4. ENVIRONMENTAL EFFECTS

A Corps permit decision authorizes a particular location and quantity of wetland fill and includes appropriate conditions. A decision is made upon application for an individual permit and is made after review of site-specific and project-specific information submitted by the landowner or provided by other sources. The information that is gathered is based on the understanding of what natural resource and other issues are applicable to the project.

The Corps presently makes its determinations of the benefit and detriments of proposed fills on a case-by-case basis. The factors to be considered, and the weight to be afforded each factor, are presently left to the professional judgment of the program manager with oversight from Regulatory Division management. The “no action” alternative would be to continue evaluating permit applications in the same manner as before the EIS.

The Corps proposes to use the information in this EIS in the review of future permits. The information will be used to identify the issues that may be relevant to the project site, provide a source of information on potential effects of the project on various issues, to provide a reference on the potential effects of the location and quantity of fill, and to describe potential effects of alternative permit conditions or constraints. The Corps is not proposing to decide, based on this EIS, to establish the location of fill, quantity of fill, or on any condition or constraint on any piece of property. That decision can only be made after review of an application.

The EIS provides a set of standardized natural resource criteria in reviewing permit applications in Southwest Florida. This set is called the Permit Review Criteria and is found at Appendix H. Important natural resource issues are shown by several maps, one for each resource, and by the Natural Resources Overlay Map in the Appendix. The Overlay Map is divided into anticipated future use areas where a project may have a high potential for adverse effect on the natural resource. The program manager (person reviewing the permit application) would evaluate each application using the criteria and evaluations suggested in the EIS applicable to the important resources found in that area. Just as some areas have greater or lesser degrees of environmental importance, so does the review of applications require greater or lesser degrees of rigor. As seen, some areas have no issues mapped. For these areas, the program manager would continue to use his/her discretion as to the appropriate reviews.

The Natural Resources Overlay Map will be used to determine the applicable permit review criteria. The map was created by the Corps based on evaluation of the effects of five future landscapes (Ensembles) that suggested different locations of development and different criteria for the permitting of those developments. The five future landscapes (Ensembles) were based on five combinations of criteria that specified by maps and legends the location of wetland fill or conversion of natural plant cover, the quantity of fill or conversion, and other conditions or constraints. The comparison of the Ensembles allowed for the identification of areas where projects may have the greater impacts to natural resources.

The use of the Permit Review Criteria and the Natural Resource Overlay Map will decrease the probability of potential effect being inadvertently overlooked on a project. The use of the assessments described in the permit review criteria will more quickly identify the degree of that effect and thereby the level of concern. The convenient reference to pertinent information compiled in this EIS will increase the knowledge and expertise of the project reviewer and applicant to address the adverse effect.

It is important to note that the Proposed Action does not significantly change the Corps' program. The Corps already analyzes its permitting decisions for effects on natural resources, including cumulative effects. The proposed action would standardize and simplify Corps' procedures for doing so. Notwithstanding the level of effort that went into preparing the Ensembles, the Ensembles are **not** the Proposed Action. The reader is cautioned that the Ensembles are simply predictions of the future, based on anticipated actions by city, county, State, and Federal governments, as well as private industry.

These predictions had, and have, no purpose other than to identify the most important resources that would be affected in the future. Accordingly, the Ensembles were used to develop the Natural Resources Overlay Map, which shows Corps reviewer where to apply the Permit Review Criteria. Because the Corps believes the Natural Resources Overlay Map clearly identifies resource impacts, the results of Corps' review using the Permit Review Criteria together with the Natural Resources Overlay Map are expected to be more protective of the natural resources than the no-action alternative of continued piecemeal reviews.

4.1 GENERAL ENVIRONMENTAL EFFECTS

General effects that may be expected include an increase in surface water flows, as most of the alternatives contain provisions that would seek to improve culvert connections and restore and/or improve flowways. Additional negative effects include loss of native vegetation, loss of hydrology and loss of fish and wildlife resources. Each of the Ensembles (and the Alternatives therein) contain design elements which would provide for environmental change. It should be noted, however, that a majority of these design elements are not wholly within the purview of the Corps to implement.

4.2 VEGETATION

Placement of fill in wetlands requires a Department of the Army Permit issued by the Corps in accordance with Section 404 of the Clean Water Act. Therefore, the number of acres of wetlands that could be impacted was estimated for each Ensemble. Interpretation of aerial photography indicates that approximately 45% of the study area is currently wetland. The actual extent of wetland can only be determined after a site visit and analysis of the vegetation, soil, and hydrology. For the Federal definition of wetlands, this analysis is based on the 1987 Corps of Engineers Wetlands Delineation Manual. For the State, this is based on Chapter 62-340, Florida Administrative Code, Delineation of the Landward Extent of Wetlands and Surface Waters. The aerial interpretation will probably be a conservative estimate, that is, will underestimate the quantity of wetlands, since only those with obvious hydrology would have probably been identified in the Geographic Information System as wetlands. Based on previous experience, the wetlands that are particularly difficult to identify in the study area are wet prairie and hydric pine flatwoods. Each of the Ensemble maps presents a prediction of the location and extent of urban development, agriculture, and other land cover types. For each land cover type, a subgroup of the ADG (1) looked at the configuration and type of existing wetlands that fell within the mapped area; (2) reviewed the criteria that went with that land cover; and (3) estimated the quantity of wetlands that could be filled. For example, for certain areas marked "Urban" in Ensemble R, the subgroup: (1) noted that many of the wetlands are generally impacted by nearby existing drainage canals; (2) reviewed existing criteria found in the Comprehensive Plan and Corps regulations; and then estimated the percentage of the wetlands that would be authorized for fill. The estimated percentage would be based on the ADG members' experiences that the typical configuration of urban projects and the nature of the wetlands has resulted in some level of unavoidable impacts to wetlands. This process was repeated for each of the alternatives and for each of the land cover types. For example, one of the criteria attached to one of the land cover types found in Ensemble U stated a prohibition of any fill in wetlands. Therefore, the evaluation is based on an estimate that zero percent of the wetlands would be filled. The total quantity of wetland that may be filled under Ensemble Q is 6.6% of the total area of wetland; for Ensemble R, 7.0%; for Ensemble S, 5.6%; for Ensemble T, 5.8%; and for Ensemble U, 5.5%. One percent(1.0%) represents approximately 1,821 ha (4,500 ac). This evaluation is important because the Federal regulations applicable to the Corps review of permits emphasize the need to avoid impacts to wetlands. An Ensemble that has less impact would better satisfy this requirement than one that had a higher percentage.

Uplands are an essential part of the natural system. They provide nesting, foraging and resting areas for species that live on uplands but forage on species that live in wetlands. Uplands support listed species, absorb rainfall, and provide clean runoff to wetlands and ultimately to groundwater or to the estuaries. The uplands also provide overflow areas for floods. Currently, wetland and upland vegetation, combined, occupy approximately 58% of the study area. Some of the wetlands and uplands also include exotic plants. Existing public preserves are estimated to encompass approximately 27% of the study area.

Therefore, about half of the natural vegetation is currently found in privately owned undeveloped areas or as inclusions within urban, rural, and agricultural areas. Each Ensemble maps locations of contiguous areas that are or are proposed to be publicly owned preserves or areas that are preserved by others (such as conservation organizations or mitigation banks) for natural resource benefits. The area so mapped totals, for Ensemble Q, 38% of the total study area; for Ensemble R, 38%; for Ensemble S, 42%; for Ensemble T, 42%; and for Ensemble U, 43%. A visual inspection of the Ensemble maps will show that the largest difference (in terms of acres) is in the periphery of the urban area. Therefore, all of the Ensembles predict an increase in contiguous preserves. Natural vegetation outside of preserves would have a higher probability of being filled and be subject to impact from surrounding land use.

In addition to the simple quantity of vegetation, the preservation of vegetation in certain landscape location is vital to maintaining fish and wildlife resources. Seasonal wetlands within the foraging range of rookeries, vegetation that connects major habitat areas, coastal habitat, and other regionally significant natural resources are discussed under Section 4.4.

The analysis so far simply reports losses of acres of vegetation. It is unrealistic to expect that there will be zero impact to wetlands. Therefore, another consideration is whether or not the Ensemble identifies adequate locations for the replacement of that vegetation. Identification of a large area of potential mitigation sites indicates that the applicants will have a wide selection of locations within which to provide that replacement. A narrow selection increases the chance that inadequate mitigation may occur because: (1) not all of the land identified in the Ensemble will be available (for example, no willing seller); and (2) some of the lands identified (for instance, rare upland habitats or uplands used by listed species) will not be suitable for the restoration or creation of wetlands. All of the Ensembles propose expansion of preserves greater than what would be expected to be provided by applicants as part of permits; that is, the acquisition and restoration of lands as conditions of permits supplement, but do not supplant, public land acquisition efforts such as the draft Strategic Land Conservation/Preservation Plan for Southwest Florida prepared by the Southwest Florida Regional Planning Council.

The Federal regulations provide that unavoidable impacts (after demonstrating that no alternative site is available and after minimization of impacts) be compensated. Therefore, the compensation made available by each Ensemble was estimated. Compensation can be provided by the restoration of the remaining wetlands within the footprint of the project ("on site mitigation"), acquisition and restoration of degraded wetlands elsewhere in the region ("off site mitigation"), or creation of new wetlands either on-site or off-site. The quantity of mitigation is based on an assessment of the quality of the restoration or creation and the quality of the wetland impacted. For example, removing ditches, implementing controlled burns, or other work on three acres of poor quality wetlands could restore them to pristine condition. This restoration work could compensate for the loss of one acre of wetland impacted by development. The ecosystem benefits received from the four acres of poor quality wetland are replaced by the benefits received from three acres of high quality wetland and one acre of development. The actual mitigation assessment will be done at the time of the individual permit review. Each of the Ensemble maps presents a prediction of the location of preserve areas that will retain their natural vegetation. All of the Ensembles predict that the acres of preserve in the future will be larger than the acres currently in public ownership. These new acres are locations of "new" preserves. The acres of wetlands within these "new" preserves represent, for Ensemble Q, 17.0% of the total wetlands in the study area; for Ensemble R, 19%; for Ensemble S, 22%; for Ensemble T, 23%; and Ensemble U, 24%.

The Ensembles can then be compared by their acreage ratio. The ratio is the number of acres of wetlands in new preserves divided by the number of acres of wetlands that may be filled. The ratio for Ensemble Q is 2.6:1; for Ensemble R, 2.7:1; for Ensemble S, 4.0:1; for Ensemble T, 3.9:1; and for Ensemble U, 4.4:1. An Ensemble with a higher ratio would indicate a greater availability of choice in lands that could be acquired and restored to compensate for each acre of predicted impact.

The ratios reported are probably optimistic since not all vegetation types for which mitigation may be required may be found within the new preserves. For example, coastal wetlands in the study area would not be appropriately replaced by wetlands in Corkscrew Marsh proper; certain isolated herbaceous

wetlands could not be appropriately replace by creating marshes outside the foraging range of rookeries; and losses within flowways would not be replaced by wetlands outside of the flowway.

The availability of compensatory mitigation can also be expressed in terms of the wetland quality. For each of the wetlands that were expected to be filled under the scenario presented by the alternative, the ADG subgroup estimated the wetland's quality at either high, medium, or low. The acres of wetlands scored high were multiplied by 3, scored medium by 2, and scored low by 1. The results were summed for a total number of "units" of impact. Then, the acres of wetlands in the new preserves which scored high were multiplied by 1, scored medium by 2, and scored low by 3. These scores reflect that there is a greater environmental lift resulting from enhancing a low quality wetland compared to a high quality one. (There is also a difference in ecosystem benefit depending on the location of the acquisition, such as if the site is on a habitat corridor: this is evaluated separately.) The "units" of potential restoration divided by the "units" of potential impact results in a ratio. Note that the ADG group prepared this computation for each of the single alternatives created by the ADG but then the Corps extended the computation over the four alternatives that make up each Ensemble. The ratio for Ensemble Q is 1.8; for Ensemble R, 1.8; for Ensemble S, 2.8; for Ensemble T, 2.8; and for Ensemble U, 3.3. An Ensemble with a higher ratio would indicate greater assurance that ecosystem benefits would be replaced because: (1) any restoration activity involves some risk that a portion will fail; and (2) the restoration work is typically funded by the development activity and so is not completed until after the impact, resulting in a temporal loss of benefits. Both of these effects would argue that permits would require ratios higher than 1.0:1. Mitigation Banks reduce this risk.

Section 4.20.1 describes the analysis of acres of fill authorized by Corps permits from 1991 to 1999. As shown by Table 18, authorizations averaged 508 acres per year. The actual date the fill is placed can be later than the year of the authorization. Those permits required compensatory mitigation through the creation of new wetlands (45 acres per year) and through enhancement, preservation or restoration of existing wetlands (1,456 acres per year). One net result is an average reduction of 463 acres per year in the number of acres of natural vegetation (from 508 acres to 45 acres). However, the habitat and other wetland functions lost from the 508 acres are replaced in the 45 acres of new wetlands and by an increase in quality of the 1,456 acres of existing wetlands. This is commonly referred to as the "Mitigation Ratio" of the projects. The mitigation ratio is 2.95 to 1 (1,501 acres of creation and restoration divided by 508 acres of fill). The number of compensatory acres required by the permit is based on an evaluation performed for each permit decision to determine if there has been appropriate compensation of the unavoidable loss of wetlands. The evaluation identifies the functions and values of the wetlands lost and the gains from the mitigation plan. This evaluation is narrative using professional judgement of the Corps reviewer. For larger and more complex projects, reviewers incorporated various numeric assessment methodologies into the evaluation. In 1998, the Corps published the Joint State/Federal Mitigation Bank Review Team Process. This included a numeric assessment technique to calculate mitigation. This technique incorporated the South Florida Water Management District's Wetland Rapid Assessment Procedure (WRAP). By public notice, the Jacksonville District of the Corps stated, "Although an applicant is not required to perform WRAP, inclusion of WRAP or another functional assessment would expedite the District's evaluation of permit applications and proposed mitigation banks." However, even with what sounds like a high mitigation ratio, there is still a loss of spatial extent of natural vegetation cover. For wildlife, a small number of acres of high quality habitat may support the same population as a large number of acres of poor quality habitat. So a simple replacement of functional capacity by enhancing or restoring poor quality habitat (or removing human impacts through preservation). But some aspects of the species life history needs are directly related to spatial location or total acres available. Therefore, the remaining sections of this EIS will look at these other aspects for the Corps to consider in its permit reviews.

Section 4.20.1 also describes an analysis that was performed of historic change of natural plant cover to other uses. The early paragraphs above in Section 4.2 describe the analysis of projected change for each of the Ensembles. Section 4.6 at **Table 9a** relates the projected conversions into change in footprint of development. Certain numbers from these tables are extracted into the following **Table 7** to describe the relative change in natural plant cover as a percentage of a theoretical starting natural

condition. One observation that can be made is the jump in percent change per year in the 1953-1973 period when the region began to develop, but as the region became one of the fastest growing areas in the State, the percentage rose slightly then dropped slightly. The Corps' authority, Section 404 of the Clean Water Act, started in 1972. Many State and local authorities related to natural resources also began in this era. The roughly equivalent rate of conversion despite the rapid growth could possibly be ascribed to the collective results of these programs. It can be ascribed to the greater awareness of the natural resource issues on the part of the landowners and to the site design techniques that have been instituted by the development industry.

Table 7. Conversion of Natural Plant Cover in Study Area

	"Start"	1900-1953	1953-1973	1973-1988	1988-1995	1900-1995	Q	R	S	T	U
Wetland	48.8%	0.3%	2.7%	6.6%	1.8%		2.1%	2.3%	1.8%	1.6%	1.7%
Upland	13.9%	0.4%	6.7%	4.3%	2.7%		9.5%	8.5%	8.4%	8.2%	7.9%
Wet/Up	37.3%	2.8%	4.2%	5.1%							
Total	100.0%	3.5%	13.6 %	16.1 %	4.5%	38.0 %	11.6 %	10.8 %	10.2 %	9.7%	9.6%
Per Year		0.1%	0.7%	1.1%	0.6%	0.4%	0.6%	0.5%	0.5%	0.5%	0.5%
Figures for Wet/Up shown before 1988 because some plant cover categories can include both upland and wetland areas.											
Note that Wetland and Upland numbers are based on interpretation of aerials and other non-site specific information.											
Numbers should be used only for comparisons to each other due to many potential interpretative inaccuracies.											

4.3 FEDERALLY THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (Act) imposes duties on all citizens related to species listed under the Act. The Corps consults with the U.S. Fish and Wildlife Service (USFWS), as provided by Section 7 of the Act, on the effect of a project so that effect can be considered as part of the decision whether to issue a Department of the Army Permit. The Corps is responsible, under the Act, to use its authority(s) to protect existing populations and habitat of listed species and also to further the recovery of those species.

Florida Panther

The USFWS developed species and habitat-level recommendations for the protection of the Florida panther in the Multi-Species Recovery Plan for the Threatened and Endangered Species of South Florida (MSRP) (USFWS 1998). Those recommendations that pertain to the study area include: (1) minimize injury and mortality from panther/vehicle collisions; (2) identify and prioritize underpass needs in South Florida; (3) enforce available protective measures; (4) initiate Section 7 consultation (ESA) when applicable; (5) implement on-site minimization, habitat compensation, and mitigation on private lands through Section 10 of the Endangered Species Act when needed; (6) monitor the South Florida panther population; (7) establish South Florida education and outreach programs for the Florida panther; (8) preserve and protect Florida panther habitat; (9) complete acquisition projects comprised of Priority 1 and Priority 2 panther habitat; (10) expedite State of Florida land acquisition projects; (11) initiate new acquisition projects comprised of Priority 1 and Priority 2 habitat; (12) complete public protection of Big Cypress Area of Critical State Concern; (13) establish, restore, and maintain important panther corridors; (14) use landowner incentive programs to conserve, restore, and manage panther habitat; (15) utilize the

Environmental Conservation Acreage Reserve, Wetlands Reserve, Conservation Reserve program, Environmental Quality Incentives Program, Wildlife Habitat Incentives Program, and the USFWS Partners for Fish and Wildlife Program to encourage private landowner protection of panther habitat; (16) determine properties best suited for habitat restoration using landowner incentive programs; and (17) develop and implement a habitat monitoring program/plan.

The Florida Game and Fresh Water Fish Commission (FGFWFC) developed habitat conservation strategies for the Florida panther in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS). Using a panther density of 1/110 km^2 (1/42mi^2) based on home range information, the FGFWFC indicated that a population of about 50-70 would probably persist for a least 200 years under favorable management conditions, utilizing as much as 8,100-16,200 km^2 (2-4 million acres) of habitat. Maehr (1990) estimates that current conservation lands in the region could support only 18-24 panthers. Conservation of additional habitat areas is needed to manage the population for long-term survival. By modeling "preferred" and "secondary" habitat types, panther avoidance of barren land cover, roadless patches, and composition of land-cover within roadless patches, the FGFWFC established a qualitative measure and score for panther habitat that ranged from 1 to 8. The largest blocks of high-scoring land cover included Collier and Lee Counties. Private lands immediately north and northwest of the Fakahatchee Strand State Preserve, Big Cypress National Preserve, and Florida Panther National Wildlife Refuge, together with lands within these preserves, formed the largest contiguous block of land cover with the high index values. These areas include a large portion of the southeast quarter of the study area (Belle Meade, Southern Golden Gate Estates, CREW and surrounding private agricultural lands). These areas form the basis of the Strategic Habitat Conservation Areas for the Florida panther within the study area.

The Florida Panther Habitat Preservation Plan (HPP) mapped lands "...considered essential to maintaining the Florida panther population south of the Caloosahatchee River at its present level." These included Priority 1 ("The lands most frequently used by the panther and/or lands of high quality native habitat that should be conserved first...") and Priority 2 lands. Total priority habitat identified by the HPP encompassed 468,600 acres south of the Caloosahatchee River and 457,700 acres north of the river. The study area includes 74% of the Priority 1 and 34% of the Priority 2 lands south of the river and 29% and 23%, respectively of the total Priority 1 and 2 habitat (north and south of the river). The changes in land cover within the study area have a large influence on the range of the species.

Table 8a. Priority Habitat for the Florida Panther in South Florida

Ensemble	Percentage of Priority Habitat south of river				Percentage of all Priority Habitat in the HPP			
	In Preserves		On Private lands		In Preserves		On Private lands	
	Pri I	Pri II	Pri I	Pri II	Pri I	Pri II	Pri 1	Pri II
Q	58%	7%	16%	27%	22%	5%	6%	18%
R	64%	7%	11%	26%	25%	5%	4%	18%
S	64%	14%	10%	19%	24%	10%	4%	14%
T	66%	12%	8%	20%	26%	8%	3%	13%
U	66%	14%	8%	20%	25%	10%	3%	13%

An Ensemble with a higher percentage of habitat on public lands would have greater assurance of preserving the existing population. All of the Ensembles predict additional lands to be placed into public or other preserve, as described by this table. These preserves also serve to preserve the mix of upland and wetland native vegetation as described earlier in Section 4.2.

Table 8b. Priority Habitat for the Florida Panther in the Study Area

Percentage of All "Priority" Habitat Within the Study Area									
Ensemble	In Preserves			In Agriculture			Other Private Land		
	Pri 1	Pri 2	1+2	Pri 1	Pri 2	1+2	Pri 1	Pri 2	1+2
Q	78%	20%	56%	11%	51%	26%	11%	29%	18%
R	86%	22%	62%	13%	69%	34%	2%	9%	4%
S	86%	43%	70%	12%	28%	18%	2%	30%	12%
T	90%	38%	71%	9%	53%	25%	1%	9%	4%
U	89%	42%	72%	9%	35%	19%	2%	23%	10%

Several of the Ensemble maps include criteria to restrict the intensification of agriculture or to preserve existing agricultural or rural land uses. Such criteria would preserve panther habitat on those agricultural lands not included in public preserves, increasing the assurance of preservation of the species since not all of the private land ownership will be of the nature that would preclude preservation of panther habitat. Therefore, the above percentages should be evaluated in terms of criteria which limit additional development; that is, although Ensembles R and S appear to protect 86% of Priority habitat, Agricultural land under R does not have the limitation on intensification found in Ensemble S.

Further examination of the table shows that even under Ensemble U, 28% of the Priority I and Priority 2 habitat, particularly Priority 2, is at risk of not being available for this species.

Occupied panther habitat is about evenly divided between public and private lands. If private land habitats are lost the existing public lands in South Florida are judged capable of supporting only 9 to 22 (Maehr 1990b) of the minimum 50 adult panthers needed to sustain a genetically viable population (MSRP 4-127). Breeding and dispersing panthers use the Corkscrew Swamp system connected to the core population center to the southeast through Camp Keais Strand. Unlike the core population center, there have been limited attempts to track and radio-collar panthers in the Greater Corkscrew Region. That the road mortalities in Rural Lee County are sub-adult males seems to support the premise that this area is primarily used by dispersing juveniles.

Early radiotelemetry investigations indicated that panther (n=6) use of mixed swamp forests and hammock forests was greater than expected in relation to the availability of these vegetative communities within the panthers home range area (Belden et al. 1988). As investigations expanded onto private lands between 1985 and 1990, it was determined that panthers (n=26) preferred native, upland forests, especially hardwood hammocks and pine flatwoods, over wetlands and disturbed habitats (Maehr et al. 1991a). For pine flatwoods, which comprised about 12 percent of the habitat available to male Florida panthers (n=5) and female Florida panthers (n=5), mean habitat use between 1986 and 1994 averaged 33 and 32 percent respectively. For hardwood hammocks, which comprised about 13 percent of the habitat available, mean habitat use averaged 38 and 31 percent respectively (Maehr 1996). Hardwood hammocks provide important habitat for white-tailed deer (Odocoileus virginianus), an important panther prey species (Harlow 1959, Belden et al. 1988, Maehr 1990a, 1992a, Maehr et al. 1991a). Understory thickets of tall, almost impenetrable, saw palmetto (Serenoa repens) have been identified as the most important resting and denning cover for panthers (Maehr 1990a). Agricultural and other disturbed habitats, freshwater marsh, thicket swamp, and mixed swamp are not preferred, and are either used in proportion to their availability or are avoided (Maehr 1990a). Panthers have not been found in pastures during daytime radiotelemetry flights but may travel through them at night (Maehr et al. 1991a, Maehr 1992a). Male and female panther home range size is inversely related to habitat quality; the greater the extent of agricultural land and wetland habitats the larger the home range, and the greater the extent of mixed hardwood forests and dry pine forests the smaller the home range. High-quality habitat produces abundant prey and influences female panther reproductive success (Maehr 1992b, Maehr et al. 1989b). The largest contiguous tract of panther habitat is in the Big Cypress Swamp/Everglades physiographic regions. Big Cypress National Preserve, Everglades NP, and Florida Panther NWR together comprise about 927,793 ha of native habitats--46 percent of which is forested. However upland forests, e.g. pine forests and hardwood hammocks, comprise only 8 percent of the total land area (Duever et al. 1986, USFWS 1996, NPS 1998). (Page 4-120)

Overall, management activities directly benefiting the panther and panther prey are limited to upland habitats which comprise only 8 percent of the total land area in Big Cypress National Preserve, Everglades NP, and Florida Panther NWR (Maehr 1996). The Immokalee Rise physiographic region includes all of Hendry County and parts of Collier, Glades, and Lee counties (i.e., the core of occupied panther habitat). Pine flatwoods in this area declined 88 percent from 153,928 ha in 1900 to 17,970 ha in 1989. Pine flatwoods have also been severely fragmented and today are comprised of thousands of patches less than 50 ha in size (Mazzotti et al. 1992). Pine flatwoods have been replaced by pasture, row crops, and citrus. Hardwood hammocks have increased (probably due to land drainage) from 6,703 ha in 1900 to 9,516 ha in 1989 but have never comprised more than 2 percent of the vegetative cover in the Immokalee Rise physiographic region (Mazzotti et al. 1992). Given the high level of panther use and scarcity as a cover type it is important that hardwood hammocks be maintained in conditions attractive to panthers and panther prey. (page 4-131). The effects of the invasion of melaleuca on the quality of habitat is unknown. Many of the FLUCCS series counted as habitat have young melaleuca, not enough yet to change the FLUCCS series, but the invasion is starting to choke out the understory and midlevel canopy layers. Most of the research on the panther has occurred in areas with little invasion and so there is little direct data.

This species range historically probably extended throughout the entire study area. **Table 7** of Section 4.2 suggests greater than a third of the natural cover has been lost. In addition, existing natural cover still present west of Interstate 75 is of less value. **Table 19** in Section 4.20.1 suggests that some of the plant cover particularly used by this species are also those with the greater historic losses. The Ensembles vary slightly in the total area of cover impacted but as seen from the figures for Priority Habitat above, the location of land uses and their relation to loss of land cover has a great influence on the habitat available to the species.

Scrub-Jay

The USFWS developed species and habitat-level recommendations for the protection of the Florida scrub-jay in the Multi-Species Recovery Plan. Those recommendations that pertain to the study area include: (1) determine the distribution of Florida scrub-jays and status of scrub habitat in South Florida; (2) maintain scrub-jay habitat and distribution data in a GIS database; (3) protect and enhance Florida scrub-jay populations; (4) develop a reserve design for Florida scrub-jays in South Florida using landscape maps, GIS and spatially-explicit population models; (5) protect, manage and enhance Florida scrub-jay populations on public lands; (6) protect, manage, and enhance Florida scrub-jay populations on privately-owned lands; (7) enforce available protective measures (initiate Section 7 of the Endangered Species Act consultation when applicable, implement on-site minimization, habitat compensation, and mitigation on private lands through Section 10 of the Endangered Species Act when needed); (8) conduct risk assessment analysis to determine the probability of persistence of the scrub-jay in south Florida, given the current amount of suitable scrub habitat as well as potentially restorable scrub habitat; (9) study the effects of habitat fragmentation due to urbanization; (10) monitor scrub-jay populations; (11) inform and involve the public (biological needs and species protection); (12) prevent degradation of existing scrub habitat; (13) prioritize areas identified in reserve design for acquisition and management; (14) protect scrub-jay habitat on private lands through easements, acquisitions, and donations; (15) continue State and Federal (land) acquisition efforts; (16) maintain suitable habitat for scrub-jays; (17) prevent loss or fragmentation of scrub habitat within scrub-jay reserves; and (18) monitor scrub habitat that is occupied by scrub-jays to insure public lands are managed to maintain scrub in suitable conditions for scrub-jays, and to assess when unmanaged areas become unsuitable for scrub-jays. Also monitor to ensure the site is not becoming a “sink” for the population.

The Florida Game and Fresh Water Fish Commission (FGFWFC) in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled limited available data (survey information being compiled by Archbold Biological Station for the USFWS was not available). This analysis identified scrub-jay family locations; patches of oak scrub, sand pine scrub, and dry prairie within 160 m (525 feet) circles of the point data; and isolated patches of oak scrub, sand pine scrub, and dry prairie within 8.1 ha

(20 ac) defined by the circles (approximate size of a scrub-jay territory). The analysis also mapped concentrations of scrub-jay occurrences, and highlighted areas were habitat patch size was considered to be capable of supporting scrub-jay families. The analysis indicated a site of potential importance to scrub-jay conservation efforts in northeast Lee County both north and south (study area) of the Caloosahatchee River in the vicinity of the Caloosahatchee State Recreation Area; FFWCC's Hickey Creek Gopher Tortoise Mitigation Park; and Bedman Creek. Other locations include an isolated population in Immokalee and south of S.R. 82 in Collier County. Historically, scrub-jays inhabited scrub habitat in the vicinity of Estero in Lee County. Scrub-jays were also reintroduced to Rookery Bay National Estuarine Reserve in Collier County in the 1990's.

There are 26 known families of scrub-jays in the study area. Not all habitat has been surveyed, so others may exist, although there is only a limited amount of remaining scrub habitat. In a typical permit, the scrub-jay habitat associated with an existing family would be preserved, based on what is expected to be the breeding/foraging needs of that family. However, removal of the remaining scrub vegetation in the region may preclude any expansion or dispersal of scrub-jays from the site. Ensembles Q, R and U would surround 20 scrub-jay families with development or other non-preserve land cover, Ensemble T, 18, and Ensemble S, 15. Several of the Ensembles include criteria to restrict the intensification of agriculture or the preservation of agricultural or rural uses that protect listed species habitat. Such criteria would increase the assurance of preservation of the species. An Ensemble with a higher number of scrub jay families in contiguous preserves would provide more assurance of the preservation of the species. This would be one of the additional benefits of preserving native plant communities, discussed in Section 4.2. Out of the 26 known families, 6 would be located within preserve areas in Ensemble Q; 6 in Ensemble R; 11 in Ensemble S; 8 in Ensemble T; and 6 in Ensemble U. Examination of these numbers point out that from 15 to 20 scrub jay families (or 57% to 77%) may be at risk under any Ensemble.

This species probably was more common in the study area. **Table 19** in Section 4.20.1 suggests that some of the plant covers with a greater potential to find scrub habitat was not a large portion of the study area but has also declined.

Red-cockaded woodpeckers

The USFWS developed species and habitat-level recommendations for the protection of the red-cockaded woodpecker in the Draft MSRP (USFWS 1998). Those recommendations that pertain to the study area include: (1) determine distribution and status of red-cockaded woodpeckers; (2) develop a reserve design for red-cockaded woodpeckers; (3) protect, manage, and enhance red-cockaded woodpecker populations on public lands; (4) enforce available protective measures (Section 7 of the Endangered Species Act where applicable and Section 10 of the Endangered Species Act when needed); (5) conduct risk assessment analysis to determine the probability of persistence of red-cockaded woodpeckers in South Florida, given the current amount of available, suitable pineland habitat, and include pineland areas that could be restored or enhanced to become suitable habitat; (6) study the effects of habitat fragmentation due to urbanization; (7) monitor red-cockaded woodpecker sub-populations; (8) inform and involve the public; (9) prevent degradation of existing red-cockaded woodpecker habitat in South Florida; (10) prioritize areas identified in reserve design for management and acquisition; (11) protect red-cockaded woodpecker habitat on private lands through easements, acquisitions and donations; (12) support State (land) acquisition efforts; (13) maintain adequate nesting habitat in addition to currently active cluster, to replace clusters abandoned or lost through mortality, and to provide for population expansion; (14) maintain adequate foraging habitat to support existing groups and to facilitate establishment of new territories; (15) prevent loss or fragmentation of pine flatwoods within reserves; (16) restore and enhance red-cockaded woodpecker habitat; (17) determine the potential carrying capacity for clusters of red-cockaded woodpeckers on existing public and private lands where suitable or restorable habitat exists; (18) monitor pineland habitat that is occupied by red-cockaded woodpeckers to insure public lands are managed to maintain habitat in suitable condition for red-cockaded woodpeckers, and to assess when unmanaged areas become unsuitable; and (19) insure public awareness of the importance of pine flatwoods communities.

The Florida Game and Fresh Water Fish Commission (FGFWFC) in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled locations of active colonies in Southwest Florida and isolated pineland, sandhill, dry prairies, and mixed hardwood-pine landcover types within 500 m of active red-cockaded woodpecker clusters to identify core habitat areas for the red-cockaded woodpecker. The analysis relied heavily on known occurrence information, therefore it does not include all areas where red-cockaded woodpeckers might occur. The analysis indicated that few large patches of habitat are known outside of public lands and that the largest patches of potential habitat are found in Orange, Glades, Collier, and Hendry counties. For the study area, the analysis highlighted the 14 active clusters west of Big Cypress National Preserve in an area west of S.R. 951 and in the Belle Meade CARL project. The analysis indicated that, although isolated, the red-cockaded woodpecker population in this area was sufficiently large to sustain the population for many generations with occasional translocations from other populations to alleviate the long-term threats. The analysis also noted the presence of isolated red-cockaded woodpecker clusters in Lee County, north, south, and east of the Southwest Florida International Airport . Recently, red-cockaded woodpeckers have been documented in the CREW CARL project and historically, red-cockaded woodpeckers were documented at Audubon's Corkscrew Swamp Sanctuary.

There are 40 known groups of red-cockaded woodpeckers in the study area. Not all habitat has been surveyed so others may exist, although there is only a limited amount of mature pine forests in the region. In a typical permit, a large number of acres in association with existing cluster may be preserved, based on the foraging needs of that group. However, removal of the pine forests beyond that then precludes any expansion of or dispersal from that colony and the adjacent development creates disturbance that could result in the death of the individual birds or abandonment of the site. Ensemble R would surround 38 groups with development or other non-preserve land type, Ensemble Q, 30; Ensemble T, 28; Ensemble S, 27; and Ensemble U, 22. Several of the Ensembles include criteria to restrict the intensification of agriculture or the preservation of agricultural or rural uses that protect listed species. Such criteria would increase the assurance of preservation of the species. An Ensemble with a higher number of groups in contiguous preserves would provide more assurance of the preservation of the species. This would be one of the additional benefits to preserving native plant communities, discussed in Section 4.2. In addition, maintaining habitat connections, discussed in Section 4.4, provides greater opportunity for expansion of red-cockaded woodpecker groups. Preservation of existing sites is also very important since there is a paucity of old-growth pine forests in the study area. Out of the 40 known locations, 10 would be located within preserve areas in Ensemble Q; 2 in Ensemble R; 13 in Ensemble S; 12 in Ensemble T; and 18 in Ensemble U. An Ensemble with a higher number of colonies in contiguous preserves would provide more assurance of the preservation of the species. However, even under Ensemble U, 22 clusters (or 55%) of the red-cockaded woodpecker clusters are at risk.

This species range historically probably extended throughout the upland forested areas of the study area. **Table 19** in Section 4.20.1 suggests that the Pinelands community has been particularly heavily reduced.

Bald eagle

The USFWS developed recommendations for the protection of the bald eagle in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) determine the distribution of the bald eagle in South Florida; (2) protect and manage bald eagle populations in South Florida; (3) prevent or mitigate the effects of behavioral degradation; (4) identify and quantify effects of disturbance on nesting eagles and incorporate into management plans; (5) identify and quantify the effect of disturbance on bald eagle feeding sites and incorporate into management plans; (6) reduce bald eagle mortalities in South Florida; (7) enforce laws protecting bald eagles; (8) continue to monitor bald eagle nesting activities in South Florida; (9) develop public information and education materials to inform the public of the recovery needs of the bald eagle in South Florida; (10) prevent further loss and degradation of bald eagle habitat in South Florida; (11) continue to gather information on the effects of habitat loss and degradation of habitat on bald eagles in South Florida; (12) identify alterations to terrestrial and aquatic habitats that adversely affect bald eagles in South Florida; (13)

quantify essential characteristics of occupied bald eagle habitat; (14) quantify responses of bald eagles in South Florida to habitat alteration; (15) protect bald eagle habitats in South Florida through site management; (16) continue to implement and adhere to “Habitat Management Guidelines for the Bald Eagle in the Southeast Region”; (17) protect eagle habitat through cooperative agreements, easements, acquisition or other appropriate means; (18) identify and incorporate important bald eagle habitat in land use plans and planning, (19) use Section 7 of the ESA to protect bald eagles and their habitats; (20) develop methods to restore previously occupied habitat or to establish new territories; and (21) increase public awareness of habitat-related that affect the recovery of the bald eagle in South Florida.

The Florida Game and Fresh Water Fish Commission (FGFWFC) in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled important nest locations and a 3-km zone around nesting locations, including freshwater marsh and open water that constitute foraging habitat. The analysis also created a 1-km zone around nesting locations to isolate potential nesting habitat. The forested uplands and wetlands within this zone were highlighted as potential nesting areas. Areas within the study area identified as important to bald eagles included most of the coastal areas of Lee and Collier County. Nesting sites on private lands along the Gulf Coast were perhaps most threatened because many nests occur on development corporation properties (Wood et al. 1989).

There are 27 known bald eagle nests in the study area. Not all habitat has been surveyed. However, most nests are found in coastal areas. In a typical permit, the nest would be buffered consistent with the Habitat Management Guidelines for the Bald Eagle in the Southeast Region (USFWS 1987). Loss or disturbance around the nest may affect the pair by reducing or eliminating breeding success, precluding any expansion of the population. Adjacent development may create disturbance and loss of foraging habitat that could result in the abandonment of the site. Ensembles Q, R and U would surround 9 nests with development or other non-preserve land type, Ensemble T, 8; and Ensemble S, 7. Several of the Ensembles include criteria to restrict the intensification of agriculture or the preservation of agricultural or rural uses that protect listed species. Such criteria would increase the assurance of preservation of the species. Some alternatives also stress preservation of lands and flowways (also discussed in Section 4.4) near the coastal area, and preserving foraging habitat. The wetlands within the foraging range are considered, in Section 4.4, to be of high priority for wetland-dependent species. An Ensemble with a higher number of nests in contiguous preserves would provide more assurance of the preservation of the species. Out of the 27 known locations, 18 would be located within preserve areas in Ensemble Q; 18 in Ensemble R; 20 in Ensemble S; 19 in Ensemble T; and 18 in Ensemble U. Therefore, even under Ensemble S, 24% of the bald eagle nesting locations are at risk.

Wood Stork

The USFWS developed species and habitat-level recommendations for the protection of the wood stork in the Multi-Species Recovery Plan (USFWS 1998). These recommendations that pertain to the study area include: (1) preventing degradation of nesting, foraging, and roosting habitat; (2) protecting and enhancing wood stork protection through provisions of Section 7 of the Endangered Species Act; (3) determining the foraging ecology and behavior of wood storks (prey base, critical foraging areas and foraging requirements); (4) protecting wood storks from mercury and other contaminants; (5) systematic censusing of wood storks in the Big Cypress basin to determine the potential sources of habitat deterioration; (6) prioritizing habitat that needs protection; (7) assisting private landowners in managing for wood storks by providing Best Management Practices, incentives, or management plans; (8) developing consistent with the Habitat Management Guidelines for Wood Storks (Ogden 1990); (9) utilizing existing wetland regulatory mechanisms to protect foraging habitat in south Florida (Federal and State permitting actions); (10) developing Habitat Conservation Plans; (11) adaptive restoration and enhancement of suitable habitat, especially in the Big Cypress basin; (12) enhancing breeding and wintering activities of wood storks in south Florida, especially significant colonies like the Audubon's Corkscrew Swamp Sanctuary; (13) determining the effects of natural and human-caused hydrologic events on the ecology of the wood stork prey base; and (14) acquire land identified as important for wood storks.

The FGFWFC, in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled wetland systems of potential importance to wood stork nesting colonies based on approximate distances that individual species will travel to forage (30 km for wood storks). Although the importance of specific wetland areas surrounding individual colonies likely changes from year to year based on rainfall and specific hydrologic conditions, the study indicated the importance of several large wetland systems such as the Corkscrew Swamp and wetlands with the Big Cypress basin. Wetland areas near nesting colonies also play a critical role during the nesting season, soon after the young hatch (Browder 1984).

Since the 1960s, the wood stork population has shown a substantial decline in southern Florida and a substantial increase in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The deterioration of the Everglades and Big Cypress basins has resulted in decreased nesting by wood storks in south Florida and increased nesting in northern Florida, Georgia, and South Carolina. The number of pairs nesting in the traditional colony sites located in the Everglades and Big Cypress regions of southern Florida declined from 8,500 pairs in 1961 to fewer than 500 pairs from 1987 through 1995. During the same years, the number nesting in Georgia increased from 4 pairs in 1965 to 1,501 pairs in 1995, and the number nesting in South Carolina increased from 11 pairs in 1981 to 829 pairs in 1995.

From 1991 through 1995, the USFWS coordinated a systematic multi-state survey of wood stork nesting colonies. The results of these surveys suggest that, on average, from 1991 to 1995, approximately 35 percent of the total nesting effort in the southeast U.S. occurred in south Florida. Historically, south Florida supported greater than 70 percent of the total wood stork nesting effort in the southeast U.S.; if these data are indicative of the ability of degraded south Florida ecosystems to support wood stork nesting, then south Florida ecosystems are functioning at approximately 50 percent of their previous capabilities.

Since the 1970s, wood storks have also shifted their nest sites to areas that are artificial impoundments or where islands have been created by dredging activities (Ogden 1991). The percentage of wood storks that nested in either altered wetlands (former natural wetlands with impounded water levels) or artificial wetlands (former upland sites with impounded water) in central and north Florida colonies increased from about 10 percent in 1960 to between 60 and 82 percent between 1976 and 1986. Nests in these artificially impounded sites often support exotic species such as Brazilian pepper (Schinus terebinthifolius) or Australian pine (Casuarina equisetifolia). Ogden (1996a) has suggested that the use of these artificial wetlands indicates that wood storks are not finding suitable conditions within natural nesting habitat or that they are finding better conditions at the artificial wetlands.

The reproductive success of storks requires habitats that provide high concentrations of certain size classes of fish over a 125 to 150-day breeding cycle. Because seasonal and annual rainfall patterns are so variable in south Florida, the quantity of these foraging habitats also varies among years (J. Ogden, SFWMD, personal communication 1998). As a result, wood storks probably have always had highly variable reproductive success throughout their history, a phenomenon that is mitigated by the relatively long life spans of adult storks. Nevertheless, most experts agree that the decline of the U.S. wood stork population far exceeds the range of historic variability in total population size and is correlated with water management activities in south Florida (Palmer 1962, Frederick 1993, Ogden 1996). During wet years, current water management practices prevent the formation of shallow pools that concentrate the fish on which wood stork forage. During dry years, current water management practices over-drain the freshwater sloughs, reduce freshwater flows into the mainland estuaries, and reduce their ability to produce the fish on which wood storks forage. As a result of these water management practices, wood storks in south Florida have experienced increased frequencies of nest failure. For example, in 1962, 1978, and 1983, wood storks in Everglades National Park did not initiate nesting. In the 1998 nesting year, only 25 pairs of wood storks were recorded nesting in Everglades National Park.

Historical data on colony locations identify the Everglades basin colonies and the Corkscrew colonies as the primary nesting locations for wood storks in south Florida (Ogden and Nesbitt 1979). In the late 1950s and early 1960s, wood storks nesting in the Everglades basin accounted for 12 percent (1,000

out of 8,609 nests based on two-year average) of the Florida population. The 1991-95 survey data reveal that the Everglades basin colonies represents on the average, 3 percent (129 out of 4,065 nests based on a four-year average) of the Florida population. More recent data provided by Ogden (1998) on three-year averages on nesting pairs of wood storks in the Everglades Basin show 343 pairs for the 1994-96 average, 283 pairs for the 1995-97 average, and 228 pairs for the 1996-98 average. These averages are higher than the three-year average for the base years, 1986 to 1995. The base year averages were a low of 130 pairs and a high of 294 pairs. In the 1998 nesting year, only 25 pairs of wood storks were recorded nesting in Everglades National Park.

Data from the late 1950s and early 1960s indicate that the Corkscrew colonies accounted for 51 percent (4,350 out of 8,609 nests based on a two-year average). The survey data also show that the Corkscrew colonies represent on the average, 12 percent (510 out of 4,065 nests based on a four-year average) of the Florida population.

On the average, the south Florida sub-population represents 53 percent of the Florida population and 34 percent of the southeastern U.S. population. These data show a nesting population of 1,339 nests in 1991, 2,546 nests in 1993, 2,015 nests in 1994, and 2,639 nests in 1995. More recent data provided in the wood stork recovery plan (USFWS 1997) give a Florida breeding population of 2,327 pairs in 1991, 4,823 pairs in 1993, 3,588 pairs in 1994, and 5,523 breeding pairs in 1995. Twenty-one breeding colonies were present in 1991, 28 breeding colonies were present in 1993, 26 in 1994, and 30 in 1995.

The wood stork is a key indicator of the health of the wetlands in the south Florida ecosystem. The wood stork is a landscape option dependent species. There is already, in Southwest Florida, an extreme loss of early season forage habitat (short hydroperiod wetlands). Wetlands near existing rookeries can be considered more important to support nesting foraging needs. Some literature has suggested wetlands within 30km are particularly important for this period of their life history (nesting) but storks will routinely travel as far as 75km. Wood storks will travel even more extensively for their "maintenance" needs, so wetlands throughout the region are equally important as those in proximity to the existing rookeries. Woodstorks appear to be attracted to Southwest Florida but when there are no early season foraging available in November to January, they are moving to North Florida and other states to initiate nesting. Southwest Florida has apparently lost many of its wetlands that dry down or concentrate early after the summer wet season, and instead wood storks are waiting until the deeper wetlands are drying down later in the winter before initiating nesting. These sort of wetlands are both shallow (thus more attractive to being filled) and more easily affected by surface water drainage modifications compared to the deeper wetlands. However, both shallow and deep wetlands are needed, since they dry down at different months during the nesting season. Part of the character of the use of wetlands by wood storks is their dependence on prey concentration during drawdown and the size of the prey which is driven by ability of prey to move from deeper wetlands (where a portion of the population avoids foraging when young) to the deeper wetlands (so called "recharging") via connections between wetlands. Wood stork use of wetlands for forage habitat is also impacted by loss of function (hydroperiod, connectivity, recharge/restock). Furthermore, this ability of the species to search for new locations gives great hope for the recovery of the species but only if that species has "options" for establishing nesting locations. Therefore, none of the remaining wetlands are unimportant since the species decline and/or movement to other areas is indicative of a stressed population and that the wetlands are at full carrying capacity. Protection or restoration of existing wetlands will prevent or restore include the following characteristics: water source sheet flow (gradual hydration) or pulse (weir); water is runoff from native vegetation (marsh ready) or from development (metals, etc.); concentration pond present in winter or dries out in winter (no prey maintained) or is constant depth (no concentration); connected to other marshes (movement of fish); shallow littoral zone or a sharp edge only shallow part of year; and shrub/tree buffer for resting/perching/cover.

This species range still extends throughout the entire study area but natural foraging habitat (as compared to ditches and retention ponds) is more and more a smaller proportion of its total foraging needs. **Table 19** in Section 4.20.1 suggests that some of the Fresh Marsh, Wet Prairie and Pineland covers appear to have halved. Wood stork populations continue to decline as they appear to be moving

to other areas of Central Florida and the Eastern Seaboard to nest, indicating the continued decline of natural foraging will impact the maintenance of this species in the region.

Audubon's Crested Caracara

The USFWS developed species and habitat level recommendations for the protection of the Audubon's crested caracara in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) determine the distribution and abundance of Audubon's crested caracara; (2) protect and enhance existing populations of Audubon's crested caracara; (3) locate and map potential habitat within the former range of the caracara that might be rehabilitated for reintroduction purposes; (4) encourage landowners to protect caracara nesting sites by providing incentives (awards, credits for mitigation, special recognition, etc.); (5) establish habitat management guidelines to protect the nests and nesting pairs of Audubon's crested caracara; (6) increase public awareness of the biology, ecology, status and trends of the Audubon's crested caracara; (7) protect and enhance currently occupied habitat; (8) protect privately-owned, occupied lands wherever possible; (9) conduct Section 7 (Endangered Species Act) consultations on all Federal activities that might affect caracaras and their habitat; (10) create, restore, or expand occupied habitat wherever possible; (11) use LANDSAT imagery and updated aerial photographs to monitor changes in land use in the core of the caracara population; and (12) educate the public on the value of prairie communities and prairie management needs.

The FGFWFC, in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled landcover and breeding bird atlas records (Kale et al. 1992), a survey by Millsap (1991), and FNAI data points, as well as a 1-km zone around territory centers to define central territory areas, not total territory size. Within these central areas, the FGFWFC isolated dry prairie, hardwood hammock, freshwater marsh, shrub and brush, and grass and agriculture landcover that might be used by caracaras (Layne 1978a). The analysis indicated limited, mostly historical information for the Audubon's caracara in the study area and did not model significant conservation areas for the caracara in the study area. However, the analysis did not include all documented caracara use, including data for agricultural lands in southeastern Lee County and north Collier County.

Caracara breeding pairs are found in prairie with areas of shrub and forest areas, though most of this plant community in south-central Florida is now improved or semi-improved pasture. Ensembles proposing the continuation of low intensity agriculture or the preservation of areas of native vegetation will provide opportunities for the population to continue or expand. In addition, the preservation of seasonal wetlands within a framework of contiguous preserves, as discussed in Section 4.4, may be important since the presence of seasonal wetlands may be an important habitat factor as caracaras frequently forage in wetlands or depend on wetlands for prey base.

This species range historically probably extended through a large portion of the study area. **Table 7** of Section 4.2 and **Table 19** Section 4.20.1 suggest losses of the natural plant covers but these tables recorded the conversion of natural cover to pasture and similar covers as a loss.

Piping Plover

The USFWS developed species and habitat-level recommendations for the protection of the piping plover in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) determine the distribution and abundance of wintering piping plovers in Florida by surveying beaches and other suitable habitat to determine additional wintering sites; (2) protect and enhance the wintering piping plover population in Florida by managing human use of beaches important to piping plovers; (3) investigate the effects of human disturbance on wintering plovers; (4) monitor known and potential wintering sites; (5) monitor human use of piping plover wintering sites; (6) protect essential wintering habitat by preventing habitat degradation and disturbance; (7) utilize the Section 7 (Endangered Species Act) consultation process to minimize the effects of Federal actions (beach renourishment, coastal armoring) on piping plover wintering habitat; (8) protect wintering habitat from disturbance by recreationists and their pets; (9) provide for long-term protection of wintering habitat,

including agreements with landowners and habitat acquisition; and (10) monitor and manage wintering and migration areas to maximize survival and recruitment into the breeding population.

The FGFWFC, in their study Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled habitat distribution using survey and point data from the USFWS, FNAI, and FGFWFC wildlife observation data bases. The analysis included mapping of coastal salt marsh, coastal strand, and barren land cover (sandy beaches). For the study area, the analysis concluded that Estero Island (Estero Island Critical Wildlife Area - Ft. Myers Beach) and Tigertail Beach (Big Marco Critical Wildlife Area - Marco Island) were potentially important habitat.

Barrier island beaches within the study area are used by this small, migratory shorebird as wintering sites and summer habitat for some juvenile birds. These beaches include those on the Gulf of Mexico in the vicinity of Estero and Marco Islands. None of the Ensembles directly affect these sites although indirect effects may occur as a result of human disturbance (pets, noise, nuisance animals) and dredge and fill activities associated with increased coastal development. The piping plover habitat could also be affected by degradation in water quality resulting from changes in watersheds, as discussed briefly in Section 4.9. Changes in water quality are described in Section 4.10.

Snail Kite

The USFWS developed species and habitat-level recommendations for the protection of the snail kite in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) expand and refine existing information on movements and distribution of the snail kite, particularly changes attributable to drought; (2) protect and enhance existing population; (3) use provisions of Section 7 of the Endangered Species Act to protect the snail kite; (4) increase public awareness about snail kites; (5) prevent degradation of existing snail kite habitat; (6) control or remove exotic vegetation in wetlands; (7) ensure that information on wetlands of importance to snail kite nesting and feeding is considered in review of regulatory permits; (8) prevent cultural eutrophication of lakes and marshes; (9) restore areas to suitable habitat; (10) monitor habitat/ecological processes; and, (11) increase public awareness of ecological relationships, environmental stressors, and restoration activities in the South Florida Ecosystem.

The Florida Game and Fresh Water Fish Commission (FGFWFC), in their Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS), modeled habitat distribution for the snail kite using known nesting and foraging sites and mapping freshwater marsh, shrub swamp, and open water found in these areas. A 0.5-km zone was established around these habitat patches which included dry prairie and grassland that may constitute appropriate habitat areas in very wet years. For the study area, the analysis identified marshes, canals, and agricultural retention areas in southeastern Lee County (Lehigh Acres) and north Collier County as Strategic Habitat Conservation Areas for the snail kite. Snail kites have also been documented in association with borrow pits in the southern Lee County.

The snail kite has a highly specific diet composed almost entirely of apple snails, found in shallow freshwater marshes. These longer-hydroperiod marshes are found throughout the study area. This species is particularly sensitive to the degradation of water quality from runoff of surrounding urban development and agricultural activities. Ensembles that propose preservation of the seasonal wetlands within a framework of contiguous preserves will have a greater probability of maintaining this species in the study area. The discussion of seasonal wetlands is found in Section 4.4 below.

West Indian Manatee

The USFWS developed species and habitat-level recommendations for the protection of the West Indian manatee in the Multi-Species Recovery Plan (USFWS 1998). These recommendations that pertain to the study area include: (1) protect and enhance existing populations by identifying and minimizing causes of manatee injury, mortality, and disturbance; (2) minimize collisions between manatees and watercraft; (3) post and maintain regulatory signs; (4) enforce and encourage manatee protection

regulations; (5) establish policies for authorizing boat races and other water sport events; (6) assess and reduce mortality caused by large vessels; (7) continue Section 7 (Endangered Species Act) and State reviews of boating facilities and watersport events; (8) minimize other human-related disturbances and harassment; (9) support the monitoring of manatee populations in South Florida; (10) maintain and improve the GIS for data on manatees and manatee habitat; (11) increase public awareness; (12) prevent degradation of existing manatee habitat in South Florida; (13) support the acquisition of manatee habitat in South Florida (additions to State Reserve, Preserve and Parks and Federal National Wildlife Refuges, Parks, and Preserves); (14) support the designation, management, and maintenance of Federal manatee sanctuaries and refuges in South Florida; (15) protect and promote regeneration of seagrass beds in South Florida; (16) include manatee protection and monitoring measures in management plans for Federal and State protected areas; (17) assist counties to develop manatee protection plans; (18) assist in implementing manatee protection plans; (19) restore and create manatee habitat in South Florida; (20) support the maintenance and restoration of water quality in fresh water sources; (21) enhance manatee habitat in South Florida; (22) determine an index of habitat fragmentation in South Florida; (23) develop and implement a manatee habitat monitoring program; and (24) establish effective manatee management programs at Federal and State protected areas.

Designated critical habitat for the manatee on the west coast includes the coastal waters and rivers from the Crystal River and its headwaters (King's Bay) in Citrus County south to Whitewater Bay in Monroe County (50 C.F.R. 17.95), including most coastal waters in the study area.

The second most significant threat to manatees is the loss and degradation of habitat, due primarily to direct damage by aquatic recreational and commercial boating activity, coastal construction, and pollution from sewage discharge and stormwater runoff (MMC 1992; Smith 1993). Coastal land conversion on the west coast, accompanying the growth of Florida's human population, has occurred largely along coastal waters and rivers used by manatees. Seagrass beds incur most of their direct damage from boat propellers (Zieman 1982). Boat-induced turbidity results from propeller dredging of bottom habitats and propeller wash and wave wake disturbance. Sediments around seagrasses become unconsolidated and suspended delaying recolonization for two to five years or longer, depending on the species.

Future coastal development will continue to degrade habitat that provides manatee food, therefore ecosystem effects of coastal development need to be evaluated (Marmontel *et al*. 1997). Seagrasses along the Florida coast have been in decline since the 1950's. In Tampa Bay, about 16,188 ha of seagrass flourished along the shallow shelf of the Bay. By 1982, only 8,741 ha remained baywide (TBNEP 1995). In Sarasota Bay, seagrasses have declined by 30 percent (SBNEP 1994). From 1945 to 1982, seagrass acreage declined by 29 percent in Charlotte Harbor; with an additional 809-3,238 ha of seagrasses destroyed or damage by boat propellers (Haddad and Sargent 1994).

The January 1999 synoptic survey documented 137 manatees in Collier County, compared to 218 manatees in 1998 and 417 in 1997. The Lee County survey documented 251 manatees as compared to 218 manatees in 1998 and 417 in 1997. The Caloosahatchee River in Lee County is the site of one of the largest wintering aggregations of manatees in Florida at the Fort Myers Power Plant in Lee County.

Manatee deaths resulting from several factors are well documented through a carcass recovery program initiated in 1974. Several factors have contributed to the current status of the manatee: collisions with watercraft; being crushed by flood gates or canal locks; other human causes (poaching, entanglement in fishing nets, ingestion of fishing gear, vandalism, etc.); perinatal deaths; disease, cold-related deaths; red tides; and hurricanes.

From 1974 through December 1998, 3,502 manatee carcasses were recovered in Florida, of which 1,065 (30 percent) were attributed to human-related causes. Of these, 828 were caused by collisions with watercraft, 145 were flood gate/canal lock-related, and another 92 were categorized as other human-related. Collisions with watercraft accounted for 78 percent of human-related causes of death during this period. The loss of 741 dependent calves occurred during this time period, cold stress was

implicated in 124 deaths, and 458 died as a result of natural death. Ninety-nine manatee deaths that were verified were not recovered, 588 deaths remained undetermined due to decomposition, and 426 deaths had an undetermined cause.

The frequency of perinatal deaths (stillborn and newborn calves) has been consistently high over the past six years and represented 24 percent of all manatee deaths in 1994 (USFWS 1998). The cause of increasing perinatal deaths is uncertain, but may result from the increase in collisions between manatees and watercraft. Some newborn calves may die when their mothers are killed or seriously injured by boat collisions, when they become separated from their mothers while dodging boat traffic, or when stress from vessel noise or traffic induces premature births (MMC 1992).

In 1996, an epizootic of unprecedented proportions struck manatees in Southwest Florida. From March 5, 1996, to April 27, 1996, 158 manatee deaths were associated with the event (MTAC 1996). Most of the manatees were recovered from Lee County, followed by Collier, Charlotte, and Sarasota (FDEP 1996). A multi-agency research team determined the cause of the massive die-off was due to the ingestion of high levels of red tide toxin produce by the phytoplankton, *Gymnodinium breve* (FDEP 1996).

In 1998, 231 manatees died in Florida, the third highest mortality year on record, including 66 from watercraft-related mortality, the highest watercraft-related mortality ever recorded. As of December 1998, Lee (104) and Collier (85) counties were second and third, respectively, behind Brevard County (159) in the number of watercraft-related manatee deaths in the State of Florida. Watercraft-related mortalities are most significant in Southwest Florida, where deaths increased from 11 to 31 percent (Ackerman et al. 1995) from 1976 to 1994.

The annual number of manatees found dead in Florida has increased at a rate of 5.3% per year, averaging 89 per year during 1976-1981 and 153 per year from 1986-1992 (Ackerman et al. 1995). Collisions with boats were the most important identified cause of mortality; boat-related mortality has increased 10.3% yearly since 1976 (Ackerman et al. 1995).

Collisions with watercraft account for 25 percent of annual manatee mortalities, which is the largest, controllable cause of manatee mortalities. The risk to manatees is high where boat traffic occurs in waterways frequently used by manatees. These risks can be reduced by selecting suitable sites for the development and location of future navigation channels and docking facilities and by controlling the manner in which boats are operated. Therefore, increasing the number of watercraft may only increase the risk of manatee mortalities unless there are adequate Manatee Protection Plan (MPP) and/or established and enforceable speed zones.

On October 24, 1989, the Governor and Cabinet approved recommendations submitted by the Florida Department of Natural Resources (now FDEP) to protect the manatee and its habitat, and to increase boating safety in the State's waterways. In these recommendations, 13 key counties with high levels of manatee mortality and use, including Lee and Collier Counties, were identified and mandated to develop comprehensive protection plans to reduce manatee mortality including regulatory speed zones for boats and boat facility siting policies. Collier County adopted a Collier County Manatee Protection Plan in May 1995 and implemented enforcement by posting additional manatee speed zones in 1998. Despite proposals for a Lee County Manatee Protection Plan, no manatee protection plan has been adopted in Lee County. A proposal is currently under review by FDEP. The Collier County MPP established additional speed zones in 1995, which were posted in 1998.

In the development of the Collier County MPP (Collier County 1995), six areas were evaluated in Collier County for manatee distribution and abundance. The sites were chosen based on possible future conflict between the manatee and human activities. The sites included Port of the Islands, Naples Bay, Everglades City, Ochopee, the Collier/Lee County line (project area), and the Marco Island area. A total of 3,207 manatee sightings were recorded from 1986 to 1989. For any month in any study area, the highest mean number of manatees per survey was in the Marco Island area (36.4), followed by Port of

the Islands (28.6); the Naples area (6.7); Everglades City (2.6); Ochopee (2.3); and the Lee/Collier County border (1.3).

The Ensembles do not directly address boating, but the changes in the land cover in the change the runoff characteristics and the water quality of nearshore waters as discussed in Section 9.10. Increases in population correlate with increases in boats utilizing manatee habitat.

American Crocodile

The USFWS developed species and habitat-level recommendations for the protection of the American crocodile in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) protecting and enhancing existing colonies of American crocodiles; (2) acquiring or otherwise protecting habitat for crocodiles; (3) reducing crocodile mortality (road and human-induced); (4) continuing assessment of pesticide and heavy metal contamination levels in crocodile eggs; (5) protecting nesting, basking, and nursery habitat; (6) restoring suitable habitat (removing exotic plants, restoring native vegetation, and restoring hydroperiods and hydropatterns in the Big Cypress, Rookery Bay, and Ten Thousand Islands drainage for deepwater adult refugia and suitable lower salinity nursery areas; and (7) managing crocodile habitat and restricting human use of important crocodile habitat.

The Florida Game and Fresh Water Fish Commission in its Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) modeled potential crocodile habitat by isolating mangrove, coastal salt marsh, and freshwater marsh cover types within the known breeding range of the species. This area did not include the southwest coast at the time because of the lack of information on successful breeding. Since 1994, at least three separate nesting locations have been documented on the southwest coast, although the eggs have been infertile. The GAPS study indicated that it was imperative that the current crocodile habitat quantity and quality not be reduced because of the small population size and limited geographic distribution. Extrapolations to similar habitat can be provided for the study area (at least as far north as Pine Island in Lee County) and include at least the waters and estuaries of Estero Bay, Estero River, Fishtrap Bay, Imperial River, Rookery Bay, McIlvane Bay, Collier Seminole State Park, Faka-Union Canal and Ten Thousand Islands Area.

Urbanization has substantially altered much of the occupied habitat. Human activities such as camping, fishing, and boating may increasingly disturb crocodiles. Several small groups and individuals are found in the mangrove swamps and along low energy mangrove-lined bays, creeks, and inland swamps from Sanibel Island at the north end of the study area south to Collier Seminole State Park. Some of the population decline on the east coast has been attributed to changes in the timing and quantity of freshwater flows. Although there is no direct causal relationship between freshwater flow alterations and American crocodile numbers, historic alterations to the natural flow have been known to directly affect plant and animal communities in the estuarine environment. Also, availability of fresh water from upstream areas is essential to hatchling crocodile survival. Therefore, Ensembles that propose maintenance of flowways, as discussed in Section 4.4, and those that would tend to reduce the potential for changes in hydropatterns, would increase the potential for preservation of this species. Those Ensembles that protect coastal habitat would also increase conservation of this species.

American Alligator

Although this species is found throughout the study area in marshes, swamps, ponds, streams, ditches, and borrow pits, it is Federally listed as threatened because it is similar in appearance to the endangered American crocodile. Ensembles that propose the preservation of seasonal wetlands within contiguous preserves, as discussed in Section 4.4, and those that propose wider flowways, as discussed in Section 4.4, should maintain the current population of this species.

Eastern Indigo Snake

The USFWS developed species and habitat-level recommendations for the protection of the eastern indigo snake in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) determine the distribution of the Eastern indigo snake in South Florida; (2) protect and enhance existing populations of indigo snakes in South Florida; (3) protect indigo snakes on public lands; protect indigo snakes on private lands; (4) enforce available protective measures; (5) conduct Section 7 consultations on Federal activities that may affect indigo snakes; (6) implement the USFWS South Florida Ecosystem Office's Indigo Snake Guidelines for Section 7 and 10 (Endangered Species Act) and incorporate the guidelines into permits where feasible; (7) monitor indigo snake populations; and (8) improve public attitude and behavior towards the indigo snake.

The FGFWFC in its Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) did not perform analysis on the Eastern indigo snake.

Loggerhead Sea Turtle, Green Sea Turtle, Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle

The USFWS developed species and habitat-level recommendations for the protection of sea turtles in the Multi-Species Recovery Plan (USFWS 1998). Those recommendations that pertain to the study area include: (1) protect and manage populations on nesting beaches; (2) evaluate nest success and implement nest protection measures; (3) reduce effects of artificial lighting on hatchlings and nest females; (4) implement and enforce lighting ordinances and resolve lighting problems in areas where lighting ordinances have not been adopted; (5) ensure beach nourishment and coastal construction activities are planned to avoid disruption of nesting and hatching activities; (6) monitor trends in nesting activity; (7) continue information and education activities; (8) protect and manage nesting habitat; (9) ensure beach nourishment projects are compatible with maintaining good quality nesting habitat; (10) prevent degradation of nesting habitat from seawalls, revetments, sand bags, sand fences or other erosion control measures; (11) acquire or otherwise ensure the long-term protection of important nesting beaches; (12) restore areas to suitable habitat; (13) reestablish dunes and native vegetation; and (14) remove exotic vegetation and prevent spread to nesting beaches.

The USFWS also developed species level recommendations for the protection of the Kemp's ridley sea turtle in the Multi-Species Recovery Plan. The recommendation that pertains to the study area includes continuing standardized surveys of nesting beaches to determine if Kemp's ridley sea turtles nest in south Florida.

The Florida Game and Fresh Water Fish Commission in its Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) did not perform analysis on the four sea turtle species that occupy the coastal areas of the study area.

Loggerhead Sea Turtles nest on beaches in the study area. A few instances of nesting by Green and Kemp's Ridley Sea Turtles have been reported. The primary activities that affect nesting sea turtles include artificial lighting, beach nourishment, increased human presence, and exotic beach and dune vegetation. None of the Ensembles directly affect the beach environment; however, increases in human presence occur as a result of more development in the study area.

Right Whale, Sei Whale, Finback Whale, Humpback Whale

Analysis of these whale species was beyond the scope of the study area.

4.4 FISH AND WILDLIFE RESOURCES

4.4.1 MULTI-SPECIES RECOVERY PLAN

The U.S. Fish and Wildlife Service (USFWS) published a Multi-Species Recovery Plan for the Threatened and Endangered Species of South Florida in 1998. The USFWS representatives and certain

others on the ADG used their knowledge of this plan and of recovery plans developed for specific species and compared these to the alternatives developed by the ADG. These members discussed how, in their judgement, the alternative by map or criteria enhanced the implementation of these Plans. The group recorder assigned a score from 1 to 6 to represent the groups comparison of the alternatives. The group presented the comparison graphically. Since an Ensemble is created by assembling four ADG alternatives, the Corps extended this evaluation by summing the four scores. The minimum possible score is 4 (best) and the maximum is 24. Ensemble Q totals 17, Ensemble R, 23, Ensemble S, 6, Ensemble T, 13, and Ensemble U, 9. The scale of 4 to 24 is not an absolute scale, but a comparison between alternatives: that is, alternatives could be developed that are "better" than Ensemble S and certainly if there was no Comprehensive Plan, an Ensemble could be developed that would score "worse" than Ensemble R. An Ensemble that scores lower indicates that it includes features that support these plans.

4.4.2 GAPS

The Florida Fish and Wildlife Conservation Commission in its Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) identified the Southwest Florida Region (6 counties including the study area) as probably the most important region in Florida in terms of maintaining several wide-ranging species that make up an important component of wildlife diversity in Florida. Those areas highlighted by the regional analysis include Catherine Island, Corkscrew Swamp Sanctuary and surrounding area, Bird Rookery Swamp, Flintpen Strand (CREW), South Golden Gate Estates (Picayune State Forest), Belle Meade (Picayune State Forest), Central Golden Gate Estates area, and an area near Lehigh Acres (Able marsh north to Hickey Creek). The Section on Coastal Barrier Resources highlights coastal areas.

The GAPS study modeled for Areas that Support Globally Rare Plant Species. These include taxa listed as “imperiled globally because of extreme rarity” or “imperiled globally because of rarity” by the Florida Natural Areas Inventory (FNAI). Within the study area, the Fakahatchee Strand (Save Our Everglades CARL project) was listed as a Strategic Habitat Conservation Area for plants.

The GAPS study also modeled 120 species of vertebrates for species-rich “hot spots” where many species might co-occur. The overlay of public land boundaries was then used to indicate areas that were not protected in the existing system of public lands. This analysis identified the areas immediately north of Fakahatchee Strand State Preserve north to Corkscrew Swamp Sanctuary as potentially important regions of rich diversity that are not protected under the public lands system.

The GAPS report maps approximately 4.74 million hectares (11.7 million acres), or approximately 33% of the total area of the State, that would provide "...some of the State's rarest animals, plants, and natural communities with the land base necessary to sustain populations into the future." Of this area, 1.95 million hectares (4.82 million acres), or 13% of the area of the State, is not currently publicly owned and is designated Strategic Habitat Conservation Areas (SHCAs). SHCAs depict lands needed to concurrently meet the minimum conservation goals of a particular list of focal species and plant communities. The study area represents approximately 2.5% of the area of the State, yet has approximately 8.2% of the total area of SHCAs in the State. The area of SHCAs that would be located within areas proposed for preserve under the Ensembles is, for Ensembles Q and R, 4.6% of the total area of SHCAs in the State; for Ensemble S, 5.4%; and for Ensembles T and U, 5.7%. The shortfall therefore ranges from 3.6% (71,133 ha(175,768 acres)) to 2.5% (49,237 ha (121,664 acres)). (Of the total area mapped as SHCA within the study area, Ensembles Q and R, 56% would be within areas mapped as preserve, Ensemble S, 65%, and for Ensembles T and U, 69%.) An Ensemble with a lower percentage indicates greater reliance on habitat found on private lands.

4.4.3 WADING BIRD ROOKERIES

There are 25 known wading bird rookeries in the study area. Additional wildlife surveys could document additional locations. In a typical permit, the actual rookery location would be preserved. Ensemble Q would surround 8 rookeries with development or other non-preserve land type; Ensemble R, 12; Ensemble S, 8; Ensemble T, 7; and Ensemble U, 8. Therefore, out of the 25 known locations, 17 would

be located within preserve areas in Ensemble Q; 13 in Ensemble R; 17 in Ensemble S; 18 in Ensemble T; and 17 in Ensemble U. Wading birds utilize core foraging areas of seasonal wetlands extending 15 kilometers (30 kilometers for wood storks) from rookery centers. Even though high numbers of rookery locations are within preserves in all of the Ensembles, surrounding areas, within the foraging range, may be impacted and the hydropattern of the wetlands, even if they are preserved, affected. An Ensemble with a higher number of rookeries and their associated foraging range in preserves would provide more assurance of the preservation of the species.

4.4.4 SEASONAL WETLANDS

Seasonal wetlands are important foraging habitat for wading birds. During the dry season, the water level drops until the surface water is only found in small depressions, concentrating the fish and insects on which the birds forage. During the wet season, the water expands into the surrounding areas, providing for increases of the fish and other wetland species. Due to their seasonality, these wetlands are often the first to be considered for filling for development. If they are preserved within development areas, the seasonal hydrology and upland buffer are usually not present, decreasing the function of the wetland. In addition, preserved wetlands are often hydrated from the surface water management system, increasing the likelihood of unnatural hydropatterns and poor water quality. The quantity of freshwater marsh in the study area was estimated based on interpretation of aerial photography. The acreage figure can be misleading since many marshes are small. Thirty percent (30%) of the total acres of freshwater marsh would be surrounded by development or other non-preserve land type in Ensemble Q; 27% in Ensemble R; 24% in Ensemble S; 25% in Ensemble T; and 14% in Ensemble U. The following proportion of the area of marshes would fall within proposed preserves: for Ensemble Q, 70% of the total area of freshwater marshes in the study area; for Ensemble R, 73%; for Ensemble S, 76%; for Ensemble T, 75%; and for Ensemble U, 86%. However, slightly more than half of the existing marsh is found in the southeast quarter of the study area, an area with the least development pressure. Looking at the remaining three-quarters of the study area, the area of marshes that fall within preserves are: for Ensemble Q, 40%; for Ensemble R, 46%; for Ensemble S, 50%; for Ensemble T, 49%; and for Ensemble U, 72%. It is worthy of note that the relatively small change in the footprint of development between Ensembles R and Q (Q expands) and R and S (S contracts) results in a relatively large change in percent. This indicates that the location of the preserves is important and the quantity of preserve is only one factor in assessing ecosystem protection. However, natural foraging habitat (as compared to ditches and retention ponds) still extend throughout the entire study area but is more and more a smaller proportion of the total foraging needs for wading birds. **Table 19** in Section 4.20.1 suggests that some of the Fresh Marsh, Wet Prairie and Pineland covers appear to have halved. Wading bird populations continue to decline, indicating the continued decline of natural foraging will impact the maintenance of this species in the region.

4.4.5 HABITAT FRAGMENTATION AND CONNECTIVITY

The fragmentation and connectivity of preserved natural vegetation is very important to wildlife. Certain members of the ADG visually compared the Ensemble maps to determine if connections are explicitly provided between major habitat areas or if the Ensemble fragmented habitat. Considerations were given to the width, length, and number of connections. These members assigned a score from 1 to 6 depending on how, in their judgement, the alternative by map or criteria enhanced the implementation of these Plans. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The minimum possible score is 4 (best) and the maximum is 24. Ensemble Q totals 21; Ensemble R, 18; Ensemble S, 6; Ensemble T, 10; and Ensemble U, 8. The scale of 4 to 24 is not an absolute scale but a comparison between alternatives; that is, alternatives could be developed that are "better" than Ensemble S and certainly if there was no Comprehensive Plan, an Ensemble could be developed that would score "worse" than Ensemble Q. An Ensemble that scores lower generally were those with wider connections between major habitat areas. Wider connections are considered to be more immune to disturbance from adjoining land uses. Also, if they are wide enough, they may contain a mix of upland and wetland, a mix of habitats not found in a narrower connection.

4.4.6 FLOWWAYS

Integrity of flowways were also important but the resulting scores were similar to those previously reported for fragmentation and connectivity. This is not surprising since most of the habitat connections mapped followed natural flowways. Ensemble Q totals 18; Ensemble R, 23; Ensemble S, 5; Ensemble T, 6; and Ensemble U, 8. An Ensemble with a lower score generally emphasized routing of flows through contiguous natural areas. These rivers, sloughs, and strands are the major ecological features of the study area. Wide flowways consisting of natural vegetation preserved their ability to store floodwaters and to prevent pulse flows downstream.

4.4.7 REGIONALLY SIGNIFICANT NATURAL RESOURCES

Section 4.2 includes a discussion of the total acres of the native upland and wetland plant communities proposed for preservation. The Southwest Florida Regional Planning Council has prepared a map describing which of these natural resources are of regional significance and has developed goals related to maintenance of natural resources in the region. Certain members on the ADG used their knowledge of these goals and compared it to the alternatives. These members assigned a score from 1 to 6 depending on how, in their judgement, the alternative by map or criteria enhanced the implementation of these Plans. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The minimum possible score is 4 (best) and the maximum is 24. Ensemble Q totals 20; Ensemble R, 17; Ensemble S, 4; Ensemble T, 6; and Ensemble U, 7. The scale of 4 to 24 is not an absolute scale but a comparison between alternatives; that is, alternatives could be developed that are "better" than Ensemble S and certainly if there was no Comprehensive Plan, an Ensemble could be developed that would score "worse" than Ensemble R. An Ensemble that scores lower indicates that it includes features that are viewed as more explicit supporting these goals.

4.4.8 HIGH PRIORITY WETLANDS

Based on a project directed by the U.S. Environmental Protection Agency (EPA), the FFWCC identified important wetlands and uplands important to wetland-dependent species. The analysis was based on the maps of existing vegetation prepared for the GAPS report. Approximately 37% of the study area is mapped as important wetland and 19% is mapped as important upland, a total of 56%. When wetlands are preserved within another land use, often times only a small area of accompanying upland is preserved. This inventory indicates upland may be one third of the total area considered important to wetland dependent species. Ensemble Q would either directly fill or surround 21% of the total acres (of wetlands identified as important to wetland dependent species) with development or other non-preserve land type, Ensemble R, 21%; Ensemble S, 18%; Ensemble T, 14%; and Ensemble U, 13%. Therefore, of the total acres of wetlands identified as important to wetland dependent species, under Ensemble Q 79% would be found within areas of preserve; under Ensemble R, 79%; under Ensemble S, 82%; under Ensemble T, 86%; and under Ensemble U, 87%. Of uplands identified as important to wetland dependent species, 37% would be found under Ensemble Q within areas of preserve (and therefore 63% would either be cleared or surrounded by development); 38% under Ensemble R (62%); 46% under Ensemble S (54%); 77% under Ensemble T (23%); and 49% under Ensemble U (51%). The major difference is in the amount of upland placed in contiguous preserves. Under all Ensembles, the wetlands within the preserves will form a greater proportion than compared to proportion in the current study area.

4.4.9 MARINE AQUATIC RESOURCES

Marine aquatic resources can be impacted by activities along the shoreline. Certain members on the ADG used their knowledge of data such as those compiled by the Florida Marine Research Institute and local knowledge, and then compared it to the development in the coastal fringe proposed by the alternatives developed by the ADG. The group recorder expressed the assessments as a score from 1 to 6, the assessments based on how, in their judgement, the alternative by map or criteria enhanced or degraded estuarine aquatic resources. In particular, how impacts to the fringe affected its ability to provide aquatic nursery and foraging habitat. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The minimum possible score is 4 (best) and the maximum is 24. Ensemble Q totals 20; Ensemble R, 21; Ensemble S, 7; Ensemble T, 7;

and Ensemble U, 8. The scale of 4 to 24 is not an absolute scale but a comparison between alternatives; that is, alternatives could be developed that are "better" than Ensemble S and certainly if there was no Comprehensive Plan, an Ensemble could be developed that would score "worse" than Ensemble R. A separate evaluation of the native vegetation that was impacted found that the Ensembles generally did not impact the coastal salt marsh nor the mangrove communities. The difference is in how the pineland and hardwood hammocks behind the fringe are treated. Ensembles that proposed development in these communities, particularly around Estero Bay and Rookery Bay, were assigned higher scores (less protective of the aquatic fringe).

4.5 HISTORIC PROPERTIES

Historic Properties are site-specific. The landscape scope of the EIS prevented the collection of data concerning the effects on any individual sites. Impacts to Historic Properties under all Ensembles should be approximately the same at the scope of this EIS. This issue will be addressed in accordance with Federal and State regulations in the course of the permit application review on a case-by-case basis.

4.6 SOCIO-ECONOMIC

The primary purpose of this section is to compare the effects on the overall economy of the region with and without these suggested criteria, not to present an analysis of the entire local economy. At the scale of the regional economy, we foresee no significant change in economic output from current conditions that would result from either the Proposed Action or any of the alternatives.

The most important reason why no significant economic change is expected from the Proposed Action or any of the alternatives is the existence of the presence Corps permitting program. Limitations on wetlands fill are already in place. The proposed action and the alternatives do not change the law or regulations. They would serve merely to standardize permitting procedures that are already in place and therefore would not have any significant economic effect, at least on a region-wide basis. In fact, standardization of permit review would be expected to benefit the economy by promoting predictability.

Second, the Corps program has no impact whatsoever except to the extent it may be more restrictive than existing limitations on developments, such as the Comprehensive Plans. In many cases, the limitations are similar. Only to the extent that the Corps decision varied from the Comprehensive Plans would the Corps program have any effect at all. In many cases, the limitations are similar, and considering the Corps program is already in place, we anticipate no economic difference in moving to the Proposed Action or any alternative.

Last, even if there were a change resulting from either the Proposed Action or any other alternative, the effect of the change would necessarily be extremely limited. As will be seen in **Table 9a**, the footprint of development essentially doubles under any of the Ensembles and only from 3% to 5% of that footprint is located on future wetland fill. Therefore, the maximum range of potential effect is 2%. The effect of losing even 2% of developable area probably has no effect on the sustainability of the economy.

4.6.1 PROPERTY RIGHTS

The ADG report described property rights as "...the right to use your property as you choose without harming others, subject to applicable law and regulation (local government land plan and State and Federal permitting regulations), timely compensation for value lost due to regulatory change, and time compensation for taking." Descriptions of the Comprehensive Plan (represented by Ensemble R) included "realistic expectation of existing property uses and vested development rights" and recognizing the "expectations of landowners." The ADG minutes also report the statement "...that the Comprehensive Plan establishes maximums." There is acceptance that the Comprehensive Plan imposes certain restrictions on the use of property. Certain members on the ADG used their experience in this area to score each ADG alternative for three factors. The factors were whether the alternative affected (1) the fair market value of property; (2) the reasonable expectations for use of land and return on investment; and (3) vested rights. These members assigned a score from 1 to 4 depending on how

the alternative restricted the use of property. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The maximum possible score is 48 (least effect) and the minimum is 0 (greatest reduction). Ensemble Q totals 45; Ensemble R, 47; Ensemble S, 18; Ensemble T, 21; and Ensemble U, 12. The scale of 0 to 48 is not an absolute scale but a comparison between alternatives; that is, for example, alternatives could be developed that are "better" than Ensemble R and an Ensemble could be developed that would score "worse" than Ensemble U. Ensembles S, T, and U because they impose additional restrictive criteria (particularly those that stated agriculture would not intensify beyond current use), reduce the area of agriculture, and provide less area of urban development compared to Ensemble R. Ensembles S and T were not scored as low as Ensemble U. Some of the remarks that explained this give insight to those scores: (1) explicitly mapping flowways as preserve areas has greater impact than a goal statement in the narrative criteria; (2) descriptions of restoration proposals that imply "more intense acquisition" has greater impact than those proposals that imply willing sellers; and (3) criteria written in terms of absolutes has greater impact. Generally, mapping lands as proposed preserve or imposition of criteria on their use will have an influence on the ability of the owner to realize his or her expectations for use of the property. On the other hand, the owner of a property adjacent to land that is acquired for preserve could see the market value increase.

4.6.2 COMPREHENSIVE PLANS

The Lee and Collier County Comprehensive Plans are the local elected officials' statement of local land use policy. The Lee County Comprehensive Plan (Ordinance 89-02 with amendments) at Chapter II (Future Land Use), states one goal is "To maintain and enforce a Future Land Use Map showing the proposed distribution, location, and extent of future land uses..." The County Future Land Use Element of the Growth Management Plan (Ordinance 97-67) states the goal is "To guide land use decision-making..." Certain members on the ADG used their experience in this area to score each ADG alternative for the significance of the difference between the alternative and the current local land use plans. These members assigned a score from 1 to 4, 4 indicating agreement with the local land use plan. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The maximum possible score is 16 (most agreement) and the minimum is 0 (greatest difference). Ensemble Q totals 14; Ensemble R, 16; Ensemble S, 7; Ensemble T, 7; and Ensemble U, 5. All of the Ensembles except for R differ from the local land use plans. The more additional criteria or restrictions imposed, the lower the score.

There was considerable discussion during the ADG meetings of the relationship between the County Comprehensive Plans and the Corps Regulatory Program. The Lee County Comprehensive Plan is described by Ordinance 89-02 with amendments. The Future Land Use Map designates certain areas as Wetlands. Policy 1.5.1 states "Permitted uses in Wetlands consist of very low density residential uses and recreational uses that will not adversely affect the ecological functions of wetlands. All development in Wetlands must be consistent with Goal 84 of this plan." Goal 84 lists several policies for review of projects affecting wetlands. Policy 84.1.2, states, "1. In accordance with F.S. 163.3184(6)(c), the county will not undertake an independent review of the impacts to wetlands resulting from development in wetlands that is specifically authorized by a FDEP or SFWMD dredge and fill permit or exemption." Also, "2. No development in wetlands regulated by the State of Florida will be permitted by Lee County without the appropriate State agency permit or authorization." The Collier County Future Land Use Map (Ordinance 97-67) includes a "Areas of Environmental Concern Overlay" and states "This overlay contains general representations for information purposes only; it does not constitute new development standards and has no regulatory effect." The Collier County Land Development Code (Ordinance 91-102 with amendments), Section 2.16.19, states "Where proposed use or development requires State or Federal development orders or permits prior to use or development, such development orders or permits must be secured from State or Federal agencies prior to commencement of any construction..." Both the Collier and Lee County Plans reference the additional restrictions imposed by State and Federal wetland permitting. Whatever the Plan may say, the landowner is further constrained by wetland permits. Both Counties do, as part of their Development Order and permitting procedures, consider the effects of proposed projects and project site plans on the wetlands and other natural

resources. In practice, however, the result for the landowner is that he or she may be presented with conditions in the Federal wetland permit that are different or more restrictive than is explicitly described by County ordinances. Arguments are presented that the Federal permitting should be consistent with the Comprehensive Plans. A counter argument is that since the Comprehensive Plans defer to and incorporate the Federal permitting, the permitting is, by definition, consistent.

4.6.3 LEHIGH ACRES

Lehigh Acres is the primarily location in Lee County for affordable housing. Area platted and infrastructure placed many years ago and many have bought with intention and expectation of building homes. The value of the average house in Lehigh Acres was 65% that of Lee County and less than 42% that of Collier County (in 1990). In addition, recent infrastructure upgrades have been constructed with public funds to support the future homeowners. Difficulty in restoring this area described by study presented by ECWCD on the Greenway of Ensemble S. Of the 20,602 acre footprint, only 91.1 acres of wetlands remain. There are 11,065 different owners of parcels in the footprint and even within the wetland areas only, 204 owners. The administrative cost of acquisition would be high. Also, the reduction in availability of land will generally increase other land prices due to scarcity. And, since these lots already have infrastructure will further increase the cost of alternative housing. Other Ensembles suggest permit review criteria. These have the potential to cause the landowner an added expense to retain environmental and legal services to respond to these criteria when applying for a permit to fill his/her wetlands. Filling of wetlands for single family houses in Lehigh Acres have been typically authorized by the Corps through a Nationwide Permit, a relatively abbreviated administrative process.

4.6.4 ECONOMIC SUSTAINABILITY

Permit decisions are one of many influences on the economic sustainability of the region. This issue is very complex and the evaluation of the potential effects of any of the Ensembles would require a professional economic impact analysis and there is great uncertainty as to how the economy will respond to the implementation of a particular Ensemble. In place of such an analysis, the ADG identified seven factors. A change in one or more of the factors could be used to identify whether an Ensemble affects this issue. Economic sustainability was defined as the "protection, enhancement, and expansion of the long term economic viability of the region, including: agricultural, commercial, construction, environmental, fisheries, industrial, residential, recreational and tourism elements." The seven factors are job creation, home affordability, cost of living, property tax base, cost to implement, and increased taxes. Certain members on the ADG used their experience in this area to score each of these factors for each of the ADG alternatives. They reported that Lee and Collier County planners have spent many hours to develop the Future Land Use Maps of the Comprehensive Plans and that these probably are the most representative of an optimal economic alternative. These members assigned a score from 1 to 4, 4 indicating the better for economic sustainability. The alternatives representing the Comprehensive Plan did not receive a "4" for all factors. The minutes record the group stating their struggle with scoring of the factors because of the difficulty to anticipate what will occur in the future. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The maximum possible score is 16 (positive perceived economic influence) and the minimum is 0 (less protective of economic sustainability).

Table 9. ADG Ranking Scores of the Impact of Each Ensemble upon Socio-Economic Sustainability Factors
(Score of 16 being the maximum positive influence)

Ensemble	Job Creation	Home Affordability	Cost of Living	Property Tax Base	Cost to Implement	Increased Taxes
Q	13	11	10	13	12	12
R	13	11	10	14	13	13
S	6	6	7	7	5	6
T	5	6	7	6	6	6
U	4	4	7	5	3	4

For the job creation factor, one of the influences noted is that some Ensembles proposed restrictions on the intensification of agriculture. One illustration that was presented is that row crop farming generally requires labor for fall, winter, and spring, but not in summer, but that citrus, more intensive, would provide opportunity for year-round labor. For the home affordability factor, one of the influences noted was the restriction on density (number of homes per acres). If the cost of infrastructure (roads, utilities, etc.) for one acre of development could be spread across, say, 20 homes instead of 10 homes, then the cost of each of the 20 homes would be lower than the 10 homes. For the cost of living factor, the difference between the Ensembles is less dramatic, but the increase toward Ensembles S, T, and U can be ascribed to the additional costs to develop under the more restrictive criteria. For the property tax base factor, Ensembles S, T, and U have smaller areas of development than Ensembles Q and R and propose restrictions on the intensification of agriculture, reducing the total value of property on which to collect taxes to support local government functions. Ensemble Q slightly increases the area of development, therefore slightly increasing the property tax base. For the cost to implement this factor, the additional preserves and the restoration activities proposed by Ensembles S, T, and U are more expensive than those proposed in Ensembles Q and R. The increased taxes factor is directly related to the cost to implement this factor and the property tax base factor. The larger costs of Ensembles S, T, and U (relative to Ensembles Q and R) divided by the smaller tax base results in a higher tax per $1,000 of assessed value.

4.6.5 LOCAL ECONOMY

The various factors identified by the ADG are closely interrelated within the local economy. Figure 12 and the following narrative provides a simplistic description of these relationships by tracing how money flows through the local economy. This paragraph will introduce the subject of economic analysis since we feel it is important to explain terminology that will be used in the remainder of the Socio-Economic section of this Environmental Impact Statement. First, some activity on a parcel of land creates a product of value that is sold for money. For example, on some acres of land, a farmer produces a crop that is sold to consumers outside of the local area in exchange for money. The Farmer records the exchange as a sale. That money is then distributed to employees (as wages), to the owner of the farm, to taxes and fees, and is used to purchase from other local companies the various services that also contributed to production of the crop. For example, two of these companies are a Trucker and Company 1. Both the Trucker and Company 1 record the purchases as sales. The money these companies received are also distributed to wages, to the company owners, to taxes, and is also used to purchase services from other companies. For example, Company 1 purchases service from Company 2. Now, some of that money is paid to an employee of Company 2. That employee then purchases a home. The Homebuilder records the purchase as a sale and then uses some of that money to, for example, to pay the Trucker whose services contributed to construction of the house. Note that one of the dollars the sale of the crop has moved through the local economy and has been recorded several times as a sale (Farmer, Company 1, Company 2, Homebuilder, and Trucker). By definition, the "economic impact" of the sale of the crop is found by adding all the related individual sales of each of the companies as the money moves through the economy. When reporting the economic impact dollar figure, economists will typically also report the sum of the wages and the number of jobs related to the sale of the crop. The dollar amount of the wages are, of course, a subset of the dollar amount of economic impact, but by itself is a very important measurement of the local economy. For analytical convenience, the dollar amount of the economic impact is divided by the dollar amount of the sale of the crop to calculate what is called the "economic multiplier". Using the example above, for one dollar of sale of crop, perhaps thirty cents goes to Company 1 and 10 cents to the Trucker. Of that thirty cents, fifteen cents goes to Company 2, then ten cents goes to the employee of Company 2, who spends five cents with the homebuilder, where one cent goes to the Trucker. So, in this very simplistic example, the dollar of the crop sale has generated fifty-one cents of sales in the local economy, for an economic multiplier of 1.51 ($1.51 total sales divided by $1.00 crop sale). Another measurement of the local economy is the "gross economic output", simply the sum of the total sales of all the companies in the local area for all industry types (for some types of activities, measurements other than sales are used).

4.6.6 PUBLIC SERVICES AND PRESERVES

Superimposed on the economy are the local government fiscal actions. Local government revenues are based on property taxes, sales tax, and other taxes and fees. These taxes and fees are paid by businesses using the money received from sales or paid by the purchaser (such as in the case of sales taxes). The property tax is based on assessed value of the land which in turn reflects the economic activity (or potential activity) taking place on it. Local government expenditures include those for schools, roads, safety, and other services to the public and businesses, and for the management of public preserves. Public preserves do not generate property tax revenues nor do activities on those lands generate products that are sold. Most residents can directly appreciate the contribution of roads, schools, etc., to their day to day activities. However, the contribution provided by the preserves is not as direct or obvious. For example, the presence of preserves attracts visitors who stay at the hotels in the area to visit or view preserves areas and the purchases by the hotels result in jobs at local companies. Another example is that natural shoreline within public preserves maintain nursery habitat for fish later caught by recreational or commercial fishermen. Wetlands within the preserves further contribute to the local economy by: providing habitat that make possible wildlife viewing by tourists and residents; assimilating pollutants and trapping sediments that maintains clean water quality; storing stormwater runoff that reduces the risk of property damage; and recharging groundwater that supplies drinking water. In addition, the very presence of preserved areas in the community increases its attractiveness as a place to live and therefore the value of the commercial and residential property, which is purchased by persons with more wealth who pay higher real estate and other taxes. We also note that a parcel of land located on the edge of an urban area goes through an economic cycle: first, it is very sought after as residential and commercial partly due to its adjacency to the rural or natural areas and development creates the newest jobs and homes in the local community; but then, as it is itself surrounded by development, turns

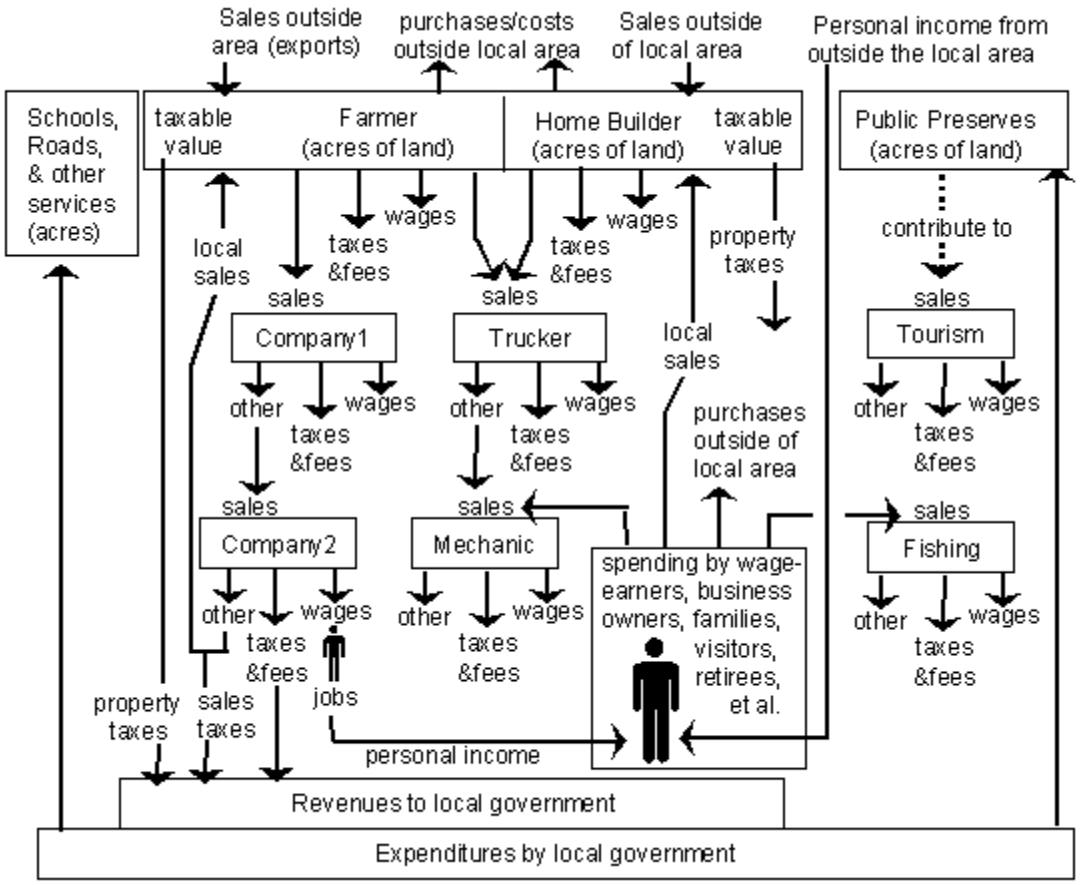


Figure 12 Flow of Money in the Local Economy.

into a less valued property and so has higher vacancy and can even slide to a blighted condition that eventually can result in a call for government investment to revitalize the area. Much has been written of examples and of techniques to describe or quantify the value of preserves to the local community. However, it is extremely difficult to identify all of the interrelationships in order to ascribe which economic benefit derived from which feature of a preserve, and some of the benefits are not measured directly in economic terms (for example, how much is clean water worth?). Based on the examples above, we can conclude that the presence of preserved natural plant communities makes possible certain businesses in the local economy (tourism, etc.), provides a natural resource infrastructure (habitat, flood attenuation, etc.), and increases the value of the remaining lands that are developed (and therefore the economic activity and government revenues that result). The values of these services are not expressed in dollars, even though they may in fact, and probably will, have effects on the economy. That same acre of natural plant community, if developed into agricultural, commercial, retail, or residential use, results in the production of services (produce, housing, etc.) whose value can be measured in dollars. The Corps Regulatory Program, when reviewing an application to fill wetlands, is, among other things, weighing the lost value of the services provided by the natural plant community against the increase in economic output from the farming, housing, etc. that will take place on the fill. The permit reviewer, however, is comparing apples to oranges. First, the wetland services are typically described using acres or as wetland functional capacity units, while the farming, housing, etc., can be described using dollars and employment. Second, the services affect different places in the local economy: the natural area benefits are more attenuated (for example, providing nursery habitat that provides fish that contributes to the fishing industry that then provides employment) than the direct economic output from the filled land (for example, homebuilding directly results in construction jobs and additional employment in the

community providing construction related services). Third, the natural area benefits are diffused across the general public while the activity on the filled land directly satisfies the needs and expectations of the landowner and a segment (sometimes a large segment) of the community (homeowners, construction, retailers supporting the new residents, etc.) An economy has a mix of services and that mix is related to the mix of land uses, both natural and developed. As noted in an early paragraph in this section, some individuals on the ADG indicate that the Future Land Use Maps of the Comprehensive Plans are probably the most representative of what the community wants. There is no available economic analysis or characterization of the Comprehensive Plans nor is there an explicitly stated economic goal. Based on the effort spent in developing the plans and their adoption by the Boards of County Commissioners, these documents represent the best indication of the local community's desired mix of services. However, a landowner can apply for and the Corps may approve fill that is not consistent with these plans. In addition, neither plan is explicit as to the total acres of development envisioned since they describe an allowable density (number of residential units, number of square feet of commercial, etc.) for the entire parcel or geographic area but then essentially refer the landowners to the State and Federal permitting to determine whether or not any of the houses or commercial space can be built on wetlands. Therefore, it could be argued that the Corps could deny all future applications for wetland fill and would still be consistent with the County Comprehensive Plans. In practice, the Corps must weigh the impacts and benefits of each individual decision. The five Ensembles provide a range of acres filled and other criteria. While the other sections of Chapter 4 of the EIS generally compare between the Ensembles the value of the natural plant community, the rest of this section will describe what is known of the value of the economic activity that would take place on the fill and use that information to compare the Ensembles.

4.6.7 FOUR STUDIES

This section describes the results from four economic analysis studies relate to the study area of the EIS that look at one or more of the aspects of the local economy. All fundamentally include the same analysis tasks: determine the local sales and labor force for a particular local industry; determine the interrelationship of other local businesses to the local industry (for example, the repair of vehicles) using the U.S. Department of Commerce's Regional Input-Output Modeling System (RIMS II); determine the portion of those sales that are exported outside of the local economy (for example, what portion of produce is sold outside the local area); and, determine the additional effects on other businesses in the local economy by employee and business spending. The studies differ in: the geographic size of how they defined the local economy; the focus of the industry studied; and, the purpose of the study. All four report their findings in terms of dollars per acre (or dollars per house, which can be related to acres). None of these analyses valued benefits from preserved natural plant communities.

Florida Stewardship Foundation, Inc, in its The Contribution of Agriculture to Collier County, Florida, November, 1996, compared economic outputs of the various industries in Collier County, estimated the economic impact of agriculture, compared each industry's share of government revenues and expenses, and presented information on common perceptions and misperceptions regarding agriculture based on 1992 figures. The report indicates that as a result of 291,960 acres under agriculture, businesses involved in agricultural production had direct sales of $326 million with 9,670 jobs and a payroll of $83.3 million. After multiplying the effect on other businesses, the economic impact in a single year resulting from agricultural production totals $534 million of sales and 14,937 jobs with payroll of $132.7 million. The document divides this number ($534 million) by the acres of agriculture to arrive at a recurring (annual) "opportunity cost" of $1,796 per acre. The study also notes that businesses providing agricultural services are closely related to production and when their contribution to the local economy is added, the total economic impact of agriculture is $636.6 million sales and 18,157 jobs with a payroll of $165.9 million. The study also estimates the one-time (first year) economic impact of residential construction to be $638,957 per acre and the recurring (annual) economic impact from residential resales to be $1,288 per acre, based on, among other things, an estimated 4.3806 units per acre. The report also projects these numbers into the future with inflation and other factors.

The National Association of Home Builders, in The Local Impact of Home Building in Naples, Florida, October, 1997, estimated the economic impacts of the home building industry in the Naples Metropolitan Area. The study estimates the one-time (first year) economic impact for every 100 single-family homes (after multiplication of the effect into the local economy) to be $14.614 million and 297 jobs and for every 100 multifamily units to be $14.758 million and 299 jobs. NAHB then estimates the recurring (annual) economic impact resulting from the spending of the occupants of the 100 single family homes (new residents for the community) to be $2.767 million and 71 jobs and for the 100 multifamily units, $2.089 million and 52 jobs.

The Florida Stewardship Foundation, Inc., in The Florida Panther & Private Lands, An Economic Analysis, December 1997, compared the impact of three alternative methods for management of agricultural lands identified as either Priority 1 or Priority 2 by The Florida Panther Habitat Preservation Plan in Lee, Collier and Hendry counties. The alternatives are: (1) government purchase and management of lands; (2) conservation easements in return for government payment to the landowner for development rights; and (3) the "conceptual plan" of various tax credits and other payments in return for a 25 year renewable lease. The study looks at the many different costs and impacts directly related to the purpose of the study. However, one part of the study estimates the recurring (annual) impact of agriculture on the three county economy to be $1,074 per acre of agriculture (averaged over all the agricultural acreage in the region).

These three studies provide an indication of the economic cost per acre for agriculture and housing if a similar analysis was performed for the EIS study area. For agriculture, the first and third studies indicate a recurring (annual) economic impact of $1,796 per acre and $1,074 per acre respectively. The difference is discussed in detail in the second report but one factor for the second, lower, figure is the larger proportion of low intensity agriculture. For residential, the first report indicates a construction (one-time) economic impact of $638,957 per acre and a recurring (annual) impact of $1,288 per year, based on 4.3806 units per acre. The second report provides figures based on 100 houses, but if the second report numbers are converted based on 4.3806 single family houses per acre, the construction (one-time) economic impact would be $640,180 per acre and the recurring (annual) impact would be $121,360 per acre. For the recurring (annual) impact, the first report based the calculation on resales of the houses and the second report based the calculation on the added income to the community of the new household.

Fishkind and Associates, Inc., in Economic Analysis of the Draft Environmental Impact Statement on Improving the Regulatory Process in Southwest Florida, January 13, 2000, estimated the economic impacts on the total economy in Lee and Collier Counties based on the difference between the Draft Permit Review Criteria (Appendix H of the Draft Environmental Impact Statement (DEIS)) and the Comprehensive Plans. Due to the time constraints imposed by the public comment period, this analysis is not as detailed or elaborate as the others. The study reports that the Southwest Florida region (defined as Lee, Collier, Charlotte, Glades and Hendry Counties) had 252,310 payroll employees in 1998 and, based on the U.S. Department of Commerce's Regional Input-Output Modeling System (RIMS II) multiplier for the region, they generated a total economic output of $9,608,700,000, or $38,083 per employee. The study then reports that employment increased by an average of 5,991 jobs per year from 1990 to 1998 and that area of development (of all types, residential, commercial, agricultural and public uses) increased by an average of 20,853 acres per year, for an average of 3.48 new jobs per acre of new development. The resulting total output is then calculated at $12,229 per acre. The study states "...the relationship between employment growth and land use established in the 1990-1998 period is likely to hold in the future. The characteristics of future growth in SW Florida are expected to be similar to the 1990-98 period." Within the boundaries of Lee and Collier Counties, the study reports the area of existing development in 1998 is 992,294 acres and that the land mapped as development but currently vacant plus expected conversion of agricultural land (the acres "available" for development) total 546,265 acres. At 20,853 acres per year, these two Counties will reach build-out in 26.2 years and at $12,229 per acre result in a total increase in economic output of $5,977,000. The $12,229 per acre figure is different from the various figures reported in the first three studies because, among other things, the three studies looked a single industry while the $12,229 is based on all economic activity. The study

then looked at the Permit Review Map and calculated the area that it shows to be mapped as development within the boundary of the EIS study area (which is a portion of Lee and Collier Counties). Then the study stated that, because of the additional new criteria described in the Appendix H of the DEIS, developers will likely reduce density or intensity of their projects to minimize their need for wetland fill. This will further reduce the land available for development. The study prepared estimates for a 10%, 25%, and 50% reduction and calculated the difference from the estimate of the land available within the EIS study area under the Comprehensive Plan. The difference was reported 136,165 acres at 10%, 191,045 acres at 25% and 282,513 acres at 50%. The study then multiplies the acre figures by $12,229 per acre to arrive at the reduction in the economic output. In addition, build-out will occur sooner than under the Comprehensive Plan, based on 20,853 acres per year. These differences in build-out were then incorporated in an analysis of future government revenues and costs. The report calculates that, from 1991 to 1997, revenues have been increasing at 2.03% a year while expenses have increased at 2.62% a year. The report notes that existing tax base can only increase by 2.5% a year or the rate of inflation, whichever is less, and that the new construction added $1,682,748 to the tax base in 1998, or $80,694 per acre based on 20,853 per acre. The report states that "...new construction adds significantly to the property tax base. Reducing the growth in the tax base ultimately requires ever-higher property taxes in the future to balance the County budgets." A fiscal analysis was then performed for the years 2000 to 2025 for the Comprehensive Plan and for the 10% and 50% plans, incorporating annual estimates of population growth, growth in property tax base, increase in value of existing tax base, and per-capita government costs and revenues. Under the Comprehensive Plan buildout, property tax rates are estimated to raise from 5.13 in the year 2000 to 8.62 in the year 2025 to achieve a balance of revenues and costs by approximately 2014 and maintain that balance while under the 10% plan, the rate raises to 9.86 and to 11.77 under the 50% plan (although Florida has a 10-mill cap). The study concludes that the tax rates will escalate under the Comprehensive Plan but that, if less land is available for growth in the tax base then the rates will escalate faster and higher.

Three additional papers also discuss government costs and revenues. The Council of Civic Associations, Inc., in From Ranches to Rooftops: Residential Development in Lee County, Florida and Its Impact on Taxpayers, discusses that, applying a calculation procedure used in a study in Oregon, that the current impact fees may not cover the cost of providing infrastructure for new homes. Over time, the paper argues, this may result in a future increase in taxes. Florida Stewardship Foundation, Inc, in The Contribution of Agriculture to Collier County, Florida, attributed the revenues collected by Collier County to each industry and then attributed the budgeted expenses to the industry to which the expense is related. Based on the way these revenues and expenses were apportioned, the report states that for every $1.00 of revenue generated by agricultural related services, $0.37 is spent by Collier County for direct services related to agriculture and for residential, for $1.00 generated, $1.20 is spent. These two papers suggest that converting land to residential use increases government costs relative to revenues (whereas the analysis in the previous paragraph simply notes there is an imbalance in total government budgets). An appropriate analysis of this concern will depend on the how government revenues and costs are estimated and allocated. A third study, the National Association of Home Builders, in The Local Impact of Home Building in Naples, Florida, notes that increases in local government revenue result both directly from the construction activity and from other businesses which benefit from the spending by the new resident to the community but did not estimate changes in local costs.

4.6.8 LAND CONVERSION

In order to quantify the changes in the economic activities, the Corps used the same map of existing land use as was used in the ADG. The existing land use mapping legends were lumped into Development, Agriculture, Upland, Wetland, and Water. The Corps then overlaid that map with the areas mapped by the five Ensembles. The Ensemble mapping legends were lumped into Development, Agriculture, or Public Preserves. Where an Ensemble map "Development" area overlaid an "Agriculture" area on the existing land use map, the acres are recorded in the following table as converted from agriculture to development. A more detailed analysis can be performed if there was less lumping, for example, within the Ensemble mapping legend for "Rural" there will be small nursery agricultural activity as well as

residential activities. So the numbers tallied must be recognized as estimates but are considered sufficient to display the order of magnitude of the potential changes. The tally is found at **Table 9a**.

4.6.9 DEVELOPMENT PERMITTING

For development, the estimated future wetland fill (which will require a Corps permit) ranges from 3% to 5% of the total build-out footprint of development for a maximum difference of 2%. Considering that the area of development approximately doubles under all the Ensembles, development of this 2% of land area will only be a small contribution to the total economy. It is also probably within the potential error of the per acre estimates of economic output. However, this 2% difference results in much more dramatic change in some of the other evaluation factors in this EIS, for example, in the 16% difference of seasonal wetlands that are primary habitat for wading birds. However, while the economic effect on the total economy is small, the effect on an individual project may be large. For example, a project to develop an industrial facility has severe constraints on the shape of the buildings and roads where a small wetland on the site may, unless filled, prevent the development of the facility. A retail project has constraints on parking lot size and location. A low or moderate priced residential project must place housing units near each other and use straight roads to reduce the utility and other infrastructure costs and use a large percentage of the site to spread the land costs across as many housing units as possible: all these constrain the ability to avoid wetland fill. Some project sites are constrained where they can locate their entrance road due to concern by transportation departments to provide spacing between entrances and provide distance from intersections to maintain traffic speed and safety on public roads. Some sites are constrained by locations of right-of-ways such as for roads and powerlines that sometimes will not fall on the site boundary. There may be other parcels in the County that have less wetland or do not have an entrance road constraint, but then the County Comprehensive Plan may not allow the particular desired use on such parcels out of concern for traffic congestion, adjoining neighbors, or other factors. But then, when the landowner applies for a Corps permit for the wetland fill, the Corps review may extend into the other portions of the site. For example, if the wetland fill is for an entrance road, thereby making the upland development possible, the Corps will also ask the applicant to describe the practicability of alternate site plans to increase upland buffers to the other wetlands on the site to minimize the total impacts to wetlands from the permit decision. In this particular example, the Corps will also, as required by the Endangered Species Act, consult with the Fish and Wildlife Service regarding effects of the entire project on Federally listed species and ask the applicant to describe practicability of alternate site plans. Therefore, for some projects, the current Corps review process imposes analysis effort and constraints even on the upland areas of the project. (In the case of the Endangered Species Act, the landowner has certain responsibilities under that law even if there is no Corps permit involved). Note that the area of upland converted to development in Ensembles S, T, and U are less than Ensemble R since that resulted in benefits to other evaluation factors in the EIS, such as those for wildlife.Ensembles S, T, and U also include criteria or descriptive review language, some of which represents constraints on project development beyond current practice or regulation. As noted in the Fishkind and Associates, Inc., report, this could have the effect that the actual acres developed will be less than the acres theoretically available in the table. That report simply reduced the available acreage by 10%, 25%, and 50% to find a range of the resulting impact to the economy. We have no way of estimating the extent to which this would occur, but suspect some of that acres would be developed but at a higher cost to the project.

4.6.10 AGRICULTURE PERMITTING

For agriculture, additional wetland fill is expected to be requested for some of the expansion and conversion of existing lands. Most of the activities within existing agricultural lands are exempted from the Corps permitting program under Section 404(f) of the Clean Water Act. As in the example in the earlier paragraph for development, for some applications for wetland fill for agricultural projects the Corps may be reviewing alternative site plans on the upland areas to avoid or minimize impacts to other wetlands on the site and to Federally listed species. (In the case of the Endangered Species Act, the landowner has certain responsibilities under that law even if there is no Corps permit involved). Note that the total footprint of agriculture in Ensembles S, T, and U are less than Ensemble R (the land

converted to public preserves) since the restoration of the uplands resulted in benefits to other evaluation factors in the EIS, such as those for wildlife. Ensembles S, T, and U also include criteria or descriptive review language, such as "limited intensity", some of which represents constraints on project development beyond current practice or regulation. Since more intensely managed crops or crops that fill a higher percentage of the parcel are considered to be less attractive to native wildlife, these Ensembles generally where scored as more beneficial for wildlife, for example, the Florida panther, than if they had (such as for Ensembles Q and R) the potential for converting to high intensity. However, while the acres are shown as available for agriculture, maintaining the wildlife habitat results in an economic impact on the landowner and the economy. The Florida Stewardship Foundation, Inc., paper The Contribution of Agriculture to Collier County, Florida (described in an earlier paragraph) reports the economic output per acre of land varies by crop type. This constraint would prevent the landowner from changing crops in reaction to market demand. The second paper, The Florida Panther & Private Lands, An Economic Analysis (described above) discusses the economic impact of this constraint has in the ability of the landowner to convert the land to development. This constraint may also reduce the ability of the landowner to secure loans to maintain agricultural production.

Table 9a. Distribution of Land Conversions within Ensembles

Distribution of land conversions within future development footprint										
	Q		R		S		T		U	
(1) Existing Development	163,998	39%	164,062	44%	163,971	42%	163,998	45%	163,997	46%
New from:										
vacant	22,655	6%	32,465	8%	32,465	8%	17,521	5%	32,465	8%
agriculture	70,778	17%	53,332	14%	66,001	17%	52,179	15%	50,306	14%
upland	76,516	19%	67,460	18%	66,685	17%	64,560	19%	61,719	17%
wetland	16,108	4%	17,177	5%	12,557	3%	10,504	3%	11,816	3%
(2) Total new	195,867	46%	170,434	45%	177,708	46%	159,708	42%	156,306	44%
(3) onsite preserve	55,427	14%	41,684	11%	48,489	12%	39,311	11%	35,308	10%
Future Developed Footprint										
(1)+(2)+(3)	405,482	100%	376,180	100%	390,168	100%	348,073	100%	355,611	100%
Distribution of land conversions within future agriculture footprint										
	Q		R		S		T		U	
(1) Existing Agriculture	166,617		166,390		166,617		166,617		166,798	
(2) Loss to other	80,937		68,870		100,192		84,240		85,201	
(3) Stays agric =(1)-(2)	85680	65%	97,520	59%	66,425	71%	82,377	68%	81,597	69%
New from:										
upland	12,000	9%	12,000	7%	12,000	13%	12,000	10%	12,000	10%
wetland	4,000	3%	4,000	2%	2,000	2%	5,330	4%	4,000	3%
(4) Total new	16,000	12%	16,000	10%	14,000	15%	17,330	14%	16,000	14%
(5) onsite preserve	30,831	23%	50,976	31%	13,312	14%	21,768	18%	19,809	17%
Future Agriculture Footprint										
(3)+(4)+(5)	132,511	100%	164,496	100%	93,737	100%	121,475	100%	117,406	100%
Notes. 1. "Existing" is actual developed/farmed acres and does not include existing on-site preserves. "Onsite preserve" is natural plant communities remaining within total footprint of existing and new development/agriculture. 2. Rural uses placed under Development although agricultural activity also takes place in those areas. 3. "Vacant" are lands such as those in Lehigh Acres that have roads but no homes yet built.										

4.6.11 ECONOMIC OUTPUT CHANGE

The economic studies presented above, narrative and numeric, suggest an almost linear relationship between availability of land to develop and increase in economic output. While this may be true for some industries, there can be (and probably are) increases in economic activity on lands that have already been converted from natural plant cover. The Corps has not multiplied the acres of wetland and upland fill by any of the dollar per acre estimates to generate a predicted growth in economic output because the actual change is based on an evaluation of many other factors than land. The estimates

are based on dividing current economic output by current acres of land. This approach is not invalid for summarizing the current economy but is questionable when used to imply "no land = no development". Land is only one contribution to economic activity although for some, such as agriculture, is more important than other activities. However, since the difference in the acres of wetland fill is a small portion of the total change in land cover, the economic impact of the permit decisions by the Corps, as a percentage of the total economy, will be small because only a small proportion of the change in land cover involves fill in wetlands. The economic impact to the individual landowner remains potentially high depending on the nature of the site and the project. However, the Corps review of natural resource effects provides a benefit to the local economy, though diffused and is not measured in dollars. Under all of the Ensembles, including the County Comprehensive Plan, the area eventually reaches build out and so other economic growth other than based on wetland fill will take place. The uncertainty as to how the economy may respond to the proposed criteria is great, just it is also great as to how it will respond to buildout.

4.7 AESTHETICS

Aesthetics proper was not directly evaluated. However, many people are attracted to this area for the presence of natural areas. Therefore, larger areas of preserved natural vegetation provide more opportunity to preserve the aesthetics of the landscape. The areas of preserve are described in Section 4.2.

4.8 RECREATION

Many of the population in the study area were attracted to the area for the recreational opportunities in the coastal waters and the inland forests and marshes. The coastal waters are affected by changes in water quality that may result from the upstream land uses presented by the Ensembles. These changes are presented in Section 4.10. The inland forests and marshes are largely accessible through publicly owned lands. The management of these public lands are affected by changes in the surrounding non-public lands. Certain members on the ADG used their knowledge of public land management and their general ecological principles to assess each ADG alternative. They considered (1) the compatibility of the surrounding land use with the land management plans of the public lands and (2) whether the alternative would be expected to degrade or improve the natural resources on the public land. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be a compilation of the four assessments. For Ensemble Q, connections were not marked between major public lands, particularly those between Estero Bay and Six Mile Cypress Slough and Estero Bay and the Corkscrew Marsh system. The width of Camp Keais Strand (connecting Corkscrew with the Florida Panther National Wildlife Refuge) was narrower in Ensemble Q then the other Ensembles. This Ensemble has the greatest area of urban development that "intrudes" eastward into the Corkscrew Marsh and Belle Meade systems. This intrusion increased the length of the boundary where public and urban lands are adjacent. Ensemble R has more preserve than Ensemble Q, thereby buffering the public lands more. This Ensemble has greater area of agriculture than the others which, while preferred to urban, if converted to intense agriculture would result in loss of habitat utilized by species that move between the public and private lands. The criteria associated with the Future Land designations of Wetlands (in Lee County) and Environmentally Sensitive Lands (in Collier County) were considered not as explicit in protecting natural resources on adjacent land uses as some of the other Ensembles. Ensemble S increases the area of contiguous preserve adjacent to public lands compared to Ensembles Q and R, and shows some of the connections to Estero Bay that were noted as missing in Ensemble Q. This Ensemble has more rural and intensive development adjacent to the Corkscrew Marsh than Ensembles T and U. Ensemble T particularly increases (compared to Ensembles Q and R) preserves around Hickey Creek and other areas along the shore of the Caloosahatchee River but not as much as Ensemble S. Ensemble T has less urban development in the vicinity of the Corkscrew Marsh and Belle Meade systems but more agriculture in the Immokalee area than Ensemble S. Ensemble U has more restrictive criteria and maps the existing strand in Golden Gate Estates as preserve. Ensembles that were considered to be supportive of public land management were those that surrounded the preserves with low-intensity activities to buffer urban development and also expanded the preserve area upstream and downstream along existing flowways to connect with other public lands.

4.9 COASTAL BARRIER RESOURCES

The activities in the watershed can affect the coastal barrier resources, particularly if they change the water quality of the runoff, as discussed in Section 4.10. Existing fish and other wildlife, as discussed in Section 4.4, are protected if existing natural resources are maintained, particularly those identified as regionally important and those along the shoreline.

The Florida Game and Fresh Water Fish Commission in its Closing the Gaps in Florida's Wildlife Habitat Conservation System (GAPS) highlighted some of the important habitats for shorebirds, migratory birds, nesting sea turtles and other components of biological diversity in coastal communities. Among the more important areas identified were the mangrove swamps of the Ten Thousand Islands (along the southern shore of the study area). In Lee County, Punta Rassa and islands to the west and Estero Bay are important to wading birds, shorebirds, and bald eagles. In Collier County, many of the beaches, bays, passes, and barrier islands (including Keewaydin, Kice, Cape Romano, Helen Key and Coon Key) between and including Barefoot Beach State Preserve south to the Ten Thousand Islands are important to wading birds, shorebirds, bald eagles, sea turtles, gopher tortoise, black bear , scrub lizard, peregrine falcon, and several State-listed plant species.

4.10 WATER QUALITY

4.10.1 EVALUATION

A change in the activity on a particular site, particularly if it removes the existing natural vegetation, is one of the many influences on water quality on the coastal waters. This issue is very complex and a thorough evaluation of the potential effects of any of the Ensembles would require a very elaborate water quality and quantity modeling. In place of such an model, the ADG performed a simple analysis and then the U. S. Environmental Protection Agency performed a more detailed analysis of the changes in land cover and reported resultant changes in quantities of water quality constituents in the runoff. The ADG identified five factors. A change in one or more of the factors could be used to identify whether an Ensemble affects this issue. The issue was defined as the maintenance of quality of the waters in the region. The first four factors are pollution loading, freshwater pulses, habitat loss, and groundwater impact. These were assessed during the ADG meetings. The fifth factor is a Water Quality Index, which measures the change in the concentration of pollutants in the receiving waterbodies. This index is calculated by the EPA analysis at the end of this section. Certain members on the ADG used their experience in this area to score each of these factors for each of the ADG alternatives. For two of the four component alternatives, these members assigned a score from 1 to 5, 1 indicating the less likely there will be a change in water quality. For the third component, they used a scale from 1 to 3. For the fourth component, the members assigned either a "+" or a "o" where "+" means the factor "was addressed". Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the three numeric scores (the 1,2,3 scale converted to 1, 3, 5) and displaying the fourth "+"/"-" score. The minimum score is 3/"+" (least likely to affect water quality) and the maximum is 15/"o" (more likely an adverse effect).

Table 10. ADG Ranking Scores of the Impact of Each Ensemble upon Water Quality Factors
(Score of 3/"+" is least likely to adversely affect water quality; the maximum score is 15/"o")

Ensemble	Pollution Loading	Freshwater Pulses	Habitat Loss	Groundwater Impact
Q	13/"o"	12/"o"	13/"o"	11/"+"
R	15/"o"	13/"o"	12/"o"	11/"+"
S	6/"o"	7/"o"	6/"+"	5/"o"
T	9/"+"	6/"+"	7/"+"	7/"o"
U	6/"+"	6/"+"	4/"+"	6/"o"

For the pollution loading factor, the major influences are the type of land use and the type of treatment. For example, urban areas have more polluted runoff but new urban development typically implements best management practices such as detention ponds to treat runoff prior to discharge into waterbodies and management actions such as street sweeping. Ensembles S, T, and U have smaller areas of urban then Ensembles Q and R and so would have lower pollution loading. In addition, Ensembles T and U propose smaller areas of development in Lehigh Acres and Golden Gate Estates, areas where implementation of BMPs on single family lots is sometimes impracticable. Ensemble S referenced an idea to implement regional stormwater management systems located on existing canals downstream of multiple urban activities. This was proposed as an idea for the developing area along the Caloosahatchee River where implementation or retrofitting of BMPs is impracticable. This contributed to the low score for Ensemble S. For the freshwater pulses factor, the major influences are the area of new impervious surface and the acres of wetland preservation. For example, urban areas have a greater percentage of paved and roofed surfaces and so the runoff is very rapid. However, an increase in urban is at the expense of wetland areas that would provide temporary storage of peak runoff flows. Ensembles Q and R have a higher amount of development and a lower amount of preserve than Ensembles S and T so they would tend to increase downstream pulses of water. The regional stormwater management proposal in Ensemble S also would reduce freshwater pulses. For the habitat loss factor, the major influence is the quantity of wetlands, particularly along shorelines. For example, a reduction in the area of these wetlands reduces the ability of waterbodies to assimilate pollutants. Ensembles S, T, and U have larger areas of preserves than Ensembles Q and R. For the groundwater impact factor, the major influence is area of natural vegetation preserved. The bulk of the urban water supply in Lee and Collier County is from the Surficial Aquifer System (some of wellfields draw from the lower Intermediate Aquifer System and below that the Floridian Aquifer System). The Surficial is recharged primarily from rain over the entire area. Ensembles Q and R scored relatively well as protective of groundwater with their specific criteria to protect the lands surrounding existing wellfields but Ensembles S, T, and U provided larger areas of preserve.

The following narrative describes the water quality index factor.

4.10.2 WATER QUALITY INDEX

4.10.2.1 Introduction

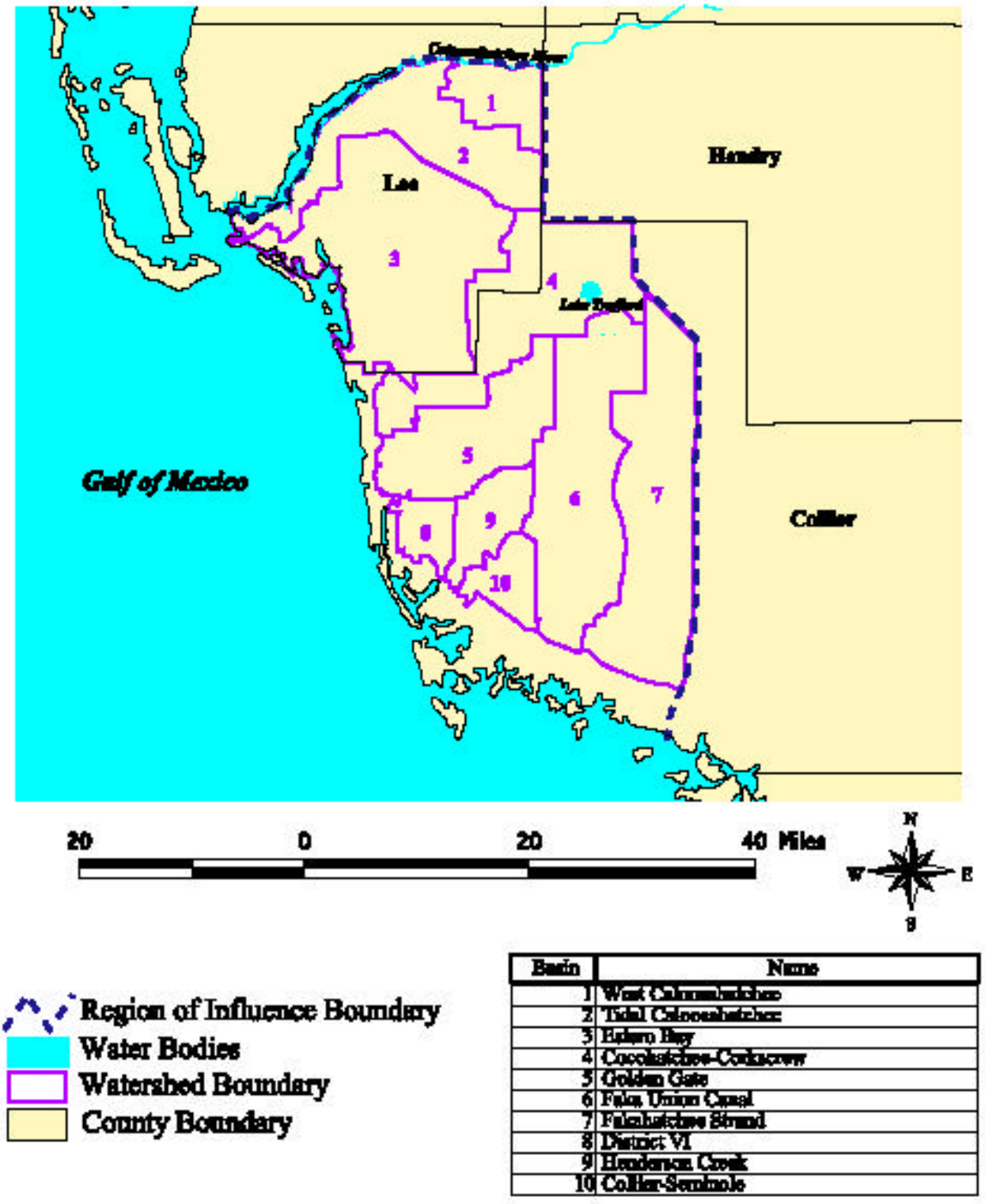
A review of the historical water quality within the study area was provided in the Affected Environment section. Although this historical review constitutes a comprehensive summary and indicates regionally deteriorating water quality through time, the data were inconclusive for many watersheds due to inadequate of monitoring data. Impacts to surface water quality associated with future land use alternatives are analyzed and discussed in this section.

The focus of this analysis was to provide a useful tool for planning purposes and for the comparative analysis of future land use alternatives. To estimate future water quality impacts to receiving water bodies which potentially result from different land use alternatives, a process for water quality analysis was developed. The methodology of this process included water quality modeling as one of several steps. After consideration of various water quality models, a model was selected which proved consistent with the resolution of the input data and which evaluates water quality impacts of large scale land use changes. Additionally, the chosen model provides a design which sufficiently and cost effectively guides planning decisions of a broader nature. Given the limited resolution of the Alternatives land use data and other sources of variability (see Section 4.10.2.6), it is also important for potential users to understand that the results of this assessment must be considered as tools for comparative Alternative analysis in the ADG and NEPA process. As such, the resulting data were used as a relative comparison of potential water quality impacts resulting from future Alternative land use scenarios.

In addition to the modeling effort completed for this report there are other efforts within the Study Area that are currently ongoing. One such effort is being pursued by the South Florida Water Management

District (SFWMD) that utilizes the MIKESHE/MIKE11 model codes. However, it does not appear that any of these efforts will cover the entire study area in the foreseeable future.

Analyses were conducted separately for each of the ten watersheds within the study area (**Figure 13**). Watersheds were selected as the hydrologic unit defining the storm water runoff to the receiving water bodies as defined by the SFWMD. Several input data are required for the water quality model, including but not limited to: the type and amount of each land use, the amount of annual rainfall, and the size of the receiving water body for each watershed. The water quality modeling provides estimates for several water quality parameters as output.



Basin	Name
1	West Caloosahatchee
2	Tidal Caloosahatchee
3	Estero Bay
4	Caloosahatchee-Cedarcrow
5	Golden Gate
6	Faka Union Canal
7	Fakahatchee Strand
8	District VI
9	Henderson Creek
10	Collier-Seminole

Figure 13. SFWMD Watersheds and Basins within the Study Area.

In non-industrial areas, stormwater runoff is typically the primary source of water quality degradation to the receiving water bodies, such as lakes, rivers, canals, and estuaries. Different types of land use affect the water quality of the stormwater runoff based on the amount of impervious surface and pollutant levels.
Generally, the greater the impervious surface area within a given land use, the greater the amount of runoff and the faster the discharge.

Best Management Practices (BMPs) are designed and constructed to reduce the potential pollutant loading of the stormwater runoff by trapping pollutants before entering the receiving water body (Rushton and Dye 1993). Additionally, BMPs are designed to reduce the increased flow rate and volume of stormwater runoff that potentially results from development (CH2M Hill 1991).

Estimates of future water quality within the receiving water bodies were summarized into an index of water quality (IWQ) for each watershed. An overall IWQ was then developed for the entire study area for the Current Day land use and each Alternative. The IWQ serves as a single unit of measure from which to compare water quality impacts among each of the Alternatives. The utility of using a water quality model and IWQ estimates within the EIS emphasizes the water quality process as a practical methodology for comparing land use Alternatives, and not a prediction of future water quality. The following sections describe the methodology used to evaluate potential environmental impacts to surface water quality from the EIS land use Ensembles.

4.10.2.2 Future Land Use

The future land use outlined in the Lee County Comprehensive Plan (Lee County 1997) and Collier County's Future Land Use Element of the Growth Management Plan (Comp Plan) (Collier County 1997) was selected as the first future land use Alternative for analysis. The Comp Plan is considered the baseline for interpretation of the future land use Alternatives, and therefore a similar methodology will be applied to the analyses of Ensemble U.

The specific land use/land cover data for each Alternative is the primary essential element in preparation of this water quality analysis process. The Current land use is based on 1995, whereas the Alternatives provide the future land use. The future land use of the Comp Plan Alternative and Ensemble U were provided as ARC View GIS maps. The Alternative land use data were based upon proposed permitting and mitigation guidelines, using very broad land use designations. Key to this methodology, is developing a consistent categorization of land use types for Current Day and each Alternative. Therefore, water quality modeling based on land use requires that the land use types conform to specific land use categories of the water quality model.

A Florida State system of land use designation and identification provides the level of detail necessary for converting land use data to the land use categories essential to the model. The Current Day land use types were easily summarized into the ten land use categories. These categories typically include, but are not limited to:

Low Density Residential	Single Family Residential
Multi-Family Residential	Commercial
Industrial	Agricultural
Open Land	Mining / Extraction
Wetland	Water

4.10.2.2.1 Comprehensive Plan Alternative

In order to make an accurate conversion to the land use types essential to the model, a GIS spatial analysis was performed. This process identified which Current Day land use types corresponded with future land use types in the Comp Plan. This is more easily understood by envisioning the future Comp Plan land use map laid upon the Current Day map and identifying and quantifying areas of intersection between the two land use systems for each watershed drainage basin. The result of the GIS spatial

analysis process provided a matrix table for identifying the types and quantities of Current Day land use types which correspond to each of the Comp Plan land use designations.

The next step of the water quality analysis process required an interpretation of the Lee and Collier County Comprehensive Plans in order to determine the amount of growth permissible for the future build out within each county. This was performed by identifying those land use categories which would experience a growth, a loss, or remain constant. This determination was made based on the descriptions in the Future Land Use Designation Description Section of the Collier County Plan and the policies contained in section two of the Lee Plan. As there is a finite amount of land within each county, the number of acres of a given land use type experiencing growth will have to be offset by an equal number of acres of alternate land use types experiencing a loss.

The Comp Plan Alternative may also allow for a mixture of future land use types to experience growth within a given future land use designation. To provide a reasonable interpretation of future growth under these circumstances, each of these land use types encouraged by the future land use designation would experience a level of growth in the same proportion as they existed in the Current Day land use distribution. For example, if the Comp Plan Alternative allows growth within the industrial and commercial land use types, then the total acres of these two land use types will increase but maintain the same ratio that existed before build out.

4.10.2.2.2 Ensemble U

As with the Comp Plan Alternative, an understanding and interpretation of the Ensemble U land use categories, restrictions, and mitigation within each of the ten (10) watersheds were required. This conversion of Ensemble U from the ADG-produced (Alternatives Development Group) criteria to land use categories was completed in a similar manner to that used for the Comprehensive Plan Alternative.

GIS spatial analyses were conducted utilizing the Ensemble U land use coverage concurrently with those for the Comprehensive Plan and the Current Day (1995). This data provides the ability to "fill in the blanks" (missing land use information) left by the lower level of detail in Ensemble U and was especially evident in the urbanized areas. This process was accomplished by determining areas of agreement between the Comprehensive Plan and Ensemble U to provide the higher level of detail provided by Lee and Collier Counties.

The Ensemble U “Urban” land use category is an example of this expanded detail process of interpretation. The Urban land use was converted (expanded) to Comprehensive Plan land use categories of Central Urban, Urban Community, Intensive Development, Urban Residential, Urban Residential Fringe and many others. These expansions of land use detail were performed in order to provide the best interpretation of the future land use designated by the ADG-produced criteria. With this exception, the Ensemble U land use analysis was completed in the same manner as outlined for the Comprehensive Plan Alternative.

It was recognized that these interpretations of the Alternatives constitute one scenario when considering the proportion of growth among the various land use types. Other scenarios were also considered but provided no difference in the overall water quality analysis process. The interpretation of land use growth for the Alternatives was identified as a potential source of variability (Section 4.10.2.6) in the overall water quality analysis process.

4.10.2.3 Best Management Practices

Best Management Practices (BMPs) primarily refer to the types and uses of surface water pollution control methods which are utilized within the study area to improve the water quality of the stormwater runoff (i.e. wet-detention ponds) (Driver and Tasker 1990). The location and size of the study area BMPs (Storm Water Treatment Certifications) were available as an ARC View GIS map (South Florida Water Management District) and were summarized by land use type, location, and quantity of acres (SFWMD 1995). BMPs are recognized as having various Pollutant Removal Efficiencies, and therefore,

function by potentially reducing the concentrations of the surface water runoff pollutants to a given receiving water body (Rushton and Dye 1993). The pollutant removal efficiencies used in this analysis were extracted from a study conducted in the nearest metropolitan area from which data were available (Tampa Bay Region) (Dames & Moore 1990). The use of data from outside of the study area was necessary due to the lack of monitoring data available for the study area. Within the study area, the total number of acres of each land use type were partitioned into two subsets, those utilizing BMPs and those without. This partitioning was conducted for the Current Day land use data as well as for the Comp Plan and Ensemble U.

Current land use data were partitioned based on the number, location, and quantity of BMPs actually permitted. In order to discern the same BMP partitioning information for each Alternative, an estimated projection of future BMP acres was required. The Alternative BMPs therefore included three components: a) acres of BMPs currently permitted, b) acres of BMPs currently under application, and c) acres of BMPs estimated to accommodate the future growth projections (Section 1.2). As a very conservative estimate, acres of BMPs necessary to accommodate the growth projections of the Alternatives were equated to the increase in acres of Urban land use with the exceptions listed below.

An estimated projection of future BMP acres within two historic development subdivisions was conducted separately. Currently, there are no requirements for BMPs associated with new construction within the Lehigh Acres and the Golden Gates subdivisions. In these areas, BMPs were not utilized. Additionally, smaller areas that do not require BMPs were identified and treated in a similar manner. Estimated projections of future BMP land use types for the Alternatives were identified as a potential source of variability (Section 1.6) in the overall water quality analysis process.

4.10.2.4 Water Quality Modeling

To accommodate the water quality analyses, the study area was partitioned into ten hydrologic units or watersheds. Watershed boundaries within the study area include portions of the larger national watershed system (Caloosahatchee and Big Cypress Basin) as defined by the USGS, as well as the smaller watersheds and basins defined by the South Florida Water Management District (**Figure 13**).

GIS spatial analyses performed to estimate changes in land use types associated with the Alternatives and were conducted individually for each of the ten study area watersheds. The resulting database consisted of land use types and quantities (acres) within the study area watersheds for the Comp Plan and Ensemble U.

Water quality modeling was performed for the receiving water bodies of each of the ten watersheds incorporating: 1) acres of each land use type; 2) associated surface water pollutant loading rates; 3) average annual rainfall; and 4) receiving water body data (Wanielista and Yousef 1993). The resulting water quality model output provided estimates of four key surface water pollutants for each watershed:

Biological Oxygen Demand (BOD)
Total Suspended Solids (TSS)
Total Nitrogen (TN)
Total Phosphorus (TP)

BMPs are designed and implemented to provide improved removal efficiencies for several water quality parameters (Kehoe 1992). Analyses were performed separately for those parcels of land which included BMPs and for those which did not. The model data estimates water quality for key surface water pollutants within each watershed for the Current Day and each Alternative land use. These data were then utilized for determining indices of water quality for each of the Alternatives. As a comparative analysis of relative change, the modeling output data are provided as a percent change from the Current Day land use to each of the Alternative land use scenarios.

4.10.2.5 Index of Water Quality

A methodology for calculating an index of water quality (IWQ) was developed and utilized for the study area. Use of a IWQ summarizes the modeling output of several water quality parameters into a single unit of measure and provides a means for Alternatives comparison.

Indices of water quality were based on the estimates of three water quality categories: clarity, oxygen-demanding substances, and nutrients (FDEP 1996). IWQs were calculated for each Alternative as well as the Current Day (1995) in order to assess water quality trends for the study area. Methodology for IWQ calculations are discussed in the Affected Environment and Appendix sections.

An overall IWQ was developed for the entire study area for the Current Day land use and each Alternative. In order to accommodate the varying runoff potential and size of each watershed, each of the overall IWQs were developed by normalizing the individual watershed IWQs. Normalizing was performed by multiplying each of the watershed IWQs by the corresponding watershed area (number of acres) and then dividing by the total study area. This procedure accounts for potential impacts of high IWQ values in a small watershed versus a large watershed.

4.10.2.6 Sources of Variability

The methodology developed for the water quality analysis process of the study area Alternatives on surface water quality has identified sources of variability inherent to various stages of the analytical process. **Table 11** identifies potential sources of variability and their relative contribution to the water quality analysis process. The inherent variability are considered relative to all Alternatives and as such, remain constant and therefore, do not impact the overall comparison of alternatives. Additionally, any new data that might be inserted into this process at a later date may create new sources of variability.

Table 11. Summary of Variability within the Water Quality Analysis Process.

SOURCE of VARIABILITY		POTENTIAL for VARIABILITY		
		Low	Medium	High
Current Day				
	Land Use Data	✓		
	Interpretation	✓		
Alternatives				
	Land Use Data		✓	
	Description Interpretations		✓	
	Discerning Land Use from Mixed Land Use Growth/Loss Projections		✓	
WQ Model				
	Rain Fall Data			✓
	Runoff Coefficients	✓		
	Pollutant Loading Rates			✓
	Receiving Water Body Data		✓	
BMPs				
	Percent Removal Efficiencies			✓
	Interpretation of Current Day BMPs	✓		
	Interpretation of Alternative BMPs		✓	
IWQ				
	Representation of Trends		✓	

	WQ Parameters		✓	
	Derivation of IWQ			✓

4.10.2.7 Water Quality Impact Analysis Results

The following section discusses the results from the water quality analysis and the IWQs for the Current Day and each Alternative land use. This methodology provides an effective assessment for relative comparisons of land use Alternatives with respect to water quality. While this analysis provides a relative comparison of water quality among Alternatives, it does not address potential secondary impacts that may occur with diminishing water quality. Secondary impacts were not assessed due to limitations in the data available for the study area; these include:

Ecosystem Impacts
Habitat destruction (i.e., mangroves, seagrasses, hard bottom, and other systems that include sessile organisms)
Change in trophic structure
Proliferation of exotic/invasive/undesirable aquatic plant and fish species
Degradation of Aquatic Resources
Fish Kills
Fish Consumption Advisories
Shellfish Harvesting Restrictions
Reduced fishery yield (species and/or abundance)
Aesthetics
Algal Blooms
Water Clarity
Odor

4.10.2.7.1 Current Day

Several water quality parameters were modeled for the Current Day land use (1995) in order to provide a baseline from which to compare future trends and changes with each Alternative land use. The water quality model results are summarized as a percent change from Current Day land use and will be provided in later sections.

Water quality parameters that would contribute most to degraded water quality within the Current Day (1995) land use study area include BOD and TSS. Those watersheds that contribute most to degraded water quality include District VI, Golden Gate Canal, Estero-Imperial Integrated, and Cocohatchee/Corkscrew Basins.

4.10.2.7.2 Comprehensive Plan Alternative

Table 12 provides a summary of the water quality model results for the Comp Plan Alternative land use as a percent change from Current Day.

Table 12. Estimated Percentage Change of Modeled WQ for the Comp Plan Alternative.

Comprehensive Plan Alternative	**Water Quality Parameters**			
	BOD	**TSS**	**Total N**	**Total P**
WATERSHEDS	**(% Change)**	**(% Change)**	**(% Change)**	**(% Change)**
Tidal Caloosahatchee Basin	49.3	82.4	-2.7	22.6
West Caloosahatchee Basin	105.5	159.0	5.1	60.1
Estero-Imperial Integrated Basin	28.5	14.1	-3.8	15.8
Cocohatchee/Corkscrew Basin	50.7	33.9	2.1	35.0
Golden Gate Canal Basin	38.6	37.4	7.9	42.3
District VI Basin	7.7	-4.0	-13.7	2.5
Henderson Creek Basin	20.2	12.8	11.3	56.9
Collier/Seminole Basin	25.4	4.5	0.6	13.3

Faka-Union Basin	32.5	0.8	9.2	26.5
Fakahatchee-Strand Basin	8.2	12.6	1.1	5.6

Notes: Percentage Change from Current Day Land Use

Water quality parameters that would contribute most to degraded water quality within the Comp Plan Alternative include BOD and TSS. Several watersheds within the Comp Plan Alternative have potential to contribute to degraded water quality in the study area and include: Golden Gate Canal, District VI, West Caloosahatchee, Tidal Caloosahatchee, Henderson Creek, and Cocohatchee/Corkscrew Basins.

4.10.2.7.3 Ensemble U

Table 13 provides a summary of the water quality model results for Ensemble U land use as a percent change from Current Day.

Table 13 Estimated Percentage Change of Modeled WQ for Ensemble U.

Ensemble U	Water Quality Parameters			
	BOD	**TSS**	**Total N**	**Total P**
WATERSHEDS	**(% Change)**	**(% Change)**	**(% Change)**	**(% Change)**
Tidal Caloosahatchee Basin	39.6	62.4	-7.7	11.1
West Caloosahatchee Basin	35.9	7.2	-28.8	-17.2
Estero-Imperial Integrated Basin	27.9	6.0	-8.6	5.7
Cocohatchee/Corkscrew Basin	44.4	30.4	1.3	27.9
Golden Gate Canal Basin	35.0	33.4	4.0	32.7
District VI Basin	26.8	20.7	2.4	24.9
Henderson Creek Basin	6.2	1.9	-2.4	15.2
Collier/Seminole Basin	16.5	-4.3	-1.0	5.6
Faka-Union Basin	12.0	-15.2	-1.2	4.3
Fakahatchee-Strand Basin	0.5	-2.8	0.0	0.2

Notes: Percentage Change from Current Day Land Use

Water quality parameters that would contribute most to degraded water quality within Ensemble U include BOD and TSS. Several watersheds within Ensemble U that have potential for degraded water quality in the study area and include: District VI; Golden Gate Canal; Tidal Caloosahatchee; and Cocohatchee/Corkscrew Basins.

4.10.2.7.4 Comparison of Alternatives with the Current Day Land Use

Table 14 provides a summary of the IWQs based on model results for the Current Day, the Comp Plan Alternative, and the Ensemble U land use.

Based on the results of the modeling process, Ensemble U shows less potential for water quality degradation than the Comprehensive Plan Alternative. The potential water quality impacts are shown for the individual watersheds and for the entire study area in **Figure 14**. The difference in potential water quality impacts is due to the more permissive land use criteria within the Comprehensive Plan Alternative and the requirements for restoration and preservation within Ensemble U. Ensemble U also has an additional criterion that requires retrofitting of certain areas that are not required by regulation to have stormwater management systems.

The Fahkahatchee-Strand Basin was identified as the watershed having the best potential water quality and contributing the lowest IWQ (48.5) to Current Day land use, whereas the District VI Basin had the worst potential water quality and contributed the highest IWQ (73.2) value. The overall study area IWQ for the Current Day land use was 56.9.

Table 14 Comparison of IWQs for each Watershed.

WATERSHEDS	Land Use IWQs w/BMPs		
	Current Day	Comprehensive Plan Alternative	Ensemble U
Tidal Caloosahatchee Basin	58.0	69.2	66.5
West Caloosahatchee Basin	48.0	71.2	53.0
Estero-Imperial Integrated Basin	59.5	64.8	63.5
Cocohatchee/Corkscrew Basin	56.0	67.6	66.5
Golden Gate Canal Basin	66.7	74.0	72.8
District VI Basin	73.2	73.1	77.0
Henderson Creek Basin	58.3	64.3	59.2
Collier/Seminole Basin	54.8	60.8	59.3
Faka-Union Basin	56.1	63.7	57.5
Fakahatchee-Strand Basin	48.5	50.7	47.1
Total Study Area:	**56.9**	**64.3**	**61.1**

The Fahkahatchee-Strand Basin was also identified as having the best potential water quality and contributing the lowest IWQ (50.7) to the Comp Plan Alternative, whereas the Golden Gate Canal Basin had the worst potential water quality and contributed the highest IWQ (74.0) value. The overall study area IWQ for the Comp Plan Alternative was 64.3. The Fahkahatchee-Strand Basin was again identified as having the best potential water quality and contributing the lowest IWQ (47.1) to Ensemble U, whereas the District VI Basin had the worst potential water quality and contributed the highest IWQ (77.0) value. The study area IWQ for Ensemble U was 61.1.

Comparative changes in water quality between the Current Day land use and each Alternative are represented in **Table 15**. Water quality drivers refer to those water quality parameters with a percent change from Current Day greater than 25 percent. Watershed drivers refer to those watersheds with the highest IWQ values and which contribute the most to increasing the overall study area IWQ.

Table 15. Summary of Water Quality Impact Analyses for Current Day and each Alternative.

	Watersheds w/ WQ Drivers		Watershed Drivers		
WQ Parameters	Comprehensive Plan	Ensemble U	1995	Comp Plan	Ensemble U
BOD	**7**	**6**	**District VI**	**District VI**	**District VI**
TSS	**4**	**3**	**District VI**	**Golden Gate**	**District VI**
TN	**0**	**0**	**District VI**	**Golden Gate**	**District VI**
TP	**5**	**2**	**District VI**	**Golden Gate**	**Golden Gate**

Notes: WQ Drivers: Indicate Watersheds with Percentage Changes in Water Quality Greater than 25%

Projected changes in water quality between the Current Day and the Comp Plan Alternative land use are best summarized by an increase in the study area IWQ from 56.9 to 64.3, indicating a potential decline in water quality. This decline was primarily driven by urban land use and the BOD and TSS water quality parameters. The West Caloosahatchee Basin has been identified as the watershed projected to experience the greatest change in water quality during build out of the Comp Plan Alternative. From the Current Day land use to the Comp Plan Alternative, water quality is estimated to potentially further degrade in all watersheds except for District VI, which indicates little to no change. Changes in the IWQ values among watersheds are represented in **Figure 15**. The shaded scale represents incremental

changes (5%) in the IWQ values from the Current Day to the Comp Plan Alternative land use. The IWQ comparisons for each of the watersheds between Current Day and the Comp Plan Alternative are represented in **Figure 14**.

Estimated changes in water quality between the Current Day and Ensemble U land use are best summarized by an increase in the study area IWQ from 56.9 to 61.1, indicating a potential decline in water quality. This potential decline was again driven by urban land use and the BOD and TSS water quality parameters. The Cocohatchee/Corkscrew Basin has been identified as the watershed projected to experience the greatest change in water quality during build out of Ensemble U. From the Current Day land use to Ensemble U, water quality is estimated to further degrade in all watersheds except for Fahkahatchee-Strand, which actually indicates a slight improvement. Changes in IWQ values among watersheds are represented in **Figure 16**. The shaded scale represents incremental changes (5%) in the IWQ value from the Current Day to the Ensemble U land use. IWQ comparisons for each of the watersheds between the Current Day and Ensemble U are represented in **Figure 14**.

Comparisons of the Comp Plan Alternative and Ensemble U water quality are best summarized by a decrease in the study area IWQ from 64.3 to 61.1, indicating potentially better overall water quality with Ensemble U. All of the Ensemble U watersheds would indicate improved water quality over the Comp Plan Alternative, except for District VI Basin. Although District VI Basin land use types do not significantly change between the Comp Plan Alternative and Ensemble U, the potential degraded water quality of this basin with Ensemble U is partly a result of nearly 2,000 fewer acres with incorporated BMPs. This difference is a result of different land use types, not differences in criteria regarding BMPs. IWQ comparisons for each of the watersheds between the Comp Plan Alternative and Ensemble U are represented in **Figure 14**.

4.10.2.8 Mitigation of Water Quality Impacts

The analysis of water quality impacts associated with the EIS Ensembles have revealed some actions to potentially mitigate the impacts of future development activities and improve the knowledge of water quality related BMP effectiveness within the study area. An examination of the ratio of acres of developed land served by BMPs to total acres impacted by various forms of development indicates great disparities among the watersheds. The differential in this ratio among watersheds exceeds 100%.

In addition to the above concerns, approximately 14 water bodies within or likely impacted by the study area have been placed on the EPA's 1998 303(d) list by FDEP. These water bodies include: Tamiami Canal; Naples Bay; Gordon River; Lake Trafford; Cocohatchee River; Imperial River; Estero Bay; Hendry Creek; Estero Bay Drainage; Spring Creek; Billy Creek; Daughtrey Creek; Manuel River; and Matlacha Pass. Section 303(d) of the Clean Water Act (CWA) requires each state to develop a list of waters not meeting water quality standards or not supporting their designated uses. In time, Total Maximum Daily Loads (TMDLs) are required for these waters because technology-based effluent limitations, current effluent limitations required by State or local authority, and or other pollution control requirements are not stringent enough to meet current water quality standards (FDEP 1998).

The following are concepts identified in preliminary discussions between EPA and the Corps concerning potential actions to increase the assurance of maintaining and improving water quality in the study area. These water quality protection concepts are included in this document to disclose that these ideas have been presented.

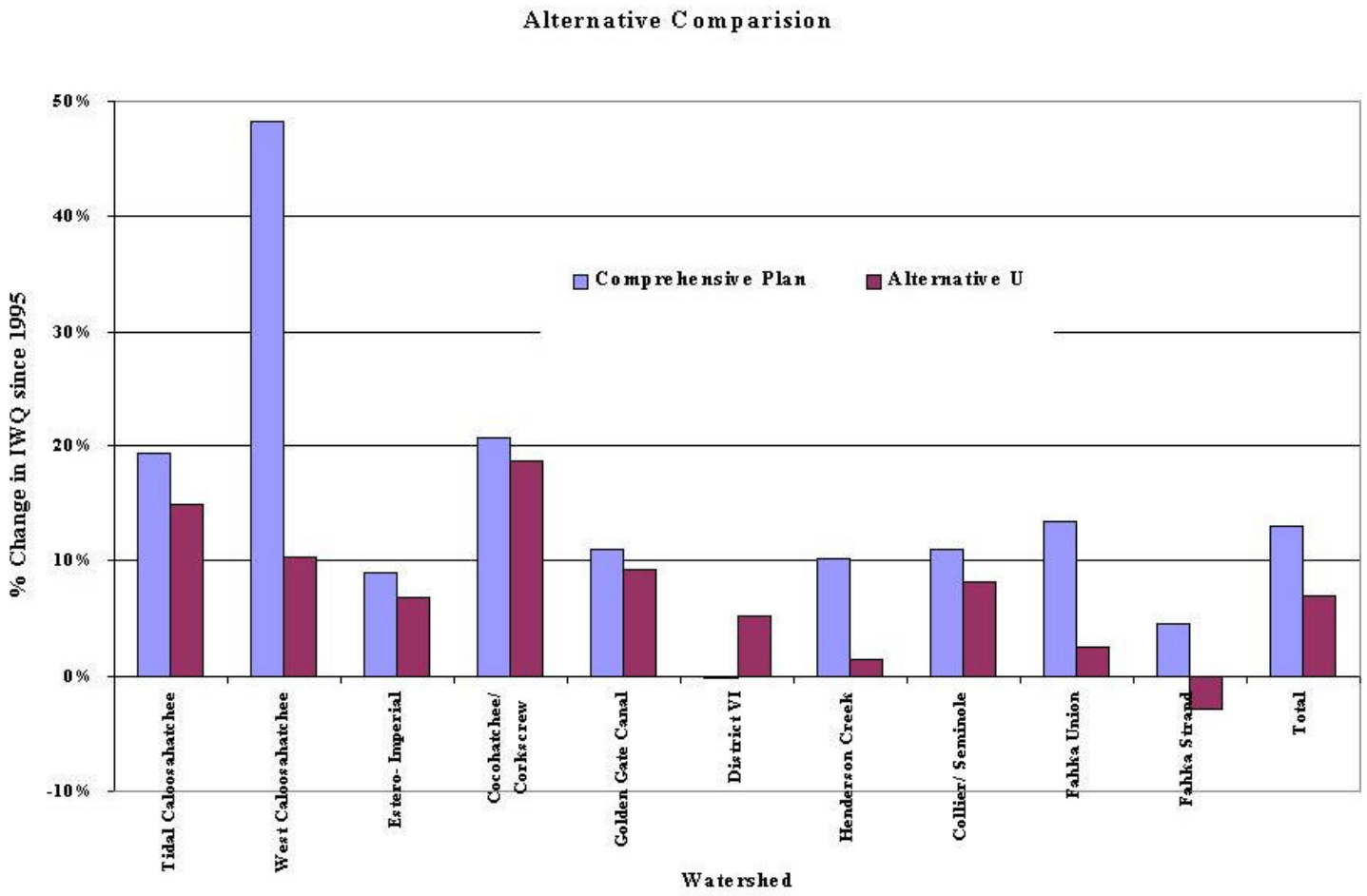


Figure 14. Comparison of Change in IWQs for Each Alternative Land Use from the Current Day (1995).

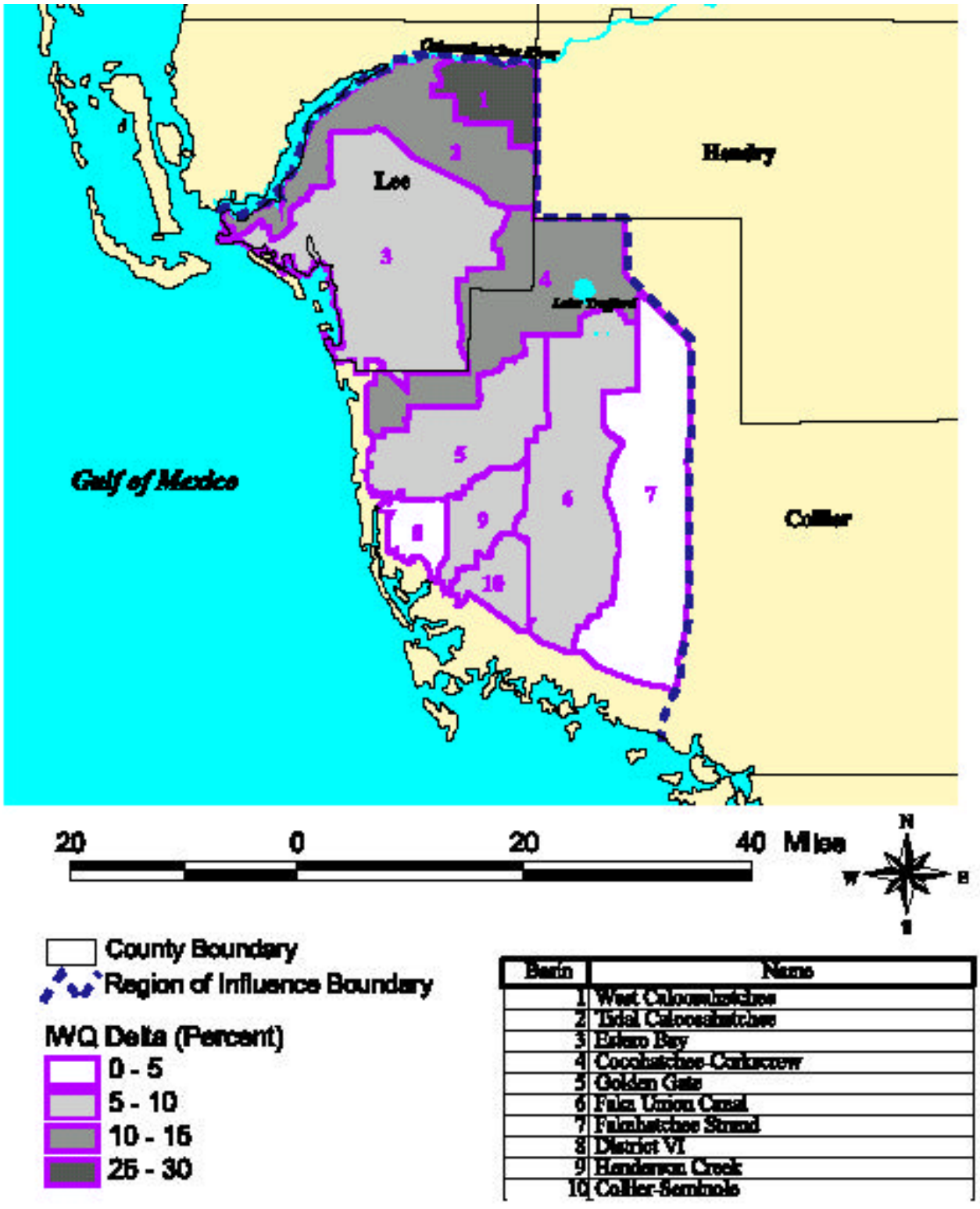


Figure 15. Changes in IWQ Values from Current Day to the Comp Plan Alternative Land Use.

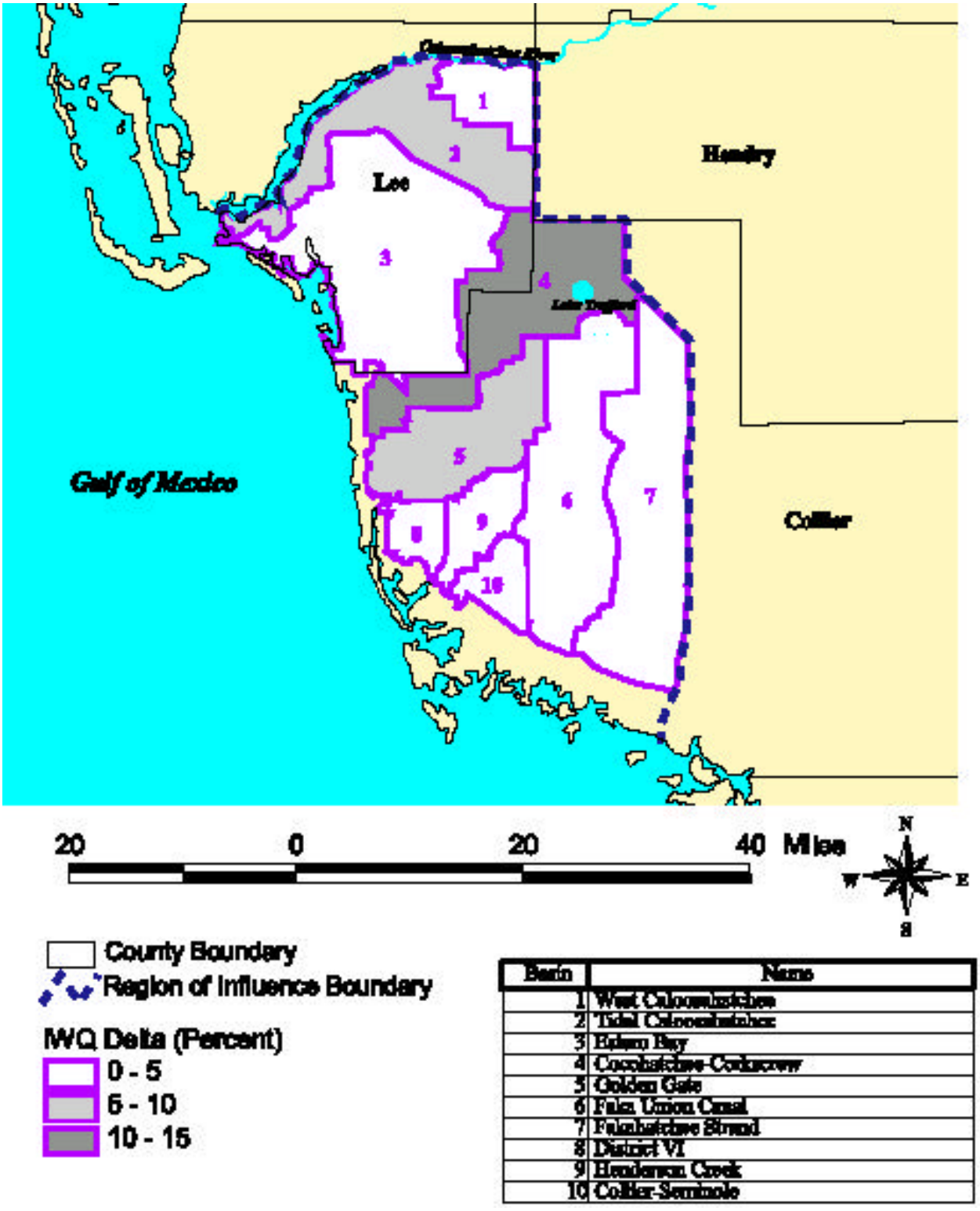


Figure 16. Changes in IWQ Values from Current Day to the Ensemble U Land Use.

4.10.2.8.1 Southwest Florida Feasibility Study (USACE/SFWMD) - Potential for Retro-fitting

Through the Corps' Central and Southern Florida Restudy Comprehensive Plan, a Southwest Florida Feasibility Study (the Study) will be initiated in 2000 for the geographic area of Collier and, Lee Counties and portions of, Charlotte, Glades, and Hendry Counties. The Study will provide a framework to address the health of aquatic ecosystems, including; water flows, water quality (including appropriate pollution reduction targets), water supply, flood protection, wildlife, and biological diversity and natural habitats. The Study also will address water resources problems and opportunities in southwest Florida. The Study may additionally provide opportunities to address solutions for reducing pollutant loading to area waterbodies from existing developments that pre-date existing State and Federal stormwater programs.

4.10.2.8.2 Water Quality Best Management Practices (BMPs)

The following ideas are based on the potential lack of sufficient BMPs and their clustered distribution within developed land uses in the study area:

4.10.2.8.2.1 Develop Local Stormwater Retention/Treatment Ordinances by Lee/Collier Counties

The EPA and other cooperating agencies could work with both local county and municipal governments within the EIS study area to develop stormwater retention and treatment ordinances that will afford greater water quality protection to local water bodies. This cooperative measure would include an evaluation of regional stormwater solutions, retrofitting of specific WQ pollutant load problem areas to determine activities that provide the greatest benefit to cost ratio. One scenario to be evaluated is the use of part of the canal system within Lehigh Acres and an appropriate amount of surrounding land to create a regional stormwater management system.

4.10.2.8.2.2 Enhanced Stormwater BMP Development for Priority Sub-Basins

The EPA and other cooperating agencies have assessed whether the development and implementation of enhanced stormwater management systems in identified sub-basins within the EIS study area is appropriate. The goal of this analysis is to adequately protect WQ conditions in the area while allowing for continuing economic development in those sub-basins that currently exhibit the highest levels of WQ degradation associated with non-point source (NPS) pollutant loading. The FDEP's current 303(d) list for impaired waterbodies in the EIS study area and the EPA's evaluation for this EIS of additional 1990's water quality data for the ten EIS sub-basins describe the basins exhibiting degraded water quality. One concept identified that could reduce the potential for further water quality decline is for future projects proposing wetland fill in degraded basins to treat of 95% of the pollutant load in their surface water runoff. This concept includes the following ideas that might be considered in implementing this concept:

1) Projects involving wetland fill within 303(d) listed watersheds would include treatment designed to the goals of the State of Florida ERP Minimum Stormwater Treatment Performance Standards, provided at Florida Administrative Code (FAC) Code Rule 62-40.432(5) currently required for Stormwater Management Systems (SMS) discharging to FDEP Outstanding Florida Waters (OFWs). This State of Florida OFW stormwater requirement requires a SMS designed to "achieve at least 95% reduction of the average annual load of pollutants" (typically measured as 95% reduction of Total Suspended Solids (TSS)) from waters discharged from SMSs approved by the ERP program.

2) Projects involving wetland fill within EIS sub-basins having EPA 1990's Water Quality Indices (WQI) of 52.0 or greater would include treatment designed to the goals of Florida ERP Stormwater Rules (FAC Code 62-40.432(5) currently required SMS for discharges to FDEP OFWs. This State of Florida OFW stormwater requirement requires the design and construction of a stormwater management system to remove 95% of average annual pollutant loads (typically measured as 95% TSS reduction from waters

discharged from Stormwater Management Systems approved by the ERP program. The following EIS sub-basins have EPA 1990's WQIs greater than 52.0: Tidal Caloosahatchee Basin, Estero Bay Basin, Cocohatchee – Corkscrew Basin, Golden Gate Canal Basin, Henderson Creek Basin, Collier – Seminole Basin and Fakahatchee Strand Basin.

3) Assurance that design efficiency of the constructed Stormwater Management System (SMS) would be provided by stormwater quality monitoring (the plan and reporting details would be negotiated between the applicant and the Corps/EPA on a case by case basis) and if appropriate by provisions for constructing an expanded SMS (such as by reserving non-mitigation lands for expansion of the SMS or establishing a mechanism to provide sufficient funds to construct an expansion)

4) Certain Stormwater Management System (SMS) designs may be encouraged; for example, those that incorporate and maximize the acreage of vegetated wetlands and grassed swales. Long-term maintenance of biological treatment systems associated with SMS is important. Other concepts for incorporating vegetated wetlands into SMS design include the use of native wetlands as buffers to SMSs, incorporation of littoral zone wetlands within SMSs, and utilization of constructed wetlands downstream of stormwater retention ponds to act a pollutant scrubbers, prior to discharge of runoff water offsite.

4.10.2.8.2.3 BMP Improvement Incentives

The EPA and other cooperating agencies will work with the private sector, municipalities, the Florida Department of Agriculture and Consumer Services, and other appropriate interest groups to evaluate what new non-point source pollutant reduction BMP incentive programs could be implemented in the EIS study area. The goal of this cooperation would be to reduce non-point source pollutant loading of area streams, canals, estuaries, wetlands and other water bodies. This evaluation would focus on suburban, rural, and agricultural areas that are currently exempt from the Environmental Resource Permit (ERP) program, Section 404, NPDES, NPS, and other regulatory programs.

4.10.2.8.3 Monitoring

The types of data necessary to make informed decisions within the study area regarding the actions listed above which do not currently exist include: 1) effectiveness of stormwater management systems as currently regulated; 2) pollutant concentrations of stormwater management system effluent; and 3) WQ impacts of different land use types within Southwest Florida. The primary benefit received from a comprehensive water quality monitoring program is the identification of water quality problems outside of the ERP program.

Listed below are ideas to provide the necessary information to make informed decisions on changes in regulatory criteria in order to provide improved protection to the water bodies within the study area.

4.10.2.8.3.1 Storm-Event WQ Monitoring in Future 404 / Environmental Resource Protection Permits

The State of Florida ERP program permits have a technology-based WQ assumption which presumes that if the required stormwater management is implemented by permitted developments, then the State WQ standards in the receiving water bodies will be protected (see Chapter 62-25, Florida Administrative Code in Appendix). Storm-event WQ monitoring in the EIS study area is not currently available to confirm the performance of the permitted stormwater management systems.

Land development projects permitted in the EIS study area by the Corps' Section 404 program and other cooperating regulatory programs could be required to implement programs to determine the effectiveness of their systems. Criteria would be established to determine which of the above mentioned projects would be required to participate in this stormwater monitoring program. These criteria could be tailored to include projects that are perceived to have a larger impact on the surrounding environment due to size, proximity to receiving water bodies, and land use impacted.

The stormwater monitoring program will require WQ monitoring during storm-events at the stormwater management system outlet structures to confirm the technology based WQ presumption for the following WQ constituents: DO, TSS, TP, TN, BOD, zinc, lead, and pesticides. This constituent list is preliminary. Regular reporting back to the EPA, the Corps, and other cooperating agencies would also be required as part of the WQ monitoring permit conditions of the 404 permits and other cooperating regulatory programs.

4.10.2.8.3.2 Create a Comprehensive Storm-Event WQ Monitoring Program (EPA/FDEP/SFWMD)

A cooperative effort could be made to develop an accurate analysis of ongoing WQ conditions and issues in the EIS study area. The goals of this comprehensive program would be to determine the relative contribution of the following land use areas on the decline of water quality within the region: large land development projects which predate regulatory standards requiring the management of stormwater for WQ concerns (i.e., Lehigh Acres, Golden Gate Estates, District VI, and others); land development projects and agricultural activities that comply with current regulatory standards; and, other land uses or activities within the study area that will provide the information necessary to make the proper regulatory or legislative decisions.

4.10.2.8.3.3 Review of the NPDES Non-Point Source Permit Programs

Under provisions of Section 402 of the Clean Water Act (CWA), the EPA is authorized to issue permits requiring BMP programs to treat non-point source (NPS) stormwater runoff to Waters of U.S., in municipal areas with populations greater then 100,000 (MS-4 Program) as well as for construction sites greater then 5 acres. The NPDES stormwater program will be delegated from the EPA to FDEP in May, 2000. Phase 2 of the NPDES stormwater permit program will extend the MS-4 permit requirement to municipalities between 50,000-100,000 in population in October, 1999. Lee County is currently permitted under the MS-4 Phase 1 program and Collier County will be permitted under Phase 2 of the NPDES MS-4 program. As a result of concerns with the detention and treatment of stormwater runoff in the EIS study area, the EPA and other cooperating agencies could conduct a review of the existing NPDES Stormwater program and make appropriate recommendations on how to revise this CWA program in such a manner that would reduce pollutant loading to water bodies in the EIS study area.

4.10.3 MANAGEMENT

Section 4.10.1 reports that, among other things, that the evaluation considered whether the alternative increased the area of development, thereby increasing pollutant loading, and noted that many but not all new development implement Best Management Practices (BMPs), which would reduce the load in the runoff. Section 4.10.2 uses a numeric model to compare change in water quality from today (1995) and two alternative futures (Ensembles R and U), expressed as a composite "Index of Water Quality" (IWQ). The variables used in the model are interdependent and changing the value of one variable will require the calculation of the entire model to determine the resulting effect on the IWQ. Most of the variables are assigned the same values in modeling the existing condition (1995), Ensemble R and Ensemble U. The primary differences between Ensembles R and U are: (1) the number of acres of land converted from one use to another; and (2) the number of acres whose runoff is treated by BMPs. In general terms, Ensemble U, compared to Ensemble R, suggests fewer acres of land converted to development

(residential, commercial, etc.) and, of the acres that are developed, a larger proportion of those acres be provided with BMPs. The Corps prepared **Table 16** to compare the two Ensembles for each basin.

For example, for the Tidal Caloosahatchee basin, 44% of the total area of the basin will be converted from agriculture, open land, and wetland to some form of development under Ensemble R (columns E, F, G, and H). Under Ensemble U, 42%. Therefore, the quantity of conversion under Ensemble U is approximately "similar" to Ensembles R (column A). However, 42% of the total area of the basin will be served by BMPs under Ensemble R compared to 49% under Ensemble U (Column J). Therefore, there is "slightly more" treatment of BMPs by Ensemble U (column B). The resulting IWQ is slightly lower for Ensemble U than for Ensemble R (column M).

The table indicates varying influence on the IWQ by the change in acres of land converted and acres of BMP. The variation reflects the unique characteristics of each of the basins and the way the Ensembles were drawn. The influence described by the model, though, is consistent with the best professional assessment in Section 4.10.1. Management decisions to fill wetlands (which contributes to the quantity of land converted to development) and decisions on whether BMP treatment will be implemented can, cumulatively, affect water quality. The model provides a mechanism to explore these potential decisions for particular watersheds.

Table 16. Influence of Increased Development Area Resulting from Ensemble R and Ensemble U upon Water Quality Model.

Ensemble "U" Compared to "R"		Basin	Period of Change - Ensemble	Percentage of Total Area of Individual Basin							Index of Water Quality (IWQ)		
Portion of Basin Changed to Dev	Proportion of new BMPs to new Dev			Land Cover Gained / Lost				Area Served w/BMPs					
				Dev (E)	Agr	Open	Wet	1995	R or U	Delta (K)	1995	R or U	Delta
Similar	Slightly More	Tidal	1995 to R	44%	-6%	-36%	-3%	12%	42%	30%	58.0	69.2	11.2
		Caloosahatchee	1995 to U	42%	-4%	-35%	-3%	12%	49%	37%	58.0	66.5	8.5
		Golden Gate	1995 to R	39%	-10%	-24%	-5%	8%	22%	14%	66.7	74.0	7.3
			1995 to U	34%	-10%	-22%	-1%	8%	27%	18%	66.7	72.8	6.1
Slightly Less	Much More	West Caloosahatchee	1995 to R	64%	-3%	-58%	-3%	2%	56%	54%	48.0	71.2	23.2
			1995 to U	58%	-2%	-54%	-2%	2%	93%	90%	48.0	53.0	5.0
Somewhat Less	Similar	Fakahatchee Strand	1995 to R	7%	-1%	-3%	-3%	17%	18%	1%	48.5	50.7	2.2
			1995 to U	0%	-1%	0%	1%	17%	17%	0%	48.5	47.1	-1.4
		Collier Seminole	1995 to R	19%	-15%	-8%	4%	37%	44%	7%	54.8	60.8	6.0
			1995 to U	10%	-7%	-6%	3%	37%	42%	5%	54.8	59.3	4.5
		District VI	1995 to R	49%	-12%	-31%	-5%	6%	55%	50%	73.2	73.1	-0.1
			1995 to U	39%	-12%	-26%	-1%	6%	45%	39%	73.2	77.0	3.8
Less	Somewhat More	Estero Imperial	1995 to R	42%	-9%	-29%	-4%	45%	69%	24%	59.5	64.8	5.3
			1995 to U	29%	-11%	-19%	1%	45%	74%	29%	59.5	63.5	4.0
		Cocohatchee	1995 to R	25%	-10%	-16%	0%	41%	54%	13%	56.0	67.6	11.6
			1995 to U	12%	-11%	-9%	8%	41%	50%	9%	56.0	66.5	10.5
Much Less	More	Fahka Union	1995 to R	26%	-3%	-8%	-14%	21%	22%	0%	56.1	63.7	7.6
			1995 to U	7%	-6%	-3%	2%	21%	24%	3%	56.1	57.5	1.4
		Henderson Creek	1995 to R	42%	-1%	-30%	-10%	11%	24%	14%	58.3	64.3	6.0
			1995 to U	6%	-3%	-4%	1%	11%	17%	6%	58.3	59.2	0.9

Note#1: Excerpts from model made by U.S. Army Corps of Engineers for purpose of comparing to ADG generalized assessment.
Note#2: "Dev" = Sum of five development categories used in model. "Agr" = Sum of agriculture and mining categories used in the model.
Note#3: "Open" = Open Lands with natural vegetation. Includes "vacant" lands adjacent to roads. "Wet" = Wetlands.
Note#4: "Land Cover Gained / Lost". 26% = 26% of total area of basin will be converted from Agriculture, Open, and Wetland to Development.
Note#5: "Proportion of New BMPs to New Development"= Change in column (K) divided by Change in column (E).

4.11 SOLID WASTE

There are landfills within the study area. None of the Ensembles make changes related to these.

4.12 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The scope of this Environmental Impact Statement limited the amount of data collected. As such, detailed information concerning hazardous, toxic, and radioactive waste generation or accumulation sites was not sought or considered. This issue will be addressed in accordance with Federal and State regulations in the course of the permit application review.

4.13 AIR QUALITY

Due to the programmatic nature of this project and the limiting scope of this Environmental Impact Statement , no specific air quality" data were collected. The short-term impacts from the changes in the permit review process associated with this project are not expected to significantly impact air quality. No air quality permits would be required for this action. Effects upon air quality" will be reviewed on a case-by-case basis, as necessary.

4.14 NOISE

The scope of this Environmental Impact Statement limited the amount of data collected. As such, detailed information concerning noise generation or noise-sensitive sites was not sought or considered. This issue will be addressed in accordance with Federal and State regulations in the course of the permit application review.

4.15 PUBLIC SAFETY

Hurricane preparedness is a particularly important issue for this study area. The study area is generally near sea level in elevation, therefore particularly vulnerable to flooding during storms. The study area is located near the end of the Florida peninsula, therefore limiting the evacuation options. The Southwest Florida Regional Planning Council presented in its Hurricane Storm Tide Atlas the expected extent of inundation from a hurricane for each county. Their Hurricane Evacuation Study provides the estimates of the population that would thereby need to be evacuated and the number of shelters, hotels, and private homes available outside of the area of flooding. The study then estimates the number of hours to evacuate to shelters and to evacuate the remainder of the population out of the region. For certain assumptions (type of storm and time of year), the evacuation time is predicted to be greater than the goal set by the RPC. The solution is to construct new roads or to provide more shelter space. The RPC has conducted a study to identify additional shelters. None of the Ensembles were considered to have changed hurricane preparedness except for the southwest portion of study area for Ensemble Q, where the increased urban area could possibly result in an increase in population.

Changes in the management of water flows can affect flooding of homes and other developed areas during less than hurricane storms. A variety of actions can affect or constrain effective water management. This issue is very complex and a thorough evaluation of the potential effects of any of the Ensembles would require a very elaborate water quantity modeling. A hydrologic study and model was recently completed for a portion of the study area by the South Florida Water Management District. Many of the recommendations of that study were incorporated by the ADG into their alternatives". The ADG performed a simple analysis in lieu of an elaborate model. The ADG identified seven factors. A change in one or more of the factors could be used to identify whether an Ensemble affects this issue. The factors are: infrastructure existence, home damage, home construction, flood depth/duration, historic flow patterns, water storage, aquifer zoning. Certain members on the ADG used their experience in this area to score each of these factors for each of the ADG alternatives". These members assigned "+" if the factor was addressed, "o" if it was not, and a "-" if a degradation. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by counting the number of "+" assigned. The minimum score is 0, indicating factor not addressed or negatively addressed.

Table 17. ADG Ranking Scores of the Impact of Each Ensemble upon Public Safety Factors
(Score of 0 indicates factors not or negatively addressed)

	Infrastructure Existence	Home Damage	Home Construction	Flood Depth	Historic Flow Patterns	Water Storage	Aquifer Zoning	Number of "+"
Q	1	0	0	0	3	2	0	6
R	3	2	3	2	1	2	1	14
S	1	0	0	4	5	4	3	17
T	0	0	0	4	5	2	2	13
U	0	0	0	5½	4½	2	2½	14½

For the infrastructure existence factor, Ensemble R was considered to have addressed this since it was considered to have provided for the funding of the maintenance and improvement of stormwater infrastructure. For the home damage factor and the home construction factor, Ensemble R was considered to have addressed this since it provides criteria that homes would either not be built within the 100 year floodplain or elevated to prevent damage. For the flood depth factor and historic flow factor, Ensembles S, T, and U provided wide flowways which are considered to have great influence on restoring the depth and duration of flooding and the maintenance of historic timing and quantity of flows. For the water storage factor, all of the Ensembles providing for preservation wetlands that can provide for storage of surface water. Ensembles S, T, and U propose larger area of preserve. For the groundwater factor, the concern was for establishing groundwater table levels such to protect natural resources. The additional area of preserves in Ensembles S, T, and U were considered to influence the preservation of adequate groundwater levels.

4.16 ENERGY REQUIREMENTS AND CONSERVATION

There is not expected to be any change in energy requirements resulting from any change in the permit review process. However, additional area of development does increase energy demands of the region.

4.17 NATURAL OR DEPLETABLE RESOURCES

A significant resource in the area is limerock quarried from open pits. Approximately 10,700 acres within the study area are currently used for quarrying limerock from open pits. Harper Brothers, Inc., provided an estimate that the cost of aggregate and baserock for a recent road project would have increased by 57% if the material had to be instead hauled from Dade County.

4.18 SCIENTIFIC RESOURCES

The Rookery Bay National Estuary Research Reserve (RBNERR) was established in 1978 in accordance with Section 315 of the Coastal Zone Management Act. The initial Reserve covered an area of approximately 1620 ha (4000 ac). Currently, some 3850 ha (9510 ac) of coastal and submerged lands surrounding Rookery Bay are include in the Reserve. The Reserve represents one of the few remaining, relatively pristine, mangrove estuaries in North America, and serves as a natural field laboratory for research and educational purposes (RBNERR 1996). The Proposed Action is not expected to directly impact nor indirectly affect the use of the Reserve for educational or scientific purposes.

The Florida Panther and Ten Thousand Islands National Wildlife Refuges (USFWS) and the Big Cypress National Preserve (NPS) also serve as viable locations for private and public research efforts. While these areas are not proposed to be directly affected by any of the Ensembles, some do propose development adjacent to these sites. This adjacent development could affect research efforts.

4.19 NATIVE AMERICANS

The Immokalee Reservation of the Seminole Tribe of Florida is located within the study area. The reservation is approximately 640 acres. The existing land use map describes small areas of development (including a residential area and the Seminole Gaming Palace) and agriculture. The majority of the site is native wetland and upland. The five Ensembles varied in their mapping: one mapped as "development", two "agriculture", and two as "preservation". This variety is due to the small size of Immokalee Reservation compared to the size of the mapping. The purpose of the maps, that encompass approximately 1,500 square miles, are to present general concepts (for example, wildlife habitat corridors) and the lines were not drawn to exactly match property lines or to avoid small areas of development. The proposed Permit Review Criteria, described in Section 2.2, does not designate a set of criteria for applications within the Immokalee Reservation. The Corps will continue to recognize the status, governmental authority, and powers of the Seminole Tribe of Florida and the rights under any tribal agreement with any agency of the U.S. Government.

4.20 CUMULATIVE IMPACTS

Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). The ADG studied the cumulative and secondary impacts of each alternative, looking at the effects upon both environmental resources (factors such as water pollution, wetlands, hydrology) and human systems (factors such as infant mortality, road needs, crime rates, and lands remaining in protected status).

4.20.1 PAST ACTIONS

The Corps Regulatory database (RAMS) was used to identify permits authorizing fill in the EIS study area. Extracted permits that were located within the study area and whose approved work types were "Fill-All Roadways", "Fill-Dev(Res/Ind/Comm)", "Fill-Golf Course", and "Fill-Other Misc.". This list includes nationwide and individual permits. When each permit is issued, the Corps Project Manager will type into the database the acres of fill broken into six plant types and the acres of compensatory mitigation broken into four categories. The list extracted from the database was reviewed to remove duplicate entries for those permits that have been modified or renewed as well as to correct obvious data-entry errors (such as square feet of fill entered instead of acres). Only permits from 1991 were used since these acreage categories were not entered earlier. The results are shown in the table. These reflect authorized fill. Some projects are not built or are built years after the permit is issued.

Table 18. Corps Permits Authorizing Fill from 1991 to 1998 inclusive in the Study Area

Acres of Fill	Forested	Herbaceous	Unvegetated	Subtotal	Total
Coastal	215	229	53	497	
Freshwater	1,597	1,894	79	3,570	4,067
Compensate	Create	Enhance	Preserve	Restore	Total
Wetland	357	9,706	1,913	27	12,004
Average 508 acres fill permitted per year. Average 63 permits per year.					
Ratio 2.95 acres compensatory mitigation per 1 acre of fill.					

Five maps of the study area were used to estimate the historic change in plant cover. The first three are for the years 1900, 1953, and 1973 found in the Department of Interior report Carrying Capacity for Man and Nature in South Florida (Costanza 1975). The second two are for the years 1988 and 1995 prepared by the South Florida Water Management District. The level of detail and complexity of the landscape of each map after 1900 increases compared to its predecessor. For example, the natural vegetation in 1995 is drawn using 10,485 polygons categorized into 50 plant types while the 1990 maps uses 469 polygons and 11 plant types. Therefore, small patches of a plant type within a larger plant

cover that are seen in the 1995 map will not show up in the 1990 map. The mapping accuracy (both delineation of the boundary of a plant type and also the identification of the plant type) will of course be less accurate. Then, over this period of time the plant cover in some areas will change from natural causes as well as from drainage works or other activities. However, since so many commenters on the Draft EIS asked for this, the following analysis was performed. It cannot be stressed too much that the numbers reported are imprecise due to the constraints listed above. The analysis was performed by comparing in turn maps from adjacent years. The 1995 map was compared to the 1988 map. Areas of natural vegetation on the 1900 map that were mapped as development on the 1953 map were sub-mapped. This resulted in square polygons the smallest of which would be around 125 acres. Then, the sub-map was compared to the 1995 map with its smaller polygons. Any areas of natural vegetation that were shown on the 1995 map were subtracted from the sub-map polygons. In addition, some of the polygons extended into natural waterbodies and so the areas of water were also subtracted. The resulting tally is recorded in the 1990-1953 column of the following table. This is the estimated acres of natural plant cover converted to development. This analysis was then repeated for the 1953-1973 map pair, the 1973 and 1988 map pair, and the 1988 and 1995 pair. The 1988 and 1995 maps used different categories of plant types from the earlier three. Acreage from the 1988 and 1995 maps were assigned to the closest comparable category of the earlier maps, thereby introducing another source of inaccuracy to the analysis results. The table also shows the distribution of natural vegetation on the 1995 map. Then the acres from each of the map pairs were added to the 1995 acres and the results shown in the "Start" column. This would represent the theoretical distribution of natural plant acres in the study area before any conversion to other uses. However, as noted above, changes of natural plant types to other plant types occur before converted. Also, the distribution is influenced by how the 1995 and 1998 plant type acres are assigned to the older categories. For comparison, the distribution in the 1990 map is presented by the table. As expected, the major difference is in the Scrub/Shrub and Pinelands types, the more difficult to interpret with aerial photographs and the ones also likely to change from other causes. Smaller differences are seen in the Wet Prairie and Fresh Marsh types.

Table 19. Distribution and Change of Natural Areas to Development

1900 Map	Plant Cover	Start	1900-1953	1953-1973	1973-1988	1988-1995	1900-1995	As of 1995
7.7%	Scrub/Shrub	12.5%	0.4%	6.1%	3.9%	0.2%	10.7 %	1.9%
35.9%	Pinelands	30.3%	2.7%	4.2%	4.9%	2.6%	14.4 %	15.9%
1.2%	Hardwoods	7.0%	0.1%	0.0%	0.1%	0.1%	0.4%	6.6%
27.7%	Cypress	27.9%	0.0%	1.1%	4.7%	0.6%	6.4%	21.5%
8.8%	Wet Prairie	5.8%	0.0%	1.2%	0.5%	0.6%	2.3%	3.5%
4.2%	Fresh Marsh	3.6%	0.2%	0.3%	1.0%	0.2%	1.7%	1.8%
1.3%	Salt Marsh	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%
11.1%	Mangroves	9.8%	0.1%	0.2%	0.4%	0.2%	0.8%	9.0%
97.9%	Subtotal	98.6%	3.5%	13.1 %	15.6 %	4.5%	36.7 %	61.9%
2.1%	Others	1.4%	0.0%	0.6%	0.4%	0.2%	1.2%	0.1%
100.0%	Total	100.0%	3.5%	13.6 %	16.1 %	4.7%	38.0 %	62.0%

4.20.2 PRESENT AND FUTURE ACTIONS

The ADG identified ten issues that generally are not measurably affected by the changes made by a single project. Effects accumulate from multiple projects eventually to the point where they are measurable. The measurement of the effects is complex and the effects have multiple causes.

Prediction of the changes can be attempted using appropriate logistics models. In place of such a model, the ADG performed a simpler analysis. The ADG identified ten factors and also subdivided them into social factors and environmental factors. A change in one or more of the factors could be used to identify whether an Ensemble affects this issue. The social factors are infant mortality, road needs, crime rates, and hurricane vulnerability. The environmental factors are air pollution, water pollution, watershed indicators, wetlands, hydrology, and quantity of preserves. Certain members on the ADG used their experience in this area to score each of these factors for each of the ADG alternatives". The relative comparisons made by the members in their discussions were converted by the group recorder a score from 1 to 7, 1 indicating the less likely there will be a cumulative degradation of the factor. Since an Ensemble is created by assembling four ADG alternatives, the evaluation here will be reported by summing the scores. The minimum score is 4 (least likely degradation) and the maximum is 28 (greater potential for degradation).

The infant mortality factor is influenced by the relative change in urban and agriculture. An Ensemble that increases (relative to another Ensemble) the area of urban and concomitant urban effects and also decreases the area in agriculture could be expected to see increased infant mortality. The road needs factor is influenced by area of urban development. An Ensemble with greater urban area will have a greater need for roads. The crime rate factor is influenced by increasing urbanization. The hurricane vulnerability factor is influenced by provisions for flowways to protect from flooding, infrastructure, and shelter availability. Ensembles S, T, and U provided flowways. The air pollution factor and the water pollution factors are both influenced by the change in the area of urban development. Ensembles with greater urban area are expected to contribute higher loads of pollutants to the region's air and waters.

Table 20. ADG Ranking Scores of the Impact of Each Ensemble upon Cumulative Social Factors
(Score of 4 is least likely degradation)

	Infant Mortality	Road Needs	Crime Rates	Hurricane Vulnerability	Subtotal of Social Factor
Q	17	15	3	11	46
R	20	24	8	13	65
S	11	11	5	9	36
T	16	14	7	3	40
U	13	15	10	4	42

Table 21. ADG Ranking Scores of the Impact of Each Ensemble Upon Cumulative Environmental Effects
(Score of 4 is least likely degradation)

	Air Pollution	Water Pollution	Watershed Indicators	Wetlands	Hydrology	Quantity of Preserve	Subtotal of Environmental
Q	16	15	20	20	14	19	104
R	20	18	18	19	18	20	113
S	15	13	10	13	10	11	72
T	11	9	11	13	13	12	69
U	14	12	12	12	11	10	71

The watershed indicator factor is based on the EPA Index of Watershed Indicators. The EPA in 1997 used available data to assign, for every watershed in the United States, scores to 14 indicators of watershed condition and vulnerability. The ADG did not repeat that exercise but did consider this index to be influenced by the portion of the landscape occupied by urban and agricultural uses. Ensembles with greater proportion were considered to have watersheds with greater vulnerability to degradation. The wetlands factor is directly influenced by the number of wetlands that may be impacted by the Ensemble. The hydrology factor is influenced by the presence of flowways and maintenance of contiguous wetland systems. The quantity of preserve factor is directly influenced by the acres of natural vegetation proposed for preserve and the influence of surrounding lands on the management of those preserves. In general, the four social factors tend to degrade with increasing percentage of urbanization, with Ensembles S, T, and U expected to have somewhat less degradation than Ensembles Q and R. The environmental factors tend to degrade with decreases in the percentage of the landscape preserved for its natural resource. Ensembles S, T, and U are expected to have much less degradation than Ensembles Q and R.

4.21 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

4.21.1 IRREVERSIBLE

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. One example of an irreversible commitment might be the mining of a mineral resource. A regulatory review process already exists to address the permit applications for impacts to Waters of the United States. The time, consumable resources, and human energy necessary to develop and

promulgate new regulatory guidance associated with the implementation of the Proposed Action would be an irreversible commitment of resources.

4.21.2 IRRETRIEVABLE

An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. An example of an irretrievable loss might be where a type of vegetation is lost due to road construction. Natural communities (upland and wetland) impacted or altered as a result of changes in land use classification and development criteria would be irretrievably lost for a period of time. However, these communities could repopulate in time given the removal of influences maintaining the altered condition (in the case of agriculture), or removal of limiting factors (e.g., impervious surfaces associated with urban land uses).

4.22 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The proposed action (standardized identification of issues in review) and the alternative of continuing unchanged (no action) does not predetermine the issuance of a permit for a given development project. Therefore, there will be no unavoidable adverse environmental effects as a result of the implementation of the proposed action.

4.23 LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Protection of the human environment is a continual effort. Acceptable modifications to the existing regulatory review process have been identified and refined. The utilization of the data collected and analyzed by the ADG and the treatment provided in this Environmental Impact Statement, in concert with changes implemented by local and State regulatory agencies, have the potential to balance the needs of the citizens of Southwest Florida with the maintenance and enhancement of the long-term productivity of the study area.

4.24 INDIRECT EFFECTS

The purpose of the proposed action is to better address environmental concerns while providing the regulated community with a timely and relatively predictable permit review process. Protection of threatened resources and redirect of development focus could provide benefits through a greater awareness of the resource availability.

4.25 COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES

The project is consistent, at this programmatic level, with the State's Coastal Zone Management Plan (see Appendix B and Section 4.30.7 on consistency determination). Further, the project was found to be consistent with the State's Coastal Zone Management Plan in the Florida Department of Community Affairs' comments on the Draft EIS. A consistency determination would be made for subsequent individual permit actions and the State's concurrence with the consistency determination would be sought. It is expected that the proposed action will be consistent with Federal, State and local plans and objectives.

4.26 CONTROVERSY

The diverse make up of the ADG was instituted in part to minimize the amount of controversy by inviting all aspects of the regulated community to join the regulatory agencies in the development of the new process. However, the proposed action and the action Ensembles of alternatives" represent a potentially marked departure from the regulatory process currently in place in the study area. It is anticipated that there will be concerns on the part of the regulated community as to the effects of the

review process. It is also anticipated that analysis of resource impacts and impacts to quality of life issues will be concerns of the resource protection agencies and the community.

4.27 UNCERTAIN, UNIQUE, OR UNKNOWN RISKS

As stated above, the proposed action involves the modification of the existing regulatory review process, and may involve some factors not previously encountered. These may include, for example, the development of an abbreviated review process for impact categories occurring in selected areas and the increased scrutiny of cumulative effects on resources resulting from permit decisions. Undesirable effects resulting from the modification of the regulatory review process are not anticipated. However, in the unlikely event of unacceptable impacts, the Corps would take corrective measures as required by permit, law, or otherwise determined appropriate.

4.28 PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS

The modification of the permitting review process in Southwest Florida is a new approach to addressing permitting concerns. If the proposed action performs as expected, further use of this process to provide planning assistance to the remaining counties of Florida (and beyond) could be indicated.

4.29 ENVIRONMENTAL COMMITMENTS

The proposed action involves the modification of the regulatory review process utilized by the Corps in Southwest Florida. The Corps is committing to improve the effectiveness of its reviews of the environmental impacts of future decisions on permit applications. This document includes draft permit review criteria that, if adopted, provide more detail in the questions that will be asked of all permits. The Corps is committed to working with the U.S. Fish and Wildlife Service to develop more detailed analysis tools to be ultimately incorporated into the Corps' decision processes. For example, there are fairly specific guidelines for protection of bald eagle nests from construction and other activities in the vicinity of the nest. There is no similar document (with such specificity) for many of the other evaluation factors. Once the detailed analysis tools are available to be used in project development and design, then these can be applied not only to review of applications but also to a re-evaluation of the predicted total change in the landscape to determine whether, and to what extent, there are adverse effects as defined by the Endangered Species Act. The development of tracking of key habitat and other indices linked to Permit Review Criteria is anticipated. Key habitat tracking data and other indices would be reviewed annually. These will also allow for the assessment and revision of maps of potential habitat and refinement of assessment criteria. Revisions will occur on individual maps and criteria as new information is developed.

4.30 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

4.30.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

The purpose of this EIS is to improve the Corps' review of permit applications for cumulative impacts. In a study area where the area of urban and suburban development is expected to roughly double, the Corps must take an extraordinary interest in the cumulative impacts. The EIS is <u>not</u> to determine what the permit decisions will be. The EIS <u>is</u> to present to the decision-maker and to the public a list of issues and concerns that could be included in the application reviews. Since the Corps' permit decisions authorize conversion of wetlands to residential, commercial, or other use, the cumulative impacts will flow from the Corps decisions on the applications submitted by landowners to change land cover. The Ensembles present five predictions of the future (twenty+ years) landscape after individual decisions accumulate. (Individual decisions include not only the Corps' decisions regarding wetlands, but also the landowner's decisions to submit the application, landowners' decisions to convert uplands, local government decisions on zoning, and many others.) The Ensembles predict different proportions of land cover types. The EIS presents the impacts at that point of time in the future for 61 evaluation factors.

The Corps decision-maker will choose which of the 61 review factors to incorporate into future application reviews based on the size or critical nature of those impacts, among other considerations. This choice does not expand the Corps existing jurisdiction. Many of the 61 factors are already found among the Corps public interest factors. The goal of this effort is to move from generalities to specifics in how the application will be reviewed. This will improve the effectiveness, efficiency, and predictability of the permit decisions. The EIS relies on best professional judgement to synthesize existing information to report orders of magnitude changes in the evaluation factors and to understand what influences those changes. Elaborate and detailed new studies are not needed to determine whether or not an issue should be included explicitly in an application review. The library of studies and geographic information system (GIS) mapping of resources were gathered. Most importantly, the intense efforts by a group of senior representatives from the community and government agencies developed a broad range of predictions, agreed to the list of cumulative effects, and offered their insights on the differences between the Ensembles. The EIS presents a range of alternatives", considers cumulative effects, and considers the best available information. The effort is in compliance with the National Environmental Policy Act of 1969, as amended.

4.30.2 ENDANGERED SPECIES ACT OF 1973

All of the Ensembles predict effects on listed species through loss of habitat. Many of the species have their own evaluation factor. The analysis of each Ensemble by the individual evaluation factor provides a simple view of the predicted cumulative loss of habitat for each species. For individual species, the magnitude of the loss for each species is extremely worrisome. Collectively, however, the solutions are similar for all, for example, maintenance of large contiguous preserves, maintenance of habitat connections, and preservation of seasonal wetlands. This EIS, through the presentation of the information on the affected environment (Section 3 above), the Ensembles, and their evaluations, provide a method to link the landscape patterns with the needs of multiple species. The map accompanying the draft permit review criteria is one potential landscape out of the five presented by the Ensembles. One goal of the proposed permit review criteria is to provide better consultations under Section 7 of the Endangered Species Act by explicitly asking questions related to the multiple species and interrelationships between them and the landscape. Consultation with the NMFS and the USFWS will be undertaken for each individual future permit action. The evaluation factors used to analyze the effects presented in this EIS are not at a sufficient level of detail to enable determination of the extent of change in the landscape or adverse affects to species as this is defined by the Endangered Species Act. The Corps is committed to working with the U.S. Fish and Wildlife Service to develop more detailed analysis tools to be ultimately incorporated into the Corps' decision processes. For example, there are fairly specific guidelines for protection of bald eagle nests from construction and other activities in the vicinity of the nest. Once the detailed analysis tools are available to be used in project development and design, then these can be applied not only to review of applications but also to a re-evaluation of the predictions in this EIS.

4.30.3 FISH AND WILDLIFE COORDINATION ACT OF 1958

Under this act, any Federal agency that proposes to modify any body of water must first consult with the U.S. Fish and Wildlife Service (USFWS) and the Florida Fish and Wildlife Conservation Commission (FFWCC) (formerly the Florida Game and Fresh Water Fish Commission). This EIS presents predictions of what might occur but the actual proposals will be made by landowners submitting applications to the Corps. Coordinations will be conducted on individual permit applications.

4.30.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

(PL 89-665, the Archeology and Historic Preservation Act (PL 93-291), and Executive Order 11593). No archival research or consultation with the Florida State Historic Preservation Officer (SHPO) have been conducted as part of the preparation of this Environmental Impact Statement. Applications for Federal dredge and fill permit authorization will be reviewed on a case-by-case basis in accordance with the

National Historic Preservation Act, as amended; the Archeological and Historic Preservation Act, as amended, and Executive Order 11593. SHPO consultation will be initiated on an "as-needed" basis.

4.30.5 CLEAN WATER ACT OF 1972

As discussed in Section 4.10, there is a concern that the increase in development may degrade water quality. The Corps will require Section 401 water quality certification or waiver prior to issuance of any permit. The certification, issued by the Florida Department of Environmental Protection (FDEP) or the South Florida Water Management District (SFWMD) , states that State water quality standards would be met. Discussion concerning the Section 404(b) evaluation is included in this report as Appendix A.

4.30.6 CLEAN AIR ACT OF 1972

There is a general concern that additional development cumulatively will increase air pollutant load. The concern is not to the level where additional permit review criteria were identified. Projects will be coordinated with the U.S. Environmental Protection Agency (EPA) on a case-by-case basis to ensure compliance with Section 309 of the Act.

4.30.7 COASTAL ZONE MANAGEMENT ACT OF 1972

A Federal consistency determination in accordance with 15 CFR 930 Subpart C is not included in this report. The statutes that are used to evaluate consistency are included as Appendix B. The project was found to be consistent with the State's Coastal Zone Management plan in the Department of Community Affairs' comments on the Draft EIS. State consistency determinations for subsequent permit actions will be performed on a case-by case basis.

4.30.8 FARMLAND PROTECTION POLICY ACT OF 1981

All the Ensembles predict a reduction in acreage of agriculture. Implementation of the draft permit review criteria and accompanying map will, for individual permits, question (albeit on the basis of habitat) proposed conversions of agricultural land to another use. Impacts to designated prime or unique farmland involving a Federal action or Federal funding will be addressed on a case-by-case basis.

4.30.9 WILD AND SCENIC RIVER ACT OF 1968

No designated Wild and Scenic river reaches would be affected by project-related activities. This act is not applicable.

4.30.10 MARINE MAMMAL PROTECTION ACT OF 1972

The Ensembles predicted direct conversions of natural vegetation to development. The evaluations described the resulting direct and indirect loss of habitat. None of the Ensembles predict direct effect on open water from dredging or filling and none mentioned adding or restricting marinas or boat docks. However, indirect effects identified included impacts from: greater presence of development on the coast (including additional boating); loss of vegetation along the shoreline; and, increased load of pollutants in water flowing from the watershed. The EIS analysis for marine mammals provides simple views of the predicted cumulative loss of habitat for each species, but do note the link between these species and landscape patterns in the watershed. Implementation of the draft permit review criteria will provide better consultations under Section 7 of the Endangered Species Act by explicitly asking questions related to the multiple species and interrelationships between them and the landscape. Consultation with the NMFS and the USFWS will be undertaken for each individual future permit action.

4.30.11 ESTUARY PROTECTION ACT OF 1968

Concerns are raised for potential impacts to Estero Bay Aquatic Preserve and the Rookery Bay National Estuary Research Reserve from, but not limited to, loss of adjacent habitat, freshwater pulses, and

change in water quality. Implementation of the permit review criteria will improve the assurance that future permit decisions would preserve these resources.

4.30.12 FEDERAL WATER PROJECT RECREATION ACT

The principles of the Federal Water Project RecreationAct, (Public Law 89-72) as amended, are not applicable to the proposed action.

4.30.13 FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976 AND THE MAGNUSON-STEVENS FISHERIES CONSERVATION AND MANAGEMENT ACT

Based upon the programmatic nature of this action, no fisheries would be directly impacted, nor would the management of local fisheries. Actions requiring Federal permits or Federal funding will be reviewed for compliance with these Acts on a case-by-case basis.

4.30.14 SUBMERGED LANDS ACT OF 1953

The project would occur on submerged lands of the State of Florida. Projects will be coordinated with the State of Florida, Division of Submerged Lands on a case-by-case basis to ensure compliance with this act.

4.30.15 COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These acts are not applicable.

4.30.16 RIVERS AND HARBORS ACT OF 1899

The Corps' authority to issues permits is based on Section 404 of the Clean Water Act of 1972 and Section 10 of the Rivers and Harbors Act of 1899. The Ensembles predict varying extents of conversion of wetlands, applications for which are submitted under Section 404. None of the Ensembles made predictions nor proposed criteria related to dredging, filling, or structures in open water, applications for which are submitted under Section 10.

4.30.17 ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be directly affected by the proposed action. Possible impacts to anadromous fish species would be evaluated on a case-by-case basis in order to ensure compliance with the act.

4.30.18 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

All the Ensembles predict a large loss of native plant cover with the greater proportion of the loss predicted to be in upland. The EIS discusses one species, the piping plover, that winters on beaches in the study area but notes that none of the Ensembles directly affect the beaches (although there may be indirect effects resulting from change in water quality resulting from changes in the watershed). Implementation of the permit review criteria, which questions the loss of native plant communities, will increase the assurance that impacts upon migratory birds, flyways, or stopover areas would be minimized.

4.30.19 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The Marine Protection, Research and Sanctuaries Act does not apply to this project.

4.30.20 E.O. 11990, PROTECTION OF WETLANDS

All the Ensembles predict the Corps will authorize the filling of wetlands, each Ensemble has a different quantity predicted. The implementation of the permit review criteria will strengthen the questioning of the need for the wetland fill. In particular, it adds a landscape perspective to valuing wetlands: projects proposing filling wetlands within the areas mapped preservation will be particularly questioned. Applications for impacts to wetlands will still be evaluated individually.

4.30.21 E.O. 11988, FLOOD PLAIN MANAGEMENT

Some of the Ensembles suggest improvement of water management and preservation (rather than development) around flowways to reduce flood hazards. Implementation of the permit review criteria specifically includes questions, for each application, whether these suggestions could be implemented. None of the Ensembles proposed relaxation of the current local rules regarding construction within the base flood plain (100-year flood).

4.30.22 E.O. 12898, ENVIRONMENTAL JUSTICE

The study area contains minority communities and low-income communities, the primary foci of this Executive Order. The ADG specifically evaluated Environmental Justice for each of the alternatives" they created, but generally found the alternatives to be equal. All of the alternatives (and the resulting Ensembles in this EIS) mapped existing areas of development as development or rural, and all the Ensembles propose expansion of that development. The expansion is found in many places in the study area and is adjacent to and provides job and housing opportunities for all economic and social categorizations.

4.30.23 E.O. 13089, CORAL REEFS

The proposed action is not expected to directly effect nor indirectly degrade the conditions of any coral reef ecosystems located within or adjacent to the boundaries of the study area. The proposed action is in compliance.