Okeechobee Tributary Sediment Dredging	320	Hendry, Glades and Lee
9.1.1.5	Lake Istokpoga Regulation Schedule	0	Highlands
9.1.2.1	Lake Okeechobee Aquifer Storage and Recovery	300	Glades and Okeechobee
9.1.3	**Caloosahatchee River Region**		
9.1.3.1	C-43 Basin Storage Reservoir and Aquifer Storage and Recovery	20,000	Hendry, Glades and Lee
9.1.3.2	Caloosahatchee Backpumping with Stormwater Treatment	5,000	Glades
9.1.4	**Upper East Coast**		
9.1.4.1	C-44 Basin Storage Reservoir	10,000	Martin
9.1.4.2	C-23/C-24/C-25/Northfork and Southfork Storage Reservoirs	48,350	Martin and St Lucie
9.1.5	**Everglades Agricultural Area**		
9.1.5.1	Everglades Agricultural Storage Reservoirs	17,500	Palm Beach
9.1.6	**Big Cypress Region**		
9.1.6.1	Big Cypress/L-28 Interceptor Modifications	1,900	Hendry and Broward
9.1.6.2	Seminole Tribe Big Cypress Water Conservation Plan - East & West	3,800	Hendry and Collier
9.1.7	**Water Conservation Areas Region**		
9.1.7.1	Flow to Northwest and Central Water Conservation Area 3A	0	Broward and Miami-Dade
9.1.7.2	Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement	255	Palm Beach, Broward and Miami-Dade
9.1.7.3	Loxahatchee National Wildlife Refugee Internal Canal Structures	5	Palm Beach
9.1.7.4	Miccosukee Water Management Plan	900	Broward
9.1.8	**Lower East Coast Region**		
9.1.8.1	Pal-Mar and J.W. Corbett Wildlife Management Area Hydropattern Restoration	3,000	Palm Beach and Martin
9.1.8.2	Water Preserve Areas / L-8 Basin	2,180	Palm Beach
9.1.8.3	Acme Basin B Discharge	930	Palm Beach
9.1.8.4	Lake Worth Lagoon Restoration	0	Palm Beach
9.1.8.5	Winsburg Farms Wetland Restoration	175	Palm Beach
9.3.6	Palm Beach County Wetlands Based Water Reclamation	2,000	Palm Beach
9.1.8.6	C-17 Backpumping and Treatment	550	Palm Beach

Report Section	Real Estate Land Requirement	Estimated Acreage	Counties
9.1.8.7	C-51 Backpumping and Treatment	710	Palm Beach
9.1.8.8	C-51 Regional Groundwater Aquifer Storage and Recovery	34	Palm Beach and Broward
9.1.8.9	Palm Beach County Agricultural Reserve Reservoir and Aquifer Storage and Recovery	1,660	Palm Beach
9.1.8.10	Protect and Enhance Existing Wetland Systems along Loxahatchee National Wildlife Refuge including the Strazzulla Tract	3,335	Palm Beach
9.1.8.11	Site 1 Impoundment and Aquifer Storage and Recovery	2,458	Palm Beach
9.1.8.12	Broward County Secondary Canal System	245	Broward
9.1.8.13	Western C-11 Diversion Impoundment and Canal and Water Conservation Areas 3A and 3B Levee Seepage Management	5,887	Broward and Miami-Dade
9.1.8.14	C-9 Stormwater Treatment Area/Impoundment	2,500	Broward
9.1.8.15	North Lake Belt Storage Area	5,861	Miami-Dade
9.1.8.16	Diverting Water Conservation Area 2 and 3 flows to Central Lake Belt Storage	837	Broward and Miami-Dade
9.1.8.17	Central Lake Belt Storage Area	5,770	Miami-Dade
9.1.8.18	Dade-Broward Levee/Pennsuco Wetlands	384	Miami-Dade
9.1.8.19	C-4 Control Structures	2	Miami-Dade
9.1.8.20	Bird Drive Recharge Area	2,877	Miami-Dade
9.1.8.21	L-31N Levee Improvements for Seepage Management and S-356 Structures	3,947	Miami-Dade
9.1.8.22	West Miami-Dade County Reuse	100	Miami-Dade
9.1.8.23	Biscayne Bay Coastal Wetlands	13,950	Miami-Dade
9.1.8.24	South Miami-Dade County Reuse	200	Miami Dade
9.1.8.25	Restoration of Pineland & Hardwood Hammocks in C-111 Basin	0	Miami-Dade
9.1.8.26	C-111N Spreader Canal	12,415	Miami-Dade
9.1.9	**Southwest Florida Region**		
9.1.9.1	Southern Golden Gates Hydrologic Restoration	0	Collier
9.1.9.2	Southern CREW Project Addition	4,670	Lee
9.1.9.3	Lake Trafford Restoration	449	Collier
9.1.9.4	Henderson Creek/Belle Meade Restoration	125	Collier
9.1.9.5	Lake Park Restoration	40	Lee
9.1.10	**Florida Bay and Keys**		
9.1.10.1	Florida Keys Tidal Restoration	5	Monroe
9.1.11	**System-wide**		
9.1.11.1	Melaleuca Eradication Project and other Exotic Plants	0	
	TOTAL	**220,141**	

9.5 ADAPTIVE ASSESSMENT AND MONITORING PROGRAM

An extensive Adaptive Assessment Program which includes a system-wide monitoring program will be conducted to support the goals and objectives of the Comprehensive Plan. This program will provide an opportunity to continue investigating concepts and issues relative to the overall Comprehensive Plan while implementation of the initial project features are underway. The Adaptive Assessment Program will include continued system-wide evaluation and analysis among other planning activities. The monitoring program will have a dual focus on the biological (including water quality) and hydrological restoration objectives in the natural systems, and the water supply and flood protection objectives in the urban and agricultural regions.

9.5.1 Adaptive Assessment Program

Adaptive assessment is a process for evaluating how well the phases of the Comprehensive Plan achieve their expected objectives, and for using these evaluations as a basis for refining future phases of the program. To be successful, an adaptive assessment process requires that the Comprehensive Plan be implemented iteratively, that a pre-determined set of targets be appropriately monitored, that it be possible to make changes in the design and sequencing of the plan in response to information learned from the monitoring program and from new research and modeling, and that a specific protocol for conducting the adaptive assessment process be in place throughout the life of the program.

Adaptive assessment provides an organized process for confronting and reducing the levels of uncertainty caused when there is insufficient information for knowing how the natural and human systems in south Florida will respond to the long-term implementation of the Comprehensive Plan. These uncertainties are inevitable, in that we are dealing with systems that are tremendously complex, not thoroughly understood, and difficult to predict. The systems are complex in their detail (i.e., in the number of different variables to consider), and in their dynamics (i.e., the number and scales of relationships that drive responses).

In addition to the inevitable uncertainties, natural and human systems will at times respond in totally unexpected ways (i.e., in ways that are not anticipated or predicted by any existing hypotheses). It is these unexpected responses, when they result in negative changes, which often are the stimuli for “crises” at political and management levels. Adaptive assessment should moderate these crisis responses, by providing an in-place process for early detection and interpretation of the unexpected, and for maximizing the learning opportunities associated with these events.

Adaptive assessment is a process for learning, and for incorporating new information into the planning and evaluation phases of the restoration program.

Adaptive assessment is valuable in that it treats all responses, expected or not, as major learning opportunities. An unexpected response does not represent a failure for the program if it can be used to substantially improve our understanding of a complex system. Much of the design of the Comprehensive Plan, including the selection of performance measures and targets, is based on a set of causal hypotheses derived from a set of conceptual ecological models for the major landscapes of south Florida. Implementation of the Comprehensive Plan provides opportunities for loosely "testing" these hypotheses (without replications), by comparing actual system responses to those predicted by the hypotheses. Actual responses, in combination with information obtained from ongoing research and modeling, can lead to refinements in the conceptual models and hypotheses, and to reduced levels of uncertainty regarding future iterations of the Comprehensive Plan.

Adaptive assessment provides a stimulus for the development and long-term operation of a regionally comprehensive monitoring program. The application of an adaptive process requires that a monitoring program be in place that provides measures of a spatially, temporally and hierarchially appropriate set of pre-determined performance targets (indicators, endpoints). The design of such a monitoring program provides a valuable opportunity for a healthy review of existing monitoring programs for their coverages, protocols, and data management adequacies, relative to the needs of adaptive assessment.

Overall, adaptive assessment provides a much needed framework for: (1) strengthening coordination across agency and disciplinary lines by establishing a commonly accepted evaluation process and set of performance targets, (2) validating the performance of each iteration in a long-term restoration program, and (3) encouraging agencies to be flexible about the design and implementation of the Comprehensive Plan. The bottom line is that adaptive assessment substantially improves the probability that a complex, regional Comprehensive Plan will be successful, by providing a structured, well-focused process for evaluating and refining the design and performance of that program on a continuing basis throughout its implementation.

9.5.2 Monitoring Program

A fundamental component of adaptive assessment is a monitoring program that is based on the goals and objectives of the project. There must be agreement on performance targets, and on the ecological changes that constitute improvements, as a prerequisite for determining which parameters in the system must be monitored. Because of the uncertainties inherent in any effort to restore such a complex and altered ecosystem, the performance targets and the interim measures of success can only be broadly stated. Nevertheless, these targets and measures need definition to design a monitoring program that is well focused and efficient; thus, to assure that it provides the kind of information required for the implementation of an adaptive

management strategy. In the following two sections, the objectives and components that should be considered for a regional monitoring program are reviewed.

A regional monitoring program should provide data for meeting several, essential objectives of the Comprehensive Plan. Although these objectives may be overlapping, each makes a discrete contribution toward the realization of the goals of the Comprehensive Plan. Monitoring will:

1. Determine problem areas as a basis for designing and setting priorities for components of the Comprehensive Plan. Knowledge of water quality, water supply and flood protection issues, which species and ecologic communities are having problems, and when and where in the system these problems are occurring, is essential information for designing a Comprehensive Plan that is well focused for correcting those problems.

2. Determine the hydrological, physical, water quality and ecological responses to each incremental step in the Comprehensive Plan, as a basis for designing and/or fine tuning subsequent steps. If each incremental step in the plan is viewed as an experiment, accompanied by one or more hypotheses that predict how that step will improve the system, monitoring will provide the measure of how well the hypotheses and the experiment achieve the expected results. This information, in turn, becomes the basis for improving the design of the experiment and the hypotheses for the next step in the program.

3. Determine the responses to each incremental step, as a means for continuing the all important process of enhancing existing knowledge of the functions and relationships in the south Florida ecosystem, and how these processes respond to alterations in the spatial temporal and hydrologic patterns in the system. Much of the uncertainty about how the overall system will respond during implementation of the Comprehensive Plan is caused by the current, incomplete knowledge of ecological and hydrological processes in the south Florida ecosystem. This is compounded by the fact that these processes have changed in ways that are not fully predictable.

4. Measure the status and trends of a wide range of hydrological, ecological, water quality and physical components of the south Florida ecosystem. A strong, ongoing monitoring program will provide a regional overview of how well the ecosystem and water management systems are functioning. This includes the status of endangered and indicator species; the range and frequencies of interannual response patterns; the effectiveness of implemented components in achieving anticipated performance; long-term effects of modified hydrological conditions on estuarine salinity gradients, saltwater intrusion protection, and on regional plant communities; and other parameters that enhance current understanding of broad trends across the ecosystem. It will determine responses

and trends at appropriate spatial and temporal scales, and from among a taxonomically representative array of components of the natural systems.

5. Contribute to an improved focus, and consensus, regarding the water quality, physical and biological elements which, collectively, will constitute a "restored" natural system, and determine when the Comprehensive Plan goals have been reached. A large number of performance targets including "ecological endpoints" for restoration have been used in the evaluation of the alternative plans and subsequent selection of the recommended plan. A regional monitoring program will reveal when and under what conditions these performance targets and endpoints have been reached and are sustainable.

9.5.3 Monitoring Program Planning Guidelines

Comprehensive, integrated ecological and water resource monitoring to measure the effects of the Comprehensive Plan components and the success of the overall Comprehensive Plan will involve coordination with the South Florida Ecosystem Restoration Working Group including it's Science Coordination Team. The general guidelines for the monitoring program include the following:

1. A single, regionally comprehensive, and integrated multi-agency monitoring program, which will operate over the entire south Florida ecosystem, with clear assignment of lead and cooperating agency responsibilities. The program will be managed by a standing, interagency coordinating team. The geographic boundaries of the monitoring program will be consistent with the outer limits of the region that is predicted to be influenced by the Comprehensive Plan.

2. Contain adequate coverage at all trophic levels, spatial and temporal scales, among hydrological, ecological, water quality and physical components, to measure both regional and local responses to the Comprehensive Plan and the overall south Florida ecosystem restoration effort. An independent peer-review process will provide recommendations on the design and coverage of the monitoring program.

3. Be designed at scales and with objectives that are proportional to the design of each sub-regional or local, component of the Comprehensive Plan. Additional, specific elements will be added to a regional monitoring program to measure more local responses to the incremental scale steps in the Comprehensive Plan.

4. Focus on those hydrological, ecological water quality, and physical parameters that can be readily and quantitatively measured, and which are understood well enough so that the monitoring data can be adequately interpreted.

5. Collection and analysis of monitoring data at temporal scales that are appropriate to the nature of the data and the design of each component of the

Comprehensive Plan. Depending upon what is being monitored, these time scales may range from hourly for hydrological parameters (such as water stage or discharge), to daily for physical parameters (such as urban flood protection levels or saltwater intrusion), to once every several years (such as for soil thickness).

6. A formally established program for sharing and managing monitoring data and reports, among the agencies, other participants and interested parties.

7. Be in place sufficiently prior to the implementation of features of the Comprehensive Plan, so that baseline information on pre-project conditions and patterns can be established, before changes occur as a result of the projects. For elements of the natural system which typically operate on multi-year cycles, or which have relatively slow response times, monitoring to establish base-line conditions must begin years prior to the implementation of Comprehensive Plan features.

8. Develop standardized monitoring protocols at the initiation of the monitoring program. The program includes resources to maintain these monitoring protocols for the life of the program and avoid problems of data interpretation, which occur when the quality and quantity of these data vary over time and space.

9. Build on existing monitoring programs by the participating agencies, including reassessing monitoring priorities and protocols by each agency, within the context of a single, integrated regional program.

10. Finally, and most importantly, the program will measure the water quality, hydrological, physical and ecological parameters that are appropriate to the ecological restoration goals and measures of success that have been set for the program.

An essential component of this regional monitoring program is the creation of a single, integrated data management system (items 6 and 8 above). The South Florida Water Management District's Kissimmee River Restoration Evaluation Program, the U. S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP), and the National Oceanic and Atmospheric Administration and Florida Department of Environmental Protection's Integrated Marine Monitoring Program are examples of the organization and implementation of such a program.

The Kissimmee program is both multi-agency and multi-disciplinary. Its overall purposes are to organize all monitoring data as a basis for quantifying and qualifying ecosystem responses to the restoration projects, and for evaluating the success of the restoration effort. To meet these purposes, the Kissimmee program provides a holistic and integrated picture of all monitoring data to ensure the proper definition of relationships among these data, and provides a database structure for

efficiently storing and managing these data to ensure efficient and timely access to restoration monitoring data. The data management system has a central location, and a single, senior program manager responsible for overall quality of the system.

The Environmental Protection Agency's EMAP has been developed based on a stratified random sampling approach, which is essential for a meaningful interpretation of landscape-scale ecological monitoring. EMAP includes a statistical survey design, which allows for ecological analysis of the effects of the Comprehensive Plan components on restoration across the entire C & SF region, not just at or near specific sampling regions.

Beginning in 1995, scientists from Federal, state and local agencies have worked together to integrate the many environmental monitoring projects taking place in south Florida's marine and estuarine waters. Led by the National Oceanic and Atmospheric Administration and Florida Department of Environmental Protection, an inventory was conducted of planned, ongoing, and completed projects in coastal waters, and information on more than 200 projects was entered into a database. Many other agencies came together to review and prioritize the major issues affecting coastal areas, determine information needs, and develop a comprehensive monitoring plan. A geographic information system for sampling sites throughout the region is now being constructed, and gaps in data collection are being filled. This extensive multi-agency coordination will help to document change at the ecosystem level, measure the effectiveness of management actions, reduce monitoring gaps and overlaps, and improve existing monitoring capabilities.

9.5.3.1 Natural Systems Monitoring

There are several major reasons, with direct applications to the restoration effort, for conducting an extensive natural systems monitoring program: construction impact assessments, adaptive assessments, and for evaluating applications to other restoration efforts.

Construction impact assessments ensure that temporary or incidental environmental impacts are documented and minimized during construction. Because of the phased construction approach, this aspect of the monitoring program could prove to be particularly valuable in reducing effects of construction-related disturbance, including potential effects on endangered species and downstream effects that could affect subsequent restoration phases.

Ecological monitoring provides a basis for adaptive assessment measures that almost certainly will be needed to facilitate early recovery, as well as, subsequent persistence of the full complement of natural resource values. Although restoration of the study area's resources will occur primarily through natural processes, the restored system will have one significant management component - inflow regulation. Modeling studies have shown that the proposed restoration features will produce

hydrologic and water quality characteristics that are within the required range of variability of the ecological restoration criteria. However, to achieve restoration and persistence of all biological components, some hydrologic characteristics, particularly discharge and flood inundation characteristics, must vary over the established historic range. Moreover, early recovery of some biological components could be slowed or inhibited if management of the regional hydrology produces hydrologic and water quality characteristics that are perhaps at one end of the spectrum of required variability. Comprehensive ecological monitoring will track restoration progress and provide the necessary data to effectively modify or adjust operation and management schemes to meet restoration objectives.

The potential that the restoration program planning and implementation principles and guidelines developed by the Restudy will be applicable to other regional restoration endeavors is another reason to conduct extensive ecological monitoring studies. One approach to evaluating the broader applicability of these principles and guidelines will be through measures of the effectiveness of the Restudy process, as demonstrated by system responses. Monitoring will provide a means for demonstrating the effectiveness of the regional planning and adaptive assessment protocols developed by the Restudy. The principles of ecosystem restoration that are being employed by the Restudy are pioneering at such vast temporal and spatial scales. The adaptive assessment strategy proposed in this process may be the most environmentally sound approach to restoration, and, over the long term, the most cost effective means of restoring the natural resource values of damaged ecosystems. It is important to demonstrate whether these planning principles and guidelines are applicable to other regions.

9.5.3.1.1 Natural System Elements to be Monitored

In order for the regional monitoring program to be both effective and efficient, substantial thought must be given to the choice of the components of the natural systems that should be monitored. Some guidelines for making these selections are presented in the Monitoring Planning Program Guidelines presented above. Additionally, it is highly important to select the most parsimonious set of components which will reveal the major (i.e., most significant) responses that are relevant to the issues being addressed by the restoration program. A major failing of many monitoring programs is that they attempt to monitor too large a number of system elements, more than are needed to evaluate how well a project meets its objectives, and more than can be adequately and consistently monitored over the time frames needed to evaluate these programs. Uncertainties in long-term funding and personnel which so commonly characterize large government programs require that excessive, and perhaps ecologically unnecessary, monitoring not be made a part of essential, long-term monitoring programs.

The Restudy is using a set of conceptual ecological models of the major physiographic and landscape features in south Florida (Ogden and Davis, in prep.) to

identify a parsimonious set of natural system elements for inclusion in a regional monitoring program. The conceptual models show the major hydrological stressors in these systems, and how these stressors link, ecologically, with a set of attributes, which can be used to characterize the ecological health of these systems. The hydrological stressors identified by these models include both the water quantity and water quality impacts, which have been the major sources of ecological change in the natural systems. Because of the links (major ecological pathways) between the stressors and attributes, it is assumed that measures of change among the attributes will reflect the levels of success of the restoration projects at correcting the problems caused by the stressors. Teams of regional natural resource specialists selected the ecological attributes shown in each model. These attributes were selected because they directly reflect impacts from the major stressors, they are measurable and reasonably well understood, and they represent responses that are expected to occur over a range of spatial, temporal and hierarchical scales in the natural systems.

Because the restoration projects should cause changes (improvements) to both the stressors and the attributes in the models, both should be included in a monitoring program. An understanding of responses by both stressors and attributes not only is necessary to measure effects from the restoration projects, but also to evaluate ("test") the hypotheses which were used to create the models and to set priorities during restoration planning.

The hydrological stressors and attributes for the landscapes of the central and southern Everglades and Florida Bay were reported by Ogden et al. 1997. The four conceptual models contained in this report, for the central and southern Everglades sloughs, the southern Everglades marl prairies and rocky glades, the mainland mangrove estuaries downstream from the southern Everglades, and Florida Bay, serve to illustrate the stressors and attributes which should be monitored to determine restoration effects in these regions.

For the central and southern Everglades sloughs, the conceptual model shows the major hydrological stressors to be: annual and multi-year hydroperiods, wet season surface-water depths dry-season ground water depths, wet season regulatory releases, impoundments created by levees, and phosphorus and mercury loadings. The ecological attributes which reflect the effects from these stressors are: peat soil accretion rates; flood, fire and exotic plant conditions on tree islands; the distribution, composition and structure of marsh communities; species composition and production rates in periphyton communities; composition and size structure and abundance of marsh fishes and aquatic invertebrates; the abundance and density of alligator nests and active alligator ponds; and the size, timing and location of wading bird nesting colonies (including recovery of "super" colonies).

For southern Everglades marl prairies and rocky glades, the conceptual model suggests the stressors to be monitored should include duration of annual hydroperiods, dry-season minimum water levels, and dry-season recession patterns.

Monitored attributes are: marl accretion; vegetation community mosaics and composition; abundance and species composition of fishes, crayfish and the herpetofauna; abundance and density of alligator nests and active alligator ponds; Cape Sable seaside sparrow nesting distribution and abundance; seasonal abundance and distribution of foraging wading birds; and mercury and toxin loads in vertebrates.

For the southern mangrove estuaries, the stressors are the volume and duration of freshwater flows into the estuaries. The indicator attributes are: the species composition of submerged aquatic plants and the species and abundance of waterfowl in the coastal lakes: primary production and sediment accretion in the mangrove communities; the distribution and cover of vegetation communities; the production and survival of resident mangrove fishes; recruitment rates of juvenile sport fishes; growth and survival of juvenile crocodiles; and the patterns and success of wood stork and roseate spoonbill nesting colonies.

For Florida Bay, the hydrologically related stressors shown in the conceptual model are freshwater influences on salinity patterns, and nitrogen and phosphorus inputs. The indicator attributes for these stressors are: species composition; density and productivity in the seagrass communities; water chemistry and turbidity; species composition of mollusc communities; pink shrimp abundance; species composition of sport fishes; and the abundance and distribution of fish-eating birds (brown pelican, osprey, cormorant).

Stressors and attributes for Lake Okeechobee are shown in a conceptual model reported by K. Havens (Havens, 1998). For the Lake, the hydrologically related stressors are; elevated levels of contaminants, nutrients and sediments: prolonged extreme high water levels; and prolonged extreme low water levels. Attributes for the Lake are: the quality and quantity of urban and agriculture water supply; sport and commercial fisheries; spatial extent and composition of marsh communities; abundance and nesting success of snail kites; and the population size and nesting success of water birds.

Stressors and attributes for the Caloosahatchee and St. Lucie Estuaries have been shown in a conceptual model reported by S. Gray and D. Haunert (Gray and Haunert, 1998). The major hydrologically related stressors on these estuaries are, flood control releases from Lake Okeechobee, the seasonal timing and magnitude of freshwater flows, increased loads of nutrient and dissolved organics, and agricultural toxins. Attributes for these stressors are, benthic invertebrate community structure, submerged aquatic vegetation distribution and abundance, seagrass community structure, abundance and biomass of larval, juvenile fishes, fish catch rates, nesting success and abundance of fish-eating water birds, and abundance and recruitment of manatee.

Stressors and attributes for the Big Cypress Basin are shown in a conceptual model reported by M. Duever (Duever, 1998). Hydrologically related stressors are: the bioaccumulation of mercury and other toxins; inflows of drainage water with high nutrient and mineral content; and lowered water tables and shortened hydroperiods. Attributes of these stressors are: mercury and toxin body burdens in vertebrates; composition, structure and distribution of vegetation communities; abundance and distribution of fishes, crayfish and amphibians; size, distribution and success of wood stork nesting colonies; and population size, reproductive success and mercury body burdens for Florida panther.

A written performance measure is prepared for each stressor and attribute (indicator) to be monitored. The performance measure identifies the restoration target and the specific parameters to be measured, as a basis for determining how each stressor and attribute responds to the restoration projects. A set of hydrological performance measures which covers the major stressors from the conceptual models was prepared by the Restudy, Alternative Plan Evaluation Team, and is described in **Section 7** of this report. Performance measures for the attributes in the models still remain to be created.

9.5.3.2 Hydrologic Monitoring

The current hydrologic monitoring system was devised primarily to support the current operations of the Central and Southern Florida Project. The design and implementation of the Restudy components necessitates the need for modifications to the current monitoring system. The need comes from: (1) new data requirements for modeling in the detail design phase; (2) the development of new components that dramatically modify the existing hydrologic patterns and conditions; and (3) changes needed in traditional monitoring programs to correctly monitor new features such as sheetflow. Traditional data collection sites may not be consistent with areas being targeted for specific hydrologic changes. Furthermore, new “trigger” points for future operational purposes may also require new monitoring sites.

In addition to identifying several areas that will require special operations, new monitoring techniques, and new monitoring sites, the Restudy process also identified significant data gaps in some areas. For example, during the development of performance measures by the Alternative Evaluation Team, data necessary for evaluation were not available for a number of ecologically sensitive areas. Vast areas within the Big Cypress National Preserve were ungaged; thus conclusive ecological evaluations dependent upon hydropatterns were not possible.

Development of a new hydrologic monitoring program will require a multi-disciplinary team to ensure the hydrologic factors needed for ecological evaluations, as well as operational input needs, are developed. Monitoring for ecological assessments will be different from sampling for operational purposes. New monitoring programs for ecological assessments will be especially critical in areas

undergoing extensive hydrologic modification. The monitoring program will be crucial to the success of adaptive management for the ecological restoration of the Everglades.

9.5.3.3 Water Quality Monitoring

Numerous water quality monitoring programs are currently being conducted by federal, state, tribal and local governments across south Florida. The location, sampling frequency and water parameters monitored associated with these existing water quality monitoring programs relate to existing regulatory, non-regulatory, and research programs. Development of an integrated, system-wide water quality monitoring program linked to hydrological and physical process monitoring programs will be a primary objective of the recommended feasibility study supporting the creation of a Comprehensive Integrated Water Quality Plan feasibility study (see ***Section 9.7.3***).

Design of a water quality monitoring program will be driven by the need to measure appropriate water quality parameters in watersheds that will be affected by the operation and construction of Comprehensive Recommended Plan components and Other Project Elements. The Restudy monitoring program should focus on developing sufficient baseline information to characterize watersheds in order to complete detailed planning and design work necessary to construct and operate recommended plan features to achieve pollutant load reduction targets. Nutrient (e.g., nitrates, phosphorus) concentrations and loads are of particular concern in south Florida water bodies. The majority of use-impaired water bodies are impaired due to elevated nutrient levels. Water quality monitoring will be also developed to obtain critical water quality information relating to ecological performance measures and ecological responses associated with the conceptual ecological models (see ***Section 9.5.3.1***) and supporting existing and future water quality models.

The Comprehensive Integrated Water Quality Plan will be crucial to the development of the Restudy water quality monitoring program since it will address issues of fragmented, uncoordinated water quality sampling, data quality, and climatological effects and trends. The Comprehensive Integrated Water Quality Plan will also include recommendations for oversight and support of improved water quality modeling efforts in south Florida, recommendations for development of additional water quality restoration targets and appropriate pollution load reduction targets, where needed, and recommendations for remediation programs to achieve water quality restoration targets. This additional information will support changes and improvements to the Restudy water quality monitoring program consistent with the adaptive assessment monitoring process described in ***Section 5***.

9.5.3.4 Physical Process Monitoring

Physical process monitoring will encompass a number of activities in the south Florida ecosystem. These activities include saltwater intrusion, flood level protection, urban and agricultural water use, sea level rise, soil subsidence/accretion, soil genesis due to restoration, and the ability of implemented components to achieve their anticipated performance. The majority of these activities are currently underway but will require a coordinated approach with long-term commitment if they are to be successful. Saltwater intrusion monitoring will allow the interagency monitoring coordination team the ability to evaluate the implementation of the recommended plan on urban areas, detect movement of the saltwater/ freshwater interface and make changes under the adaptive management strategy of the C&SF Comprehensive Review Study Implementation Plan, to counter unwanted movement. A successful monitoring program coupled with an adaptive management strategy will ensure the long-term health and integrity of the water supply wellfields of the region.

Flood level protection monitoring will ensure that the existing level of protection is not compromised as a result of implementation of the recommended plan. Coupled with an adaptive assessment strategy any unforeseen effects of the plan could be corrected.

Urban and agricultural water use monitoring will ensure that any significant deviation from forecasts of urban consumption and estimates of agricultural consumption that were included in the assumption base for this plan will be accounted for. Periodic comparisons (e.g., every three to five years) of actual consumption with that used in the Comprehensive Plan will allow for plan adjustments through time.

Sea level rise will need to be continuously monitored so that both saltwater intrusion protection and flood protection levels within the south Florida urban areas is not compromised as a result of this global process. Sea level rise will also affect the south Florida ecosystem in ways that are not fully anticipated or understood. Monitoring in the natural system will help resource managers understand how the ecosystem is evolving in response to the changing conditions and to better understand the relative contribution that sea level rise and changes in freshwater flow into the estuaries have on vegetation composition in the coastal zones.

Soil subsidence/ accretion and soil genesis monitoring will be used as another indicator metrics to determine if the recommended plan is moving the restoration process in the predicted direction of success. A major success measure for the slough system is the recovery of organic soils. Where portions of the slough systems currently are losing organic soils through increased fire frequencies and increased soil subsidence, restoration should result in soil accretion. Longer, more natural hydroperiods are expected to recover the processes that build organic soils. A long-

term monitoring program will need to be institutionalized, to provide regional measures of rates of change in soil depths.

Post-construction monitoring of the recommended components, such as reservoirs and aquifer storage and recovery facilities, will be needed to determine whether their performance is achieving that anticipated in the planning process. This monitoring is necessary to evaluate the plan's overall effectiveness in providing the water needs of the south Florida ecosystem.

9.6 FISH AND WILDLIFE MITIGATION

During subsequent phases of this project, the construction features of the Comprehensive Plan will be designed to first avoid and then minimize unavoidable impacts to wetlands or other aquatic sites and natural upland habitats. Unavoidable impacts to these habitats are expected to be offset by the ecological improvement throughout the south Florida ecosystem that results from the overall restoration achieved by the Comprehensive Plan. Accordingly, separate compensatory mitigation features are not included in the recommended Comprehensive Plan for these impacts.

However, in certain wetland or upland areas, the construction and operation of Comprehensive Plan features may adversely affect unique or scarce habitats. In such cases, the project components will be sited and engineered to be environmentally compatible when possible. As site-specific details for the components are developed during the Project Implementation Report process, land suitability analyses will be utilized as part of the site selection process. Sites with extensive unique or scarce habitats will be avoided to the greatest extent practicable. For selected sites where impacts to these habitats are unavoidable, impacts will be minimized through project design. If impacts to unique or scarce habitats can not be avoided, a separable compensatory mitigation plan may be needed.

There also could be impacts to existing wetland compensatory mitigation sites that were established by authorized regulatory permits. These compensatory mitigation sites were established as permit requirements in order to offset the adverse environmental impacts of permitted development projects and the attendant reduction of the spatial extent of wetlands at the development sites. Subsequent elimination or reduction of these environmental benefits due to Restudy activities may require reevaluation of the mitigation analysis used in the original permit decision by the District Engineer.

Furthermore, one of the Restudy goals is to increase the spatial extent of wetlands within the study area. Adverse effects to regulatory-derived mitigation sites, which were intended to offset losses in the spatial extent wetlands, could result in the Restudy contributing to losses in spatial extent. Accordingly, adverse

impacts to regulatory-derived compensatory mitigation sites attributable to construction of a Comprehensive Plan component or its operation will be offset as part of Restudy implementation. This compensatory mitigation requirement for the Restudy must be derived from sources other than the benefits claimed by the Comprehensive Plan itself. Therefore, a separable compensatory mitigation plan for these impacts may be needed. The type and extent of the mitigation requirement will be determined in subsequent phases of this project on a case by case basis.

9.7 NEW FEASIBILITY STUDIES

The time frame of this feasibility study did not permit a thorough investigation of all the regional water resource problems of south Florida. Therefore, subsequent to the completion of this feasibility study, a number of new feasibility studies are proposed. They include a Florida Bay and the Florida Keys Feasibility Study, a Southwest Florida Feasibility Study, and a Comprehensive Integrated Water Quality Plan. These studies will be conducted under the authority of the Water Resources Development Act of 1996 that allows for the continuation of studies and analyses that are necessary to further the Comprehensive Plan.

9.7.1 Florida Bay and the Florida Keys Feasibility Study

Construction of Flagler's railroad to Key West and subsequent conversion into U.S. Highway 1 (US-1) involved the placement of fill material in wetlands and open water for the numerous causeways between keys. These causeways altered tidal flows between Florida Bay and the Atlantic Ocean, resulting in adverse water quality and fish and wildlife habitat impacts. One of the House of Representatives Committee on Public Works and Transportation resolutions of September 24, 1992 requested that the Corps of Engineers conduct a study of Florida Bay, including a comprehensive, coordinated ecosystem study with hydrodynamic modeling of Florida Bay and its connections to the Everglades, the Gulf of Mexico, and the Florida Keys Coral Reef ecosystem. Hydrodynamic and water quality models currently under development for Florida Bay will provide the tools necessary for evaluation of the problem in a holistic manner. A feasibility study is recommended to comprehensively evaluate Florida Bay and to determine the types of modifications that are needed to successfully restore water quality and ecological conditions of the Bay.

9.7.2 Southwest Florida Feasibility Study

The Caloosahatchee River is the only portion of the C&SF Project that lies in southwest Florida. The river serves as an outlet from Lake Okeechobee to the Gulf of

Mexico and is the major source of surface water supply for the Lower West Coast region. It provides agricultural and lawn irrigation, public water supplies and is used to recharge shallow wellfields. The river also provides drainage for private drainage systems and local drainage districts.

The facilities included in the Comprehensive Plan for the Caloosahatchee River Basin will help meet the needs of the basin. However, there are additional water resources problems and opportunities in southwest Florida that require studies that are beyond the scope of the Comprehensive Plan. For example, primary water quality and hydrologic data do not exist for much of the region. This lack of information, assessments and monitoring data is a fundamental gap for this region of the state and greatly hinders its long-term water resources management opportunities.

The Southwest Florida Feasibility Study will include Collier, Lee, Charlotte, Glades, and Hendry Counties; and provide a framework to address the health of aquatic ecosystems; water flows; water quality (including appropriate pollution reduction targets), water supply; flood protection, wildlife, and biological diversity and natural habitat. The study will also investigate non-structural alternatives.

9.7.3 Comprehensive Integrated Water Quality Plan

The recommended Comprehensive Plan includes a number of construction features, such as stormwater treatment areas, specifically designed to improve water quality conditions for the purpose of south Florida ecosystem restoration. Further, the plan includes other construction features, such as water storage reservoirs that could be designed to maximize water quality benefits to downstream water bodies. Optimizing the design and operation of construction features of the recommended plan to achieve water quality restoration targets is essential for achieving overall ecosystem restoration goals for south Florida.

Degradation of water quality throughout the study area is extensive, particularly in agricultural and urban coastal areas. The Florida Department of Environmental Protection listed approximately 160 use-impaired water bodies in south Florida in its 1998 Section 303(d) list (see ***Section 5.3***). Although there are several ongoing water quality restoration programs in the study area (e.g. National Pollutant Discharge Elimination System (NPDES) point and non-point source regulatory programs, total maximum daily loads (TMDLs) development and remediation programs, Surface Water Improvement and Management planning efforts), there is no comprehensive plan for achieving water quality restoration in south Florida which links together water quality restoration programs in the context of comprehensive planning for ecosystem restoration. It is also recognized that achieving all of the water quality goals for ecosystem restoration in all use-impaired water bodies within the study area will depend on actions outside the scope of the Restudy. The South Florida Water Management District, Florida Department of Environmental Protection, U.S. Environmental Protection Agency and other agencies

have developed or are developing water quality improvement programs for several of the impaired water bodies within the Restudy area. The most notable example is the Everglades Forever Act, which focuses on achieving adequate water quality in the Everglades. Other examples include the Surface Water Improvement and Management Act planning efforts for the Indian River Lagoon, Lake Okeechobee, and Biscayne Bay, and the Florida Keys National Marine Sanctuary Water Quality Protection Program. However, the degree to which some of the existing water quality improvement programs have been implemented has been limited. To ensure that south Florida ecosystem restoration objectives are achieved, a Comprehensive Integrated Water Quality Plan that links water quality restoration targets and remediation programs to the hydrologic restoration objectives of the recommended plan must be developed for the entire study area.

Development of a comprehensive integrated water quality plan for south Florida is consistent with recommendations of the South Florida Ecosystem Restoration Task Force and the Florida Governor's Commission for a Sustainable South Florida. In its July, 1998 Interim Report on the C&SF Project Restudy (GCSSF, 1998), the Governor's Commission recommended that a water quality implementation plan for the Restudy be developed with Florida Department of Environmental Protection as the lead agency, in cooperation with the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, South Florida Water Management District, the Seminole and Miccosukee Native American Tribes, and local governments. In order to resolve water quality problems on an ecosystem wide basis, the Governor's Commission recommended that a comprehensive water quality plan be initiated as a feature of the Restudy.

The Comprehensive Integrated Water Quality Plan for south Florida would involve identifying pollution-impaired water bodies, quantifying types and sources of pollution, establishing interim and final pollution load reduction targets necessary to achieve ecosystem restoration, recommendations for development of potential source reduction programs, recommendations for baseline and future water quality monitoring programs to assess ecological responses to water quality changes, and recommendations for designing and constructing water quality treatment facilities, if necessary. Although the scope of the feasibility study has not yet been developed, it is envisioned that the feasibility study would also address issues of fragmented, uncoordinated water quality sampling, data quality, and climatological effects and trends; recommendations for oversight and support of improved water quality modeling efforts in south Florida; development of additional water quality restoration targets, where needed; recommendations for remediation programs to achieve those targets; recommendations for Best Management Practices in specific agricultural and urban areas where appropriate (including identifying those urban areas where participation in the NPDES municipal stormwater program is needed); and, recommendations for synchronizing water quality restoration programs with the implementation schedule for the components of the recommended plan. The Comprehensive Integrated Water Quality Plan would also include recommendations

for locations of water storage and treatment areas and design features for optimizing recommended plan components to achieve water quality restoration targets. The comprehensive integrated water quality plan may also lead to recommendations for additional features (e.g., polishing cells, operational features) for recommended plan components currently lacking specific water quality performance elements.

A discrete task which has already been identified to be performed as part or the Comprehensive Integrated Water Quality Plan study is further evaluating the feasibility of dredging phosphorus-enriched sediments in Lake Okeechobee. For other regions of the study area, the extent of water quality problems and key water quality restoration targets are less well known. Particular regions where establishment of pollutant load reduction targets needs to be accelerated to enable optimization of recommended Comprehensive Plan components for water quality benefits are: the lower Kissimmee River region; the Lake Okeechobee watershed; the St. Lucie River and estuary and Indian River Lagoon, the Caloosahatchee River and estuary, the Lake Worth Lagoon, Biscayne Bay, Florida Bay, and the Florida Keys.

For the Florida Keys particularly, the Comprehensive Integrated Water Quality Plan would ensure that the Florida Keys Water Quality Protection Program is integrated with the recommended Comprehensive Plan and with water quality improvement activities in the Keys. The Comprehensive Integrated Water Quality Plan would also expedite development of salinity based water quality criteria for Florida Bay and appropriate pollution load reduction targets for pollutants causing impairment in nearshore waters of the Florida Keys.

9.8 FUTURE IMPROVEMENTS TO THE COMPREHENSIVE PLAN

In response to comments made by the public and in the draft Fish and Wildlife Coordination Act report, the Study Team identified a process by which key ecosystem restoration features could be further improved through optimization and adaptation of the draft comprehensive plan (D-13R). Most notably since November 1998, the Study Team has developed and run several modeling "scenarios" (described in ***Section 7***) in which the draft comprehensive plan was modified in an effort to improve restoration in key areas of the south Florida ecosystem. These scenarios were vital in demonstrating the robust and flexible nature of the recommended comprehensive plan and its ability to be manipulated to further improve performance.

A major impetus for developing these scenarios was to determine if additional water could be captured in the Lower East Coast urban areas and used to better meet performance measure targets in the Water Conservation Areas and Everglades National Park, as well as for investigating alternative sources of water for Biscayne Bay. The importance of improving the performance of the draft plan in these areas is fully understood. Also, consistent with the Governor's Commission for

a Sustainable South Florida's long held principle that no part of the ecosystem will be harmed during the implementation phase of the Restudy, such improvements cannot be undertaken at the ecological expense of the Water Conservation Areas. These efforts ultimately resulted in scenario runs D-13R$_{1-4}$. Preliminary evaluation by the interagency Alternative Evaluation Team indicates that additional captured water (about 245,000 acre-feet) helps to meet hydrologic targets for Everglades National Park, Biscayne Bay and some areas within the Water Conservation Areas. In other areas of the Water Conservation Areas and the Pennsuco Wetlands, performance declines markedly relative to D-13R. In addition, issues relative to treating urban runoff prior to discharge into the Water Conservation Areas and the Everglades, and impacts to secondary canals have not been resolved.

The Restudy is committed to implementing the final plan in a manner that provides improvements to the operation of the Water Conservation Areas as well as providing more water for Everglades National Park and Biscayne Bay. In addition, the Restudy is committed to solving the remaining operational problems of the Water Conservation Areas associated with the Comprehensive Plan. The final comprehensive plan that is implemented will provide for an improved capability for delivery of additional water to Everglades National Park and Biscayne Bay by capturing additional runoff from urban areas. The Implementation Plan (***Section 10***) includes a phased approach to provide for substantial improvements and the maximum ecological benefits to the Water Conservation Areas, Everglades National Park, Biscayne Bay, and those other natural areas that have been adversely affected by the C&SF Project. The ultimate amount of additional water recaptured and its distribution will be determined based on this phased approach and the ability to obtain the maximum ecological benefits in each of these areas. While some implementation scenarios indicate a reduction of fresh water flows to Biscayne Bay, the Comprehensive Plan will be implemented in a way that avoids such results. Scientists, including scientists from Biscayne National Park, are reviewing the performance measures for Biscayne Bay and it is possible that there will be a consensus conclusion that alternative fresh water flow patterns may be beneficial to Biscayne Bay. Only in that event would reducing flows below the 1995 base to Biscayne Bay during the implementation phase of the Restudy be considered.

Many of the issues that have been raised regarding the Restudy performance in natural areas will be addressed during the development of the Project Implementation Report for each component. The ideal restoration solution for the remnant natural areas would be one without control structures. For that reason, where control structures are required, a preference for the use of passive control structures will be established. For example, in those cases where structural controls within natural areas are unavoidable for water management, the detailed design for project components will include passive control features to the maximum extent practicable. Further, the Implementation Plan (***Section 10***) will commit to limiting

the use of active features, such as pumps and gates, to those situations where passive controls are not adequate.

9.9 COST ESTIMATE

The estimated cost estimate for the Comprehensive Plan include construction and real estate costs which have been termed Initial Costs; Adaptive Assessment and Monitoring Program costs, and Operation and Maintenance Costs.

9.9.1 Initial Costs

The total estimated cost of the recommended Comprehensive Plan is $7,800,000,000 (rounded) at October 1999 price levels. The cost estimate is shown in ***Table 9-2***. This estimate is the "base line" estimate, and does not account for future price escalation.

9.9.2 Adaptive Assessment and Monitoring Costs

The adaptive assessment and monitoring program for the Comprehensive Plan is still under development. Given the conceptual nature of plan and the need to integrate the monitoring program with other ongoing efforts, it is difficult to prepare a detailed estimate of its cost at the present time. However, based on other ongoing monitoring programs such as the Kissimmee River and the C-111 Project, the annual monitoring cost was estimated to be $10,000,000 during the period of construction.

9.9.3 Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) Costs

Annual operation and maintenance costs were estimated for the construction features of the recommended Comprehensive Plan. The operation and maintenance costs were determined by extrapolating from operational cost histories supplied by the South Florida Water Management District. The costs reflect projected values based on past trends encountered and represent the difference between with versus without the Comprehensive Plan. Replacement costs were calculated for culverts and mechanical and electrical equipment related to pump plants and spillway structures. The annual OMRR&R costs are estimated to be $172,000,000 (rounded) and are provided in ***Table 9-3***.

TABLE 9-2
ESTIMATED INITIAL COST FOR CONSTRUCTION FEATURES
($1,000, October 1999 Price Levels)

Report Section	CONSTRUCTION FEATURES	Construction	Real Estate	Total Initial Cost
9.1.1	**Kissimmee River Region**			
9.1.1.1	North of Lake Okeechobee Storage Reservoir	$95,134	$189,720	$284,854
9.1.1.2	Taylor Creek/Nubbin Slough Storage and Treatment Area	$74,326	$29,700	$104,026
9.1.1.3	Lake Okeechobee Watershed Water Quality Treatment Facilities	$47,800	$14,448	$62,248
9.1.1.4	Lake Okeechobee Tributary Sediment Dredging	$3,800	$900	$4,700
9.1.1.5	Lake Istokpoga Regulation Schedule	$50	$0	$50
9.1.2.1	Lake Okeechobee Aquifer Storage and Recovery	$1,108,797	$7,515	$1,116,312
9.1.3	**Caloosahatchee River Region**			
9.1.3.1	C-43 Basin Storage Reservoir and Aquifer Storage and Recovery	$313,574	$132,621	$446,195
9.1.3.2	Caloosahatchee Backpumping with Stormwater Treatment	$69,715	$13,179	$82,894
9.1.4	**Upper East Coast**			
9.1.4.1	C-44 Basin Storage Reservoir	$21,888	$90,675	$112,563
9.1.4.2	C-23/C-24/C-25/Northfork and Southfork Storage Reservoirs	$281,175	$429,048	$710,223
9.1.5	**Everglades Agricultural Area**			
9.1.5.1	Everglades Agricultural Storage Reservoirs	$350,112	$86,536	$436,648
9.1.6	**Big Cypress Region**			
9.1.6.1	Big Cypress/L-28 Interceptor Modifications	$36,051	$6,700	$42,751
9.1.6.2	Seminole Tribe Big Cypress Water Conservation Plan - (East & West)	$69,553	$5,735	$75,288
9.1.7	**Water Conservation Areas Region**			
9.1.7.1	Flow to Northwest and Central Water Conservation Area 3A	$30,877	$0	$30,877
9.1.7.2	Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement	$185,408	$26,279	$211,687
9.1.7.3	Loxahatchee National Wildlife Refugee Internal Canal Structures	$7,324	$345	$7,669
9.1.7.4	Miccosukee Water Management Plan	$22,741	$1,718	$24,459
9.1.8	**Lower East Coast Region**			
9.1.8.1	Pal-Mar and J.W. Corbett Wildlife Management Area Hydropattern Restoration	$2,500	$8,000	$10,500
9.1.8.2	Water Preserve Areas / L-8 Basin	$383,541	$31,641	$415,182
9.1.8.3	Acme Basin B Discharge	$11,600	$8,500	$20,100
9.1.8.4	Lake Worth Lagoon Restoration	$2,000	$300	$2,300
9.1.8.5	Winsburg Farms Wetland Restoration	$10,000	$4,140	$14,140
9.3.6	Palm Beach County Wetlands Based Water Reclamation	$24,900	$2,800	$27,700
9.1.8.6	C-17 Backpumping and Treatment	$9,824	$10,367	$20,191
9.1.8.7	C-51 Backpumping and Treatment	$19,156	$13,475	$32,631

Report Section	CONSTRUCTION FEATURES	Construction	Real Estate	Total Initial Cost
9.1.8.8	C-51 Regional Groundwater Aquifer Storage and Recovery	$122,391	$9,945	$132,336
9.1.8.9	Palm Beach County Agricultural Reserve Reservoir and Aquifer Storage and Recovery	$66,442	$57,657	$124,099
9.1.8.10	Protect and Enhance Existing Wetland Systems along Loxahatchee National Wildlife Refuge including the Strazzulla Tract	$3,800	$48,972	$52,772
9.1.8.11	Site 1 Impoundment and Aquifer Storage and Recovery	$116,792	$23,587	$140,379
9.1.8.12	Broward County Secondary Canal System	$10,978	$1,920	$12,898
9.1.8.13	Western C-11 Diversion Impoundment and Canal and Water Conservation Areas 3A and 3B Levee Seepage Management	$57,526	$167,646	$225,172
9.1.8.14	C-9 Stormwater Treatment Area/Impoundment	$26,207	$62,939	$89,146
9.1.8.15	North Lake Belt Storage Area	$381,193	$154,868	$536,061
9.1.8.16	Diverting Water Conservation Area 2 and 3 flows to Central Lake Belt Storage	$66,336	$13,321	$79,657
9.1.8.17	Central Lake Belt Storage Area	$402,502	$100,359	$502,861
9.1.8.18	Dade-Broward Levee/Pennsuco Wetlands	$10,103	$8,676	$18,779
9.1.8.19	C-4 Control Structures	$1,834	$495	$2,329
9.1.8.20	Bird Drive Recharge Area	$52,459	$71,625	$124,084
9.1.8.21	L-31N Levee Improvements for Seepage Management and S-356 Structures	$89,514	$94,704	$184,218
9.1.8.22	West Miami-Dade County Reuse	$435,998	$3,540	$439,538
9.1.8.23	Biscayne Bay Coastal Wetlands	$93,928	$205,655	$299,583
9.1.8.24	South Miami-Dade County Reuse	$359,700	$3,324	$363,024
9.1.8.25	Restoration of Pineland & Hardwood Hammocks in C-111 Basin	$600	$0	$600
9.1.8.26	C-111N Spreader Canal	$48,268	$45,766	$94,034
9.1.9	**Southwest Florida Region**			
9.1.9.1	Southern Golden Gate Estates Restoration	$15,550	$0	$15,550
9.1.9.2	Southern CREW Project Addition	$3,434	$30,104	$33,538
9.1.9.3	Lake Trafford Restoration	$14,664	$744	$15,408
9.1.9.4	Henderson Creek/Belle Meade Restoration	$3,776	$1,029	$4,805
9.1.9.5	Lake Park Restoration	$5,000	$166	$5,166
9.1.10	**Florida Bay and Keys**			
9.1.10.1	Florida Keys Tidal Restoration	$1,200	$51	$1,251
9.1.11	**System-wide**			
9.1.11.1	Melaleuca Eradication Project and other Exotic Plants	$5,772	$0	$5,772
9.7	Additional Feasibility Studies	$20,300		$20,300
	TOTAL	$5,598,113	$2,221,435	$7,819,548
			Rounded	**$7,800,000**

TABLE 9-3
OPERATIONS, MAINTENANCE, REPAIR, REPLACEMENT AND REHABILITATION COSTS

Report Section	Operations and Maintenance	Cost
9.1.1	**Kissimmee River Region**	
9.1.1.1	North of Lake Okeechobee Storage Reservoir	$1,515,245
9.1.1.2	Taylor Creek/Nubbin Slough Storage and Treatment Area	$2,164,114
9.1.1.3	Lake Okeechobee Watershed Water Quality Treatment Facilities	$2,602,000
9.1.1.4	Lake Okeechobee Tributary Sediment Dredging	$0
9.1.1.5	Lake Istokpoga Regulation Schedule	$0
9.1.2.1	Lake Okeechobee Aquifer Storage and Recovery	$25,000,000
9.1.3	**Caloosahatchee River Region**	
9.1.3.1	C-43 Basin Storage Reservoir and Aquifer Storage and Recovery	$6,707,889
9.1.3.2	Caloosahatchee Backpumping with Stormwater Treatment	$2,273,076
9.1.4	**Upper East Coast**	
9.1.4.1	C-44 Basin Storage Reservoir	$759,953
9.1.4.2	C-23/C-24/C-25/Northfork and Southfork Storage Reservoirs	$4,832,774
9.1.5	**Everglades Agricultural Area**	
9.1.5.1	Everglades Agricultural Storage Reservoirs	$14,458,409
9.1.6	**Big Cypress Region**	
9.1.6.1	Big Cypress/L-28 Interceptor Modifications	$404,457
9.1.6.2	Seminole Tribe Big Cypress Water Conservation Plan	$775,000
9.1.7	**Water Conservation Areas Region**	
9.1.7.1	Flow to Northwest and Central Water Conservation Area 3A	$1,102,327
9.1.7.2	Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement	$740,111
9.1.7.3	Loxahatchee National Wildlife Refugee Internal Canal Structures	$42,045
9.1.7.4	Miccosukee Water Management Plan	$540,000
9.1.8	**Lower East Coast Region**	
9.1.8.1	Pal-Mar and J.W. Corbett Wildlife Management Area Hydropattern Restoration	$60,000
9.1.8.2	Water Preserve Areas / L-8 Basin	$2,273,929
9.1.8.3	Acme Basin B Discharge	$594,000
9.1.8.4	Lake Worth Lagoon Restoration	$0
9.1.8.5	Winsburg Farms Wetland Restoration	$200,000
9.3.6	Palm Beach County Wetlands Based Water Reclamation	$2,500,000
9.1.8.6	C-17 Backpumping and Treatment	$752,435

Report Section	Operations and Maintenance	Cost
9.1.8.7	C-51 Backpumping and Treatment	$1,089,682
9.1.8.8	C-51 Regional Groundwater Aquifer Storage and Recovery	$1,496,000
9.1.8.9	Palm Beach County Agricultural Reserve Reservoir and Aquifer Storage and Recovery	$1,019,500
9.1.8.10	Protect and Enhance Existing Wetland Systems along Loxahatchee National Wildlife Refuge including the Strazzulla Tract	$90,000
9.1.8.11	Site 1 Impoundment and Aquifer Storage and Recovery	$2,052,608
9.1.8.12	Broward County Secondary Canal System	$418,017
9.1.8.13	Western C-11 Diversion Impoundment and Canal and Water Conservation Areas 3A and 3B Levee Seepage Management	$783,432
9.1.8.14	C-9 Stormwater Treatment Area/Impoundment	$615,743
9.1.8.15	North Lake Belt Storage Area	$1,241,234
9.1.8.16	Diverting Water Conservation Area 2 and 3 flows to Central Lake Belt Storage	$146,635
9.1.8.17	Central Lake Belt Storage Area	$1,964,519
9.1.8.18	Dade-Broward Levee/Pennsuco Wetlands	$105,871
9.1.8.19	C-4 Control Structures	$30,015
9.1.8.20	Bird Drive Recharge Area	$1,470,869
9.1.8.21	L-31N Levee Improvements for Seepage Management and S-356 Structures	$4,647,234
9.1.8.22	West Miami-Dade County Reuse	$36,500,000
9.1.8.23	Biscayne Bay Coastal Wetlands	$923,300
9.1.8.24	South Miami-Dade County Reuse	$47,815,000
9.1.8.25	Restoration of Pineland & Hardwood Hammocks in C-111 Basin	$0
9.1.8.26	C-111N Spreader Canal	$59,586
9.1.9	**Southwest Florida Region**	
9.1.9.1	Southern Golden Gates Hydrologic Restoration	$93,000
9.1.9.2	Southern CREW Project Addition	$160,000
9.1.9.3	Lake Trafford Restoration	$0
9.1.9.4	Henderson Creek/Belle Meade Restoration	$41,000
9.1.9.5	Lake Park Restoration	$62,000
9.1.10	**Florida Bay and Keys**	
9.1.10.1	Florida Keys Tidal Restoration	$0
9.1.11	**System-wide**	
9.1.11.1	Melaleuca Eradication Project and other Exotic Plants	$5,000
	TOTAL	$172,404,805
	Rounded	**172,000,000**

9.9.4 Annual Costs

Investment costs were converted to annual costs using an interest rate of 6 7/8 percent and a project life of 50 years to compute interest and amortization. Annual operation and maintenance costs were then added to the interest and amortization costs to determine the average annual cost, which is $404,946,000 for the recommended Comprehensive Plan.

9.9.5 Cost Estimate Uncertainties

The current estimated cost of the recommended Comprehensive Plan is based on the best available information. Appropriate contingency factors were used in developing the cost estimates to reflect the uncertainties inherent at this stage of project development. It is anticipated that the cost of the plan will be modified in the future as pilot projects and individual Project Implementation Reports are completed. As more site specific analysis is completed the contingency factors will be revised to reflect the greater levels of certainty. Value engineering will be used to optimize the design of facilities in the detailed planning and design phases of implementation for individual projects. During the detailed design phases, opportunities will be sought that reduce the number of control structures as well as using more passive control structures wherever feasible, which could result in reduced construction and OMRR&R costs of projects.

In addition there are other factors which may reduce the cost of the recommended plan. For instance, the aquifer storage and recovery pilot projects will evaluate the water quality of the source water to be used for aquifer storage and recovery and help identify the level of treatment necessary as defined by the U. S. Environmental Protection Agency and Florida Department of Environmental Protection. ***Appendix C*** provides a more detailed discussion of aquifer storage and recovery treatment methods. However, preliminary water quality information and correspondence from the U.S. Environmental Protection Agency indicates that the high level of treatment for aquifer storage and recovery facilities included in the recommended Comprehensive Plan may not be required and a reduction in treatment costs up to $500,000,000 may be possible (U.S. Environmental Protection Agency, 1999). Information derived from the pilot projects will be used to conduct a risk-based analysis of treatment requirements. Reducing the requirements of treating water for aquifer storage and recovery may also result in a reduction in the OMRR&R costs for these facilities.

Further, wastewater reuse facilities included in the recommended Comprehensive Plan which provide additional water flows to Biscayne Bay is another area where project cost estimates may be modified. Refinement of ecological goals and objectives for Biscayne Bay along with evaluation of alternative sources of water for Biscayne Bay may result in a reduction in the need for superior, advanced wastewater facilities and a subsequent reduction in project costs. The two wastewater

reuse facilities account for an estimated $84,000,000 (rounded) of the total OMRR&R costs. As noted previously, the evaluation of alternative water supply sources for Biscayne Bay may reduce the need for advanced treatment or the need for all or a part of the volume of wastewater that is currently identified in the recommended Comprehensive Plan.

9.10 COST SHARING

Responsibilities for implementing the recommended Comprehensive Plan will be shared by the Corps of Engineers, on behalf of the Federal government, and the non-Federal sponsor, the South Florida Water Management District. The Corps will design the project and administer construction contracts to build the project. The South Florida Water Management District will be involved in the project design; will share the design and construction costs; furnish necessary lands, easements, rights of way, relocation, and disposal areas (collectively referred to as LERRD); and operate and maintain the completed project. Rules, which determine how project responsibilities are shared, are established in Federal law and related Administration implementing policies.

9.10.1 Cost Sharing of Water Quality Features

Section 528 of the Water Resources Development Act of 1996 requires that the Comprehensive Plan include water quality features necessary to provide water to restore, preserve, and protect the south Florida ecosystem. The Act further states that if the Secretary of the Army determines that a project feature to improve water quality is essential to Everglades restoration, the non-Federal cost of the feature shall be 50 percent. This provision does not apply to any feature of the Everglades Construction Project being constructed by the State of Florida.

Ecosystem restoration in south Florida depends, in part, on improving the timing and increasing the amount of water entering the Everglades to levels more typical of pre-drainage conditions. The source of this water is stormwater now sent to the coast in drainage canals, and diversions from Lake Okeechobee and other water storage facilities.

The State of Florida has water quality standards and regulatory programs in place that include protection of natural flora and fauna. However, requisite water quality characteristics (even for the same use classification) can vary depending on the type of natural flora and fauna present, or desired to be present. For example, while the water quality for the stormwater now discharged to the coast or Lake Okeechobee through drainage canals generally meets State standards, the Comprehensive Plan will result in delivering this water to areas that have a different

water quality need. Therefore, the Comprehensive Plan was formulated to clean up this water before sending it to areas for ecosystem restoration purposes.

For the purpose of analyzing Federal participation in these water quality features, it is assumed that the Clean Water Act and State/Tribal water quality standards are being met for the existing use classification. This assumes that all reasonable measures within watersheds are in place to assure that the waters being received by the C&SF Project canal system are of sufficient quality to meet published standards. If these measures did not provide water of adequate quality for south Florida ecosystem needs, then additional features for water quality improvement were deemed essential for Everglades restoration and formulated and included in the Comprehensive Plan with 50-50 cost sharing. These features were formulated as either water reuse or water reclamation projects and are list in ***Table 9-4.***

Water reclamation includes modifying the C&SF Project system so that the stormwater that was once released to coastal waters or disposed of in some other way will be pumped back into the C&SF Project system to increase the volume of water available for ecosystem restoration. An example of reclaiming water includes the authorized C-51 Project which involves diverting stormwater that was formerly discharged to the Lake Worth Lagoon into the Loxahatchee National Wildlife Refuge (WCA-1) for restoration purposes. Given the change in discharge locations from the original canal design, the water will require additional treatment in a stormwater treatment area (STA-1E) prior to discharge into the Everglades. The Water Preserve Areas features of the Comprehensive Plan are another case of reclaiming waters that are presently discharged to coastal waters. The new locations of the proposed discharges will require water quality treatment prior to diverting the water into the wetlands adjacent to the Everglades. In these cases, the modification of the C&SF Project would warrant Federal participation in Comprehensive Plan water quality features due to the diversion of stormwater for Everglades restoration.

Water reuse involves changing the final use of the water for ecosystem restoration. Water that was originally discharged for flood control or used for water supply purposes will require treatment prior to being used for Everglades restoration. For example, proposed operational changes for Lake Okeechobee include water supply deliveries to the Water Conservation Areas for Everglades restoration. Water quality standards for nutrient concentrations in Lake Okeechobee are much less stringent than those for the Everglades. Therefore, any water delivered from Lake Okeechobee must be treated prior to direct use in the Everglades for ecosystem restoration purposes. These projects include modifying the final use classification of the water for the sole purpose of ecosystem restoration. Hence, all the features in the recommended plan are essential to Everglades restoration and 50-50 cost sharing applies.

TABLE 9-4
COMPREHENSIVE PLAN
WATER QUALITY FEATURES

Report Section	Plan Feature	Reuse	Reclamation
9.1.1.1	North of Lake Okeechobee Storage Reservoir	✓	
9.1.1.2	Taylor Creek/Nubbin Slough Storage and Treatment Area	✓	
9.1.1.3	Lake Okeechobee Watershed Water Quality Treatment Facilities	✓	
9.1.1.4	Lake Okeechobee Tributary Sediment Dredging	✓	
9.1.3.2	Caloosahatchee Backpumping with Stormwater Treatment		✓
9.1.6.1	Big Cypress/L-28 Interceptor Modifications	✓	
9.1.6.2	Seminole Tribe Big Cypress Water Conservation Plan	✓	
9.1.7.4	Miccosukee Water Management Plan	✓	
9.1.8.3	Acme Basin B Discharge	✓	
9.1.8.5	Winsburg Farms Wetlands Restoration		✓
9.3.6	Palm Beach County Wetlands Based Water Reclamation		✓
9.1.8.6	C-17 Backpumping and Treatment		✓
9.1.8.7	C-51 Backpumping and Treatment		✓
9.1.8.13	Western C-11 Diversion Impoundment and Canal and WCAs 3A and 3B Levee Seepage Management		✓
9.1.8.14	C-9 Stormwater Treatment Area/Impoundment		✓
9.1.8.15	North Lake Belt Storage Area		✓
9.1.8.17	Central Lake Belt Storage Area		✓
9.1.8.22	West Miami-Dade County Reuse		✓
9.1.8.23	Biscayne Bay Coastal Wetlands		✓
9.1.8.24	South Miami-Dade County Reuse		✓
9.1.8.26	C-111N Spreader Canal		✓
9.1.9.1	Southern Golden Gates Hydrologic Restoration		✓

9.10.2 Cost Sharing of Construction and Land Costs

Section 528 of the Water Resources Development Act of 1996 and U.S. Army Corps of Engineers policy requires that:

- LERRD will be provided by the non-Federal sponsor.

- The total first cost of the project, including the value of LERRD and pre-construction engineering and design costs, will be shared equally between the Federal government and the non-Federal sponsor. The non-Federal sponsor will provide cash as necessary during project construction to meet its 50 percent share of the total first cost of the project.

Table 9-5 contains an apportionment of project costs between the Federal government and the non-Federal sponsor based on these cost sharing provisions.

TABLE 9-5
COST APPORTIONMENT OF RECOMMENDED PLAN
(First Costs - rounded)

ITEM	TOTAL	FEDERAL	NON-FEDERAL
Construction	$5,500,000,000	$3,900,000,000	$1,600,000,000
LERRD	$2,300,000,000	$0	$2,300,000,000
Total	$7,800,000,000	$3,900,000,000	$3,900,000,000

9.10.3 Cost Sharing of Adaptive Assessment and Monitoring

The Adaptive Assessment Program that includes a system-wide monitoring program has been developed as described in ***Section 9.5.*** This program is needed to provide essential information that supports the development and the implementation of the recommended Comprehensive Plan. Continued system-wide planning data collected as part of the monitoring program is critical to the continuing development of the components of the plan by providing the basis for adjustments to design and operation criteria as needed. The monitoring program is a necessary component for assuring that ecosystem benefits are achieved in Everglades National Park, Biscayne Bay National Park, Big Cypress National Preserve, and the Loxahatchee Wildlife Refuge, as well as other natural areas. Consequently, it would be appropriate that these costs be shared between the Federal government and the non-Federal sponsor and that the costs be shared the same as the construction costs (50-50). It should be noted that monitoring cost associated with the Kissimmee River Restoration Project are cost shared 50 percent Federal and 50 percent non-Federal under the Corps of Engineers Construction Program.

9.10.4 Cost Sharing of Operations and Maintenance

Section 528 of the Water Resources Development Act of 1996 specifies that operation and maintenance of the Comprehensive Plan shall be a non-Federal responsibility. However, this provision is not consistent with previous C&SF Project authorizations. Some Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) costs for the existing C&SF Project are cost shared between the South Florida Water Management District and the Corps of Engineers. The Corps, under the provision of the 1948 Flood Control Act (House Document 80-643) is responsible for the operation and maintenance of the levees, channels, locks, and control works of the St. Lucie Canal, Lake Okeechobee, and Caloosahatchee River and main spillways of the conservation areas. The SFWMD is responsible for operation and maintenance of the remainder (except for the Upper St. Johns Basin)

of the C&SF Project Works in accordance with regulations prescribed by the Secretary of the Army.

The Flood Control Act of 1968 (Senate Document 90-369, Paragraph 119) states the following: "The cost of the project works for providing water to Everglades National Park is considered to be a wholly Federal responsibility...It was considered that the Federal Government would share in the major pumping costs for water supplies on the basis of 60 percent Federal and 40 percent non-Federal, which approximates the ratio of pumped water delivered to the Everglades National Park and the non-park users."

As a result of the Everglades National Park Expansion and Protection Act of 1989, OMRR&R costs of all proposed structure modifications of the C&SF project associated with Modified Water Deliveries to Everglades National Park are cost shared with the non-Federal sponsor. That cost sharing is set at 75 percent Federal and 25 percent non-Federal. The C-111 project is another project for which cost sharing was established on OMRR&R costs. The Flood Control Act of 1968 and Section 316 of the Water Resources Development Act of 1996 established this cost sharing at 60 percent Federal and 40 percent non-Federal for water supply to Taylor Slough and Everglades National Park. Cost sharing for both of these projects was established on the basis of benefits to Everglades National Park.

The recommended Comprehensive Plan contains a large number of components that together accomplish restoration of the south Florida ecosystem and directly benefit Everglades National Park, Biscayne National Park, Big Cypress National Preserve, and the Loxahatchee National Wildlife Refuge. The recommended Comprehensive Plan includes storage features such as in-ground and above-ground reservoirs as well as aquifer storage and recovery wells that are located outside the remaining natural Everglades. These storage facilities capture wet season excess flows that would normally be discharged into the coastal waters through the C&SF Project canals and retains them in the system until they are needed. This storage provides benefits to both the natural system (including Everglades National Park, Biscayne National Park, Big Cypress National Preserve, and the Loxahatchee National Wildlife Refuge) as well as the urban or agricultural users. The stored water that is returned to the Everglades directly benefits the natural system to achieve the goals of restoration. Further, the operation of these features of the Comprehensive Plan provides direct benefits to threatened and endangered species. These benefits will be experienced on Federal lands including Everglades National Park, Biscayne National Park, Big Cypress National Preserve, and the Loxahatchee National Wildlife Refuge, but they will also be experienced on non-Federal lands which threatened and endangered species utilize in south Florida.

The comprehensive plan contains a number of components that together accomplish restoration of the south Florida ecosystem and consequently benefit

Everglades National Park, Biscayne National Park, Big Cypress National Preserve, and the Loxahatchee National Wildlife Refuge. The Plan works as a whole to provide environmental restoration to the south Florida ecosystem. Given the multi-objective nature of these components and the difficulty of determining separable benefits for the components of the Comprehensive plan, it is appropriate that the costs for OMRR&R associated with the Comprehensive Plan be shared equally between the Federal government and the non-Federal sponsor.