

SECTION 8
ENVIRONMENTAL EFFECTS

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SECTION 8 ENVIRONMENTAL EFFECTS

This section includes a brief summary of the expected beneficial and adverse physical, ecological, and socio-economic effects on resources of regional concern within the study area. It does not attempt to provide comprehensive coverage of all effects or all resources; rather its purpose is to provide a summary account of effects on a “big picture” scale. In all instances the assessment of effects is based on a comparison between the recommended Comprehensive Plan and the Without Plan Condition (2050 Base).

Further information on effects on the regional system and the ten study regions is available in **Appendix K**. Detailed analyses of effects on water quality are available in **Appendix H**, air quality in **Appendix I**, and to socio-economics in **Appendix E**. Supporting information, including Fish and Wildlife Coordination Act Reports supplied by the Department of Interior and the Florida Game and Fresh Water Fish Commission, and a Programmatic Biological Opinion on effects on threatened and endangered species, supplied by the U.S. Fish and Wildlife Service, are provided in **Annexes A** and **B**, respectively.

8.1. SOILS

Peat soils in the central Everglades marshes are expected to be positively affected by the Comprehensive Plan. With the recovery of multi-year hydroperiods, especially in many overdrained slough regions, peat accretion is likely. Any measurable affects to soils would probably occur over a medium to long-term time scale. The Restudy should include plans for close monitoring of soil accretion and possible loss, with a view to providing a more accurate, detailed assessment in the future.

For peat soils, an increase in hydroperiod will result in retardation of subsidence. A decrease in hydroperiod will accelerate soil oxidation, rate of subsidence and frequency of peat fires. Immediate effects of a shorter hydroperiod would be soil shrinkage, alteration of vegetation types, and reduction in productivity of current agriculture. On a regional scale, the Comprehensive Plan results in generally longer hydroperiods. Therefore, areas containing peat soils will experience reduced soil subsidence, and possibly reduced frequency of peat fires. Furthermore, retardation of soil subsidence in certain areas may result in conditions favorable for optimal productivity and maintenance of desired vegetation.

8.2. GEOLOGY

No significant effect is anticipated on the geology of the study area as a result of implementation of Comprehensive Plan. The only geologic resource exploited in the study area is limerock, and this activity will not be affected. The construction of a seepage barrier or curtain wall within the Central Lake Belt area may locally affect geology and groundwater flows.

8.3. CLIMATE

Overall, climate is not expected to be directly or indirectly affected by implementation of the Comprehensive Plan. Possible moderating effects on local micro-climates near large above ground storage reservoirs may occur due to the fairly extreme change in land use from some blend of terrestrial and wetland environment to an open water environment for up to several months or longer each year.

8.4. AIR QUALITY

Air quality is not expected to be permanently affected by implementation of the Comprehensive Plan. Small to moderate localized and temporal impacts are likely to occur due to the use of earth moving equipment for levee degradation, and other construction activities over the period of project construction. Detailed information on effects on air quality within the study area are in **Appendix I**.

8.5. NOISE

Implementation, operation and maintenance of the proposed project will have little effect on ambient noise levels. Noise levels will be moderate in both scope and scale, and limited to construction areas. These localized impacts would likely occur for relatively brief periods at any one location. On a regional basis however, noise impacts due to construction activities may occur for an extended period of time, as the schedule for construction activities may last up to 20-30 years prior to project completion. Additional pumps associated with regional Aquifer Storage and Recovery facilities will introduce a new noise source into the region, but most will be located far from inhabited areas. Within the Lower East Coast region pump operations will likely represent a new noise source for inhabitants and visitors to areas near the ASR facilities.

8.6. VEGETATION

Implementation of the Comprehensive Plan is expected to have profound effects on native and exotic vegetation. More natural hydroperiods should assist in restoring natural plant communities. The reduction in persistent high water levels in some areas that are now “too wet”, and the provision of more and better-timed water to regions that are now “too dry”, should result in a more natural mosaic of plant communities. Restored hydroperiods, decompartmentalization of important interior areas of the Everglades Protection Area, restoration of more natural sheet flow, and the filling of several interior canals, it is believed, are all changes that will benefit native vegetation to the detriment of exotics. Native vegetation will further benefit through restored water quality conditions (see **Appendix H**), and removal of interior canals such as the C-6 and the L-29 borrow canal, among others, which act as transportation corridors for nutrients, pesticides, and exotic plants and animals.

The Comprehensive Plan reduces dependence on water storage in Lake Okeechobee by increasing water storage in the regional system. In the past, this storage has resulted in extreme high lake water levels that damage the littoral zone. Restored, moderate lake levels will aid in maintaining a more healthy marsh and littoral vegetative community. Alternative storage areas, proposed under the Comprehensive Plan, also reduce and improve the timing of water releases to the Caloosahatchee River Estuary, and St. Lucie Estuary, and into the Everglades Protection Area. Regulatory flood releases, which in the past have negatively affected salinity and seagrass beds in the estuaries, will be substantially reduced. Extreme high and low water events in the central Everglades will no longer be as pervasive or as damaging to freshwater marsh vegetation. Although unnaturally long hydroperiods still remain a concern in portions of the central Everglades, their impact is less under the Comprehensive Plan than under either the existing condition or the Without Plan Condition. Further improvements should be addressed during detailed studies, by operational changes, monitoring, and adaptive management practices designed to address uncertain results for certain actions.

The northern and central Everglades constitute roughly 900,000 acres of Everglades landscape. The managed system caused widespread loss of peat soils from over-drainage, followed by microbial oxidation and muck fires. Tree island vegetation was destroyed by muck fires in over-drained regions and by prolonged high water in deeply ponded areas. The Comprehensive Plan appears to make major progress toward solving these two critical problems. Although all of the final alternatives developed by the Restudy Team helped relieve drought conditions and damage to peat soils, the Comprehensive Plan provides the best reduction in extreme high-water conditions that would flood tree island plant communities. Existing flows to the southern Everglades, Shark River Slough and estuaries of Florida Bay are believed to be a principal cause of seagrass die-off and expansion of

woody vegetation into coastal marshes. The Comprehensive Plan produces greater overland flow and restored hydroperiods in the southern Everglades, which should result in restored conditions for seagrasses in Florida Bay and interstitial lakes, reduce the spread of mangroves into coastal marshes, and woody vegetation into marl prairies (J. Ogden, pers. comm.).

The Comprehensive Plan resulted in an overall decrease in surface water discharges to Biscayne Bay from Snake Creek. The projected discharges from Snake Creek would be expected to cause significant fluctuations in salinity, which may adversely affect existing vegetation. However, these impacts may be minimized through operational modifications to the Lake Belt reservoirs.

8.7. FISH AND WILDLIFE

Fish and wildlife and their habitat are expected to greatly benefit under conditions brought about under the Comprehensive Plan.

Lake Okeechobee will function more as a natural lake, rather than as a reservoir with prolonged high lake stages. This change should benefit fish reproduction and growth. Juvenile fish and other small aquatic species depend on a healthy, vegetated littoral zone for food and cover. Under the Comprehensive Plan, ecological conditions within the Lake marsh and littoral zone, valuable habitat for the fishery, would be enhanced. Heterogeneity of vegetation assemblages will be protected with less frequent prolonged flooding and extreme drydown events. There will be lower phosphorus loading to the littoral zone from the open water zone of the Lake.

In the northern and central Everglades, the Comprehensive Plan tends to reduce extreme high and low water events at the expense of increasing hydroperiod in several areas. Compared to the Without Plan Condition, the plan improves conditions in southern Water Conservation Area-3A by reducing high water and in northern Water Conservation Area-3A by reducing drydowns, but may affect conditions in northeastern Water Conservation Area-3A and Water Conservation Area 3B by increasing high water. Across Trophic Level Systems Simulation (ATLSS) model results predict higher average fish abundance under the Comprehensive Plan than the Without Plan Condition. Restoration of this important link in the food chain would enhance not only the fishery, but those animals such as wading birds, alligators (*Alligator mississippiensis*), otters (*Lutra canadensis*), minks (*Mustela vison evergladensis*), raccoons (*Procyon lotor*), and predatory fish, that prey upon them. Longer hydroperiods in sloughs also will improve habitats for limpkins (*Aramus guarauna*), mottled ducks (*Anas fulvigula*), pied-billed grebes (*Podilymbus podiceps*), pig frogs (*Rana grylio*), crayfish (*Procambarus alleni*), and other organisms.

The reduction of excessive high water conditions in many portions of the Water Conservation Areas should provide slightly better foraging conditions and reduce white-tailed deer mortality due to starvation and drowning. Conditions in Water Conservation Areas 2B and 3B are still wetter than optimal and do not result in improved foraging conditions as they do in Water Conservation Area 3A, particularly south of I-75. In Everglades National Park where deer habitat is already poor, the Natural System Model-like conditions in the plan would further reduce quality. For those few areas with high deer breeding potential (Long Pine Key, surrounding short hydroperiod marsh and northwest Big Cypress), there will be little impact.

In the southern Everglades and Florida Bay, the Comprehensive Plan approaches modeled natural hydropatterns. Improved timing and duration of freshwater flows to the Florida Bay estuaries and improved timing of fish-concentrating drydowns should lead to improved wading bird foraging and breeding conditions in the southern Everglades, when compared to existing conditions or the Without Plan Condition. Wetter conditions in marl prairies and greater flow into mainland estuaries (lower salinity) should substantially improve degraded alligator habitat. Improved freshwater flows are also expected to markedly improve conditions for pink shrimp (*Penaeus duorarum*), and a variety of fish and invertebrate species that inhabit the mangrove swamps and Florida Bay.

The rehydration of coastal wetlands and shifting of point source canal flow to distributed overland flow should provide more stable estuarine conditions along the western shoreline of southern Biscayne Bay. Stabilized estuarine conditions will result in enhanced nursery habitat for estuarine-dependent organisms.

Within those areas proposed for large-scale above-ground reservoirs, Stormwater Treatment Areas and regional scale Aquifer Storage and Recovery systems, a potentially large number of acres of uplands and wetlands may be permanently altered due to the need to site these facilities in the least sensitive areas. This would include existing uplands and wetlands around Lake Okeechobee, within the Everglades Agricultural Area, Water Preserve Area, and Caloosahatchee River and St. Lucie River Basins. Even though upland resources are valuable in and of themselves, particularly within the study area where wetland resources are abundant, and uplands are relatively fewer, avoidance of wetlands over uplands generally receives priority in planning. Many of these uplands support wildlife habitat of some value and adverse impacts to sensitive, rare or particularly valuable habitat needs to be avoided or minimized whenever possible.

8.8. THREATENED AND ENDANGERED SPECIES

Within the regional system, improved habitat conditions are anticipated for the West Indian manatee (*Trichechus manatus latirostris*), American crocodile (*Crocodylus acutus*), snail kite (*Rostrhamus sociabilis*), wood stork (*Mycteria americana*), Cape Sable seaside sparrow (*Ammospiza maritima mirabilis*), and the Okeechobee gourd (*Cucurbita okeechobeensis*). In the case of the manatee and crocodile, this is due to substantially enhanced freshwater flows to Florida Bay, and decreased salinities in the Florida Bay and Shark River Slough estuarine habitats relative to the Without Plan Condition. For the snail kite, wood stork, and Cape Sable seaside sparrow, improvements in restoring more natural hydroperiods, with Natural System Model-like conditions throughout much of their habitat, leads to an overall regional improvement in their populations. In some instances there may be local, minor negative impacts to habitat, caused by vegetation shifts over time, or increased ponding depths in relatively small areas currently serving as functional foraging or breeding grounds.

The endangered Okeechobee gourd is also expected to benefit due to a reduced occurrence of high water events and flooding of its habitat on the south shore of Lake Okeechobee.

Locally, the Florida scrub jay (*Aphelocoma coerulescens*), bald eagle (*Haliaeetus leucocephalus*), caracara (*Polyborus plancus*), and eastern indigo snake (*Drymarchon corais couperi*) may be negatively impacted by the Comprehensive Plan, primarily by the construction and operation of new water storage and treatment areas, mostly within the Kissimmee River and Caloosahatchee River regions. Filling in of canals is also likely to negatively impact some eastern indigo snake habitat, and may cause direct mortality of snakes, as they are known to utilize crab holes as refugia. The impacts to these animals are not likely to jeopardize their continued existence.

The opinion of the Department of Interior regarding impacts to Federally listed threatened and endangered species resulting from implementation of the Comprehensive Plan, is stated in their preliminary programmatic biological opinion, dated August 7, 1998 and confirmed by letter dated March 1, 1999 as the final biological opinion (see **Annex B**). The Opinion states that the Comprehensive Plan is not likely to jeopardize any of the listed species or adversely affect critical habitat.

8.9. WATER MANAGEMENT

For the Kissimmee Basin, water managers will use a climate based inflow forecasting model, in conjunction with operational rules, which will help them in

deciding when to pump water to the storage facilities outside Lake Okeechobee. Under the Comprehensive Plan, most of the water previously stored in the lake at prolonged and even extreme lake stages and/or sent to tide via the estuaries, will be pumped to storage north of the lake (127,000 acre-feet on a mean annual basis) or to other storage facilities in the Everglades Agricultural Area, Caloosahatchee River (C-43) Basin or the St. Lucie (C-44) Basin.

Changes to the existing Lake Okeechobee operation schedule (Run-25) include operational changes only, except for the project features designed to enhance water storage outside of the lake. Water storage facilities are expected to reduce the frequency and duration of flood control releases to the St. Lucie and Caloosahatchee Estuaries. Water from Lake Okeechobee will be pumped into Aquifer Storage and Recovery wells when the climate-based inflow forecasting model projects that the lake water level will rise significantly above those levels that are desirable for the littoral zone. Water management of the lake will rely on existing structures that will not require modification. In order to meet capacity requirements for water conveyance to Aquifer Storage and Recovery facilities, and storage reservoirs, additional canals, resizing existing canals, pumps and conveyance structures will be constructed outside of the immediate lake area.

The Caloosahatchee Basin storage reservoir and Aquifer Storage and Recovery system will capture local basin runoff and releases from Lake Okeechobee. Water from the reservoir will be used to provide environmental deliveries to the Caloosahatchee Estuary, to meet demands in the Caloosahatchee Basin, and to inject water into the Aquifer Storage and Recovery wellfield for long-term (multi-seasonal) storage. Lake Okeechobee water will also be used to meet any remaining local basin demands subject to supply-side management. The operation of project components in the Caloosahatchee Basin will significantly improve regional water managers' abilities to meet local basin agricultural/urban demands as well as the environmental needs of the downstream estuary. Water will be pumped to the storage facilities in the Everglades Agricultural Area with increased conveyance from Lake Okeechobee to the reservoir. The purposes are to improve timing of environmental deliveries to the Water Conservation Areas (including damaging flood releases from the Everglades Agricultural Area to the Water Conservation Areas) reduce Lake Okeechobee regulatory releases to the estuaries, meet supplemental agricultural irrigation demands, and increase flood protection within the Everglades Agricultural Area.

The proposed storage areas under the Comprehensive Plan will significantly improve water management on the Upper East Coast relative to the Without Plan Condition. Water storage sites will allow localized rainfall runoff to be captured and used for flow augmentation to the St. Lucie Estuary when needed during the dry season. The greatest benefit will come from storage of peak rainfall inside the basins, and reduced loss of this turbid, nutrient-laden water to tide. The

Comprehensive Plan reduced the frequency of high-flow discharges to the estuary by nearly 80 percent.

The Comprehensive Plan introduced operational changes in Water Conservation Area 2A that improved inundation patterns in the north, but in so doing increased the frequency of extreme drought conditions in the south. It appears that water management in Water Conservation Area 2A imposes tradeoffs involving improved marsh conditions in some areas but worse conditions in others. If rainfall based operational rules are adopted for Water Conservation Area 1 in the future, such unnatural fluctuations in depth in Water Conservation Area 2A may be alleviated. Rather than combining high water in the south with over-drainage in the north, as is currently the case in all of the Water Conservation Areas, the Comprehensive Plan predicts longer hydroperiods near Stormwater Treatment Area-2 input in the north, increased drying in the south, and accumulation of water at the southern end of in Water Conservation Area 2B.

A number of components in the Comprehensive Plan lead to significant predicted changes in hydrologic conditions in Water Conservation Area 3A. The Comprehensive Plan succeeded in limiting the frequency of extreme high water events within the overall bounds defined for the natural system by the Natural System Model. This performance can clearly be credited to the barrier provided by the L-67 levee, which prevents excess build up of water within the northern and central sections of the Water Conservation Areas. The Comprehensive Plan predicts a lower frequency of extreme high water events, and reduced flooding in Water Conservation Area 3B relative to the Without Plan Condition. The Without Plan Condition however, still predicts drier conditions than the ideal restoration target in Northeast Shark River Slough.

The principal changes in water management will be an increase in the number of structures (levees, pumps, weirs, and canals) associated with the storage areas and their operation. A fairly complex operation schedule will have to be designed and implemented to maximize the benefits of these storage sites. Water will be pumped into and out of the storage areas, requiring fuel and causing additional noise to nearby areas.

The Water Preserve Areas located adjacent to the eastern protective levee will function to prevent seepage out of the Water Conservation Areas and Everglades National Park, increase Everglades spatial extent by restoring existing quality wetlands, capture and store excess water that is currently lost to tide, buffer the urban developed areas from the natural areas, and treat water prior to returning it to the natural system. They are a critical element of the Comprehensive Plan, particularly in terms of re-routing flows from Water Conservation Area 2 south to the Central Lake Belt and into Biscayne Bay and Everglades National Park. They will be highly effective at reducing undesirable

discharges to Lake Worth Lagoon, as well as conserving water originating from the natural system, currently lost to tide through the east coast canals.

The proposed changes in water management associated with southern and central Biscayne Bay will be due to the shifting of point source canal flow to distributed overland flow and to the transport of recycled water to the Bay from wastewater reuse plants. The backpumping from canals to the Lake Belt reservoirs resulted in significant decreases in freshwater flows to Biscayne Bay from Snake Creek and the Miami River. The Comprehensive Plan may enhance saltwater intrusion protection for the surficial aquifer in the south Miami-Dade area due to increased canal stages in the dry season. The effects of above ground storage on flood protection will be positive. The western C-4, C-9, and Hillsboro basins are currently flood prone basins. Available above ground storage areas should greatly reduce flooding in those areas during storm events.

Overall, the remaining Everglades will be managed as a whole, not as individual subcomponents of the regional system. A number of hydrologic benefits could be gained by construction of the Everglades Construction Project and implementation of rainfall-driven hydropattern targets within the Everglades. Rainfall-based delivery plans for Water Conservation Areas 2A and 3A based on antecedent rainfall and natural system hydropatterns should be developed. In addition, modifications should be made to the Everglades National Park's current rainfall-based delivery plans in a manner that replicates natural system-like conditions. Model results showed that using the rainfall-driven targets significantly improved the quantity, timing, and distribution of water delivered to Water Conservation Area 2A, Water Conservation Area 3A, and Everglades National Park to closely match natural pre-drainage conditions.

8.10. WATER QUALITY

The Comprehensive Plan is expected to improve water quality conditions in the study area; however, water quality improvement in south Florida must be viewed as an integrated effort with several interdependent parts. As outlined below, these include: several components and other project elements of the Comprehensive Plan, with emphasis on a proposed Comprehensive Integrated Water Quality Plan (see **Section 9.7.3**); the State of Florida's Everglades Forever Act; Surface Water Improvement and Management (SWIM) Act planning efforts, including the development of pollutant load reduction goals (PLRGs); development of total maximum daily loads (TMDLs) under Section 303(d) of the Federal Clean Water Act; and the Florida Keys Water Quality Protection Program.

Water quality was a consideration in every aspect of the Comprehensive Plan. Major features include creation of approximately 181,270 acres of surface

water storage area, totaling approximately 1.5 million-acre feet of additional storage volume. Surface water storage areas will reduce pollution loading into downstream receiving water bodies through the attenuation of surface flows and settling of attendant pollution loads prior to discharge. The Comprehensive Plan also includes a feasibility study to develop a Comprehensive Integrated Water Quality Plan, which will ensure that Comprehensive Plan facilities will be designed and operated to achieve maximum water quality benefits. More detailed descriptions of the positive water quality benefits that will be provided to waterbodies across the Restudy project area from construction and operation of the water storage areas are provided in **Appendix H** and **Attachment F** (Water Quality, Environmental Effects).

Additionally, many components and other project elements of the Comprehensive Plan include treatment features to ensure that water quality conditions are improved. Specifically, the Comprehensive Plan includes over 19 Stormwater Treatment Areas totaling approximately 35,550 acres of treatment area. These Stormwater Treatment Areas represent additional storage and treatment volume beyond that provided by the storage areas. More detailed descriptions of the positive water quality benefits that will be provided to waterbodies across the Restudy project area from construction and operation of the Stormwater Treatment Areas is provided in **Appendix H** and **Attachment F** (Water Quality, Environmental Effects). Those components of the Comprehensive Plan involving Aquifer Storage and Recovery and wastewater reuse also include treatment facilities to meet applicable State of Florida water quality standards.

Furthermore, implementation of the Comprehensive Plan according to the Implementation Plan (see **Section 10**) will lead to the optimization of water quality benefits, above and beyond merely increasing surface water storage. Significant benefits to water quality conditions in waterbodies in the following study regions are anticipated through construction and operation of the above-discussed water storage areas and Stormwater Treatment Areas: Lower Kissimmee River, Lake Okeechobee, St. Lucie River/estuary, southern Indian River Lagoon, Lake Worth Lagoon, Caloosahatchee River/estuary, the Everglades Protection Area, Biscayne Bay, and Florida Bay.

However, water quality restoration in all water bodies within the study area depends on actions outside the scope of the Restudy. To fully achieve ecological restoration in all regions of the study area, pollution loads must be identified and quantified within each of the study area regions, and load reduction and concentration targets for pollutants of concern must be established. Concurrent with or prior to the proposed operation of components of the Comprehensive Plan, water quality improvement programs for degraded and/or designated use-impaired water bodies must be implemented by the responsible agencies in order to fully achieve ecological restoration objectives.

In its 1998 report to the U. S. Environmental Protection Agency, the Florida Department of Environmental Protection identified approximately 160 use-impaired waterbodies in the study area in accordance with the requirements of Section 303(d) of the Federal Clean Water Act. Section 303(d) listing is based on designated and actual uses of waterbodies, ambient monitoring data, and water quality standards. The South Florida Water Management District, Florida Department of Environmental Protection, and other agencies have developed water quality improvement strategies for several of the impaired waterbodies 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 Surface Water Improvement and Management Act (SWIM) planning efforts for the Indian River Lagoon, Lake Okeechobee, and Biscayne Bay, and the Florida Keys National Marine Sanctuary Water Quality Protection Program. However, there is not, presently, a comprehensive water quality strategy for the entire Restudy area, and implementation of some of the existing water quality improvement plans has been limited by lack of funding to complete assessment and planning activities. Watershed assessments are necessary to develop pollutant source reduction programs and to design and construct water quality treatment facilities, if necessary.

To address the lack of a comprehensive water quality strategy for south Florida, the recommended plan includes a feasibility study to develop a Comprehensive Integrated Water Quality Plan (see **Section 9.7.3**). Development of this plan will involve an interagency effort to ensure that recommended plan facilities are designed and operated to achieve maximum water quality benefits in watersheds where Restudy facilities are located. An essential element of the Comprehensive Integrated Water Quality Plan is the development of total maximum daily loads (TMDLs) of pollutants for specific use-impaired waterbodies, and subsequent implementation of management programs to achieve TMDL pollution reduction targets. It is anticipated that the Comprehensive Integrated Water Quality Plan will expedite the process of developing TMDL pollution reduction targets and management plans for water quality impaired waterbodies in the study area.

8.11. WATER SUPPLY

The Comprehensive Plan will substantially improve water supplies for the Lake Okeechobee and Lower East Coast Service Areas when compared to the future Without Plan Condition. The Comprehensive Plan meets public water demands, minimizes the duration of water supply cutbacks, and maintains saltwater intrusion stages in the primary coastal canals in this region. Compared to the Without Plan Condition, it greatly improves the ability to meet public water supply

demands and prevent saltwater intrusion. All of the alternative plans reduce the dependence of users on Lake Okeechobee and the Water Conservation Areas by providing regional water from new storage facilities. In the Comprehensive Plan, 23 percent less water will be delivered from the Water Conservation Areas and Lake Okeechobee through the structures to the Lower East Coast than in the Without Plan Condition. The future for urban and agricultural water supply shows significant problems in the Without Plan Condition even if the health of the environment were not a consideration. The urban areas will benefit from a sustainable system that supports their future water supply demands and restores the Everglades ecosystem.

8.12. SOCIO-ECONOMICS

The economic impact evaluation of the alternative restoration plans includes the following:

- Agricultural water supply,
- Municipal and industrial (M&I) water supply,
- Flooding potential,
- Commercial navigation,
- Recreation (Everglades-related),
- Commercial and recreational fishing,
- Costs,
- Regional economic effects, and
- Other social effects.

Four of the above are translated into monetary terms. Positive effects of the different alternatives on agricultural water supply range from about \$1.7 to \$2.0 million on an average annual basis. The effect for the Comprehensive Plan is \$1.9 million per year. Positive effects on municipal and industrial water supply range from \$21.5 to \$27.2 million annually, the latter being the estimated impact associated with the Comprehensive Plan. Costs of the plans, on a uniform annual equivalent basis, range from \$254 to \$402 million for the Comprehensive Plan. The initial costs for construction and real estate range from \$5.2 to \$7.8 billion for the Comprehensive Plan. Recurring annual costs for operation and maintenance, and monitoring, range from \$70 to \$165 million per year. Average annual regional effects on total sales range from +\$173 to +\$307 million. Employment effects range from about +1,700 to +3,165 jobs. Impacts on earnings range from \$59 to \$108 million per year. While these are large numbers, they are small taken in the context of total economic activity within the study area, accounting for about 1/10th of one percent of total economic activity within the study area.

Flooding impacts of the alternatives are inconclusive at this time, due to the limitations of the analytical tools available within the scope and time frame of this study. It is possible that some areas will benefit from reduced flooding, and some areas will require more detailed analysis. Such an analysis will be done as a part of any plan implementation.

Very small positive effects on commercial navigation in Lake Okeechobee are expected to result from any of the alternative plans. These effects are due to decreased occurrence of low stages.

Plan implementation may cause some significant impact on recreation. Recreation and tourism are significant economic activities in Florida, and small incremental changes to this large activity base have the potential to be significant. Potential negative impacts on recreation include, among others, the filling in of canals and closure of points of access to established fisheries, most notably along the L-29 and L-67A canals. It is anticipated that existing fishery resources impacted within the Everglades Protection Area, would be offset, in the long term, by reservoir construction proposed as a part of the Comprehensive Plan. These effects have not been quantified or translated into monetary values due to uncertainties regarding the actual timing and effects of alternatives on recreation, and regarding plans and policies for recreational facilities and marketing. Such details will become known during implementation planning expected to follow this study. Lacking a clear vision of these pertinent factors at this time, it would be speculating to quantify recreational effects of the Comprehensive Plan or any of the other alternatives.

The alternative plans have the potential to affect recreational and commercial fishing throughout south Florida by modifying the hydrologic regime in the region's waterways and estuaries. The linkage between hydrologic changes and ecological changes is expected to be positive, which would possibly result in positive economic implications for fishing. Not enough is known about the linkages between fishing and hydrological changes, which would be brought about by plan implementation, nor is enough known about the timing of the linkages between these changes, the resulting ecological changes, and ultimately the changes in the value of fishing, to estimate the economic effects on fishing in this study. All of the plans are expected to positively impact fishing, with the exception of Biscayne Bay, whose fishery would likely benefit only under Alternative D and the Comprehensive Plan.

The most potentially significant "other social effects" consideration for the alternative plans concerns the development of new storage reservoirs in the rural areas surrounding Lake Okeechobee, and the consequences for urban and community impacts and displacement of people. These project features would convert farm land to reservoirs. Their development could eliminate the jobs of the

individuals who are employed in the affected area and have adverse effects on local communities and economies. The potential locations of the new reservoirs are not known at this time. However, the resilience of local economies and the cohesion of local communities to agricultural land conversion depend on a variety of factors, including the age, ethnic, and racial composition of the community and income, unemployment, and poverty levels. A social vulnerability index was developed using county-scale socio-economic characteristics, and this type of analysis could be replicated in more detail when and if new reservoir sites are proposed.

8.13. LAND USE

The most significant effect on land use will be the proposed creation of approximately 181,270 acres of storage reservoirs within the Caloosahatchee River Basin, St Lucie River Basin, Kissimmee River Basin, the Everglades Agricultural Area, and the Lower East Coast. It is anticipated that the majority of the storage needs will be met with agricultural lands, undeveloped lands and lands adjacent to the east coast protective levees. Therefore, implementation of these features in the Comprehensive Plan will likely have an effect on existing agricultural land use.

Storage reservoirs designed to augment the regional water supply system will occupy 25,000 acres in the Kissimmee River region and 60,000 acres in the Everglades Agricultural Area. There is also proposed a 20,000 acre storage reservoir in the Caloosahatchee River basin, a 5,000 acre Stormwater Treatment Area in the Kissimmee River region and 10,000 acres of storage in the St. Lucie Canal Basin, on mostly existing agricultural or vacant lands. In the remaining Upper East Coast region, additional storage facilities are planned for the C-23, C-24, C-25, North Fork and South Fork Basins totaling 35,550 acres. The acreage proposed for these project features is subject to change depending on design depths, which will be determined during final design and specifications. Proposed Aquifer Storage and Recovery facilities include 200 5-Million Gallon per Day wells located near the landside of the Herbert Hoover Dike, which surrounds the Lake. These Aquifer Storage and Recovery wells will require some land for construction, operation, and maintenance. Agricultural production may be compatible with Aquifer Storage and Recovery wells, as the structures are expected to take up minimal land above ground. It appears likely; however, that more than 120,000 acres of land in the northern portion of the study area will be taken out of existing or future agricultural production. Conversion of 60,000 acres of agricultural land in the Everglades Agricultural Area to create storage reservoirs would be approximately a nine percent reduction of the area farmed in this region, which is designated as unique farmland. Implementation of the Comprehensive Plan should have no negative effect on future urban land use around Lake Okeechobee. Urban lands surrounding the lake should benefit through a greater, more consistent source of

water for urban and industrial use, including continued flood protection, beyond that projected in the Without Plan Condition.

Several thousand acres of land will be needed for water management facilities in the Lower East Coast region. The lands proposed for the Water Preserve Areas in the Lower East Coast are generally vacant or are in agricultural production. It is assumed that the majority of these lands would eventually be designated urban land, especially low density residential. These urban land uses can in general be accommodated on other vacant lands or by increasing the density of development. The lake belt reservoirs, which are in-ground facilities, are not expected to diminish the land use of rock mining or impinge on productive agricultural land. Seepage management should not cause changes to existing land use, as minimal land is required for the wells and physical barrier methods. Seepage control components along eastern Water Conservation Areas 3A and 3B are located on wetlands. These components will lengthen the hydroperiods of the wetlands involved.

Land use within the Big Cypress Basin will not likely be significantly affected by implementation of the Comprehensive Plan. The urban areas along the Lower West Coast, including the municipalities of Naples, Everglades City, and Marco Island, are outside the area of hydrologic influence of the Comprehensive Plan and land use will be unaffected by the project.

The Comprehensive Plan does not include construction features in the Florida Keys, therefore it will not affect land use. However, improvements in freshwater flow, and lower salinities in upper Florida Bay, may enhance the pink shrimp fishery in the Keys.

8.14. RECREATION RESOURCES

Some limited impacts to recreation may be assumed under the Comprehensive Plan. In an effort to restore more natural sheet flow and reduce negative ecological and hydrologic effects wrought by interior canals, miles of canals would be filled and levees degraded. Some of these canals currently support regionally important sport fisheries. New opportunities for recreation resource growth would become available with the implementation of the Comprehensive Plan. These include the restoration of existing national and regionally significant fisheries, including Lake Okeechobee, Indian River Lagoon and others, and the creation of tens of thousands of acres of reservoirs, which could function, in part, as recreation resources. If properly sequenced, fishery resources could be established within new project features, prior to impacting existing canals scheduled for filling in through levee degradation.

Restoration of the Everglades, a unique and internationally recognized wetland resource with huge spatial extent, and proven recreation potential in and of itself, should provide vast benefits to recreation resources. Native wildlife game and non-game populations are expected to increase in a sustained manner under improved ecological conditions resulting from the Comprehensive Plan. It is reasonable to conclude that overall, there is greater regional recreation resource potential under the Comprehensive Plan than either the existing condition or the Without Plan Condition.

As stated previously, the Comprehensive Plan may result in an initial localized decline in the mileage of canals available to fishermen, some of these are of state-wide importance. According to Corps design and cost estimates for the Comprehensive Plan, approximately 72 miles of canals are scheduled to be filled, while 74 miles of new canals will be constructed, and 100 miles of existing canals will be widened. The planned construction of the Water Preserve Areas, in Palm Beach, Broward and Miami-Dade Counties offers an important potential for new water based recreational areas.

8.15. AESTHETIC RESOURCES

Restoration of the south Florida ecosystem is expected to result in a healthier environment that will support vigorous plant communities, larger fish and aquatic animal populations, large numbers of wading birds, alligators, and sustainable populations of wide-ranging mammals in a natural setting, in perpetuity. Viewing wildlife, wetlands and open, relatively pristine spaces are valued by people, as tourism statistics for south Florida would seem to support. Regardless, the anticipated increase in native animals and native plants alone will probably not appreciably impact aesthetics to the casual observer. To the casual observer, the Everglades may already meet those criteria, as it is already a wilderness of pristine character to the casual viewer. Implementation of the Comprehensive Plan will not so much change the aesthetic as ensure that a truly healthy and sustainable ecosystem exists into perpetuity.

There are undoubtedly some areas where degradation of the natural environment has reached the point where restoration benefits may be seen and appreciated. Improvements to water quality and clarity should benefit important parts of the environment currently being impacted, including the waters of Lake Okeechobee, the Everglades Protection Area, the estuaries, and Florida Bay. Reducing damaging freshwater releases into the Caloosahatchee and St. Lucie Estuaries will improve water quality and clarity, reduce seasonal fish kills, restore important seagrass beds, oyster beds, and improve estuarine fisheries and wading bird foraging. Improvements in inflow water quality, and an overall reduction in exotic vegetation, should enhance conditions for a more natural heterogeneous

assemblage of native vegetation, providing the necessary conditions to support optimal wildlife populations.

8.16. CULTURAL RESOURCES

Component features at this stage of planning are conceptual and feature locations are not precisely determined. Under the tiering concept of NEPA, specific effects on culturally significant sites will be addressed and coordinated with the State Historic Preservation Officer under Section 106 of the National Historic Preservation Act. In the future, separate Environmental Assessments or supplemental Environmental Impact Statements will be prepared for each project feature, and cultural resources assessments will be conducted in support of those documents, when necessary. Specific effects on historic period and pre-Columbian period archeological sites and standing structures, engineering structures and architectural features will be evaluated after individual project feature sites are provided. Effects from the proposed project are anticipated to come from project feature construction, operational changes, erosion, human disturbance, and changes in the hydrologic regime of the flood plain.

The State Historic Preservation Officer, in a letter dated August 14, 1998, reaffirmed the archeological and historical potential of the C&SF Project area. They also acknowledged our commitment to adhere to the procedures outlined in 36 CFR Part 800, and concurred that at this stage of project planning, the Restudy will have no adverse effect on historic properties listed or eligible for listing on the National Register.

8.17. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTES

A Phase I Hazardous, Toxic and Radioactive Waste (HTRW) site assessment was conducted in the general vicinity of proposed project features or existing features proposed for significant modification for the entire area of the Restudy. Several site visits were conducted over the past few years, with the most recent survey having been performed in August 1998. The HTRW database search was performed on the entire area and it indicated that overall, the majority of the proposed new construction areas are free of hazardous and toxic waste. Most of these general features are proposed for remote and rural areas, and were farms, vacant land, or wildlife management areas. The most common type of HTRW being hydrocarbons, was found along state highways where the majority of the gasoline stations had leaking underground storage tanks.

Perusal of relevant databases also revealed that several locations are National Priority Listed. Most of these National Priority Listed sites are due to

past landfill operations. These sites are located in Palm Beach County, the Lower East Coast Lake Belt area in the vicinity of the S-9 Structure and in Broward County south of Alligator Alley. Contaminated sites located on the perimeter of any proposed water storage area may experience migration or expansion of leachate or other pollutants into the study area. Any such sites would require further survey and specific evaluation prior to detailed design. Another feature of concern is the numerous landfills and waste handling facilities in the Lower East Coast region. To the extent feasible, water storage areas should not be sited immediately adjacent to these known sites.

These findings and conclusions are of existing conditions at this time. The project conditions assume that any HTRW found during any phase of the project would be remediated in accordance with local, state and federal laws. Therefore, it can be assumed that conditions at future construction sites will be contamination free or of low levels, which would include de minimis conditions that generally do not present a material risk of harm to the public health or the environment.

8.18. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Land Use (Agriculture)

Cumulatively, a significant number of acres of agricultural lands will be permanently removed from production due to the construction of large above ground storage reservoirs and Stormwater Treatment Areas. Affected areas are north of Lake Okeechobee, in the Caloosahatchee River and St. Lucie River Basins, and Upper East Coast Basins, and within the Everglades Agricultural Area. Further agricultural land use will be permanently removed from Palm Beach, Broward and Miami-Dade Counties due to the construction of the Water Preserve Areas.

Wetlands

A limited number of acres of wetlands will be permanently altered within the boundaries of the large above-ground storage reservoirs and Stormwater Treatment Areas, and within the Water Preserve Areas.

Uplands

A potentially large number of acres of uplands may be permanently altered within the boundaries of the large above-ground storage reservoirs and Stormwater Treatment Areas, and within the Water Preserve Areas. Due to their relative value in a study area rich in wetland resources, upland resource impacts should also be studied carefully during detailed planning in order to avoid or minimize impacts to particularly valuable or sensitive upland areas.

Water quality

Temporary increases in turbidity of local waters are expected from the removal of canals and levees and by the construction of raised roadways and other structures.

Air quality

Fugitive dust from vehicular traffic and earth moving will be unavoidable but insignificant overall.

Soils

Temporary disruption of soils is expected from the removal of canals and levees and most construction activities.

Wildlife

Significant short-term disruption of wading bird colonies is expected from altering hydroperiods in the Water Conservation Areas. Localized disturbances to fish and wildlife are expected from removal of canals and levees and from the elevation of roadways and construction of other structures.

Recreation

Limited impacts to recreation resources (canal fisheries for example) are expected. However, project features proposed under the Comprehensive Plan, including restoration of existing natural resources, construction of new canals, deep water storage reservoirs and Stormwater Treatment Areas, all offer potentially important recreation benefits, which should offset existing resource loss.

Cultural Resources

An unknown number of historic and archeological sites may be affected. Studies will identify significant sites and necessary mitigation will be developed, on a project-specific basis.

8.19. RELATIONSHIP BETWEEN SHORT TERM USES AND LONG TERM PRODUCTIVITY

While regional conditions will improve, short-term or localized problems will undoubtedly occur. For example, in the process of improving wading bird nesting

and foraging areas regionally, existing rookeries may be affected. Although overall restoration of the Everglades watershed is expected to improve habitat for nesting wading birds regionally over time, the transition period might adversely affect regional wading bird populations. Proper sequencing of project features should mitigate impacts to existing wildlife resources expected to be impacted by restoration activities within their vicinity. Further study and close monitoring will be critical to recovery and maintaining viable wading bird populations during the implementation of the Comprehensive Plan.

8.20. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Construction of the proposed project will include many features considered permanent, or modifications to existing C&SF Project features, which may be deemed irreversible. This would include, for example, construction of large reservoirs, degradation of levees and filling in of canals. Construction of regional Aquifer Storage and Recovery facilities, curtain walls, large storage reservoirs, Stormwater Treatment Areas, Water Preserve Areas, and waste water reuse facilities, are all necessary for the restoration of the natural ecosystem and maintenance of the urban and agricultural system. These features on the scale proposed in the Restudy, are probably of such a magnitude that these features would represent an irreversible and irretrievable commitment of resources. Resources committed would include state and Federal funding to purchase lands and labor, energy and project materials to build, operate, and maintain the project.

Fish and wildlife habitat will be permanently altered, (converted to open water particularly in the case of storage reservoirs and Stormwater Treatment Area facilities). These features would likely be inundated for much of the year.

8.21. CUMULATIVE EFFECTS

Large areas north of Lake Okeechobee, within the Everglades Agricultural Area, around the Lake, in the Caloosahatchee River Basin, and on the Upper East Coast will be used to increase water storage for the overall gain and long-term benefit of the regional system. These project features will provide important storage functions and are essential to the overall restoration of the freshwater marshes and the estuaries. Project features will cause some adverse consequences to agricultural land use, permanently removing tens of thousands of acres from agricultural production. These impacts may be felt locally and/or regionally as the economic base derived from agriculture is incrementally reduced relative to other sectors of the economy. The overall benefit to the regional system is expected to be far greater than the localized adverse effects. As these features occur disparately across the landscape within different hydrologic basins, and as distinct units rather than

multiple features within a single watershed, they will not likely result in a significantly detrimental cumulative effect.

Overall, the Restudy project elements in the Water Preserve Areas may cumulatively affect the current rate of westward expansion of Lower East Coast cities and may increase the value of other residential or potentially residential lands. Restudy project components are not expected to result in a cumulative negative effect on the human environment of the Lower East Coast. Project components in the area, especially storage, seepage control, redirection of point source canal flows to overland flow, and water reuse plants, will act to restore more natural freshwater flows to Biscayne Bay, reduce seepage losses from the Everglades, improve recharge of the Biscayne aquifer, and should result in other beneficial environmental effects. In order to support the construction, maintenance and operation of project features contained in the Comprehensive Plan, the cost of water in urban areas may rise beyond that predicted by the Without Plan Condition.