DRAFT ENVIRONMENTAL IMPACT STATEMENT
ON
IMPROVING THE REGULATORY PROCESS IN SOUTHWEST FLORIDA
LEE and COLLIER COUNTIES, FLORIDA

JULY 1999

PREPARED BY

U.S. ARMY CORPS OF ENGINEERS

JACKSONVILLE DISTRICT

LEAD AGENCY

U.S. FISH AND WILDLIFE SERVICE
U.S. ENVIRONMENTAL PROTECTION AGENCY
COOPERATING AGENCIES

The study area consists of nearly one million acres comprising much of Lee and Collier Counties. This area is experiencing rapid growth and development. A number of valuable resources occur in the area including protected species, other fish and wildlife, wetlands, preserves, refuges, water supply, flood plain, shoreline, and other natural resources. Pressure for development has resulted in requests for permits from the U.S. Army Corps of Engineers to fill a substantial amount of wetlands in the study area. Based on data and maps from a Geographic Information System (GIS), the work of an Alternatives Development Group (ADG), water quality modeling, and other sources; we evaluated a number of predicted futures for the study area. The ADG consisted of a diverse group of stakeholders including proponents of development, agriculture, and conservation. Also represented were governmental officials at the Federal, state, and local level. The ADG met a number of times over a five-month period under the guidance of a professional and neutral facilitator. The ADG focused their efforts on developing alternatives and evaluating their effect. While the predicted futures were realistic possibilities, they varied from the more environmental friendly to pro development with minimum consideration of many environmental resources. This Environmental Impact Statement (EIS) examines five possible futures derived from the efforts of the ADG. This EIS discloses the criteria that if applied, would result in the different futures. In addition, it discusses the authorities of various regulatory agencies to affect the future. This EIS does not evaluate any specific permit action. This EIS does not change any regulation or policy. However, the information developed will enable the Corps (and other agencies) to better evaluate the cumulative impacts of future permit decisions in the study area. The EIS discloses several sets of questions which would be asked during the evaluation of a permit application to help evaluate cumulative impacts. Our goal is to make more efficient, timely, and appropriate permit decisions while balancing the demands of growth and development with protection of the environment.

For more information, contact Kenneth R. Dugger, U.S. Army Corps of Engineers, Planning Division, P.O. Box 4970, Jacksonville, Florida 32232-0019, phone (904) 232-1686 or facsimile 232-3442. You can also visit our web site at http://www.saj.usace.army.mil/permit/swfeis/contents.htm. Additional comments must be received in writing by August 23,1999.

US Army Corps of Engineers®
Jacksonville District

SUMMARY

DRAFT ENVIRONMENTAL IMPACT STATEMENT
On
Improving the Regulatory Process in
Southwest Florida
Lee and Collier Counties, Florida

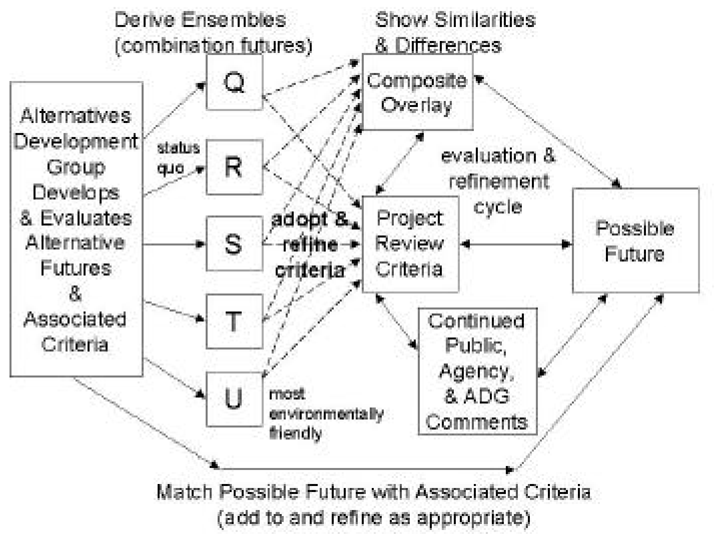
Need or Opportunity The study area consists of a large portion of Lee and Collier Counties located in the southwestern portion of Florida. This area has experienced a rapid rate of growth. The area also contains a number of important resources including protected species, wetlands, marine and estuarine resources, habitat preserves, sanctuaries, other public and private conservation lands, and other important ecological resources. The rapid development of the area has an impact on these ecological resources as well as water quality, air quality, housing, agriculture, tourism, industry, and the local economy in general.

The U.S. Army Corps of Engineers, Jacksonville District (Corps), has received or expects to receive applications for permits to fill wetlands and to impact other waters of the United States in the study area. The number of acres of wetlands that would be impacted would be a substantial portion of the national total resulting from permit actions by the Corps of Engineers. The Corps must consider a number of public interest factors and comply with a number of Federal and State requirements in association with any permit action. Independent of the Corps' permit process, there are a number of Federal and State environmental requirements which also affect water quality, air quality, land use, protected species, etc. These are largely beyond the control of the Corps.

The EIS is being drafted to support future Corps' decisions on whether or not to issue Department of the Army Permits (Permit). As provided by the Clean Water Act of 1972, a person must apply for and be issued a Permit prior to placing fill in wetlands or other Waters of the United States. The EIS was initiated out of concern that the Corps' incremental (permit-by-permit) review may not be adequately addressing the cumulative (total) effects. To identify the total effects, the Corps must predict the total set of applications that will be submitted.

Major Findings and Conclusions This EIS discloses a set of predicted futures based on assumptions (or criteria) about future land use in the study area. The impacts of these futures on various environmental and socio-economic factors are explored (see diagram illustrating the process for alternative selection and evaluation). The foundation of this effort was accomplished by a diverse group of stakeholders (the Alternatives Development Group). The Alternatives Development Group (ADG) consists of representatives from local, State, and Federal governments; environmental groups; and business interest. This effort was further refined by the Corps with input from other agencies, groups, and the general public. Substantial input on protected species and other fish and wildlife resources was provided by the U.S. Fish and Wildlife Service. Substantial input on water quality was provided by the U.S. Environmental Protection Agency. The interaction of future land use with environmental requirements (especially the requirements of the Endangered Species Act and the Clean Water Act) are heavily considered in postulating the alternative futures.

Identifying cumulative effects (Evaluation Factors). All of the land use/cover futures (referred to as Ensembles) predict that suburban development will continue, but they differ in how much more. Approximately 20% of the study area is currently urban or suburban development (included in this 20% are "vacant" lots and lands with roads). The five Ensembles predict that the future extent of development will range from 31% to 41% of the study area. This increase in area of development will occur as a result of a combination of: (1) filling wetlands (which requires a Corps permit); (2) clearing of non-wetland native vegetation; and (3) conversion of farmland. The Ensembles predict that from 5.5% to 6.6% of all the wetlands in the study area will be filled. The Ensembles report the predicted effects on a number of other factors as well (see **Table 3** in the EIS).



The Alternatives Selection and Evaluation Process

Using available information (Best Professional Judgement) The level of detail of the analysis corresponds to the size of the study area. The maps cover approximately 1,500 square miles and areas of urban, agriculture, and preservation were drawn literally using felt tips. The purpose of the maps is to describe broad concepts, for example, wildlife habitat corridors. The maps are not detailed delineation of parcel boundaries but are general locations of different land cover types. The group was asked to identify issues, the factors that influence those issues, and to create and evaluate how different configurations of land cover types would affect those issues. The participants used their expertise to identify which of the differences between the maps had the greatest influence on a particular set of issues. The Corps, in its permit application reviews, relies on this same use of "best professional judgement" and does not require applicants to develop elaborate economic or other logistics models.

Taking Stock (New Information) Currently, the Corps' evaluation of cumulative effects of an individual application is based on the issues identified by the Corps' project manager and concerns raised by the public or other agencies. This EIS provides new information. First, it provides a prediction of the total effect for twenty years of applications and other actions. Therefore, the effect of the individual application can now be compared to the total predicted effect. Second, it provides a comprehensive list of issues. Therefore, the Corps' project manager can ensure all appropriate issues are addressed in the evaluation of an individual application. Third, it provides a list of factors to evaluate the cumulative effect. Therefore, the Corps project manager can ensure the evaluations are consistent between individual applications.

Alternatives Rather than looking at alternatives for any particular permit action by the Corps, this EIS looks at various alternative futures for the study area. Based on how a particular permit action fits into the predicted future, this EIS provides information that will be useful in making decisions and determining cumulative impacts of individual permit action alternatives (including permit issuance, denial, project modification, or other mitigation).

Predicting Impacts (Alternatives) A group of local citizens and agency representatives (the ADG), at the Corps request, created and evaluated several predictions ("alternatives"). One of the alternatives represents the *status quo* (not considering the information provided by this EIS). Other alternatives include ideas that the ADG collectively or individually felt might occur or would like to see occur. Since the Corps cannot control the type of applications that are submitted, the EIS will present these alternatives and the evaluations. This information will be used in the review future applications.

<u>Relating to Local Planning (Comprehensive Plans</u>) The Corps' authority is independent of Florida's Comprehensive Planning process; however, existing Comprehensive Plans make reference and defer to State and Federal wetland permitting. The Lee County Comprehensive Plan states "...the county will not undertake an independent review of the impacts to wetlands resulting from development of wetlands that is specifically authorized by a DEP or SFWMD dredge and fill permit or exemption." The Collier County Future Land Use Map includes an "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." Collier County Land Development Code requires "...permits must be secured from State or Federal agencies prior to commencement of construction..." Comprehensive Plans designate land use. The Corps does <u>not</u> designate land use. Landowners are free to submit applications requesting authorization for any use. Landowners have submitted, and the Corps must accept, applications for permits that would fill wetlands for uses contrary to County Comprehensive Plans.

<u>Presenting Futures (Ensembles</u>) The EIS presents five predictions of what the study area will look like in approximately 20 years. Each prediction is called an "Ensemble" (assembled from predictions for the four sub-areas or "zooms"). The Ensembles are labeled "Q", "R", "S", "T", and "U". Each Ensemble consists of a map (showing location of development, preservation, agriculture, and other land cover types) and a variety of criteria that apply to activities within those land cover types. The ADG subdivided the study area into four pieces (called "Zoom A", "Zoom B" or "The Hub", "Zoom C", and "Zoom D") and created several alternatives for each. The ADG created a total of twenty-nine alternatives. Each Ensemble selects one alternative from Zoom A, one from Zoom B, one from Zoom C, and one from Zoom D so that the Ensemble covers the entire study area. Alternatives with similar characteristics were placed in the same Ensemble. For example, Ensemble R consists of the alternative in Zooms A that represents the Lee County Comprehensive Plan, the alternatives each from Zoom B, C, and D that represent the Lee County and Collier County Comprehensive Plans. The other Ensembles were assembled using alternatives that were similar to each other.

<u>Comparing Visions (Overlay of Alternatives</u>) The maps were overlaid to observe the similarities and differences in land cover/use among the different predicted futures (Ensembles). The various Ensembles propose the same future land cover type for 67% of the study area. In other words, the different Ensembles essentially share the same vision of the future landscape for 67% of the study area. Land cover/use types include items such as "urban" or "industrial" to indicate that the land cover will be commercial, retail, residential and other types of urban or suburban development. These areas of "development" identified in common for all the ensembles constitute 14% of the study area. For the remaining land cover/uses that were common to all the ensembles, it was found that "Lehigh Acres", "Golden Gate Estates" and "Rural" land cover types are similar for all futures on 8.8% of the study area, "agricultural" on 5.4%, and "preservation" on 38.8%. For 25% of the study area, one or more of the Ensembles map a location as "preservation" while other Ensembles map the same location as "development", "agriculture", etc. For the remaining 8% of the study area, each Ensemble maps different land cover types. While there is agreement among the various futures for 67% of the study area, different land cover/use is envisioned for 33% of the study area (25%+8%) by the various Ensembles.

Preferred Alternative(s) This EIS provides information on cumulative impacts which will be useful for future permit decisions. This EIS provides information that will help the Corps (and possibly other agencies) to better carry out their responsibilities. However, this EIS does not make a decision on any particular permit application. This EIS does not change any law, regulation, or policy of the Corps.

<u>Reviewing Future Permit Applications (Permit Review Criteria</u>) From the list of evaluation factors and the extent of the reported effects, the Corps has drafted a Permit Review Map (Map) and Permit Review Criteria (Criteria). The Map is based on the Overlay of Alternatives discussed above; some locations were designated "development", others "preservation", etc. The Criteria provides several lists of questions: if

the proposed project located within a "preservation" location on the Map, the applicant will be asked the "preservation" list of questions; if the proposed project is in "development" the applicant will be asked a different set of questions; and so forth. The questions are designed to compare the project's contribution to the total predicted cumulative effect. The evaluation of the cumulative effect of an individual project will be recorded in the memoranda the Corps prepares for every individual permit decision. The Map does not designate the Corps permit decision. For example, if an application submitted proposes construction of a residential development and if the project site is shown as "preservation" on the Map, the Corps will still consider all the circumstances and design of the individual project prior to deciding whether to issue or deny a permit. The difference is that additional attention will be given to the application in order to answer the questions listed by the Criteria for "preservation." A draft is enclosed as Appendix G.

Issues Raised by the Public and Agencies A number of issues were identified by the Alternatives Development Group and others. These include the following: property rights; water management; water quality; ecosystem function; wildlife habitat; listed species; regulatory efficiency and effectiveness; economic sustainability; local land use policy; avoidance of wetland impacts; mitigation; cumulative/secondary impacts; restoration/retrofit; and public lands management/use.

Areas of Controversy Decisions on permit applications and implementation of various other laws to protect environmental resources may be in conflict with certain plans for development and other land use changes. In addition, the question has been raised as to how much restriction on use of private property is justified by the public benefit of environmental protection. As long as there are strong and diverse viewpoints on these issues there will be a degree of controversy.

<u>Listening to Community Input (Comments</u>) The Corps' decisions on applications to fill wetlands have impacts on other issues important to the community. The Corps hosted the Alternatives Development Group and is using the Environmental Impact Statement (EIS) process to obtain public input in order to improve its understanding of these issues and to "fit into" the Comprehensive Plans, particularly where the Counties have deferred to or referenced the Corps on wetlands. Comments on the content of this Draft of the EIS will be used to revise the Draft and prepare a Final EIS. The Corps will then prepare a Record of Decision describing and decisions resulting from the EIS.

Unresolved Issues This EIS does not result in a decision on any particular permit application. It does explore the cumulative impact of the Corps regulatory decisions and decisions by others for the study area and provide information useful in determining the cumulative impacts of individual permit decisions. Each permit application will continue to be addressed on a case-by-case basis in accordance with laws and regulations. Similarly, the areas of controversy will be addressed on a case-by-case basis in accordance with applicable laws and regulations. The Corps recognizes that this EIS represents just one step in the development of an appropriate analysis that can appropriately describe the many interrelationships of wildlife and other issues across the landscape. The Corps is committed to, after the publication of this Draft EIS, 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 the extent that adverse impacts to listed species cannot be avoided and if adverse effects as defined by the Endangered Species Act remain, formal consultation may become necessary.

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1. PROJECT PURPOSE AND NEED

1.1 PROJECT LOCATION

The project area covers approximately 400,167 hectares (988,800 acres) in Lee County and portions of Collier County on the southwest coast of Florida. (**Figure 1**). The geographic area is defined as follows: the north boundary being the south shore of the Caloosahatchee River from its mouth at San Carlos Bay to the Hendry County line, a distance of approximately 54 kilometers (km) (34 miles); the east boundary being the Hendry County line to the City of Immokalee, then south along State Road 29 to the Ten Thousand Islands Area at Chokoloskee Bay; the south boundary being the Ten Thousand Islands and Marco Island; the west boundary being the coastline along the Gulf of Mexico (USACE 1998).

This study area was further subdivided into four sub-areas (zooms) referred to as Zoom A, Zoom B (also referred to as the "hub"), Zoom C, and Zoom D (**Figure 2**). Zoom A (798 square kilometers (sq. km) (308 square miles)) is bounded on the north by the Caloosahatchee River, on the west by the Gulf of Mexico, on the east by the Lee County-Hendry County line, and on the south by the northern boundary of the Estero-Imperial Integrated Watershed. Zoom B (the "hub") is roughly defined as the Estero-Imperial Integrated Watershed as it occurs within Lee and Collier Counties. The Estero-Imperial Integrated Watershed does extend into Hendry County, but the Hendry County portion was not considered during this process. Zoom B covers approximately 795 sq. km (307 sq. mi.). Zoom C, which encompasses1,194 sq. km (461 sq. mi.) is roughly defined as the western portion of the Faka-Union Watershed. The western boundary is the Gulf of Mexico while the Faka-Union Canal, Miller Boulevard (part of the eastern portion of Golden Gate Estates), Winchester Strand, and Big Corkscrew Island form the eastern limits. Zoom D is defined on the south by Chokoloskee Bay, on the east by State Road 29, on the north by State Road 846, and on the west by Zoom C. Zoom D is the largest of the four areas, covering 1,246 sq. km (481 sq. mi.).

1.2 PROJECT NEED OR OPPORTUNITY

The State of Florida, and the study area in particular, has undergone rapid growth and development over the last twenty years. With this increased development has come a concomitant increase in the number, the scope, and the complexity of development permit applications submitted to local, County, State, and Federal regulatory agencies. This situation has led to difficulty on the part of the Corps and these other agencies in, on a case-by-case basis, addressing their responsibilities under Federal and State law. Permit processing is taking longer, permit denials are becoming more frequent, and the environment may be receiving less protection than required by law. The subject EIS is designed to offer regulatory and planning-based remedies to these short-comings, by seeking an effective balance between natural systems and economic stability through the examination of natural and social interactions that occur in the study area.

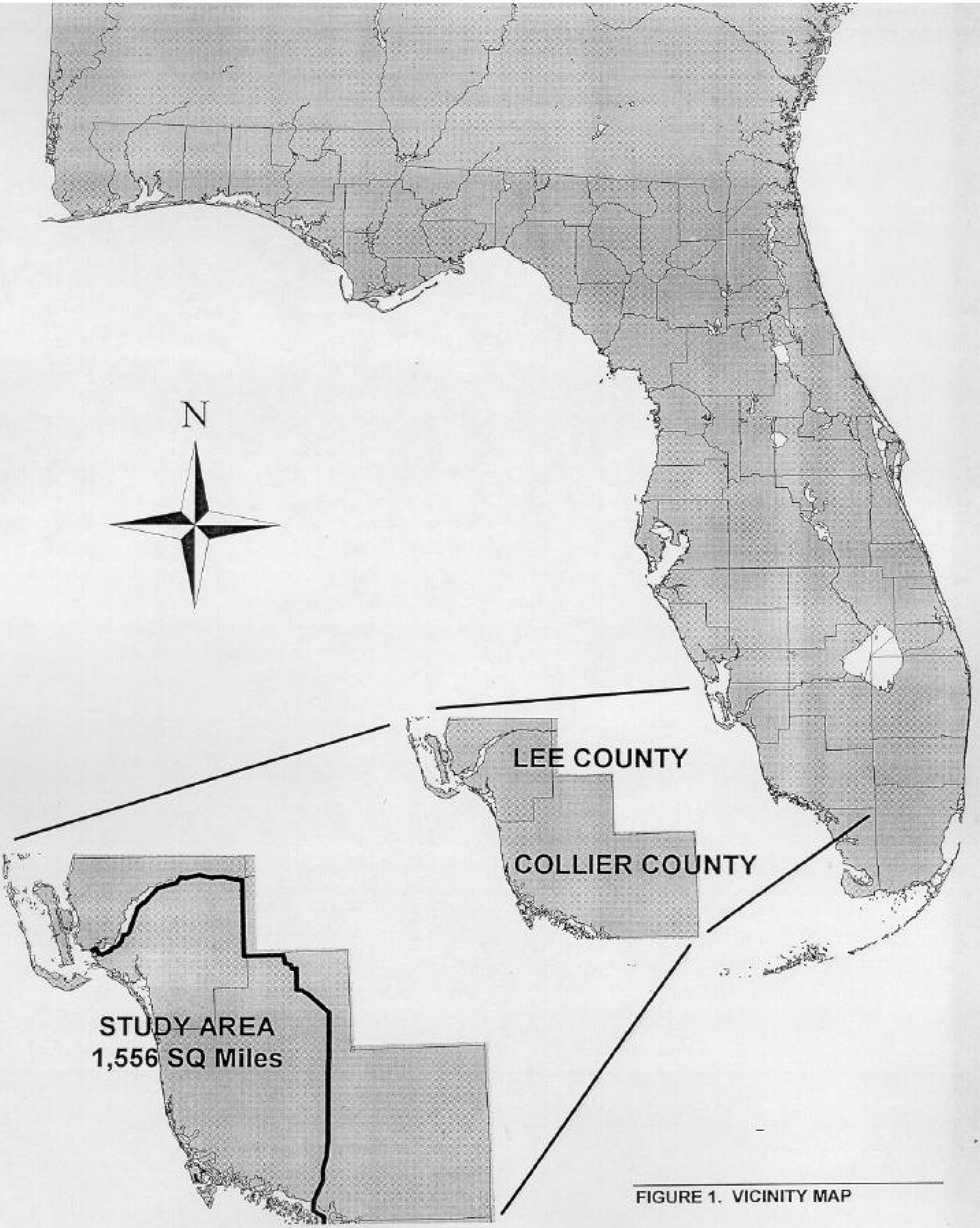
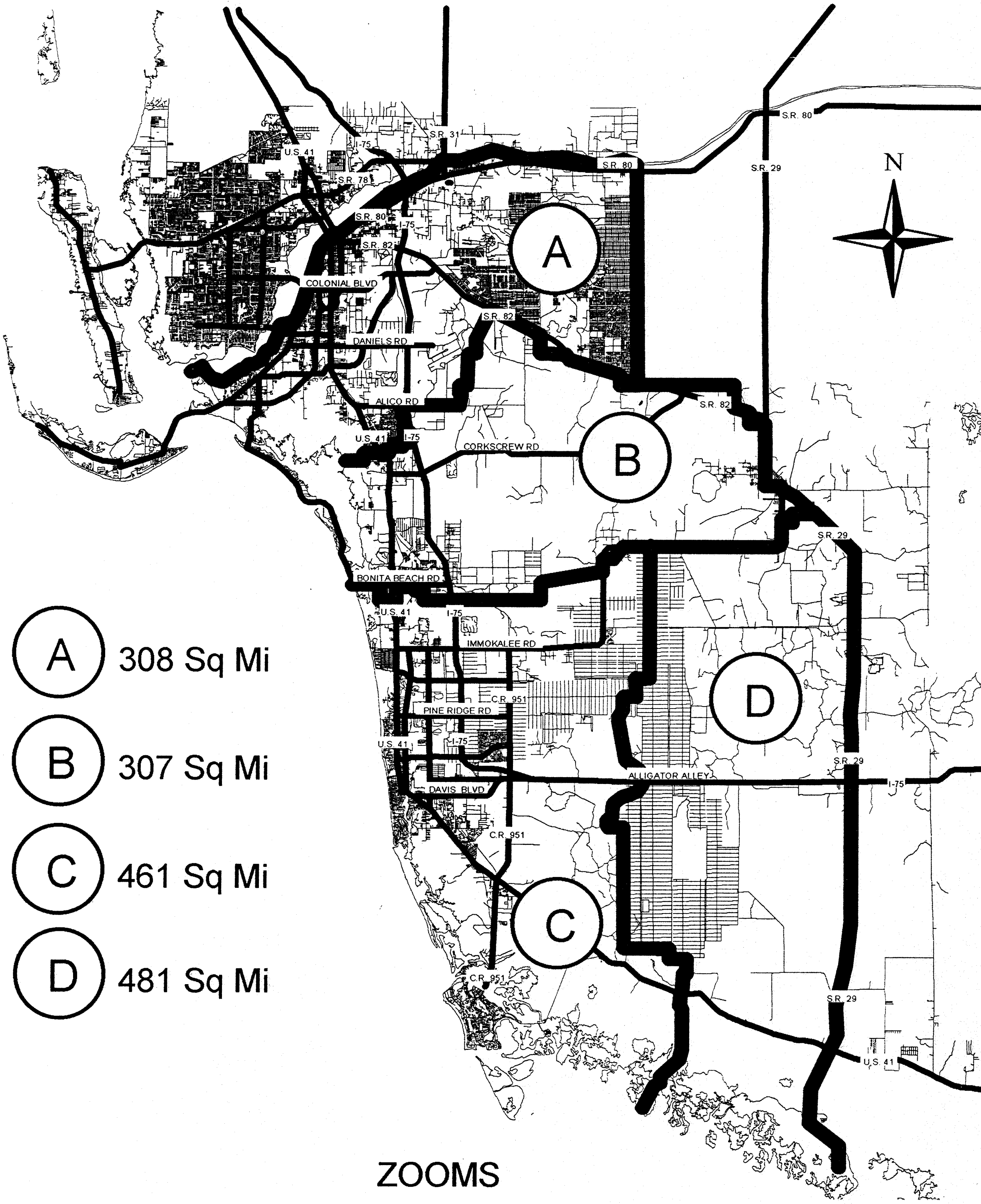


FIGURE 1. VICINITY MAP



ZOOMS

FIGURE 2. ZOOM AREAS

1.3 AGENCY GOAL OR OBJECTIVE

The purpose of this effort is to establish a better foundation of information and knowledge of existing conditions and identification of future alternatives for balancing the demands of growth and conservation. The goal of this effort is a more effective, timely, streamlined, cost-conscious, objective, productive, and predictable environmental permitting process for projects within the study area. The objective is to implement permit review criteria (keyed to a map) that provides specific questions to ask and answer during the review of an application. The purpose of these measures is to facilitate efficient, timely, and appropriate planning and permitting while affording an appropriate level of review to the cumulative effects on natural resources.

This document presents several potential future landscapes, each represent the potential outcomes of future decisions on permit applications. This document reports the impacts and benefits associated with the various future outcomes. The information presented in this EIS will be used to develop the permit review criteria, and an accompanying landscape map, that will be used, on individual applications, to evaluate the cumulative effect of the individual decision from a regional landscape perspective.

1.4 RELATED ENVIRONMENTAL DOCUMENTS

The following is a list of related documents:

1.4.1 NATIONWIDE PERMITS

Certain minor activities requiring a permit from the Corps have been determined to qualify for authorization by one or more Nationwide Permits under the Corps regulatory permit program. The Nationwide permits are issued for a period of 5 years in accordance with Section 404(e) of the Clean Water Act. In addition, activities requiring a permit pursuant to Section 10 of the Rivers and Harbors Act of 1899 may be authorized by certain Nationwide permits. The Nationwide permits are issued by the Chief of Engineers for application throughout the United States.

Since the Nationwide permits are valid for a period of 5 years, the Chief of Engineers must periodically reissue them. These actions are announced in the Federal Register (applicable announcement on December 13, 1996) and become part of the Code of Federal Regulations (33 CFR 330 and its Appendix A). The Nationwide permit re-issuance is conducted in compliance with the National Environmental Policy Act (an Environmental Assessment is prepared by the Chief of Engineers). In addition, the Nationwide permits comply with other applicable environmental requirements.

1.4.2 INDIVIDUAL PERMITS

Activities requiring an individual Department of the Army permit from the U.S. Army Corps of Engineers, would be evaluated on a case-by-case basis. These individual permit actions would normally require preparation of an Environmental Assessment or an Environmental Impact Statement (if there would be a significant impact on the human environment). A number of permit actions and associated environmental documents have been prepared for activities in the study area.

1.4.3 C&SF RESTUDY FEASIBILITY REPORT AND EIS

The study area of the document you are reading is within the region being examined under the Feasibility Report and EIS. The purpose of this report and EIS is to re-examine the Central and Southern Florida project and what might be done to mitigate the impacts or enhance the benefits of the Corps' project.

1.4.4 CRITICAL PROJECTS

Section 528 of the Water Resources Development Act of 1996 (WRDA 96) authorizes the Secretary of the Army to develop specific water quality related projects features which are essential to Everglades restoration. The section authorizes an appropriation of $75 million over three fiscal years for the construction of projects determined by the Secretary to be critical to the restoration of the Everglades.

A number of these "critical projects" are being pursued by the Corps. At least three of which would occur in the study area: Southern Golden Gate Estates, Lake Trafford, and Southern Corkscrew Regional Ecosystem Watershed (CREW). These projects would require preparation of an Environmental Assessment or an Environmental Impact Statement. In addition, a Fish and Wildlife Coordination Act Report was prepared for Southern CREW and Lake Trafford.

1.4.5 TIERED DOCUMENTS

Based on the principle of "tiering" (40 CFR 1502.20 and 1508.28), this EIS takes a broader geographic or programmatic approach. Future and more specific actions would be evaluated by subsequent documents. This document does not complete evaluation of the following items which are not yet ripe for decision: any specific permit action by the Corps of Engineers (Sections 404(a) and 404(e) of the Clean Water Act); any specific determination of jeopardy or incidental take by the U.S. Fish and Wildlife Service (Endangered Species Act); any denial or restriction for any specified area by the Environmental Protection Agency (Section 404(c) of the Clean Water Act); or any other regulatory action. This document does disclose, in a general way, the potential future outcomes of such actions for the study area to better evaluate the cumulative impacts of such actions.

The information in this EIS will be used as a reference and background for future documents (EISs and Environmental Assessments) prepared pursuant to the National Environmental Policy Act for these more specific actions. We expect this EIS to be particularly useful for evaluating cumulative impacts on important resources in the study area.

1.5 DECISIONS TO BE MADE

The information presented in this Environmental Impact Statement will result in specific questions to be used in the review of applications in Southwest Florida. This document does not directly lead to a permit decision on any specific application or for any particular property.

1.6 SCOPING AND ISSUES

A Notice of Intent (NOI) to prepare a draft of this EIS appeared in the Federal Register on 12 January 1998. In addition, the NOI was mailed to interested and affected parties by letter dated 12 January 1998. A copy of the letter and NOI are in Appendix C. Two public meetings were held to receive comments. At public meetings held on 9 February 1998, more than 200 people (of whom 60 spoke) attended and provided comments regarding geographic area, specific issues, and the manner of the EIS process. The Corps also addressed a joint session of the Boards of County Commissioners of Lee and Collier Counties. In addition, there was a series of intensive working meeting by the ADG to help develop alternatives, evaluation factors, and assessment of the impacts.

1.6.1 ISSUES EVALUATED IN DETAIL

The following issues were identified during scoping, through the meetings of the Alternatives Development Group (ADG), and by the preparers of this Environmental Impact Statement to be relevant to the proposed action and appropriate for detailed evaluation:

a. Property Rights

b. Water Management
c. Water Quality
d. Ecosystem Function, Wildlife Habitat, and Listed Species
e. Regulatory Efficiency and Effectiveness
f. Economic Sustainability
g. Local Land Use Policy
h. Mitigation
i. Cumulative/Secondary Impacts
j. Restoration/Retrofit
k. Avoidance of Wetland Impacts
l. Public Lands Management/Use

The ADG is a group of resource experts, regulatory agency personnel, concerned citizens appointed by actions of the Lee County and Collier County Boards of County Commissioners as well as through actions of other agencies and entities, and development and business interests representing their respective industries/interests. Further detail regarding the ADG and its charge are discussed in Section 2 - Alternatives.

1.6.2 IMPACT MEASUREMENT

The following provides the means and rationale for measurement and comparison of impacts of the proposed action and alternatives as selected by the ADG. For the purpose of utility, each issue is repeated followed by the factors developed as a means of measurement. They are as follows:

a. Property Rights
   1. Fair Market Value
   2. Vested Rights
   3. Reasonable Expectation For Use of Land and Return on Investment

b. Water Management
   1. Infrastructure Existence (Stormwater Utility/Maintain and Improve)
   2. Home Damage During Storm Events (Level of Flood Protection)
   3. Home Construction to Meet the One-Hundred Year Storm Event
   4. Flood Depth and Duration
   5. Historic Flow Patterns (Maintain and Improve)
   6. Adequate Water Storage (Balance Consumption with Hydroperiods)
   7. Groundwater Data Floors and Ceilings (Aquifer Zoning)

c. Water Quality
   1. Pollution Loading
   2. Freshwater Pulses
   3. Habitat Loss
   4. Groundwater Impacts

d. Ecosystem Function, Wildlife Habitat, and Listed Species
   1. Effects on Florida Game and Fresh Water Fish Commission's (FGFWFC) Strategic Habitat Conservation Area (SHCA) habitat planning objectives (GAPS)
   2. Effects on the U.S. Fish and Wildlife Service's (USFWS) Priority I and II Florida Panther habitat (Florida Panther Habitat Preservation Plan).
   3. Effects on Southwest Florida Regional Planning Council (RPC) Resources of Regional Significance
   4. Effects on USFWS Draft Multi-species Recovery Plans for South Florida and Recovery Plans for Federally listed species.
   5. Effects on Occurrences of Listed Species

6. Effects on Occurrences of Rookeries
7. Effects on Loss of Native Plant Communities (Common and Rare)
8. Effects on Fragmentation and Connectivity of Plant and Animal Habitats
9. Effects on Loss of Seasonal Wetlands
10. Effects on Integrity of Flowways (Rivers, Sloughs, and Strands)
11. Effects on Wetlands of Importance to Critical Wildlife
12. Effects on Aquatic Resources

e. Regulatory Efficiency and Effectiveness
   1. Permit Review Time and Level of Effort
   2. Pre-identified Impact/Mitigation and Preserve Areas
   3. USFWS/FGFWFC General Concerns Addressed

f. Economic Sustainability
   1. Job Creation
   2. Home Affordability
   3. Cost of Living
   4. Property Tax Base
   5. Cost to Implement
   6. Increased Taxes
   7. Environmental Justice

g. Local Land Use Policy
   1. Significance of Conflicts with Local Land Use Plans and Regulations
   2. Hurricane Preparedness (i.e., Evacuation Routes and Shelter Availability)

h. Mitigation
   1. Total Acres Provided for Mitigation Opportunity
   2. Total Wetland Function Improvement Opportunity Provided

i. Cumulative/Secondary Impacts
   1. Impacts on Infant Mortality
   2. Impacts on Road Needs
   3. Impacts on Air Pollution Loading
   4. Impacts on Water Pollution Loading
   5. Impacts on Crime Rates
   6. Impacts on Hurricane Vulnerability
   7. EPA Index of Watershed Indicators
   8. Impacts on Wetlands Only
   9. Impacts on Hydrology
   10. Amount of Lands in Public and Private Ownership in Protected Status

j. Restoration/Retrofit
   1. Natural Functions Maintained in Natural Systems (i.e., Flowways)
   2. Exotic Species Control (Percent and Size of Parcels Treated and Restored)
   3. Percent of Residents Using Self-Supplied Infrastructure (i.e. Septic Tanks)
   4. Percent of Agricultural Land Applying Best Management Practices (BMP)
   5. Wildlife Habitat Restoration

k. Avoidance of Wetland Impacts
   1. Total Acres at Risk
   2. Total Wetland Acres by Functionality at Risk

l. Public Lands Management/Use

1. Compatibility with Land Management Plans
2. Degradation or Improvement of Resources on Public Lands

The means of evaluation within each impact issue was based upon analysis of local data and assessment of proposed changes against existing and proposed economic and resource protection goals.

1.6.3 ISSUES ELIMINATED FROM DETAIL ANALYSIS

The following issues were not considered during the detailed analysis as part of this Environmental Impact Statement. The ADG identified two issues that did not fit within the twelve previously listed issue categories; a holistic approach to management, and higher standards for data and information. The ADG concluded that these were goals to strive for in Southwest Florida, not issues that could be addressed in the development of alternatives (ADG 1998) for the purposes of this EIS.

1.7 PERMITS, LICENSES, AND ENTITLEMENTS

No local, State of Florida, or Federal permits are required at this time. However, individual permit applications would be evaluated on a case-by-case basis. See also Section 2.7 on Implementation and Section 4.30 on Compliance with Environmental Requirements.

2. ALTERNATIVES

The alternatives section is the heart of this EIS. This section describes the “status quo” alternative, the proposed action, and other reasonable alternatives that were studied. Because termination of the Corps’ regulatory process in Southwest Florida is not a practicable solution, there is no true No-Action Alternative.

Based on the information and analysis presented in the sections on the Affected Environment and the Probable Impacts, this section presents the beneficial and adverse environmental effects of all alternatives in comparative form, providing a clear basis for choice among the options for the decisionmaker and the public.

A unique dimension of this EIS is the formation of the ADG to support the Corps in the drafting of the EIS. The ADG was specifically tasked with the creation and evaluation of the alternatives to be considered and evaluated in this EIS.

Accordingly, the Corps initiated and sought participation for the ADG which consisted of key individuals representing the interests and vision of Southwest Florida. The specific charge of the ADG as offered by the Corps was to:

“*Report on alternatives for improving the regulatory process to:*

- *protect natural environmental values*
- *provide for sustainable economic growth*
- *manage appropriate changes in water flows and quality*
- *respect public involvement and private rights*

The ADG will collectively develop alternatives, evaluate the merits of each and seek consensus on recommendations” (ADG 1998).

To effectively accommodate the charge and, more importantly, to create alternatives and evaluation factors that will bring added efficiency to the regulatory activities in the future, it was imperative that this be a collaborative effort, drawing upon the perspectives of the key stakeholders in the Southwest Florida. The Corps worked closely with the Lee and Collier County Commissions and others in selecting, from a large number of interested persons, representatives to the ADG. The ADG encompasses a range of backgrounds and interests, offering technical and political perspectives, as well as interests, that are driven by both environmental pursuits and economic development motivations. There was also representation of the general public on the ADG (ADG 1998).

2.1 CONVERSION OF ADG ALTERNATIVES TO EIS ENSEMBLES

For ease of analysis, the alternatives developed by the ADG were combined into Ensembles.

2.1.1 CODING SYSTEM APPLIED TO ADG ALTERNATIVES.

The ADG developed many alternatives. Each alternative map has from three to six legends, each legend defines the geographic areas mapped by the alternative. As described in Chapter VII of the Final Report from the Alternatives Development Group (Appendix D), each legend was then categorized into "families" and "subfamilies." A "family" is the general land cover that is intended by the legend. A "subfamily" is the review criteria applied to the legend. For example, the legends **Urban**, **Industrial** and **Develop (Compensate off-site for wide ranging species)** all envision that Corps Permits and/or other decisions will result in urban and/or suburban land cover. These legends are assigned to the same "Development" family. However, the **Develop (Compensate off-site...)** legend envisions that the Corps' Permit decision will include off-site compensation. This criteria is not explicitly described by the **Urban** legend. Therefore, the two legends are assigned to different subfamilies within the "Development" family. Numerical codes are assigned to ease subsequent analysis. In this example, all three legends are coded family number 100 (Development). The **Urban** and **Industrial** legends are coded subfamily number 110 and the **Develop (Compensate off-site...)** is assigned subfamily number 130. The result is analogous to having a set of building blocks, each piece representing a unique subfamily code. Each of the alternatives can then be depicted as assemblies of these building blocks.

2.1.2 OVERLAY OF ADG ALTERNATIVES

Using this coding scheme, the alternative maps were then overlaid to find which geographic locations were mapped with similar legends. The results are presented by figure VII-1 of the Final Report from the Alternatives Development Group (Appendix D), repeated here as **Figure 3A**. For 67% of the study area, the alternatives mapped the same family. These are the areas with crosshatching. Within any single crosshatch area, however, the alternatives presented different descriptive language or criteria which, as described, were numerically coded as subfamilies. Fundamentally, the alternatives do not vary the land cover type but vary in the review criteria to be applied. For 25% of the study area, the alternatives mapped a combination of two families. For example, in some locations the two families might be Development and Preserve, or Preserve and Agriculture, etc. These are the areas in gray. For the remaining 8% of the study area, shown in white, the alternatives map more than two families.

2.1.3 IDENTIFYING THE OPTIONS

The goal of this EIS is to present the optional land cover types and review criteria for the gray areas in the overlay map. These options are presented by five "Ensembles." Each "Ensemble" comprises four of the twenty nine alternatives created by the ADG. The ADG subdivided the study area into four pieces (called "Zoom A", "Zoom B" or "The Hub", "Zoom C", and "Zoom D") and created several alternatives for each. Each Ensemble selects one alternative from Zoom A, one from Zoom B, one from Zoom C, and one from Zoom D so that the Ensemble covers the entire study area. Alternatives with similar characteristics were placed in the same Ensemble. For example, Ensemble R consists of the alternative in Zooms A that represents the Lee County Comprehensive Plan, the alternatives each from Zoom B, C, and D that represent the Lee County and Collier County Comprehensive Plans. The other Ensembles were assembled based on a combination of: the similarity in the proportion of acreages mapped for land cover types (assisted by the family coding system, for example: alternatives within each Zoom that map the largest number of acres for the Development family are placed in Ensemble Q); the similarity of the legends (assisted by the subfamily coding system, for example, the alternatives within each Zoom that describe similar criteria to maintain the low density mix of uses within the Rural family are placed in Ensemble S); and the similarity of the individual alternative maps when joined to their neighbors.

2.1.4 ALTERNATIVES ELIMINATED FROM EVALUATION

Not every alternative was placed into an Ensemble because there are not an even number of alternatives and the result would be a large number of Ensembles with many duplicate features. The subfamily coding system was used to ensure that all criteria found in the entire set of alternatives were represented in the Ensembles. For example, one of the alternatives not assembled into an Ensemble describes criteria for Golden Gate Estates, but those criteria are found in Ensemble S because the criteria were also used by another alternative. Therefore, none of the features in the alternatives are eliminated.

2.1.5 USE OF ENSEMBLES

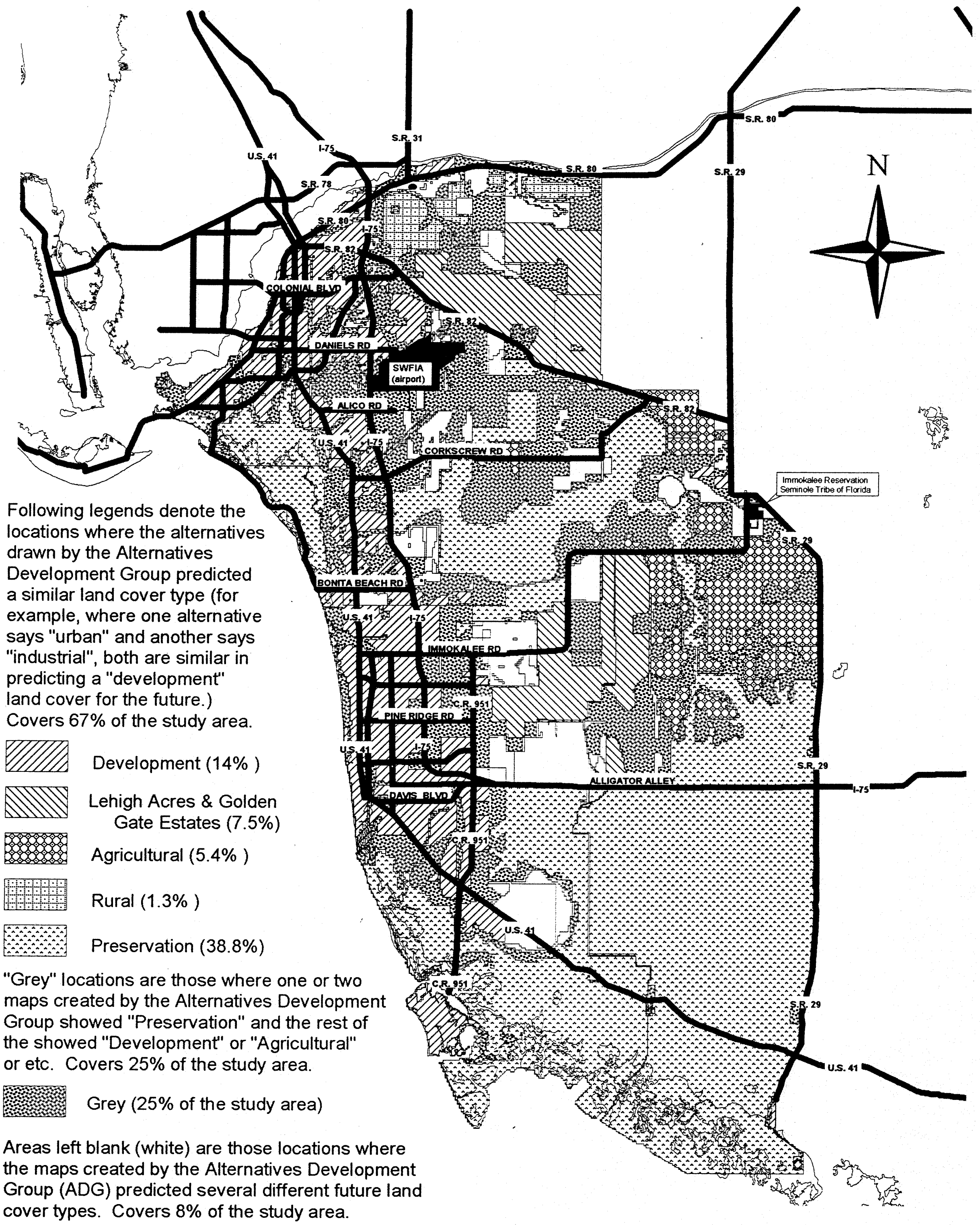
The evaluations in this EIS are presented using five Ensembles. As described above, a numeric coding system was used to ease the preparation of a suite of Ensembles that represented the range of options. Hereafter, the term "land cover types" will be used instead of "family" code and the term "review criteria" will be used instead of the "subfamily" code. The Ensembles are labeled Q, R, S, T, and U.

2.2 IMPLEMENTATION

This EIS will not identify a preferred alternative. The Ensembles presented by this EIS describe several "futures" that might result from a combination of actions by many landowners and, for those subset of projects that involve fill in wetlands, actions by the Corps. A landowner submits an application to the Corps requesting authorization to place fill in wetlands in order to construct some project on some parcel of land. The Corps considers the characteristics of the parcel and the benefits and impacts ascribed to the proposed project to decide whether or not to issue a Department of the Army Permit (Permit). The Permit, if issued, authorizes the placement of fill. The parcel's "land cover type" changes from wetland to something else (for example, residential). For any single parcel that includes wetlands, a prediction of the future (say twenty years) land cover type depends on the combination of (1) whether the landowner proposes to fill the wetlands and (2) what the Corps decides after considering the project specific information. All of the landowners in the study area could possibly construct all of their projects in such a way that would result in a land cover type map that exactly matches Ensemble R. However, it is not unlikely that some of the landowners in the study area will construct projects that do not match Ensemble R. These differences could be reflected in the different maps of Ensembles Q, S, T and U. In addition, for the portion of the total set of projects that involve wetland fill, the landowners' applications and the Corps' permit decisions may not exactly match any one particular Ensemble. The Ensembles do not represent all the possible combinations of projects and permits but are representing a range of possibilities. Each Ensemble represents the <u>cumulative</u> total of all the projects, including the subset of those with permit decisions rendered by the Corps. The accompanying evaluation of those Ensembles present the <u>cumulative</u> total benefits and impacts. Along with an evaluation of direct impacts, the Corps will, as part of the decision for an individual application, consider the proposed project's incremental contribution to the cumulative total. The decision will give appropriate weight to the cumulative and appropriate weight to the individual impact or benefits of the proposed project. The remainder of this section describes how the Corps could use this information to improve its reviews.

2.2.1 USE OF THE "OVERLAY OF ALTERNATIVES" MAP

The Ensembles propose the same land cover type for 67% of the study area. For example, the alternatives created by the ADG variously use legends such as "urban," "industrial" or "development" on 14% of the study area to indicate that the land cover will be commercial, retail, residential and other types of urban or suburban development. These areas of similarity are mapped with cross-hatching on **Figure 3A**. The remaining cross-hatching represents development within the Lehigh Acres, Golden Gate Estates, and rural areas (8.8%), agricultural areas (5.4%) and preservation areas (38.8%). (This figure is also found in Chapter VII of the Final Report from the Alternatives Development Group.) Therefore, if a landowner submits an application for some type of urban or suburban development within the cross-hatched 14% of the study area, the Corps could decide, as a result of this EIS, that its permit reviewers need not spend extensive time on questioning whether the development should be located elsewhere, for example, preparation of an analysis of alternative geographic locations for the project. The Corps decision to implement such a change in its permit reviews will, if a change is made, be presented in the Record of Decision after the completion of this EIS. Then, in the subsequent permit reviews, the Corps will incorporate by reference this EIS in the environmental assessment supporting the permit decision. The benefits of such a change would include: increased certainty for the landowner submitting the application; increased efficiency by reducing the permit review time; and increased effectiveness in that hours the Corps staff would have spent on this question can now be spent addressing natural resource concerns on other applications.



OVERLAY OF ALTERNATIVES

FIGURE 3A. OVERLAY OF ALTERNATIVES

2.2.1.1 Sixty-Seven Percent of Overlay Map

Within the 67% crosshatched area, the Corps still will review certain details of the development's design to understand the impacts and benefits to various issues as required under Federal Law. Most Ensembles associate its legends with new review criteria. For example, Ensemble R (that represents the Comprehensive Plan) associates the "development" legend with the policies and procedures that implement the Comprehensive Plan. Other Ensembles use the "development" legend but associate additional criteria beyond those in the Comprehensive Plan. These five Ensembles present a variety of review criteria. The reviewers will ask the applicant questions based on the review criteria. The Corps will pick and choose criteria from several of the Ensembles and, with refinement, implement the final set in the review of permit applications. The Corps will present its decision to implement such a change in its permit application reviews in the Record of Decision after the completion of this EIS. The benefits of such a change will include: increased certainty over which issues will be reviewed; increased applicant efficiency through knowing up front what the issues are; and, increased effectiveness since there will be less likelihood an issue would be overlooked in the press of review. The Corps could also decide, after the EIS is completed, to further refine some of the criteria and issue a public notice proposing a Regional General Permit for certain activities in certain portions of the study area.

2.2.1.2 Thirty-Three Percent of Overlay Map

For the remaining 33% crosshatched portion of the study area, the Ensembles do not agree on the land cover types. For 25% of the study area, the difference is between two land cover types, for example, one Ensemble maps "preserve" and the others "development." This 25% is shown in gray on **Figure 3A**. For the remaining 8%, shown in white on **Figure 3A**, there are three or more land cover types mapped.

2.2.1.3 Twenty-Five Percent of Overlay Map

For the 25% (gray) area, the fundamental disagreement is on the appropriate geographic boundary between two adjacent land cover types, and commonly this is between "preserve" and some other land cover type. The quantity and location of native vegetation that is or is not preserved influenced many of the evaluation factors(presented in Chapter 4), particularly those related to wildlife. The Corps could decide, as a result of this EIS, that its permit reviewers will assess the direct cumulative effect on wildlife through assessments of impacts to native vegetation preserved. (This would not necessarily be the only measurement for effects on wildlife.) The Corps decision to implement this measurement will be presented in the Record of Decision after the completion of this EIS. The benefits of such a measurement will include: increased certainty for the "yardstick" to be used; increased efficiency (after several projects) since the measure will become familiar to reviewers; and increased effectiveness since there will be an opportunity to track certain evaluation factors for management review. The Corps recognizes that some of the evaluation factors as used in Chapter 4 rely on best professional judgment, but they do provide clear acknowledgment and some indication of the order of magnitude of the cumulative benefit or impact from Corps permit decisions.

2.2.1.4 Eight Percent of Overlay Map

For the 8% (white) area, review of permit applications will be challenging. The evaluations in this EIS ascribe benefits to the local economy from expansion of development but the evaluations also show serious incremental impacts to natural resources. There is not a defined "threshold" number of acres of preserve or development where unequivocally a certain number of these acres are considered to be the ideal balance between natural resources and economic development. This EIS presents multiple evaluation factors and expresses each as relatively simple indices (such as percent of study area) that could be used to compare the many benefits and impacts.

2.2.2 THE "PROJECT REVIEW CRITERIA"

The above concepts will be applied to day-to-day permitting through a document called the Project Review Criteria. This document consists of permit review criteria that are keyed to a map of land cover types (Project Review Map). These land cover types are the same as those mapped in **Figure 3A** for the 67% (crosshatched) portion of the study area. The Project Review Criteria are independent of the Comprehensive Plan. For example, the landowner would present a proposed project to either Collier County or Lee County. The County's review is based on the policies and criteria described in the County's Comprehensive Plan and other implementing ordinances, some of which (such as density) are keyed to the Future Land Use Map. Both Collier County and Lee County require that appropriate State and Federal permits be obtained either before issuance of the County development order or commencement of construction. If the proposed project involves fill in wetlands, the landowner also submits a permit application to the State under the joint application process with the Corps. The Corps' review is based on the policies published in the Code of Federal Regulations including the Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines) issued by the U.S. Environmental Protection Agency under Section 404(b)(1), 40CFR230. The Project Review Criteria and associated Project Review Map has been developed consistent with the 404(b)(1) Guidelines, particularly Subpart B. The Project Review Criteria acting in concert with the Comprehensive Plan, will assist all levels of government to support the Clean Water Act and Endangered Species Act. The draft of the Project Review Criteria and associated Project Review Map is found at Appendix H. If a proposed project is in an area mapped with the development land cover type, then the development subset of the Project Review Criteria is used. For 67% of the study area the land cover types in the map for the Selected Review Criteria match the land cover types of all of the other alternatives created by the ADG and the County Comprehensive Plans (these are the cross-hatched areas of the "Overlay of Alternatives" map). For the remaining portion of the study area (the gray and white areas of the "Overlay of Alternatives" map), the Federal agencies considered the choices presented by the Ensembles and selected land cover types that appear to most effectively protect the Federal interest. The draft list of criteria and the associated map are based on Ensemble S, but the Federal agencies deleted some pieces, selected some pieces from other alternatives, and added clarifying language and formatting.

2.2.3 ADDITIONAL ANALYSIS.

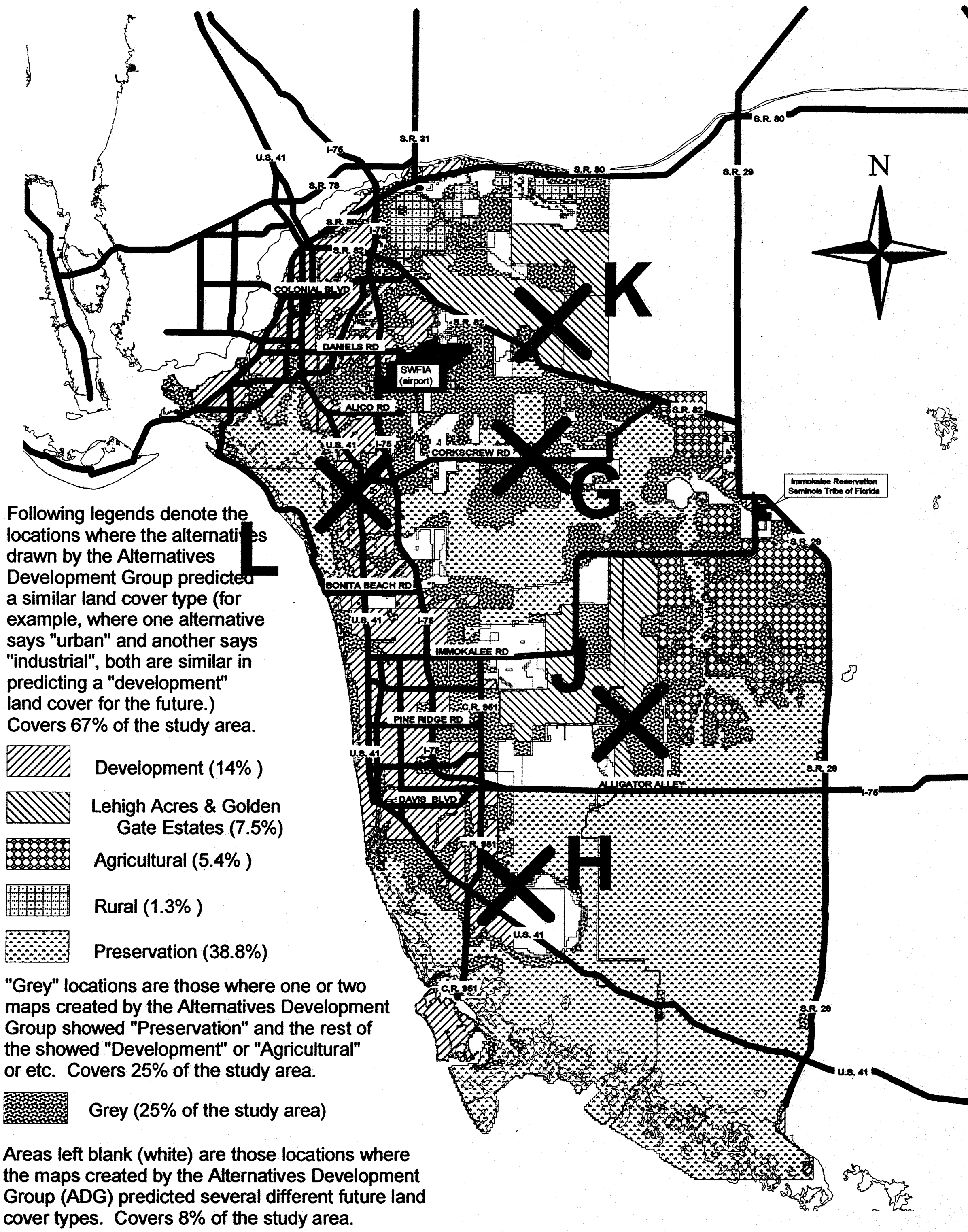
The evaluation factors used to analyze the effects presented in this EIS are not elaborate. Their purpose is to present the differences between the Ensembles. They are incorporated into the Draft Permit Review Criteria to ensure this information is used in review of permit applications. The Corps recognizes that this EIS represents just one step in the development of an appropriate analysis that can appropriately describe the many ecological relationships and other issues across the landscape. The Corps is committed to, after the publication of this Draft EIS, working with the U.S. Fish and Wildlife Service and other agencies 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.

2.2.4 PRESUMPTION

An application that does not address the listed criteria or proposes a land cover type different from the map will initially be presumed to be contrary to the Federal interest. This does not imply that the Corps permit will "automatically" be denied. This presumption will be either rebutted or confirmed based on project specific information during the individual application review. The Project Review Criteria is to assist the reviewer and landowner to determine the individual project contribution to the cumulative effects (including direct, indirect, and interrelated impacts) on the ecosystem. The Corps is not establishing a threshold acreage or location for any of the land cover types, but will use the quantities and geographic descriptions in the criteria (based on the associated map) to better understand the various impacts and benefits resulting from the proposed project.

2.2.5 ILLUSTRATIONS

Several hypothetical applications follow that illustrate the use of the two maps. The project sites are marked on **Figures 3B** and **3C**.



OVERLAY OF ALTERNATIVES

FIGURE 3B. SITE LOCATIONS FOR ILLUSTRATIONS ON OVERLAY MAP

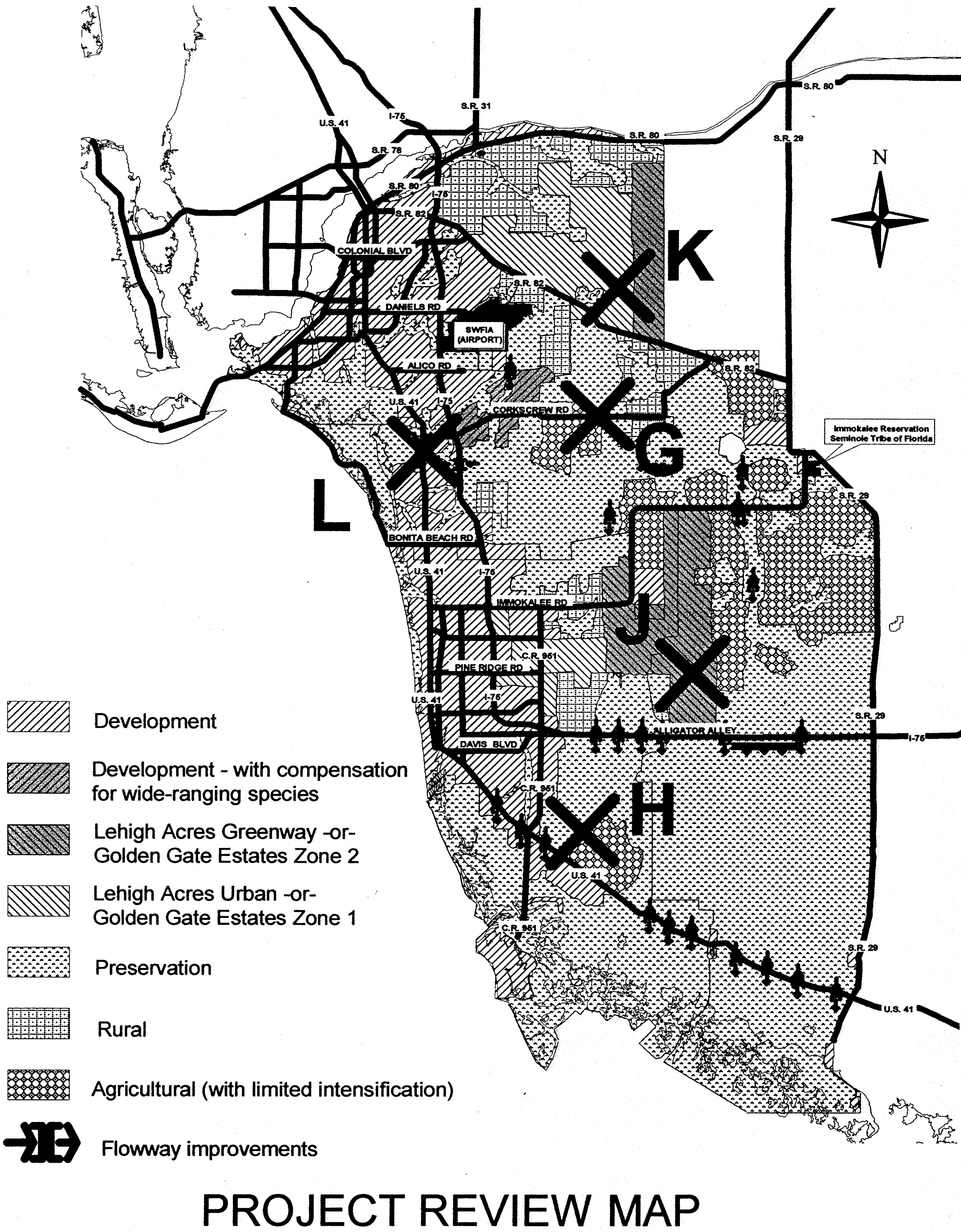


FIGURE 3C. SITE LOCATIONS FOR ILLUSTRATIONS ON PROJECT REVIEW MAP

2.2.5.1 Illustration “G”

The landowner for site "G" proposes to clear and fill wetlands to construct canals and dikes for agriculture. Some alternatives map this location as agriculture, some as preserve. This is part of the 25% of the study area that is "gray." The Project Review Map shows Preserve. The reviewer will use the subset of criteria listed under Preserve to ask questions of the applicant. One of the proposed criteria questions whether native vegetation is preserved to provide habitat connection between the Corkscrew Regional Ecosystem Watershed (CREW) and other areas. This question is included in the list of criteria because the Ensembles present varying number of connections, that is, one Ensemble maintains a large number of connections and others show the cumulative result of potential permit decisions to sever connections. Several of the evaluation factors were influenced by the change in the presence of connections, particularly those related to wildlife and to public lands. If these criteria are adopted, an application that proposes to sever the connection between the CREW and the adjacent publicly owned preserve will be presumed, unless rebutted, to be contrary to the Federal interest due to the incremental adverse impact to the wildlife and public land factors. Another of the proposed criteria questions whether habitat is maintained for the Florida panther. This question is included in the list because the Ensembles present different percentages of the panther habitat remaining within contiguous preserves. The evaluation factor for the Florida panther reported beneficial effects of maintaining habitat in contiguous preserves. If this criteria is adopted, an application that proposes to eliminate panther habitat will be presumed, unless rebutted, to be contrary to the Federal interest due to the incremental loss of contiguous preserve. These two measurements (presence of connection and presence of panther habitat) would be used when the cumulative effect of the proposed project is assessed. The evaluation measurements can also be used by the landowner when designing the footprint of the project. If the site is proposed for a mitigation bank, these same evaluation factor measurements could be used to calculate the benefits of the proposal.

2.2.5.2 Illustration “L”

The landowner for site "L" proposes to clear and fill wetlands to construct infrastructure for a residential development. All alternatives map this location for development but some map a wide preserve on either shore of the river. This is part of the 67% of the study area that is cross-hatched. The Project Review Map shows this part of Lee County as development and show preserves along the waterways. The reviewer will use the subset of criteria listed under Development to ask questions of the applicant. One of the proposed criteria questions whether adequate buffer zones are provided to streams. This question is included in the list of criteria because the Ensembles present varying width of flowways; that is, some Ensembles describe or map wide buffer zones around streams. Several of the evaluation factors were influenced by the width or presence of flowways, including those related to water management. If this criteria are adopted, an application proposing a wide buffer will be presumed, unless rebutted, not to be contrary to the Federal interest. Another one of the criteria questions whether a buffer is provided for Bald eagle nests. The evaluation factor for this species was influenced by the presence of contiguous preserve in conjunction with buffering the nest. If this criteria is adopted, an application that does not maintain bald eagle buffers preserve will be presumed to be contrary to the Federal Interest.

2.2.5.3 Illustration “J”

The landowner for site "J" proposes to clear and fill wetlands to construct a home. Some of the Ensembles map this location as residential development of this nature and other Ensembles map the remnant of the Picayune Strand as preserve. This is within the 25% of the study area that is "gray." The Project Review Map shows this as Golden Gate Estates Zone 2. The reviewer will use subset of criteria listed under Golden Gate Estates to ask questions of the applicant. One of the criteria questions whether the clearing of native vegetation exceeds a certain amount. This question is included in the list of criteria because the Ensembles by map or criteria present a range in the quantity of vegetation preserved. Some of the evaluation factors were influenced by the quantity of native vegetation, particularly those related to wildlife. If this criteria is adopted, an application that proposes to clear the entire site will be presumed, unless rebutted, to be contrary to the Federal interest due to the incremental impact to the wildlife factors.

2.2.5.4 Illustration “K”

The landowner for site "K" proposes to clear and fill wetlands to construct a home. All of the Ensembles map this location for residential development and therefore it is part of the 67% of the study area that is cross-hatched. The Project Review Map shows this as Lehigh Acres. The reviewer will use the subset of criteria listed under Lehigh Acres to ask questions of the applicant. One of the proposed criteria questions whether seasonal wetlands and their interconnections are maintained. This question is included in the list of criteria because the Ensembles present different percentages of the number of seasonal wetlands remaining within contiguous preserves (with the remaining seasonal wetlands either authorized for fill or surrounded by development). Several of the evaluation factors for wading birds in general and Wood storks in particular were influenced by the quantity remaining in contiguous preserves. Preserving these wetlands in a contiguous preserve was considered beneficial. This site is within the foraging range of some wading bird rookeries. If this criteria is adopted, an application that proposes to degrade or sever connections between the seasonal wetlands will be presumed, unless rebutted, to be contrary to the Federal interest due to its impact to the wading bird evaluation factor. Another proposed criteria questions whether Scrub jay families are protected. This question is included in the list of criteria because the Ensembles present varying levels of protection for Scrub jay families. The evaluation factor for this species was influenced by the presence of contiguous preserve in conjunction with the family. If this criteria is adopted, an application that does not maintain a wide or contiguous preserve will be presumed to be contrary to the Federal Interest. The Lehigh Acres subset of the Project Review Criteria also list criteria that encourage modification of the water management system. This encouragement is included in the list because some of the Ensembles included these modifications. Some of the evaluation factors, particularly for water quality, indicate that benefits to the natural resources would result. The Corps would not implement this modification but would use the information in this EIS, among other sources, if a landowner proposed such a modification. These ideas, and others presented throughout the Ensembles, may warrant further consideration in future studies.

2.2.5.5 Illustration “H”

The landowner for site "H" proposes to clear and fill wetlands to construct a residential development. One of the Ensembles maps this location for residential development but others map it as agriculture or preserve. This area is within the 8.4% of the study area that is shown as "white". The Project Review Map shows this as Agriculture. The reviewer will use the subset of criteria listed under Agriculture to ask questions of the applicant. One of the proposed criteria questions whether a "strict" alternative analysis has been performed by the applicant under the Guidelines issued by the U.S. Environmental Protection Agency under Section 404(b)(1) of the Clean Water Act. An alternative analysis seeks, among other things, to identify another site with less impact to the ecosystem. This question is included because the Ensembles present different extents of development and agriculture. Many evaluation factors were influenced by an increase in the area of development and/or decrease in the area of agriculture. For several factors, this change was not beneficial to natural resources. The Project Review Criteria in this instance "errs on the side of the natural resources" by requiring an elaborate geographic and site design alternative analysis if the proposed land use is different from the land cover type mapped. If this criteria is adopted, an application that proposes a land cover type to something other than agriculture will be presumed, unless rebutted by the elaborate alternative analysis, to be contrary to the Federal interest. The alternative analysis would use, among other things, some of the evaluation factor measurements described in this EIS and the Project Review Criteria to assess the impact to natural resources of alternative geographic site or site plans.

2.2.6 Result

The Corps will remain cognizant of the direct and cumulative impacts of an individual permit decision by using the Project Review Criteria, associated Project Review Map, and the evaluations presented by the Ensembles. Potential cumulative impacts will influence the individual permit decision. The Ensembles and the Project Review Criteria are not maps of where permits will or will not be issued. This EIS does not replace consideration of individual circumstances unique to the site. In addition, others beside the

Corps are encouraged to use this document since it represents visions presented by representatives of the community.

2.3 DESCRIPTION OF ENSEMBLES.

2.3.1 ALTERNATIVES CONSIDERED

As detailed in the previous section, the Corps developed five of alternative "Ensembles" in an effort to streamline the presentation of the mass of information from the many alternatives developed by the ADG (Appendix D). **Table 1** shows the relationship between the Ensembles and the alternatives developed by the ADG. **Table 2** provides the expected land use acreages within the study area for each of the Ensembles. These Ensembles differ in their specific levels of preservation and protection of resources, as well as the development potential (see **Figure 4** comparing the expected land use distribution under the various Ensembles, and **Figures 5 through 9** which are maps depicting typical land use patterns expected under the various Ensembles).

TABLE 1: RELATIONSHIP BETWEEN THE ALTERNATIVE ENSEMBLES AND THE 28 ADG ALTERNATIVES (zoom = sub-area)

Ensemble ↓ Zoom→	ADG Alternatives A	B	C	D
Q	4	4A	4	4
R	Status Quo	Status Quo	Status Quo	Status Quo
S	2	2A	2	2
T	3A	2B	3A	3
U	5	3B	1A	1A

TABLE 2: EXPECTED LAND USE FOR SOUTHWEST FLORIDA STUDY AREA FOR ALTERNATIVE ENSEMBLES (IN THOUSANDS OF ACRES)

EXPECTED LAND USE	Q	R	S	T	U
Lehigh (re-development)[1]	46	0	0	0	0
Lehigh (water storage area)[2]	10	0	0	0	0
Lehigh Acres (zone limitations)[3]	0	0	36	0	0
Lehigh (restore/fix)[4]	0	0	0	34	0
Lehigh (restore/fix & zone limitations)	0	0	0	0	34
Lehigh (greenway)	0	0	15	0	0
Golden Gate (development criteria)[5]	0	0	55	51	54
Other Development	346	363	213	253	223
TOTAL DEVELOPMENT	404	363	320	339	312
Agriculture (end go preserve)[6]	0	0	0	54	0
Agriculture (limited intensity)[7]	0	0	97	0	0
Agriculture (zone limitations)	0	0	0	0	28
Rural (low density)[8]	0	0	61	0	0
Other Agriculture/Mining	140	181	0	77	124
TOTAL AGRICULTURE & MINING	140	181	158	130	152
PRESERVATION[9]	447	468	518	518	532
Undecided	5	0	0	8	0
GRAND TOTAL	996	995	996	995	996

[1] re-development = redistribute/reassign densities and cluster people to central area of Lehigh Acres
[2] water storage area = part of re-development, regional water storage facility near Harnes Marsh
[3] zone limitations = limitations to activities in certain specified areas or zones to protect natural resources
[4] restore/fix = acquire, restore, & fix, then place in preservation status
[5] development criteria = allow planned development meeting development criteria: zone 1 limitations = avoid, minimize, and mitigate wetland impacts and address protected species impacts; zone 2 limitations = limited fill, not impede sheet flow, and eliminate exotics plus zone 1 criteria
[6] end go preserve = abandoned agriculture goes to preserve and does not convert to development
[7] limited intensity = no changes that require additional loss of natural habitat
[8] low density = low density rural development such as ranchettes and plant growing nurseries (single family)
[9] preservation = areas that now or will soon be owned by government or private entities to protect natural resources

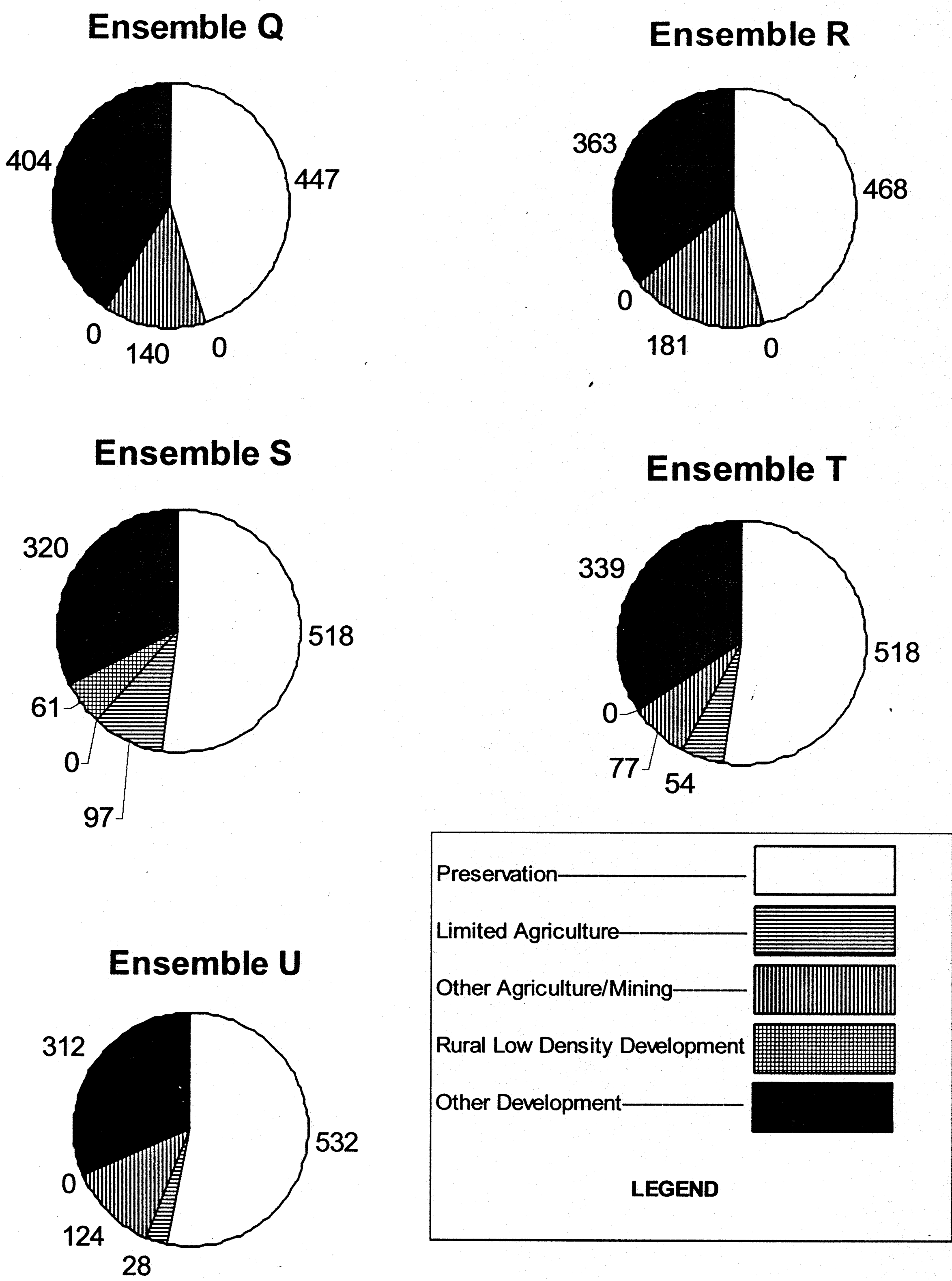


FIGURE 4. COMPARISON OF EXPECTED LAND USE UNDER THE ALTERNATIVE ENSEMBLES

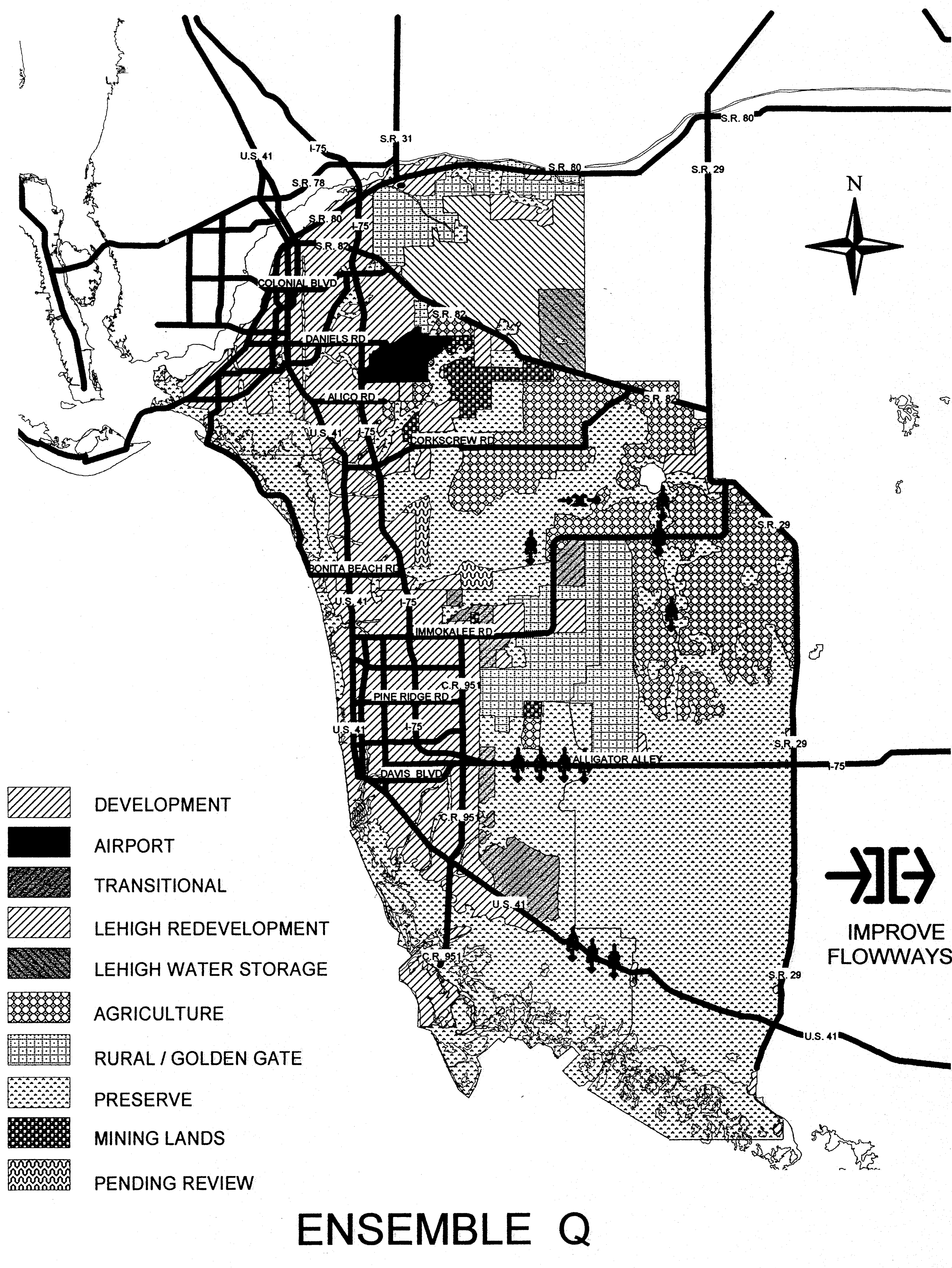


FIGURE 5. ENSEMBLE Q

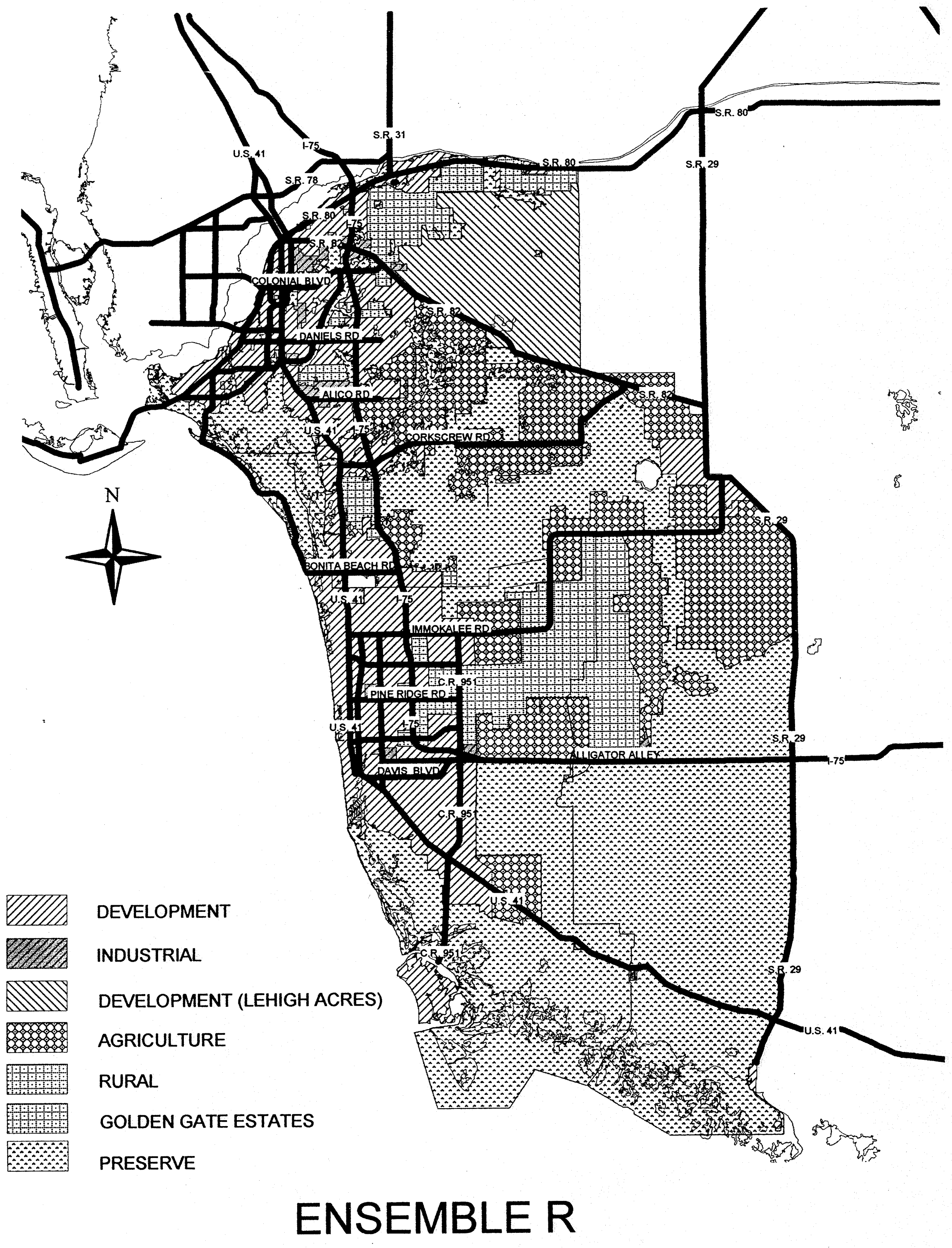


FIGURE 6. ENSEMBLE R

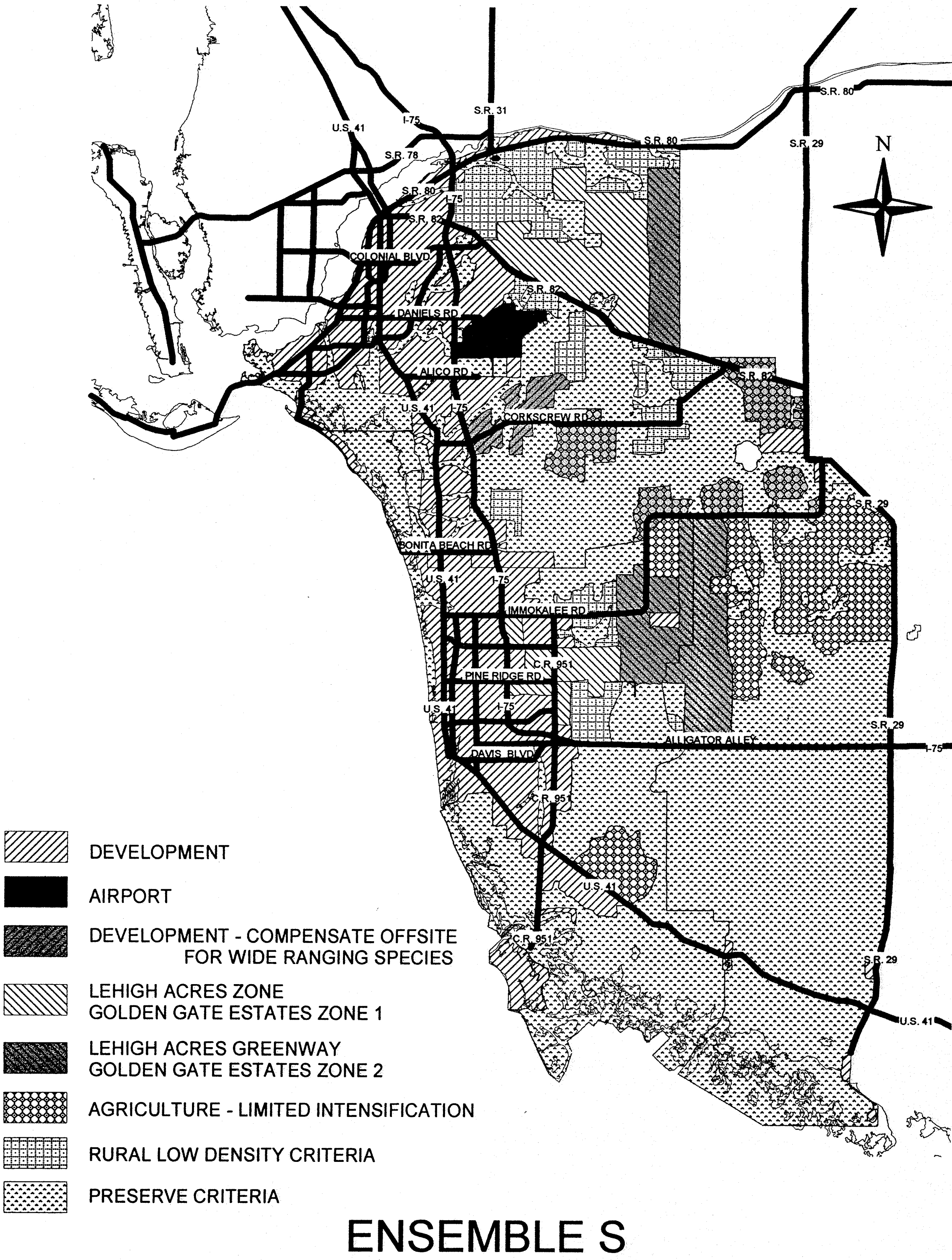


FIGURE 7. ENSEMBLE S

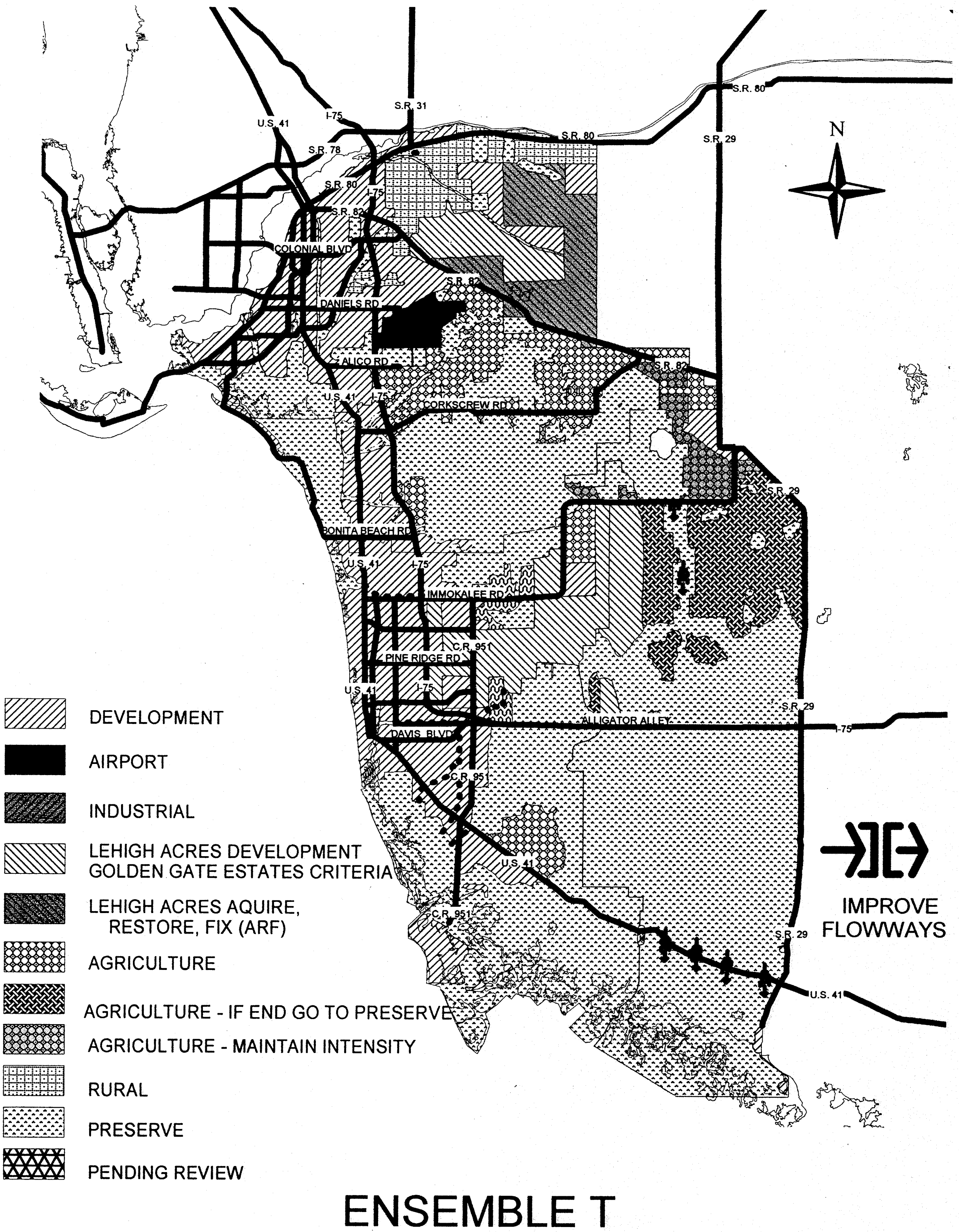
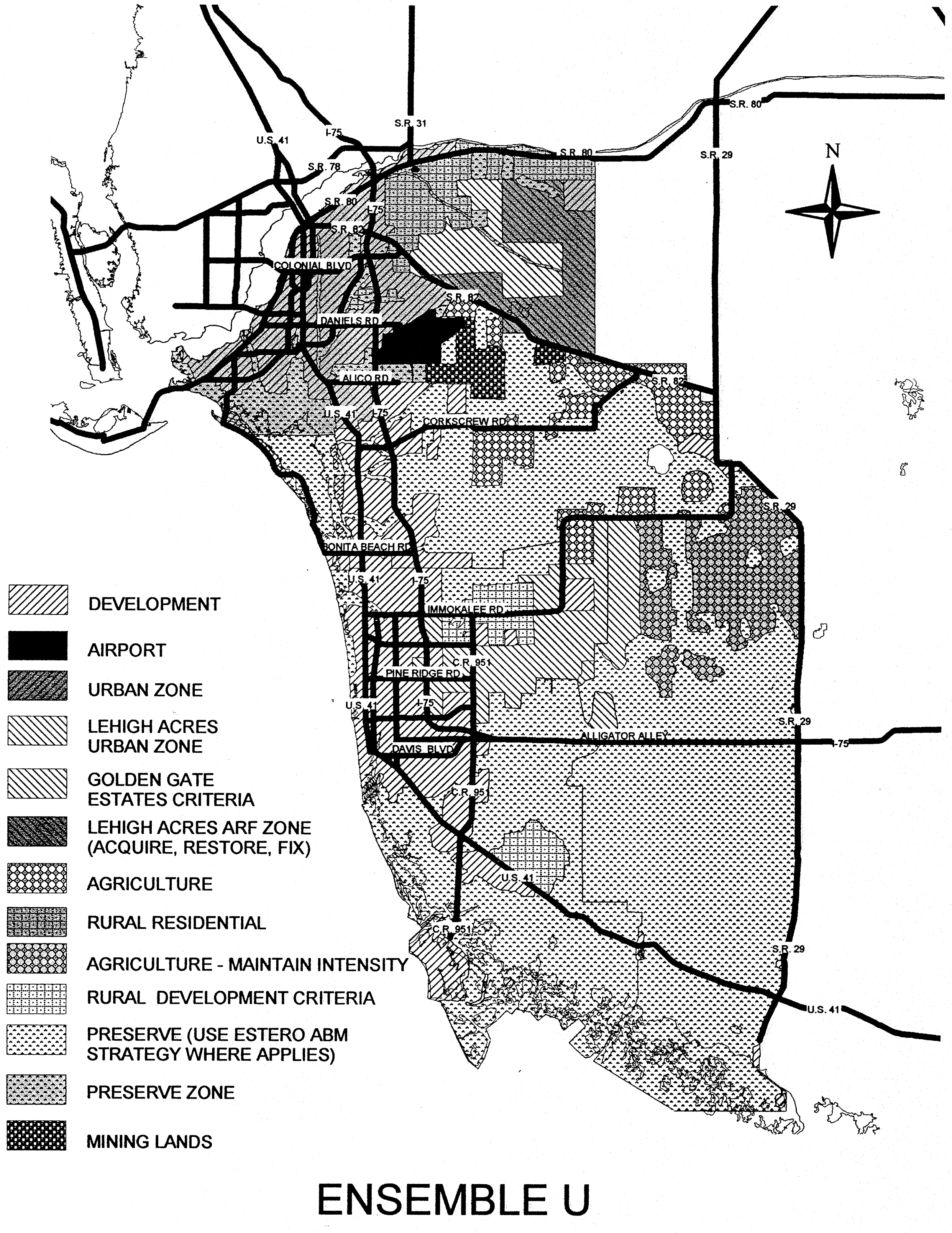


FIGURE 8. ENSEMBLE T



INSERT FIGURE 9. ENSEMBLE U

2.3.2 ENSEMBLE Q

This grouping of alternatives builds on the Comprehensive Plans and provides a larger acreage of development than the comprehensive plan. The Ensemble also suggests the establishment of new flowways or restoration of historic flowways. The alternatives used to assemble this Ensemble are: Zoom A, Alternative 4; Zoom B, Alternative 4A; Zoom C, Alternative 4; and Zoom D, Alternative 4.

2.3.2.1 Legend: Development Within the Urban areas, flowways improvements were shown in various locations and connected to the Preservation areas. Some of these are as described in the South Lee Watershed Plan presented by the South Florida Water Management District. The western end of Golden Gate Estates was included in the Urban designation. An increase in density within Golden Gate City is also proposed.

2.3.2.2 Legend: Development (Transition) Those lands currently in agriculture that will likely change to the Urban designation.

2.3.2.3 Legend: Lehigh Redevelopment Suggests Lee County should consider redevelopment alternatives, particularly for the Greenbriar Area, to restore flowways.

2.3.2.4 Legend: Lehigh Water Storage An area in southeast Lehigh Acres was identified as potential use for water storage.

2.3.2.5 Legend: Agriculture The definition for Agriculture is the same as the Comprehensive Plan.

2.3.2.6 Legend: Rural The definition is the same as the Comprehensive Plan.

2.3.2.7 Legend: Golden Gate Estates The remainder of Golden Gate Estates would retain the same Rural Residential designation as found in the Comprehensive Plan.

2.3.2.8 Legend: Preserve Flowways are proposed through the urbanized areas and, within Preservation Lands, removal or culverting of various roads to restore flowways, for example, culverts under I-75 and Tamiami Trail to improve sheetflow of surface waters. Preservation Lands include lands surrounding Ten Mile Canal and certain flowways leading to Six Mile Cypress Slough and others leading to the Caloosahatchee River. Of the Ensembles, this one proposes the narrowest footprint for Preservation Lands within Camp Keais Strand, restricting it to areas not currently under agriculture, but proposes culverts in the Strand to improve flows.

2.3.2.9 Legend: Mining Lands Mining lands are shown separate from Agriculture.

2.3.2.10 Legend: Pending Review Two areas are designated Pending Review as the group preparing the alternative could not agree whether to designate the location as development or preservation.

2.3.3 ENSEMBLE R

This grouping of alternatives represents the “status quo” and incorporates the Lee County and Collier County Comprehensive Plans, including the implementing policies and procedures for approval of projects. The alternatives used to assemble this Ensemble: Zoom A, Alternative 1; Zoom B, Alternative 1; Zoom C, Alternative 1; Zoom D, Alternative 1.

2.3.3.1 Lee County Comprehensive Plan (Ordinance 89-02 with amendments)

Chapter II (Future Land Use) of the Lee County Comprehensive Plan states the first goal is “To maintain and enforce a Future Land Use Map showing the proposed distribution, location, and extent of future land uses by type, density, and intensity...” Under this first goal are listed approximately 22 categories. Other goals in this chapter and other chapters in the Ordinance provide specific policies for evaluation of proposed development designs or rezoning. Chapter XIII (Procedures and Administration) states “...all development and all actions taken in regard to development orders shall be consistent with the plan...” The Ordinance also provides for a Year 2010 Overlay which divides the County into 105 sub-districts. Within each district is assigned an acreage for each land designation within that district. The number of acres are those proposed for the year 2010. No development orders will be issued which exceed these acreage numbers. This overlay is being replaced by a Year 2020 Overlay which divides Lee County into 20 Planning Communities. Therefore, the Future Land Use Map shows “build-out” acres for each designation, but the acres projected for the year 2020 will be something less. The Ordinance itself states “With the exception of Cape Coral and Lehigh Acres, the County’s urban areas will be built out by 2020.” Due to the difficulty of mapping these 2020 projections, the alternative was created using the “build-out” map. It appears the evaluations were generally performed using “build-out” although at least one sub-group discussed the 2020 overlays while preparing their evaluations.

2.3.3.2 Collier County Future Land Use Element of the Growth Management Plan (Ordinance 97-67)

The Collier County Ordinance states the goal is “To guide land use decision-making...” and provides several objectives and policies. The ordinance also defines approximately twelve land use designations that “...generally indicate the types of land uses for which zoning may be requested.” For each designation, the ordinance describes the uses and standards to be applied and shows the properties affected on the Future Land Use Map. Note that Ordinance 97-67 is the amendment of the current Future Land Use Element and is not in effect (as of May 11, 1998) while concerns raised by the Florida Department of Community Affairs(DCA) are resolved. The Land Development Code (Ordinance 91-102) implements applicable portions of the Growth Management Plan. Article 2, Zoning, includes, among other things, a requirement for open space and for special requirements in areas of environmental sensitivity designated as Special Treatment Overlay District. Article 3, Development Requirements, includes, among other things, a requirement for an Environmental Impact Statement for certain projects, and various requirements for protection of natural vegetation and endangered species.

2.3.3.3 Land Use Legends

The Ensemble uses five land use legends: Agricultural; Industrial; Preserve; Rural; and Urban. The Lee County Future Land Use Map shows 22 land use designations and the Collier County Future Land Use Map shows 12. These 34 designations were collapsed into five simply to ease the preparation of other alternatives and for convenience in evaluation. Agricultural represents Density Reduction/Groundwater Resource (Lee) and Agricultural/Rural Mixed (Collier). Industrial represents Industrial Development, Industrial Interchange, Industrial Resource (Lee) and Industrial District (Collier). Preserve represents Wetlands, portions of Density Reduction Groundwater Resource (Lee), and Agricultural/Rural Mixed Use District (Collier) that currently are or are proposed to be preserved and managed to maintain natural resource values. Rural represents Rural, Rural Community (Lee), Estates Designation, and Rural Settlement Area District (Collier). Urban represents Central Urban, Suburban, Outlying Suburban, Urban Community, University Community, the various Interstate Highway Interchange areas (except for the Industrial and the Industrial Commercial types), Public Facilities (other than certain parks that were placed in the preserve legend). New Community, and the various Airport areas (Lee), Urban and Commercial sub-districts under the Urban Designation (except for the Industrial District), Urban Residential Sub-district, and Mixed Use Activity Center Sub-District (Collier).

2.3.4 ENSEMBLE S

This grouping of alternatives represents the ensemble that provides greater emphasis on listed species and their habitat, particularly wide-ranging species such as the Florida panther and the Florida black bear. Other foci of this ensemble are restrictions on the clearing of native vegetation, preservation and restoration of habitat corridors and flowways, and increased regulatory and public awareness of the presence and extent of sensitive resources. The alternatives used to assemble this Ensemble are: Zoom A, Alternative 2; Zoom B, Alternative 2A; Zoom C, Alternative 2; and Zoom D, Alternative 2A. In some cases, some particular criteria was proposed for one alternative, but not explicitly repeated in others. Therefore some of the narratives below note to which portion of the study area the criteria applies to (each portion labeled either Zoom A, B, C, or D).

2.3.4.1 Legend: Development Within Zoom A, flowway improvements are proposed. Within Zoom C, the Ensemble proposes encouraging planting of emergent and shoreline planting in stormwater retention lakes and continuation of the Corps standards for wetland protection. The alternative also adopts what are called "Urban Zone" criteria that requires project designs will: restore flowways; retrofit residential septic systems and package treatment plants; provide adequate hurricane shelters and evacuation times; restore or retrofit buffer zones around wetlands, flowways, natural streams, rivers and creeks; and, meet Pollution Load Reduction Goals when set.

2.3.4.2 Legend: Development - Compensate for Wide Ranging Species An area is mapped for Development with a requirement for off-site compensatory mitigation for wide-ranging species.

2.3.4.3 Legends: Lehigh Acres Zone and Lehigh Acres Greenway Allows development but proposes criteria that includes: identify existing wetlands, location of historic flowways, and potential water storage areas (per pre-Townsend Canal); identify development concentrations; identify xeric oak scrubs; transfer development rights from important resource areas (existing wetlands, xeric scrub) to development clusters; redistribute/reassign densities for a more balanced community that includes an appropriate mix of uses (i.e., mix of single-family, multifamily, etc.); geographically cluster people to central area of Lehigh Acres where highest land and least amount of wetland are located and move development away from the eastern and southeastern areas of Lehigh Acres; adjacent rural lands should have opportunities to be included in Lehigh Acres planning process to prevent urban sprawl in unregulated areas; abandon major infrastructure plans that promoted growth inconsistent with these criteria; where zones vacated, abandon/retrofit infrastructure (canals, roads); create regional stormwater management facilities to benefit Caloosahatchee/Orange Rivers, water quality restoration and protect Hickey and Bedman Creek watersheds. Since the projected growth is generally in an "L" pattern for near future, try to develop a "greenway" approximately 2 miles wide that extends north from State Road 82 along the County line on the east side of Lehigh Acres and connect north to Greenbriar Swamp and Hickey Creek, Bedman Creek watersheds (which include wetlands, scrubs and water storage); and a potential appropriate location for a regional water storage facility is adjacent to existing Harnes Marsh.

2.3.4.4 Legend: Golden Gate Estates - Zone 1 Zone 1 is the more densely developed western Golden Gate Estates. Criteria proposed include: avoid/minimize and mitigate wetland impacts; culverting entrance roads; address listed species concerns; development of an educational pamphlet on resource issues; and, implementation of a Florida Yards and Neighborhood program.

2.3.4.5 Legend: Golden Gate Estates - Zone 2 Zone 2 is the eastern portion of Golden Gate Estates toward Picayune Strand. Criteria proposed include: no more than 10% fill; no more than 50% fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and culverting entrance roads. Zone 2 would also be designated a receiving area for mitigation.

2.3.4.6 Legend: Agriculture - Limited Intensification

The Ensemble “assumes limited intensification of use, that is, no changes that require additional loss of native habitat, no changes (such as intensification of citrus) that would lower hydrology. For example, range and improved range stay the same, vegetable crops change or go to fallow field and back again. No golf course or ranchette development, as these are not associated with true agriculture." The Ensemble assumes rotation of crops but no additional clearing.

2.3.4.7 Legend: Rural Low Density Criteria - Zoom A

In Rural Residential, the alternative adds development of greater planning detail to identify existing flowways, forested habitats, and seasonal wetlands that are large or contiguous to one another. This information would then be used to protect these areas in a connected landscape as the area develops. Within Zoom C, two areas of rural are mapped immediately adjacent to Golden Gates Estates, one area north of Golden Gate Estates and one area south. For the north area, the criteria include: avoid and minimize impacts to wetlands; protect nesting areas; mitigate wide-ranging species including mangrove fox squirrels, off-site; and, maintain or improve hydrology (for example, weirs in Cocohatchee Canal). For the south area, the criteria include: avoid and minimize impacts to wetlands; protect red-cockaded woodpecker habitat or mitigate off-site when their viability is affected; mitigating off-site for wide-ranging species (black bear); and maintain or improve hydrology (for example, the depth of the I-75 canal). For both north and south areas, the alternative also adopts the Buffer Transition Zone criteria that requires project designs will: result in no net loss of wetland acreage and function; result in no net loss in historical water table height and recharge area; not alter water sheet flow characteristics; contribute to the restoration of historic flowways; preserve buffer zones around wetlands, flowways, natural streams, rivers, and creeks; not impact water quality; not contribute to hurricane shelter deficit nor increase evacuation times; and implement the principals adopted by the Estero Bay Agency on Bay Management (copy enclosed in Appendix F).

2.3.4.8 Legend: Preserve Criteria

Within Zoom A, the area of Preservation Lands was drawn to emphasize connections between the Rural Residential and Airport preservation areas to the Six Mile Cypress Slough and between the Slough and Estero Bay. Preservation Lands were also drawn in wetland areas in the Rural areas between Lehigh Acres and the Caloosahatchee River. Within Zoom B, the mapping of Preserve used the Land Conservation/Preservation Strategy Map adopted by the Estero Bay Agency on Bay Management (copy enclosed in Appendix F), added connections to the boundary of the CREW for long range species, and proposes riparian corridors through the urban areas. Within Zooms C and D, the Ensemble proposes expansion of preserves beyond that mapped by the Comprehensive Plan and provides following criteria for project design and review: no public utilities; no new or expanded transportation; no well-field expansion; restoration or retrofit of certain areas with hydrologic problems (the retrofits listed are: add culverts under Tamiami Trail; "fix" I-75 canal plugs; protect Rookery Bay watershed; "fix" District 6 drainage basin works; "fix" Cocohatchee Canal; restore Clam Bay; and "fix" Golden Gate Canal to protect Naples Bay); and use as mitigation receiving areas only those portions of Preservation Lands that are currently not in public ownership.

2.3.4.9 Mining

Mining is not identified separately as a category but is classified as either Rural or Preserve depending on the ultimate use.

2.3.5 ENSEMBLE T

This Ensemble seeks to increase the area of preserves through restore, retrofit, and redevelopment of vacant lands within Lehigh Acres, greater protection afforded to isolated wetlands, and limitation on the extent of clearing and filling activities, within Golden Gate Estates and other areas. Agricultural activities are proposed to be limited to existing acreage with limited intensification therein. Flowways and connectivity of habitat would be improved and/or restored. The alternatives used to assemble this Ensemble are as follows. The alternatives used to assemble this Ensemble are: Zoom A, Alternative 3A; Zoom B, Alternative 2B; Zoom C, Alternative 3A; and Zoom D, Alternative 3. In some cases, some particular criteria was proposed for one alternative, but not explicitly repeated in others. Therefore some of the narratives below note to which portion of the study area the criteria applies to (each portion labeled either Zoom A, B, C, or D).

2.3.5.1 Legend: Development Within Zoom D, the Ensemble proposes flowway improvements along the Cocohatchee Canal, Golden Gate Canal, and sloughs in eastern Naples, coordinated with improvements within Preservation Lands.

2.3.5.2 Legend: Lehigh Acres Development and Lehigh Acres - Acquire, Restore, Fix (ARF) Within Lehigh Acres, this Ensemble proposes an Acquire, Restore, Fix (ARF), similar to the Restoration, Retrofit, and Redevelopment (3 R's) approach proposed for another alternative, to remove roads and canals in vacant areas to restore hydrology and preserve wildlife habitat.

2.3.5.3 Legend: Agriculture and Agriculture - Maintain Intensity Areas would remain agricultural but also delineated a sub-area where there would be no intensification in activity.

2.3.5.4 Legend: Agriculture - If End go to Preserve Current agriculture would continue with limited intensification but if agriculture ceases, then the lands would be placed in preservation.

2.3.5.5 Legend: Golden Gate Estates Criteria Within Zoom C, permitting would continue under the current processes but with additional protection afforded isolated wetlands by the following criteria: no general permits; determination of wetland jurisdiction prior to Collier County permitting; reconnection of wetlands along historic flowways; and, limitations on the clearing of residential lots. Within Zoom D, criteria are: no more than 10% fill; no more than 50% fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and culverting entrance roads. This area would also be designated a receiving area for mitigation.

2.3.5.7 Legend: Rural No particular criteria noted.

2.3.5.8 Legend: Preserve Within Zoom A, the areas mapped Preserve provided filter marshes along Ten Mile Canal and the canals leading from Lehigh Acres. In addition, lands south of the Airport are proposed to be preserved. Within Zoom B, the areas mapped Preserve were based on an assembly of several items: the preserves shown in the Comprehensive Plan, all proposed acquisitions; the Strategic Habitat Conservation Area mapping for the Florida Panther; and, the Priority 1 and 2 areas of the Florida Panther Habitat Preservation Plan. It was found that all mapped eagle nests, rookeries, rare native plant communities, seasonal wetlands and flowways, and various coastal resources of interest were encompassed within these areas. Within Zoom D, the Ensemble proposes culverts within Camp Keais Strand and across Tamiami Trail to improve flowways.

2.3.5.9 Legend: Pending Review The group preparing the alternative could not agree whether to designate the location as development or preservation.

2.3.5.10 Mining Mining is considered in the Agricultural category to the extent consistent with the Comprehensive Plan.

2.3.6 ENSEMBLE U

This Ensemble proposes the largest area of preserve among the Ensembles through criteria that limit the conversion of natural vegetation to other land cover types. This criteria also seeks to increase the difficulty of placing fill in wetlands by "strict" application of the presumption, under the EPA Section 404(b)(1) guidelines, that alternative non-wetland sites are available. The alternatives used to assemble this Ensemble are: Zoom A, Alternative 5; Zoom B, Alternative 3B; Zoom C, Alternative 1A; and Zoom D, Alternative 1A. In some cases, some particular criteria was proposed for one alternative, but not explicitly repeated in others. Therefore some of the narratives below note to which portion of the study area the criteria applies to (each portion labeled either Zoom A, B, C, or D).

2.3.6.1 Legend: Development

Flowways are included through the urban areas.

2.3.6.2 Legend: Development: Urban Zone and Lehigh Acres Urban Zone

For the Urban Zone within Zoom A, the alternative proposes "…a presumption that alternatives exist to locating dredge and fill activities in creeks, rivers, other historic flowways and adjacent wetlands; and to locating dredge and fill activities in isolated wetlands identified as important to wading birds, other species of concern, water quality, groundwater recharge or flood control." The proposal also describes numerous criteria for the Corps to apply during permit review. For example, certain limits to the use of nationwide and general permits, promotion of the restoration of flowways, and restoration of buffer zones. The proposal states the vision is, in part, to "..direct development into this zone...while maintaining watershed integrity within the zone."

2.3.6.3 Legend: Lehigh Acres ARF Zone

For the Acquire, Restore, Fix (ARF) Zone within Lehigh Acres, the alternative proposes that the "Corps strictly applies the Section 404(b)(1) Guidelines, including: (1) a strong presumption that practicable alternatives exist outside of the ARF Zone to dredge and fill activities (except restoration/retrofit activities)..." The proposal also describes numerous criteria for the Corps to apply during permit review. For example, certain limits to the use of nationwide and general permits, application of the criteria of the Big Cypress Area of Critical State Concern regulations, and restoration of flowways. The proposal states the vision is, in part, to "...protect and restore critical resources..." The complete set of criteria is enclosed in Appendix F.

2.3.6.4 Legend: Golden Gate Estates Criteria

A flowway program is suggested though without details. Within the more densely developed western Golden Gate Estates, criteria proposed include: avoid/minimize and mitigate wetland impacts; culverting entrance roads; address listed species concerns; development of an educational pamphlet on resource issues; and, implementation of a Florida Yards and Neighborhood program. Within the eastern portion of Golden Gate Estates (toward Picayune Strand), criteria proposed include: no more than 10% fill; no more than 50% fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and, culverting entrance roads. The eastern portion would also be designated a receiving area for mitigation.

2.3.6.5 Legend: Agriculture and Agriculture - Maintain Intensity

Some portions of the areas mapped Agriculture propose additional criteria that current agricultural activities would continue but intensification would be limited.

2.3.6.6 Legend: Rural Residential Zone

Within Zoom A, the proposal provides criteria for an Agricultural Zone and a Buffer Zone. These would be applied to the Rural Residential designation of this alternative. The proposal provides "...a strong presumption that alternatives exist outside.." either the Buffer Zone or Agricultural Zone and includes numerous criteria for the Corps to apply during permit review. The proposal states the vision is, in part, that agricultural "…should remain in agricultural use, compatible with conservation purposes..." and to "...discourage urban expansion in and through..." the Buffer Zone. The complete set of criteria is enclosed in Appendix F.

2.3.6.7 Legend: Rural Development Criteria

Criteria proposed are: one residential unit per five acres (overall); clustering; preserve 50% of the land area in natural state; maintain corridors, flowways with connectivity outside project boundaries; and 100% wetland preservation/restoration.

2.3.6.8 Legend: Preserve Within Zoom A, this Ensemble proposes denial of all permits in the areas mapped Preserve. The proposal states the vision is, in part, that these areas would be "...off limits to future development activity." The complete set of criteria is enclosed in Appendix F. Within Zoom B, the areas designated Preserve were based on the Land Conservation/Preservation Strategy Map adopted by the Estero Bay Agency on Bay Management. Included are flowways through the urban areas and within existing agricultural areas. Within Zoom D, areas mapped as Preserve include historic flowways within Golden Gate Estates and along Camp Keais Strand.

2.3.6.9 Legend: Mining Lands Mining lands are mapped with no comment.

2.4 ALTERNATIVES NOT WITHIN JURISDICTION OF LEAD AGENCY

The charge to the ADG specifically set forth the goals for the development of alternatives which protect natural environmental values, provide for sustainable economic growth, manage appropriate changes in water flows and quality, and respect public involvement and private rights. Some of the specific aspects set forth in a particular alternative will not be within the jurisdiction of the Corps. First, the Corps has jurisdiction over the placement of fill in wetlands and other Waters of the United States. Wetlands cover a portion of the study. Only those activities that are dependent upon the filling wetlands will be reviewed by the Corps. Second, the Corps only reviews activities proposed by and to be performed by the landowner. The Ensembles describe a range of possible activities that may or may not be proposed by the landowners. However, the analysis of the cumulative benefits and impacts presented by the Ensembles are within the purview of the Corps because the Corps must consider the cumulative impacts of its decision to issue a permit. Even though the permits that will be issued are only a subset of all the activities that will occur in the study area, the activities authorized by these permits will contribute to the cumulative total.

2.5 COMPARISON OF ALTERNATIVES

Table 3 lists alternatives considered and summarizes the major features and consequences of the proposed action and alternatives. See Section 4.0 Environmental Effects for a more detailed discussion of impacts of alternatives.

2.6 MITIGATION

Unavoidable impacts proposed in applications for a Federal dredge and fill permit will be evaluated on a case-by-case basis, and compensatory, project-specific mitigation for wetland acreage and function will be addressed at that time.

2.7 AUTHORITIES TO IMPLEMENT

The U.S. Army Corps of Engineers [U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency] will exercise its [their] authority as described below.

2.7.1 U.S. ARMY CORPS OF ENGINEERS

Pursuant to Section 404 of the Clean Water Act, the Corps of Engineers has regulatory authority to permit the discharge of dredged or fill material into wetlands and other waters of the United States at specified disposal sites. The Corps conducts a public interest review of the probable impact of the proposed activity and its intended use. The review covers nineteen (19) factors, including effects upon conservation, fish and wildlife values, recreation, water quality, and cultural values. The guidelines pursuant to Section 404(b) of the Act require that impacts to the aquatic environment be avoided and minimized to the extent practicable. Also, unavoidable impacts are to be compensated (mitigated) to the extent practicable. A permit is typically issued provided that the proposed use is not contrary to the public interest, or not in compliance with the guidelines promulgated by the EPA pursuant to Section 404(b) of the Clean Water Act.

In determining whether to issue a permit, the Corps must also comply with other requirements including, but not limited to, the Section 7 of the Endangered Species Act of 1973 (50CFR part 402), the National Environmental Policy Act of 1969, the Coastal Zone Management Act, Sections 401, 404, and 404b(1) of the Clean Water Act of 1977, Section 10 of the Rivers and Harbors Act of 1899, Fish and Wildlife Coordination Act, and other applicable Federal laws. Modifying land for new uses also involves zoning, land use planning, water management, and other regulatory/planning requirements at the local, regional, State, and Federal level.

The Administrator of the EPA has the authority to prohibit the specification of any defined area, and to deny the use of any such defined area, for the placement or excavation of fill material. This veto authority can be exercised (only after notice and opportunity for public input and review) where the discharge of materials will have an unacceptable adverse effect on potable water supplies, fishery areas, wildlife areas, or recreational areas.

Memoranda of Agreement between the Department of the Army and the Department of the Interior (USFWS), the Department of Commerce (National Marine Fisheries Service), and the EPA allow the "elevation" of the decision to issue a permit above the District level pursuant to Section 404(q) of the Clean Water Act. These decisions to elevate are typically the result of: insufficient interagency coordination (procedural failure or failure to resolve concerns raised by the commenting agency(s)); significant new information being developed that did not previously exist; or the project raising environmental issues of national importance requiring policy level review. The permit decision is first elevated to the Division level, and if not resolved there, the commenting agency has the option to further elevate the decision to the national level, where the office of the Secretary of the Army would review the record, and Corps Headquarters would issue guidance to the District Engineer as to the disposition of the permit application.

2.7.2 U.S. FISH AND WILDLIFE SERVICE

Section 7 of the Endangered Species Act (16 U.S.C. 1531 *et seq*.) (ESA) outlines the procedures for Federal interagency cooperation to conserve Federally listed species and designated critical habitats. Section 7(a)(1) directs all Federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of species listed pursuant to the ESA. Section 7(a)(2) requires that each Federal agency, in consultation with the Secretary (Secretary of the Interior/Secretary of Commerce) shall ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

Consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (Services) in accordance with Section 7 of the ESA was not completed for any alternative presented in this DEIS. (The term "Services" is used to generically refer to both agencies together. This is not meant to imply that all actions discussed herein are taken by the Services jointly.) Actions proposed within the framework of this EIS will undergo consultation, either formal or informal, as appropriate.

The Corps will prepare biological assessments for "major construction activities" which may significantly affect the quality of the human environment as referred to in the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq*.). Major construction activities include dams, buildings, pipelines, roads, water resource developments, channel improvements, and other such projects that modify the physical environment and that constitute major Federal actions.

Although a biological assessment may not be required for all projects proposed within the framework of this EIS, formal consultation cannot be initiated until an assessment of effects is completed. The Corps may submit a biological assessment, or some other form of biological evaluation, early to benefit from the informal consultation process. The Corps may also request early consultations with the Services to reduce the conflicts between listed species or critical habitat and proposed actions. Early consultation is an optional process that occurs before a prospective applicant files an application for a Federal permit. To qualify, a prospective applicant must provide the Corps, in writing: (1) a definite proposal outlining the action and its effects; and (2) intent to implement the proposal, if authorized.

A biological evaluation will be completed if listed species or critical habitat may be present in the action area. The Corps may designate the applicant or a non-Federal representative (often a consultant) to prepare the evaluation, although the Corps is responsible for the content of the evaluation and for the findings of effect. The evaluation ensures the Corps involvement and increases the chances for resolution during informal consultation.

The evaluation will address all listed and proposed species found in the action area, not just those listed and proposed species likely to be affected, to help make the determination of whether the proposed actions are likely to adversely affect listed species and critical habitat. Because proposed species will be addressed, the evaluation will help determine the need for conference as well as formal consultation. The evaluation should include a detailed description of all aspects of the proposed action; the results of surveys to determine the presence of listed species or their habitat; an analysis of the likely effects of the proposed action on the species or critical habitat based on biological studies, review of the literature, and views of species experts. The evaluation should also describe any known unrelated non-Federal activities, or cumulative effects, which are reasonably certain to occur and that are likely to affect listed species or critical habitat.

If, after review of the biological evaluation, the Corps determines that a proposed project has no likelihood of adverse effect, the Corps will request written concurrence from the Services. The Services' letters of concurrence, based on review of all biological information, completes informal consultation. Although not required, the Corps may also request written concurrence from the Services if a proposed action will have no effect on listed species or critical habitat. If the Corps determines that a proposed action may adversely affect listed species or critical habitat, the Corps will initiate formal consultation through a written request to the Services. The Services may meet or communicate with the Corps and applicant to gather additional information necessary to conduct the consultation. With early coordination and cooperation, the Services ensure the Biological Opinion, including an Incidental Take statement, is prepared and delivered within 135 days of initiation of formal consultation.

2.7.3 U.S. ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) has the authority to administer the Clean Water Act (CWA) statutes and regulations; however, the EPA has authorized or delegated the CWA Section 401, water quality program to the Florida Department of Environmental Protection. The EPA's role is to ensure that the delegated State agency's program is as stringent as the requirements of the Federal statues and regulations. If it is determined that a state environmental program is deficient, the EPA must administer remedies to bring the program back into compliance.

The Clean Water Act (CWA) Section 404 dredge and fill program has not been delegated to the Florida Department of Environmental Protection and is administered by the Army Corps of Engineers. The EPA's role in the CWA Section 404 process is to provide independent comments on proposed permit applications to ensure the CWA Section 404(b)(1) Guidelines are met. In addition, the EPA has the authority to elevate permit objections under the CWA Section 404(q) process for projects that involve aquatic resources of national importance. In addition, under the CWA Section 404(c) "veto authority" the EPA must determine whether the proposed discharge of dredged or fill material will have an unacceptable adverse effect on either municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas. The veto authority may be used before, during or after the Army Corps' action on a permit application. The EPA may also exercise this authority in the absence of a permit application. The EPA is the only Federal agency that has the regulatory authority to veto a proposed project and to that end, the EPA has the final decision but also the burden of proof.

2.7.4 FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Section 401 of the CWA requires any applicant for a Federal permit that may result in a discharge of a pollutant into waters of the United States to obtain a certification in which the discharge originates. This certification must pertain not only to the construction of a facility, but also to the subsequent operation of the facility. In Florida, issuance of a State stormwater permit in accordance with Chapter 62-25, Florida Administrative Code (F.A.C.), or an Environmental Resource Permit (ERP) in accordance with Part IV of Chapter 373, Florida Statutes constitutes State water quality certification. Alternatively, a No-Permit-Required letter from the State signifies compliance with State water quality certification procedures.

Authorization for use of Sovereign submerged lands (under Chapter 18-21, F.A.C.) are reviewed concurrent with the ERP application and one cannot be issued without the other. “Sovereign submerged lands" means those lands including but not limited to, tidal lands, islands, sand bars, shallow banks, and lands waterward of the ordinary or mean high water line, beneath navigable fresh water or beneath tidally-influenced waters, which the State of Florida acquired title on March 3, 1845, by virtue of statehood, and which have not been heretofore conveyed or alienated. Authorization for use of Sovereign submerged lands can be issued by the State permitting agency or through an action of the Governor and Cabinet sitting as the Board of Trustees of the Internal Improvement Trust Fund.

Section 307 of the Coastal Zone Management Act of 1972 requires agencies conducting development projects which directly affect a states coastal zone to comply to the maximum extent practicable with the state’s approved coastal zone management program. The Act also requires any non-Federal applicant for a Federal permit to conduct an activity affecting land or water uses in the state’s coastal zone to furnish a certification that the proposed activity will comply with the state’s coastal zone management program. The issuance of an ERP constitutes compliance with the State of Florida coastal zone management program under Section 380.23(3) (c), Florida Statutes.

2.7.5 SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Section 401 of the CWA requires any applicant for a Federal permit that may result in a discharge of a pollutant into waters of the United States to obtain a certification in which the discharge originates. This certification must pertain not only to the construction of a facility, but also to the subsequent operation of the facility. In Florida, issuance of a State stormwater permit in accordance with Chapter 62-25, Florida Administrative Code (F.A.C.), or an Environmental Resource Permit (ERP) in accordance with Part IV of Chapter 373, Florida Statutes constitutes State water quality certification. Alternatively, a No-Permit-Required letter from the State signifies compliance with State water quality certification procedures.

Authorization for use of Sovereign submerged lands (under Chapter 18-21, F.A.C.) are reviewed concurrent with the ERP application and one cannot be issued without the other. “Sovereign submerged lands" means those lands including but not limited to, tidal lands, islands, sand bars, shallow banks, and lands waterward of the ordinary or mean high water line, beneath navigable fresh water or beneath tidally-influenced waters, which the State of Florida acquired title on March 3, 1845, by virtue of statehood, and which have not been heretofore conveyed or alienated. Authorization for use of Sovereign submerged lands can be issued by the State permitting agency or through an action of the Governor and Cabinet sitting as the Board of Trustees of the Internal Improvement Trust Fund.

Section 307 of the Coastal Zone Management Act of 1972 requires agencies conducting development projects which directly affect a states coastal zone to comply to the maximum extent practicable with the state’s approved coastal zone management program. The Act also requires any non-Federal applicant for a Federal permit to conduct an activity affecting land or water uses in the state’s coastal zone to furnish a certification that the proposed activity will comply with the state’s coastal zone management program. The issuance of an ERP constitutes compliance with the State of Florida coastal zone management program under Section 380.23(3) (c), Florida Statutes.

2.7.6 LOCAL GOVERNMENT

Chapter 163, Florida Statutes, requires local governments to prepare, adopt, and implement comprehensive plans that encourage the most appropriate use of land and natural resources in a manner consistent with the public interest. All public and private development is required by this statute to conform with the area's local government comprehensive plan adopted pursuant to the statute. Lee County's Comprehensive Plan is found at Ordinance 89-02 with amendments. Collier County's Future Land Use Element of the Growth Management Plan is found at Ordinance 97-67.

Table 3. Summary of Direct and Indirect Impacts

Evaluation Factor.	Measurement.	Q	R	S	T	U	What influenced evaluation.	Conclusion/Comparison.
Avoidance of wetland impact.	Estimate of percent of total area of wetland that will be filled.	6.6%	7.0%	5.6%	5.8%	5.5%	How flexible is typical configuration of site design for the land use compared to distribution/shape of wetlands in the area that land use is mapped.	Ensemble with less impact better satisfy requirement for avoidance.
Loss of uplands adjacent to wetlands.	Portion of study area preserved for natural resource benefits.	38%	38%	42%	42%	43%	Existing preserves total 27%. Native vegetation (upland and wetland) occupy 58% of the study area.	Uplands outside of preserves have higher probability to be impacted.
Availability of compensatory mitigation.	Percent of total wetlands in study area that are within areas that are not now preserved but are proposed to be preserved ("new preserves").	17%	19%	22%	23%	24%	Typical compensation is to restore degraded wetlands and preserve in perpetuity.	Larger percentage provides greater selection of wetlands that could be restored.
Acreage ratio.	Acres of wetlands in "new preserves" divided by acres of wetlands that will be filled.	2.6:1	2.7:1	4.0:1	3.9:1	4.4:1	Some wetlands in "new preserves" will not be suitable for compensatory mitigation.	Larger ratio provides greater choice in lands to be acquired and restored.
Availability of replacement of wetland function.	Wetlands in "new preserves" were Converted to a scored high, medium, and low for their potential quantity of "units of restoration" and wetlands to be filled were Converted to a scored for the "units of impact". Ratio is the "units of restoration" divided by "units of impact".	1.8	1.8	2.8	2.8	3.3	Wetlands adjacent to existing development, canals, etc. Converted to a scored "low".	Higher ratio indicate greater assurance that ecosystmem benefits would be replaced.
Florida Panther	Percent of Priority 1 and 2 lands (within study are) ithin preserves.	56%	62%	70%	71%	72%	Existing public preserves with panther use.	Higher percentage on public lands provide greater assurance of preserving population.
Florida Panther	Percentage of lands in agriculture and whether criteria for non-intensification of use applied.	26%, No criteria	35%, No criteria	18%, Criteri a	25%, Criteri a	19%, Criteri a	Low-intensity agriculture minimizes impacts to panther.	Greater area of low-intensity agriculture increases assuarance of conservation of the species.
Scrub Jay	Number of families within contiguous preserves.	6	6	11	8	6	26 known families within study area.	Higher number within contiguous preserves increase assurance of preservation of species.

Red cockaded woodpeckers.	Number of known clusters located within contiguous preserves.	10	2	13	12	18	40 known groups in study area. Existing sites in old growth pine.	Higher number of groups in preserves increases assurance of preservation of the species.
Bald Eagle.	Number of nests located within contiguous preserves.	18	18	20	19	18	74 known nests in study area. Concern also with adjacent lands.	Higher number of nests in contiguous preserve provides more assurance of preservation of the species.
Woodstork.	Number of rookeries within contiguous preserves.	11	9	12	11	14	14 known rookeries in study area. Also concerned with foraging area.	Higher number of rookeries in contiguous preserves provide more assurance of preservation of species.
Audubon's crested caracara.	Continuation of low intensity agriculture (compare to Panther) and preservation of seasonal wetlands (see Seasonal Wetlands).	140,000 acres agriculture, no criteria.	181,000 acres agriculture, no criteria.	97,000 acres agriculture w/ limited intensification.	130,000 acres agriculture, 54,000 with no intensification.	152,000 acres agriculture, some with limited intensification.	Study area fringe of 10 county area where population is found.	Greater areas of continuation of low intensity agriculture and greater area of preservation of seasonal wetlands better provide opportunities for population to expand.
Piping Plover	Affect on beaches directly or by water quality change.						Barrier beaches used as wintering sites.	No direct effect (fill) but could be affected by water quality. Increased coastal development degrades habitat.
Snail Kite	Preservation of seasonal wetlands.						Feed only on apple snails, only found in seasonal wetlands.	Greater number of seasonal wetlands within contiguous preserves increases probability of maintenance of species.
West Indian Manatee.	Coastal development and seagrass loss.						Boating mortality, loss of seagrass from prop dredging and decline in water quality.	Increased coastal development degrades habitat.
American Crocodile.	Changes in timing and quantity of freshwater (see Flowways factor).						Changes in freshwater flows affects plant and animal communities in estuarines.	Maintenance of flowways reduce potential changes in hydropatterns, increasing potential for preservation of the species. Increased coastal development degrades habitat.

American Alligator	Area of seasonal wetlands in preserves (see Seasonal Wetlands factor) and flowways (see Flowways factor).						Habitat is in large wetlands areas.	Preservation of wetlands within contiguous preserves continue the population of this species.
Eastern Indigo Snake.	Native Habitat							More fragmentation and reduction in habitat impacts species.
Sea Turtles (Loggerhead, Green, Hawksbill, and Kemp's Ridley)	Effect on beaches.						Effects include artificial lighting, beach renourishment, human presence, and exotic vegetation.	None directly affect beach. More coastal development degrades habitat.
Multi-Species Recovery Plan (MSRP)	BPJ assessment of how the alternative enhances implementation of the MSRP. Converted to a score from 4 (best) to 24.	17	23	6	13	9	Whether landuse/criteria included that explicitly supported the MSRP.	Those with mapping of preserves or, for all land types, criteria such as found in the MSRP enhanced its implementation.
Strategic Habitat Conservation Area (SHCA).	Percentage of the total area of SHCA in the study area that will be in preserve.	56%	56%	65%	69%	69%	8.2% of SHCA in State is within study area.	Lower percentage indicates greater reliance on habitat found on private land.
Wading Bird Rookeries.	Number rookeries found within contiguous preserves.	17	13	17	18	17	Not measured is effect on foraging range up to 15 kilometers (30 kilometers for Woodstorks). Total 25 sites.	Higher number of rookeries and foraging range in preserves provide more assurance of preservation of species.
Seasonal wetlands.	Percent of total area that will be found within contiguous preserves.	70%	73%	76%	75%	86%	Seasonal wetlands not evenly distributed across landscape.	
Connectivity provided between major habitat areas.	BPJ assessment of number of connections explicitly provided. Converted to a score 4 (best) to 24.	21	18	6	10	8	Wider the connection Converted to a scored lower (better).	Wider and more numerous connections are more immune to disturbance from adjoining land uses.
Flowways.	Similar to Connectivity, since most connections follow natural flowways. Converted to a score 4 (best) to 24.	18	23	5	6	8	Routing flows through contiguous natural areas Converted to a scored lower (better).	Wider flowways of natural vegetation preserved ability to store floodwaters and prevent downstream pulse flows.
Regional significant natural resources. Plans and goals of the Southwest Florida Regional Planning Council.	Assessment of how enhanced the implementation of plans and goals. Converted to a score 4 (best) to 24.	20	17	4	6	7	Comparison of mapping or criteria to the goals.	Explicit inclusion of maps or criteria better support the goals.

High priority wetlands important to wetland dependent species.	Percentage of wetlands and uplands that would be within contiguous preserves.	79% wetland / 37% upland	79% wetland / 38% upland	82% wetland / 46% upland	86% wetland / 77% upland	87% wetland / 49% upland	37% of study area is important wetland and 19% of study area is important upland.	Percentages of upland lower than wetland indicate greater imbalance in mix of plant communities.
Shoreline.	Assessment how enhances or degrades fringe's ability to provide aquatic nursery and foraging habitat. Converted to a score 4 (best) to 24.	20	21	7	7	8	Reduction in area of mangrove, saltmarsh, or, behind the fringe, pineland and hardwood hammock plant communities.	No direct affect of mangrove or salt marsh, but higher Converted to a scores reflect development behind the fringe.
Historic Properties.	Not.						Site specific.	Addressed in specific application.
Property Rights.	Assessment of reduction in rights. Converted to a score 48 (least effect) to 0 (greatest reduction).	45	47	18	21	12	Affect on fair market value of property, reasonable expectation for use of land and return on investment, and vested rights.	
Difference from Comprehensive Plans.	Assessment of significance of difference. Converted to a score 16 (most agreement) to 0 (greatest difference).	14	16	7	7	5	Additional criteria or restrictions lowered Converted to a score.	Large difference between Ensembles.
Economic Sustainability: Job Creation	Assessment on creation or elimination of jobs. Converted to a score 16 (positive influence) to 0 (less protective of economic sustainability)	13	13	6	5	4	One influcence is restrictions on intensification of agriculture prevents year round jobs from citrus.	Restrictions on area or type of land use restrict opportunity for job creation.
Economic Sustainability: Home affordability.	Assessment of change in cost of homes. Converted to a score 16 (positive influence) to 0 (less protective of economic sustainability).	11	11	6	6	4	One is restrictions on density (number of homes per acre).	More restrictions increases cost per unit of homes.
Economic Sustainability: Cost of living.	Assessment of change in costs. Converted to a score 16 (positive influence) to 0 (less protective of economic sustainability).	10	10	7	7	7	Restrictions add to costs. Costs passed to consumers.	More restrictive criteria increases cost of living.
Economic Sustainability: Property tax base.	Assessment of the area of development. Converted to a score 16 (positive influence) to 0 (less protective of economic sustainability).	13	14	7	6	5	Number of acres and type of land use.	Restrictions on use of land (intensification of agriculture) or area of development reduces tax base.

Economic Sustainability: Cost to implement.	Assessment of relative cost to acquire preserves and peform restoration. Converted to a score 16 (positive influence) to 0 (less protective of economic sustainability).	12	13	5	6	3	Area of proposed "new preserves".	Larger "new preserves" adds costs passed to local goods and services.
Economic Sustainability: Increased taxes.	"Cost to implement" divided by "Property Tax Base". Converted to a score 16 (positive influence) to 0 (less protective of economic sustainability).	12	13	6	6	4	Preserves must be supported by property tax base.	Higher area of preserves at same time as smaller area of development increases taxes.
Aesthetics.	Not.						Areas of contiguous preserve.	Many persons attracted to area for presence of natural areas.
Management of Public Lands.	Narrative assessement of effect on management.	Greatest area of development.	Greatest area of agriculture, preferable to urban land uses.	Increases area of preserve adjacent to public lands.	Less urban adjacent to Corkscrew Marsh.	More restrictive criteria.	Considered (1) compatability of the surrounding land use with the land management plans and (2) whether change in land use degrade or improve natural resources on public land.	Management least effected when public lands surrounded by low intensity activities and by expansion of contiguous preserves.
Water Quality: Pollution Loading	Assessment. Converted to a score 3/+ (least likely to affect water quality) to 15/0 (more likely an impact).	13/0	15/0	6/0	9/+	6/+	Type of land use and type of treatment of the runoff.	Reduction in area of urban or criteria to provide treatment reduced likelihood of impact.
Water Quality: Freshwater pulses.	Assessment. Converted to a score 3/+ (least likely to affect water quality) to 15/0 (more likely an impact).	12/0	13/0	7/0	6/+	6/+	Area of new impervious surface and acres of wetland preservation.	Increase in urban with decrease in wetland areas (that provide peak storage) increases pulses.
Water Quality: Habitat Loss	Assessment. Converted to a score 3/+ (least likely to affect water quality) to 15/0 (more likely an impact).	13/0	12/0	6/+	7/+	4/+	Quantity of wetlands.	Higher quantity of natural vegetation preserved maintains capability to assimilate pollutants.
Water Quality: Groundwater impact.	Assessment. Converted to a score 3/+ (least likely to affect water quality) to 15/0 (more likely an impact).	11/+	11/+	5/0	7/0	6/0	Protection of Surficial Aquifer System.	Protection of lands surrounding wellfields either by criteria or placing in preserve reduces likelihood of impact.

Hurricane Preparedness	Assessment.	Increase in urban area.					Increase in population offset by increase in roads and shelters.	None were considered to have change preparedness.
Water Management. (7 factors: infrasturcture, home damage, home construction, flood depth, historic flow patterns, water storage, and aquifier zoning.)	Assessment whether seven factors were "addressed", Converted to a scored a "+". Converted to a score is the number of +'s. Higher the Converted to a score, the less potential for impact.	6	14	17	13	14.5	Provision for funding infrastructure. Criteria to prevent home construction in floodplain. Preservation of flowways. Preservation of wetlands (store water and preserve groundwater levels).	R provides criteria for homes within floodplain and funds infrastructure. S, T, and U provide wetland preserves and flowways.
Cumulative impacts: Social factors. (4 factors: Infant mortality, Road needs, Crime rates, Hurricane vulnerability).	Assessment of the cumulative effect for each of the individual factors. Lower the Converted to a score, the less likely will be a degradation.	46	65	36	40	42	Area of urban development. For Hurricane vulnerability, presence of flowways.	Increase in urbanziation has cumulative impacts, but flooding from hurricane addressed by presence of flowways.
Cumulative Impacts: Environmental factors. (6 factors: Air pollution, Water pollution, Watershed indicators (vulnerability of watershed to degradation), Wetlands, Hydrology, and Quantity of preserve.).	Assessment of the cumulative effect for each of the individual factors. Lower the Converted to a score, the less likely will be a degradation.	104	113	72	69	71	Area of development and contiguous preserves. Presence of flowways.	Greater development increases of air and water pollution (and vulnerability of watershed) while increases in contiguous preserves reduces impacts to wetlands, hydrology, and preserves.

3. AFFECTED ENVIRONMENT

The Affected Environment section succinctly describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision to be made. It does not describe the entire existing environment, but only those environmental resources that would affect or that would be affected by the alternatives if they were implemented. This section, in conjunction with the description of the "status quo" alternative, forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

3.1 GENERAL ENVIRONMENTAL SETTING

The Southwest Florida Environmental Impact Statement study area is comprised of temperate and sub-tropical habitat in portions of Lee and Collier Counties. The major features include the Fakahatchee Strand State Preserve, the Florida Panther National Wildlife Refuge, the Ten Thousand Islands National Wildlife Refuge, the Big Cypress National Preserve, the Corkscrew Regional Ecosystem Watershed, the Rookery Bay and Estero Bay Aquatic Preserves, the Corkscrew Swamp Sanctuary, and the Picayune Strand State Forest. The interior parts of the study area show remnants of prehistoric shoreline, forming sand ridges, interspersed with large wetland strands. The coastal areas along the Gulf of Mexico are cut by islands, bays, and lagoons, and include portions of the largest mangrove ecosystem in the continental United States (**Figures 10a-e**, Map of Environmental Resources).

3.2 BIOLOGICAL RESOURCES

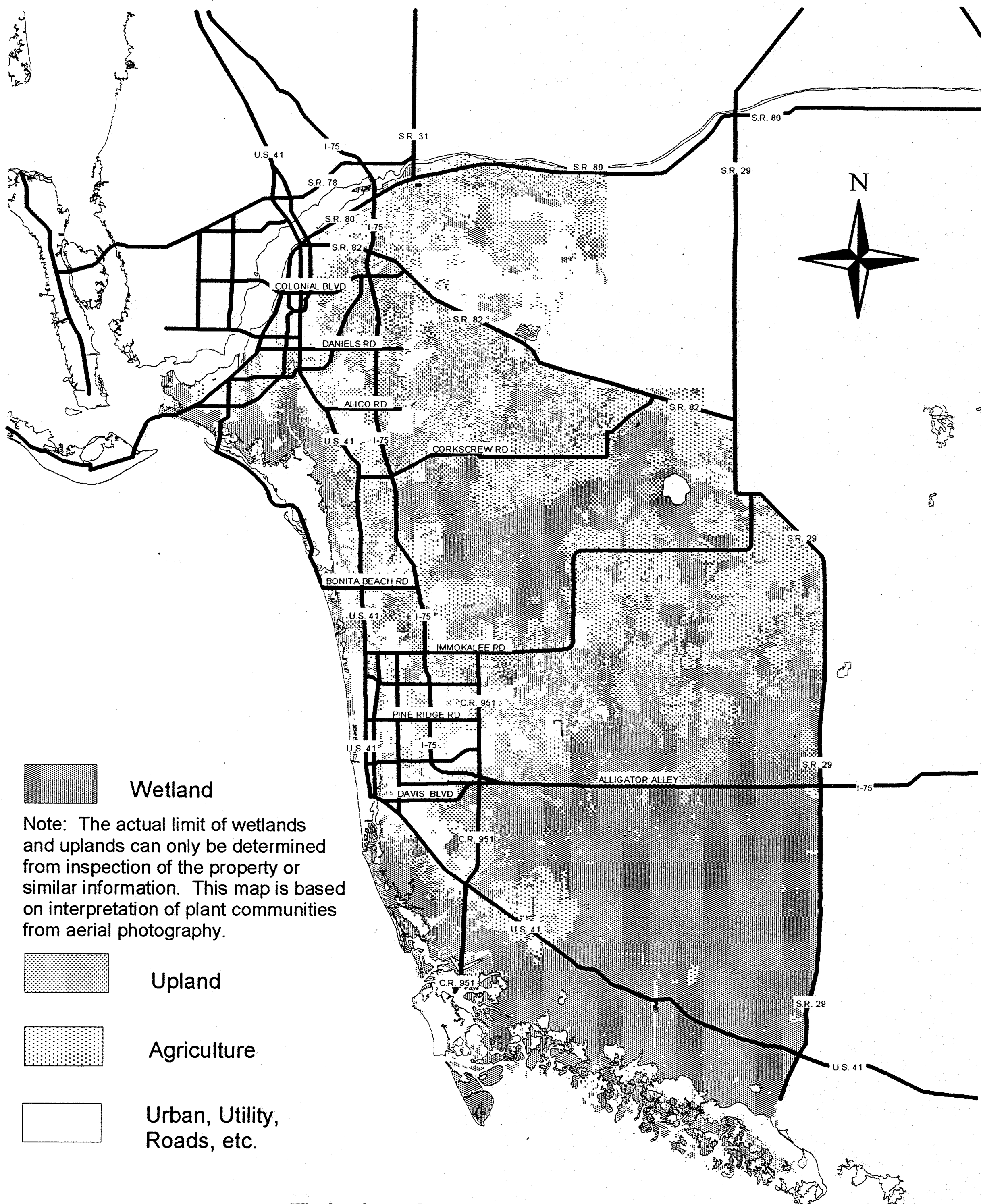
Southwest Florida features floral assemblages characteristic of both temperate and subtropical systems, as well as influences from the Caribbean. The coastal climatic influences, as well as the sheltered habitat afforded by the relatively remote sloughs and cypress strands of the region, provide suitable habitat for several tropical plant species that are rarely seen elsewhere in Florida (Ward 1979). In terms of supporting wide-ranging species (e.g., Florida panther, Florida black bear, and wood stork), the Southwest Florida area likely represents the most important region of Florida (Cox et al. 1994).

3.3 THREATENED AND ENDANGERED SPECIES

3.3.1 FAUNA

Twenty-three faunal species which are known to occur in Lee and Collier Counties are currently listed as threatened or endangered by the United States Fish and Wildlife Service (USFWS). Forty-five faunal species known to occur in these counties are currently listed as threatened, endangered, or as species of special concern by the Florida Game and Fresh Water Fish Commission (FGFWFC) (**Table 4**).

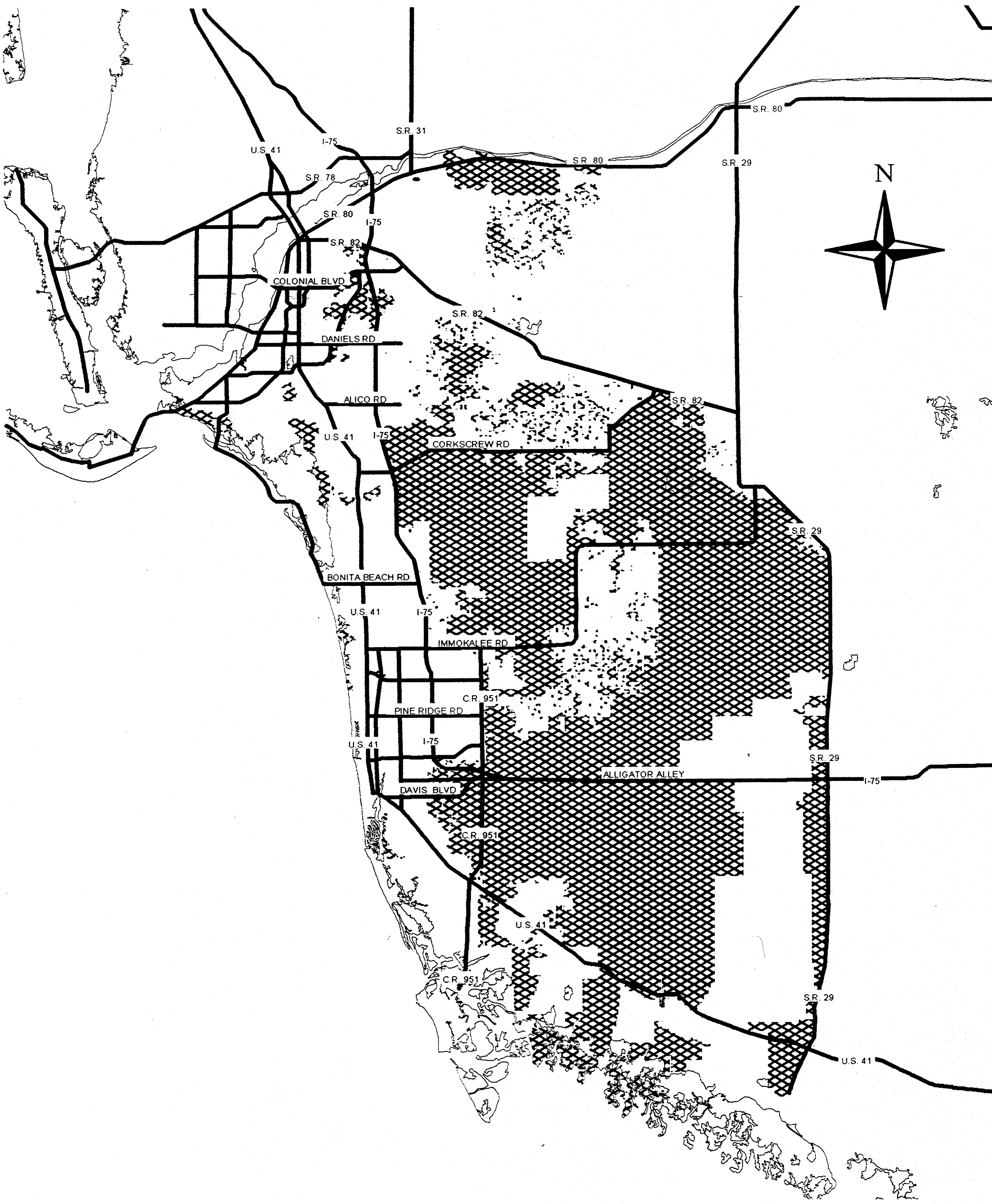
The Corps, through consultation with the USFWS, has determined that seventeen listed faunal species which occur in the study area could be affected by the proposed project. These species include the American crocodile, Eastern indigo snake, Florida scrub-jay, bald eagle, wood stork, red-cockaded woodpecker, piping plover, Audubon’s crested caracara, Everglades snail kite, Florida panther, mountain lion, West Indian manatee, and the Loggerhead, Hawksbill, Green, Leatherback, and Kemp's Ridley Sea Turtles.



Existing Land Use

Simplified based on 1995 Aerial Mapping

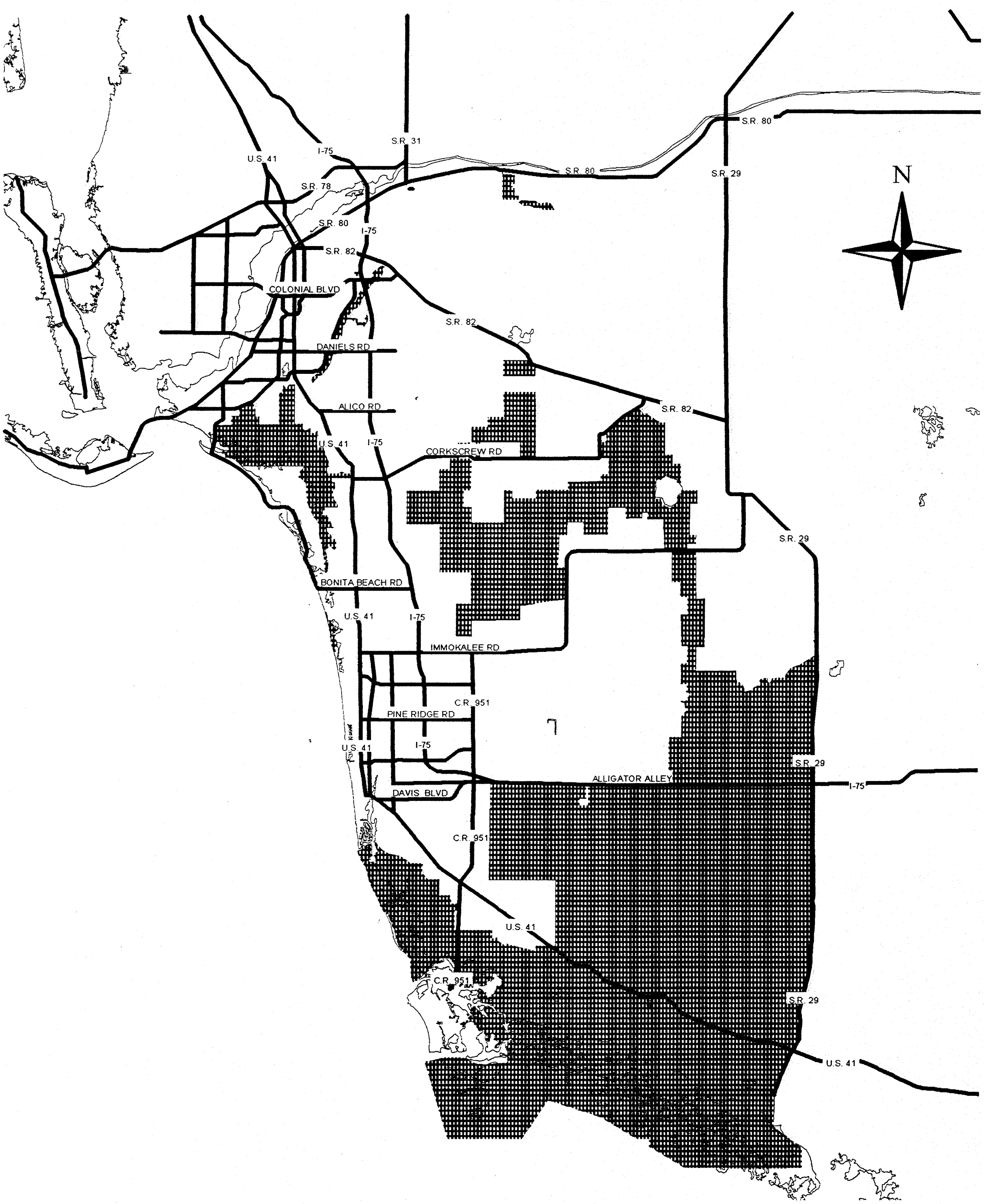
FIGURE 10a. MAP OF ENVIRONMENTAL RESOURCES - EXISTING LAND USE



Strategic Habitat Conservation Areas

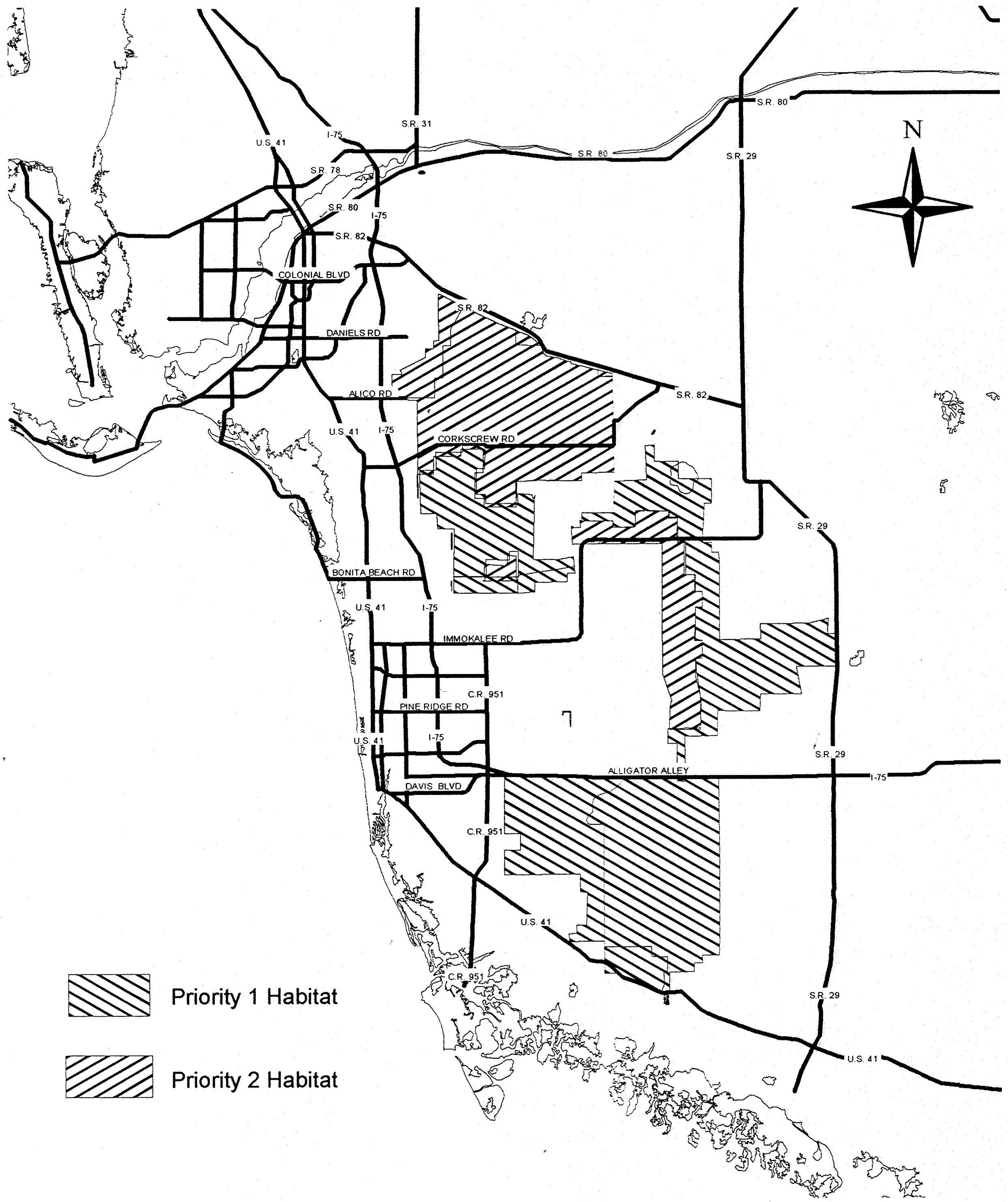
from Florida Game and Fresh Water Fish Commission (1994)
Closing the Gaps in Florida's Wildlife Habitat Conservation System

FIGURE 10b. MAP OF ENVIRONMENTAL RESOURCES - STRATEGIC HABITAT CONSERVATION AREAS



Conservation Lands
(Existing and Proposed)

FIGURE 10c. MAP OF ENVIRONMENTAL RESOURCES - CONSERVATION LANDS



Florida Panther Priority 1 & 2 Habitat

from Florida Panther Interagency Committee (1983)
Panther Habitat Preservation Plan

FIGURE 10d. MAP OF ENVIRONMENTAL RESOURCES - PANTHER HABITAT PRESERVATION PLAN

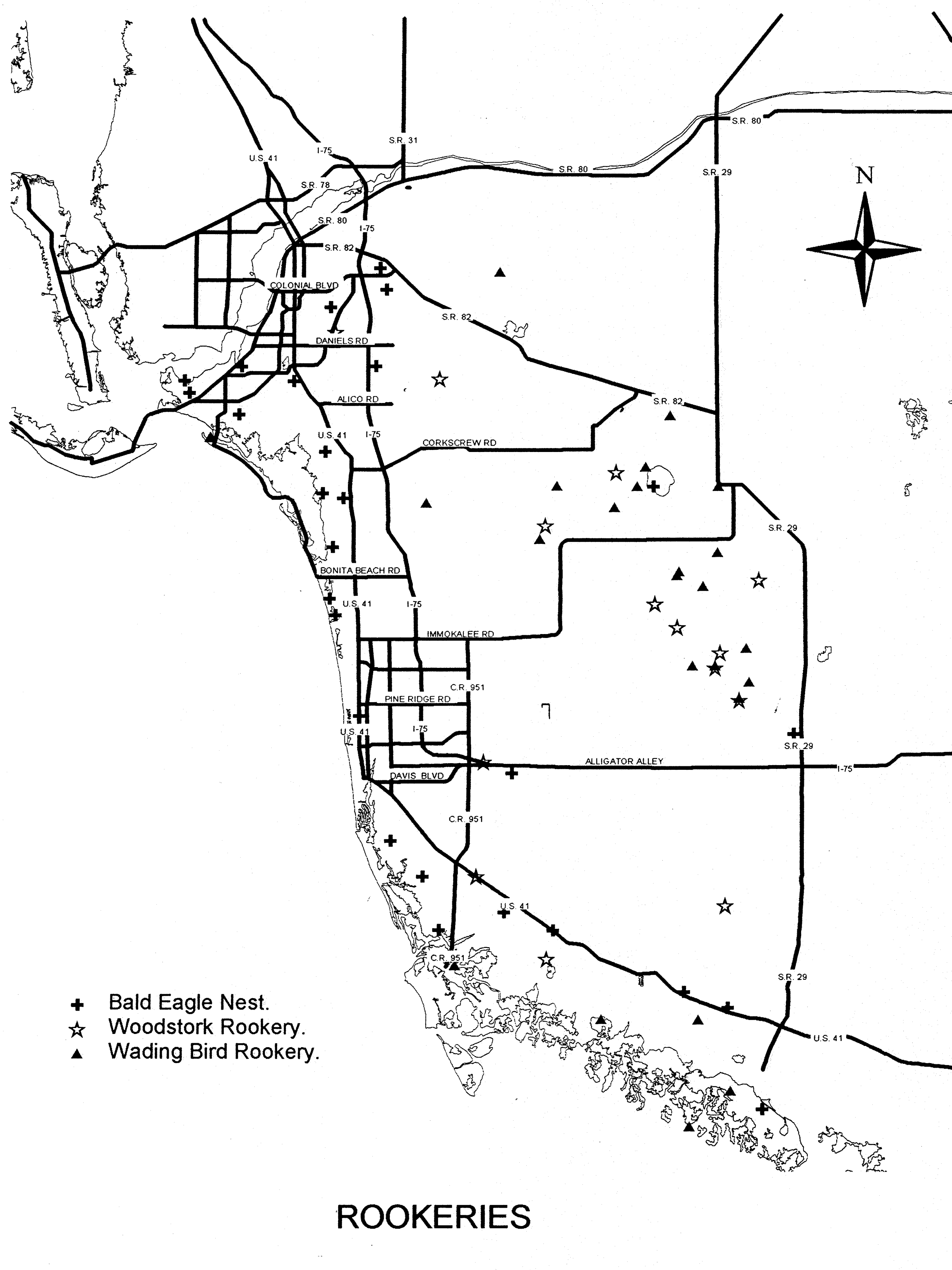


FIGURE 10e. MAP OF ENVIRONMENTAL RESOURCES - ROOKERIES AND NEST SITES

Table 4. Listed Faunal Species Occurring In Lee & Collier Counties, Florida
(USFWS & FGFWFC, 1998)

Scientific Name	Common Name	Federal Status[1]	State Status[2]
AMPHIBIANS			
Rana capito	Gopher frog		SSC
REPTILES			
Alligator mississippiensis	American alligator	T (SA)	SSC
Caretta caretta	Loggerhead sea turtle	T	T
Chelonia mydas	Green sea turtle	E	E
Crocodylus acutus	American crocodile	E	E
Dermochelys coriacea	Leatherback sea turtle	E	E
Drymarchon corais couperi	Eastern indigo snake	T	T
Eretmochelys imbricata	Hawksbill sea turtle	E	E
Gopherus polyphemus	Gopher tortoise		SSC
Lepidochelys kempii	Kemp's ridley sea turtle	E	E
Pituophis melanoleucus mugitus	Florida pine snake		SSC
BIRDS			
Ajaia ajaja	Roseate spoonbill		SSC
Aphelocoma coerulescens	Florida scrub-jay	T	T
Aramus guarauna	Limpkin		SSC
Caracara plancus	Audubon's crested caracara	T	T
Charadrius alexandrinus tenuirostris	Southeastern snowy plover		T
Charadrius melodus	Piping plover	T	T
Egretta caerulea	Little blue heron		SSC
Egretta thula	Snowy egret		SSC
Egretta tricolor	Tricolored heron		SSC
Eudocimus albus	White ibis		SSC
Falco peregrinus tundrius	Arctic peregrine falcon		E
Falco sparverius paulus	Southeastern American kestrel		T
Grus canadensis pratensis	Florida sandhill crane		T
Haematopus palliatus	American oystercatcher		SSC
Haliaeetus leucocephalus	Bald eagle	T	T
Mycteria americana	Wood stork	E	E
Pelecanus occidentalis	Brown pelican		SSC
Picoides (= Dendrocopos) borealis	Red-cockaded woodpecker	E	T
Rhyncops niger	Black skimmer		SSC
Rostrhamus sociabilis plumbeus	Everglades snail kite	E	E
Speotyto cunicularia floridana	Florida burrowing owl		SSC
Sterna antillarum	Least tern		T
MAMMALS			
Balaena glacialis	Right whale	E	E
Balaenoptera borealis	Sei whale	E	E
Balaenoptera physalus	Finback whale	E	E
Blarina brevicauda shermanii	Sherman's short-tailed shrew		SSC
Felis concolor coryi	Florida panther	E	E
Felis concolor	Mountain lion	T (S/A)	E
Megaptera novaeangliae	Humpback whale	E	E
Mustela vison evergladensis	Everglades mink		T
Oryzomys palustris sanibelli	Sanibel Island rice rat		SSC
Physeter catodon	Sperm whale	E	E
Podomys floridanus	Florida mouse		SSC

Scientific Name	Common Name	Federal Status[1]	State Status[2]
Sciurus niger avicennia	Big Cypress fox squirrel		T
Trichechus manatus	West Indian manatee	E, CH	E
Ursus americanus floridanus	Florida black bear		T

[1]Federal Legal Status (US Fish and Wildlife Service)

E = Listed as an Endangered Species in the List of Endangered and Threatened Wildlife and Plants under the provisions of the Endangered Species Act. Defined as any species which is in danger of extinction throughout all or a significant portion of its range.

T = Listed as a Threatened Species. Defined as any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

T/SA = Threatened due to similarity of appearance.

CH = Critical Habitat has been designated for this species in both counties

[2]State Legal Status (Florida Game and Fresh Water Fish Commission)

E = Listed as an Endangered Species. Defined as a species, subspecies, or isolated population which is so rare or depleted in number or so restricted in range of habitat due to any man-made or natural factors that it is in immediate danger of extinction or extirpation from the state, or which may attain such a status within the immediate future.

T = Listed as a Threatened Species. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.

SSC = Listed as a Species of Special Concern. Defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species.

A description of each species reported by the USFWS and the FGFWFC with the potential to be affected follows. For Federally listed species, the complete species account from the Draft Multi-Species Plan is attached at Appendix G.

Gopher frog *Rana capito*

This medium-sized frog is a commensal of the gopher tortoise (*Gopherus polyphemus*) and is typically found in and around gopher tortoise burrows (Ashton and Ashton 1988).

The typical habitat is native, upland, xeric communities, particularly xeric oak scrub, although they are also found in pine flatwoods, sand pine scrub, and xeric hammocks (Godley 1992). The only documented occurrence of the gopher frog in the study area is in coastal Lee. and Collier counties.

The gopher frog is currently listed as a species of special concern by the FGFWFC because of loss of upland habitat and wetland nesting habitat, typically ephemeral marshes located within a kilometer of the upland habitat.

American alligator *Alligator mississippiensis*

The American alligator’s range extends across the southeastern states of Alabama, Arkansas, North and South Carolina, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas.

This reptile utilizes freshwater swamps and marshes as its primary habitat, but is also seen in rivers, lakes, and smaller bodies of water. Alligators have been shown to be an important part of the ecosystem, and are thus regarded by many as a “keystone” species. This role as a keystone species includes control of prey species and creation of peat through their nesting activities (University of Florida 1998).

Populations of the American alligator were severely affected in the early parts of this century due to hunting of the animal for its skin. In 1967, this species was listed as an endangered species which prohibited alligator hunting. As a result, the alligator has undergone a successful recovery. The alligator is hunted in Florida today under permit from the FGFWFC.

The American alligator is currently listed as threatened by the USFWS, due to its similarity to the American crocodile *(Crocodylus acutus)*. The American alligator is currently listed as a species of special concern by the FGFWFC.

Loggerhead Sea Turtle *Caretta caretta*

The loggerhead turtle is the most common sea turtle species in South Florida (USFWS 1998). The total number of loggerhead sea turtle nests surveyed in South Florida account for over 90 percent of all nests reported State-wide (USFWS 1998).

The nesting and hatching season for loggerhead sea turtles in South Florida extends from mid-March through November, with the female laying an average of 110-120 eggs per nest, with multiple nestings (commonly 2-6 nests) spaced at two-week intervals (Dodd 1992).

Little is known regarding their behavior beyond the nesting beaches, although hatchlings are known to ride offshore drift lines in the Atlantic, and small juveniles are closely associated with floating mats of *Sargassum* in open ocean habitat (Ashton and Ashton 1991; Dodd 1992).

The diet of the loggerhead varies, but is primarily composed of mollusks, crustaceans, and horseshoe crabs (Dodd 1992).

The loggerhead is listed due to pressures on several levels, ranging from habitat alteration due to urbanization of coastal beaches, to pollution of the ocean, and human predation.

The loggerhead is listed as a threatened species under the Endangered Species Act of 1973, and is also listed as threatened by the FGFWFC.

Green Sea Turtle *Chelonia mydas*

The only herbivorous sea turtle, the Green sea turtle is found throughout the tropic and subtropics, worldwide (Ehrhart and Witherington 1992). The green turtle, in Florida, nests primarily on the east coast, from Volusia County south to Dade County. The first recorded nesting in Southwest Florida occurred in 1994; prior to that there was only one recent nesting record on the west coast of Florida, occurring at Eglin Air Force Base in the Florida panhandle in 1987 (USFWS 1998; Ehrhart and Witherington 1992). However, the west coast of Florida does support important populations of immature green turtles (Ehrhart and Witherington 1992).

The green turtle is listed due to commercial exploitation (for meat, oil, and skins), habitat alteration due to urbanization of coastal beaches, and pollution of the ocean.

The green turtle is listed as a threatened species under the Endangered Species Act of 1973, except for the breeding populations in Florida and on the west coast of Mexico, which are listed as endangered. The green turtle is also listed as endangered by the FGFWFC.

American Crocodile *Crocodylus acutus*

The American crocodile's range extends across southernmost Florida, Mexico, Central America, the Caribbean Islands, and northern South America.

This reptile utilizes coastal saltwater swamps and marshes as its primary habitat, but is also seen in saline lakes. The crocodile has also been known to range a few miles inland.

Populations of the American crocodile in Florida were likely relatively small historically, and the severely limited present distribution in Florida makes the population susceptible to catastrophic crash due to disease, or loss of habitat and individuals in a severe storm event (i.e., hurricanes) (Moler 1992). The species has been depleted elsewhere in its range due to hunting of the animal for its skin, and through loss of habitat.

The American crocodile occurs in low numbers within the study area. Crocodiles have been sighted as far north as Pine and Sanibel Islands and occur in the Rookery Bay, McIlvane Bay and Imperial River areas. Although no successful reproduction has occurred on the Southwest coast, nesting has occurred.

The American crocodile is currently listed as an endangered species by both the USFWS and the FGFWFC.

<u>Leatherback Sea Turtle</u> *<u>Dermochelys coriacea</u>*

The largest extant turtle species, the leatherback turtle can reach 2.4 meters (8 feet) in length and weigh up to 725 kilograms (1600 pounds) (Ashton and Ashton 1991).

Leatherback turtles nest during the Spring and Summer months, laying 80 or more eggs, which hatch 60-70 days later. The adult leatherback turtle is considered omnivorous, feeding on jellyfish, drift algae, seaweed, sea urchins, and squid.

Serious threats to the leatherback turtle on its nesting beaches include artificial lighting, beach nourishment, increased human presence, and exotic beach and dune vegetation (USFWS 1998).

The leatherback turtle is listed as endangered by both the USFWS and the FGFWFC.

<u>Eastern Indigo Snake</u> *<u>Drymarchon corais couperi</u>*

The Eastern indigo snake is the largest non-venomous snake in North America. It is an isolated subspecies occurring in Southeastern Georgia and throughout peninsular Florida.

The Eastern indigo snake prefers drier habitats, but may be found in a variety of habitats from xeric sandhills, to cabbage palm hammocks, to hydric hardwood hammocks. Indigo snakes often forage adjacent to wetlands, particularly seasonal wetlands.

Indigo snakes need relatively large areas of undeveloped land to maintain population. The main reason for its decline is habitat loss due to development. Further, as habitats become fragmented by roads, indigo snakes become increasingly vulnerable to highway mortality as they move through their large territories (Schaefer and Junkin 1990).

The Eastern indigo snake occurs throughout the study area.

The Eastern indigo snake has been classified as a threatened species by the USFWS since 1978 and by the FGFWFC since 1971.

<u>Hawksbill Sea Turtle</u> *<u>Eretmochelys imbricata</u>*

The hawksbill sea turtle is found throughout the tropic and subtropics, worldwide. The hawksbill turtle rarely appears in historical records in Florida, but nests have been noted along the east coast (from Volusia County south to Monroe County) since the early 1980's (Meylan 1992). Stranding and museum records indicate the occurrence of the Hawksbill within the study area. The hawksbill is primarily associated with coral reefs, but also occupies other hard-bottom habitats (Meylan 1992).

The hawksbill turtle is listed due to commercial exploitation (for meat, oil, and skins), habitat alteration due to urbanization of coastal beaches, and pollution of the ocean, although exploitation for tortoiseshell is the principal cause for population decline worldwide (Meylan 1992).

The hawksbill turtle is listed as an endangered species under the Endangered Species Act of 1973. The hawksbill turtle is also listed as endangered by the FGFWFC.

Gopher tortoise *Gopherus polyphemus*

The gopher tortoise is found throughout peninsular Florida, with the bulk of the population in central and northern portions. The south Florida population is scattered due to habitat loss and fragmentation, as well as urbanization (Diemer 1992).

Typical habitat for the gopher tortoise includes sand pine scrub, coastal strand, oak hammocks, oak scrub, dry prairies, pine flatwoods, palmetto prairies, pasture, fallow cropland, and disturbed upland habitats (Diemer 1992).

The population is threatened by fragmentation of habitat and urbanization, as well by conversion of habitat to agricultural use, changes in land management practices (i.e., suppression of fire), and by susceptibility to upper respiratory infections. Coastal populations in Southwest Florida have been greatly reduced by urban development. Few tortoise populations (with the exception of the Immokalee area) exist outside coastal or riverine dune ridges in the study area.

The gopher tortoise is listed as a species of special concern by the FGFWFC.

Kemp's Ridley Sea Turtle *Lepidochelys kempii*

The Kemp's ridley sea turtle is found throughout the tropical and subtropical Atlantic, although adult ridleys are apparently limited to the Gulf of Mexico, worldwide (Ogren 1992). The majority of the turtle nest *en masse* at Rancho Nuevo, Tamaulipas, Mexico. A few nests have been noted recently in Texas, and one nest was documented in Pinellas County, Florida in 1989 (Ogren 1992).

The Kemp's ridley turtle is listed due to intensive egg collection, commercial exploitation (for meat, oil, and skins), and shrimp trawl mortality prior to the installation of Turtle Excluder Devices (TEDs).

The Kemp's ridley turtle is listed as an endangered species under the Endangered Species Act of 1973. The Kemp's ridley turtle is also listed as endangered by the FGFWFC.

Florida pine snake *Pituophis melanoleucus mugitus*

Florida pine snakes, which were once common throughout the southeast, are typically found in open, sandy, pine-turkey oak woodlands and abandoned fields, as well as in sandhill, scrub, and longleaf pine forests (Tennant and Krysko 1997). The pine snake is listed by the FGFWFC as a species of special concern, primarily due to loss and fragmentation of habitat, overcollecting, and road mortality (Franz 1992). The distribution of this species extends to Lee County only, and is not well-documented.

Limpkin *Aramus guarauna*

The limpkin is a heron-sized wading bird with a long neck, bill, and legs (Bryan 1996). They are typically found along the shallows of slow-moving freshwater rivers, marshes, and lakeshores. Nesting occurs in bulrush marshes, in the tops of cypress and cabbage palms, and amongst cypress knees (Bryan 1996).

The primary threat to the limpkin appears to be loss of its primary food source, the apple snail (*Pomacea paludosa*). The apple snail population is threatened by degradation of water quality, changes in hydroperiod and hydrology, pollution, and the proliferation of exotic plants, particularly water hyacinth (*Eichornia crassipes*), hydrilla (*Hydrilla verticillata*), and Brazilian elodea (*Egeria densa*).

The limpkin occurs throughout the study area, primarily in undeveloped areas.

The limpkin is listed as a species of special concern by the FGFWFC.

Red-cockaded woodpecker *Picoides (=Dendrocopos) borealis*

The red-cockaded woodpecker is a territorial, non-migratory, year-round resident of mature pine forests in the Southeastern United States (Hovis 1996).

The red-cockaded woodpecker uses open upland and hydric pine forests, as well as mixed pine/cypress forests in Southwest Florida. Like the Florida scrub-jay, red-cockaded woodpeckers exhibit cooperative breeding where immature birds aid in the rearing of the young (Ehrlich et al. 1992).

Red-cockaded woodpeckers in Southwest Florida require an average of 200 to 500 acres of old pine forest to support foraging and nesting habitat. Territory size is larger in Southwest Florida than in other parts of the species range due to available habitat.

The red-cockaded woodpecker appears to play a crucial role in the Southern pine forest ecosystem. A number of other birds use the nest cavities excavated by red-cockaded woodpeckers, such as bluebirds, and several other woodpecker species, including the downy, hairy, and red-bellied woodpecker (USFWS 1993). Larger woodpeckers may take over a red-cockaded woodpecker cavity, sometimes enlarging the hole enough to allow screech owls, wood ducks, and even raccoons to later move in. Flying squirrels, several species of reptiles and amphibians, and insects, primarily bees and wasps, also will use red-cockaded cavities (USFWS 1993).

In the study area, red-cockaded woodpeckers are documented in central Lee County east of Naples, Golden Gate Estates, Belle Meade (Picayune Strand State Forest).

The red-cockaded woodpecker rapidly declined as its pine habitat was altered for a variety of uses, primarily timber harvest and agriculture. The species was listed as endangered in March 1970 by the Department of the Interior. The red-cockaded woodpecker is listed as a threatened by the FGFWFC and endangered by the USFWS.

Audubon's Crested Caracara *Caracara plancus*

The crested caracara is about the size of an osprey. The caracara is an opportunistic feeder; its diet includes both carrion and living prey. The living prey usually consist of small turtles, frogs, and lizards.

Adult caracara maintain large territories, usually with their mates. Pair bonds are strong, persisting until one of the mates dies. The nest is typically located in a cabbage palm. The breeding peak is from January to March, with the usual clutch being two or three eggs (Layne 1996).

The region of greatest abundance for this Florida population is a five-county area north and west of Lake Okeechobee (Layne 1996). Caracara occur in the following Florida counties: Glades, DeSoto, Highlands, Okeechobee, Osceola, Lee, Collier, Hendry, Charlotte, Hardee, and Polk Counties. Historically the Florida population was more widespread, but has diminished rapidly with expansion of development.

The crested caracara is a bird of open country. Dry prairies with wetter areas and scattered cabbage palm (*Sabal palmetto*) comprise their typical habitat. Caracara also occur in improved pasture lands and even in lightly wooded areas with more limited stretches of open grassland (Layne 1996). Adult caracara tend to spread thinly over a wide area, with each pair maintaining a large territory.

The primary cause for the decline of the crested caracara has been habitat loss. Real estate development, citrus groves, tree plantations, improved pastures, and other agricultural uses are all competing for the same habitat. Less significant factors may include illegal killing and trapping; increased numbers of road kills due to a rising volume of traffic; slow recovery from population losses because of the caracara's low reproductive rate; and possible loss of genetic variability (due to the relatively small population), thus making the caracara more vulnerable to stresses than would otherwise be the case (USFWS 1991).

Most caracara occur on privately-owned lands in Florida. The only Federal land on which the bird might permanently reside is the Air Force's Avon Park bombing range in Polk and Highlands County. Without any significant areas of habitat under State or Federal protection, long-term survival of the Florida population will depend largely upon finding innovative means of preserving the extensive tracts of prairie habitat in private ownership (USFWS 1991). Caracaras are documented in the eastern portions of the study area, primarily in association with agricultural lands. Historically, caracaras were documented as far west as Colonial and Summerlin Boulevards in Ft Myers.

The Audubon's crested caracara is listed as threatened by both the USFWS and the FGFWFC.

Little blue heron — *Egretta caerulea*
Snowy egret — *Egretta thula*
Tricolored heron — *Egretta tricolor*
White ibis — *Eudocimus albus*

These wading birds forage in relatively shallow streams, lakes, ponds, rivers, cypress domes, mixed pine/cypress, hydric pine, and isolated wetlands in Southwest Florida. Wetlands within 15 km (9.3 miles) of rookeries are considered core foraging areas for wading birds (Cox et al. 1994). They also utilize estuaries, mangroves, and beaches in the study area. They feed on fish, frogs, crawfish, mice and insects.

Nesting occurs in flooded woodlands and on islands. Typical vegetation includes cypress, red maple, mangrove, willow, and buttonbush (Rodgers, Jr. 1996). Data collected in 1996 (FGFWFC) indicate that 25 wading bird rookeries occur within the EIS study area.

The primary threat to these wading birds is loss of foraging habitat, particularly seasonal and isolated wetlands, through habitat alteration, including filling and changes in hydrology. Exposure to pollution, pesticide residues, and disturbance of colony sites may also play a role (Rodgers, Jr. 1996).

These four wading bird species are listed as species of special concern by the FGFWFC.

Arctic peregrine falcon — *Falco peregrinus tundrius*

The peregrine falcon is the largest of the falcons found in Florida. Florida serves as an important wintering area and migratory route for this subspecies. Migrants can be found in Florida after the first fall cold front with some individuals remaining all winter. Florida's coastline (including the Marco Island and Ten Thousand Island areas) and inland lakes and marshes, both abundant with shorebirds and waterfowl, attract these spectacular hunters. Dry prairies, wet prairies, and agricultural environments also serve as suitable feeding areas. Abundant bird prey and high perching areas are a must for this species. The peregrine falcon is listed as endangered by the FGFWFC and was recently delisted by the USFWS.

Southeastern American kestrel — *Falco sparverius paulus*

The Southeastern American kestrel is the smallest of the falcons found in the United States. Florida also serves as an important wintering area for the similar American kestrel (*F. s. sparverius*). Both subspecies prefer open areas with scattered trees, as well as urban and cultivated habitats (Stys 1993). Typical food items consist of insects and small vertebrates, such as lizards and toads. Population decline appears to be due to man-induced changes including urbanization and changes in land use practices (e.g., suppression of fire). While clearing of timber and clearing for cattle has resulted in new foraging areas, it has also resulted in loss of suitable nest sites (Smallwood 1990 *in* Stys 1993). The Southeastern American kestrel is not well-documented in the study area but few comprehensive surveys have occurred. The Southeastern American kestrel is listed as threatened by the FGFWFC.

Florida sandhill crane *Grus canadensis pratensis*

The Florida sandhill crane is one of Florida's largest birds, and is one of six recognized subspecies of sandhill crane. The sandhill crane utilizes open prairies, active or fallow cropland, and improved pastures for foraging, and herbaceous wetlands as nest sites. The cranes are opportunistic feeders, feeding on invertebrates, plants, seeds, berries, birds, and small mammals (Stys 1997).

Concentrations of cranes have been noted in the area surrounding the Southwest Florida International Airport, as well as agricultural areas within the study area (Arnold Committee 1996). The crane is at risk due to loss of wetlands from filling or ditching, degradation or loss of prairie and range habitats, and fragmentation of remaining habitat into patches too small or remote to be considered suitable for crane use (Stys 1997). Low fecundity is also a concern for the long-term fitness and recovery of the species. The Florida sandhill crane has been listed as threatened by the FGFWFC since 1974.

Florida burrowing owl *Speotyto cunicularia floridana*

The Florida burrowing owl is listed as a species of special concern by the FGFWFC. The Florida burrowing owl is typically found in open, well-drained treeless areas where the herbaceous ground cover is low or close-cropped, such as pastures and athletic fields (Millsap 1996). The primary prey items include insects, brown anoles, Cuban treefrogs, roadkill animals, songbirds, and small rodents. The primary threats to the species are from development and intensive cultivation (Millsap 1996).

Although the status of the owl population in the study area is unclear, owls are known to occur on mining lands and improved pasture, and in the area surrounding the Southwest Florida International Airport, Marco Island, and some areas of Lehigh Acres (Arnold Committee 1996).

Florida Scrub-Jay *Aphelocoma coerulescens*

The Florida scrub-jay was listed by the USFWS as threatened under the Endangered Species Act in 1987, primarily due to habitat loss, fragmentation, and degradation. The scrub-jay is also listed as threatened by the FGFWFC. Scrub habitats associated with Florida's coastal islands, mainland coasts, and the Lake Wales Ridge are considered to be among the most threatened natural systems in the United States, with an estimated habitat loss of more than 80 percent relative to pre-settlement acreage (Fitzpatrick et al. 1991).

Florida scrub-jays are non-migratory and relatively sedentary, rarely traveling farther than 8-10 km (5-6 miles). Scrub-jays occupy territories on a continual (i.e., year-round) basis (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991; Fitzpatrick et al. 1994). Territory size averages 9-10 ha (22 to 25 ac), with a minimum size of about 5 ha (12 ac). The availability of territories is a limiting factor for scrub-jay populations.

There are relatively few predators of adult Florida scrub-jays, but the most frequent predators are raptors such as Cooper's hawk (*A. cooperii*), sharp-shinned hawk (*Accipiter striatus*), merlin (*Falco columbarius*), and the Northern harrier (*Circus cyaneus*). Snakes, raccoons (*Procyon lotor*), and feral cats (*Felis cattus*) are also known to prey on nestlings and adults (Fitzpatrick et al. 1994).

The Florida scrub-jay has very narrow habitat requirements, being endemic to Florida's relict dune ecosystems and scrubs, which occur on well-drained, nutrient-poor, sandy soils (Myers 1990; Fitzpatrick et al. 1994). This relict oak-dominated scrub, or xeric oak scrub, is crucial habitat for the Florida scrub-jay. The phenotypic oak scrub is predominantly four species of evergreen, low-growing oaks (Chapman oak (*Quercus chapmanii*), sand live oak (*Q. geminata*), myrtle oak (*Q*. *myrtifolia*), and scrub oak (*Q*. *inopina*)), with or without the presence of rosemary (*Ceratiola ericoides*) and/or sand pine (*Pinus clausa*) or slash pine (*P. elliottii* var. *densa*) (Myers 1990). In optimal scrub-jay habitat, these oaks are one to three meters (3 to 10 feet) tall, with a mosaic of sandy openings comprising 25 to 50 percent of the total cover, and a pine (sand pine or slash pine) canopy of less than 20 percent (Woolfenden and Fitzpatrick 1990).

The predominant communities providing suitable scrub-jay habitat in Southwest Florida are oak scrub and scrubby flatwoods, the latter of which differs from scrub in that it has a sparse cover of slash pine. Portions of the EIS study area (the western two-thirds of Lee County, the northern portion of Collier County, and the Immokalee area) are mapped as containing suitable habitat types (USFWS 1998). This habitat, in addition to similar habitat in Charlotte, Glades, and Hendry Counties, acts as a “connector” between the larger habitat areas designated as the “Southern Gulf Coast sub-region” and the “Lake Wales Ridge sub-region.” The Immokalee scrub-jay population has been designated by the USFWS and the FGFWFC for special protection measures (Arnold Committee 1996). Scrub jays have been reintroduced to oak scrubs at Rookery Bay National Estuarine Research Reserve.

The Southwest Florida area has experienced significant habitat fragmentation and loss due to development and urbanization (USFWS 1998). This loss of habitat, as well as degradation due to suppression of fire (necessary to maintain “optimal” habitat) has placed additional burdens on this region’s scrub-jay populations.

<u>Bald Eagle</u> *<u>Haliaeetus leucocephalus</u>*

The bald eagle is the only eagle unique to North America. It ranges over most of the continent, from the northern reaches of Alaska and Canada down to northern Mexico.

The bald eagle occurs in various habitats near lakes, large rivers, and coastlines. In general, eagles need an environment of quiet isolation; tall, mature trees; clean waters; a source of prey; and prefer nesting within one-half mile (0.8 km) of water.

The bald eagle population was decimated in the 19th and early 20th centuries by habitat destruction, hunting, pesticide use and lead poisoning. In 1967, bald eagles were officially declared an endangered species. Due to this and other protective measures, the population has made a tremendous comeback, its populations greatly improving in numbers, productivity, and security in recent years. Its largest populations are currently found in Alaska and Florida (USFWS 1995).

Twenty-six active bald eagle nests are recorded within the study area, as of the 1996 winter census (FGFWFC 1996). In Lee ,and Collier counties, the nesting eagles are mainly concentrated along coastal areas. Nests typically occur in pines and cypress within the study area but occasionally eagles nest in Australian pines.

The bald eagle is currently listed as a threatened species by both the USFWS and FGFWFC.

<u>Wood Stork</u> *<u>Mycteria americana</u>*

The wood stork is the only stork occurring in the United States. In the U.S., the wood stork's range includes Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas. The only states in which this bird is known to nest, however, are Florida, Georgia, and South Carolina.

Wood storks are wetland dwellers and use fresh, brackish, and saltwater habitats for feeding and nesting. Nesting occurs in cypress, hardwood and mangrove swamps. The extreme dependence of the wood stork on naturally functioning wetlands makes it an excellent indicator of the health of wetland ecosystems. Feeding takes place in shallow ponds, tidal pools, swamps, and marshes. Wetlands found within 30 km (18.6 miles) of rookeries are considered core foraging areas by the FGFWFC (Cox et al. 1994).

Until the last few decades, the wood stork was a common sight in Florida's wetlands. However, between the 1930's and 1960's, there was a serious decline in this species. One reason for the decline in population has been the changes in the hydrologic regime of the Everglades, which affected its foraging habitat and food production (Mazzotti 1990).

Four wood stork rookery sites were mapped within the EIS study area (all in Collier County) during the late 1980's (Runde et al. 1991). The largest wood stork rookery in the United States is located in the Audubon Society's Corkscrew Swamp Sanctuary (Arnold Committee 1996).

The wood stork is currently listed as an endangered species by both the USFWS and FGFWFC.

<u>Everglade Snail Kite</u> *<u>Rostrhamus sociabilis plumbeus</u>*

Although previously located in freshwater marshes over a considerable area of peninsular Florida, the range of the snail kite is currently more limited. This bird is now restricted to several impoundments on the headwaters of the St. John's River; the southwest side of Lake Okeechobee; the eastern and southern portions of Water Conservation Areas (WCA) 1, 2A and 3; the southern portion of WCA 2B; the western edge of WCA 3B; and the northern portion of Everglades National Park.

The snail kite inhabits relatively open freshwater marshes which support adequate populations of apple snail (*Pomacea paludosa*), upon which this bird feeds almost exclusively. Favorable areas consist of extensive shallow, open waters such as sloughs and flats, vegetated by sawgrass (*Cladium jamaicense*) and spikerushes (*Eleocharis spp.*). The areas are often interspersed with tree islands or small groups of scattered shrubs and trees which serve as perching and nesting sites. The water level must be sufficiently stable to prevent loss of the food supply through drying out of the surface.

In the study area, the snail kite has been noted in the area around the Southwest Florida International Airport mitigation lands, in canals and Harnes Marsh in Lehigh Acres (Arnold Committee 1996) and in agricultural retention areas in eastern Lee County.

The snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once snail kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth which inhibits the snail kite's ability to see its prey (USFWS, May 1996).

Three (3) snail kite roosting areas were identified within the EIS study area, based upon FGFWFC (1996) data - one each in Zooms B (the Hub), C, and D. An additional four (4) roosting areas are located just east of Zoom D. Snail kite use of habitat in Southwest Florida may be linked to drought conditions in other areas. Birds may also be dispersing juveniles (Toland USFWS pers. comm. 1996).

The snail kite is currently listed as an endangered species by both the USFWS and FGFWFC.

<u>Sherman's short-tailed shrew</u> *<u>Blarina brevicauda shermanii</u>*

The Sherman's short-tailed shrew is typically found in mesic forests and slash pine and palmetto flatwoods with dense herbaceous areas in Southwestern Florida. The primary threats to the shrew are habitat loss or disturbance, through changes in hydrology or land clearing activities, and predation by feral and domestic house cats (Layne 1992). Based upon current knowledge, Sherman's short-tailed shrew has one of the most restricted ranges of all Florida mammals (Layne 1992). The shrew has been collected along the Orange River and along Hickey Creek, located west and north of Lehigh Acres, respectively (Arnold Committee 1996).

The Sherman's short-tailed shrew is currently listed as a species of special concern by the FGFWFC.

Florida panther *Felis concolor coryi*

The Florida panther is one of the most endangered large mammals in the world and was designated as an endangered species by the Department of the Interior on 11 March 1967. The panther is also listed as endangered by the FGFWFC. A small population in South Florida, estimated to number between 30 and 50 adults (30 to 80 individuals), represents the only known remaining wild population of an animal that once ranged throughout most of the Southeastern United States from Arkansas and Louisiana eastward across Mississippi, Alabama, Georgia, Florida, and parts of South Carolina and Tennessee (USFWS 1998).

Geographic isolation, habitat loss, population decline, and associated inbreeding have resulted in a significant loss of genetic variability and health of the Florida panther. Population viability projections in 1989 and 1992 concluded that under the current demographic and genetic conditions, the Florida panther would probably become extinct within twenty to forty years (USFWS 1998).

The only known remaining panther population is centered in and around the Big Cypress Swamp and Everglades area of South Florida. Native landscapes within the Big Cypress Swamp region are dominated by pine, cypress, and freshwater marshes, interspersed with mixed-swamp forests, hammock forests, and prairies (Duever et al. 1979). Tracking data from radio-collared members of this population indicate that its epicenter is in Collier and Hendry Counties. Collared panthers have also been documented in Broward, Dade, Glades, Hardee, Highlands, Lee, Monroe, and Palm Beach Counties. There are still large areas of privately-owned land in Charlotte, Collier, Hendry, Lee, and Glades Counties where uncollared individuals may reside (Maehr 1992a). Lands under private ownership account for approximately 53% of the occupied panther range in South Florida (Logan et al. 1993). The greatest concentration of unprotected, occupied panther habitat is found on private land in eastern Collier County and southern Hendry County (Maehr 1992a). For the most part, privately owned lands are higher in elevation, better drained, have a higher percentage of hardwood hammocks and pine flatwoods, and are higher in natural productivity than public lands south of Interstate 75. Private lands contain some of the most productive panther habitat in South Florida, primarily due to habitat and general land management practices. However, better soils and drainage make this land more suitable for intensive agriculture and urban growth than public lands (Maehr 1992b).

Historically, the Florida panther population was tied to the population of its primary prey, the white-tailed deer (*Odocoileus virginianus*). As deer populations varied due to disease and to changes in land cover and land management practices, the panther took advantage of a human-introduced alternative to the deer - the feral hog (*Sus scrofa*) (Maehr 1992b). Food habit studies of panthers in Southwest Florida indicate that the feral hog was the most commonly taken prey followed by white-tailed deer, raccoon, and nine-banded armadillo (*Dasypus novemcinctus*). Although domestic cattle are readily available, they are rarely taken as prey items (Maehr 1990 *in* USFWS 1998).

The typical home range size for a female panther is 195 km^2 (75 square miles) (Logan et al. 1993). Female home range size has been positively correlated with higher percentages of dry prairie, shrub swamp, and shrub and brush, with the larger home ranges containing greater amounts of these cover types (Maehr 1992a). Similarly, female panther home range size is inversely related to habitat quality and may also influence reproductive success (Maehr 1992a). Male Florida panthers use more cover types and have larger home ranges than females. The average home range size for a male is approximately 518 km^2 (200 square miles) (Logan et al. 1993). The home range size of male panthers is influenced by the percentages of hardwood hammock, hardwood swamp, water, grass and agricultural land, barren land, and scrub and brush in the landscape. Smaller male home ranges have greater percentages of hardwood hammocks and hardwood swamp, while larger home ranges have greater percentages of water, grass and agricultural land, barren land, and shrub and brush. Dispersing males may wander widely through non-forested and disturbed areas (Maehr 1992b). 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 1990). Habitats avoided by panthers include agricultural, barren land, shrub and brush, and dry prairie. The area of southeastern Lee County is typically used by young, dispersing cats prior to establishment of a permanent territory. These cats follow the forested areas along I-75 north from the CREW (Arnold Committee 1996).

Transportation infrastructure to accommodate for increased agricultural and urban growth and the associated increase in traffic volumes have resulted in significant threats to the panther. Although the relative significance of highway deaths to other sources of mortality is not entirely known, it has been the most often documented source of mortality (Maehr 1989; Maehr et al. 1991b *in* USFWS 1998). Roadways in Lee County have experienced the greatest level of panther mortality outside of the Fakahatchee Strand area (Arnold Committee 1996). Underpasses beneath Interstate 75, State Road 29, and Corkscrew Road have been constructed as a means to reduce risks along documented panther travel corridors. However, highways may also affect panthers (and other wide-ranging species) through habitat fragmentation. Rapidly increasing human populations and expanding agriculture in this portion of the State are compromising the ability of natural habitats to support a self-sustaining panther population. Increasing growth on the west coast of Florida, and the spread of agricultural development in the interior have placed increasing pressures on forested tracts in Collier, Glades, Highlands, and Hendry counties (Maehr 1992b).

<u>Everglades mink</u> <u>*Mustela vison evergladensis*</u>

The Everglades mink was first described as a subspecies in 1948 (Humphrey 1992). Its primary habitat is shallow wetlands of all types, although swamp forests are utilized more than most due to more stable hydroperiods. The diet of the mink consists of insects, crayfish, small mammals, and fish.

The primary threats to the species are from habitat degradation/alteration (draining of wetlands) and from conversion of habitat to citrus culture.

The Everglades mink is documented in the Big Cypress Preserve just east of the study area.

The Everglades mink is listed a threatened species by the FGFWFC.

Big Cypress fox squirrel <u>*Sciurus niger avicennia*</u>

The Big Cypress fox squirrel is a distinct subspecies of fox squirrel with a range restriction to Southwestern Florida. Habitat use by the Big Cypress fox squirrel is complex and poorly understood. They are found in a variety of forested communities, especially open pinelands, with the exception of dense mixed cypress-hardwood strands. This may be due to avoidance of gray squirrels (*Sciurus carolinensis*), which densely occupy the mixed cypress-hardwood community (Humphrey 1992).

The cones of the South Florida slash pine (*Pinus elliottii* var. *densa*) seem to be a favorite food item, although cypress (*Taxodium* spp.) cones, cabbage palm (*Sabal palmetto*) fruits, and acorns are also utilized. The Big Cypress fox squirrel nests in pines, constructing nests of grapevine and cabbage palm thatch, but also utilizes cypress, bromeliads and exotic trees such as melaleuca (*Melaleuca quinquenervia*).

The primary threat to the species is habitat destruction. Large-scale development west of the Big Cypress National Preserve, conversion of pinelands to agriculture, and road construction are considered serious threats.

The Big Cypress fox squirrel is documented in pinelands, mixed pine-cypress, open cypress heads and mixed forested areas in the study area.

The Big Cypress fox squirrel is listed as a threatened species by the FGFWFC, and is proposed as a candidate species for listing by the USFWS.

Florida black bear *Ursus americanus floridanus*

The Florida black bear is the largest extant land mammal in Florida (Maehr 1992c). Several fragmented sub-populations exist throughout the State, most notably around the Ocala National Forest, the Apalachicola National Forest, and in Southwest Florida. Large, undeveloped wooded tracts are the bear's preferred habitat. In Southwest Florida, the black bear also utilizes mangrove forests.

The black bear is omnivorous, feeding primarily on succulent vegetation (tubers, bulbs, berries, nuts, young shoots) and colonial insects. The berries of the saw palmetto (*Serenoa repens*), cabbage palm, swamp tupelo (*Nyssa biflora*), and acorns are preferred foods in the fall. The honey bee (*Apis mellifera*) is the most frequently consumed insect, and nine-banded armadillos the most commonly consumed vertebrate (Maehr 1992c).

The primary threat to the black bear is loss of habitat through clearing and fragmentation of forested land for agricultural uses, urbanization, and other development. Loss of individuals due to vehicular collisions is also of concern in areas where highways bisect remaining bear habitat. There have been forty-seven (47) recorded roadkills within the study area, primarily in the southern portion (Zooms C and D).

The black bear occurs throughout the undeveloped and rural areas within the study area.

The black bear has been listed as a threatened species by the FGFWFC since 1974.

West Indian Manatee *Trichechus manatus*

The West Indian manatee, is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers, and springs of Florida. Florida is essentially the northern extent of the West Indian manatee's range, although some manatees occasionally are reported from as far north as Virginia and the Carolinas.

The West Indian manatee lives in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. It can be found in both clear and muddy water. Water depths of at least 1 to 2 m (3 to 7 ft) are preferred, and flats and shallows are avoided unless they are adjacent to deeper water. During the summer months, manatees range throughout the coastal waters, estuaries, bays, and rivers of both coasts of Florida, and are usually found in small groups. During the winter, manatees tend to congregate in warm springs, and outfall canals associated with electric power generation facilities.

Over the past centuries, the principal sources of manatee mortality have been opportunistic hunting by man and deaths associated with unusually cold winters. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. The largest single mortality factor is collision with boats and barges. Manatees also are killed in flood gates and canal locks, by entanglement or ingestion of fishing gear, and through loss of habitat and pollution (FP&L 1989).

Lee and Collier counties have the second and third highest manatee mortality related to watercraft in the State. In 1996, 158 manatees died in Southwest Florida as a result of complications related to a red tide outbreak in Lee and Collier Counties.

The West Indian manatee is currently listed as an endangered species by both the USFWS and FGFWFC.

3.4 FISH AND WILDLIFE RESOURCES

Fish and wildlife species are still abundant and widespread throughout the study area, although the distribution and numbers of species has been changed as a result of development and general urbanization of the coastal areas. The southwest region of Florida has a rich diversity of native animal life, including species that are endemic to the region, and sub-tropical species found nowhere else in the United States, augmented seasonally by migratory patterns of many different birds and fish species. The species for which Southwest Florida is known include the alligator, the West Indian manatee, the wood stork, the Florida panther, the tarpon (*Megalops atlanticus*), and the pink shrimp (*Penaeus duorarum*) (SWFRPC 1995).

3.5 WATER QUALITY

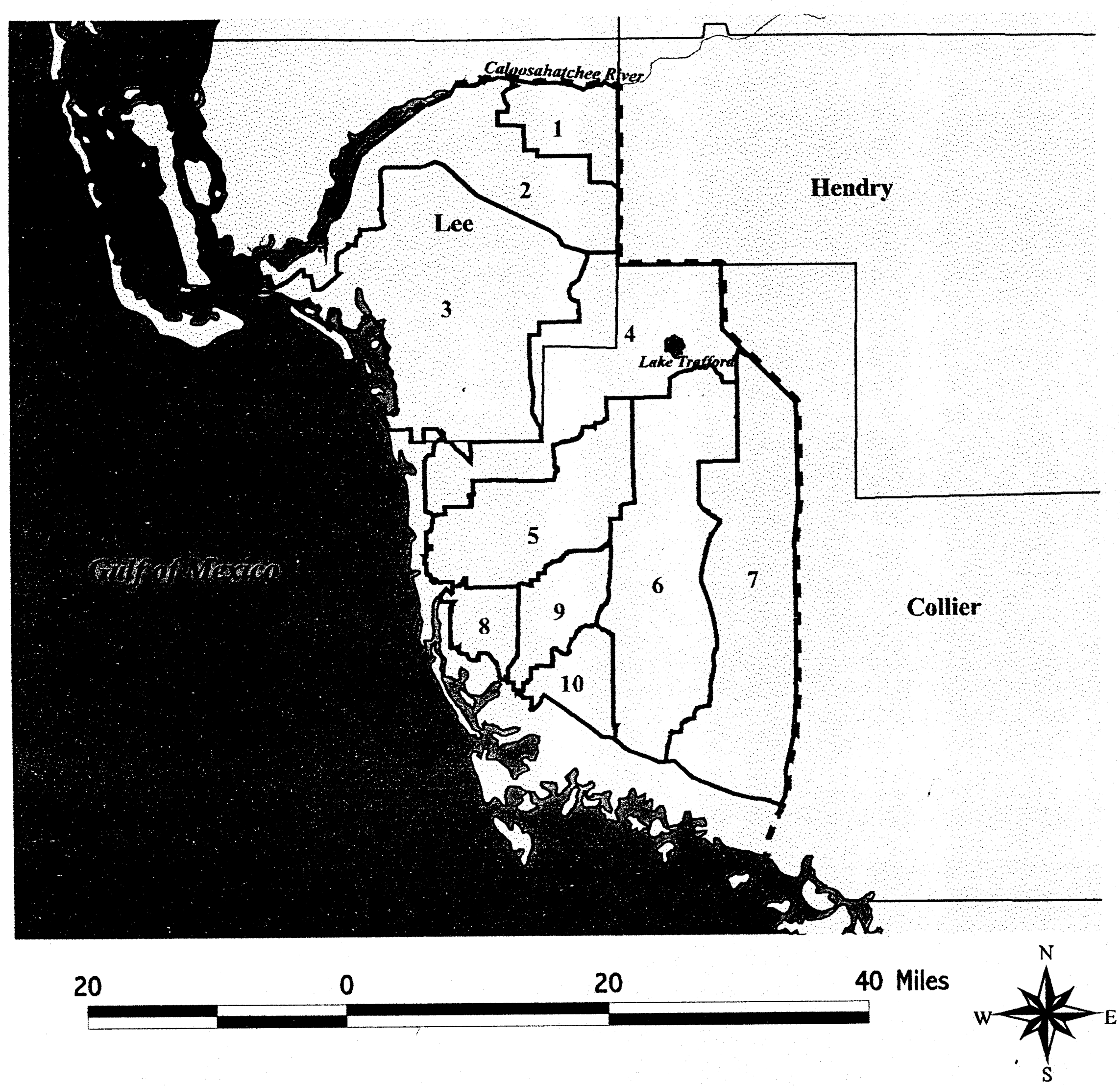
3.5.1. INTRODUCTION

This section provides descriptions of the methodology, terminology, and rationale used to characterize the affected environment of surface and ground water quality within the study area. The status of historical and current water quality conditions for the study area are described by means of water quality parameters, Florida State water classifications, water quality indices, and exceedences of Florida State water quality criteria. Water quality trends were based on available data for the study area, which for some watersheds, were not always complete.

3.5.2. SURFACE WATERS

This section describes surface water quality as defined by physical and biological parameters, flow characteristics, pollutants, nutrients and, if known, biological indicators. The descriptions of water quality are largely based on STORET data summaries for individual watersheds within the larger study area watersheds. STORET is an Environmental Protection Agency (EPA) database of water quality information collected by numerous agencies. Other water quality studies were consulted as well (CDM, Inc. 1995; Gibson 1997). Geography, topography, rainfall, evaporation, and man-made alterations within the watershed, such as hydrographic modifications (drainage canals, dams), development, and agriculture, affect the quality of water. The EPA and FDEP use STORET data to assess water quality trends in watersheds by condensing certain parameters into one of two indices, thereby facilitating year to year comparisons. Non-point source pollution, contaminant information, and exceedences of water quality standards are also evaluated for trend determination. In the following sections, water quality of rivers, creeks, bays, canals, and swamps will be discussed for the three watersheds of interest to this study.

For purposes of historical descriptions, the study area has been sectioned into four regions which include the Caloosahatchee, the Estero-Imperial Integrated, the Big Cypress/West Collier, and the Southern Big Cypress Swamp. More recent hydrologic descriptions of the study area, however, utilize smaller regions as described by the SFWMD watershed basins. These study area watershed basins are identified in **Figure 11** and **Table 5**. Introductory information on the physical setting, surrounding land use, natural habitats, and physical characteristics of the various watershed systems have been provided to better assess historic and current water quality within the study area.



Region of Influence Boundary
Water Bodies
Watershed Boundary
County Boundary

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

Figure 11. SFWMD Watersheds and Basins within the Study Area.

Table 5. Watersheds And Receiving Waters Of The Study Area

WATERSHED	DRAINAGE BASIN	RECEIVING WATER BODY	ULTIMATE ENDPOINT
Caloosahatchee Watershed	Tidal Caloosahatchee Basin	Tidal Caloosahatchee River	San Carlos Bay
	West Caloosahatchee Basin	West Caloosahatchee River	West Caloosahatchee River
Estero-Imperial Watershed	Estero Bay Basin	Estero River, Spring Creek	Estero Bay
	Imperial River Basin	Imperial River	Estero Bay
Big Cypress/West Collier Watershed	Corkscrew-Cocohatchee River Basin	Cocohatchee River, Corkscrew Swamp	Wiggins Pass/Gulf of Mexico
	Golden Gate Canal Basin	Golden Gate Canal	Naples Bay
	District VI Basin	Lely Canal	Gulf of Mexico
	Faka-Union Canal Basin	Faka-Union Canal	Faka-Union Bay
	Henderson Creek Basin	Henderson Creek	Rookery Bay
	Collier-Seminole Basin	CR92 Canal	Gullivan Bay
Big Cypress Swamp	Fakahatchee Strand Basin	Fakahatchee Strand	Ten-Thousand Islands

The study area (**Figure 11**) incorporates portions of the Tidal Caloosahatchee and West Caloosahatchee watershed basins and sections of the Caloosahatchee River. The East Caloosahatchee River (although not shown in **Figure 11**) is also discussed since it drains into the study area, impacting the water quality of the western and tidal sections of the Caloosahatchee.

The East and West portions of the freshwater segment of Caloosahatchee River have been restructured into a canal known as C-43. Drinking and irrigation water is obtained from the eastern portion of the canal, while the western portion is designated for wildlife and recreational use. There are about 60 tributaries of varying water quality with respect to FDEP indices within the Caloosahatchee River watershed.

Physical Description

To accommodate navigation, flood control, and land reclamation needs, the Caloosahatchee River has been radically altered from its natural state. One of the most dramatic changes was the dredging that connected the Caloosahatchee to Lake Okeechobee in 1881 in order to lower the water level of Lake Okeechobee. In 1882, the channelization of the lower reaches of the river began.

Due to intensive canal construction by 1910, shallow draft navigation from the Gulf of Mexico to the Atlantic Ocean was possible. Canal locks at Moore Haven were completed in 1918, and the locks at Ortoona were completed in 1937. The W. P. Franklin Lock was completed in 1969, preventing saline water from flowing upstream of Olga (Kimes and Crocker 1998).

In addition to the alteration of the main channel, many canals have been constructed along the banks of the river. These canals were constructed for both water supply and land reclamation in order to support the many agricultural communities along the river.

Land use within the Caloosahatchee watershed is dominated by rangeland and agriculture, particularly in the upper part of the basin (FDEP 1996a). The major urban areas that occur along the tidal Caloosahatchee watershed basin are Ft. Myers and, across the river, the large residential areas of Cape Coral and North Ft. Myers.

Flow and stage height in the Caloosahatchee River is controlled by a series of locks. Agricultural practices and navigation channels have for many years dictated the patterns of surface water drainage. Canal, lock, and spillway construction and dredging have been occurring since the late 1800s, altering the natural watercourse of the Caloosahatchee River. Today, three primary locks function to regulate water level, usage, and saltwater intrusion. One, at Moore Haven, regulates Lake Okeechobee waters. The Ortoona Lock delineates the east river basin from the west and controls water on the adjoining land areas. The Franklin Lock at Ft. Myers prevents saltwater intrusion from the tidal Caloosahatchee River segment from proceeding eastward. The pattern and period of flow of the Caloosahatchee River is highly variable, based on demand. River flows are negative (from west to east) for a majority of the year, possibly resulting from heavy irrigation usage or losses to groundwater and/or evapotranspiration (Drew and Schomer 1984).

Historical Description

Camp, Dresser and McKee (CDM), Inc. (1995) compared monitoring results of a 1993-94 study on the freshwater Caloosahatchee River with data from 1973-1980. CDM concluded that historical water quality differed from current water quality only with respect to small differences in nutrient concentrations. The report stated dissolved oxygen was historically low, as were suspended solids. Total phosphorus was comparable to other Florida water bodies, but nitrogen and chlorophyll a were generally high. Decreasing trends in total nitrogen were observed westward from Lake Okeechobee. Measurements of DO, pH, conductivity, and total phosphorus generally increased westward from Lake Okeechobee.

Historical information on the tidal Caloosahatchee from 1975-76 was available from Drew and Schomer (1984). Previous surveys indicated some aspects of water quality, such as DO, improved as one moved downstream away from the urbanized areas. Seasonal water quality fluctuations have also been observed, with DO decreasing in October and December and stabilizing in February. Salinity decreased, temperature decreased, and chlorophyll a decreased in the winter. During the 1970s, pollution was attributed to the following major sources: downstream flow from the Franklin Lock; Orange River inflow; the wastewater treatment plant (WWTP) effluent from the cities of Cape Coral and Fort Myers; and the residential development, Water Way Estates (Drew and Schomer 1984).

Freshwater Systems

The freshwater systems of the Caloosahatchee River are discussed as the Eastern and Western Caloosahatchee (**Figure 11**). The Western Caloosahatchee begins at the point where Franklin Lock separates the tidally influenced waters from the upland waters. The Eastern Caloosahatchee begins at Ortoona Lock and extends to Lake Okeechobee. Before reaching Lake Okeechobee, the Eastern Caloosahatchee encounters Lake Hicpochee which is a small waterbody and historically (within the last twenty years) poor in water quality (FDEP 1996a).

Water quality parameters are expressed as annual averages and include physical and biological parameters, nutrients, and contaminants. Sediment quality data, if available, are also briefly discussed. Known impaired usage of the basins is presented last. The majority of the current data discussion represent data collected from 1990 to 1995.

Eastern Caloosahatchee Basin

Eastern Caloosahatchee waters are usually above neutral in pH (>7), but tend towards low DO (<4.8 mg/L). CDM (1995) recorded seasonal lows from May through October. Water clarity is characterized by low turbidity and mostly low TSS, although color is higher than average (>71 PCUs) for Florida waters. Conductivity is above average for Florida waters (>335 micromhos), usually measuring above 500 for most stations in the Eastern Caloosahatchee (FDEP 1996a). Ninemile Canal, which feeds into Lake Hicpochee, is of historically poor water quality having high color (120 PCUs), high conductivity (1195), and exceeding FDEP standards for DO (0.6 mg/L) (FDEP 1996a).

The chlorophyll a content was high (32 µg/L), which is above 90% for other typical Florida waters. Average BOD levels (2.8 mg/L) also exceeded Florida standards. Low diversity, pollution-tolerant species, and algal blooms have been reported from Ninemile Creek (FDEP 1996a). Coliform bacteria levels are low in the Eastern Caloosahatchee. However, Goodno Canal, a tributary with otherwise excellent water quality, exceeds FDEP standards for fecal coliform.

The average total nitrogen was high (>1.89 mg/L) in the river and in the tributaries while phosphorus measured 0.08 mg/L (FDEP 1996a). In 1993-94, total nitrogen values ranged from 1.1 to 2.2 mg/L and were highest from August through December. Total phosphorus was also highest during the summer with a range of 0.05 to 0.25 mg/L (CDM 1995). Lake Hicpochee exhibits “poor” water quality due to excessive nutrient concentrations. The lake rated a TSI value of 74 due to high nitrogen (2.6 mg/L) and low DO. Ninemile Canal near Lake Hicpochee also exceeds State standards for total nitrogen. Total nitrogen standards are set at >1.6 mg/L as an exceedence. Impaired use of the basin has been linked to agricultural runoff (CDM 1995).

West Caloosahatchee Basin
Reductions in pH and increased suspended solids are partially responsible for an observed degrading trend for areas north of Townsend Canal (FDEP 1996a). Chlorophyll a levels are improving and most other parameters are holding steady. Other areas of the basin rate “good” on the FDEP’s WQI scale.

Physical water quality parameters throughout most of the basin are characterized by relatively neutral pH, DO readings mostly above 7.0 mg/L, good water clarity (i.e., low turbidity, low color, low TSS), and specific conductance between 500 and 700. No State standards for physical water quality are exceeded.

Biological oxygen demand is low (<2.3 mg/L) in the West Caloosahatchee and chlorophyll a ranges from 2-8 µg/L, an improvement over previous years. Nutrients generally do not exceed State standards, but at most basins are slightly higher than average for State waters. All waters in the West Caloosahatchee are rated “good” on the WQI scale.

Fecal and total coliform bacteria counts are low and do not exceed State standards. However, conventional pollutants (mercury) are present (FDEP 1996a).

Approximately 41% of the West Caloosahatchee Basin are agricultural lands. Wetlands and pine forests make up 12% and 16%, respectively. Impaired usage in this basin primarily results from agricultural runoff.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 41.4, 42.9, and 45.2; respectively.

Estuarine Systems

Tidal Caloosahatchee Basin
The tidal Caloosahatchee (**Figure 11**) extends 28 miles from Franklin Lock to San Carlos Bay, and is so named because its waters are subject to tidal forces (Drew and Schomer 1984). Tributaries of the tidal Caloosahatchee include Billy Creek, Whiskey Creek, Orange River, Hickey Creek, Roberts Canal, and Daughtrey Creek.

Physical water quality of the tidal Caloosahatchee is represented by pH, DO, conductivity, and water clarity. pH ranges slightly above neutral at 7.3 – 7.8. Except for Deep Lagoon and Manuel Branch, the average DO of the tidal Caloosahatchee and its tributaries ranges from 6.5 to 7.4. The overall DO trend is stable. Conductivity is usually above 10,000 micromhos, which is typical for estuarine waters. The freshwater tributaries are lower in conductivity. Orange River is the lowest at 508 micromhos. Water clarity varies along the river and tributaries. Deep Lagoon color was highest at 130 PCUs. A low of 33

PCUs occurs in the lower tidal basin. TSS are generally low at 1-10 mg/L. The highest TSS occurs in Manuel Branch. Turbidity is generally low, ranging between 1.3-6.3. The most turbid waters occur in Manuel Branch. Overall physical chemistry is stable (FDEP 1996a).

Measured values of key biological parameters indicate degraded water quality in parts of the tidal Caloosahatchee and tributaries. Biochemical oxygen demand (BOD), fecal coliform bacteria, and chlorophyll a levels exceeded State standards at several locations. Fecal coliform bacteria were high in 1992 at Manuel Branch (2195 MPN/100 ml) and Billy Creek (1839 MPN/100 ml). The State screening level for fecal coliform bacteria is >190 MPN/100 ml (FDEP 1996a). Chlorophyll a was high (27 µg/L) in Deep Lagoon and Billy Creek (57 µg/L). Due to the poor biological parameters, the tidal Caloosahatchee only partially meets its designated use as a Class II water, suitable for recreation and wildlife (FDEP 1996a).

Nutrient measurements for total nitrogen and total phosphorus in the tidal Caloosahatchee were highest at or east of Ft. Myers. Total nitrogen levels were exceeded in the Caloosahatchee at a station adjacent to Ft. Myers with an average measurement of 1.64 mg/L in 1991. Total nitrogen exceedences (>1.22 mg/L) were also observed east of Ft. Myers in the Caloosahatchee, and at Billy Creek and Deep Lagoon. Averages for total phosphorus exceeded State standards (i.e., were >0.07) in most cases, with the exception of Orange River. The nutrient status as indicated by the TSI is “poor” for Deep Lagoon, “poor” for Billy Creek, and “fair” but close to “poor” for the tidal Caloosahatchee. The WQI for freshwater streams and rivers rated Orange River water quality “good” (FDEP 1996a).

Impaired usage occurs from wastewater inputs from Ft. Myers WWTPs, high nutrient waters from upriver, inputs from tributaries, and stormwater runoff from cities. Algal blooms occur frequently because of excess nutrients (FDEP 1996a).

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 63.5, 46.0, and 58.7; respectively.

3.5.2.2. Estero-Imperial Integrated Watershed

Introduction

The Estero-Imperial Integrated Watershed is comprised of the Estero Bay Watershed and northern portions of the Big Cypress Watershed. The Caloosahatchee River Watershed to the north, the Golden Gate Canal Watershed to the south, and the Gulf of Mexico to the west border the area. Interstate 75 runs north to south through the westernmost portion of the Estero-Imperial Integrated Watershed and divides the more developed coastal areas from the less developed interior. Most of the watershed lies in Lee County with a small percentage located in Hendry County (**Figure 11**). The Estero and Imperial Rivers, and Spring Creek, though small, are the major tributaries within the Estero-Imperial Integrated Watershed that drain into Estero Bay. According to several reports, surface runoff and altered freshwater flows impact water quality greatest within this watershed. Warm, slow moving, estuarine water bodies such as the Estero and Imperial Rivers have some naturally low water quality characteristics such as low DO. Therefore, these may be more susceptible to water quality impacts resulting from changes in land use.

Physical Description

Population centers include the towns of Bonita Springs and Immokalee with 13,600 and 14,120 persons, respectively (U.S. Department of Commerce 1992). Bonita Springs is south of the Imperial River and above the Lee-Collier County border, and Immokalee is located along the eastern edge of the Estero-Imperial Integrated Watershed. Rapid growth is occurring in Bonita Springs where the population more than doubled from 1980 to 1990. Residential areas, cattle, and vegetable farms occupy the landscape and, except for the coastal areas, the population is low (FDEP 1996a).

The Estero and Imperial Rivers and Spring Creek provide minor freshwater flow into Estero Bay. The naturally low flow characteristics of these tributaries make Estero Bay notably susceptible to altered upland drainage water quality, volume, and seasonal inputs (Gissendanner 1983). The topography of the watershed is relatively level, thus accounting for the "sluggish" water movement in this part of the basin (FDEP 1996a).

The highest freshwater inflows into Estero Bay occur in September with great variation in volume observed over the course of the year (Kenner and Brown 1956; Drew and Schomer 1984). At one time, tidally induced flows in Estero Bay exceeded the amount of freshwater inflow (Jones 1980). Estero Bay tides are mixed and average about 0.54 m (1.75 ft) (Estevez et al. 1981), with velocities in the three major Bay-Gulf passes ranging from 0.64 m/s (ebb tide) to 1.52 m/s (flood tide). Flood tides can reach 1.07 m (3.5 ft) in height with volumes of 819 million cubic feet (measured for one pass in 1976) (Drew and Schomer 1984). The low freshwater inflow into Estero Bay allows for generally high saline conditions year-round (around 34 ppt in the dry season), yet is high enough to prevent hypersaline conditions. Salinity seldom falls below 10 ppt even in the wet season (Tabb et al. 1974). Saltwater intrusion into local aquifers has resulted from inadequate recharge of groundwater. This occurrence has been attributed to surface hydrology modifications such as drainage canal construction.

The construction of canals has increased surface water flow such that aquifers are not recharging, thereby allowing saltwater to infiltrate (Daltry and Burr 1998). The Ten Mile Canal was constructed about 1920 to drain a 70 square mile area for agricultural uses and directs this water into Mullock Creek, a tributary of Estero Bay. Generally, this watershed does not have the extensive drainage network of the surrounding areas, but the construction of roads and other berms has still significantly altered the hydrology of the area. These changes have resulted in extensive flooding along the Imperial River. In addition, where flows from the Imperial and Estero Rivers into Estero Bay were once approximately equal, the proportional flow from the Estero River is now much less than that of the Imperial River (Johnson Engineering, Inc. et al. 1998). Surface water from the more interior areas of Flint Pen Strand and Bird Rookery Swamp are drained into Estero Bay and the Wiggins Pass/Cocohatchee River Estuarine System through the Imperial River, Spring Creek, and the Cocohatchee Canal (SFWMD 1998a).

Historical Description

The Estero-Imperial Integrated Watershed was, and in many areas still is, typical of low, flat South Florida lands dominated by wetlands and characterized by slow, sheet-flow drainage patterns. In the past, the naturally dispersed water patterns served to distribute nutrients over broad areas of wetland vegetation. Thus, nutrient levels remained low in undrained areas of this watershed (Haag et al. 1996a). Seasonal fluctuations in flow due to rainfall created the necessary salinity regime in Estero Bay for good estuarine productivity. Estero Bay became the State's first aquatic preserve in 1966 (CHNEP 1997). In 1983, the Estero Bay Aquatic Preserve Management Plan was implemented with emphasis placed on "enhancing the existing wilderness condition" (Gissendanner 1983). Increasing development in the 1960s led to changes in the natural river systems around Estero Bay (CHNEP 1997). Changes in water quality and quantity have been observed. For example, the Imperial and Estero Rivers historically delivered less fresh water to Estero Bay. From 1940 to 1951, the maximum discharge from the Imperial River was 2,890 cubic feet. Low flows were common and no flows occurred on occasion. Periodic flooding has occurred (Kenner and Brown 1956).

Freshwater Systems

Currently, physical water quality in the coastal areas of the Estero and Imperial Basins is characterized by clear water with neutral pH (7.1 to 7.3) but relatively high conductivity values (>16,000 micromhos). DO is slightly lower in the Imperial Basin (4.9 mg/L compared to 5.7 mg/L) than in the Estero Basin. Estero and Imperial Basin water clarity is attributed to low turbidity at <5.0 NTU/NTUs, generally low suspended solids at <10 mg/L, above average Secchi disc depths of 0.9 m to 1.5 m, and low color at 43 to 55 PCUs. Chloride measurements are not available, but conductivity indicates high dissolved mineral content in the Estero and Imperial Rivers. Biological parameters of chlorophyll a and 5-day biochemical oxygen demand (BOD-5) are of slightly lower quality in the Imperial River than in the Estero River. To clarify, BOD in the Imperial River is higher (2.4 mg/L over 1.4 mg/L) than in the Estero River; chlorophyll a is higher in the Imperial (12 μg/L over 2 μg/L), but generally, the two systems are comparable with respect to water quality. Water from the Estero and Imperial Rivers has a "residency time in the Bay of at least several days during the wet season" (Clark 1987). The Estero and Imperial Rivers were evaluated by the FDEP as having "fair" water quality based on their nutrient status as determined by chlorophyll a, total nitrogen, and total phosphorus measurements.

Metals have been detected from limited sampling of the waters of the Estero-Imperial Integrated Watershed. In addition, elevated levels of cadmium, chromium, lead, mercury, and zinc have been found in the sediments of Estero Bay and River, Imperial River, and Spring Creek as recently as 1986 (Clark 1987). In general, analysis of metals, pesticides and PCBs is lacking for the Estero-Imperial Watershed, with metals having only been sampled six times (with the exception of iron) within the last 30 years.

The Imperial River is classified in terms of usage as a Class III water body, suitable for wildlife and recreation. Due to low DO, nonpoint pollution, and conventional pollutants, water quality only partially supports the Imperial River for this type of use (FDEP 1996a). Likewise, Estero River and Spring Creek are only in partial support of use; Spring Creek because of conventional pollutants and low DO, and Estero River for low DO and fecal coliform.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 52.9, 52.0, and 58; respectively.

Estuarine Systems

Estero Bay

Estero Bay waters are described as shallow, turbid, and of "fair" quality (FDEP 1996a). Nutrients at levels that exceed State standards tend to drive water-quality ratings down. Consequently, this water body only partially meets its Class III use designation (FDEP 1996a).

Water clarity, as indicated by turbidity, TSS, and color (8.5 NTU/NTUs, 28 mg/L, 25 PCUs, respectively) is low. Waters were well oxygenated with mean DO levels at 6.5 mg/L. Conductivity was 37800 micromhos (FDEP 1996a). Low chlorophyll a and low BOD were observed in the past. The mean for chlorophyll a was 8 mg/L, and the mean BOD was 1.6 mg/L.

Estero Bay phosphorus levels were above FDEP screening concentrations. Phosphorus screening levels are >0.07 mg/L and Estero Bay concentrations were 0.10 mg/L. Total nitrogen measured 0.81 mg/L, which is considered low for estuaries. Historical water quality has been described by FDEP as fair based on these parameters.

Estero Bay has not had a problem with high bacterial counts as indicated by the low total and fecal coliform analyses. Some contamination by cadmium, chromium, lead, mercury, and zinc in Estero Bay sediments has been observed. Concentrations of pesticides and PCBs were below minimum detection limits (Clark 1987).

Nutrient inputs from agricultural runoff (fertilizers) are cited as the source of high phosphorus. Habitat alteration through possible destruction of forests and wetlands, water flow changes, and pollution are listed as other impairments to use (CHNEP 1997).

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). TSIs were calculated by decade (1970-1979 and 1990-1998) and approximate 27.0 and 62.4, respectively, for the Estero/Imperial coastal area. Insufficient data for the period 1980-1989 precluded calculation of a TSI for that decade.

3.5.2.3 Big Cypress/West Collier Watershed

Physical Description

The Big Cypress/West Collier Watershed is a large basin encompassing several of the southern study area SFWMD watersheds, primarily including: Cocohatchee/Corkscrew Swamp; Golden Gate Canal; District VI; Henderson Creek; Faka-Union Canal; and Collier/Seminole basins (**Figure 11**). This region of the study area is situated in Big Cypress Preserve, an area of low flat lands of cypress trees, pine forests, and wet and dry prairies. Agriculture and urban are the main types of human land use; however, it should be noted that lands that are zoned as agricultural may in actuality be swamp. Major urban areas situated along the coastal area of the watershed are Naples, East Naples, North Naples, Naples Park, Marco Island, and Golden Gate. The single most conspicuous feature of the area is the expansive system of roads and canals constructed during the 1960s for the Golden Gate Estates (GGE) land development project. The Golden Gate Estate canals channel drainage from approximately 200,000 acres into the Gordon River, Naples Bay, and the Faka Union Bay (USACE 1980). Impacts from the Golden Gate Canal include overdrainage of surface waters, lowering of groundwater levels, altered traditional drainage patterns, reduction of habitats, and declines in agriculture potential (USACE 1980). Thus, the existing condition of water quality in the rivers and bays is undoubtedly linked to the major hydrological changes that have occurred in the past. Historically, the Big Cypress Basin was dominated by sheet flow, but several land reclamation projects starting at the beginning of the century have dramatically changed the hydrology. The majority of Collier County inside of the study area has been drained through the construction of canal networks. The construction of Golden Gate Estates (GGE) has dramatically lowered the groundwater table and changed salinity regimes of coastal areas of the Big Cypress/West Collier watershed.

Cocohatchee River, Naples Bay, Gordon River, Blackwater River, Faka Union Bay, Fakahatchee Bay, Marco Bay, and Rookery Bay are the major natural water bodies within the study area. Barron Canal, Golden Gate Canal, Cocohatchee River Canal, Faka-Union Canal, Gordon River Canal, and Henderson Creek Canal are the major artificial drainage systems within this watershed. Flow direction and areas drained by canals are dependent upon rainfall amount. For example, the Cocohatchee River Canal drains an area southwest of Lake Trafford during dry periods and may have no flow during very dry years. During the rainy season, the Cocohatchee River Canal along with Henderson Creek Canal serves to collect excess drainage from the Golden Gate Estates area (**Figure 11**).

Faka-Union Canal collects drainage from a series of smaller canals and discharges into the Ten Thousands Islands area. The Golden Gate Canal and Gordon River drain into Naples Bay, the periphery of which is lined with an extensive network of finger canals and residential developments. The Barron River Canal, built as a source of fill to make roads, drains strands and sloughs of the Big Cypress National Preserve (Drew and Schomer 1984).

Historical Description

No pre-canal water quality data exist to describe the original water quality within the Big Cypress/West Collier Watershed. However, there are some basic factors to consider related to the channelization of wetlands. Canal construction, which began in the 1920s, undoubtedly led to increased drainage of freshwater from wetlands into the estuaries and a subsequent increase in dissolved minerals. Possible changes in salinity, sedimentation, turbidity, and nutrients likely resulted. In lieu of more detailed pre-canal water quality descriptions, STORET data from the 1980s provides a historical description of post-canal water quality of the Golden Gate Watershed for comparison with the present day. Physical water quality was characterized by neutral pHs, DO levels that were on the average low (>5.0) at stations sampled in Naples Bay, Barron River Canal, Blackwater River, Gordon River, and Gordon River Canal, and conductivity above >1275 in some of the freshwater bodies (Cocohatchee River, Blackwater River). BOD and chlorophyll a were high in the Gordon River Canal and in the Blackwater River. Fecal coliform counts were high (>190 MPN/100 ml) in the Gordon River. Water quality in the Faka-Union canal was excellent, rating a very low 16 on the WQI scale. Naples Bay rated “fair” in terms of nutrient conditions according to the FDEP TSI with a 53. In general, the areas along the Blackwater River have the worst water quality.

Freshwater Systems

Corkscrew Swamp

Portions of Corkscrew Swamp are described as pristine due to its status as a National Audubon Society sanctuary. The Corkscrew Swamp Regional Ecosystem Watershed is a South Florida Water Management District (SFWMD) project that encompasses the sanctuary with goals to restore hydrologic conditions in impacted areas (Bird Rookery Swamp) and maintain flows and water quality in undisturbed areas of Corkscrew Swamp (SFWMD 1998a). Lake Trafford, north of Corkscrew Swamp is of historically good to fair water quality that fully supports use designation as a Class III water.

Cocohatchee River

Current physical water quality of the Cocohatchee River is characterized relative to typical State waters by low turbidity (2.9-3.5 NTU/NTUs), low TSS (2 –10 mg/L), higher than average color (85 –100 PCUs), neutral pH, variable DO (3.2 to 7.0 mg/L), and variable conductivity (675 – 2,650 micromhos (FDEP 1996a). The low DO results from excessive aquatic vegetation in the canals using up more oxygen than what is produced through photosynthesis (Kirby et al. 1988).

Chlorophyll a levels were well below State standards with a mean concentration of 5 μg/L. BOD was, at one location, higher than average for typical Florida waters, but just shy of exceeding State criteria. BOD averaged between 1.6 and 2.0 for two stations in the Cocohatchee River. Total coliform bacteria levels were higher than average for State waters, and fecal coliform counts exceeded State standards with 2,650 MPN/100 ml.

Nutrient levels are lower than average, with phosphorus and nitrogen levels below State screening levels. Low DO (5.1 mg/L) and high fecal coliform counts (381 MPN/100 ml), averaged from two locations, drive the WQI rating for the Cocohatchee River down. The Cocohatchee River is a Class II water, suitable for shellfish harvesting, which partially meets its designated use.

Cocohatchee River Canal

According to STORET data, the Cocohatchee River Canal has not been sampled since 1988; therefore, a current account of water quality is not possible. Historical data collected from 1980 to 1988 provide the basis of the following description. The Cocohatchee River Canal is about 13 miles long and less than 5 feet deep with better water quality than its natural counterpart. Compared to other State waters, physical water quality is better than average for most State waters.

Biological data for the Cocohatchee River Canal are absent from STORET for 1980-1988. Therefore, no BOD, coliform, or chlorophyll a information is presented.

Nutrients are present in amounts higher than average for most estuaries, but do not exceed State standards. Total nitrogen measured between 0.99 and 1.08 for two stations, and total phosphorus measured 0.03 for both stations.

No contaminants have been recently detected according to STORET data. However, the database compiled for this study indicates copper and zinc exceeded State standards in 23% and 14% of samples respectively from 1990-1998). Water quality is exhibiting a stable trend and fully supports designated use for a Class III water body (FDEP 1996a). Sediment quality information is not available for the Cocohatchee River Canal.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 46.5, 53.9, and 69.3 for the Corkscrew/Cocohatchee Basin. The data, though limited, indicate a degrading trend.

Golden Gate Canal

Current water-quality data were not available for the Golden Gate Canal from the STORET database. However, historical STORET water quality data from 1980-1989 are available. Physical water quality in the 1980s was characterized by relatively low turbidity (3.5-4.3 NTUs), low TSS (2-3 mg/L), higher color content than average (50-99 PCUs), neutral pH, and low to moderate levels of DO (4.8-6.0 mg/L). Conductivity was higher than average for typical State waters (572-650 micromhos).

BOD exceeded State standards with an average of 2.4 mg/L at one canal sample location. The State standard is 2.3 mg/L. One location was sampled for chlorophyll a and was higher than average for typical State waters with 19 µg/L. Fecal coliform bacteria were lower than average (55 MPN/100 ml).

Total nitrogen and total phosphorus met State standards and overall were lower than average for other State waters. Total nitrogen ranged from 0.81-1.07 and total phosphorus ranged from 0.02-0.03 for three locations along the Golden Gate Canal. The WQI for the Golden Gate Canal ranged from 36 to 40, an indication of "good" water quality (FDEP 1996a). Sediment quality information was not available.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 55.5, 59.4, and 54.1, respectively, for the Golden Gate Canal Basin. Although limited, the data indicate a stable trend.

Henderson Creek/Blackwater River

Henderson Creek appears to be of good water quality until it intersects Blackwater River, which is of historically fair to poor water quality, depending on which index is applied. The TSI rated Blackwater River a 61, which is "poor", while the WQI rated the river a 46, which is "fair", and close to "good". Low DO (3.5 mg/L) and high BOD (2.8) drive the index down. Because of these factors, the FDEP states that Blackwater River only partially meets its use designation. However, the overall status (derived from a combination of indices, contaminant information, nonpoint source assessments, and expert opinion) of the Blackwater River is represented as "poor" in the 1996 305b report (FDEP 1996a).

Fecal coliform bacteria counts from STORET data were 3 MPN/100 ml, averaged over five observations. The study area database compiled for this report indicates average fecal coliform levels from 1980 to 1990 was closer to 111 MPN/100 ml. No total coliform counts were available from STORET records for this period, but data summarized for **Table 13** (Appendix E) indicate high total coliform levels in Henderson Creek, averaging 1830 MPN/100 mls. Chlorophyll a levels measured 40 µg/L, which is higher than 90% of similar State waters; however, total nitrogen and total phosphorus levels remained low at 0.98 mg/L and 0.03 mg/L, respectively.

Sediment quality data was not available, and the literature provided very little historical or current water quality data for the District VI Basin.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 67.3, 73.1, and 47.4 respectively for the Henderson Creek Basin. Data are insufficient, particularly from 1990-1998 to support any observations regarding improving or degrading trends in water quality.

Faka Union Canal

No current data were available for Faka Union Canal. Historical water-quality data from two stations from 1980 to 1989 indicate exceptional physical water quality. Turbidity measured less than 1 NTU, better than

90% of State waters, and color was low, between 10 and 30 PCUs. The DO was high (6.4 mg/L), and at one station it was above saturation (9.9). Conductivity was between 600 and 700, which is above average, but far from exceeding State standards.

Nutrient levels, bacterial contaminants, and BOD were all well within State standards. Total nitrogen ranged from 0.51-0.73 mg/L and total phosphorus measured 0.01 mg/L. The WQI rated Faka-Union Canal a 17, an indication of "good" water quality.

The WQIs for Faka-Union Canal Basin for 1970-1979, 1980-1989, and 1990-1998 were 60.6, 21.9, and 32.2, respectively. Though data are limited, particularly for 1990-1998, water quality appears to have improved from the 1970s to the 1980s, and remains relatively stable.

Collier-Seminole Basin

The Collier-Seminole Basin drains primarily cypress wetlands ultimately into Gullivan Bay. The basin exists within the boundaries of the Collier-Seminole State Park. The literature provided very little historical or current water quality data for the Collier-Seminole Basin. Sediment quality information was not available.

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). The WQI for 1990-1998 was 57.4 for the Collier-Seminole Basin. No data were available for the previous two decades.

Estuarine Systems

Naples Bay

Current water quality information is not available for Naples Bay. STORET data from 1989 are used to describe water quality. Water clarity is characterized by near average turbidity (3.6-4.5 NTU/NTUs), and slightly better than average color (40-80). No information on TSS was available from STORET for Naples Bay. Low DO was observed at two sample locations in the Bay. Average DO ranged from 4.5 to 6.0 mg/L. Chlorophyll a was low, measuring 6-7 μg/L, while total nitrogen levels exceeded State standards (1.31 mg/L), as did total phosphorus (0.10 mg/L). Sediment quality information was not available.

Historically, the major sources of freshwater to Naples Bay were the Gordon River, Haldeman Creek, Rock Creek, and direct run-off from the city of Naples, providing a combined discharge of approximately 100 cubic feet per second (cfs). The construction of Golden Gate Canal has considerably increased the flow of freshwater into the Bay in the wet season to as much as 1,500 cfs. In contrast, during the dry season in April, discharge to the Bay drops to near zero (Simpson et al. 1979).

Rookery Bay

Current water quality data are not available through STORET. Under the National Oceanic Atmospheric Association (NOAA) National Estuarine Reserve Research (NERR) National Monitoring Program, automated data collectors deployed throughout Rookery Bay will soon make continuously collected water quality data available on the Internet. In addition to being part of the NERR program, Rookery Bay is designated by the State of Florida as an aquatic preserve, and as a National Audubon Society Wildlife Sanctuary.

Rookery Bay has been described as a "transitional" estuary in terms of its location between the high-energy (erosional forces) coastline to the north and the lower energy. Physical water quality is characterized by large fluctuations in salinity and low flushing due to the small size of the adjacent upstream watershed. Freshwater arrives into Rookery Bay via Henderson Creek to the west and Stopper Creek to the northwest. Tidal exchange is low due to the presence of oyster bars and low flushing of the shallow creeks that feed into the Bay. Hypersaline conditions can result during periods of drought (Drew and Schomer 1984).

Based on recent nonpoint source assessments, Rookery Bay fully meets its designated use as a Class II water body for support of recreation and wildlife (FDEP 1996a).

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). However, insufficient data precluded calculation of TSIs.

Marco Bay
Neither current nor historic water quality data was available through STORET. However, Drew and Schomer (1984) presented some general information on the freshwater and tidal exchange, nutrients, and habitats of the estuary.

Freshwater flow into Marco Bay is through coastal wetlands, and from groundwater between the freshwater aquifer and the saline coastal aquifer. Inputs from the wetlands are approximately 100 to 200 times that of the groundwater input, with some of this large surface volume attributed to man-made drainage operations (Drew and Schomer 1984).

DO levels were frequently found to be lower in natural areas than in disturbed areas (i.e., canals). Accumulations of mangrove detritus and restricted backwater circulation were cited as the cause for the low DOs (Drew and Schomer 1984).

Nutrients are low in natural and artificial waterways of the Marco Bay/Estuary system. Locally, high nutrient conditions are theorized to result from certain wind conditions mixing the water column and causing releases from sediments (Drew and Schomer 1984). Chlorophyll a was highest in the canals. No data accompanied the descriptions.

Fakahatchee Bay
Current water-quality information on Fakahatchee Bay estuarine waters was not available from the STORET database. Relative comparisons between Fakahatchee Bay and adjacent Faka Union Bay were given in Drew and Schomer (1984) for freshwater input, salinity regimes, and nutrient loading. Salinity ranges from 0 to 40 ppt throughout the wet and dry seasons. Specific data on other water quality parameters are lacking. Heavy metal analysis from data collected in the 1970s did not indicate contamination of the waters, but some sediments did contain detectable amounts of lead, particularly those near areas receiving roadway runoff (Drew and Schomer 1984). Pesticides were also detected in some of the sediment samples; waters were described as uncontaminated.

Abbott and Nath (1996) cited increased freshwater from Faka Canal and abnormal salinity levels to blame for disappearance of seagrass meadows, displaced benthic habitats and fish communities, and declines in shellfish harvests.

3.5.2.4. Southern Big Cypress Swamp: West Collier County

The Southern Big Cypress Swamp is a large basin encompassing the southern and western portions of the study area, including the Fakahatchee Strand basin (**Figure 11**). The Southern Big Cypress Swamp is located in the southern half of the Big Cypress National Preserve and is part of the Big Cypress Swamp Watershed, USGS unit 03090204. The study area is situated in the western part of the Southern Big Cypress Swamp. Interest will focus on the Fakahatchee Strand, Okaloacoochee Slough, and the Barron and Turner River canals, two canals which hydrologically affect the western portion of the preserve. The Turner and Barron River canals were not originally designed for the specific purpose of draining land, but as a supply source for road construction materials (Drew and Schomer 1984).

Physical Description
Perhaps the most important drainage feature of the Big Cypress Swamp is the Fakahatchee Strand. A strand is an elongate area of large trees growing within drainage depression with no well-defined channel. The Fakahatchee Strand is a natural community of mixed hardwood swamp about five miles wide and

twenty miles long. Along with Okaloacoochee Slough, it is a principal drainage slough of the western Big Cypress Swamp (McElroy and Alvarez 1975).

Land use within the Southern Big Cypress Swamp is primarily wetlands, with an estimated less than 5% of land under agricultural use and less than 5% in small towns. Census data record that in 1990, Everglades City, at which the Barron River Canal discharges, had a population of 317, and Chokoloskee, a small fishing town at which Turner River discharges, had a population of 240 (U.S. Department of Commerce 1992).

The Turner and Barron River canals drain freshwater from the strands and sloughs of the Big Cypress Swamp, and also receive additional freshwater input from the shallow water aquifer. Okaloacoochee Slough and Deep Lake Strand are two such features that contribute freshwater to the canals. The Barron River canal flow rate varies from 0 to 8.27 m^3/s (0 to 292 cfs) over the course of a year. During dry season, flows are low, from 1.42 to 2.84 m^3/s (50 to 100 cfs), but increase during the wet season to between 2.84 and 4.96 m^3/s (100 to 175 cfs). Over the long term (decades), flows average 2.89 m^3/s (102 cfs). Given the age of the canals, constructed over 50 years ago, water levels in the Barron and Turner River canal watersheds are assumed to have stabilized. A series of removable stop-log gates control flow along the Barron River canal, inserted during the dry season to conserve the aquifer and removed during the wet season to accommodate increased drainage (Drew and Schomer 1984).

Historical Description

Historical data from STORET indicate that water quality within much of the Big Cypress has been “fair” to “good” with respect to physical and biological parameters, and nutrient condition. However, metals were detected in previous sample data from Chokoloskee Bay at levels higher than in other local estuaries. Monitoring data from 1980-89 indicate that Barron River canal had good water conditions with a pH of 7.6, good water clarity as indicated by low turbidity (2.0 NTUs), low TSS (1 mg/L), and low color (55 PCUs). However, DO levels failed to meet State criteria with an average of 4.2 mg/L. Conductivity was normal at 536 micromhos. The Turner River canal exhibits freshwater conditions inland and estuarine conditions nearer the coast. Samples of the Turner River collected near the Tamiami indicate that physical water quality is good with an average DO of 7.3, low turbidity of 1.0 NTUs, and pH of 8.4. Conductivity, however, exceeded State standards with an average measurement of 1300 micromhos. Where Turner River flows into Oyster Bay, turbidity was higher at 4 NTUs, color was higher at 40, and conductivity was higher at 41250 micromhos due to higher salt content. DO was high at 8.5.

Biological parameters, BOD, chlorophyll a, and fecal coliform bacteria, were 1.3 mg/L, 7 µg/L, and 14 MPN/100 ml, respectively. None of these values exceeded (i.e., failed to meet) State standards. Nitrogen and phosphorus levels of Barron River canal runoff into the Gulf have been historically low. The annual average for total nitrogen was 0.98 mg/L, and for total phosphorus, concentrations were low at 0.02 mg/L. The TSI for Barron River canal runoff into the Gulf was 46 and for Turner Canal, 47.

Freshwater Systems

The literature provided very little historical or current water quality data for the Fakahatchee Strand Basin. A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979 and 1990-1998) and approximate 62.0 and 55.4 for the Fakahatchee Strand Basin. Though data are missing for 1980-1989 and limited where present, a slight improvement in water quality was noted from the 1970s to the 1990s.

Estuarine Systems

Chokoloskee Bay

Recent water quality information was obtained from Gibson (1997) for 1990-1995. Historical data were obtained from the STORET database and from Drew and Schomer (1984).

The hydrology or rates of flushing and mixing of Chokoloskee Bay are not well known (Drew and Schomer 1984). Historically salinity has varied from 2.5 ppt to 20.2 ppt at the mouth of the bay. The water has been relatively clear as indicated by the average turbidity (3 NTUs), and color (30 PCUs). DO was high at 8.5 and the pH was normal for saline waters at 8.5. High conductivity (41,250 micromhos) is normal for waters with high salt content. No historical bacterial analyses or chlorophyll a measurements were available.

Historically nutrients increase with the rainy season from apparent increased flow from the Barron River Canal. Other sources of nutrients are possibly the oxidation of drained soils and runoff from agricultural and roadways (Drew and Schomer 1984). Total nitrogen has historically been lower than average at 0.64 mg/L compared to other Florida streams. Total phosphorus likewise has been lower than average at 0.03 mg/L. The TSI indicated that the overall nutrient status of Chokoloskee Bay was good, with a 46. Contaminants have been sampled in the Bay, but seasonal increases were theorized to result from “desorption by dissolved ions in seawater” as salinity varied (Drew and Schomer 1984). Manganese, copper, lead, and zinc were metals that increased with an increase in salinity. Concentrations of these metals were reported to be 1.5 to 3 times higher than metal concentrations from estuaries that received natural drainage (Drew and Schomer 1984).

The literature provided very little historical or current water quality data for many of the bays and estuaries of Southwest Florida. Limited data are available for the Ten Thousand Isles region, and the associated bays of Chokoloskee and Faka Union.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). However, data were insufficient to calculate TSIs for Chokoloskee Bay, Faka Union Bay, and the Ten Thousand Isles region.

3.5.3 GROUNDWATER (AQUIFERS)

The Surficial, Intermediate, and Floridan Aquifer systems are the principal aquifers within the study area. The Floridan Aquifer system is widely used for ground water supply in other areas of the State but, within the study area, it is of naturally poor quality, having a high degree of mineralization. Thus, only the Surficial and Intermediate Aquifer Systems are used for groundwater supply (SFWMD 1995). The Floridan Aquifer is separated from the Surficial and Intermediate Aquifers by several layers of confining beds. Recharge areas for the Floridan Aquifer are outside the study area.

Within the study area, the Surficial Aquifer system contains the undifferentiated water table aquifer and the confined lower Tamiami Aquifer. The Biscayne Aquifer is another principal aquifer system within the Surficial Aquifer that occurs outside the study area (SFWMD 1995).

Florida Geological Survey: Water Quality
The primary data and discussion material for aquifer water quality was provided from Florida’s Ground Water Quality Monitoring Program. This program derives aquifer water quality data from three sources: Background Network wells, Very Intensive Study Area (VISA) Network wells, and Private Well Surveys. Only preliminary data from the Background Network were available from 1984 through 1988. A summary of these water quality data for the Surficial, Intermediate, and Floridan Aquifers is presented in Appendix E (**Table 27**).

Study Area: Water Quality
To evaluate more recent and geographically specific water quality data available within the study area, supplemental data (USGS) were gathered (including STORET) through June 1998 and water quality trends were revisited. To assess historical and current water quality trends for the study area aquifers, summary data statistics for various water quality parameters were recalculated for the following time periods: 1970-1980, 1980-1990, and 1990-1998.

3.5.3.1. Surficial Aquifer System

The Surficial Aquifer System is located beneath and adjacent to the land surface and is composed of Pliocene to Holocene quartz sands, shell beds, and carbonates. It consists of porous unconsolidated quartz sand deposits mixed with hardened carbonated rocks belonging to the Upper Miocene to Holocene Series (Florida Department of Natural Resources 1992). The carbonate rocks are the water-producing zones (SFWMD 1995).

Within the Surficial Aquifer system, the water table is mostly unconfined, but in deeper regions some partially confined or locally confined conditions may predominate from beds of low permeability. Underneath the Surficial Aquifer are broad thick beds that are more confining. In South Florida, sediment beds of the Surficial Aquifer are the Tamiami, Caloosahatchee, Fort Thompson, and Anastasia Formation, the Key Largo, and Miami Limestones, and the undifferentiated sediments (Florida Department of Natural Resources 1992). In general, Surficial Aquifer water levels slope downwards in a southwesterly direction towards the coast. Little seasonal fluctuation of the Surficial Aquifer water levels occurs (Dames and Moore 1997).

Median values for water quality measurements for the Surficial Aquifer are within State drinking water standards, with the exception of iron and lead. The MCL secondary standard for iron is 0.3 mg/L and the average for the Surficial Aquifer within the SFWMD was 0.88 mg/L. The high maximum values (>5mg/L) are likely the result of using unfiltered samples during analysis (Florida Department of Natural Resources 1992). Iron is high in the Surficial Aquifer system due to its proximity to iron minerals, organic rich soil horizons, and dissolved humic substances (Florida Department of Natural Resources 1992). Lead occurs in the surficial at “high” levels (Florida Department of Natural Resources 1992). Given the lack of natural sources of lead in Florida, the presence of lead is attributed to human sources, most often lead weights used in water level recorders (Florida Department of Natural Resources 1992).

Saltwater intrusion, incomplete flushing of seawater from the Everglades, and leftover irrigation water from the Floridan Aquifer system have created areas of increasing mineralization and high dissolved solids along the coast (SFWMD 1995). The Surficial Aquifer System is susceptible to anthropogenic contamination due to its closeness to the land surface. Lack of confinement, high recharge, and relatively high permeability and high water table all increase contamination potential. The increasing demands heighten the constant threat of saltwater intrusion, often resulting in water usage restrictions to users of the Surficial Aquifer (SFWMD 1995).

Physical and Geological Description

Water quality data in this section is derived from the FY95/96 Trend Ground Water Quality Monitoring Program for Collier County (Gibson 1997). Ground water samples from sixteen monitoring wells sampled quarterly were analyzed for “specific chemical analytes that are indicative of natural ground water geochemistry and potability” and compared to public water supply standards. In 1995-96, total dissolved solids, iron, chloride, and sulfate levels in the monitoring wells exceeded MCL standards established in F.A.C. 17-550 for treated community water supplies, but still compared favorably with historical data. The report concluded that these conditions “appear to represent the norm” for Surficial Aquifer waters in Collier County (Gibson 1997). The lower Tamiami Aquifer supplies Collier County with most of its potable water supplies (Dames and Moore 1997).

Withdrawals/Public Use

The principal source of urban water in Lee County is the Shallow Water Table Aquifer. The Shallow Water Table Aquifer is also used for agricultural irrigation. Transmissivities for the water table within Lee County range from 10,000 to 1,000,000 gpd/ft. Typical yields from public water supply wells are around 300 gpm (SFWMD 1995).

The Tamiami is a major potable resource for Collier County serving as the primary source of municipal, industrial, and agricultural water supply (SFWMD 1995). The water quality is similar to that of the water table aquifer, but often with lower iron concentrations, making it more suitable for potable supplies. Chloride concentrations may still be high in some coastal areas, with levels up to 10,000 mg/L. Aquifer thickness ranges from 150 feet to over 250 feet. Transmissivities range from 100,000 to 500,000 gpd/ft (Dames and Moore 1997). Water use of the Surficial and Intermediate Aquifers by Collier and Lee Counties in 1995 is presented in **Table 6**. More water is used in agricultural irrigation than any other category for both counties. In Collier County, agricultural irrigation accounted for approximately 68% of all water use in 1995.

Table 6. 1995 Water Use For Collier And Lee County*

County	Public Supply	Domestic Self-Supply (private well)	Industry/ Commercial Self-Supply	Agricultural Irrigation Self-Supply	Recreation Self-Supply	TOTAL
Collier	14,250	1,785	2,181	51,985	16,641	**86,842**
Lee	14,673	2,081	1,974	22,063	12,011	**52,802**
TOTAL	**28,923**	**3,866**	**4,155**	**74,048**	**28,652**	**139,644**
% of Total	***20.7%***	***2.8%***	***3.0%***	***53.0%***	***20.5%***	***1%***

Source: SFWMD, 1998b * Note: Millions of Gallons per Year

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). No data were available from 1970-1979 but slight increases in most minerals and an increase in pesticides was observed from the 1980s to the present decade.

3.5.3.2. Intermediate

The Intermediate Aquifer System is located in the Hawthorn group sediments and is comprised of two confined or in place semi-confined aquifers. The Sandstone Aquifer present in Lee County and Collier County north of Alligator Alley and the mid-Hawthorn aquifer underlie Collier County (Dames and Moore 1997).

Physical and Geological Description

The Sandstone Aquifer is composed of sandy limestone, dolomites, and sandstone up to 100 feet thick and is possibly part of the Peace River Formation. The aquifer slopes southeastward, gradually thinning out. The transmissivity is generally below 100,000 gpd/ft with hydraulic gradients ranging from 0.5 feet per mile to 5 feet per mile. A recharge zone exists northeast of Immokalee. The iron content is relatively low and the chloride concentrations are usually less than 600 mg/L. Increases in hardness and alkalinity occur as one moves toward the coast. Water quality is described overall as good. Within Collier County, the direction of water flow in most confined layers is southwestward (Dames and Moore 1997).

Limestone and dolomites from the Acadian Formation comprise the mid-Hawthorn Aquifer. Transmissivities are less than 50,000 gpd/ft. The mid-Hawthorn averages 100 feet in thickness with highly mineralized water. High levels of chlorides, calcium, magnesium, and sulfate are present within this aquifer. The mid-Hawthorn slopes toward the east-southeast and is under sufficient hydrostatic pressure to produce artesian conditions for wells drilling into this aquifer (Dames and Moore 1997).

Mean water quality parameters meet State drinking water standards with the exception of lead and total dissolved solids. Total dissolved solids in the Intermediate Aquifer range from 47 mg/L to 4188 mg/L within the SFWMD. Contact of water with carbonates and chemically unstable silicates (e.g. clays, opal), as well as saline intrusion are probable sources of high total dissolved solids (Florida Department of Natural Resources 1992).

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). No clear trends in water quality were evident for the Intermediate Aquifer. However, from 1980 to 1998, most mineral concentrations decreased, while iron and fluorides slightly increased. Pesticide concentrations increased notably.

3.5.3.3. Floridan Aquifer

The Floridan Aquifer within the study area is characterized by low hydraulic potential, low flushing, and saline intrusion from long contact/high dissolution of base strata of aquifer and coast (Florida Geological Survey 1992). It is composed of Tampa Formation sediments and is connected to the underlying Suwannee and Ocala Limestone, and Avon Park, Oldsmar, and Cedar Keys Formations. It is separated from the Intermediate Aquifer through confining sediments of the Hawthorn Group. The transmissivity ranges from 75,000 to 450,000 gpd/ft in the upper areas of the Floridan. Water quality has been described as brackish, degrading with depth and towards the coast (Dames and Moore 1997).

Mean chloride levels for Floridan Aquifer wells within the SFWMD exceed the States MCLs for drinking water. Median levels are 419.6 mg/L and the State standard is 250 mg/L. Median levels of total dissolved solids also exceed State standards (Florida Department of Natural Resources 1992).

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). No distinct trends were observed, but slight increases in some minerals were noted along with a small decrease in chlorides.

3.6 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

The State of Florida contains some 20,000 waste generators and facilities, most associated with business and industry in populated areas. The exception to this is the use of pesticides and a variety of solvents associated with agri-business.

3.7 AIR QUALITY

Southwest Florida's air quality is among the best in the State. Based on existing data, the EIS study area is an attainment area for ozone and carbon monoxide pollution; however, particulate pollution and ozone have shown upward trends in recent years (SWFRPC 1995). Portions of this upward trend, specifically particulate pollution, is attributable to land clearing and other development activities.

3.8 NOISE

Much of the eastern study area is currently undeveloped, and as such, exhibit relatively low ambient noise levels. Heavy traffic roadways in and around the urbanized area may have noise levels on the order of 65 to 70 decibels (dB), measured 30 meters (100 feet) from the traffic artery. Around construction areas, or near the airports in Ft. Myers, Lehigh Acres and Naples, noise levels may exceed the EPA recommended upper level of 70dB by 25 to 30 decibels.

3.9 AESTHETIC RESOURCES

Consideration of aesthetic resources within the project study area is required by the National Environmental Policy Act of 1969 (NEPA) PL 91-190, as amended. Aesthetic Resources are defined in ER 1105-2-50 as " those natural and cultural features of the environment which elicit . . . a pleasurable response" in the observer, most notably from the predominant visual sense. Consequently, aesthetic resources are (commonly referred to as) visual resources, . . . features which can potentially be seen.

The EIS study area has a variety of natural systems that contribute to the aesthetic resources of the region. These range from aquatic (marine and freshwater) systems to upland forest systems. These natural communities provide a solid base of aesthetic values and functions that serve the permanent and seasonal residents of the region. Natural systems within the EIS study area include hundreds of kilometers of coastal shoreline, as well as a number of bays, sounds, and other shoreline water body features. The Region's economy is highly dependent on these areas providing natural attributes that are important to residents and tourists and providing food resources. Due to the attractiveness of coastal areas, there is an intense demand for land in these areas.

The EIS study area also contains a number of municipal, County, State, and Federal parks and preserves, including Rookery Bay National Estuarine Research Reserve, Estero Bay Aquatic Preserve, Collier-Seminole State Park, Wiggins Pass State Preserve, Koreshan State Park, Lover's Key State Park, Florida Panther National Wildlife Refuge, Ten Thousand Islands National Wildlife Refuge, Corkscrew Regional Ecosystem Watershed, Big Cypress Preserve, Picayune State Forest, and Fakahatchee Strand State Preserve. The study area also contains private preserves such as the Audubon Society's Corkscrew Swamp Sanctuary.

3.10 RECREATION RESOURCES

In the Southwest Florida EIS study area, there are hundreds of public parks and recreation areas, excluding beaches and boat access sites. These areas are administered by the Federal government, State government, Lee and Collier County governments, and various municipal governments, as well as by private agencies and private commercial interests.

Types and sizes of parks vary widely in the Region. Parks and recreation areas have been classified into two categories: user-oriented and resource-based. User-oriented recreation areas are defined as those containing facilities which can be provided almost anywhere for the convenience of the user. Among such facilities are ballfields, golf courses, and playgrounds. Resource-based outdoor recreation areas are dependent upon some particular element or combination of elements in the natural environment. These areas include beaches or hunting areas. Sizes of parks in Southwest Florida range from less than one acre to several thousand acres.

Within the urban setting, most of the regionally-significant parks and recreation areas are owned by the State of Florida or a local government. Outside the urban setting, nationally and internationally recognized preserves are managed for various active and passive recreational uses by the USFWS, the National Park Service, the Florida Department of Environmental Protection, the Florida Division of Forestry, and the South Florida Water Management District.

3.11 HISTORIC AND ARCHEOLOGICAL RESOURCES

The Southwest Florida region has a large number of historic and archaeological sites. According to the Division of Archives, Florida Department of State, there are 8,219 historic and archaeological sites in Southwest Florida recorded on the Florida Master Site File (1994). There are 689 sites in Collier County and 1,723 sites in Lee County. Only parts of the Region have been extensively surveyed; consequently, there may be considerably more sites to be discovered.

At present, few of Southwest Florida's historical or archaeological sites are listed on the National Register of Historic Places. Collier County has twelve sites listed, including the Seaboard Coast Line Railroad Depot, while Lee County has twelve sites, such as the Koreshan Unity Settlement Historic District.

Southwest Florida was the home of the Calusa people, whose unbroken history has been traced back to 500 BC by archeologists (Milanich 1995). The Calusa were the most important aboriginal group in Southern Florida in terms of influence, population size and density, and military power (Milanich 1995). Calusa towns were spread throughout Southwest Florida from Lake Okeechobee to the coast around Port Charlotte, and southward along the coast to the Ten Thousand Islands area. Major Calusa towns are thought to have been located on Horr and Marco Islands, on Mound Key in Estero Bay, and along the shores of Charlotte Harbor.

3.12 SOCIOECONOMIC RESOURCES

In Southwest Florida, the major economic contributors are retirement, tourism, construction, and agriculture. Each has an important part in the economy of the Region (SWFRPC 1995).

Southwest Florida has been a destination for retirees for years, especially since World War II. The effects of this influx of retirees are seen in the age of the population of the Region. Older people make up a larger proportion of the population of Southwest Florida than they do in the State as a whole. Based upon 1993 estimates, twenty-five percent of the EIS study area population is age 65 or older (SWFRPC 1995).

It is expected that retirement will continue to be important economically, even as the population grows more diverse. Retirees have time and money to spend on recreation and entertainment. They also tend to require more health and medical services. Households comprised of elderly or disabled residents represent a significant concern in Southwest Florida.

Tourism is a second major factor in economic development. It is becoming a year-round activity, with increasing numbers of summer tourists to balance the "snowbirds" and winter residents. Tourism is also a factor in population growth. Persons who visit as tourists may decide to move here during their working years or later as retirees.

The growing population within the study area results in the construction of more housing. From 1980 to 1993, housing unit growth in the Region averaged 5.8% per year (SWFRPC 1995). Collier County has had the greatest overall percentage of growth since 1980 (110.2%), although Lee County has had the greatest increase in the number of dwelling units (67,576) (SWFRPC 1995).

In addition to new housing, both tourism and retirement lead to other development of all kinds, although residential building forms the majority of the total permit activity noted above. Movie theaters, restaurants, shopping centers, grocery stores, and service stations are all needed for tourists, and new permanent and seasonal residents.

The importance of agriculture in Southwest Florida has changed to reflect the pattern of development in the Region. Increased development pressures in the coastal counties have caused agriculture to be less important there compared with other economic sectors. Farm acreage in the Region decreased 8.9% from 1982 to 1992 (SWFRPC 1995).

Citrus, long important in the Region, is increasing as production has shifted over the last few years from other areas of the State to Southwest Florida and its milder weather.

4. ENVIRONMENTAL EFFECTS

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 feed on species that live in wetlands. Uplands 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 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 poor quality 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.

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 authorities 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 Draft 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 indicates 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 7. 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 8. 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 Ensemble R appears to protect 96% of Priority I and Priority 2 habitat compared to 86% in Ensemble S, Agricultural land under R does not have the limitation on intensification found in Ensemble S.

Locations of certain of the proposed preserves are particularly important since they maintain connectivity between major habitat areas, as described in Section 4.4.

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.

Scrub Jay

The USFWS developed species and habitat-level recommendations for the protection of the Florida scrub-jay in the Draft 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; FGFWFC’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.

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.

Bald eagle

The USFWS developed recommendations for the protection of the bald eagle in the Draft 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 storks

The USFWS developed species and habitat-level recommendations for the protection of the wood stork in the Draft 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).

There are 14 known wood stork rookeries in the study area. Not all habitat has been surveyed so others may exist. In a typical permit, the rookery location would be preserved. Out of the 14 known locations, 11 would be located within preserve areas in Ensemble Q; 9 in Ensemble R; 12 in Ensemble S; 11 in Ensemble T; and 14 in Ensemble U. As discussed in Section 4.4 for wading bird rookeries, the primary foraging habitat for wood storks are shallow, often small and isolated, herbaceous wetlands up to 30 kilometers from rookery centers. Even though rookeries may be within preserves in most of the Ensembles, surrounding wetlands, within foraging range, may be impacted. As also discussed in Section 4.4, the hydropattern of the seasonal wetlands, even if wetlands are preserved, could be affected by development. The hydropatterns could also be affected if flowways, discussed in Section 4.4, are eliminated and the wetlands are used to store water longer, resulting in a loss of drawdown that concentrates the forage base of the wood stork. An Ensemble with a higher number of colonies and their associated foraging range in preserves would provide more assurance of the preservation of the species.

The wetlands within the foraging range of the wood stork are included in those considered, in Section 4.4, to be of high priority for wetland-dependent species. Therefore, it is difficult to assess the risk for long-term maintenance of wood stork rookeries.

Audubon's Crested Caracara

The USFWS developed species and habitat level recommendations for the protection of the Audubon's crested caracara in the Draft 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 Milsap (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.

Piping Plover

The USFWS developed species and habitat-level recommendations for the protection of the piping plover in the Draft 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 Draft 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 Draft 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 Draft 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.

Although this species was probably never common in the study 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 Draft 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 Draft 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 Draft 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 draft 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 Game and Fresh Water Fish 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 nests 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.

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 FGFWFC 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

The scope of this Environmental Impact Statement limited the amount of data collected. As such, detailed information concerning archeological sites and historic properties 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 on a case-by-case basis.

4.6 SOCIO-ECONOMIC

Property rights are affected by Corps decisions on applications for Department of the Army permits. The origin of these rights is based on the Constitution. Ensemble R is assembled from four of the alternatives developed by the ADG to represent the County Comprehensive Plans. One of those alternatives was described as a "realistic expectation of existing property uses and vested development rights." Another alternative was described as 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 property rights. 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 reduced property rights. 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 totals45; 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, 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 resulted in a reduction of property rights 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 changes that would moderate the impact to property rights: (1) explicitly mapping flowways as preserve areas has greater impact than a goal statement in the narrative criteria; descriptions of restoration proposals that implied "more intense acquisition" has greater impact than those proposals that imply willing sellers; and (3) criteria written in terms of absolutes had 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 their expectations for the property and so reduced property rights. On the other hand, the owner of the property adjacent to land that is acquired for preserve could see the market value increase.

The Lee and Collier County Comprehensive Plans are the local elected official's 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 Collier 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 differed 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 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.

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 an professional economic impact analysis. 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 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.

Three economic analysis studies relate to the ADG evaluation of the economic impact. As discussed, an economic analysis at the same level of detail as these three studies has not been performed for this EIS, therefore the information in these studies is neither confirmed nor compared, but is presented to expand on the ADG discussion of some of the evaluation factors. All three studies fundamentally include the same analysis tasks: determine the local sales and labor force for a local industry; determine the interrelationship of other local businesses to the local industry (for example, the repair of vehicles) based on 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. Each analysis reports a total economic impact based on direct sales and jobs of the particular industry combined with the multiplied additional spending and jobs of other businesses in the local area. The three 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 three report their findings in terms of dollars per acre (or dollars per house which can be related to acres). None of these three analysis included benefits of natural resource protection.

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 study 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.

Simplistic uses of these numbers, for each Ensemble, includes: (1) determining the economic impact of converting agriculture to preserve by multiplying the agriculture's per acre economic impact cost by the number of acres proposed to be converted; (2) determining the loss of potential future economic growth by multiplying the residential per acre economic impact cost by the difference in the number of acres of development proposed between two Ensembles; and (3) determining the economic impact of converting agricultural lands to residential by multiplying the per acre economic impact costs by the number of acres proposed by each Ensemble to be converted. However, an appropriate economic analysis must represent the dynamic nature of the rapid conversion of land within the study area and would include, for example, predictions of the percent of the total economy provided by agriculture and by construction in the future (as the proportion of land use changes and growth of other industries occur) and predictions of the resultant shifts of the interrelationships with other industries in the local economy.

Three papers raise a concern related to the ADG discussion of the evaluation factor for Increased Taxes. 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. 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 business which benefit from the spending by the new resident to the community. An appropriate analysis of this concern will depend on the how new revenues and expenses are estimated (related to the economic analysis predictions) and allocated.

In any case, the economic impact of the permit decisions by the Corps, as a percentage of the total economy, will be small. First, only a small proportion of the change in land cover shown by the ensembles involve fill in wetlands (and the Corps jurisdiction is based on wetland fill). The acres of upland vacant or agricultural land converted to development are much larger than the acres of wetlands converted. Second, the proportion of the total economy that is based on construction will get smaller as the areas of development (and economic activity occurring on those developed areas) increase. Florida Stewardship Foundation, Inc, in The Contribution of Agriculture to Collier County, Florida, estimated the construction sector in 1992 represented 7.8% of the total jobs and 8.8% of the total sales in Collier County (although this figure did not attempt to attribute what percent of other non-construction jobs and payroll were attributed to construction).

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, 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.

Analyses were conducted separately for each of the ten watersheds within the study area (**Figure 12**). Watersheds were selected as the hydrologic unit defining the storm water runoff to the receiving water bodies as defined by the South Florida Water Management District (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.

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.

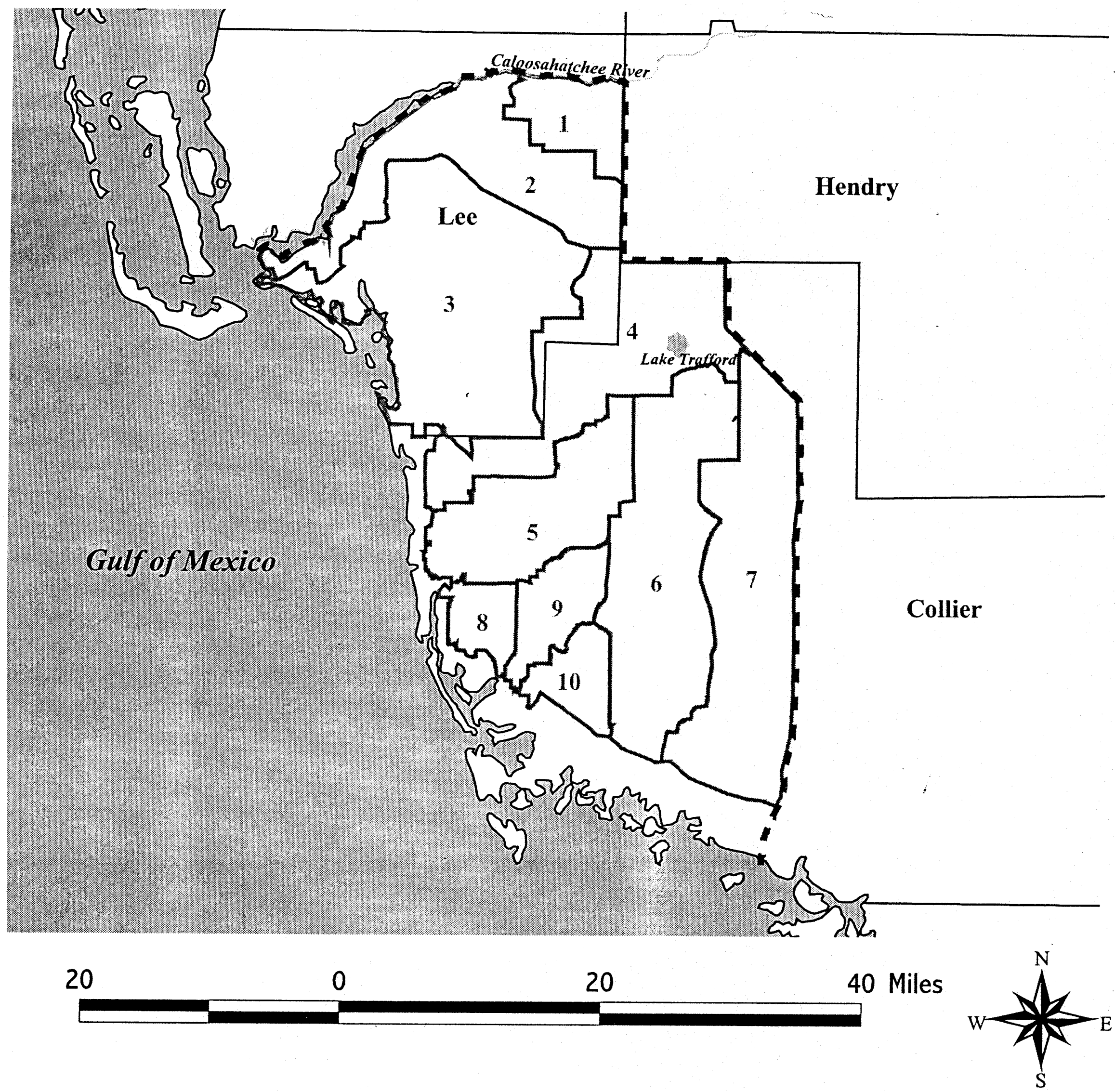
4.10.2.2 Future Land Use

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



Region of Influence Boundary
Water Bodies
Watershed Boundary
County Boundary

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

Figure 12 SFWMD Watersheds and Basins within the Study Area.

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 1.6) 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 12**).

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.

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:

<u>Ecosystem Impacts</u>
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

<u>Degradation of Aquatic Resources</u>
Fish Kills
Fish Consumption Advisories
Shellfish Harvesting Restrictions
Reduced fishery yield (species and/or abundance)

<u>Aesthetics</u>
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 13**. 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.

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 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.

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	**Comp 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 14**. 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 13**.

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 15**. 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 13**.

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 13**.

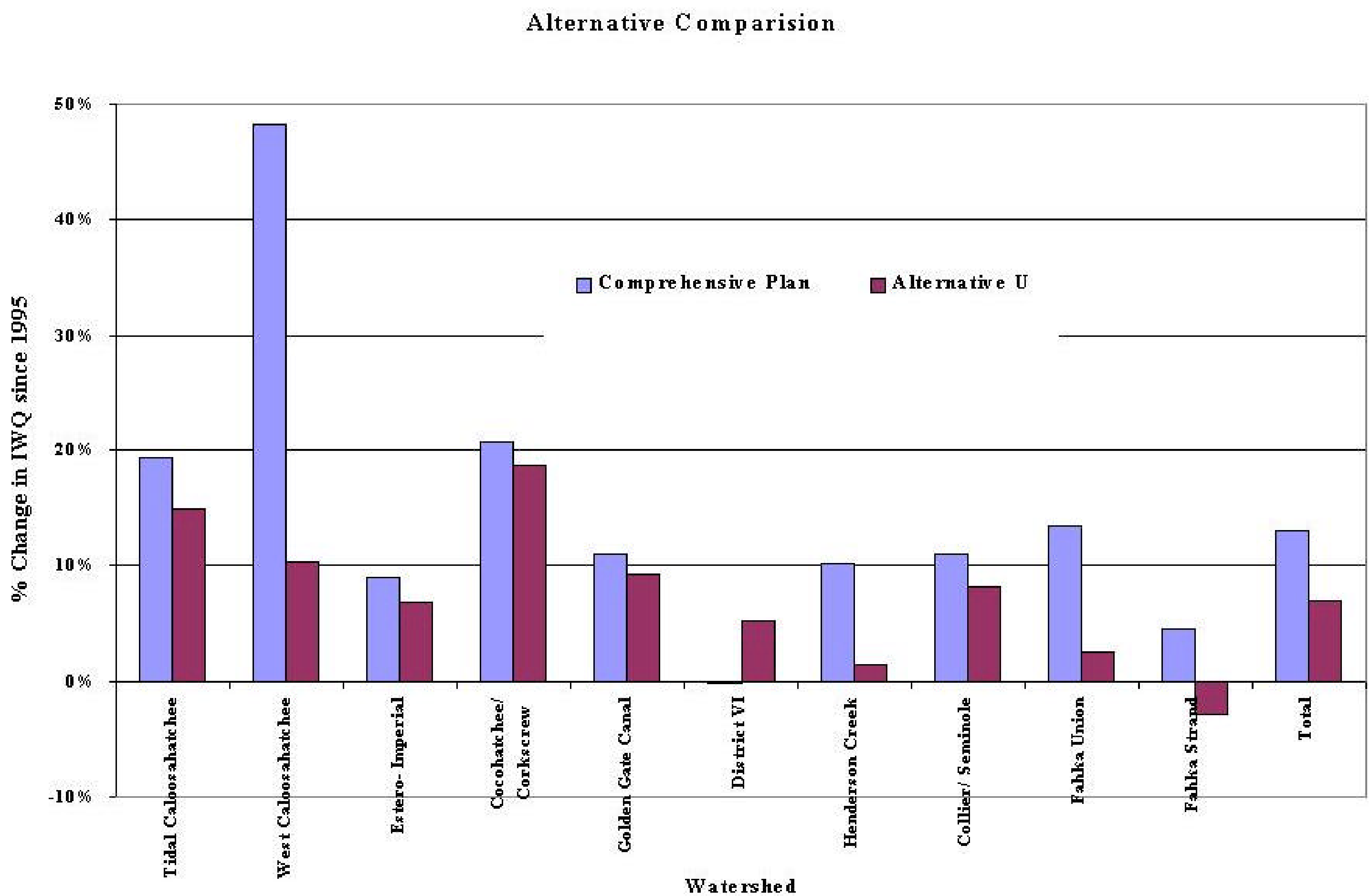
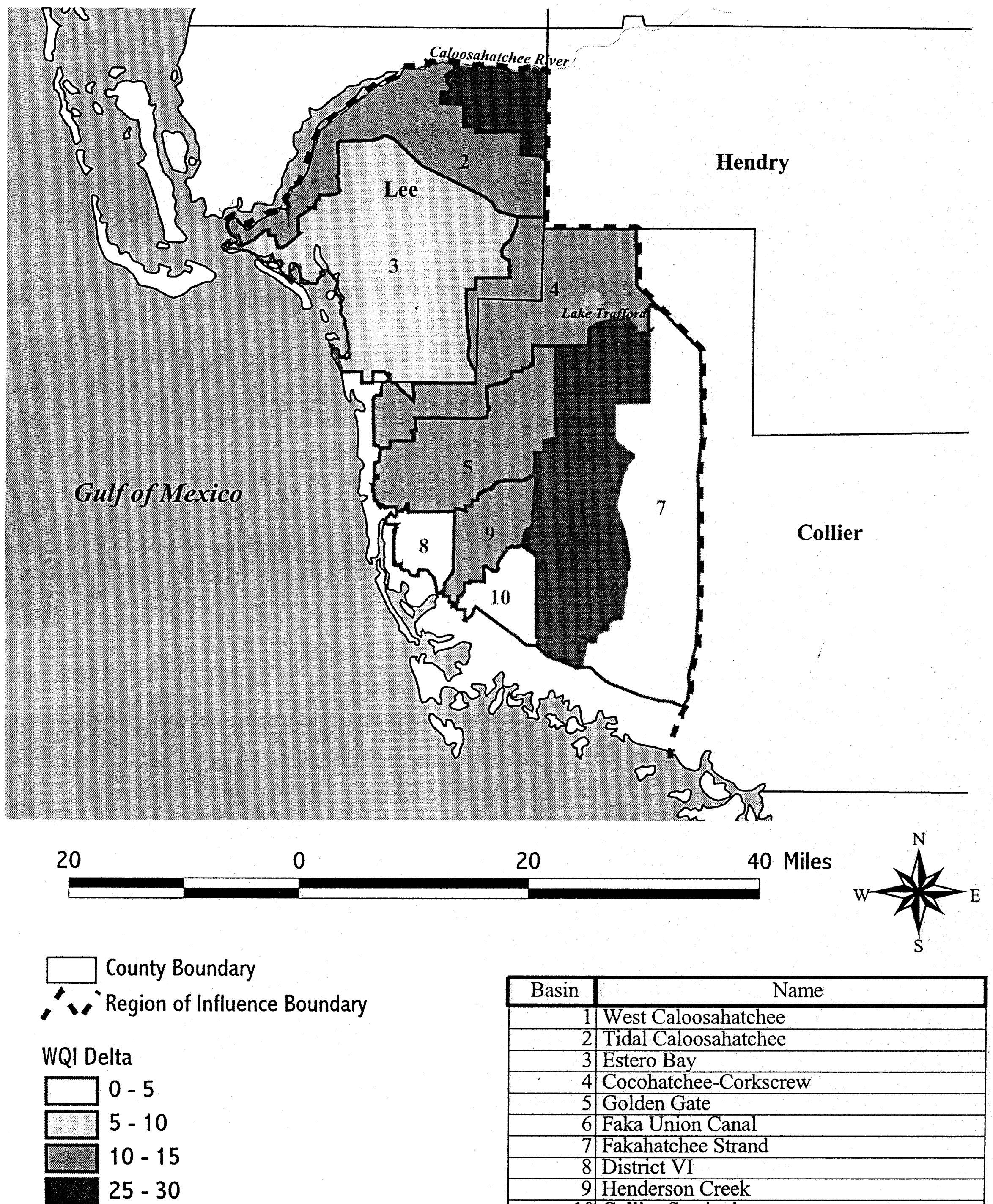
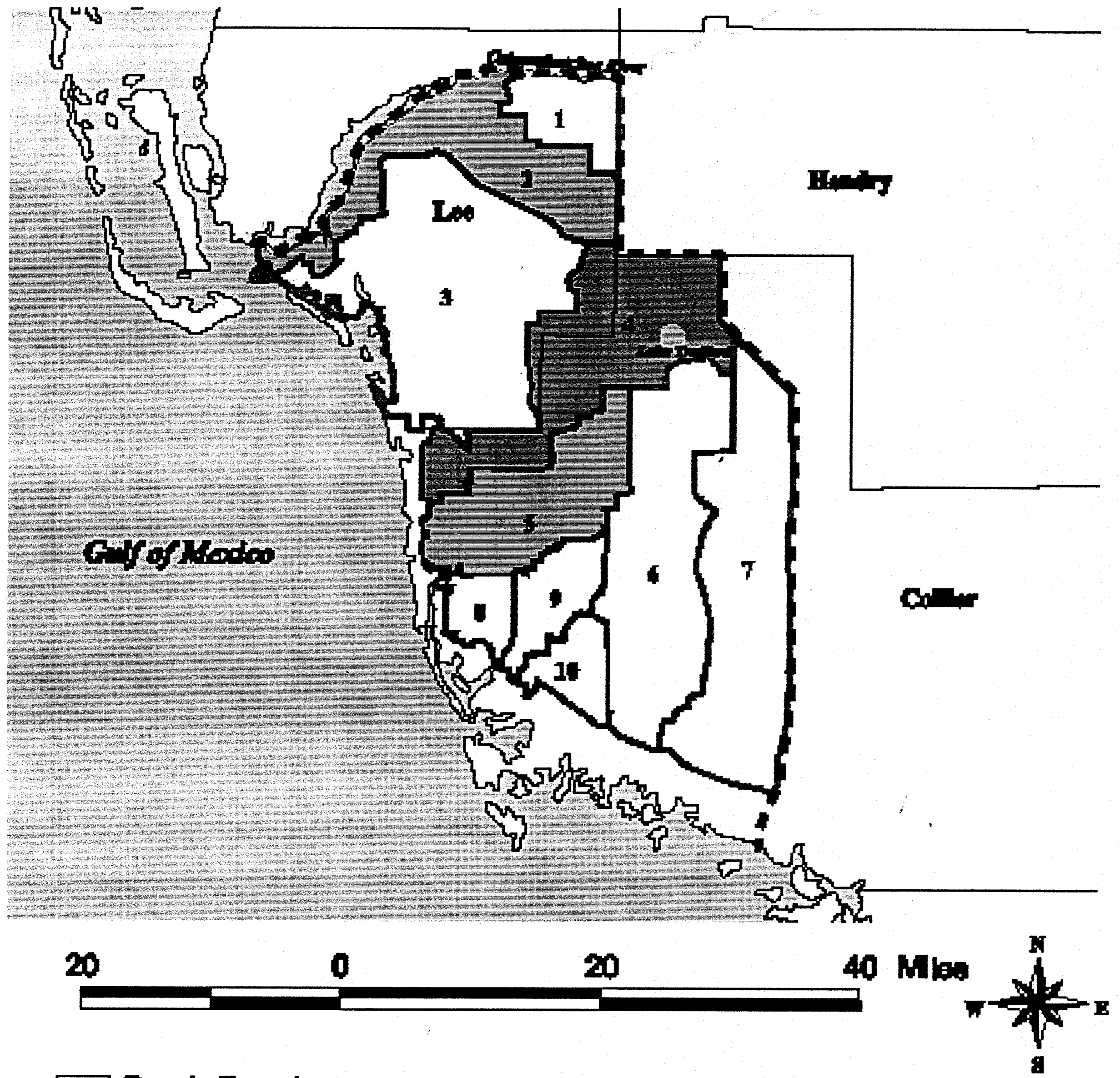


Figure 13. Comparison of Change in IWQs for Each Alternative Land Use from the Current Day (1995).



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

Figure 14. Changes in IWQ Values from Current Day to the Comp Plan Alternative Land Use.



County Boundary

Region of Influence Boundary

IWQ Delta (Percent)

0 - 5

5 - 10

10 - 15

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

Figure 15. Changes in IWQ Values from Current Day to the Ensemble U Land Use.

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 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 13 water bodies within or likely impacted by the study area have been placed on the EPA's 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; 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 the ideas identified in some very preliminary discussions of actions to increase the assurance of maintaining and improving water quality in the study area. These are included in this document to disclose that these ideas have been presented.

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, Lee, 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 existing developments that pre-date existing State and Federal stormwater programs.

4.10.2.8.2 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 Detention/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 detention 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 could assess 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 would be to adequately protect WQ conditions in the area while allowing for continuing economic development in these sub-basins that currently provide the highest levels of WQ degradation associated with NPS pollutants.

4.10.2.8.2.3 BMP Improvement Incentives

The EPA and other cooperating agencies could 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.

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.

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	Agr	Open	Wet	1995	R or U	Delta	1995	R or U	Delta
Similar	Slightly More	Tidal Caloosahatchee	1995 to R	44%	-6%	-36%	-3%	12%	42%	30%	58.0	69.2	11.2
			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"= Column K divided by Column E.

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

In order to examine past authorization for filling of wetlands within the study area, we took a look at our data base. For the study area, the average amount of fill authorized since 1991 is 535 acres per year.

There were an average of 64 permits actions per year. This is only permits for fill and does not include permits for docks, dredging, and other work not involving fill in wetlands. Also, this does not include permit actions prior to 1991 which would be more difficult to extract from our data base for the study area.

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 an 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).

Table 18. **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 19. **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 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. 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 group 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 and the other Ensembles promote a change to the regulatory review process, but do not necessarily warrant 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 proposed action is consistent with the State's Coastal Zone Management plan (see Appendix B on consistency determination). 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, after the publication of this Draft EIS, 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.

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, after the publication of this Draft EIS, 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 Game and Fresh Water Fish Commission (FGFWFC) . 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 PreservationAct (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 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. 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 Recreation Act, (Public Law 89-72) as amended, are not applicable to the proposed action.

4.30.13 FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

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 this Act 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.

5. LIST OF PREPARERS

5.1 PREPARERS

Name (affiliation)	Discipline	Years	Role
Don J. Silverberg (Lotspeich & Assoc.)	Biologist/NEPA	12	Principal Author
Jeff Rhodes (SAIC)	Biologist	5	Water Quality Model
Bob Barron (Corps)	Civil Engineer	15	ADG Report

5.2 REVIEWERS

Name (affiliation)	Discipline	Years	Role
Renee L Thomas (Lotspeich & Assoc.)	Biologist	12	General Review
Kenneth R. Dugger (Corps)	Biologist	28	EIS contract oversight & general review
Bob Barron (Corps)	Civil Engineer	15	General Review
Al Lucas (EPA)	Ecologist	20	Water Quality & General Review
Paul Szerszen (SAIC)	Engineer	15	Water Quality Model

6. PUBLIC INVOLVEMENT

6.1 SCOPING AND DRAFT EIS

A Notice of Intent (NOI) to prepare a draft of this EIS appeared in the Federal Register on 12 January 1998. In addition, the NOI was mailed to interested and affected parties by letter dated 12January 1998. A copy of the letter and NOI are in Appendix C. Two public meetings were held to receive comments. At public meetings held on 9 February 1998, more than 200 people (of whom 60 spoke) attended and provided comments regarding geographic area, specific issues, and the manner of the EIS process. The Corps also addressed a joint session of the Boards of County Commissioners of Lee and Collier Counties on 11 February 1998.

6.2 AGENCY COORDINATION

Representatives of the EPA, USFWS, FGFWFC, SFWMD, FDEP, and the Florida Department of Community Affairs (DCA) were participants in the Alternatives Development Group process, and played significant roles in the development, refinement and review of the alternatives and the metrics associated with their evaluation.

6.3 LIST OF STATEMENT RECIPIENTS (DRAFT EIS)

Copies of the draft EIS were mailed to the following parties: local, state, and Federal agencies having jurisdiction or expertise; conservation groups; and other parties expressing a desire for a copy. In addition, the availability of the Draft EIS is published in the Federal Register. A complete mailing list for the NOI and NOA is in Appendix C.

6.4 COMMENTS RECEIVED

Comments received during the scoping process were considered in preparing the Draft EIS. A copy of these comments are in Appendix C. Comments on the Draft EIS will be considered in producing the Final EIS.

REFERENCES

Abbot, G.C. and A.K. Nath. 1996. Hydrologic Restoration of Southern Golden Gate Estates Conceptual Plan. Final Report. Big Cypress Basin Board, South Florida Water Management District. Naples.

Ackerman, B.B., S.D. Wright, R.K. Bonde, C.A. Beck, and D.J. Banowetz. 1995. Analysis of watercraft-related mortality of manatees in Florida, 1979-1991. Pages 259-268 in T.J. O'Shea, B.B. Ackerman, and H.F. Percival, eds. Population biology of the Florida manatee: Information and Technology Report I. U.S. Department of the Interior, National Biological Service. Washington, D.C.

Arnold Committee. 1996. Arnold Committee Report and Recommendations for the Siting of Florida Gulf Coast University. 50 pp.

Ashton, R.E., Jr. and P.S. Ashton. 1988. Handbook of Reptiles and Amphibians of Florida - Part Three - The Amphibians. Windward Publishing. Miami, Florida.

Boyer, J.N. and R.D. Jones. 1996. The Florida Bay Water quality Monitoring Program: Assessing Status and Trends (1989-1995). Florida International University, Southeast Environmental Research Program, Miami. Abstracts Sheraton Key Largo € Key Largo, Florida. December 10-12.

Browder, J.S. 1984. Wood stork feeding areas in southwest Florida. Florida Field Naturalist 12:81-96.

Bryan, D.C. 1996. Limpkin. Pages 485-496 *in* Rare and Endangered Biota of Florida. Volume V: Birds. Rodgers, J.A., Jr., H.W. Kale II, and H.T. Smith, eds. University Press of Florida. Gainesville, Florida.

Camp, Dresser and McKee, Inc (CDM). 1995. Caloosahatchee River Basin Assessment Water Quality Data Analysis Report (Phase II). Prepared for Upper District Planning, South Florida Water Management District. West Palm Beach.

CH2M Hill, Inc. 1991. Best Management Practices and Construction Standards for Local Government Stormwater Management. Prepared for the South Florida Water Management District, West Palm Beach, Florida. CH2M Hill, Deerfield Beach, Florida.

Charlotte Harbor National Estuary Program (CHNEP). 1997. Charlotte Harbor National Estuary Program. Harbor Happenings. M. Upton, Ed. Vol. 1, No. 2. Summer, 1997. Fort Myers, Florida.

Clark, R. 1987. Water Quality, Circulation and Patterns and Sediment Analysis of the Estero Bay Estuarine System, 1986. Department of Community Development, Lee County, Florida. Prepared under Coastal Zone Management Grant CM-123 from the Florida Department of Environmental Regulation.

Coile, N.C. 1998. Notes on Florida's Endangered and Threatened Plants, 2nd Edition. Florida Department of Agriculture and Consumer Services, Division of Plant Industry. Gainesville, Florida.

Collier County. 1997. Collier County Growth Management Plan, Public Facilities Element, Natural Groundwater Aquifer Recharge Sub-element Ordinance 97-59. Collier County, Florida.

Collier County Environmental Services Division.. May 1995. Collier County Manatee Protection Plan. Collier County Natural Resources Departmtne, Naples, Florida

Cox, J., R. Kautz, M. MacLaughlin, and T. Gilbert. 1994. Closing the Gaps in Florida's Wildlife Habitat Conservation System. Office of Environmental Services. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida. 239 pp.

Curnutt, J.L. 1996. Cape Sable seaside sparrow. Pages 137-143 *in* Rare and Endangered Biota of Florida. Volume V: Birds. Rodgers, J.A., Jr., H.W. Kale II, and H.T. Smith, eds. University Press of Florida. Gainesville, Florida.

Daltry, W.E. and D.Y. Burr. 1998. Base Programs Analysis. Volume 1: Description of the Existing Laws, Policy, and Resource Management Structure in the Greater Charlotte Harbor Watershed. Technical Report 98-01. Prepared for the Charlotte Harbor National Estuary Program. Fort Myers, Florida.

Dames and Moore. 1997. Big Cypress Basin Watershed Plan. Task A&B – Project Orientation and Data Collection. Prepared for South Florida Water Management District Big Cypress Basin Board. Contract No. C-7703.

Dames & Moore, Inc. 1990. Urban Stormwater Analysis and Improvements for the Tampa Bay Watershed. Prepared for the Southwest Florida Water Management District, Brooksville, Florida by Dames & Moore, Tampa, Florida and Environmental Research and Design. Orlando, Florida. December 1990.

Diemer, J. 1992. Gopher tortoise. Pages 123-127 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Dodd, C.K. 1992. Loggerhead sea turtle. Pages 128-134 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Drew, R.D. and N.S. Schomer. 1984. An Ecological Characterization of the Caloosahatchee River/Big Cypress Watershed. U.S. Fish Wild. Serv. FWS/OBS-82/58.2. 225 pp.

Driver, N.E. and G.D. Tasker. 1990. Techniques for Estimation of Storm-Runoff Leads, Volumes, and Selected Constituent Concentrations in Urban Watersheds in the United States. United States Geological Survey Water-Supply Paper 2363, U.S. Department of the Interior. U.S. Government Printing Office, Washington, D.C.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1992. Birds In Jeopardy: The imperiled and Extinct Birds of the United States and Canada including Hawaii and Puerto Rico. Stanford University Press. Stanford, California.

Estevez, E.D., J. Miller, and J. Morris. 1981. A review of scientific information of the Charlotte Harbor estuarine system complex. Mote Marine Laboratory. Sarasota, Florida.

Fitzpatrick, J.W., R. Bowman, D.R. Breininger, M.A. O'Connell, B. Stith, J. Thaxton, B.R. Toland, and G.E. Woolfenden. 1994. Habitat conservation plans for the Florida scrub jay: a biological framework. Unpublished report. On file at U.S. Fish and Wildlife Service, South Florida Ecosystem Office. Vero Beach, Florida.

Fitzpatrick, J.W., G.E. Woolfenden, and M.T. Kopeny. 1991. Ecology and development-related habitat requirements of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*). Florida Game and Freshwater Fish Comm. Nongame Wildlife Program Technical Report Number 8. Tallahassee, Florida.

Florida Department of Environmental Protection (FDEP). 1996a. 1996 Water Quality Assessment for the State of Florida. Technical Appendix, South and Southeast Florida. Bureau of Surface Water Management, Division of Water Facilities. Tallahassee, Florida.

Florida Department of Environmental Protection (FDEP). 1996b. 1996 Water Quality Assessment for the State of Florida, Section 305(b), Main Report. Florida Department of Environmental Protection, Bureau of Water Resources Protection, Division of Water Facilities, Tallahassee, Florida.

Florida Department of Environmental Protection (FDEP). 1996. Florida Marine Research Institute. Manatee Mortality Map, January 1974 through September 1997.

Florida Department of Environmental Protection (FDEP). 1986. Ambient Air Quality. Tallahassee, Florida. *in* Southwest Florida Regional Planning Council. 1995. Strategic Regional Policy Plan of the Southwest Florida Regional Planning Council. Southwest Florida Regional Planning Council. North Fort Myers, Florida.

Florida Department of Natural Resources (FDNR). 1992. Florida's Ground Water Monitoring Program, Hydrogeologic Framework. Florida Geological Survey Special Publication No. 32. Tallahassee, Florida.

Florida Game and Fresh Water Fish Commission (FGFWFC). Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida, 1 August 1997.

Florida Game and Fresh Water Fish Commission (FGFWFC). 1996. Species data *in* Wilson, Miller, Barton & Peek, Inc. 1998. Geographic Information System Output Data. Compilation of Areal Coverages from ADG-Formulated Alternatives. Naples, Florida.

Florida Panther Interagency Committee. 1993. Florida Panther Habitat Preservation Plan - South Florida Population. Florida Panther Interagency Committee. 102 pp.

Florida Power and Light (FP&L). 1989. The West Indian Manatee In Florida. Written by Victoria Brook Van Meter for Florida Power & Light Company. Miami, Florida.

Franz, R. 1992. Florida pine snake. Pages 254-258 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Gardner, T. 1988. Rookery Bay and Cape Romano-Ten Thousand Islands Aquatic Preserves Management Plan. Florida Department of Natural Resources. Tallahassee, Florida.

Gibson, G. 1997. FY 95/96 Collier County Trend Ground Water Quality Monitoring Data Report. Water Resources Management Section, Collier County Pollution Control Department. Naples, Florida.

Gibson, G. and S.V. Preston. 1993. Delineation and Management Plan of High Natural Aquifer Recharge Areas, Collier County, Florida. Pollution Control Department. Publication Series PC-OFR-93-01. Naples, Florida.

Gissendanner, E.J. 1983. Estero Bay Aquatic Preserve Management Plan. Florida Department of Natural Resources. Division of Recreation and Parks, Bureau of Environmental Land Management. Tallahassee, Florida.

Godley, J.S. 1992. Gopher frog. Pages 15-19 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Godschalk and Associates. 1988. Lee County Coastal Study. A Report to the Lee County, Florida Department of Community Development. Vol. 1. Findings and Recommendations.

Haag, K.H., R.L. Miller, L.A. Bradner, and D.S. McCulloch. 1996. Water Quality Assessment of Southern Florida: An Overview of Available Information on Surface and Ground-Water Quality and Ecology. U.S. Geological Survey. Water-Resources Investigations Report 96-4177. Tallahassee, Florida.

Hatcher, and W. D. Lorenz, Jr. 1988. Big Cypress Basin Water Quality Monitoring Network Annual Report for 1987. Collier County Environmental Science and Pollution Control Department. Naples, Florida.

Hovis, J.A. 1996. Red-cockaded Woodpecker. Pages 81-102 *in* Rare and Endangered Biota of Florida. Volume V: Birds. Rodgers, J.A., Jr., H.W. Kale II, and H.T. Smith, eds. University Press of Florida. Gainesville, Florida.

Humphrey, S.R. 1992. Big Cypress fox squirrel. Pages 224-233 *in* Rare and Endangered Biota of Florida. Volume I: Mammals. S.R. Humphrey, ed. University Press of Florida. Gainesville, Florida.

Humphrey, S.R. 1992. Southern Florida Population of Mink. Pages 319-327 *in* Rare and Endangered Biota of Florida. Volume I: Mammals. S.R. Humphrey, ed. University Press of Florida. Gainesville, Florida.

Johnson Engineering, Inc., Agnoli, Barber, and Brundage, Inc., and Boylan Environmental Consultants, Inc. 1998. South Lee County Watershed Plan (Interim). Volume I. Prepared for the South Florida Water Management District.

Jones, C.P. 1980. Big Hickory Pass, New Pass, and Big Carlos Pass. Glossary of inlets. Florida Sea Grant College Rep. No. 8. 47 pp.

Kale, H.W. II, et al. 1992. – Section 4.3 (Species Description)

Kehoe, M.J. 1992. Water-Quality Survey of Twenty-four Stormwater Wet-Detention Ponds (Final Report). Environmental Section, Southwest Florida Management District, Brooksville, Florida.

Kenner, W.E. and E. Brown. 1956. Interim Report on Surface Water Resources and Quality of Waters in Lee County, Florida. U.S. Geological Survey.

Kimes, C.A., and L. C. Crocker. 1998. The Caloosahatchee River and its Watershed (Draft). Prepared for Florida Gulf Coast University Library Services. Ft. Myers, Florida.

Kirby, M. N., J. M. Hatcher, and W. D. Lorenz, Jr. 1998. Big Cypress Basin Water Quality Monitoring Network Annual Report for 1987. Collier Co. Environmental Science and Pollution Control Department, Naples, Florida.

Layne, J.A. 1996. Crested caracara. Pages 197-210 *in* Rare and Endangered Biota of Florida. Volume V: Birds. J.A. Rodgers, Jr., H.W. Kale II, and H.T. Smith, eds. University Press of Florida. Gainesville, Florida.

Layne, J.N. 1992. Sherman's short-tailed shrew. Pages 328-334 *in* Rare and Endangered Biota of Florida. Volume I: Mammals. S.R. Humphrey, ed. University Press of Florida. Gainesville, Florida.

Layne, . 1978a. – Section 4.3 (Caracara Species Description)

Lee, C.C. 1992. Environmental Engineering Dictionary. Second Edition. Government Institutes, Inc. Rockville, Maryland.

Lee County. 1997. The 1994 Lee Plan, 1996 Codification, As Amended through May, 1997. Lee County Department of Community Development, Division of Planning. Fort Myers, Florida.

Lehninger, A.L. 1982. Principles of Biochemistry. Worth Publishers, Inc. New York, New York.

Lerman, M. 1986. Marine Biology, Environment, Diversity, and Ecology. The Benjamin/Cummings Publishing Company, Inc. Menlo Park.

Logan, T.H. 1997. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Florida Game and Freshwater Fish Commission, Tallahassee, Florida.

Logan, T.J., A.C. Eller, Jr., R. Morrell, D. Ruffner, and J. Sewell. 1993. Florida panther habitat preservation plan - south Florida population. Prepared for the Florida Panther Interagency Committee. Tallahassee, Florida.

Maehr, D.S. 1990. Florida panther movements, social organization, and habitat utilization. Final Performance Report, Study No. 7502. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida. *in* U.S. Fish and Wildlife Service. 1998. Multi-species recovery plan for the threatened and endangered species of South Florida, Volume 1 of 2, The Species. Technical/Agency Draft. Vero Beach, Florida.

Maehr, D.S. 1992c. Florida black bear. Pages 265-275 *in* Rare and Endangered Biota of Florida. Volume I: Mammals. S.R. Humphrey, ed. University Press of Florida. Gainesville, Florida.

Maehr, D.S. 1992b. Florida panther. Pages 176-189 *in* Rare and Endangered Biota of Florida. Volume I: Mammals. S.R. Humphrey, ed. University Press of Florida. Gainesville, Florida.

Maehr, D.S. 1992a. Florida panther distribution and conservation strategy. Final Report, Study No. 7572. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida. *in* U.S. Fish and Wildlife Service. 1998. Multi-species recovery plan for the threatened and endangered species of South Florida, Volume 1 of 2, The Species. Technical/Agency Draft. Vero Beach, Florida.

Marine Technical Advisory Council (MTAC). 1996. Update. Florida Department of Environmental Protection: Tallahassee, Florida

Marine Mammal Commission (MMC). 1992. Annual Report to Congress, 1991. Marine Mammal Commission. Washington, D.C.

Mazzotti, Frank J. December, 1990. University of Florida, Florida Cooperative Extension Service. Publication SS-WIS-12: Wood Storks (*Mycteria americana*). Gainesville, Florida.

McElroy, W.J. and K.C. Alvarez. 1975. Final Report on the Augmentation of Surficial Flow through the Fakahatchee Strand Collier County, Florida. Water Resource Report No. 2. Department of Environmental Regulation and Department of Natural Resources. Tallahassee, Florida.

Meylan, A. 1992. Hawksbill turtle. Pages 95-99 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Milanich, J. 1995. Florida Indians and the Invasion from Europe. University Presses of Florida. Gainesville, Florida. 290 pp.

Millsap, B.A. 1996. Florida burrowing owl. Pages 579-587 *in* Rare and Endangered Biota of Florida. Volume V: Birds. Rodgers, J.A., Jr., H.W. Kale II, and H.T. Smith, eds. University Press of Florida. Gainesville, Florida.

Milsap, 1991. – Section 4.3 (Caracara Species Description)

Moler, P.E. 1992. American crocodile. Pages 83-89 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Myers, R.L. 1990. Scrub and high pine. Pages 150-193 *in* R.L. Myers and J.J. Ewel, eds. Ecosystems of Florida. University of Central Florida Press. Orlando, Florida.

Ogden, J.C. 1990. Habitat management guidelines for the wood stork in the southeast region. Prepared for the U.S. Fish and Wildlife Service. Atlanta, Georgia.

Ogden, L.H. 1992. Atlantic ridley turtle. Pages 100-104 *in* Rare and Endangered Biota of Florida. Volume III: Amphibians and Reptiles. P.E. Moler, ed. University Press of Florida. Gainesville, Florida.

Rice University. 1998. Key Water Quality Indicators. http://riceinfo.rice.edu/armadillo /Galveston/Chap6/water.quality.indicator.html.

Rodgers, J.A., Jr. 1996. Little blue heron. Pages 413-419 *in* Rare and Endangered Biota of Florida. Volume V: Birds. Rodgers, J.A., Jr., H.W. Kale II, and H.T. Smith, eds. University Press of Florida. Gainesville, Florida.

Rookery Bay National Estuary Research Reserve. 1996. Rookery Bay Advance Identification of Wetlands Project - Draft Technical Summary Document. Naples, Florida.

Runde, D.E., J.A. Gore, J.A. Hovis, M.S. Robson, and P.D. Southall. 1991. Florida Atlas of Breeding Sites for Herons and Their Allies - Update 1986-89. Florida Game and Fresh Water Fish Commission. Nongame Wildlife Program Technical Report Number 10. Tallahassee, Florida.

Rushton, B. and C. Dye. 1993. The Effectiveness of Permitted Stormwater Systems for Water Quality Control. Reprinted from the Fourth Annual Symposium, Florida Lake Management Society. Deland, Florida.

Rushton, B.T. and C.W. Dye. 1993. An In Depth Analysis of a Wet Detention Storm Water System. Southwest Florida Water Management District. Brooksville, Florida.

Sarasota Bay National Estuary Program (SBNEP). 1994. Sarasota, Florida

Sawyer, C.N. and P.L. McCarty. Chemistry for Environmental Engineering. Third Edition. McGraw-Hill Publishing Company. New York.

Schaefer, J., and J. Junkin. 1990. University of Florida, Florida Cooperative Extension Service. Publication SS-WIS-24: The Eastern Indigo Snake: A Threatened Species. Gainesville, Florida.

Simpson, B. L., R. Aaron, J. Betz, D. Hicks, C. Van der Kreeke, and B. Yokel. 1979. The Naples Bay Study. The Collier County Conservancy. Naples, Florida.

Smallwood, J.A. 1987. Sexual segregation by habitat in American kestrels wintering in southcentral Florida: vegetative structure and responses to differential prey availability. Condor 89:842-849. *in* Stys, B. 1993. Ecology and Habitat Protection Needs of the Southeastern American Kestrel (*Falco sparverius paulus*) on Large-Scale Development Sites in Florida. Nongame Wildlife Technical Report No. 13. Office of Environmental Services. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Smith, K.N. 1993. Manatee habitat and human-related threats to seagrass in Florida: A review. Department of Environmental Protection, Division of Marine Resources. Tallahassee, Florida.

Smith, R.A, R.B. Alexander, and K.J. Lanfear. 1994. Stream Water Quality in the Coterminous United States—Status and Trends of Selected Indicators During the 1980's. USGS National Water Summary home page. http://h20.usgs.gov/public /nwsum/sal/trends.html.

South Florida Water Management District (SFWMD). 1995. District Water Management Plan, Volume I. Planning Department, South Florida Water Management District. West Palm Beach, Florida.

South Florida Water Management District (SFWMD). 1998a. Save Our Rivers 1998 Land Acquisition and Management Plan. West Palm Beach, Florida.

South Florida Water Management District (SFWMD). 1998b. District-wide Water Supply Assessment. South Florida Water Management District. West Palm Beach, Florida.

Southwest Florida Regional Planning Council. 1995. Strategic Regional Policy Plan of the Southwest Florida Regional Planning Council. Southwest Florida Regional Planning Council. North Fort Myers, Florida.

Stys, B. 1997. Ecology of the Florida Sandhill Crane. Florida Game and Fresh Water Fish Commission. Nongame Wildlife Technical Report No. 15. Tallahassee, Florida. 20 pp.

Stys, B. 1993. Ecology and Habitat Protection Needs of the Southeastern American Kestrel (Falco sparverius paulus) on Large-Scale Development Sites in Florida. Nongame Wildlife Technical Report No. 13. Office of Environmental Services. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Tabb, D.C., R.G. Rehrer, P. Larson, S. Berkeley, E.J. Heald, M.A. Roessler, and T.R. Alexander. 1974. Ecological inventory of coastal waters and adjacent uplands of Lee County, Florida in the vicinity of Estero Bay marine preserve. Rosentiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida. UM-RSMAS No. 73013.

Tampa Bay National Estuary Program (TBNEP). 1995. Tampa, Florida

Tennant, A. and K.L. Krysko. 1997. A Field Guide to Snakes of Florida. Gulf Publishing Company. Houston, Texas. 257 pp.

Toland, B. 1996. USFWS: Personal communication.

U.S. Army Corps of Engineers (USACE). 1998. Charge to the Alternatives Development Group of the Southwest Florida Environmental Impact Statement *in* Meeting Notes of The Alternatives Development Group (ADG) Southwest Florida Environmental Impact Statement-Meeting #1, April 16-17, 1998.

U.S. Army Corps of Engineers (USACE). 1980. Reconnaissance Report. Golden Gate Estates. Department of the Army, Jacksonville District, Corps of Engineers. Jacksonville, Florida.

U.S. Department of Commerce. 1992. 1990 Census of Population and Housing Summary Tape File 3A. Florida, Alachua-Lee Counties. Bureau of the Census, Data User Services Division. Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 1996. Why Watersheds? OWOW Homepage http://www.epa.gov/OWOW /watershed/why.html.

U.S. Fish and Wildlife Service (USFWS). 1999. Federally Listed Endangered Species and Threatened Species and Candidates for Federal Listing in Collier County Florida. U.S. Fish and Wildlife Service South Florida Field Office. Vero Beach, Florida.

U.S. Fish and Wildlife Service (USFWS). 1999. Federally Listed Endangered Species and Threatened Species and Candidates for Federal Listing in Lee County Florida. U.S. Fish and Wildlife Service South Florida Field Office. Vero Beach, Florida.

U.S. Fish and Wildlife Service (USFWS). 1998. Draft Multi-species recovery plan for the threatened and endangered species of South Florida, Volume 1 of 2, The Species. Technical/Agency Draft. Vero Beach, Florida.

U.S. Fish and Wildlife Service (USFWS). May, 1996. U.S. Fish and Wildlife Service Division of Endangered Species. Everglade Snail Kite, Species Account. Internet Resource: <http://www.fws.gov/r9endspp/i/b/sab0v.html>

U.S. Fish and Wildlife Service (USFWS). July, 1995. Bald Eagle, Wildlife Species Biologue. Internet Resource: <http:/www.fws.gov/r9extaff/biologues/bio_eagl.html>

U.S. Fish and Wildlife Service (USFWS). May, 1993. Red-Cockaded Woodpecker, Wildlife Species Biologue. Internet Resource: <http:/www.fws.gov/r9extaff/biologues/bio_rcw.html>

U.S. Fish and Wildlife Service (USFWS). February, 1991. Audubon crested caracara, Species Account. Internet Resource: <http:/www.fws.gov/r9endspp/i/b/sab6e.html>

U.S. Fish & Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook. Final March 1998.

University of Florida. 1998. Florida Museum of Natural History, Species Account. Internet Resource: <http//www.flmnh.ufl.edu/natsci/herpetology/brittonerocs/csp_amis.htm>

Wanielista, M.P. and Y.A. Yousef. 1993. Stormwater Management. John Wiley & Sons, Inc. New York, New York.

Ward, D.B., editor. 1979. Rare and Endangered Biota of Florida. Volume Five. Plants. University Presses of Florida. Gainesville, Florida.

Water Quality Association. 1997. Chemical Oxygen Demand (COD). Water Quality Association Glossary of Terms, 3rd Edition. http://www.wqa.org/WQIS/Glossary/Cod.html.

Wilson, Miller, Barton & Peek, Inc. 1998. Geographic Information System Output Data. Compilation of Areal Coverages from ADG-Formulated Alternatives. Naples, Florida.

Wood, D. A. 1994. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Florida Game and Freshwater Fish Commission, Tallahassee, Florida.

Wood, P.B., T.C. Edwards, and M.W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. Journal of Wildlife Management 53(2):441-449.

Woolfenden, G.E., and J.W. Fitzpatrick. 1990. Florida scrub jays: A synopsis after 18 years of study. Pages 241-266 *in* P.B. Stacey, and W.B. Koenig, eds. Cooperative breeding in birds. Cambridge University Press. *in* U.S. Fish and Wildlife Service. 1998. Multi-species recovery plan for the threatened and endangered species of South Florida, Volume 1 of 2, The Species. Technical/Agency Draft. Vero Beach, Florida.

Woolfenden, G.E., and J.W. Fitzpatrick. 1984. The Florida scrub jay: demography of a cooperative-breeding bird. Princeton University Press. Princeton, New Jersey.

Zieman, J.C. 1982. The ecology of the seagrasses of south Florida: a community profile. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, D.C. FWS/OBS-82/25.

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APPENDIX A - SECTION 404(B) EVALUATION

Because this EIS is programmatic in nature, a final determination of compliance with the guidelines pursuant to Section 404(b)(1) of the Clean Water Act would be made for subsequent permit actions on a case-by-case basis. Compliance with these guidelines is required before a Department of the Army permit can be issued. These guidelines prohibit the issuance of a permit if there is a less environmentally-damaging practicable alternative, if water quality standards would be violated, if it violates the Ocean Dumping Act, if it jeopardizes the continued existence of a Federally threatened or endangered species, if it would adversely modify a designated critical habitat for such species, or if the activity would cause or contribute to significant degradation of Waters of the United States. See part 230.11 of Title 40 of the Code of Federal Register (CFR) for additional detail.

APPENDIX B - COASTAL ZONE MANAGEMENT CONSISTENCY

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION PROCEDURES

PRELIMINARY DRAFT
ENVIRONMENTAL IMPACT STATEMENT
ON
IMPROVING THE REGULATORY PROCESS IN SOUTHWEST FLORIDA
LEE and COLLIER COUNTIES, FLORIDA
DECEMBER 1998

Since this EIS is programmatic in nature, a final determination of consistency with the Florida Coastal Zone Management Program would be made for subsequent permit actions on a case-by-case basis. The following statutes would be applied:

1. Chapter 161, Beach and Shore Preservation. The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

2. Chapters 186 and 187, State and Regional Planning. These chapters establish the State Comprehensive Plan which sets goals that articulate a strategic vision of the State's future. It's purpose is to define in a broad sense, goals, and policies that provide decision-makers directions for the future and provide long-range guidance for an orderly social, economic and physical growth.

3. Chapter 252, Disaster Preparation, Response and Mitigation. This chapter creates a State emergency management agency, with the authority to provide for the common defense; to protect the public peace, health and safety; and to preserve the lives and property of the people of Florida.

4. Chapter 253, State Lands. This chapter governs the management of submerged State lands and resources within State lands. This includes archeological and historical resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; submerged lands; spoil islands; and artificial reefs.

5. Chapters 253, 259, 260, and 375, Land Acquisition. These chapters authorize the State to acquire land to protect environmentally sensitive areas.

6. Chapter 258, State Parks and Aquatic Preserves. This chapter authorizes the State to manage State parks and preserves. Consistency with this statute would include consideration of projects that would directly or indirectly adversely impact park properties, natural resources, park programs, management or operations.

7. Chapter 267, Historic Preservation. This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.

8. Chapter 288, Economic Development and Tourism. This chapter directs the State to provide guidance and promotion of beneficial development through encouraging economic diversification and promoting tourism.

9. Chapters 334 and 339, Public Transportation. These chapters authorize the planning and development of a safe balanced and efficient transportation system.

10. Chapter 370, Saltwater Living Resources. This chapter directs the State to preserve, manage and protect the marine, crustacean, shell and anadromous fishery resources in State waters; to protect and enhance the marine and estuarine environment; to regulate fishermen and vessels of the State engaged in the taking of such resources within or without State waters; to issue licenses for the taking and processing products of fisheries; to secure and maintain statistical records of the catch of each such species; and to conduct scientific, economic, and other studies and research.

11. Chapter 372, Living Land and Freshwater Resources. This chapter establishes the Game and Fresh Water Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

12. Chapter 373, Water Resources. This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.

13. Chapter 376, Pollutant Spill Prevention and Control. This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

14. Chapter 377, Oil and Gas Exploration and Production. This chapter authorizes the regulation of all phases of exploration, drilling, and production of oil, gas, and other petroleum products.

15. Chapter 380, Environmental Land and Water Management. This chapter establishes criteria and procedures to assure that local land development decisions consider the regional impact nature of proposed large-scale development.

16. Chapter 388, Arthropod Control. This chapter provides for a comprehensive approach for abatement or suppression of mosquitoes and other pest arthropods within the State.

17. Chapter 403, Environmental Control. This chapter authorizes the regulation of pollution of the air and waters of the State by the Florida Department of Environmental Regulation (now a part of the Florida Department of Environmental Protection).

18. Chapter 582, Soil and Water Conservation. This chapter establishes policy for the conservation of the State soil and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop, and utilize soil and water resources both onsite or in adjoining properties affected by the project. Particular attention will be given to projects on or near agricultural lands.

APPENDIX C - PERTINENT CORRESPONDENCE

An estimated 700 pages of coments were received during the scoping process. These comments have been made part of the record and were considered in preparing the EIs. A copy of these comments are available for inspection. Copies can be made upon request for a reasonable fee for reporduction.

APPENDIX D - ALTERNATIVES DEVELOPMENT GROUP (ADG) REPORT

Alternatives for the Southwest Florida Environmental Impact Statement

Final Report

December 1998

ALTERNATIVES FOR THE SOUTHWEST FLORIDA ENVIRONMENTAL IMPACT STATEMENT

FINAL REPORT

by

Alternatives Development Group

with support from

Planning and Management Consultants, Ltd.

Report Submitted to

U.S. Army Corps of Engineers
Jacksonville District

December 1998

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LIST OF ACRONYMS

Acronym	Description
ABM	Estero Bay Agency on Bay Management
ADG	Alternatives Development Group
ARF	Acquire, Restore, and Fix
BCACSC	Big Cypress Area of Critical State Concern
BMP	Best Management Practices
Corps	U.S. Army Corps of Engineers
CREW	Corkscrew Regional Ecosystem Watershed
CRPA	Critical Resource Protection Area
DCA	Florida Department of Community Affairs
DEP	Florida Department of Environmental Protection
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
GFC	Florida Game and Freshwater Fish Commission
GIS	Geographic Information System
Hub	Zoom B of the study area
NEPA	National Environmental Policy Act
PMCL	Planning and Management Consultants, Ltd.
RPC	Southwest Florida Regional Planning Council
RRR	Restoration, Retrofit, and Redevelopment
SAIC	Science Applications International Corporation
SFWMD	South Florida Water Management District
SHCA	Strategic Habitat Conservation Area
Zoom	Section of the study area

I. ADG PURPOSE, MEMBERSHIP, AND REPORT

BACKGROUND

The Alternatives Development Group (ADG) was formed to support the U.S. Army Corps of Engineers (Corps) in the drafting of an Environmental Impact Statement (EIS) for a region that spans portions of Lee and Collier counties in southwest Florida (shown in Figure I-1). The increasing number, size, and complexity of development permit requests by the citizens and business interests of southwest Florida have created a condition where the Corps and other regulatory agencies are experiencing difficulty in, on a case-by-case basis, addressing their responsibilities under federal and state law. Thus, the Corps is at the point where permit processing is taking longer, permit denials become more frequent, and the environment may receive less protection than required by law. The subject EIS is designed to offer regulatory and planning-based remedies to these shortcomings, by seeking an effective balance between natural systems and economic stability through the examination of natural and social interactions that occur in the study area.

This EIS has many roots including (1) comments submitted by the public and community organizations on individual permit applications that expressed concerns on cumulative impacts, (2) other studies and work in region, and (3) initiatives to incorporate watershed and ecosystem-based principals into permit reviews. The Corps publicly shared some ideas on whether and how to perform a review of its regulatory program and received many letters and comments from the public, civic and industry associations, conservation organizations, and other agencies. Some supported and encouraged the review or aspects of the review, some advised of the potential detrimental effects of a change in the program or of the review itself, and most had questions or ideas on the scope of the review in relation to Corps authority. The Corps initiated and tailored the EIS process based on this input.

A unique dimension of this EIS is the formation of the ADG, which was tasked with the creation and evaluation of alternatives—a central component for the EIS. The nature of the EIS is to consider the range of important issues guiding the evolution of southwest Florida. Accordingly, the Corps initiated and sought participation from the ADG that consisted of key individuals representing the interests and vision of southwest Florida. The specific charge of the ADG as offered by the Corps was to:

Report on alternatives for improving the regulatory process to:

- *Protect natural environmental values*
- *Provide for sustainable economic growth*
- *Manage appropriate changes in water flows and quality*
- *Respect public involvement and private rights*

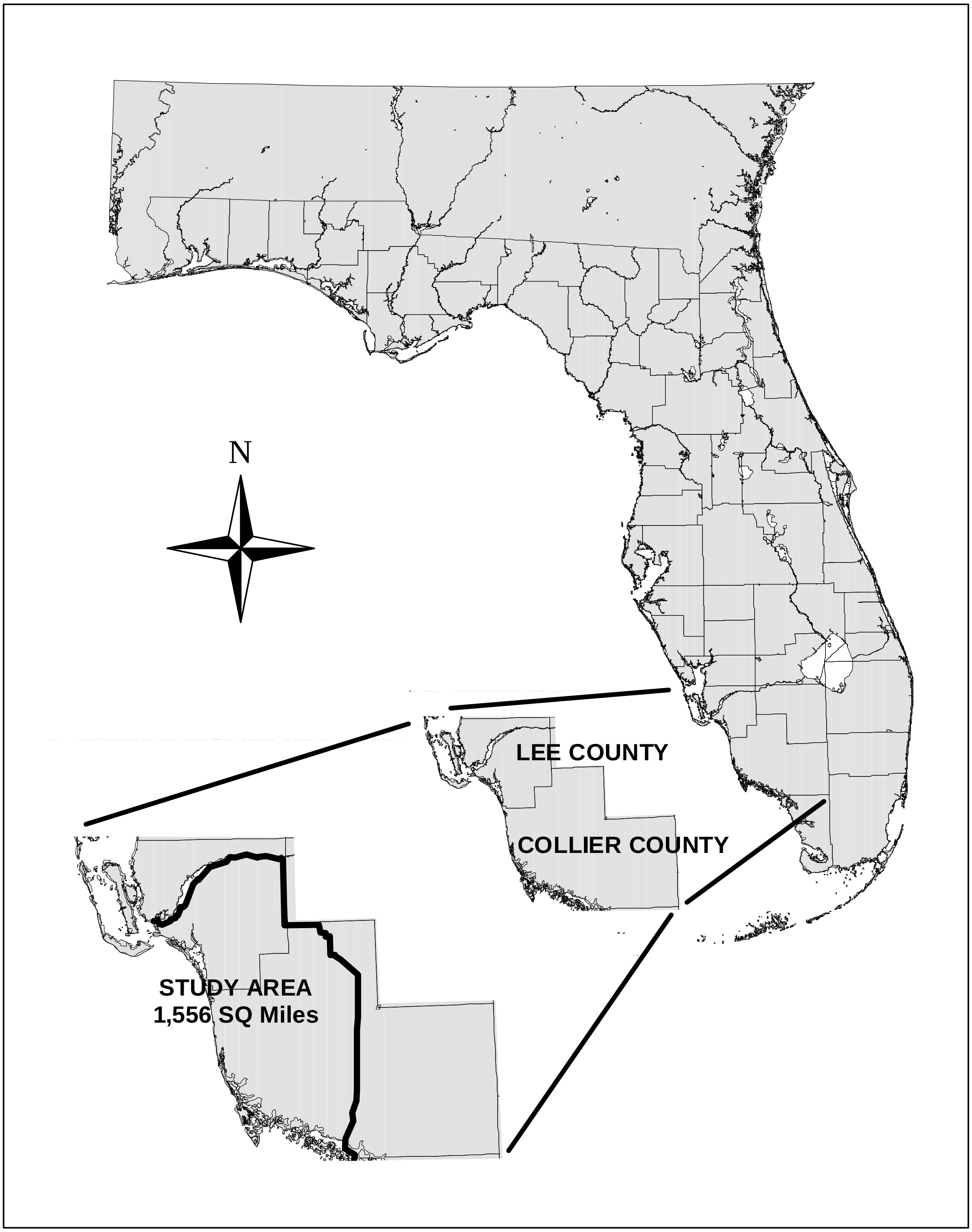


FIGURE I-1

ADG STUDY AREA

The ADG will collectively develop alternatives, evaluate the merits of each, and seek consensus on recommendations.

To effectively accommodate the charge and, more importantly, to create alternatives and evaluation factors that will bring added efficiency to regulatory activities in the future, it was imperative that this be a collaborative effort, drawing upon the perspectives of the key stakeholders in southwest Florida. The Corps worked closely with the Lee and Collier County Commissions and others in selecting, from a large number of interested persons, representatives to the ADG, which are listed in Appendix A. The list reveals a range of backgrounds and interest offering technical and political perspectives as well as interests that are driven by both environmental pursuits and economic development motivations. There was also representation of the general public on the ADG.

REPORT PURPOSE AND ORGANIZATION

This report summarizes the activities and results of the ADG. There was a significant amount of information—to include reports, data, presentations, maps—that was drawn upon during the ADG deliberations. Each of the ten core ADG meetings was documented with meeting notes that provided details of meeting activities. Supplemental process materials and data were provided in the attachments. These meeting notes and attachments and other materials numbered in the hundreds of pages of support materials provided to the ADG. While all of this information will be available to the Corps in the creation and management of the EIS, it was not practical or necessary to include all of that information in the ADG report. However, a listing of all the information presented to and utilized by the ADG is found in Appendix B.

The present document focuses on the results, summarizing the many hours of meeting activities and associated analyses embarked upon by the ADG. This report will be used directly within the EIS documentation to support the "alternatives" section of the EIS. The Corps will use the ADG report to support and guide the Corps in the development of EIS alternatives as required by the National Environmental Policy Act (NEPA). The other portions of the EIS documentation are being developed in parallel with ADG activities. The entire EIS will be assembled to completion and will be worked through standard review channels and public comment.

Following this introductory chapter there are five chapters that describe details of the ADG process and results. The final chapter of this report offers an interpretation of ADG results as compiled by the Corps and the facilitation team. The following is a brief summary of the remaining chapters.

Chapter II - Process Overview. Describes the general activities, style, and rules that guided the ADG's deliberations.

Chapter III - Issues and Evaluation Factors. Presents the key issues that were raised by the ADG and how they were used to evaluate alternatives.

Chapter IV - Alternatives Developed. Describes how the alternatives were developed making reference to Appendix C, which contains profiles of each alternative.

Chapter V - Evaluation of Issues: Themes and Direction. Offers discussion of key points and trends that were revealed through the development and evaluation of alternatives.

Chapter VI - Concluding Remarks. Closes the report with summary remarks and identification of where additional analysis could be used.

Chapter VII - Interpretation of Results. Offers commentary of how the alternatives were aligned with one another and implications of permit activities.

II. PROCESS OVERVIEW

The ADG embarked upon a process that was designed to elicit the perspectives of a range of stakeholders in the development and analysis of a series of alternatives. A series of ten two-day meetings were held starting in April and ending in August of 1998. Over the course of these ten meetings, a very deliberate process was followed that was designed to satisfy the ADG's charge given the spectrum of representation, the timeframe allowed, and available information. The basic tenets of the process are illustrated in Figure II-1. The meetings were designed, managed, and facilitated by a professional team with the goal of encouraging quality information exchange in an unbiased manner in support of the ADG charge. The meetings were open to the public and several people came to observe, as did members of the press.

This chapter provides an overview of the process defining the framework for the ADG activities. The results of these activities are provided in subsequent chapters. The present chapter also touches on some of the important dynamics of the ADG in terms of how they interacted and postured entering into this process. The overall "group attitude" about the activities is a key dimension of the progress of the ADG. Several points in this regard are made in this chapter.

CONTROVERSY AND COMMITMENT

A great deal of controversy surrounded the creation of the subject EIS and the ADG's role in it. Some factions were supportive, while others were either opposed to the idea, reluctant, or skeptical. A significant portion of the first three meetings was dedicated to answering the question of why this initiative was needed and how it was in the Corps purview. Overall, most saw that examining the region in a systemic and holistic manner would improve the regulatory process in southwest Florida. The first meetings were instrumental in solidifying commitment from participants through hearing each other's concerns and defining issues.

Commitment consisted of two elements. First, they would be required to spend twenty working days (ten two-day meetings) over a five-month period plus special assignments and review time. Indeed, participation in the ADG was going to be a time-consuming venture. The second element was commitment to the nature of what was needed to occur within the ADG for it to be truly successful. This required complete and honest delivery of information during the process at all times. Rephrased: Bring everything to the table. Also, ADG members were expected to be able to represent and consider the opposing perspectives requiring creativity, compromise, and negotiations. Holding to positions with no room for compromise was counter to the spirit of what was being sought in the ADG. This commitment, as shown in Figure II-1, was the foundation on which the process could be built.

ISSUES, EVALUATION, AND RESULTS

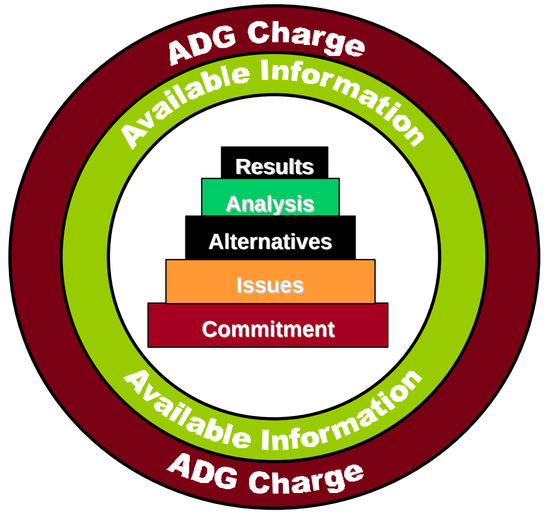


FIGURE II-1
ADG PROCESS

Information on issues associated with southwest Florida were brainstormed by the ADG. The ADG gained an understanding of each other's perspectives and learned details of the Corps and county regulatory processes. Further discussion of these issues formed the basis for creation of evaluation factors used to examine the merits of alternatives. All issues were reviewed by the ADG and resulted in twelve categories of issues. The ADG agreed that consideration of these twelve categories, as alternatives were analyzed, would accommodate the major areas of impact that could be addressed within an EIS setting.

The next stage of the process brought the ADG toward how these issue categories could be utilized to discriminate among proposed alternatives. The discriminators were referred to as evaluation factors. Each of the issue categories was analyzed by factor specialty groups, which were formed within the ADG. These factor specialty groups were tasked with closely considering how a series of measures could be used to represent the issues surfaced by the ADG. Representation in these factor specialty groups was driven by expertise and interest. Specific measures along with data sources were identified by each factor specialty group. Again, these were presented, reviewed, and accepted by the ADG in their entirety.

Alternatives were created for the entire study area by focusing on four subareas that the ADG termed zooms. For each zoom the ADG created a series of alternatives that were intended to represent the range of issues facing southwest Florida. Some alternatives utilized hydrologic features, while others applied selected management criteria. The result was the creation of twenty-eight alternatives. Each of these alternatives was examined according to measures and evaluation factors developed based upon the twelve issue categories.

This analysis of alternatives allowed the members of the ADG to explore the merits of each alternative as well as the motivation, or drivers, behind what made a particular alternative better or worse than its fellows. From this, the ADG was able to provide results to the Corps on a set of alternatives and used the factors to evaluate those alternatives, all of which will be used in the EIS.

AVAILABLE INFORMATION AND BEST PROFESSIONAL JUDGMENT

The ADG was going to be covering some highly sensitive topics, some of which would be based on scientific fact. However, much of what was being addressed in the ADG had to be approached from best professional judgment. Many participants in the ADG were generally uncomfortable with this situation but recognized that assumptions and judgments—sometimes crude—would be unavoidable in order for progress to be made on this initiative.

The concept of using available data as illustrated in Figure II-1 was very difficult to enforce, as the tendency of most members of the ADG was to do higher level, typically quantitative, analyses to support decisions. Fortunately, for many of the issue categories, a great deal of information was already available. For example, many of the layers of GIS data needed to evaluate ecosystem, and wildlife parameters were published and readily available.

In order for the ADG to have the best available information to support its analyses, several presentations were made by experts inside and outside the ADG. Each presentation was requested specifically by the ADG and was typically scheduled at the beginning of a pertinent session. Thus, the information offered would be fresh to the ADG participants. Typically, presenters would provide handouts to the ADG members and would utilize overheads/slides to support their remarks. All of this information was made part of the record, and technical reports provided were made part of the ADG's library of information. This information was frequently referred to during the analyses and deliberations of the ADG, and will be utilized further by the Corps as it develops other sections of the EIS. A full listing of the references brought to the ADG is found in Appendix B.

FACILITATION AND MANAGEMENT OF MEETINGS

The ADG meetings were professionally designed and facilitated and generally followed the design shown in Figure II-1. The meetings were structured to ensure efficient and effective communication of information in moving toward completion of the ADG charge. The process moved forward at a pace the group was able to handle, depending on progress. An iterative system of checks and balances was instituted with a steady push to completion of the ADG goals.

The facilitation team was commissioned to operate in an unbiased manner giving all involved parties an opportunity to offer ideas. All members of the ADG were given the opportunity to provide their perspectives in this process. Consensus was sought at critical junctures. Ground rules, designed specifically for and by the ADG, were established at the first meeting and governed all activities. For example, a policy for alternate members was established, and a system of showing thumbs up or down was used to quickly demonstrate agreement.

The facilitation team documented all activities and kept records of the proceedings. Each set of meeting notes was reviewed and subsequently approved by the ADG as an accurate reflection of what occurred at each meeting. The facilitation team with assistance from the Corps developed the present report, acting as a ghost-writer for the ADG.

III. ISSUES AND EVALUATION FACTORS

The identification of issues relevant to the study area is an important step in the development of alternatives. Also, all stakeholders are made aware of issues they may not have considered prior to this process. Thus, a varied group of stakeholders assures that relevant issues are identified and considered in the alternatives development and evaluation process. Issues addressed a myriad of perspectives such as economic, social, and environmental. This chapter presents the ADG's identification of issues and development of evaluation factors by which the ADG could ensure that the alternatives developed addressed the group's concerns.

ISSUES IDENTIFICATION

Each member of the ADG represents one or many perspectives. The affiliation(s) of the ADG members and alternates is presented in Appendix A. Given these different perspectives, members of the ADG identified and presented their own various key issues to the ADG. The thirty-three members of the ADG were divided into four subgroups to help find commonality in the issues presented by the members of that subgroup. The use of subgroups allowed the ADG to more quickly and openly discuss the key issues.

These small groups presented nearly one hundred issues to the ADG. There was much commonality among them. The task of the subgroups was to identify those issues that were common, thus significantly reducing the number of issues. Lastly, the ADG identified from the remaining issues those that were similar and categorized them. The ADG identified the following twelve issue categories.

1. Property rights
2. Water management
3. Water quality
4. Ecosystem function, wildlife habitat, and listed species
5. Regulatory efficiency and effectiveness
6. Economic sustainability
7. Local land use policy
8. Avoidance of wetland impacts
9. Mitigation
10. Cumulative/secondary impacts
11. Restoration/retrofit
12. Public lands management/use

The ADG identified two issues that did not fit within the twelve issue categories: (1) a holistic approach to management and (2) higher standards of data and information. The ADG concluded that these were goals to strive for in southwest Florida, not issues that could be addressed in the development of alternatives.

EVALUATION FACTORS BY ISSUE CATEGORY

To ensure that the alternatives developed for the study area addressed these twelve issue categories that encapsulate the key issues of the ADG, the group developed factors by which to evaluate the alternatives. These factors were both qualitative and quantitative. Thus, at minimum twelve evaluation factors, one for each issue category, had to be developed by the ADG. The purpose of the evaluation factors are to aid the ADG in discriminating among alternatives. The ADG divided again into four subgroups, factor specialty groups, to efficiently address the development of evaluation factors.

First, the ADG grouped the issue categories into four sets of three issue categories. These were grouped according to similarity among the issue categories and the expertise of the ADG. The twelve issue categories were grouped as follows;

1. Property rights, local land use policy, and economic sustainability
2. Regulatory efficiency and effectiveness, avoidance of wetland impacts, and mitigation
3. Water management, water quality, and restoration/retrofit
4. Ecosystem function, wildlife habitat, and listed species, cumulative/secondary impacts, and public land management/use

The factor specialty groups were formed based on member expertise or interest in the issue categories. Each factor specialty group developed factors for each of their three issue categories. The factor specialty groups defined the evaluation factors, determined the type of measurement, and identified the associated data sources and reference materials. All factors were reviewed by the ADG prior to their use in the evaluation of alternatives.

The ADG was reminded that they were directed by the ADG charge, time, and available data. Time was a significant constraint in the development and evaluation of alternatives. For instance, economic models were available to address the issue of economic sustainability. However, the complexity of the models discouraged the use of these models in the time frame in which the ADG was operating. The use of available geographic information system (GIS) data supported the ADG and added efficiency to some analyses. Also, driven by these constraints, is distinguishing between “need to know” and “nice to know” information in terms of evaluation factors. ADG members were encouraged to focus on data and issues that were central to the task at hand. The development of evaluation factors by issue category is described in the following sections and summarized in Table III-1.

TABLE III-1

SUMMARY OF EVALUATION FACTORS BY ISSUE CATEGORY

Issue Category	Number of Factors	Summary Points
Property Rights	3	Comprehensive plan established expectations
		Comprehensive plan is the standard to which all other alternatives were compared
Water Management	7	Improve flowways, reduce flood damages, and improve water supply
		Best professional judgment
Water Quality	5	Land use types used to estimate water quality
Ecosystem Function, Wildlife Habitat, and Listed Species	12	GIS assist qualitative judgement
		Current habitat and sighting maps compared to all alternatives to determine impacts
Regulatory Efficiency and Effectiveness	3	Many factors but hard to measure
		Use quantity and functionality of wetlands and habitat impacted as a surrogate for permit review time and level of effort
Economic Sustainability	7	Models identified but require greater detail and time than available
		Best professional judgment
Local Land Use Policy	2	Comprehensive plan is the local land use policy
		Comprehensive plan is the standard to which all other alternatives were compared
Avoidance of Wetland Impacts	2	GIS assisted
		Index of number of acres at risk calculated
Mitigation	2	GIS assisted
		Index of mitigation opportunities calculated
Cumulative & Secondary Impacts	10	Social and environmental impacts
		Best professional judgment used to rank the alternatives
Restoration/Retrofit	5	Flowways and habitat restoration
		Opportunities seen within residential and agricultural land
Public Lands Management/Use	1	Adjacent land use types indicate compatibility
		GIS utilized

Property Rights

The factor specialty group that addressed this issue 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
- Timely compensation for taking

The group cited the property owner's constitutional right as a given. However, the ADG recognized the local government's comprehensive plan generally sets forth the current expectation of land use and contributes significantly to expectations of land value.

The factor specialty group identified three factors to evaluate the extent to which the alternatives addressed the issue of property rights. These factors were (1) fair market value, (2) vested rights, and (3) reasonable expectation for use of land and return on investment.

The factor specialty group suggested means by which to measure these factors as well as data sources (i.e., property appraiser records, tax records, and independent appraisals). However, given the time available, the factor specialty group relied on the members best professional judgment. The group graded the alternatives by evaluation factor on a scale of one to four where one was worst and four was best in terms of property rights. The comprehensive plan was considered the standard from which to compare all alternatives.

Water Management

The factor specialty group that addressed this issue described that the purpose of water management is to provide adequate water supply for human consumption, agriculture, and commercial, recreational, and natural resource demands while balancing these with the need to provide flood protection.

The factor specialty group identified seven evaluation factors to ensure the alternatives addressed fully the issue of water management. The seven evaluation factors are as follows;

1. Infrastructure existence (stormwater utility/maintain and improve)
2. Home damage during storm events (level of flood protection)
3. Home construction to meet the one-hundred-year storm event
4. Flood depth and duration
5. Historic flow patterns (maintain and improve)
6. Adequate water storage (balance consumption with hydroperiods)
7. Groundwater data floors and ceilings (aquifer zoning)

To measure infrastructure existence, the group decided to compare the impact the alternatives would have on capital costs and maintenance costs. The group addressed home damage during storm events by estimating the number of homes affected. The group also evaluated whether the alternative increased, maintained, or decreased flood depth and duration. Also, alternatives were evaluated on whether they destroyed, maintained, or improved historical flow patterns, including the timing, direction, quantity, quality, and duration of these flows. Water supply was evaluated with respect to needs for natural resources, water storage, and groundwater floors and ceilings.

Given all of these possible means for measuring the impacts of the alternatives by evaluation factor, the group utilized the professional judgment of its members to aid in the evaluation of the alternatives. The factor specialty group applied a scoring method of +, 0, - to signify whether each alternative addressed, did not address, or negatively addressed the evaluation factor, respectively.

Water Quality

The factor specialty group that addressed this issue defined that the purpose of the water quality issue is to ensure the maintenance of surface- and groundwater quality.

Several presentations were made to the ADG concerning the status of water quality of the region's rivers and tributaries, estuaries, and bays. Presentations made it clear that there is a lack of data to answer some questions regarding water quality. The group first recommended that more data collection and monitoring are needed to fully understand water quality trends and related issues in southwest Florida.

The factor specialty group identified four factors that can be applied to evaluate whether the alternatives developed by the ADG address the issue of water quality. The identified factors are as follows:

1. Pollution loading
2. Freshwater pulses
3. Habitat loss
4. Groundwater impact

The group noted several items that the factors needed to address, such as establishing standards for point and nonpoint pollution, impacts on marine plant and animal communities, recreation, and health. All of these items are addressed in the four evaluation factors.

Groundwater impacts were estimated by analyzing acres of development in significant recharge locations. The number of acres converted to impermeable surfaces by alternatives was utilized to estimate the impact of freshwater pulses. Habitat loss was derived by the acres of alterations to wetlands and mangroves. Pollution loading was addressed utilizing a water quality index that was estimated for each alternative.

Pollutant-loading estimation was done based on land use types and land use criteria defined in the alternatives. Thus, the acreage of the different land use types defined by the alternatives drives the estimation of water quality. This screening method was developed and tailored to the ADG process by the consulting firm Science Applications International Corporation (SAIC), contracted by the U.S. Environmental Protection Agency (EPA). The pollutant ranges and definitions are based upon those utilized by the Florida Department of

Environmental Protection (DEP). Given these calculations and best professional judgment, the factor specialty group equally weighted the factors during the ranking of alternatives.

Ecosystem Function, Wildlife Habitat, and Listed Species

The factor specialty group addressed upland, wetland, and aquatic habitat changes, effects of fragmentation on listed species and ecosystem functions, and the maintenance of ecological integrity and biodiversity.

The factor specialty group identified twelve factors that can be applied to evaluate whether the alternatives developed by the ADG address the topics of the issue category ecosystem function, wildlife habitat, and listed species. The twelve evaluation factors are listed below.

1. Effects on Florida Game and Freshwater Fish Commission's (GFC) Strategic Habitat Conservation Area (SHCA) habitat-planning objectives
2. Effects on Priority I and II Florida Panther habitat
3. Effects on Southwest Florida Regional Planning Council (RPC) resource regional significance goals
4. Effects on U.S. Fish and Wildlife Service (FWS) Multi-species Recovery Plan and the Florida Panther Habitat Preservation Plan
5. Effects on occurrences of listed species
6. Effects on occurrences of rookeries
7. Effects on loss of native plant communities (common and rare)
8. Effects on fragmentation and connectivity of plant and animal habitats
9. Effects on loss of seasonal wetlands
10. Effects on integrity of flowways (rivers, sloughs, and strands)
11. Effects on wetland dependant species
12. Effects on aquatic resources

Much of the information, primarily maps, utilized by the factor specialty group was available and able to be readily digitized for analysis using geographic information system (GIS) capabilities. Thus, digitized alternatives compared against digitized natural resource maps were able to generate acres or counts of impacted areas or species, respectively. As a result, the units impacted can be compared among alternatives to determine, with judgment, which is better or worse for that particular factor. However, the evaluation factor, effects on FWS Multi-species Recovery Plan and the Florida Panther Habitat Preservation Plan, was not GIS applicable.

Regulatory Efficiency and Effectiveness

The factor specialty group that considered this issue defined its intent as the effort to add certainty, consistency, clarity, and celerity to the permitting process while improving its integrity and effectiveness. The basis for analysis of this factor was the amount of area on the alternatives maps that was or was not filled. Areas not filled suggested that agreement could not be reached which reflected negatively on regulatory efficiency and effectiveness. The factor specialty group originally identified three factors that could be applied to evaluate whether the alternatives developed by the ADG addressed the issue category regulatory efficiency and effectiveness. These evaluation factors are listed below.

1. Permit review time and level of effort
2. Pre-identified impact/mitigation and preserve areas
3. FWS/GFC general concerns addressed

After applying these factors to several alternatives, the factor specialty group concluded that the means by which the factors were being measured did not discriminate among alternatives which was one of the main objectives of the evaluation activities. Thus, at the tenth meeting, the factor specialty group revisited the measures and created a series of measures that supported the three named factors. The first factor assesses the level of restrictions on an alternative land use legend. The second factor considered the degree of commonality between the alternatives as well as current regulatory processes. These two are in addition to the original measure that quantified the area of the alternative map that was filled in. For the third factor, measures were identified to reflect: potential need for section 7 coordination; potential that permit review will be slowed due to the sensitivity of natural resources within nonpreserve designations; effectiveness of the program to meet federal mandates and charges; and efficiency in the timelines and cost.

Economic Sustainability

The factor specialty group defined the purpose of this issue as the protection, enhancement, and expansion of the long-term economic viability of the region, including agricultural, commercial, construction, environmental, fisheries, industrial, residential, and recreational and tourism elements. Given these many purposes addressed by this issue category, the group had to develop a number of evaluation factors to adequately address these purposes.

The factor specialty group identified seven factors that were applied to evaluate whether the alternatives developed by the ADG address the purposes of economic sustainability. The seven evaluation factors are listed below.

1. Job creation
2. Home affordability
3. Cost of living
4. Property tax base
5. Cost to implement

6. Increased taxes
7. Environmental justice

The use of economic-based models and projections was discussed as an option to address several of these factors. However, given the time and data available, this was not a viable option. Although these models could not be applied at this time, they should be included in the Corps' conclusion of the EIS. Given that the factor specialty group did not apply these models, the group relied on their best professional judgment in the evaluation of alternatives utilizing the seven factors. The group scored the evaluation factor on a scale of one to four where one was worst and four was best in terms of economic sustainability. Since the comprehensive plan was created with economic sustainability as one of its primary objectives, it was considered the standard to compare all alternatives.

Local Land Use Policy

The factor specialty group that considered this issue wanted to ensure that alternatives recognized the local land use plans and regulations. To ensure this, the group evaluated each alternative's consistency with these plans and regulations. The Lee and Collier County Comprehensive Plans are the legally adopted local land use plans and establish regulations for unincorporated areas. Thus, all other alternatives are compared with these comprehensive plans making this a rather straightforward analysis.

The factor specialty group identified two factors that can be applied to evaluate whether the alternatives developed by the ADG address the issue category local land use policy. The two evaluation factors are (1) significance of conflicts with local land use plans and regulations and (2) hurricane preparedness (i.e., evacuation routes and shelter availability).

Avoidance of Wetland Impacts

The factor specialty group that considered this issue wanted to ensure that alternatives avoided to some degree impacts to wetlands. The group addressed both the acres of wetlands at risk as well as the functional importance of the wetland acres at risk by an alternative. The two evaluation factors identified by the group were (1) total acres at risk and (2) total wetland acres by functionality at risk by each alternative. Thus, this factor specialty group relied heavily on the outputs of GIS.

The basic premise behind the two factors is determining the number of wetland acres and functions at risk by an alternative. For instance, the acres at risk are the total wetland acres within a particular use type (i.e., agricultural, residential, and urban) multiplied by a risk factor. The factor specialty group relied on their best professional judgment to determine risk factors by land use type. Likewise, those acres at risk are identified as having high, medium, or low wetland function. Each level of function has a multiplier representing the relative level of function associated with the acres within that level of function.

Mitigation

The factor specialty group that considered this issue wanted to ensure appropriate mitigation for unavoidable wetland impacts. The group addressed both the acres of wetland mitigation opportunity as well as the functional importance of the wetland acres available for mitigation by an alternative. The two evaluation factors identified by the group were (1) total acres provided for mitigation opportunity and (2) total wetland functional improvement opportunity provided. These evaluation factors were dependent upon GIS outputs of acres of opportunity.

The basic premise behind the two factors is designating lands for potential mitigation (opportunity) versus the number of wetland acres and functions at risk by an alternative. For instance, the number of acres proposed for preservation versus the number of wetland acres at risk by a given alternative provides a useful measure by which to compare other alternatives. The concept of risk is discussed under the topic of avoidance of wetland impacts.

Likewise, the level of wetland function of the proposed preservation acreage is taken into account. The factor specialty group, relying on best professional judgment, assigned factors indicating the functionality of the potential mitigation acres. Wetland areas were identified as either high-, medium-, or low-functioning wetlands within various levels of opportunity of mitigation identified based on geographical context. This weighted index is then compared with the index of wetland functions at risk. The concept of risk is discussed under the topic of avoidance of wetland impacts.

Cumulative/Secondary Impacts

The factor specialty group first defined the terms cumulative and secondary impacts as they apply to the study area. Cumulative impacts are the impacts on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal and nonfederal) or person undertakes such other actions. Secondary impacts are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.

The factor specialty group developed ten factors by which to evaluate alternatives. These ten factors fall within two categories: (1) environmental and (2) social impacts. Below are the ten evaluation factors.

1. Impacts on infant mortality
2. Impacts on road needs
3. Impacts on air pollution loading
4. Impacts on water pollution loading
5. Impacts on crime rates
6. Impacts on hurricane vulnerability
7. EPA Index of watershed indicators

8. Impacts on wetlands only
9. Impacts on hydrology
10. Amount of lands in public and private ownership in protected status

To measure these factors, several models that could be driven by GIS were recommended. However, given the time and available data, in addition to GIS, the factor specialty group applied their best professional judgment to compare the alternatives for the study area by each of the ten factors.

Restoration/Retrofit

The factor specialty group defined restoration/retrofit as the act of mimicking natural functions and re-creating urban areas related to water management, water quality, and ecological systems, and to provide economic sustainability and quality of life by upgrading existing infrastructure to current standards. The factor specialty group recognized the benefit of a larger planning vision and investment in regional natural systems.

To address the items raised in the factor specialty group's definition of restoration/retrofit, the group identified five factors to evaluate the alternatives. The evaluation factors are listed below.

1. Natural functions maintained in natural systems (i.e., flowways)
2. Exotics control (percent and size of parcels treated and restored)
3. Percent of residents using self-supplied infrastructure (i.e., septic tanks)
4. Percent of agricultural land applying Best Management Practices (BMP)
5. Wildlife habitat restoration

Originally the group identified a factor that addressed quality of life. However, during the process of evaluation, it was concluded that this was an overall goal for the region and not a factor by which to evaluate alternatives. Given limited data, the factor specialty group applied professional judgment in the evaluation of alternatives using the five evaluation factors listed above. Using best professional judgment, the factors specialty group applied a scoring method of +, 0, - to signify whether each alternative addressed, did not address, or negatively addressed the evaluation factor, respectively. GIS outputs were utilized to aid the group in their determinations.

Public Lands Management/Use

The factor specialty group developed evaluation factors to ensure that the alternatives did not negatively impact the management and use of public lands. The two factors were (1) compatibility with land management plans and (2) degradation or improvement of resources on public lands. The compatibility of various on-site and adjacent land use was considered. The measure of whether an alternative negatively or positively impacted public lands was the land use type identified adjacent to the boundary of current public lands. Thus, an industrial park adjacent to public lands would be less compatible than agricultural activities. Also, the factor specialty group took into consideration indirect impacts of land uses not adjacent to public lands, such as activities upstream. The use of GIS was beneficial in allowing the factor specialty group to identify land use types and their extent of potential impact.

SUMMARY

The ADG identified twelve issue categories from nearly one hundred individual issues presented by the ADG members. These issues were important to consider in the development of alternatives. To ensure that the alternatives addressed these issues, the ADG developed evaluation factors by which to measure the extent to which alternatives addressed the issues, thus allowing the comparison of alternatives. The number of evaluation factors by issue category ranged from one to twelve. GIS maps and resulting tables played an important role in the graphical depiction and evaluation of the alternatives. Chapter IV presents the alternatives development process as well as the alternatives for the study area. Chapter V applies the evaluation factors to those alternatives.

IV. ALTERNATIVES DEVELOPED

The primary objective of the ADG was to create alternatives for the study area. These alternatives and the analysis of the alternatives are presented in the "alternatives" section of the Corps EIS. This section describes how the ADG proceeded in creating the alternatives. A map with a brief description of key features of each alternative is provided in Appendix C.

The ADG examined the study area in four subareas, or "zooms," as shown in Figure IV-1. The ADG first created alternatives for Zoom B, also referred to as the "hub." This term "hub" was brought into the process by the Corps to demonstrate the notion that this area, roughly the Estero Imperial Integrated Watershed boundary, was the central analytical focus of the EIS. This was not to suggest that the other portions of the study area would not be addressed by the ADG. The remaining areas were examined in the following sequence: C, D, and A.

An existing alternative for each of the four zooms was the respective county comprehensive plan(s). The comprehensive plans were provided to the ADG as the preferred alternatives by the participating county governments and Florida's Department of Community Affairs (DCA). The comprehensive plans were some of many alternatives evaluated by the ADG. The comprehensive plans were created using a planning process that received a great deal of input from the public on a wide range of issues. Thus, the future land use maps of comprehensive plans are accompanied by detailed documentation that supports certain features presented graphically.

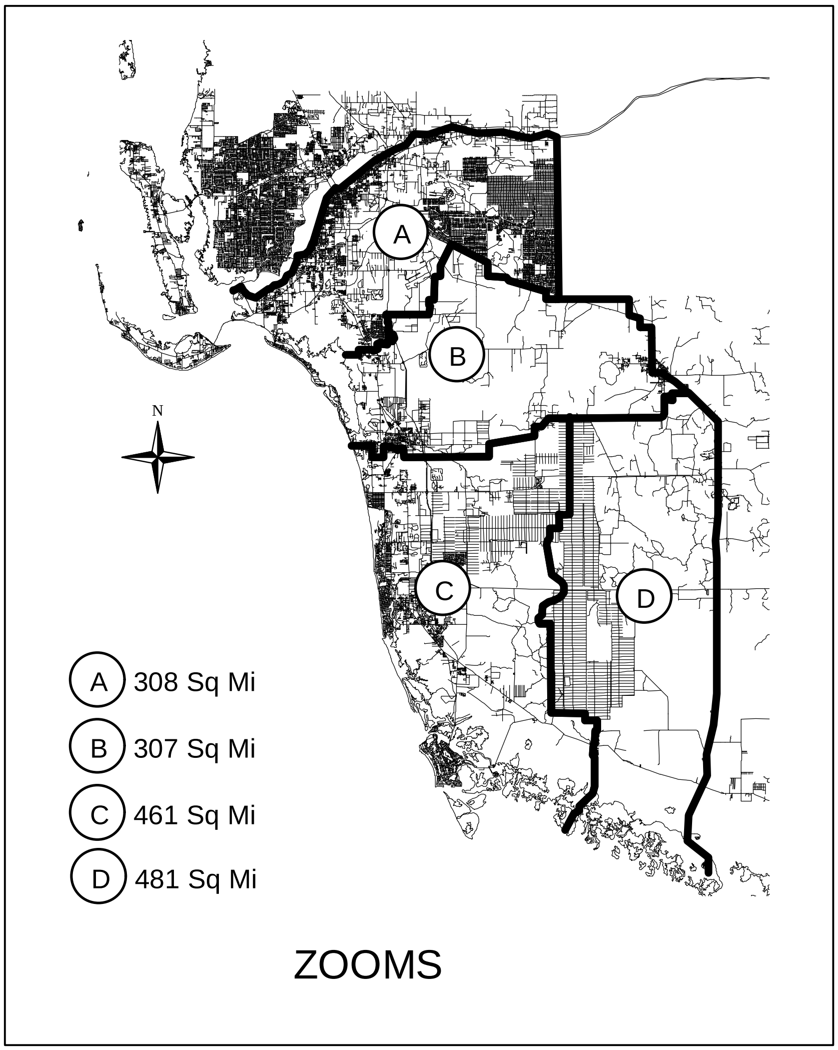


FIGURE IV-1

PROSPECTIVE ZOOMS

Additional alternatives for each zoom were created by dividing the ADG membership into four subgroups tasked with developing up to two alternatives for each area. The alternatives were to be created recognizing the range of issues described in Chapter III. The groups were formed randomly, with the objective of getting members representing a variety of interests in each subgroup. Likewise, the alternatives created by each subgroup would represent a range of interests. However, the way the process actually unfolded, some of the subgroups were dominated by particular interests, which resulted in alternatives that were more indicative of particular interests. In the end though, given the input of the different subgroups, the ADG had an adequate range of alternatives to evaluate for each zoom.

These alternatives were presented on maps where land use and hydrologic features and enhancements were shown. Many alternatives were supported with conditions and criteria that described land use designations. The alternatives were created by drawing features on maps, using different shading to represent selected aspects. Each alternative was presented to the ADG by the subgroup that authored the alternative. It should be noted that while appropriate for the level of analysis being conducted by the ADG, the resolution of some of the alternatives drawings varied in precision because of scale, tools used, and transfer of data to the GIS. The precise location of the lines drawn should be interpreted cautiously. Also, some existing land use features (e.g., existing rock mines) were not depicted on the maps.

Typically, descriptions of land features accompanied the alternatives maps. Early on, during the alternatives development phase of the process, many representatives of environmental interests collaborated on a set of permit conditions that was used to further elaborate standards and strategies deemed critical to the environmental perspective. Other sets of criteria were developed for certain areas such as Lehigh Acres and Golden Gate Estates. Both the land use configurations depicted on the alternative maps and associated narratives were considered in the evaluation of the alternatives. The evaluation of the alternatives is presented in Chapter V and Chapter VII.

V. EVALUATION OF ISSUES: THEMES AND DIRECTION

The ADG evaluated each of the alternatives developed for the four zooms in the study area. The factor specialty groups used the evaluation factors described in Chapter III to evaluate each alternative. The factor specialty groups placed the alternatives on a continuum from best to worst according to the factor they were considering. All twelve evaluation factors were presented to the entire ADG with the alternatives positioned on the continuum according the to deliberations of the factor specialty groups. Questions from the ADG on the evaluations presented were entertained and discussion, mainly in the form of clarification, was offered. This communicated the important aspects of each alternative in terms of the measures defined through the evaluation factors. The resultant continuums are shown in Appendix D by issue category.

As the results of these analyses were presented, certain themes based upon the trends in the analyses surfaced. These themes are central to what was being sought from the ADG in support of the EIS process. The resulting themes, organized by issue category, are presented in the remaining sections of this chapter.

PROPERTY RIGHTS

The comprehensive plans of Lee and Collier counties, while adding a layer of further restriction from the constitutional perspective, were viewed by the ADG's property rights advocates as acceptable, having been developed through an intensive participatory political process. The comprehensive plans have established landowner expectations of potential property values and land uses. Any alternative being more restrictive than the comprehensive plans was viewed as reducing property rights. The evaluation factors applied to the alternatives were (1) fair market value, (2) expectation of land use and value, and (3) vested rights.

At one end of the spectrum of property rights are the landowner's constitutional rights allowing the landowner to use his or her property as he or she chooses without harming others. But for the good of the community, government, using zoning and other means, has placed additional restrictions on property owners. The factor specialty group looked for alternatives that would minimize these types of restrictions.

The comprehensive plan is considered the standard by which all other alternatives must be compared. The comprehensive plan alternative, was generally regarded as the best alternative in terms of property rights. However, several alternatives were considered equal or better to the comprehensive plan by expanding the rights of the property owner. For instance, Alternative 4A of Zoom B showed a more realistic urban area designation for areas surrounding Immokalee than that estimated by the comprehensive plan. Those alternatives typically placed at the worst end of the continuum were those that presented restrictive criteria, expanded preservation areas, and decreased urban and agricultural areas. For example, Alternative 5 for Zoom A included detailed criteria and was considered over restrictive within the property rights category. Thus, the more restrictive the criteria the less appealing in terms of property rights.

WATER MANAGEMENT

The factor specialty group applied seven evaluation factors addressing flooding, flowways, and water storage. Several presentations were made to the ADG concerning water management issues in the study area. One such study was the South Lee County Watershed Plan coordinated by the South Florida Water Management District (SFWMD). This plan presented several proposed alternatives with respect to water management. Likewise, the Big Cypress Basin Watershed Study that addressed many of the same issues was conducted in Collier County. Also, the Estero Bay Agency on Bay Management (ABM) presented an alternative restoring and preserving the connectivity of habitats and flowways.

The concepts of these studies were included in a number of alternatives. Also, one member of the ADG presented a flowway concept that was referred to in many alternatives. This flowway concept emphasized recognition and preservation of historic flow patterns and isolated wetlands. The best alternatives typically provided flowway restoration and maintenance concepts. Alternative 4B for Zoom B raised much discussion during several meetings. This alternative applied South Lee County Watershed Study’s berm alternative. Although the berm was controversial, it was part of a proposed water management alternative.

WATER QUALITY

The factor specialty group applied four evaluation factors: (1) pollution loading, (2) freshwater pulses, (3) habitat loss, and (4) groundwater impacts. Several presentations were made to the ADG addressing water quality issues in the study area. All presenters stated that water quality is expected to continually decline in the study area. Water quality indicators such as vegetation and other marine life attest to decline that has already occurred. Freshwater pulses have impacts on certain fisheries. Heavy metals and other nutrient loadings impact marine habitats. Impervious surfaces such as parking lots impact groundwater recharge and pollution loading.

Land use was the basis for evaluating impacts to water quality. Alternatives that allowed more development were not favorable to water quality. Thus, the comprehensive plan was typically the worst alternative in terms of water quality impacts. Other alternatives proposed ways to decrease the duration and volume of freshwater pulses. Many alternatives suggested improving and maintaining isolated wetlands and the connectivity of habitats and flowways, all of which were perceived to improve water quality.

ECOSYSTEM FUNCTION, WILDLIFE HABITAT, AND LISTED SPECIES

The factor specialty group relied heavily on GIS outputs in their evaluation of alternatives. Many resource agencies such as the Florida Game and Freshwater Fish Commission (GFC), U.S. Fish and Wildlife Service (FWS), and the U.S. Environmental Protection Agency had data and maps that were applied to the alternatives. The use of GIS provided the group a relatively clear picture of the quantitative and spatial impacts of alternatives and allowed the group to use their best professional judgment to determine the qualitative impacts. The factor specialty group evaluated alternatives on such things as impacts to panther habitat, listed species, rookeries, seasonal wetlands, and native plant communities.

Natural resource agencies have collected data, conducted field surveys, written many plans, and drawn many maps. Examples of resource information utilized by the factor specialty group included the Closing the GAPs in Florida's Wildlife Habitat Conservation System (GFC), the Draft Multi-species Recovery Plan for South Florida (vol. 1) (FWS), the Florida Panther Habitat Preservation Plan (Florida Panther Interagency Committee), the Estero Bay Agency on Bay Management's Conservation Lands Map, and National Wetland Inventory Maps (FWS). All data and information were available and able to be compiled into maps that were GIS applicable. The outputs of the GIS were a foundation for the evaluations of this factor specialty group. However, the factor specialty group did not make decisions on numbers alone. Many of the alternatives and their respective land use types had criteria and standards associated with them. These criteria influenced the evaluations of this group. For example, criteria that called for non-intensification of agricultural activities was viewed as favorable to wildlife. This strategy was used to allow for continued agricultural activity while addressing wildlife concerns. An example of this type of criteria was found in Alternative 2B for Zoom B.

Alternatives that increased habitat preservation, addressed restoration of habitat areas, or considered criteria for existing land uses that would improve habitat were ranked high by the group. Alternatives that did not address these items were ranked low for ecosystem function, wildlife habitat, and listed species. Also, alternatives that expanded urban areas and did not propose habitat protection criteria on agricultural and residential areas east of Interstate 75 were ranked low in terms of this issue. Thus, the comprehensive plan was typically viewed as least favorable for this factor.

REGULATORY EFFICIENCY AND EFFECTIVENESS

The factor specialty group initially found the evaluation of this issue to be complex in terms of being able to evaluate alternatives. However, the ADG pressed forward, recognizing that regulatory efficiency and effectiveness are central and essential to the regulatory review and permitting process. This prompted the factor specialty group to offer some level of comparative analysis. The two evaluation factors applied by the factor specialty group were (1) permit review time and level of effort and (2) preidentified impacts. The factor specialty group anticipated that the alternatives maps would reflect areas of regulatory difficulty by locations of contention not being identified by any particular land use. This was not the case. All alternatives had all locations identified with some land use type as well as associated criteria. Thus, the methodology by which the factor specialty group had hoped to measure permit review time and level of effort was unable to distinguish among alternatives.

At the tenth meeting, the factor specialty group with the assistance of additional ADG members went to the drawing board to identify new means by which to more appropriately measure the issue of regulatory efficiency and effectiveness. Since the new measures were defined at the tenth meeting, the group applied a subset of these measures for which tabular information was available. The new approach was applied to Zoom B of the study area. An alternative that was considered the best in terms of regulatory efficiency and effectiveness for Zoom B placed the fewest acres of wetlands and panther habitat at risk.

ECONOMIC SUSTAINABILITY

The factor specialty group considered the comprehensive plan the standard to compare all alternatives. The seven factors applied to evaluate the alternatives were (1) job creation, (2) home affordability, (3) cost of living, (4) property tax base, (5) cost to implement, (6) increased taxes, and (7) environmental justice.

Several economic growth models were suggested for use in the evaluation of alternatives. However, data were not readily available for the development and use of such models. The composition of the factor specialty group allowed them to apply their best professional judgment in the evaluation of alternatives. Similar to the issue of property rights, the county comprehensive plans established some expectation of economic growth. The comprehensive plans and those alternatives that expanded upon the comprehensive plans growth potential were viewed as the most favorable for economic sustainability.

Alternatives that constrained the intent of the comprehensive plans were regarded as poor for economic sustainability. For instance, the criterion of nonintensification of agricultural activities was viewed as constraining job creation. The factor specialty group provided the ADG an example. The farming of row crops requires seasonal labor during the fall, winter, and spring but not in the summer. Whereas, citrus farming requires yearround labor. Thus, conversion to citrus would provide yearround employment rather than seasonal employment. Restricting the location of homes also constrains the potential number of homes that could be built, ultimately decreasing the ability to afford a home. A general theme of the evaluations is the more criteria and standards the less favorable for economic sustainability.

LOCAL LAND USE POLICY

The factor specialty group addressing the issue category of local land use policy evaluated the alternatives developed for zooms A, B, C, and D of the study area. The factor specialty group considered the comprehensive plan the standard by which all other alternatives are evaluated as noted in the evaluation factors. The factors applied in the evaluation of alternatives were (1) significance of conflicts with the local land use plans and regulations and (2) hurricane preparedness evacuation routes. The comprehensive plan is the local land use policy, thus, it is typically the best alternative. Alternatives with more restrictive land use criteria ranked lower than the comprehensive plan. Hurricane preparedness was discussed and brief presentations were made on this topic. This continues to be an important issue in southwest Florida, which has a deficit of shelters and long evacuation times. The alternatives offered typically did not present a great deal of variability with respect to hurricane preparedness. For instance, all the alternatives developed for Zoom B of the study area were all viewed to be equal in terms of addressing hurricane preparedness. None of them proposed any significant strategies for improving hurricane preparedness.

AVOIDANCE OF WETLAND IMPACTS

The factor specialty group applied two factors in the evaluation of alternatives for the study area: (1) total acres at risk from impact and (2) total acres at risk weighted by function. The factor specialty group relied on GIS maps and tables of the alternatives to determine the acres at risk. Those alternatives placing the least number of acres of highly functional wetlands at risk are favorable.

Using best professional judgment, the factor specialty group categorized wetlands by perceived functionality into the categories of high-, medium-, and low-functioning wetlands. Also, the group established risk factors based on land use types (i.e., agricultural, residential, and urban). Risk factors were typically higher for urban and residential land uses. Thus, alternatives proposing the greatest number of urban and residential land use acres were typically considered the worst in terms of avoiding wetland impacts. Alternative 5 for Zoom A was an example of an alternative with favorable characteristics relating to this factor. This alternative used both land use features and criteria to put relatively few high-functioning acres at risk. Typically, the comprehensive plans were among the alternatives that placed the most wetland acres as well as function at risk.

MITIGATION

The factor specialty group applied two factors in the evaluation of alternatives for the study area: (1) total acres of opportunity and (2) total acres of opportunity by level of wetland functionality. The factor specialty group relied on GIS overlays of the alternatives and wetlands to determine the acres at risk and the functionality of those wetland acres at risk. The wetland acres at risk were then compared with the acres of opportunity for mitigation (proposed preservation acres). Also, the functionality of the wetland acres at risk was compared with the functionality of the wetland acres being proposed for preservation.

Those alternatives placing less acres of highly functional wetlands at risk are favorable. This is addressed specifically by the issue category of avoidance of wetland impacts. However, the values derived in the calculations for avoidance of wetland impacts are utilized in the calculations performed for mitigation. Mitigation is somewhat reliant upon the issue of avoidance of wetland impacts. Also, those alternatives that provide for greater acres of wetland mitigation to offset those impacted were favored by the factor specialty group. The functionality of those mitigation acres was also very important. The comprehensive plans in certain zooms were among the alternatives that placed the most wetland acres at risk and proposed the least amount of acres for mitigation opportunities.

CUMULATIVE/SECONDARY IMPACTS

The factor specialty group applied ten factors in the evaluation of alternatives for the study area. The ten evaluation factors addressed both social and environmental impacts. Social impacts included (1) infant mortality, (2) road needs, (3) crime rate, and (4) hurricane vulnerability. Environmental impacts included (1) air pollution, (2) water pollution, (3) watershed, (4) wetlands, (5) hydrology, and (6) amount of lands in protected status.

As the dominant land use type shifts from preservation to agriculture to residential to urban, infant mortality typically rises. Likewise, the crime rate increases but the nature of the crimes between rural and urban areas is different. Increased development requires more infrastructure. The increased development, depending on the location, may increase vulnerability of citizens to hurricane-related damages.

Similarly, increased development depending on how and where it occurs may have negative environmental impacts. One of the main reasons the Corps initiated the ADG was to address cumulative environmental impacts in southwest Florida. For instance, the permits of singular projects may have merit on their own, but as they accumulate, the result is cumulative and secondary impacts. This issue reflects the cumulative impacts realized by several other issue categories such as water quality, water management, and avoidance of wetland impacts. The comprehensive plan was generally associated with more negative cumulative and secondary impacts than the other alternatives for the majority of the study area.

RESTORATION/RETROFIT

The factor specialty group applied five factors in the evaluation of alternatives for the study area. These factors addressed the natural system of southwest Florida by restoring natural functions, through removing exotics, decreasing septic tanks, increasing the use of best management practices, and restoring wildlife habitat and historic flowways.

These concepts of restoration/retrofit were addressed throughout the study area. Many of the alternatives discussed restoring flowways, wetlands, and the connectivity of habitats. The greatest debates and ingenuity of the restoration/retrofit concepts were related to Lehigh Acres and Golden Gate Estates. Alternatives 1, 3A, and 5 of Zoom A proposed strategies of restoration for Lehigh Acres, such as the Three R's (restoration, retrofit, and redevelopment) and ARF (acquire, restore, and fix), respectively. Alternative 2A of Zoom D proposed that east Golden Gate Estates be used for mitigation to help restore flowways and wildlife habitat. Landowners would be able to build rural residences in west Golden Gate Estates while utilizing east Golden Gate Estates for mitigation and restoration purposes. These alternatives received the favor of the factor specialty group.

PUBLIC LANDS MANAGEMENT/USE

The factor specialty group applied one composite factor in the evaluation of alternatives for the study area. This factor evaluated each alternative's compatibility with public land management plans, compatability of adjacent land use with public land management plans, and whether the alternative improved or degraded the resources and public use on public lands.

The factor specialty group determined whether an alternative improved or degraded public lands by viewing the land use type adjacent to the boundary of current public lands. For instance, a residential area adjacent to public lands that need to be managed with prescribed burning would be less compatible than adjacent agricultural activities. The idea is that some land use types buffer public lands better than others. For example, public lands near Belle Meade and CREW Trust were viewed as relatively well protected by Alternatives 1A and 2 in Zoom C because they showed the least amount of development adjacent to these lands. Likewise, the factor specialty group took into consideration indirect impacts of land uses not adjacent to public lands, such as agricultural activities upstream. Criteria associated with land use types (e.g., agriculture) were considered important attributes to differentiate alternatives in considering both direct and indirect impacts. The use of GIS was beneficial in allowing the factor specialty group to identify land use types and their extent of potential impact.

VI. CONCLUDING REMARKS

The ADG, through a series of eleven two-day meetings, has addressed the charge set forth by the Corps to support the creation of an EIS for southwest Florida. Specifically, the ADG was tasked with developing a series of alternatives that accommodate the range of environmental and socioeconomic interests in the region. In addition, the ADG developed a series of evaluation tools that embody the critical issues being faced in southwest Florida. These tools were used by the factor specialty groups to evaluate and rank the proposed alternatives. The alternatives and evaluation tools should be used to serve the appropriate section of the EIS. Thus, the ADG successfully completed its charge.

The ADG was successful in developing and evaluating alternatives. Given the evaluation tools created and the dialogue offered, it appears that a smaller set of alternatives is within reach. This smaller set of alternatives will be developed by the Corps and made part of the EIS. After public comment on the draft EIS, the ADG will reconvene to assist the Corps in responding to public comments on the alternatives.

The accomplishments of the ADG go beyond contribution to the standard EIS process. The activity of communicating the various perspectives and issues of a very environmentally complex region is an important by-product of the ADG. It is essential as southwest Florida continues to grow that it be done in a way that environment and economy are mutually supported and sustained. This can most readily be accomplished if collaborative examination of the issues, in a systemic way, continues to be conducted in the future.

VII. INTERPRETATION OF RESULTS

The ADG was tasked with fully exploring and evaluating a series of alternatives for southwest Florida. The ADG was not directly tasked with identifying a consensus-based, preferred alternative. While the spirit of consensus and seeking agreement was certainly apparent at the ADG meetings, the time frame for this process did not allow for the delivery of one fully defined alternative that the Corps could use in the EIS. Some argued that coming to a single consensus alternative would nearly be impossible. Others within the ADG thought that it might be possible, suggesting that the twenty-eight alternatives could at least be reduced in number through compromise and negotiation.

Thus, the interpretation of analysis and results does not lead to a single alternative. However, as the alternatives are reviewed in aggregate, selected inferences can be made from the ADG's deliberations. This chapter provides selected observations that define overall trends in terms of specific alternatives. These observations are further processed to offer concluding remarks about how the ADG's results may be used to solidify permit improvements. **The analyses, methodology, and conclusions presented in this chapter are authored solely by the facilitation team and the Corps**. Based on the ADG's products, this chapter presents one interpretation of the synthesis of alternatives and analysis provided by the ADG.

EXAMINATION OF ALTERNATIVES: AREAS OF AGREEMENT

A significant amount of work went into the development of alternatives. The intent of the ADG was not to necessarily bring out "the best" alternative or identify a consensus alternative. However, as the alternatives were offered, it was very clear that the alternatives were in agreement for a majority of the study area. That is, all four subgroups designated that land for the same purposes/strategy to support their vision for southwest Florida. In total, approximately 67 percent of the study area analyzed by the ADG was characterized by full agreement at the general level of land use. However, there were many areas for which ADG members had varying ideas. The value of the work from the ADG is where there is disagreement; the Corps has a very good understanding of the nature of disagreement.

To get to these general statements of inference, a fair amount of analysis of the alternatives was required. The following sections describe this analysis leading to a graphical portrayal of the areas of agreement and disagreement. A synopsis of each alternative is presented in Appendix C.

Description of Alternative Families and Subfamilies

The ADG prepared twenty-eight alternatives. A list of all the legends finds a total of 137 names. This is too large a number to begin comparing and contrasting the alternatives. Further study shows 59 unique names. For example, one unique name is “Urban and Industrial” that was used by ten alternatives as-is without any additional remarks. However, two other alternatives used this designation but with the additional proposal for flowway improvements. So this would be a second unique name. On the other hand, the name “Rural Residential” in Zoom A in Lee County and “Rural Residential” applied to Golden Gate Estates in Collier County do not imply the same review and permitting standards.

The Corps developed two indices to cross-reference each of the legends to a uniform set of names. This retains the original legends as written by the members of the ADG and also provides for a systematic analysis. The first index is referred to as Families. Each of the 137 legends are cross-referenced to one of eight Families.

The second index is referred to as Subfamilies. Each of the 137 legend names are cross-referenced to one of thirty-eight Subfamilies. Although this is a large number of Subfamilies, in many cases there does not appear to be a major difference between Subfamilies within their parent Family. A complete list of Families, Subfamilies, and respective legends are provided in Appendix E.

Development (100)

Family 100 is called Development. Legend names that are cross-referenced to 100 are Development, Urban and Industrial, Urban, Airport, Urban Land Uses, Transition, Industrial, and Rural Residential (for Zoom A).

Within the Development (100) Family are six Subfamilies: 110 is indexed to those names that added no additional modifiers; 120 is indexed to legends that proposed flowway improvements; 130 indexed to the Zoom B (hub) Alternative 2A legend proposing off-site compensation for wide-ranging species; 140 to the proposal for regional/comprehensive stormwater management; 150 to the Zoom C Alternative 1B proposal to replumb Henderson Canal and for culverts under Tamiami Trail; 160 to the criteria found in Attachment S of meeting 8 for the urban area. Three of these directly speak to flowway improvements and could be combined.

Lehigh Acres (200)

Family 200 is called Lehigh Acres. Legend names that are cross-referenced to 200 are Urban Zone (Lehigh Acres); Restoration, Retrofit, Redevelopment; Acquire, Restore, Fix; Redevelopment; Lehigh Acres Zone; Lehigh Acres Greenway; and Water Storage. The 200

Family was created distinct from the 100 Family to highlight the level of discussion given this area by the ADG.

Within the Lehigh Acres (200) Family are seven Subfamilies: 210 is indexed to the "Urban (Lehigh Acres)" name that had no additional modifiers; 220 is unassigned; 230 through 270 are indexed to the various names by which several Zoom A alternatives proposed various ideas for redevelopment and restoration within Lehigh Acres.

Golden Gate (300)

Family 300 is called Golden Gate. Legend names that are cross-referenced to 300 are Golden Gate Estates, Golden Gate Estates Zone 1, Golden Gate Estates Zone 2, Estates (Rural Residential), and Rural Residential (from Zooms C and D). This Family was created to highlight the unique characteristics of this area. In Zoom C, Alternatives 1A, 1B, 2, 3A, and 3B used the various Golden Gate names for the same area named in Alternative 1 as "Rural Residential." Alternative 1 used the name "Rural Residential" over a portion of this footprint and "Urban" over the rest. In Zoom D, Alternatives 2A and 2B used Golden Gate names for the same area named "Rural Residential" in Alternatives 1 and 4. Alternatives 1A and 3 used Golden Gate names over a portion of this footprint and "Preservation Lands" over the rest.

Within the Golden Gate (300) Family are five Subfamilies: 310 is indexed to the names that had no additional modifiers; 320 is unassigned; 330 through 360 are indexed to the various names by which several alternatives in Zooms C and D proposed various criteria to be applied to projects within Golden Gate Estates.

Agriculture (400)

Family 400 is called Agriculture. Legend names that are cross-referenced to 400 are Agriculture, Agricultural Preserve, Agriculture (Limited Intensification), Agriculture - Maintain Intensity; Agriculture - go to preserve, Agriculture (BCACSC), Mining, and Mining Lands. Only three alternatives actually designated mining. Some of the other alternatives indicated in their remarks that mining was an authorized land use within their agricultural designation.

Within the Agricultural (400) Family are Seven Subfamilies: 410 is indexed to the names that had no additional modifiers; 420 is indexed to names designating areas for mining; 430 is indexed to the names proposing nonintensification of agriculture, while 440 is indexed to those names proposing limited intensification; 450 is indexed to the Zoom D Alternative 2B proposal to remove the exemption from the Big Cypress Area of Critical State Concern; 460 is indexed to the proposal that if agricultural activity ends, the land reverts to preservation; 470 is indexed to the criteria found in Attachment S of meeting 8 for agriculture. Three of these directly speak to degrees of intensification and could be combined.

Rural (500)

Family 500 is called Rural. Legend names that are cross-referenced to 500 are Rural, Rural Development, and Rural Cluster (Agriculture). These legends could almost be placed in the Agriculture (500) Family. In Zoom B (hub), Alternative 2A assigns two names, “Rural” and “Agriculture,” to approximately the same lands assigned a single “Agricultural” name in Alternatives 1, 1A, 3B, and 4A. Note the use of the word “approximately” as these alternatives include subareas designated with various mining and urban names. In Zoom C, Alternatives 1A, 1B, and 2 assign “Rural” and “Agricultural” names to approximately the same area as the single “Agriculture” in Alternative 1. Alternative 3B names “Rural Cluster” and does not have a separate agriculture name. Alternative 3A does not use the term rural. Alternatives 1 and 4 apply “Rural Residential” to the Golden Gate Estates proper. In Zoom D, Alternatives 2A and 2B assign “Rural” and “Agricultural” names to approximately the same area as the single “Agriculture” of Alternative 1. Alternatives 1A and 3 do not use the term “Rural.” Alternatives 1 and 4 apply “Rural Residential” to the Golden Gate Estates proper. However, in Zoom A, all the alternatives clearly name approximately similar areas using various “Rural” names. The impression is that most of the rural names reflect a view of a mixture of existing ranchette, nursery, and similar uses in a fabric of natural vegetative cover. Therefore, the Rural Family was created in the interest of capturing the alternatives in Zoom A but with the recognition of the overlap with the Agriculture (400) Family in the other zooms.

Within the Rural (500) Family are Seven Subfamilies: 510 is indexed to the “Rural Residential” or “Rural Development” names in Zoom A that had no additional modifiers; 520 through 560 are indexed to the various names by which several alternatives proposed various ideas for rural development criteria, including clustering and provision for maintenance of historic flowways. In addition, a detailed draft for clustering criteria was presented and found in Attachment E of meeting 9.

Preserve (600)

Family 600 is called Preserve. Legend names that are cross-referenced to 600 are Preservation Lands, Preserve (Existing and Proposed), Preservation/Conservation, Preservation, and Conservation Lands.

Within the Preserve (600) Family are five Subfamilies: 610 is indexed to those names that had no additional modifiers; 620 is indexed to those names that proposed improvement of flowways; 630 is indexed to the name “Preserve (Existing and Proposed)” of Alternatives 2A and 3B of Zoom B (hub) that noted their delineation was based on the Land Conservation/Preservation Strategy Map adopted July 13, 1998, by the Estero Bay Agency on Bay Management; 640 is indexed to the criteria found in Attachment S of meeting 8 for preserves.

Permit Standards (700)

Family 700 is called Permit Standards. Legend names that are cross-referenced to 700 are Critical Resource Protection Area, Preservation Zone, Buffer Transitional Zone, Agricultural Zone, and Urban Zone (two names, one in Zoom A and one in Zoom B (hub)). These are proposed criteria and standards to be used in permit review. In Alternative 4B of Zoom B (hub), these criteria were described as an overlay on the underlying designations: in other words, the “Agricultural” designation of Alternative 4A is used, but in addition the criteria for “Critical Resource Protection Area (CRPA)” would be applied. In Alternative 4B, CRPA overlaps areas designated as “Agricultural,” “Preservation Lands,” and a sprinkling of others. In Zoom A, Alternative 5 subdivides the criteria between agricultural and preservation and other uses, but there remains the fundamental premise that these criteria are focused on the permitting process. This separate Family has been created to capture the unique thoughts presented by these alternatives and how they were evaluated. However, note that Zoom C’s Alternative 2 and Zoom D’s Alternatives 1A, 2A, 2B and 3 included in their definition of “Golden Gate Estates Zone 2” the criteria for the Buffer Transition Zone. These were cross-referenced to the Golden Gate (300) Family, since these were mixed with other criteria clearly identified with Golden Gate.

Within the Permit Standards (700) Family are six Subfamilies: 710 is unassigned; 720, 730, and 740 are assigned to the criteria proposed by Alternatives 2C, 3A, and 4B in Zoom B (hub) and are found in Attachment E of meeting 7; 750, 760, and 770 are assigned to various criteria proposed by Alternative 5 in Zoom A and are found in Attachment W of meeting 9.

Nonagreement (800)

Family 800 is called nonagreement. Legend names that are cross-referenced to 800 are Pending Review and Berm. Alternative 4A of Zoom B (hub) and 3A of Zoom C both identified areas where the groups preparing the alternatives could not agree whether to designate the location as development or preservation. Alternative 4B of Zoom B (hub) identified a Berm that the group could not agree to add to Alternative 4A. This Family was to capture these three circumstances that did not fall cleanly into any of the other alternatives.

Within the Non Agreement (800) Family are two Subfamilies: 810 is unassigned; 820 is indexed to the Berm proposed by Alternative 4B of Zoom B (hub); 830 is indexed to the name “Pending Review” where the group developing the alternative could not agree.

Agreement Map Structure

These Family and Subfamily indices were then added to the geographic information system (GIS) maps of the alternatives. The alternatives were then stacked on top of each other using the GIS software.

The steps of the GIS process were (1) dividing each alternative's map into a grid of squares measuring approximately 90 feet wide; (2) transferring the index value from the map into the grid cell; (3) comparing the Family and Subfamily indices found in the grid cells at the same geographic location for each of the alternatives; (4) creating two maps showing the number of different Family and Subfamily, respectfully, index values at a grid cell location; (5) checking the "slivers" of cell locations where the mapping of alternatives did not exactly line up and adjusting the maps accordingly; and (6) producing a final map.

The resulting map, "Overlay of Alternatives," shows for a large portion of the study area that the alternatives assigned the same Families. The various crosshatching shows the Family designation in those areas where the alternatives assigned the same Family. This overlay did not include the Permit Standards (700) nor the Non Agreement (800) Families.

The solid gray shows areas where there were two different Families assigned by the alternatives. For example, if four alternatives assigned Preserve (600) Family and the fifth assigned Agriculture (400), then there were two different Families and the area would be shaded gray. Typically, the two Families within the gray area can be determined by looking at the Families indexed adjacent to the gray. For example, a gray area found sandwiched between an area designated as "Preserve" and another as "Agricultural" is typically reflecting that some alternatives assigned the Preserve Family and the others the Agriculture Family.

The white areas, unshaded and not crosshatched, are those with more than two families. These areas of disagreement are a very small proportion of the total area.

The number of Subfamilies is strongly correlated to the zoom. For example, whenever all of the alternatives indexed the Development (100) Family within Zooms C and D they also agreed on the Subfamily. In Zoom B (hub), there were two Subfamilies, and in Zoom C, three Subfamilies. There are six Subfamilies in the Development (100) Subfamily. The number of Subfamilies is probably a combination of the (1) characteristics of each zoom and (2) the creativity of the group when the alternatives were developed.

IMPLICATIONS FOR PERMIT STRATEGIES

The agreement map shown in Figure VII-1 provides a basis for subsequent analysis and application to the permit program. The following are some examples picked out from the large mass of information represented by this map.

Within Zoom D, there was agreement to designate the center of Camp Keais Strand as "Preserve." However, there was a difference in how wide the Preserve should be. One alternative delineated as Preserve only those areas that are covered with natural vegetation. The adjoining farmlands were designated "Agriculture." Other alternatives included in their delineation of Preserve some of these adjoining farm fields. The farm fields that are delineated as Preserve in one alternative and Agricultural in the others are colored gray on the map. The next

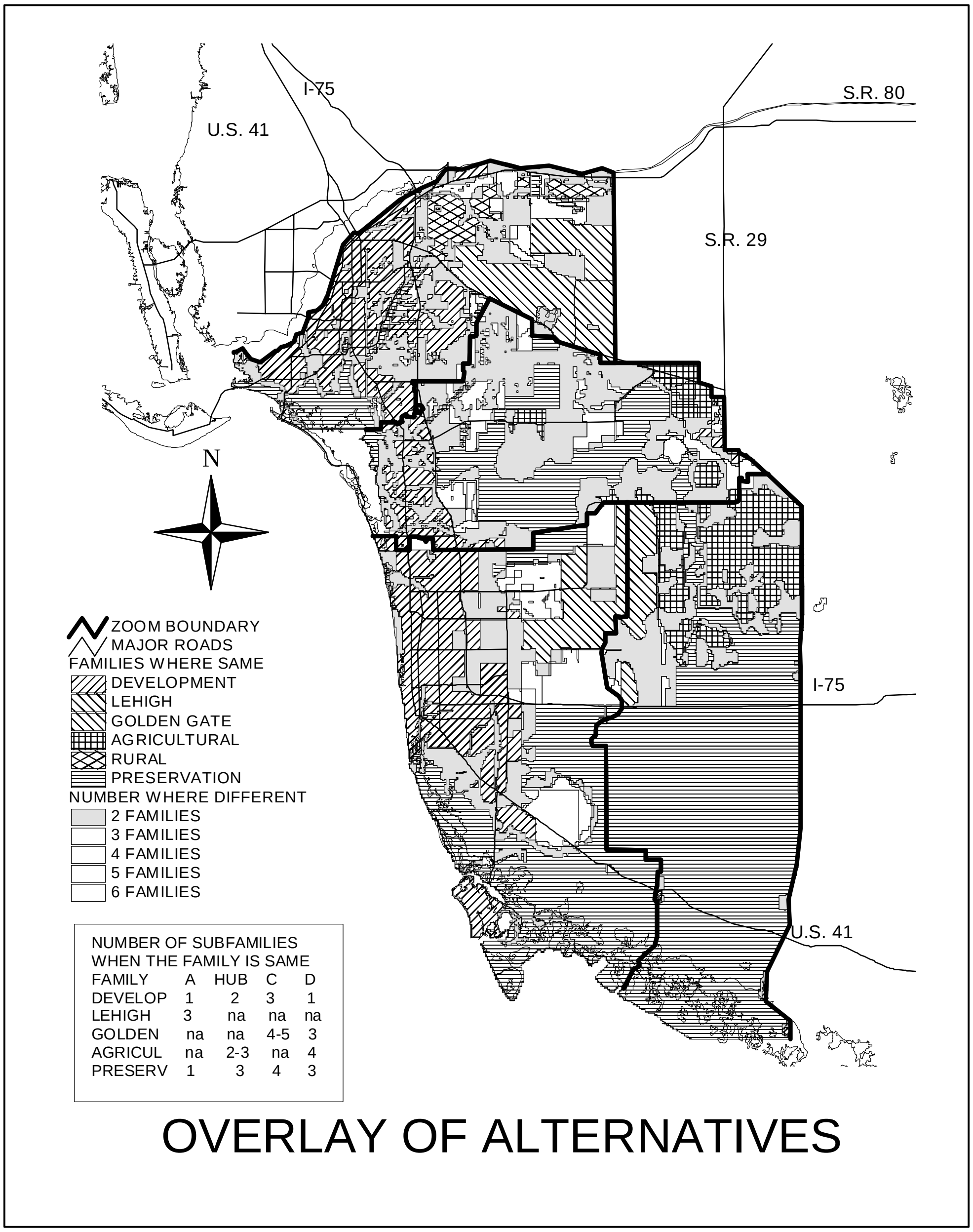


FIGURE VII-1

task would be to study the evaluations of the one alternative and compare it with the evaluations of the other alternatives to understand the ramifications of choosing one width over the other.

Potential Permit Implications: Zoom D

Within Zoom D, all of the alternatives delineated Southern Golden Gate Estates as Preserve. For Northern Golden Gate Estates, the alternatives did not agree for the portion of the Estates adjacent to I-75. Two alternatives delineated that portion as Preserve to show the historic assemblage and interconnection of the wetlands. The other three alternatives delineated continued residential development. This area is shown in gray. However, one of the three alternatives included criteria to preserve these wetlands but did not explicitly map them. For the remainder of Northern Golden Gate Estates, all the alternatives agreed to residential development. The area of agreement is crosshatched on the map as Golden Gate. Three of these alternatives proposed additional criteria for project review. The next task would be to compare the evaluations of those alternatives proposing preservation with the evaluations of the other alternatives to understand the benefits and impacts of adopting one or a combination of the preservation proposals.

Potential Permit Implications: Zoom C

Three patches of white are mapped within Zoom C. These are areas where the alternatives did not agree. One location of disagreement is on Immokalee Road; one is in Belle Meade; and the third is off of I-75. All three areas are just outside (east of) the urban boundary. Within all three areas, alternatives delineated a wide variety of project types. For example, in the Immokalee area: one alternative delineated part of the area as Agriculture and part as Urban; three alternatives delineated part Rural with varying amounts of Preserve and Urban; one alternative delineated a part of the area as Transition and the rest either Urban or Mining; and the group that prepared one alternative could not agree whether to delineate it as Development or Preserve. All three of these white areas are expected to be the locations of future development, yet there is no agreement that development is appropriate. One can anticipate contentious permit reviews in these areas.

Within Zoom C, an area along Tamiami Trail south of Naples is shaded gray. South of the gray area (along the coast), all of the alternatives agreed on Preservation. North of the gray area all of the alternatives agreed on Development. The alternatives delineated various proportions of the gray area as Preserve and Development. This indicates the appropriate boundary between the Preserve and Development is unclear. A study of the evaluations may provide insight into the ramifications of the different boundaries.

Potential Permit Implications: Zoom B (Hub)

Within Zoom B (hub), the majority of the area west of I-75 is delineated Development. The streaks of gray through the Development crosshatching follow existing waterways. Two alternatives delineated these areas simply as Development. Four alternatives proposed various widths and extents of flowways through developed areas and delineated them as Preserves. Three other alternatives proposed permitting criteria that would require these flowways with development. None of the groups attempted to draw exact boundaries between the flowways and development. A comparison of the evaluations between the Alternatives may validate the concept with the details to be addressed during individual project review.

Within Zoom B (hub), all of the alternatives agreed on delineating an area centered on the Corkscrew Swamp as Preserve. However, the lands surrounding that Preserve are shaded gray. One alternative delineates this gray area as Agriculture. One delineates a portion as Agricultural and the rest as mining. Two alternatives delineate a part as Agriculture and the rest as Preserve or Mining. Two delineate part as Preserve and the rest as Rural or Agriculture with a limitation on the intensification of current activity. Three alternatives overlay permit criteria that preclude expansion into existing natural areas. Essentially, each Alternative selects one of three approaches: current Agricultural and other uses; explicitly map an expansion of the Corkscrew Preserve; or impose constraints on project activity to maintain the existing natural areas.

Potential Permit Implications: Zoom A

Within Zoom A, all of the alternatives gave special attention to Lehigh Acres. All but one of the alternatives described a variety of ideas for redevelopment. This presents an opportunity to discuss these ideas now before their implementation is precluded as houses are built.

Within Zoom A, several gray areas are shown around the perimeter of Lehigh Acres. In each gray area, the alternatives delineated two types of projects. The combination of which two varied: for two patches the difference is between Development and Preservation and in the others between Development and Rural. The Development includes not only the "Urban" legend but also the various ideas for redevelopment. The differences reflect three broad categories of ideas for the fringe around Lehigh Acres: establish Preserves surrounding the remaining natural areas at the headwaters of various waterways; limit to Rural; or develop as Urban.

Permit Generalizations

In conclusion, three generalizations can be made.

Within the crosshatched areas, there is fundamental agreement on the appropriate type of future projects but variations in the criteria to be applied to their review. The next step should be to review what the evaluations reported for the range of criteria. This will improve the understanding of which criterion or combination of criteria could be incorporated into review processes to increase permitting efficiency.

Within the shaded areas, there is disagreement on the appropriate type of future projects, but generally the disagreement is where to locate the geographic boundary between the two types. The next step should be to review the evaluations that bracket the range of disagreement. This will improve the understanding of which issues are most affected by permitting decisions that cumulatively will establish this boundary.

Within the white areas, the disagreement indicates that any individual project review will be very challenging. These evaluations would provide a starting point if an opportunity arises to open discussions prior to formal project review.

APPENDIX A

ADG MEMBERS, ALTERNATES, AND SUPPORT TEAM

LIST OF MEMBERS ALTERNATIVES DEVELOPMENT GROUP	
NAME	**AFFILIATION**
Baker, Bob	Council of Civic Associations
Barber, Rick	Lee and Collier County Commissions
Beck, Tom	Department of Community Affairs
Cassani, John	Lee County Hyacinth Control District
Daltry, Wayne	SW FL Regional Planning Council
Davenport, Claudia	Big Cypress Basin Board
Douglas, David	David Douglas Assoc., N Ft. Myers Chamber of Commerce
Dryden, Kim	U.S. Fish and Wildlife Service
Durham, Tim	Wilson, Miller, Barton & Peek, Inc.
Folks, John	Department of Agriculture and Consumer Services
Graham-Elliott, Clara Anne	League of Women Voters of Lee County
Griffith, Ed	WCI Communities
Guggenheim, David	The Conservancy of Southwest Florida
Hall, John R.	U.S. Army Corps of Engineers
Hammond, Bill	South Florida Water Management District
Hartman, Bradley J.	Florida Game and Fresh Water Fish Commission
Highsmith, Peggie	Department of Environmental Protection
Inge, Ronald	Lee County Horizon Council, Harper Bros., Inc.
Kain, Wallace	City of Sanibel
Kegg, Earl	Collier County
Klaas, Richard	Florida Real Estate Consultants
Kranzer, Bonnie	Governor’s Commission for Sustainable South Florida
Lucas, Al	U.S. Environmental Protection Agency
Merriam, Chip	South Florida Water Management District
Montgomery, Neale	Pavese, Garner, Haverfield, Dalton, Harrison & Jensen
Mulhere, Bob	Collier County Planning
O'Connor, Paul	Lee County: Planning Division
Roth, Robert H.	Barron Collier Partnership/Silver Strand Division
Stallings, Fran	General Public – Several Environmental Organizations
Strain, Mark P.	Gulf Bay Communities, Inc.
Thoemke, Kris	National Wildlife Federation
Uhle, Matthew D.	Economic Dev. Coalition of Lee Co.
Ward, Whit	Collier Building Industry Association, Inc.

LIST OF ALTERNATES ALTERNATIVES DEVELOPMENT GROUP	
NAME	**AFFILIATION**
Barron, Bob	U.S. Army Corps of Engineers
Beardsley, Gary	League of Women Voters of Lee County
Beever, Jim	Florida Game and Fresh Water Fish Commission
Brundage, Daniel	Lee and Collier County Commissions
Burr, David	SW FL Regional Planning Council
Dolan, Terrance	WCI Communities
English, Katherine	Pavese, Garner, Haverfield, Dalton, Harrison, and Jensen
Gauthier, Charles	Department of Community Affairs
Goldman-Carter, Jan	National Wildlife Federation
Hasty, Collum	General Public – Several Environmental Organizations
Hayden, Tracy L.	Harper Bros., Inc.
Johnson, Karen	South Florida Water Management District
Jolly, William	Department of Agriculture and Consumer Services
Loflin, Rob	City of Sanibel
Maier, Gary	Department of Environmental Protection
Morton, Mark	Barron Collier Partnership
Noble, Matt	Lee County, Division of Planning
Olds, W. Tom	U.S Fish and Wildlife Service
Rhodes, Jeff	Science Applications International Corporation (SAIC) (EPA)
Rice, Terry	Science Applications International Corporation (SAIC) (EPA)
Rietmann, Michael	Collier Building Industry Association, Inc.
Roeder, Mike	Economic Dev. Coalition of Lee Co.
Simonik, Michael	The Conservancy of Southwest Florida
Tears, Clarence	South Florida Water Management District

ADG SUPPORT TEAM ALTERNATIVES DEVELOPMENT GROUP	
NAME	**AFFILIATION**
Feather, Timothy	Planning and Management Consultants, Ltd.
Brown, Dale	Planning and Management Consultants, Ltd.
Beezhold, Michael	Planning and Management Consultants, Ltd.

APPENDIX B

REFERENCE LIST

Reference List

Alternatives Development Group Meeting Notes (1-11)
An Environmental Characterization of the Rookery Bay National Estuarine Research Reserve: Phase I (1993)
Bio-diversity Hot Spots
Charlotte Harbor NEP Area Studies
Closing the GAPS in Florida Wildlife (Habitat Conservation System, 1994)
Collier County Environmental Services Division: Pollution Control Department, 1993, Assessment Report: Inland Surface-Water Quality Monitoring Network: (January 1979 to December 1989), Publication Series PC-AR-91-02
Collier County Manatee Mortality: 1/74-10/97 (map)
Collier County Manatee Mortality: February 1998 (map)
Collier, Hendry, and Lee County Future Land Use 2010: (Southwest Florida Regional Planning Council)
Composite Strategies Conservation Map - Work in Progress
Environmentally Sensitive Index maps: Peninsula 2 Florida
EPA Wetlands map
Estero Bay Drainage Basin: Lee, Collier, and Hendry County
Florida Black Bear: Potential Habitat (map)
Florida Department of Environmental Protection, 1997, Rookery Bay National Estuarine Research Reserve and the Ten Thousand Islands Aquatic Preserve: Estuarine Habitat Assessment
Florida Panther Habitat Preservation Plan. Florida Panther Interagency Committee. (April 1991.)
Florida Panther: Potential Habitat (map)
FTP Site: ftp://ftp.saj.usace.army.mil/pub/bbarron/readme.htm
Future Land Use Map: Collier County
Future Land Use Map (map 1): Lee County
Generalized Existing Land Use Map, Collier County, Florida (1-7)
Henderson Creek Canal: request for consideration by concerned citizen
Hurricane Preparedness/ Evacuation Study
Hurricane Shelter Deficit Reduction Report
Interim Final Guidance for Incorporating Environmental Justice Concerns in EPA's
Lee County Comprehensive Plan
Lee County land use database
Lee County Manatee Mortality: February 1998 (map)
Lee County: Planning Community Existing Conditions Summary
Lee County Planned Development Update: revised 1998
Lee County projects development approvals
Map of Lee County: Existing Land Uses
Microcomputers and Economic Analysis: Spreadsheet Templates for Local Government (revised and expanded edition 1987)

Mollusk and Sediment Contaminant Levels and Trends in South Florida Coastal Waters (1986 to 1994)
Multi-species Recovery Plan for South Florida (Vol. 1). U.S. Fish and Wildlife Service. (March 1998)
National Association of Home Builders Local Impact of Home-building Model (1997)
NEPA Compliance Analysis (EPA 1997)
Nominations with Secondary Screening Criteria Ratings: Lee County (map)
Open Spaces: Collier County (map)
Roadway Cost Analysis – Local Mines Versus Non-Local Mines: Daniels Road Case Study. Inge. August 1998.
Soil Survey of Collier County
Soil Survey: Detailed Reconnaissance Collier County, Florida: Series No. 8 (1942)
Soil Survey of Lee County, Florida
South Florida Study - 1973
South Lee County Watershed Plan: draft (1998)
Southwest Florida District Water Quality – 1996 305(b) Technical Appendix
Southwest Florida Region Regionally Significant Natural Resources (map)
Southwest Florida Strategic Regional Policy Plan (1995)
State of Bay - Agency for Bay Management
Storm Surge Atlas - Lee & Collier Counties
Strategic Habitat Conservation Areas (map)
Study Area of the Caloosahatchee Water Management Plan (SFWMD)
Sustainable America: A New Consensus For Prosperity, Opportunity, and a Healthy Environment for the Future. (February 1996)
Takings Law in Plain English (Christopher Duerksen and Richard Roddewig)
The 1994 Lee Plan: 1996 Codification: as amended through May 1997
The Local Impact of Home Building in Lee County, Florida (1997)
The Local Impact of Home Building in Naples, Florida (1997)
Wading Bird Rookery, Bald Eagle, and Florida Scrub Jay locations
Wetlands Regulation and the Takings Issue (Robert Multz)

APPENDIX C

PROFILES AND MAPS OF ADG ALTERNATIVES

ZOOM A–COMPREHENSIVE PLAN

This alternative represents Lee County's Comprehensive Plan (Ordinance 89-02 with amendments), including the implementing policies and procedures for approval of projects.

The Lee County Ordinance at Chapter II (Future Land Use), states the first goal is "To maintain and enforce a Future Land Use Map showing the proposed distribution, location, and extent of future land uses by type, density, and intensity..." Under this first goal are listed approximately 22 categories. Other goals in this chapter and other chapters in the Ordinance provide specific policies for evaluation of proposed development designs or rezoning. Chapter XIII (Procedures and Administration) states "...all development and all actions taking in regard to development orders shall be consistent with the plan..." The Ordinance also provides for a Year 2010 Overlay which divides the County into 105 Subdistricts. Within each district is assigned an acreage for each land designation within that district. The number of acres are those proposed for the year 2010. No development orders will be issued exceed these acreage numbers. This overlay is being replaced by a Year 2020 Overlay which divides Lee County into 20 Planning Communities. Therefore, the Future Land Use Map shows "build-out" acres for each designation, but the acres projected for the year 2020 will be something less. The Ordinance itself states "With the exception of Cape Coral and Lehigh Acres, the county's urban areas will be built out by 2020." Due to the difficulty of mapping these 2020 projections, the alternative was created using the "build-out" map. It appears the evaluations were generally performed using "build-out" although at least one sub-group discussed the 2020 overlays while preparing their evaluations.

The alternative uses five land use legends: Agricultural; Industrial; Preservation; Rural Residential; Urban; and Urban (Lehigh Acres). The Lee County Future Land Use Map shows 22 land use designations. These designations were collapsed into six simply to ease the preparation of other alternatives and for convenience in evaluation. Agricultural represents Density Reduction/Groundwater Resource. Industrial represents Industrial Development, Industrial Interchange, and Industrial Commercial Interchange. Preserve represents Wetlands and those portions of Density Reduction Groundwater Resource, Wetland and Suburban that currently are or are proposed to be preserved and managed to maintain natural resource values. Rural Residential represents Rural and Rural Community Preserve. Urban represents Intensive Development, Central Urban, Urban Community, Suburban, Outlying Suburban, the Interstate Highway Interchange designations except for the Industrial and the Industrial Commercial types, Public Facilities, New Community, and the various Airport areas. Urban (Lehigh Acres) is portions of Central Urban and Urban Community within Lehigh Acres.

ZOOM A–ALTERNATIVE 1A

This alternative generally seeks to provide greater interconnection of existing natural areas.

Within Lehigh Acres, this alternative proposes a Restoration, Retrofit, and Redevelopment (3 R's) approach for those areas least built-out. Strategies to implement would include use of clustering and multi-family to create areas of high density to provide opportunity for restoration in other portions. This would require retrofitting and redevelopment of the existing roads and other infrastructure.

In Urban and Industrial areas, this alternative proposes adoption of regional stormwater management. This approach would: develop a plan for each watershed; identify the location of a single stormwater detention facility to serve a region (several development projects); provide channel improvements; use non-structural measures (such as acquiring parkland or floodproofing) to supplement structural control measures; and coordinate infrastructure improvements with point and non-point source management.

In Rural Residential, the alternative proposes development of greater planning detail to identify existing flowways, forested habitats, and seasonal wetlands that are large or contiguous to each other. This information would then be used to protect these areas in a connected landscape as the area develops.

The area of Conservation Lands was drawn to emphasize connections between the Rural Residential to the Six Mile Cypress Slough and between the Slough and Estero Bay.

ZOOM A–ALTERNATIVE 2

This alternative emphasizes restoration within Lehigh Acres and maps interconnection of natural areas.

A Lehigh Acres Greenway is proposed for the eastern two miles of Lehigh Acres. The remainder of Lehigh Acres would be designated Lehigh Acres Zone. A list of specific development criteria is found at Attachment V of Meeting Minutes 9. The criteria calls for: the mapping of wetlands, flowways, xeric oak scrubs, and development concentrations; reassign densities and provide transfer of development rights to cluster residences toward the central area of Lehigh Acres where the highest elevation and fewest wetlands are located; and create regional stormwater and water storage facilities.

In Rural Residential, this alternative adds development of greater planning detail to identify existing flowways, forested habitats, and seasonal wetlands that are large or contiguous to each other. This information would then be used to protect these areas in a connected landscape as the area develops.

Other areas of Preservation Lands were drawn to emphasize connections between the Rural Residential and Airport preservation areas to the Six Mile Cypress Slough and between the Slough and Estero Bay. The Preservation Lands were also drawn in wetland areas in the Rural areas between Lehigh Acres and the Caloosahatchee River.

ZOOM A–ALTERNATIVE 3A

This alternative generally seeks to "fix" Lehigh Acres and enlarge the value of some wetland features.

Within Lehigh Acres, this alternative proposes an Acquire, Restore, Fix (ARF) Restoration, Retrofit, and Redevelopment (3 R's) approach, particularly noting the Halfway Pond feature.

The Preservation Lands mapping included providing filter marshes along Ten Mile Canal, canals leading from Lehigh Acres. In addition, lands south of the Airport are proposed to be preserved.

ZOOM A–ALTERNATIVE 4

This alternative generally emphasizes restoration of flowways and addition of storage.

Within Lehigh Acres, this alternative suggests Lee County, using Greenbriar as a model, should consider redevelopment alternatives such as curvilinear streets and the retention of natural areas to restore flowways for the rest of Lehigh Acres. An area in southeast Lehigh Acres was identified as potential use for water storage.

Preservation Lands included lands surrounding Ten Mile Canal and certain flowways leading to Six Mile Cypress Slough and others leading to the Caloosahatchee River.

ZOOM A–ALTERNATIVE 5

This alternative focuses on the Corps permit review process by proposing particular criteria.

The geographic map is the same as for Alternative 3A. The criteria and rationale in detail is found at Attachment W of Meeting Minutes 9.

Within the Preservation Zone, denial of all permits. The proposal states the vision is, in part, that these areas would be "...off limits to future development activity."

For the Acquire, Restore, Fix Zone within Lehigh Acres, the alternative proposes that the "Corps strictly applies the Section 404(b)(1) Guidelines, including: (1) a strong presumption that practicable alternatives exist outside of the ARF Zone to dredge and fill activities (except restoration/retrofit activities)..." The proposal also describes numerous criteria for the Corps to apply during permit review, for example, certain limits to the use of nationwide and general permits, application of the criteria of the Big Cypress Area of Critical State Concern regulations, and restoration of flowways. The proposal states the vision is, in part, to "...protect and restore critical resources..."

For the Urban Zone, the alternative proposes…" a presumption that alternatives exist to locating dredge and fill activities in creeks, rivers, other historic flowways and adjacent wetlands; and to locating dredge and fill activities in isolated wetlands identified as important to wading birds, other species of concern, water quality, groundwater recharge or flood control." The proposal also describes numerous criteria for the Corps to apply during permit review, for example, certain limits to the use of nationwide and general permits, promotion of the restoration of flowways, and restoration of buffer zones. The proposal states the vision is, in part, to "..direct development into this zone...while maintaining watershed integrity within the zone."

The proposal provides criteria for an Agricultural Zone and a Buffer Zone. This would be applied to the Rural Residential designation of this alternative. The proposal provides "...a strong presumption that alternatives exist outside.." either the Buffer Zone or Agricultural Zone and includes numerous criteria for the Corps to apply during permit review. The proposal states the vision is, in part, that agricultural "…should remain in agricultural use, compatible with conservation purposes..." and to "...discourage urban expansion in and through..." the Buffer Zone.

These criteria are an update and refinement of those presented for Zoom B (hub) by Alternatives 2C, 3A, and 4B.

ZOOM B (HUB)–COMPREHENSIVE PLAN

This alternative represents Lee County's Comprehensive Plan (Ordinance 89-02 with amendments) and Collier County's Future Land Use Element of the Growth Management Plan (Ordinance 97-67), including the implementing policies and procedures for approval of projects. For a discussion of these ordinances, see the second paragraph at Zoom C – Comprehensive Plan (Collier County) and Zoom A – Comprehensive Plan (Lee County).

The alternative uses five land use legends: Agricultural; Industrial; Preserve; Rural; and, Urban. The Lee County Future Land Use Map shows 22 land use designations and the Collier County Future Land Use Map shows 12. These 34 designations were collapsed into five simply to ease the preparation of other alternatives and for convenience in evaluation. For this zoom: Agricultural represents Density Reduction/Groundwater Resource (Lee) and Agricultural/Rural Mixed (Collier); Industrial represents Industrial Development (Lee) and Industrial District (Collier); Preserve represents Wetlands (Lee) and portions of Density Reduction Groundwater Resource (Lee), Wetland (Lee) and Agricultural/Rural Mixed Use District (Collier) that currently are or are proposed to be preserved and managed to maintain natural resource values; Rural represents Rural (Lee); Urban represents Suburban (Lee), Outlying Suburban (Lee), Urban Community (Lee), University Community (Lee), the various Interstate Highway Interchange areas (Lee), Public Facilities other than certain parks that were placed in the preserve legend (Lee); and Mixed Use Activity Center SubDistrict (Collier).

ZOOM B (HUB)–ALTERNATIVE 1A

This alternative defined the Preservation Lands overlapping maps from other efforts.

Preservation lands were identified by overlapping the Strategic Habitat Conservation Areas, the Land Conservation/Preservation Strategy Map adopted by the Estero Bay Agency on Bay Management, the boundary of the Corkscrew Regional Ecosystem Watershed (CREW), and the Environmental Protection Agency map of priority wetlands.

The Agricultural designation is the same as for comprehensive plan.

Within the Urban and Industrial, the alternative proposes flowway improvements such as those described in the South Lee Watershed Plan presented by the South Florida Water Management District .

ZOOM B (HUB)–ALTERNATIVE 2A

This alternative give particular emphasis to the needs of wide-ranging species.

The mapping of Preserve used the Land Conservation/Preservation Strategy Map adopted by the Estero Bay Agency on Bay Management, and added connections to the boundary of the Corkscrew Regional Ecosystem Watershed (CREW) for wide-ranging species. The alternative also proposes riparian corridors through the urban areas.

For Agriculture, the alternative "assumes limited intensification of use, that is, no changes that require additional loss of native habitat, no changes (such as intensification of citrus) that would lower hydrology. For example, range and improved range stay the same, vegetable crops change or go to fallow field and back again."

In Rural, the alternative proposes development of greater planning detail to identify existing flowways, forested habitats, and seasonal wetlands that are large or contiguous to each other. This information would then be used to protect these areas in a connected landscape as the area develops.

The alternative did not separately identify mining as a category but classified mining as either Rural or Preserve depending on the ultimate use.

An area is mapped for Development with a requirement for off-site compensatory mitigation for wide-ranging species.

The alternative proposes flowway improvements for the Development area.

ZOOM B (HUB)–ALTERNATIVE 2B

This alternative builds on the mapping of natural resources by others.

The mapping of Preserve started with the Preserves shown in comprehensive plan, then added the following: all proposed acquisitions; the Strategic Habitat Conservation Area mapping for the Florida Panther; and the Priority 1 and 2 areas of the Florida Panther Habitat Preservation Plan. Found that within these areas were found all mapped eagle nests, rookeries, rare native plant communities, seasonal wetlands and flowways, and various coastal resources of interest.

The alternative proposes area Agricultural would remain agricultural but also delineated a sub-area where there would be no intensification in activity. Mining is considered in the Agricultural category to the extent consistent with the comprehensive plan.

The alternative notes that whatever the mapping shows, existing Development Orders remain vested.

ZOOM B (HUB)–ALTERNATIVE 2C

This alternative focuses on maintaining a mix of natural areas, urbanization, and agriculture through use of certain criteria to be applied in project review.

The detailed description of the mapping of each designation and of the criteria proper are found at Attachment E of Meeting 7.

Within the Critical Resource Protection Area, the alternative proposes that projects: meet the Big Cypress Area of Critical State Concern Development Criteria and Standards (with agriculture not exempted); result in no net loss of wetland acreage and function; result in no net loss of active agricultural area; meet total maximum daily loads set for the area of the watershed; improve water quantity, quality, timing and direction; protect on-site wetlands with an easement;

do not fragment or sever a wetland system; and meet the criteria of the Buffer Transitional Zone. Also, agricultural activities would remain but with no intensification. Existing mining is captured under the Agricultural zones. However, there are restrictions on new mines.

Within the Buffer Transitional Zone, the alternative proposes that projects: result in no net loss of wetland acreage and function; result in no net loss in historical water table height and recharge area; do not alter water sheet flow characteristics; contribute to the restoration of historic flowways; preserves buffer zones around wetlands, flowways, natural streams, rivers, and creeks; do not impact water quality; do not contribute to hurricane shelter deficit nor increase evacuation times; and implement the principals adopted by the Estero Bay Agency on Bay Management.

Within the Urban Zone, the alternative proposes that projects: restore flowways; retrofit residential septic systems and package treatment plants; provide adequate hurricane shelters and evacuation routes; restore or retrofit buffer zones around wetlands, flowways, natural streams, rivers and creeks; and meet Pollution Reduction Goals when set.

ZOOM B (HUB)–ALTERNATIVE 3A

The developers of this alternative emphasized that the large area mapped Critical Resource Protection Area was not Preserve, but a mix of preserve and other uses.

The detailed description of the mapping of each designation and of the criteria proper are found at Attachment E of Meeting 7.

Within the Critical Resource Protection Area, the alternative proposes that projects: meet the Big Cypress Area of Critical State Concern Development Criteria and Standards (with agriculture not exempted); result in no net loss of wetland acreage and function; result in no net loss of active agricultural area; meet total maximum daily loads set for the area of the watershed; improve water quantity, quality, timing and direction; protect on-site wetlands with an easement; do not fragment or sever a wetland system; and meet the criteria of the Buffer Transitional Zone. Also, agricultural activities would remain but with no intensification.

Within the Buffer Transitional Zone, the alternative proposes that projects: result in no net loss of wetland acreage and function; result in no net loss in historical water table height and recharge area; do not alter water sheet flow characteristics; contribute to the restoration of historic flowways; preserves buffer zones around wetlands, flowways, natural streams, rivers, and creeks; do not impact water quality; do not contribute to hurricane shelter deficit nor increase evacuation times; and implement the principals adopted by the Estero Bay Agency on Bay Management.

Within the Urban Zone, the alternative proposes that projects: restore flowways; retrofit residential septic systems and package treatment plants; provide adequate hurricane shelters and evacuation routes; restore or retrofit buffer zones around wetlands, flowways, natural streams, rivers and creeks; and meet Pollution Reduction Goals when set.

ZOOM B (HUB)–ALTERNATIVE 3B

This alternative built on the work of the Estero Bay Agency on Bay Management.

The areas designated Preserve were based on the Land Conservation/Preservation Strategy Map adopted by the Estero Bay Agency on Bay Management. Included are flowways through the urban areas and within existing agricultural areas. Agriculture would remain with no intensification. Development would by guided by the principles of the Estero Bay Agency on Bay Management.

The alternative also maps mining lands with no comment.

ZOOM B (HUB) - ALTERNATIVE 4A

This alternative builds on comprehensive plan.

In this alternative, Mining lands are shown separate from Agriculture. The definition for Agriculture is the same as comprehensive plan.

This alternative proposes implementation of flowways through the urbanized areas and, within Preservation Lands, removal or culverting of various roads to restore flowways. These are as described in the South Lee Watershed Plan presented by the South Florida Water Management District.

Two areas are designated Pending Review as the group preparing the alternative could not agree whether to designate the location as development or preservation.

ZOOM B (HUB)–ALTERNATIVE 4B

This alternative builds on Alternative 4A by adding criteria and a water control berm.

The alternative proposes the construction of a berm as described in the South Lee Watershed Plan presented by the South Florida Water Management District. The berm will store water when downstream conveyances are at capacity. All of the evaluations were performed using the berm located as mapped. Three of the evaluations also included evaluations of two other possible alignments, described in Attachment AG of Meeting #10.

The detailed description of the mapping of each designation and of the criteria proper are found at Attachment E of Meeting 7.

Within the Critical Resource Protection Area, the alternative proposes that projects: meet the Big Cypress Area of Critical State Concern Development Criteria and Standards (with agriculture not exempted); result in no net loss of wetland acreage and function; result in no net loss of active agricultural area; meet total maximum daily loads set for the area of the watershed; improve water quantity, quality, timing and direction; protect on-site wetlands with an easement; do no fragment or sever a wetland system; and meet the criteria of the Buffer Transitional Zone. Also, agricultural activities would remain but with no intensification.

Within the Buffer Transitional Zone, the alternative proposes that projects: result in no net loss of wetland acreage and function; result in no net loss in historical water table height and recharge area; do not alter water sheet flow characteristics; contribute to the restoration of historic flowways; preserves buffer zones around wetlands, flowways, natural streams, rivers, and creeks; do not impact water quality; do not contribute to hurricane shelter deficit nor increase evacuation times; and implement the principals adopted by the Estero Bay Agency on Bay Management.

Within the Urban Zone, the alternative proposes that projects: restore flowways; retrofit residential septic systems and package treatment plants; provide adequate hurricane shelters and evacuation routes; restore or retrofit buffer zones around wetlands, flowways, natural streams, rivers and creeks; and meet Pollution Reduction Goals when set.

ZOOM C–COMPREHENSIVE PLAN

This alternative represents Collier County's Future Land Use Element of the Growth Management Plan (Ordinance 97-67), including the implementing policies and procedures for approval of projects.

The Collier County Ordinance states the goal is "To guide land use decision-making..." and provides several objectives and policies. The ordinance also defines approximately twelve land use designations that “...generally indicate the types of land uses for which zoning may be requested.” For each designation, the ordinance describes the uses and standards to be applied and shows the properties affected on the Future Land Use Map. Note that Ordinance 97-67 is the amendment of the current Future Land Use Element and is not in effect (as of May 11, 1998) while concerns raised by the Florida Department of Community Affairs are resolved. The Land Development Code (Ordinance 91-102) implements applicable portions of the Growth Management Plan. Article 2, Zoning, includes, among other things, a requirement for open space and for special requirements in areas of environmental sensitivity designated as Special Treatment Overlay District. Article 3, Development Requirements, includes, among other things, a requirement for an Environmental Impact Statement for certain projects, and various requirements for protection of natural vegetation and endangered species.

The alternative uses five land use legends: Agricultural; Industrial; Preservation/ Conservation; Rural Residential; and Urban Land Uses. The Collier County Future Land Use Map shows 12 land use designations. These designations were collapsed into five simply to ease the preparation of other alternatives and for convenience in evaluation. Agricultural represents Agricultural/Rural Mixed Use District; Industrial represents Industrial District; Preservation/ Conservation represents portions of the Agricultural/Rural Mixed Use District that are or are proposed to be preserved and managed to maintain natural resource values; Rural Residential represents the Estates Designation and the Rural Settlement Area District. Urban represents the various Urban and Commercial subdistricts under the Urban Designation except for the Industrial District.

ZOOM C–ALTERNATIVE 1A

This alternative is particularly concerned with the nature of development in the rural areas.

Within areas designated Rural Development Criteria, the alternative proposes application of the criteria drafted for the Twin Eagles project. These areas are found in southern Belle Meade and the Immokalee Road corridor.

The Preservation Lands area is larger than comprehensive plan.

For Golden Gate Estates, the alternative suggests a flowway program though without details.

ZOOM C–ALTERNATIVE 1B

This alternative emphasizes need for flowway improvements along Tamiami Trail.

This alternative proposes designating a portion of the existing agricultural area in Belle Meade as Rural Development. The balance would be Urban and Industrial, along with flowway improvements to direct water from Henderson Creek into sheet flow across Tamiami Trail.

ZOOM C–ALTERNATIVE 2

This alternative expands preserves beyond comprehensive plan and provides criteria for project design and review.

The criteria for each land use designation are summarized below. The detailed list is described in Attachment S of Meeting 8.

Preservation Lands include some lands in Belle Meade north of I-75 as well as lands around Naples Bay. The alternative proposes additional criteria. These include: No public utilities; no new or expanded transportation; no wellfield expansion; restoration or retrofit of certain areas with hydrologic problems; and use as mitigation receiving areas only those portions of Preservation Lands that are currently not in public ownership.

The alternative proposes two sets of criteria for Golden Gate Estates. Zone 1, the more densely developed western Golden Gate Estates includes: avoid/minimize and mitigate wetland impacts; culverting entrance roads; address listed species concerns; development of a educational pamphlet on resource issues; and implementation of a Florida Yards and Neighborhood program. Zone 2, toward Picayune Strand, criteria includes: no more than 10 percent fill; no more than 50 percent fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and culverting entrance roads. Zone 2 would also be designated a receiving area for mitigation.

The alternative shows two areas as Rural, one north and the other south of Golden Gate Estates. For the north, the criteria includes: avoiding and minimizing impacts to wetlands; protecting nesting areas; mitigating wide-ranging species including fox squirrels off site; and, maintain or improve hydrology (for example, weirs in Cocohatchee Canal. For the south, the criteria includes: avoiding and minimizing impacts to wetlands; protecting Red cockaded woodpecker habitat or mitigating off-site when viability affected; mitigating off-site for wide ranging species (bear); and maintaining or improving hydrology (for example, the depth of the I-75 canal). For both north and south, the alternative also adopts the Buffer Transition Zone criteria as described in Alternative 4B of Zoom B (hub), described in detail at Attachment E of Meeting 7.

For lands designated Agricultural, the alternative states no golf course or ranchettes as these are not associated with true agriculture. The alternative also “assumes limited intensification of use, that is, no changes that require additional loss of native habitat, no changes (such as intensification to citrus) that would lower hydrology. For example, range and improved range stay the same, vegetable crops change or go to fallow field and back again.”

For lands designated Urban and Industrial, the alternative proposes encouraging planting of emergent and shoreline planting in stormwater retention lakes and continuation of the Corps standards for wetland protection. The alternative also adopts the Urban Zone criteria as described in Alternative 4B of Zoom B (hub), described in detail at Attachment E of Meeting 7.

ZOOM C–ALTERNATIVE 3A

This alternative recognizes continued expansion of development to the west.

The area designated Golden Gate would continue under the current processes but with additional protection afforded isolated wetlands by proposing: no general permits; determination of wetland jurisdiction prior to Collier County permitting; reconnection of wetlands along historic flowways; and, limitations on the clearing of the lot.

Within the Urban and Industrial, provide flowway improvements along the Cocohatchee Canal, Golden Gate Canal, and sloughs in eastern Naples, coordinated with improvements within Preservation Lands.

Two areas are designated Pending Review as the group preparing the alternative could not agree whether to designate the location as development or preservation.

ZOOM C–ALTERNATIVE 3B

This alternative seeks to maintain 50 percent of the rural landscape in natural area.

Within the Rural Cluster designation, the alternative proposes preserving 100 percent of the wetland, maintain 50 percent as natural area, maintenance of corridors and flowways to interconnect wetlands, and provide facilities to protect water quality. The alternative proposes applying this criteria also to the Golden Gates Estates, which is designated Estates (Rural Residential).

Within the Urban and Industrial Area, the alternative proposes restoration of flowways through acquisition, though no detail was presented.

ZOOM C–ALTERNATIVE 4

This alternative describes various areas east of the current urban area that are in transition from current uses.

The areas designated Transition are those lands currently in agriculture that will likely change to the Urban designation.

The western end of Golden Gate Estates was included in the Urban designation. The alternative proposed no increase in density within Golden Gate City. The rest of Golden Gate Estates would retain the same Rural Residential designation as found in the comprehensive plan.

Within the Urban areas, flowways improvements were shown in various locations and connected to the Preservation areas.

The alternative proposed, within the Preservation/Conservation designation, improvements to culverts under I-75 and Tamiami Trail for sheetflow.

ZOOM D–COMPREHENSIVE PLAN

This alternative represents Collier County's Future Land Use Element of the Growth Management Plan (Ordinance 97-67), including the implementing policies and procedures for approval of projects. See the second paragraph at Zoom C – Comprehensive Plan for a discussion of this Ordinance.

The alternative uses five land use legends: Agricultural; Industrial; Preserve; Rural; and, Urban. The Collier County Future Land Use Map shows 12 land use designations. These designations were collapsed into five simply to ease the preparation of other alternatives and for convenience in evaluation. Agricultural represents Agricultural/Rural Mixed Use District; Industrial represents Industrial District; Preserve represents portions of the Agricultural/Rural Mixed Use District that are or are proposed to be preserved and managed to maintain natural resource values; Rural represents the Estates Designation. Urban represents the Urban Residential Subdistrict.

ZOOM D–ALTERNATIVE 1A

This alternative proposes no intensification of the development with existing agricultural and Golden Gate areas.

This alternative proposes to include as Preservation Lands historic flowways within Golden Gate Estates and along Camp Keais Strand. However, current activities would remain.

For the Agricultural Preserve designation, current agricultural activities would continue but intensification would be limited.

Within Golden Gate Estates, the alternative proposes criteria that includes: no more than 10 percent fill; no more than 50 percent fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and culverting entrance roads. This area would also be designated a receiving area for mitigation. The criteria for each land use designation is summarized below. The detailed list is described in Attachment S of Meeting 8.

ZOOM D–ALTERNATIVE 2A

This alternative applies additional criteria for the review of projects in the non-urban areas.

For Agriculture, the alternative assumes limited intensification of use, that is, no changes that require additional loss of native habitat, no changes (such as intensification to citrus) that would lower hydrology. For example, existing range and improved range use stay the same, vegetable crop uses could change or go to fallow field and back again. The alternative assumes rotation of crops but no additional clearing.

Within Golden Gate Estates, the alternative proposes criteria that includes: no more than 10 percent fill; no more than 50 percent fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and culverting entrance roads. This area would also be designated a receiving area for mitigation. The criteria for each land use designation is summarized below. The detailed list of criteria is described in Attachment S of Meeting 8.

For areas designated Preservation, the alternative proposes criteria that include: no public utilities; no new or expanded transportation; no wellfield expansion; restoration or retrofit of certain areas with hydrologic problems; and use as mitigation receiving areas only those portions of Preservation Lands that are currently not in public ownership. The detailed list of criteria is described in Attachment S of Meeting 8.

A small area is designated Rural to reflect the low density mix of current land uses.

ZOOM D–ALTERNATIVE 2B

This alternative is identical to Alternative 2A except it adds restrictions to certain areas currently in agriculture.

> Certain areas of agriculture are within the boundaries of the Big Cypress Areas of Critical State Concern and are currently exempt from the implementing criteria. This alternative proposes removing that exemption.

ZOOM D–ALTERNATIVE 3

This alternative envisions most of the area ultimately going to preserve.

For the Agricultural areas, the alternative proposes that current agriculture would continue with limited intensification but if agriculture ceases then the lands would be placed in preservation.

Within Golden Gate Estates, the alternative proposes criteria that includes: no more than 10 percent fill; no more than 50 percent fill in pervious areas; no impeding sheet flow; elimination of exotics; develop pamphlet on resource issues; Florida Yards and Neighborhood program; and culverting entrance roads. This area would also be designated a receiving area for mitigation. The criteria for each land use designation is summarized below. The detailed list of criteria is described in Attachment S of Meeting 8.

Within areas designated Preservation, the alternative proposes culverts within Camp Keais Strand and across Tamiami Trail to improve flowways.

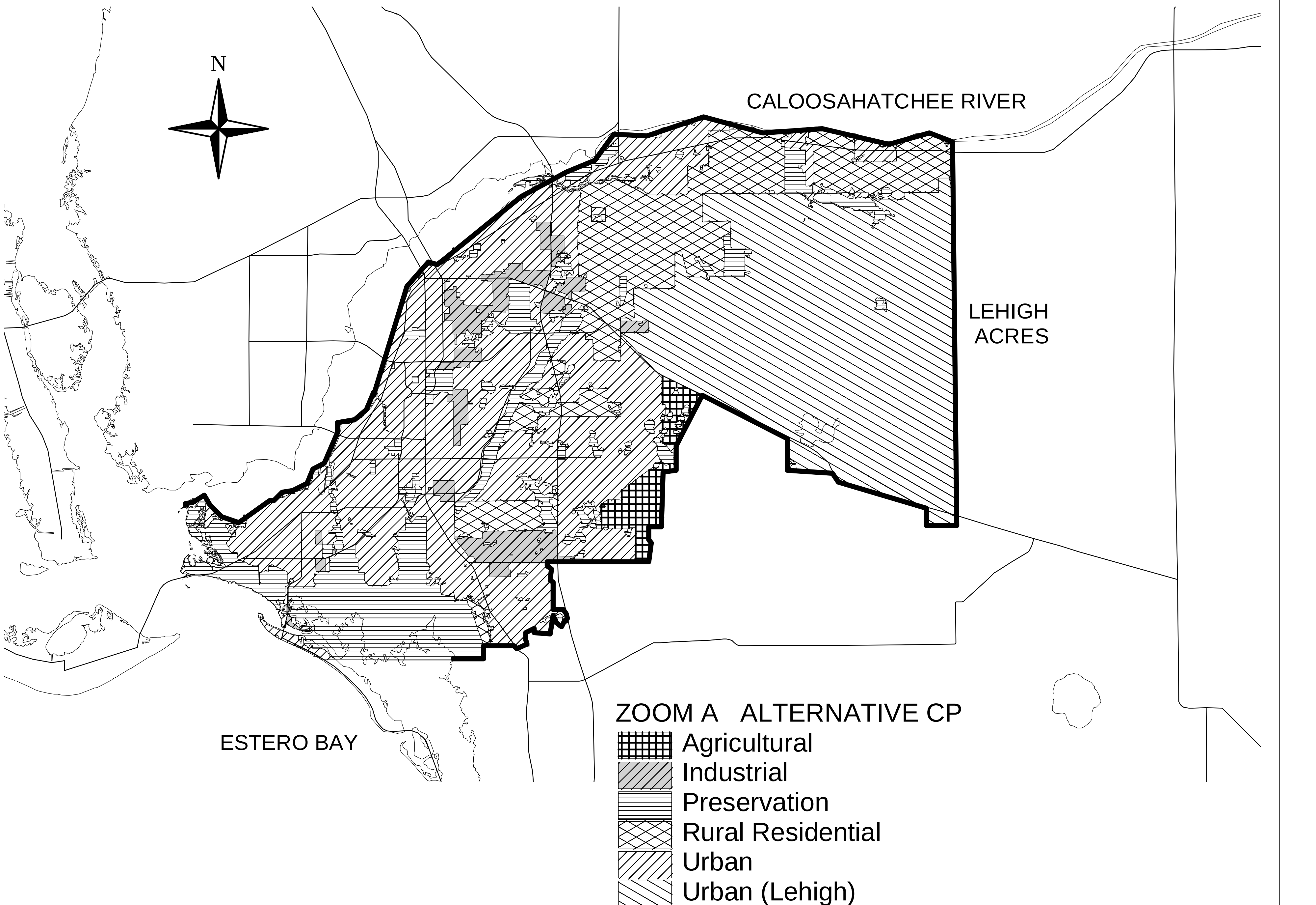
One area of Industrial is designated to reflect the current land use (Ford Test Track).

ZOOM D–ALTERNATIVE 4

This alternative preserves the status quo for current land uses.

Of the alternatives, this one proposes the narrowest footprint for Preservation Lands within Camp Keais Strand, restricting it to areas not currently under agriculture. The alternative does propose culverts under existing road crossing in the Strand to improve flowways.

One area of Industrial is designated to reflect the current land use (Ford Test Track).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CALOOSAHATCHEE RIVER
LEHIGH ACRES
ESTERO BAY
ZOOM A ALTERNATIVE CP
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Industrial
Preservation
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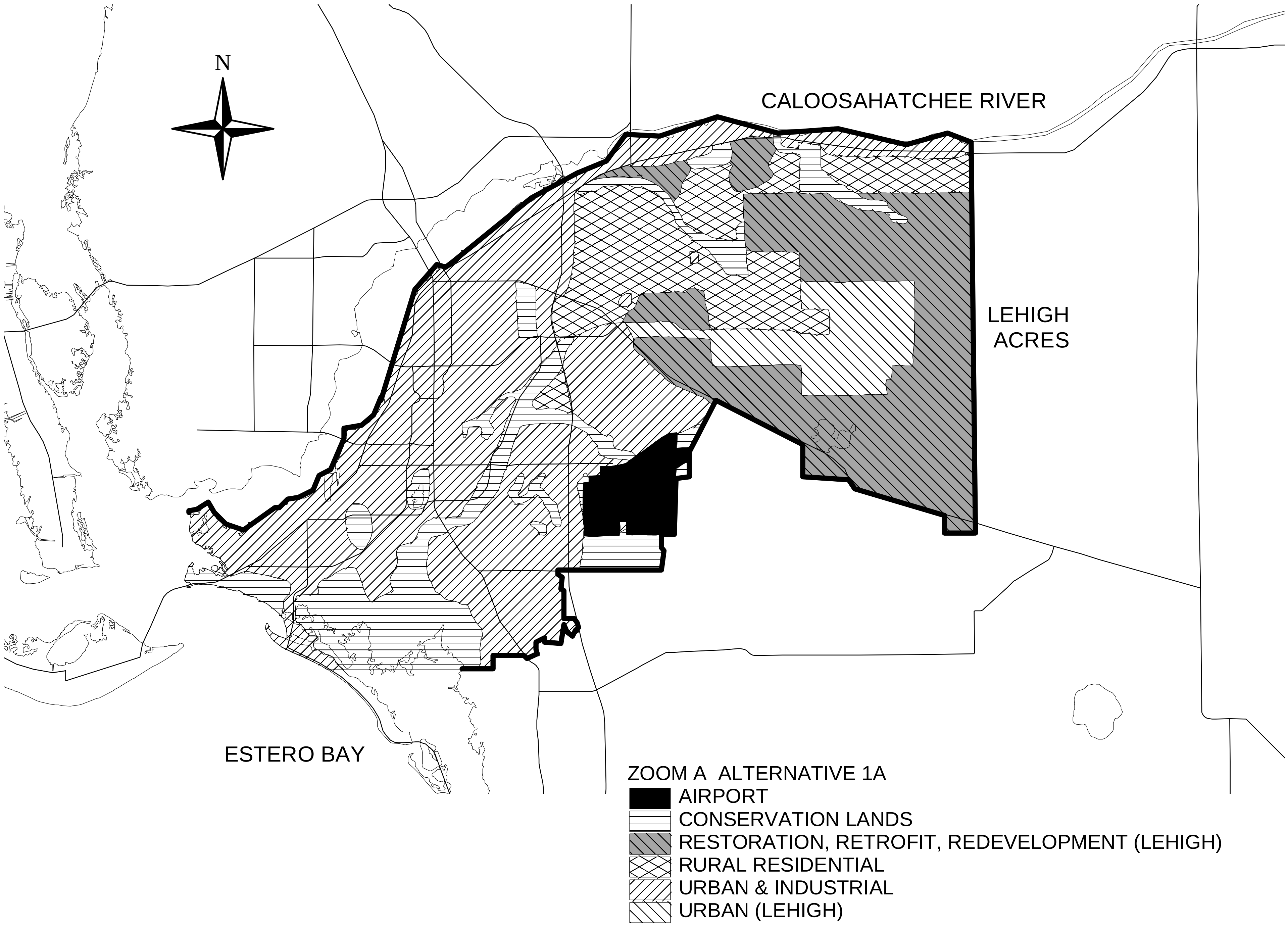
Urban
Urban (Lehigh)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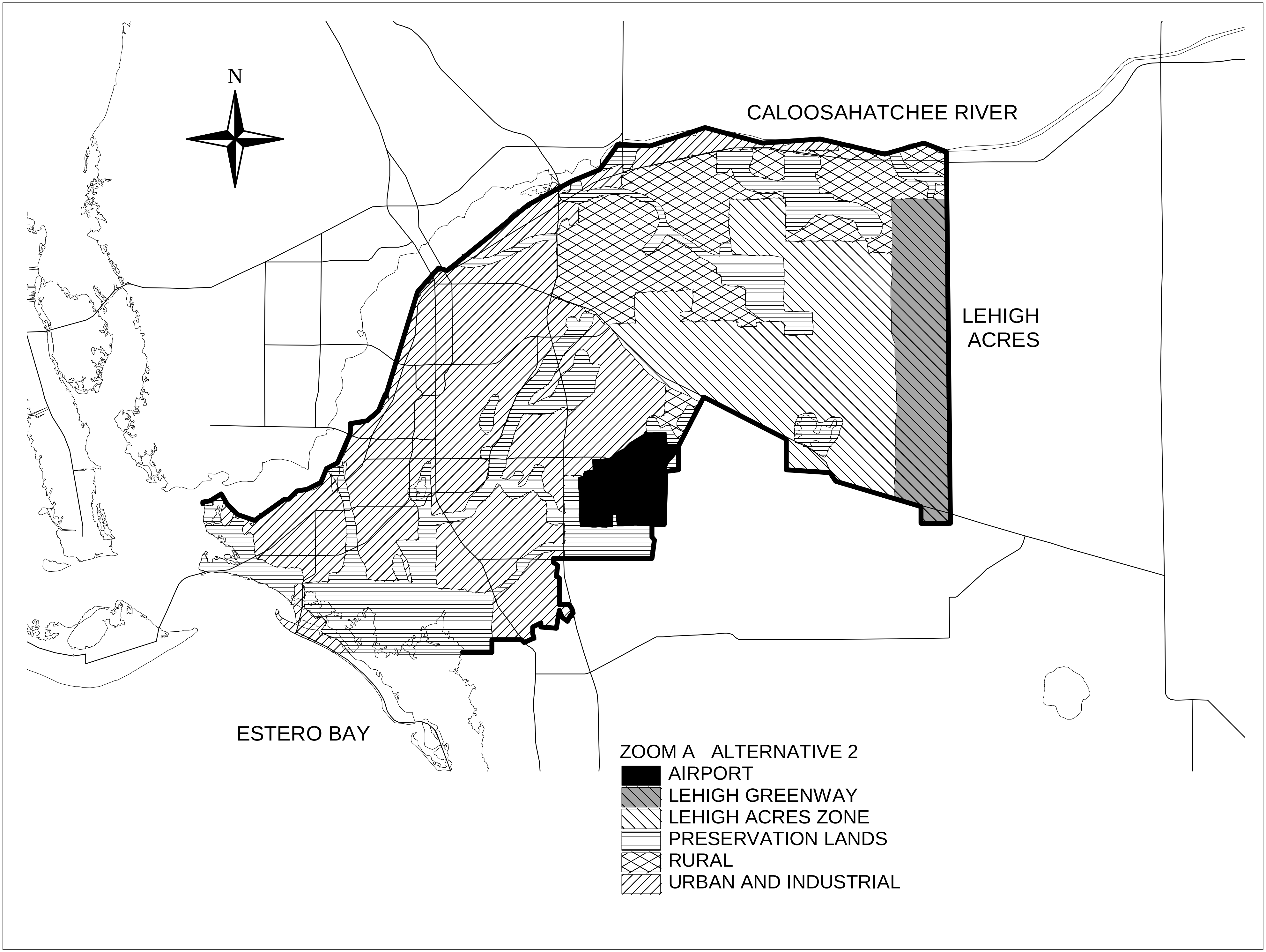
LEHIGH ACRES
ESTERO BAY
ZOOM A ALTERNATIVE 1A
AIRPORT
CONSERVATION LANDS
RESTORATION, RETROFIT, REDEVELOPMENT (LEHIGH)
RURAL RESIDENTIAL
URBAN & INDUSTRIAL
URBAN (LEHIGH)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LEHIGH ACRES
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AIRPORT
LEHIGH GREENWAY
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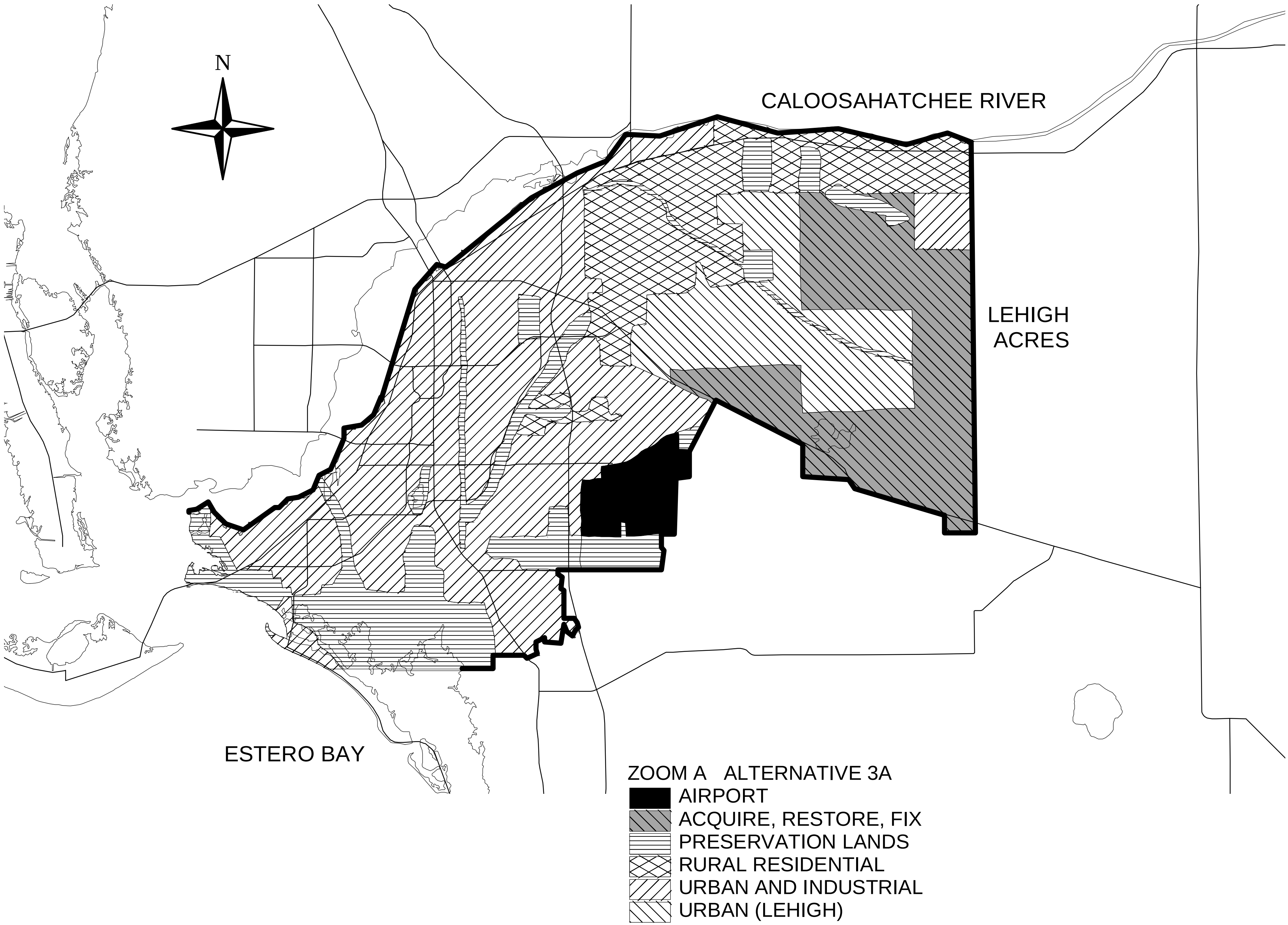
PRESERVATION LANDS
RURAL
URBAN AND INDUSTRIAL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LEHIGH ACRES
ESTERO BAY
ZOOM A ALTERNATIVE 3A
AIRPORT
ACQUIRE, RESTORE, FIX
PRESERVATION LANDS
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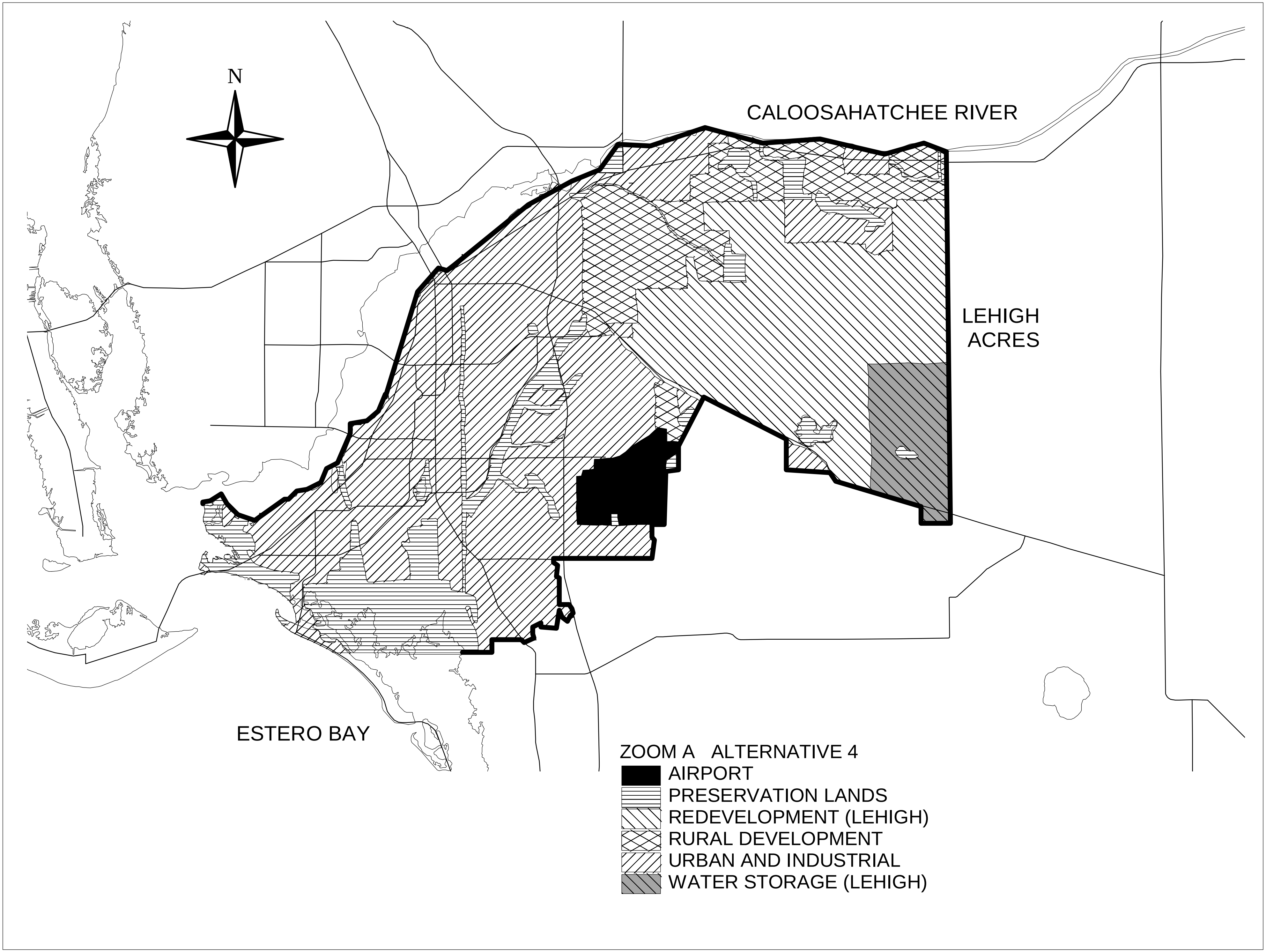
URBAN AND INDUSTRIAL
URBAN (LEHIGH)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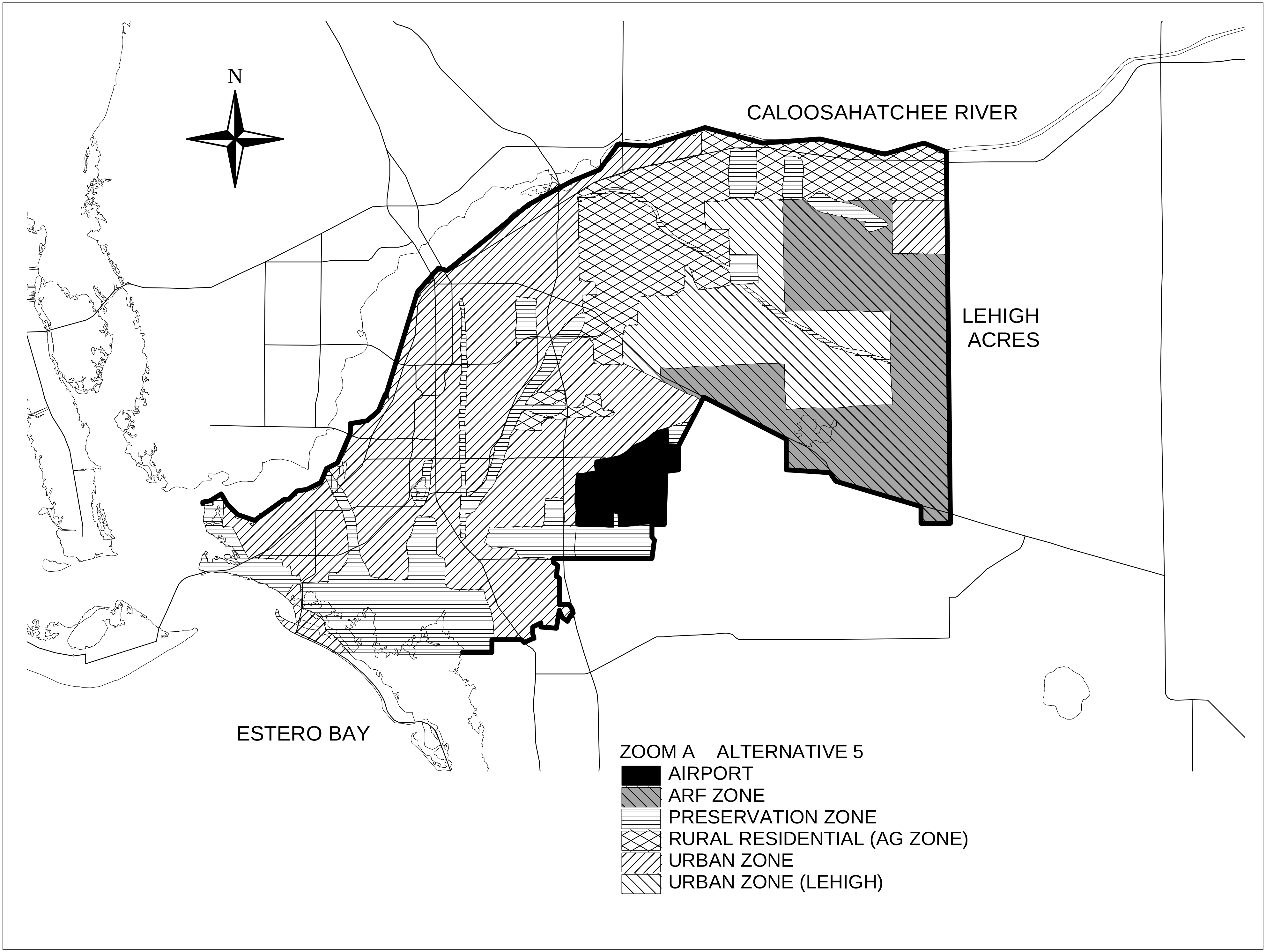
LEHIGH ACRES
ESTERO BAY
ZOOM A ALTERNATIVE 4
AIRPORT
PRESERVATION LANDS
REDEVELOPMENT (LEHIGH)
RURAL DEVELOPMENT
URBAN AND INDUSTRIAL
WATER STORAGE (LEHIGH)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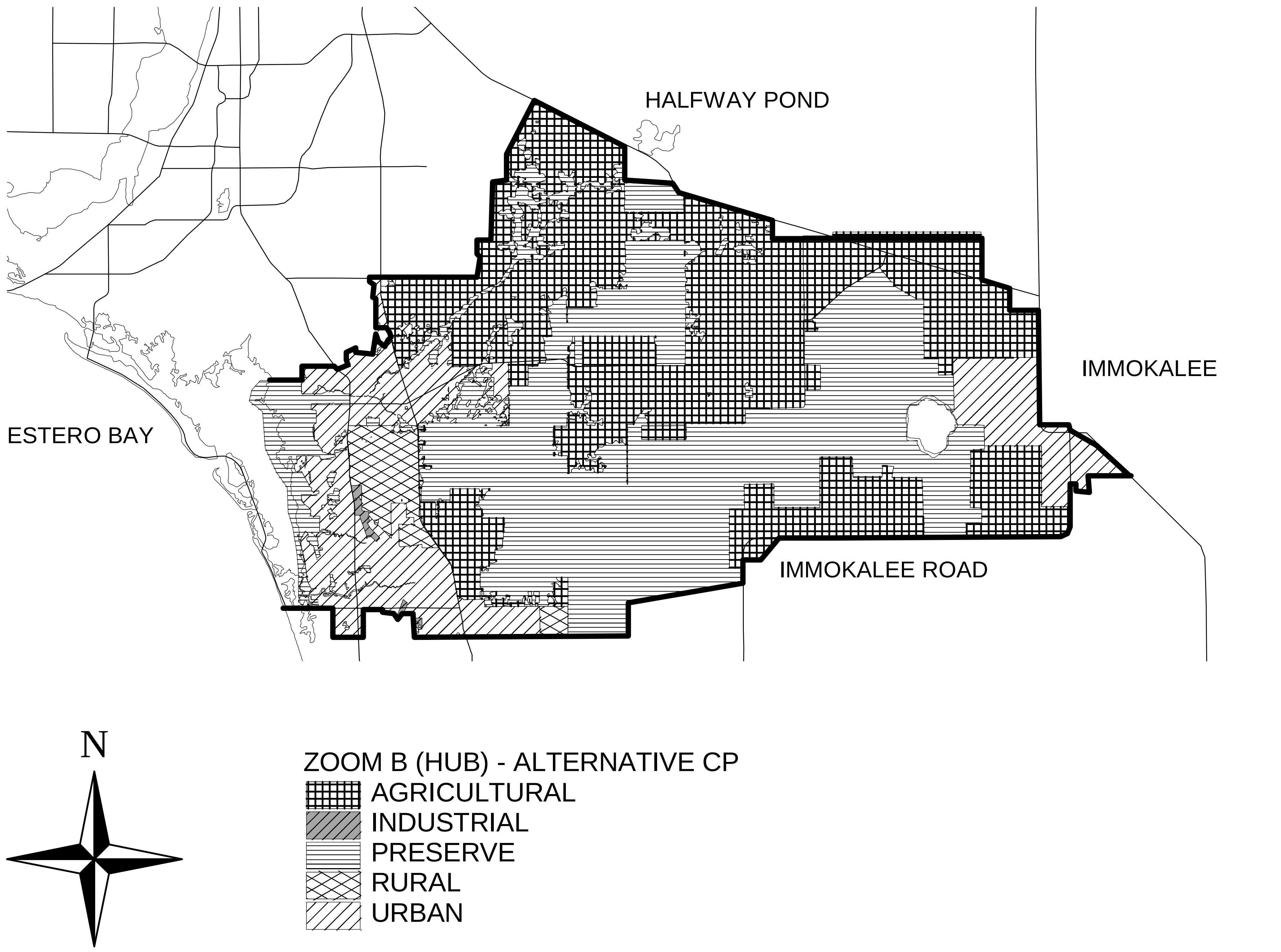
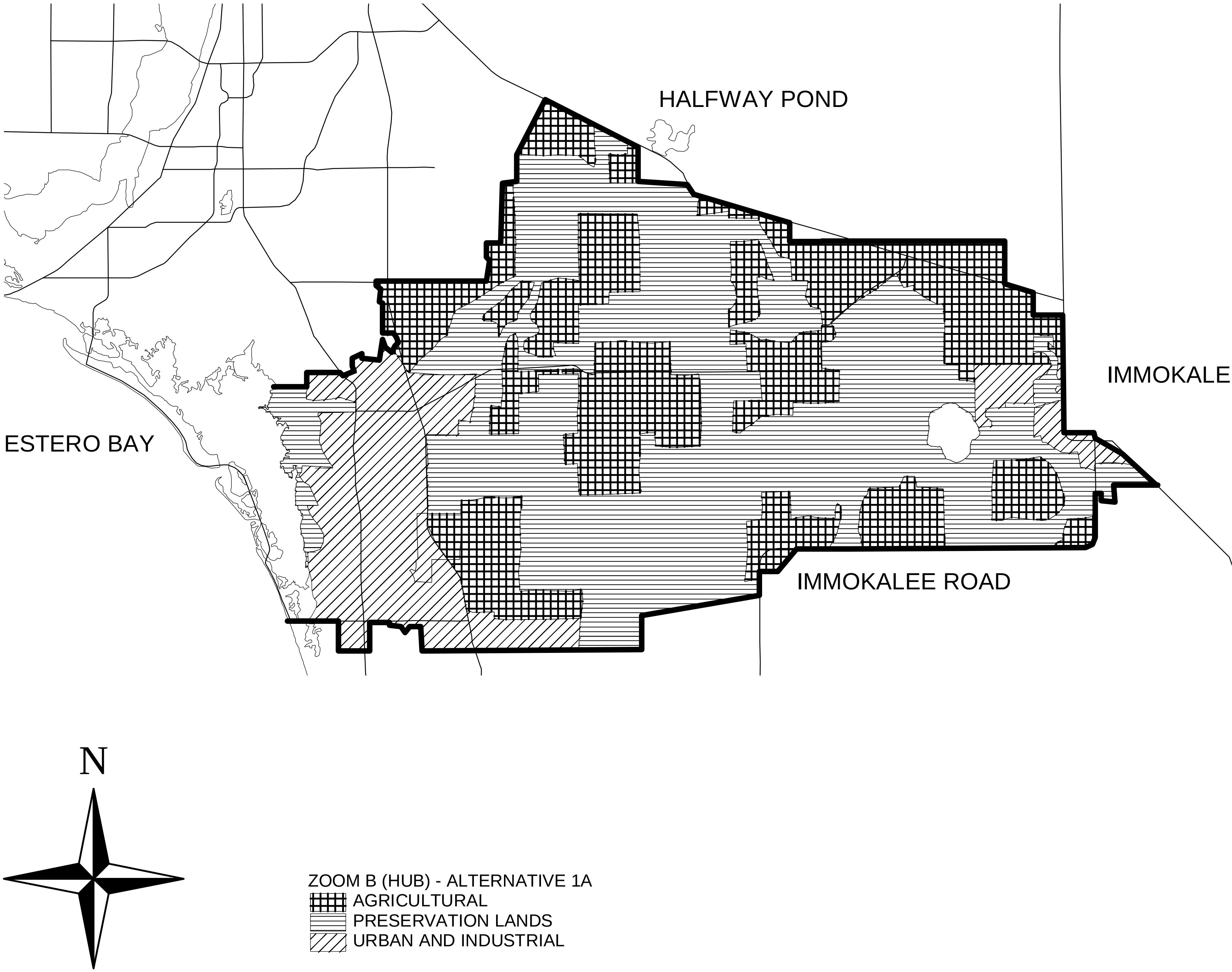
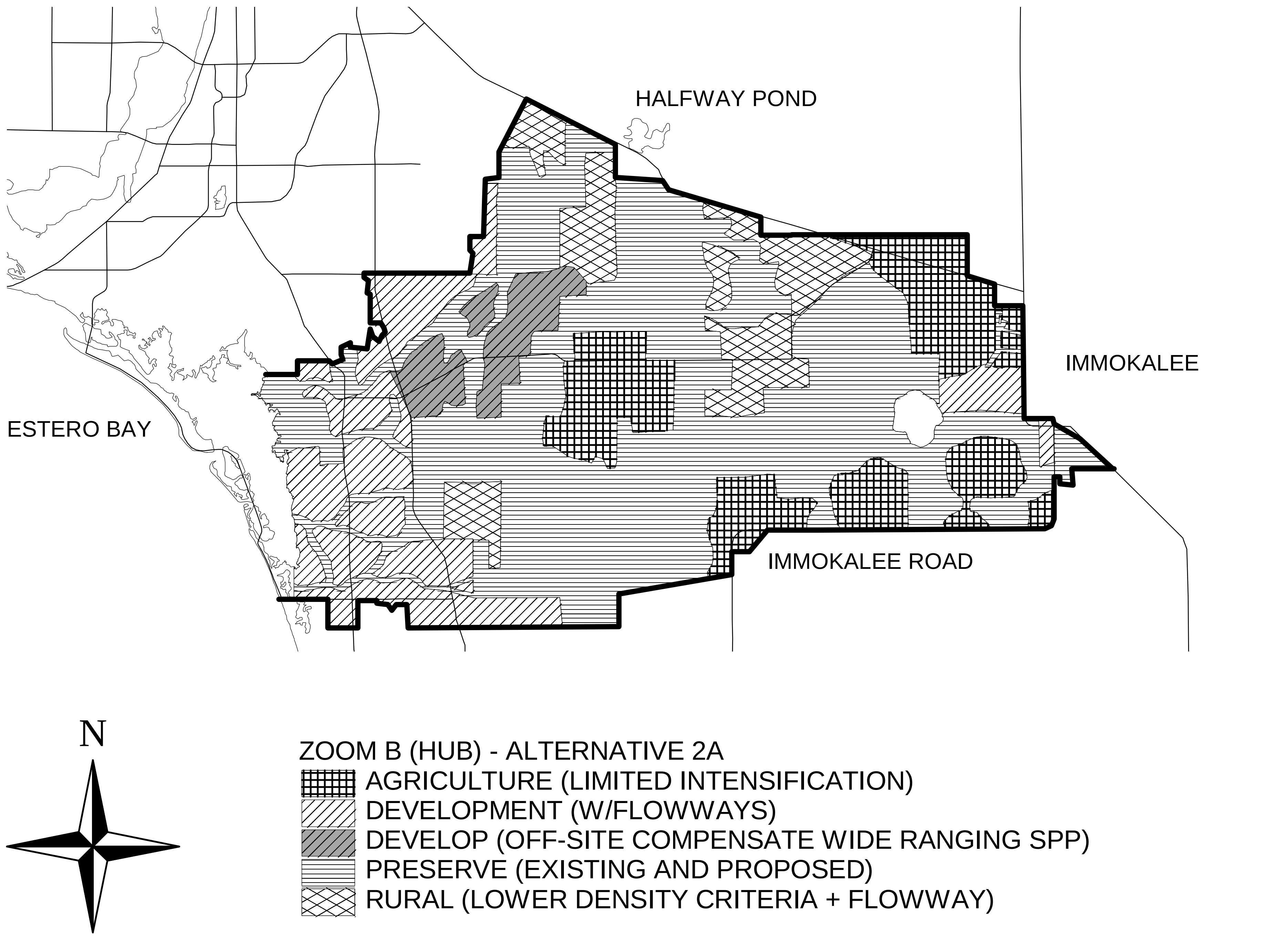
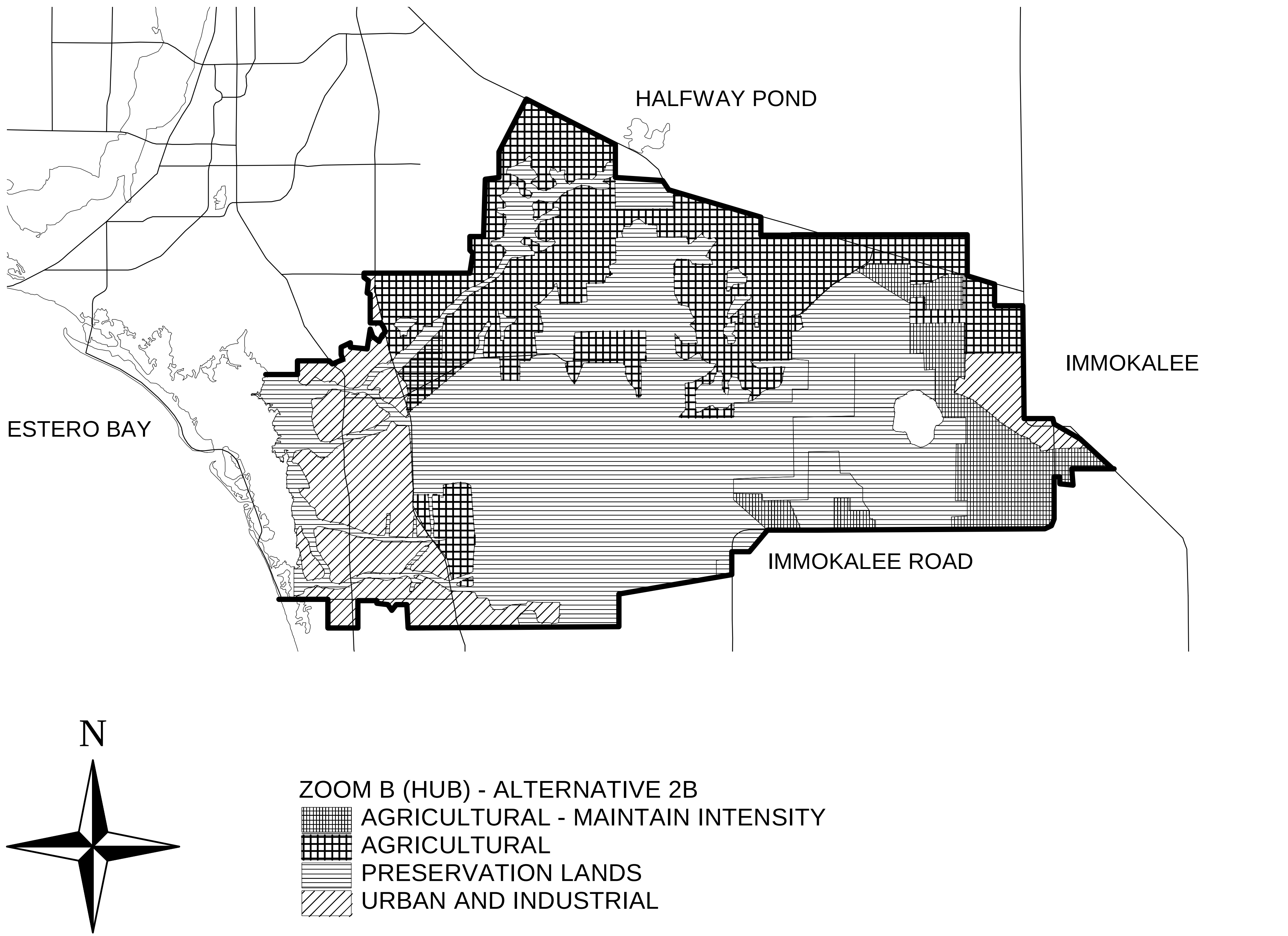
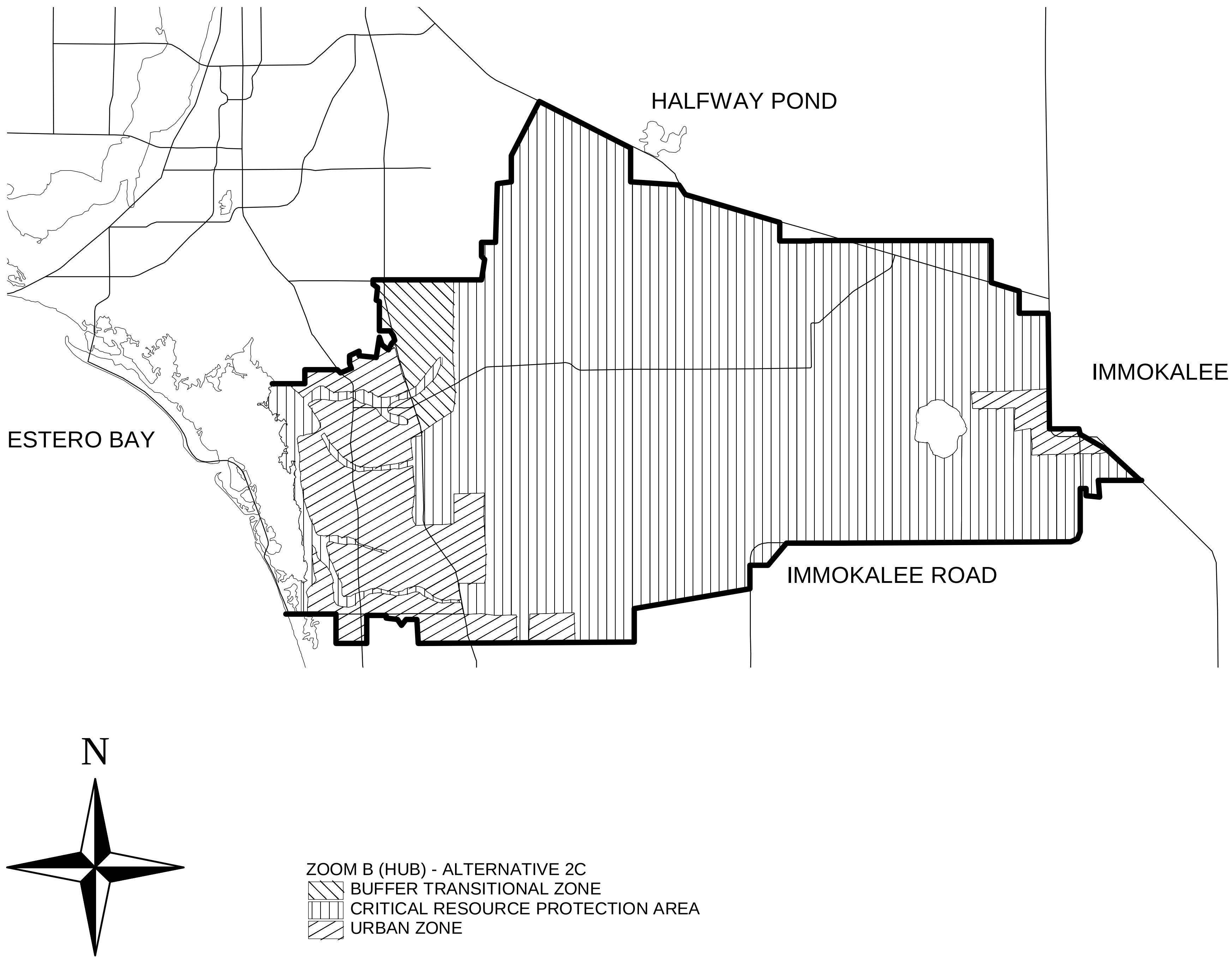
CALOOSAHATCHEE RIVER
LEHIGH
ACRES
ESTERO BAY
ZOOM A ALTERNATIVE 5
AIRPORT
ARF ZONE
PRESERVATION ZONE
RURAL RESIDENTIAL (AG ZONE)
URBAN ZONE
URBAN ZONE (LEHIGH)


HALFWAY POND
ESTERO BAY
IMMOKALEE
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE CP
AGRICULTURAL
INDUSTRIAL
PRESERVE
RURAL
URBAN

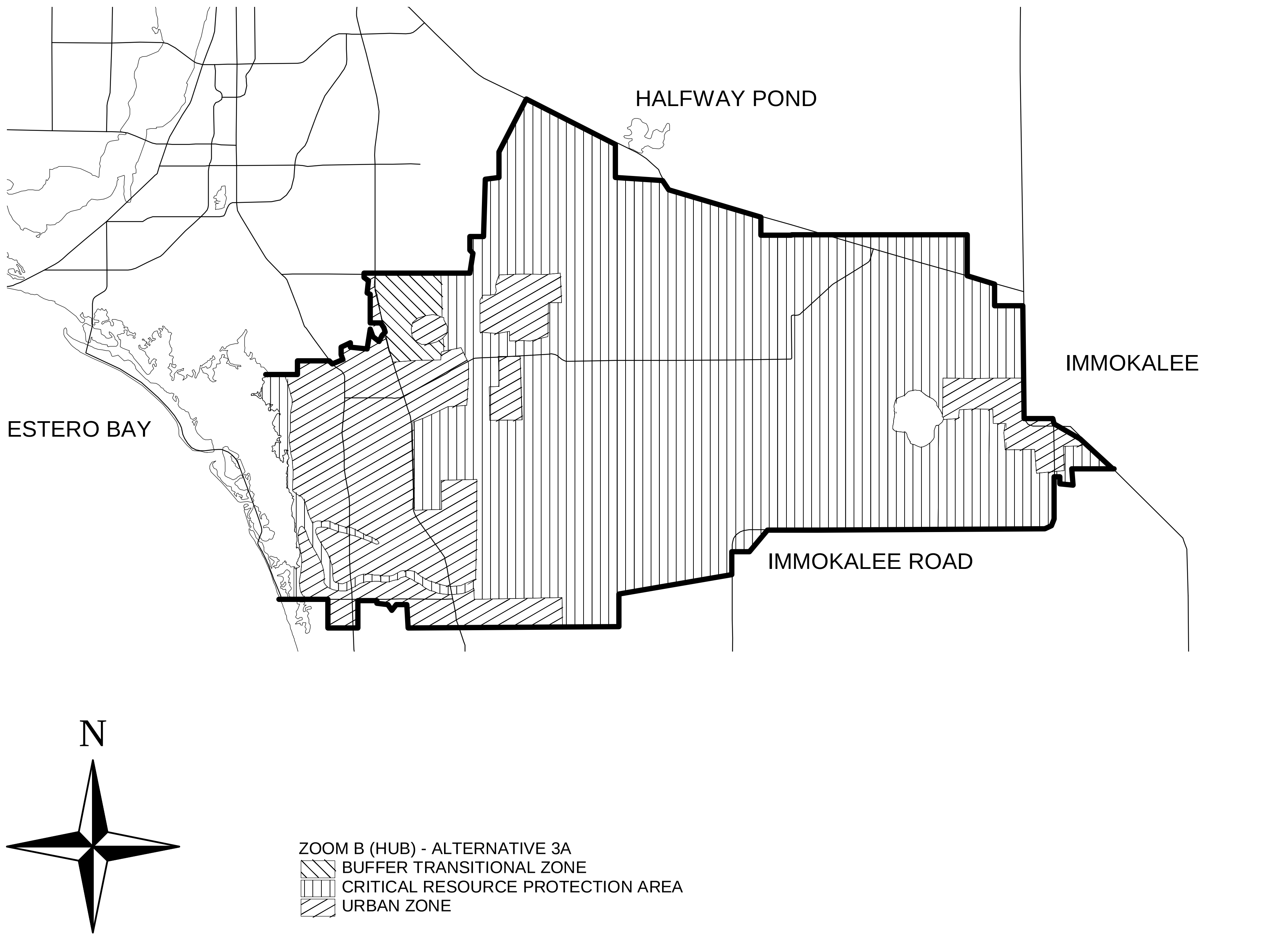

HALFWAY POND
ESTERO BAY
IMMOKALEE
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE 1A
AGRICULTURAL
PRESERVATION LANDS
URBAN AND INDUSTRIAL

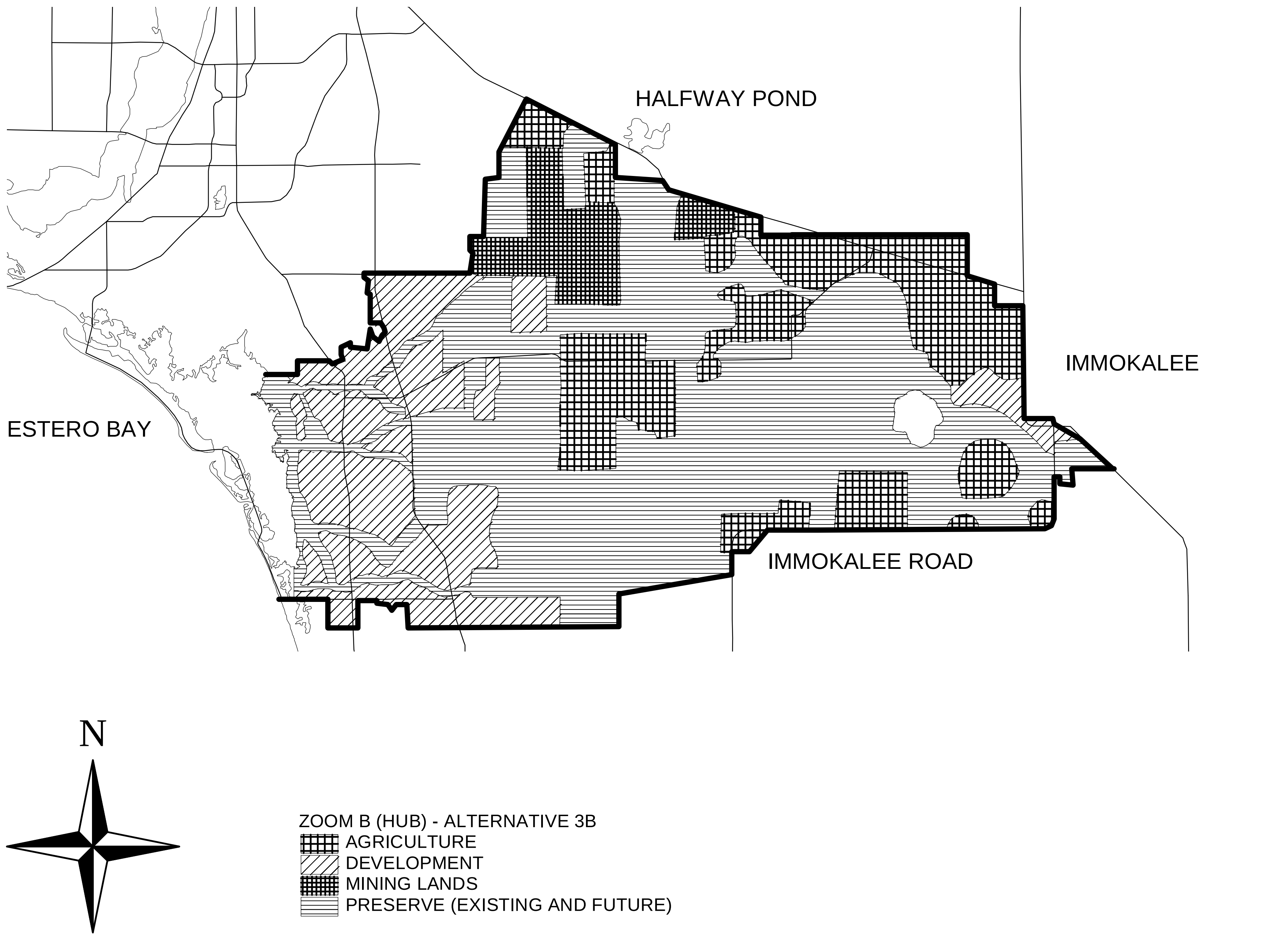

HALFWAY POND
IMMOKALEE
ESTERO BAY
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE 2A
AGRICULTURE (LIMITED INTENSIFICATION)
DEVELOPMENT (W/FLOWWAYS)
DEVELOP (OFF-SITE COMPENSATE WIDE RANGING SPP)
PRESERVE (EXISTING AND PROPOSED)
RURAL (LOWER DENSITY CRITERIA + FLOWWAY)

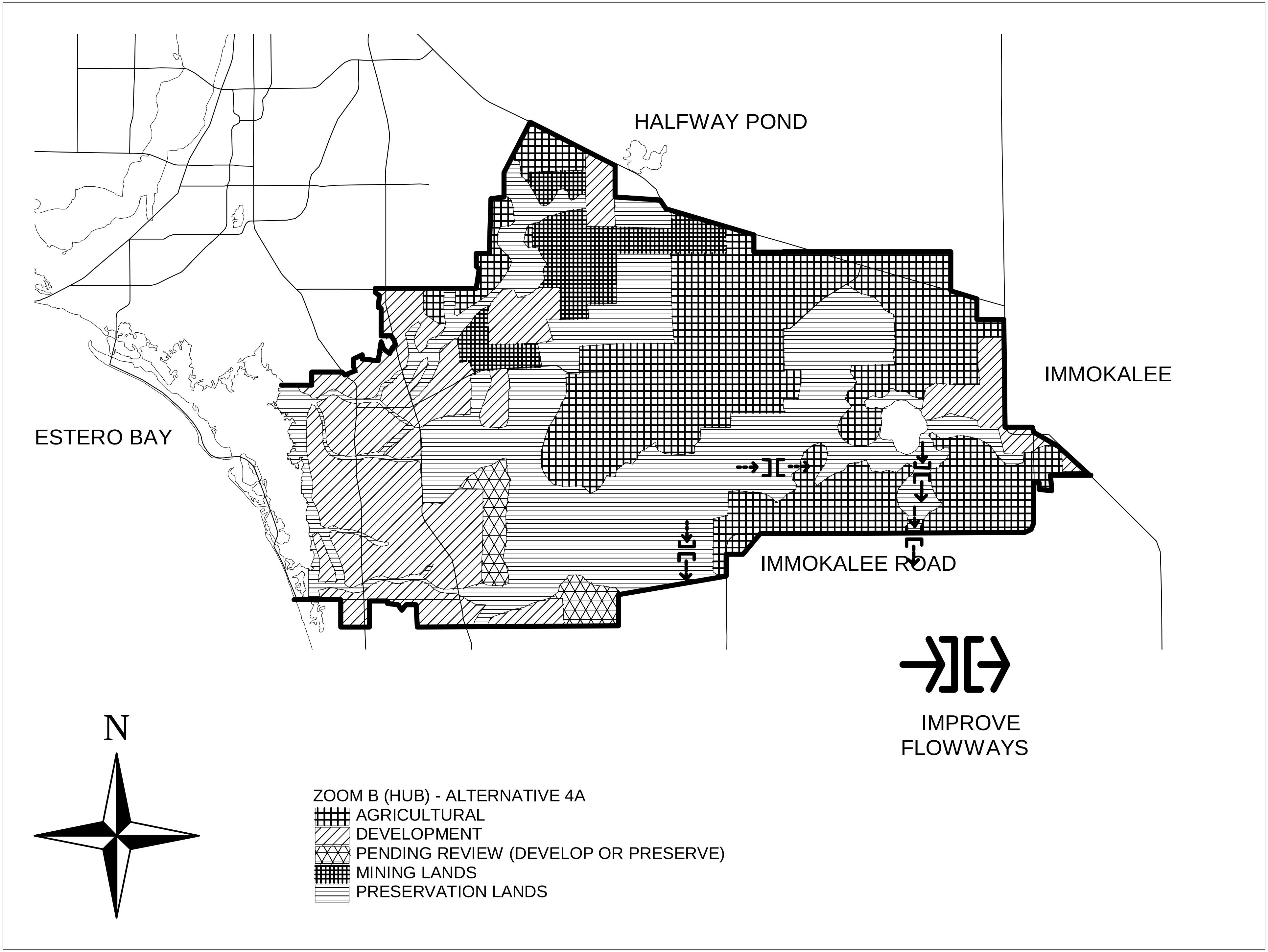

HALFWAY POND
IMMOKALEE
ESTERO BAY
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE 2B
AGRICULTURAL - MAINTAIN INTENSITY
AGRICULTURAL
PRESERVATION LANDS
URBAN AND INDUSTRIAL

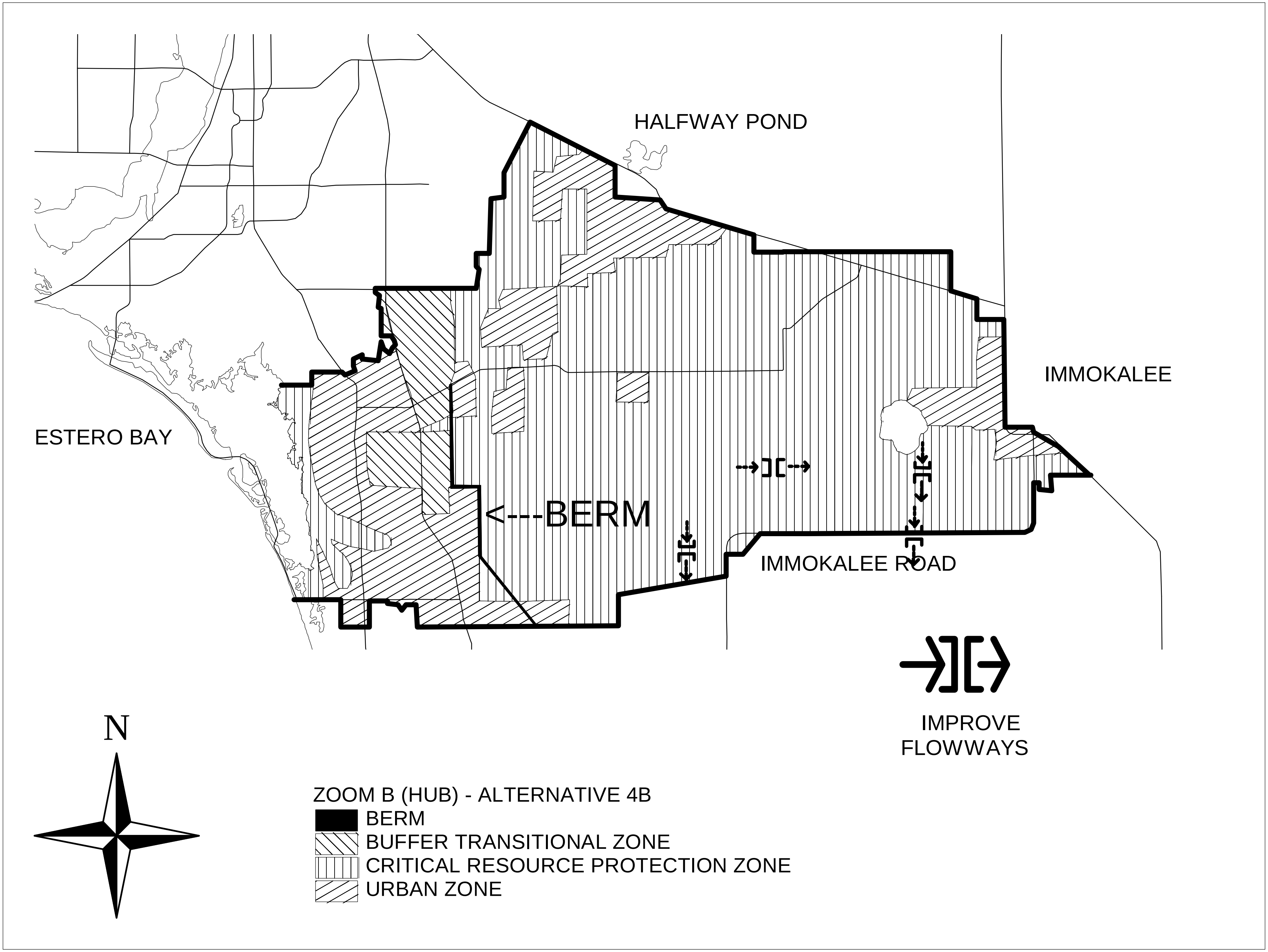


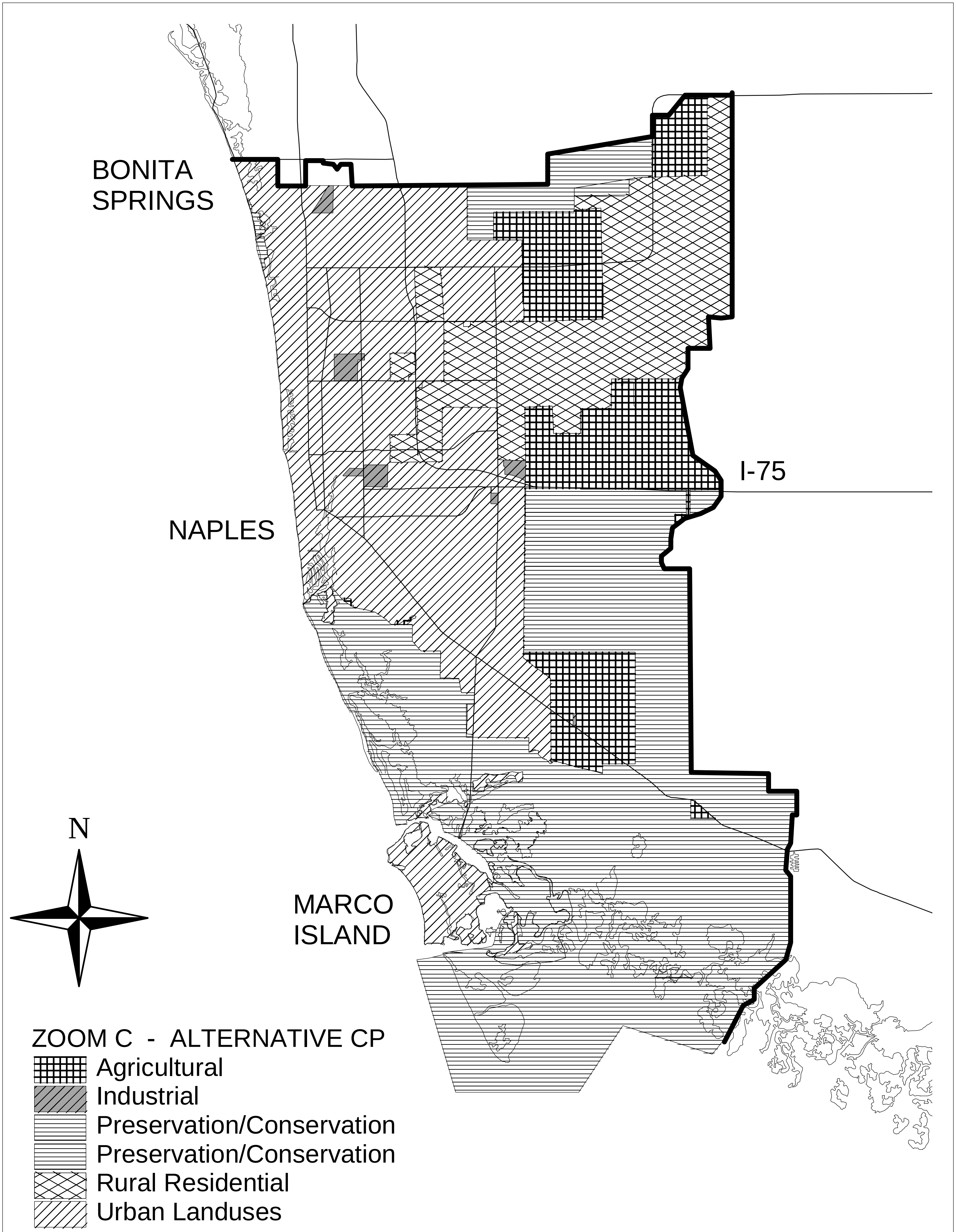
HALFWAY POND
IMMOKALEE
ESTERO BAY
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE 2C
BUFFER TRANSITIONAL ZONE
CRITICAL RESOURCE PROTECTION AREA
URBAN ZONE

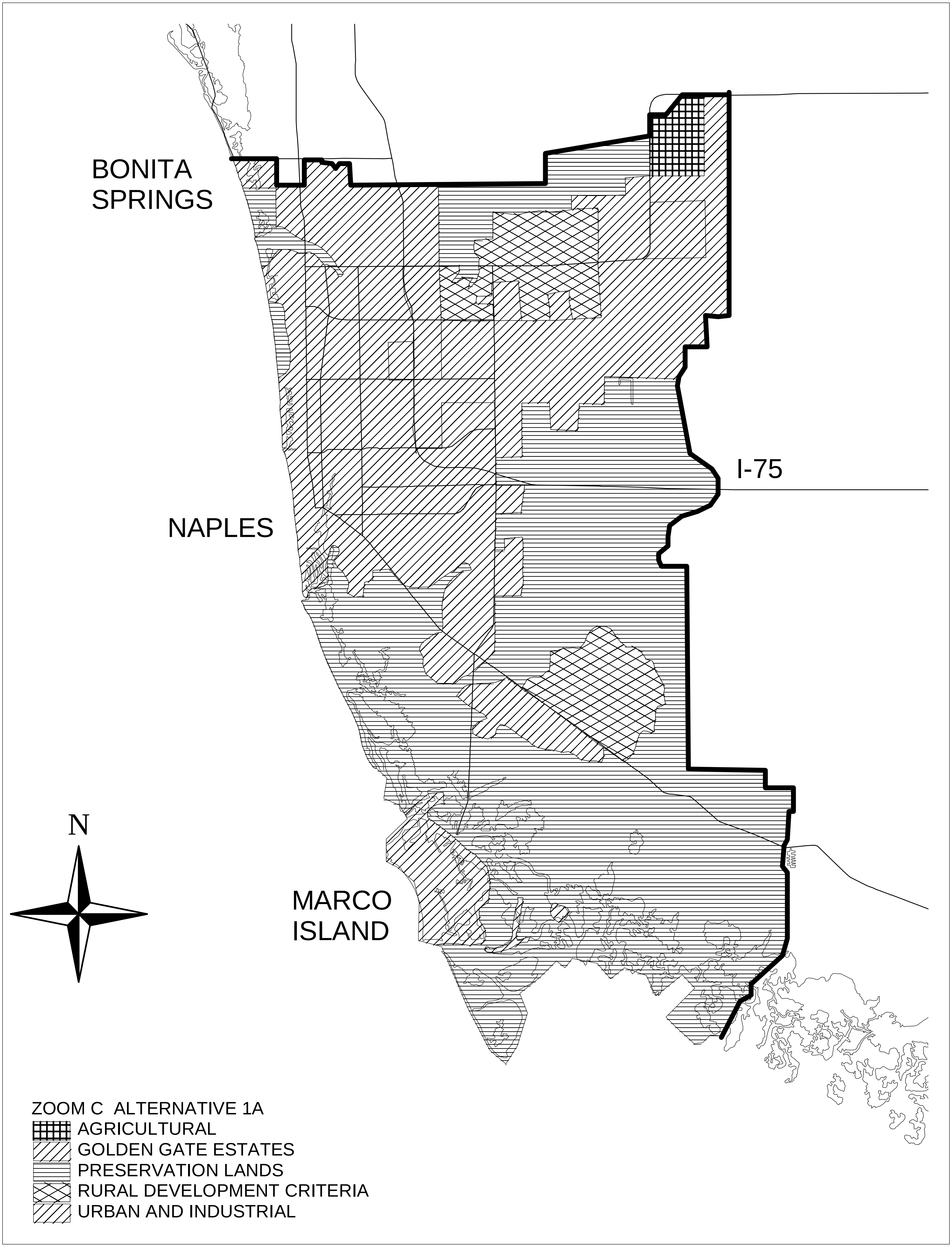

HALFWAY POND
IMMOKALEE
ESTERO BAY
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE 3A
BUFFER TRANSITIONAL ZONE
CRITICAL RESOURCE PROTECTION AREA
URBAN ZONE

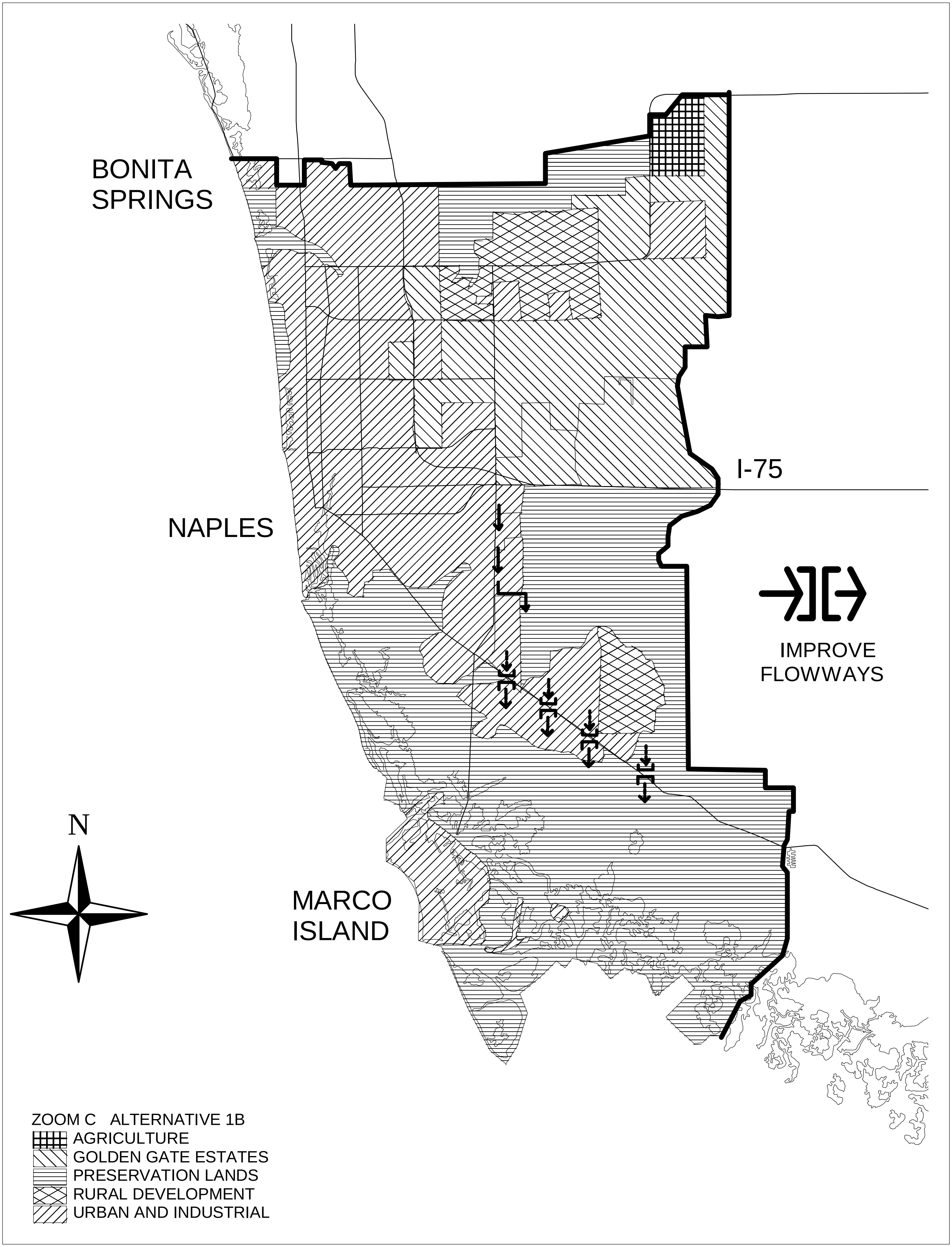

HALFWAY POND
IMMOKALEE
ESTERO BAY
IMMOKALEE ROAD
N
ZOOM B (HUB) - ALTERNATIVE 3B
AGRICULTURE
DEVELOPMENT
MINING LANDS
PRESERVE (EXISTING AND FUTURE)

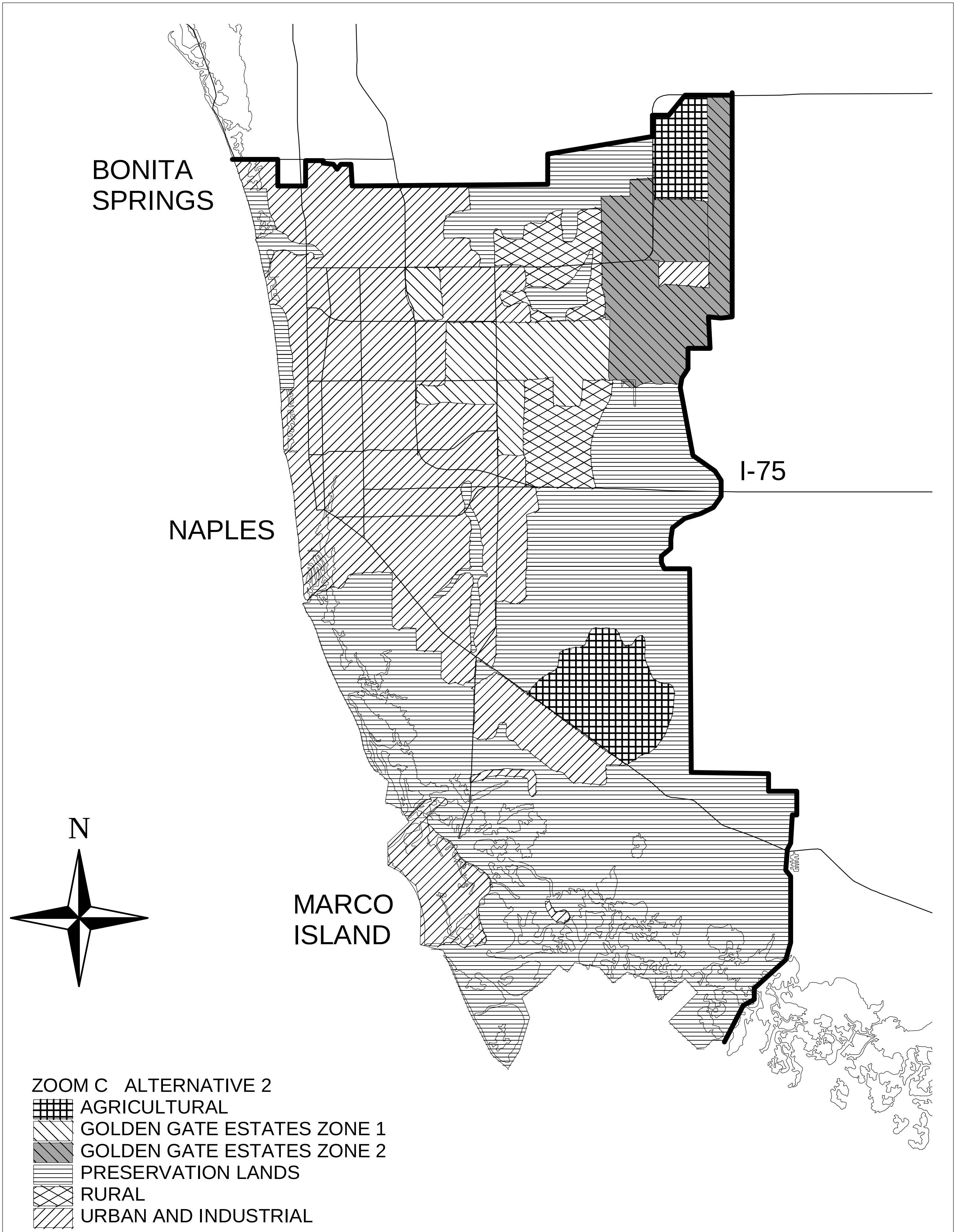

HALFWAY POND
IMMOKALEE
ESTERO BAY
IMMOKALEE ROAD
IMPROVE FLOWWAYS
N
ZOOM B (HUB) - ALTERNATIVE 4A
AGRICULTURAL
DEVELOPMENT
PENDING REVIEW (DEVELOP OR PRESERVE)
MINING LANDS
PRESERVATION LANDS

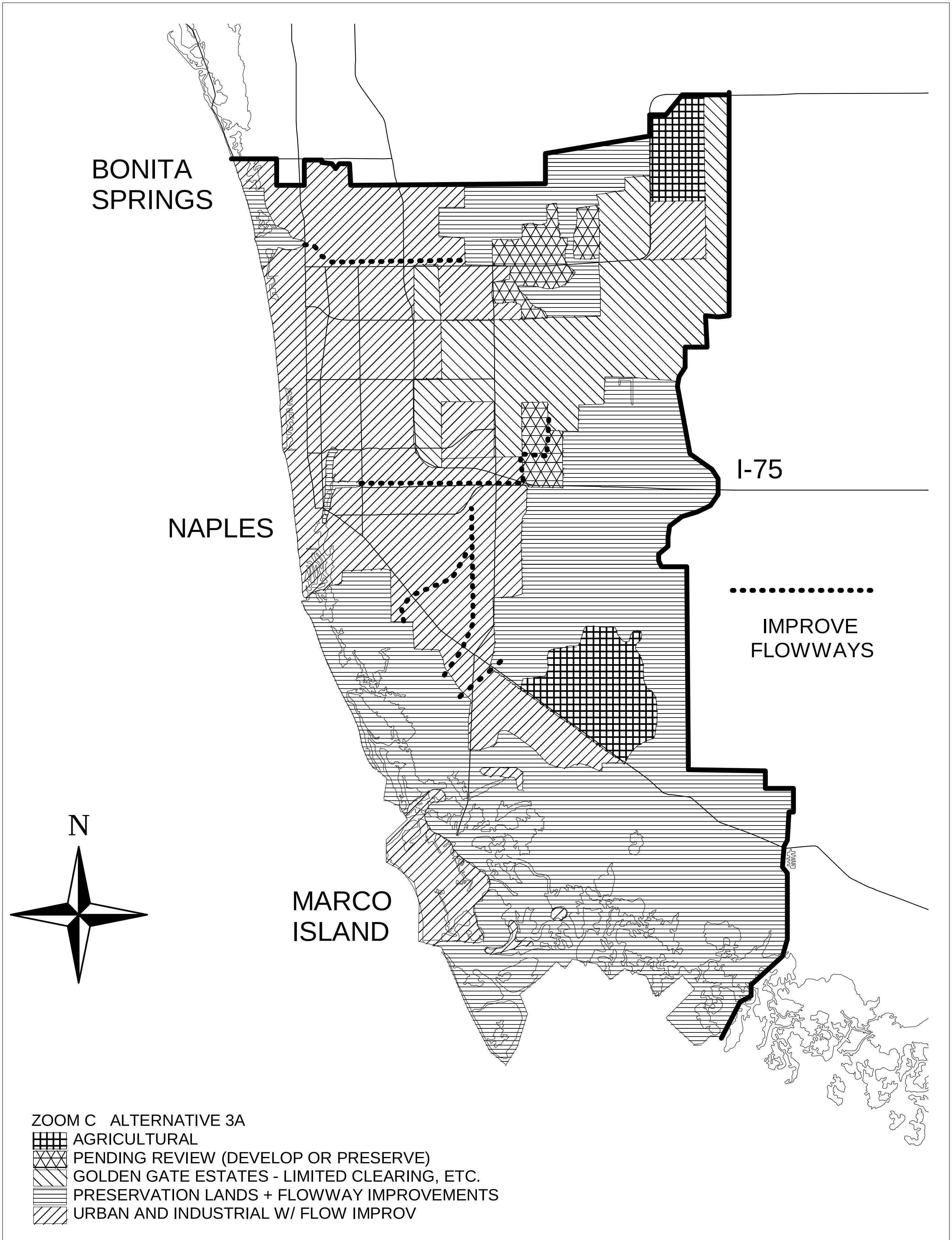

HALFWAY POND
IMMOKALEE
ESTERO BAY
<---BERM
IMMOKALEE ROAD
IMPROVE
FLOWWAYS
N
ZOOM B (HUB) - ALTERNATIVE 4B
BERM
BUFFER TRANSITIONAL ZONE
CRITICAL RESOURCE PROTECTION ZONE
URBAN ZONE

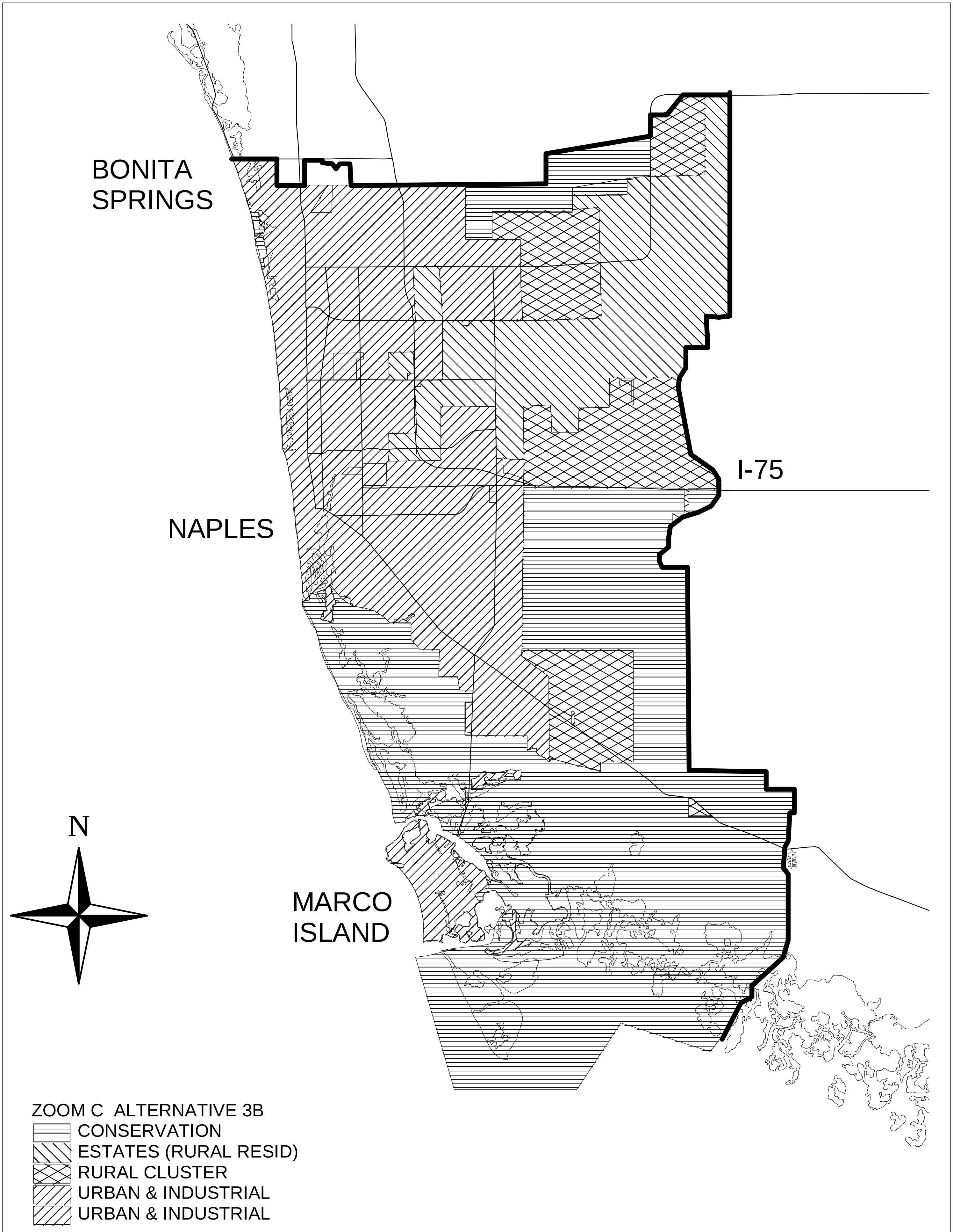

BONITA
SPRINGS
I-75
NAPLES
MARCO
ISLAND
N
ZOOM C - ALTERNATIVE CP
Agricultural
Industrial
Preservation/Conservation
Preservation/Conservation
Rural Residential
Urban Landuses

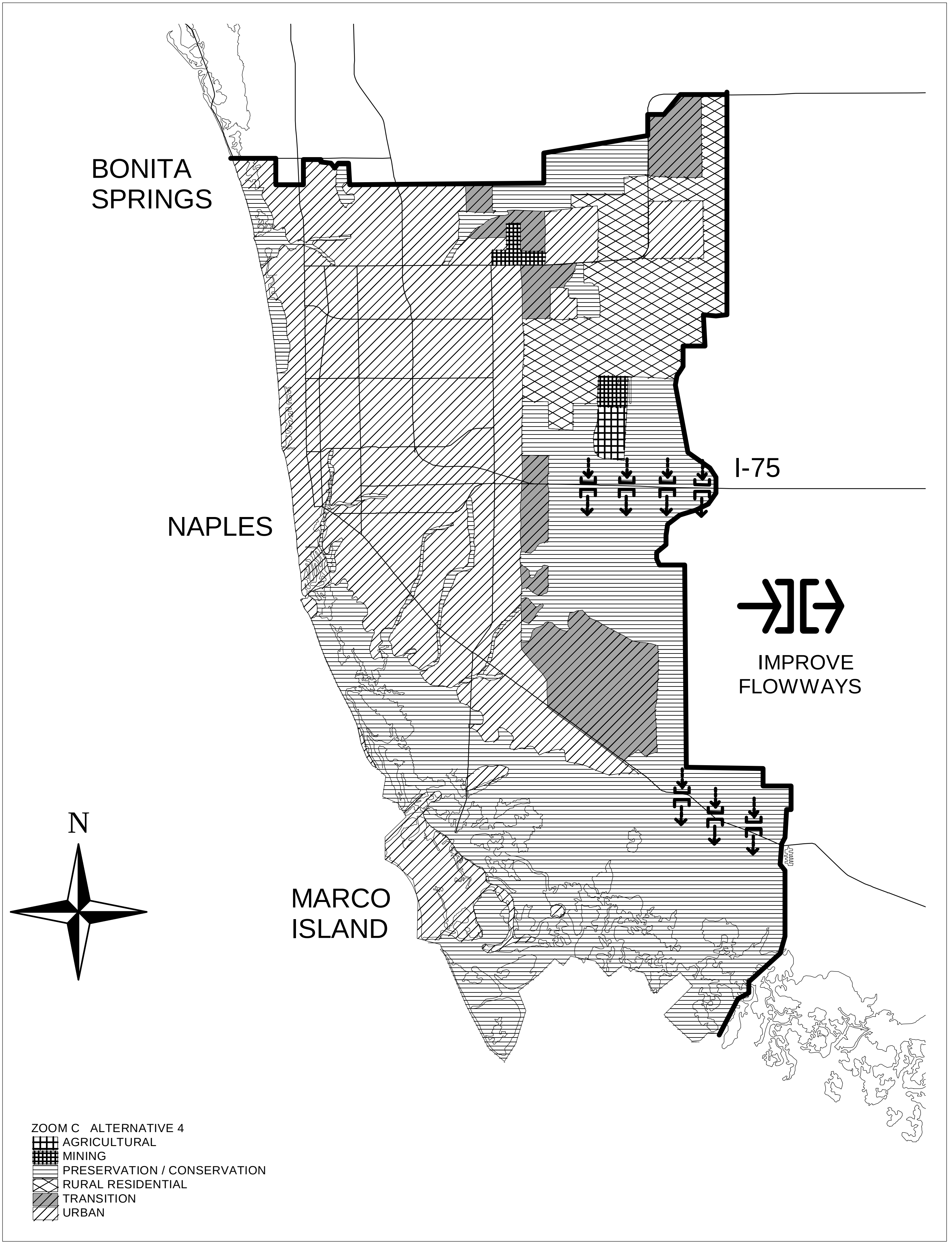

BONITA SPRINGS
NAPLES
I-75
MARCO ISLAND
N
ZOOM C ALTERNATIVE 1A
AGRICULTURAL
GOLDEN GATE ESTATES
PRESERVATION LANDS
RURAL DEVELOPMENT CRITERIA
URBAN AND INDUSTRIAL


BONITA SPRINGS
NAPLES
MARCO ISLAND
I-75
IMPROVE FLOWWAYS
N
ZOOM C ALTERNATIVE 1B
AGRICULTURE
GOLDEN GATE ESTATES
PRESERVATION LANDS
RURAL DEVELOPMENT
URBAN AND INDUSTRIAL

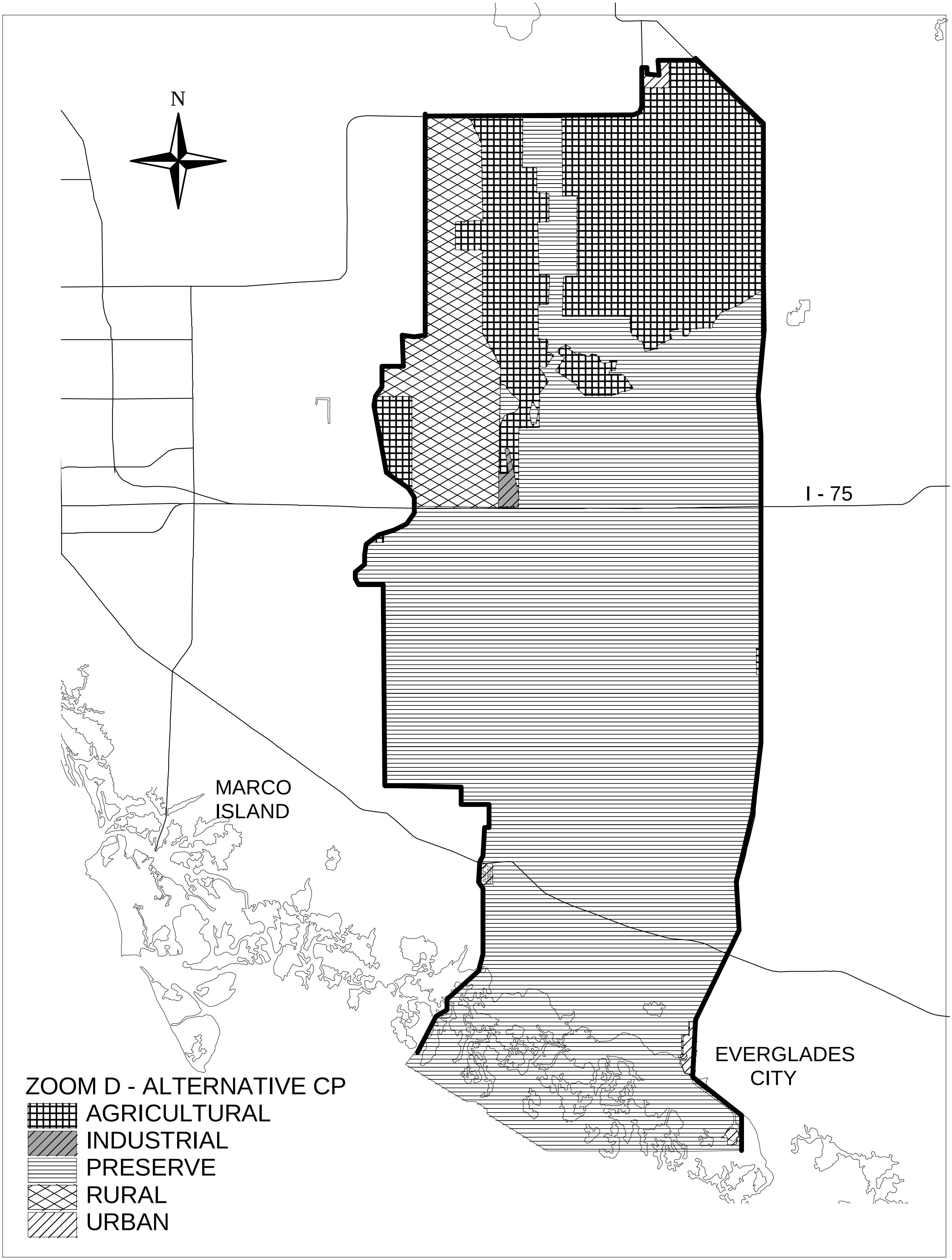

BONITA SPRINGS
NAPLES
I-75
MARCO ISLAND
N
ZOOM C ALTERNATIVE 2
AGRICULTURAL
GOLDEN GATE ESTATES ZONE 1
GOLDEN GATE ESTATES ZONE 2
PRESERVATION LANDS
RURAL
URBAN AND INDUSTRIAL

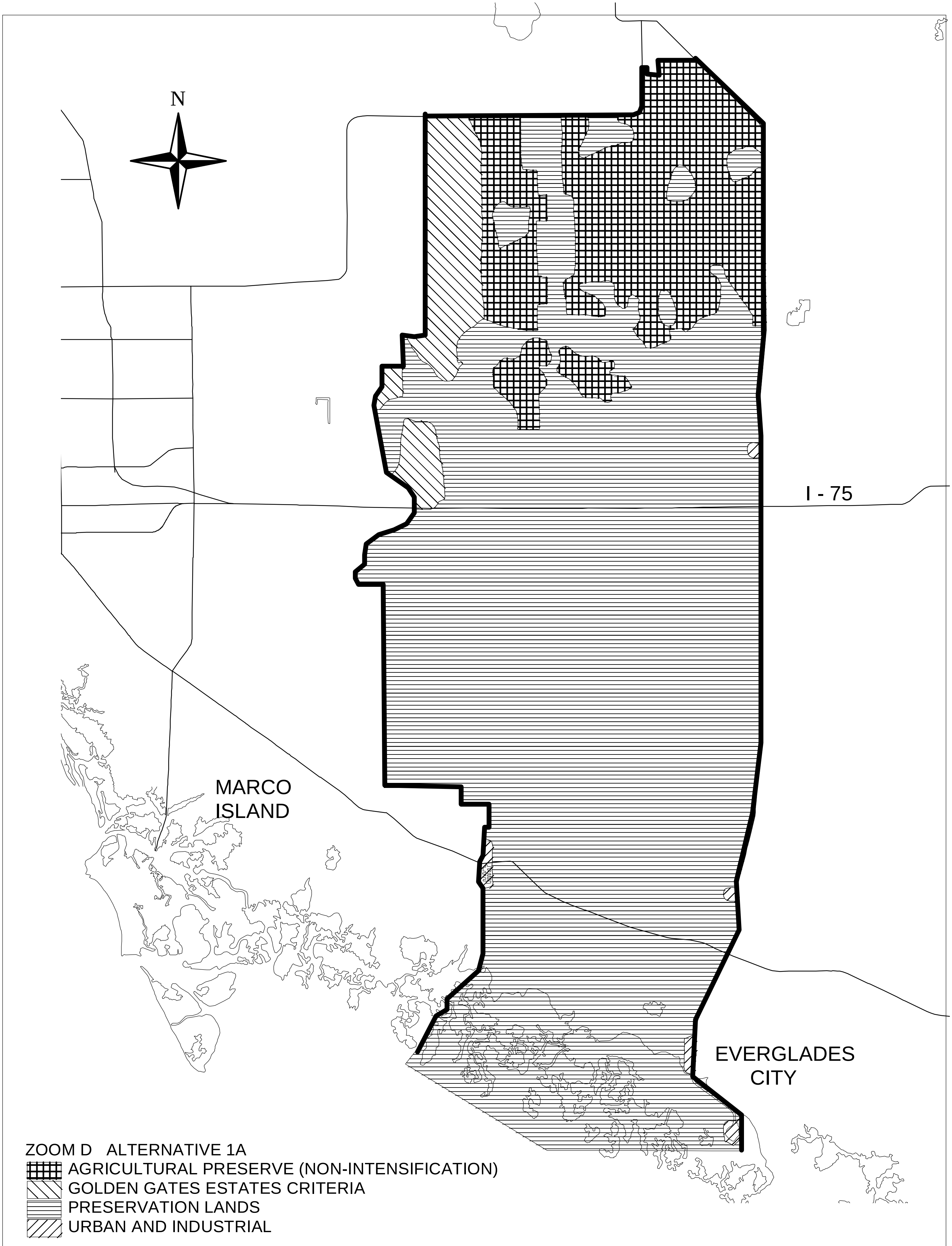

BONITA SPRINGS
NAPLES
MARCO ISLAND
I-75
IMPROVE FLOWWAYS
N
ZOOM C ALTERNATIVE 3A
AGRICULTURAL
PENDING REVIEW (DEVELOP OR PRESERVE)
GOLDEN GATE ESTATES - LIMITED CLEARING, ETC.
PRESERVATION LANDS + FLOWWAY IMPROVEMENTS
URBAN AND INDUSTRIAL W/ FLOW IMPROV

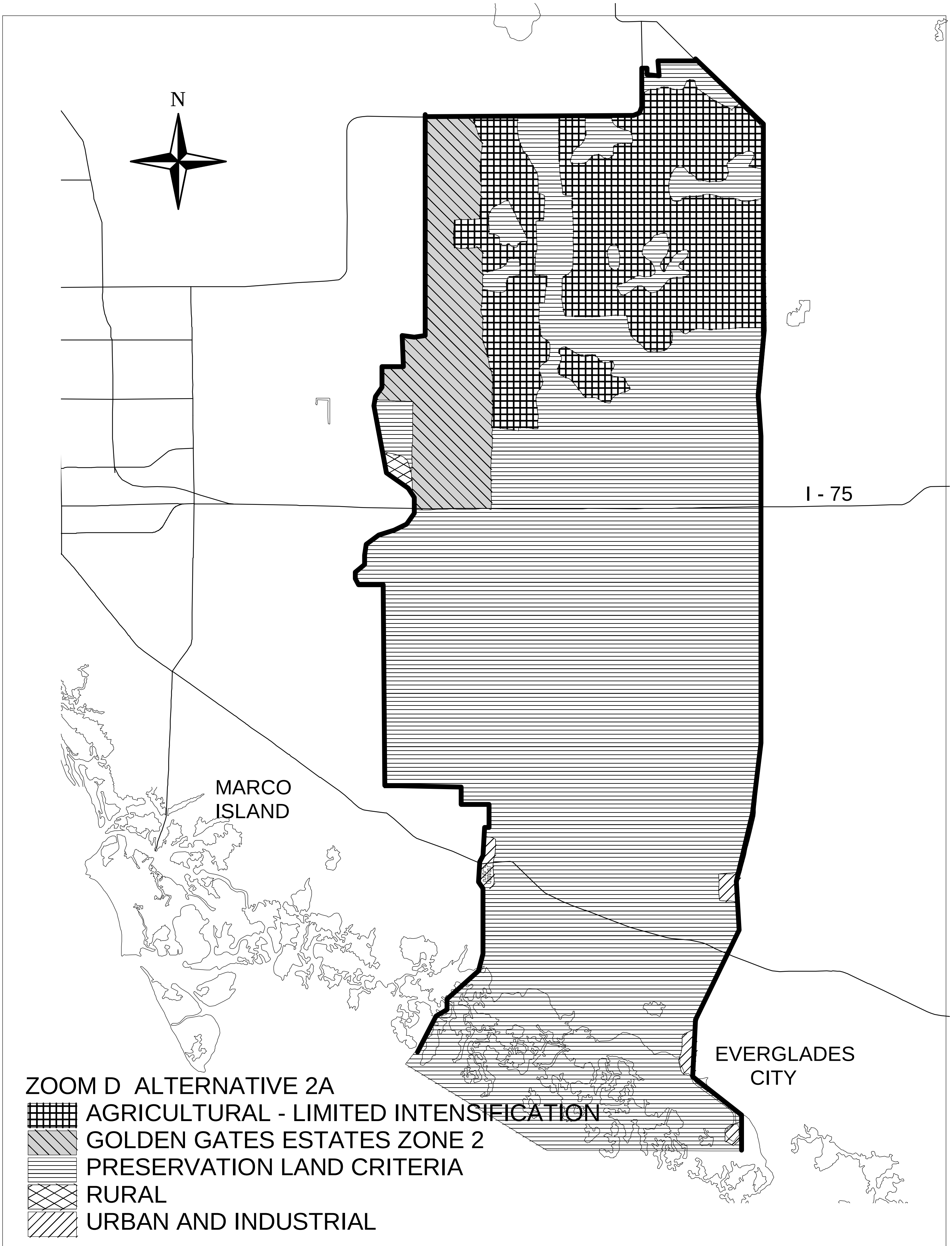

BONITA
SPRINGS
NAPLES
MARCO
ISLAND
I-75
N
ZOOM C ALTERNATIVE 3B
CONSERVATION
ESTATES (RURAL RESID)
RURAL CLUSTER
URBAN & INDUSTRIAL
URBAN & INDUSTRIAL

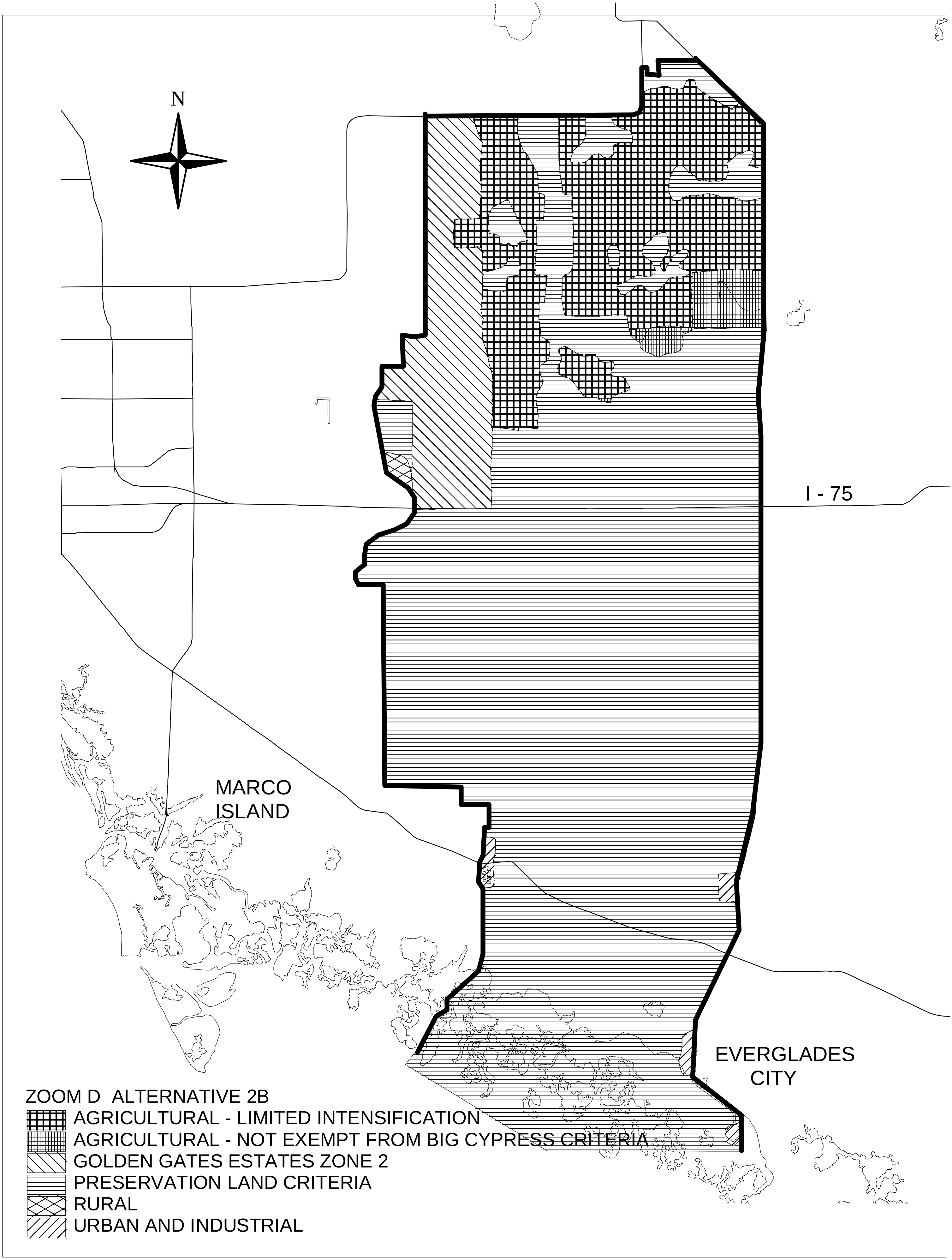


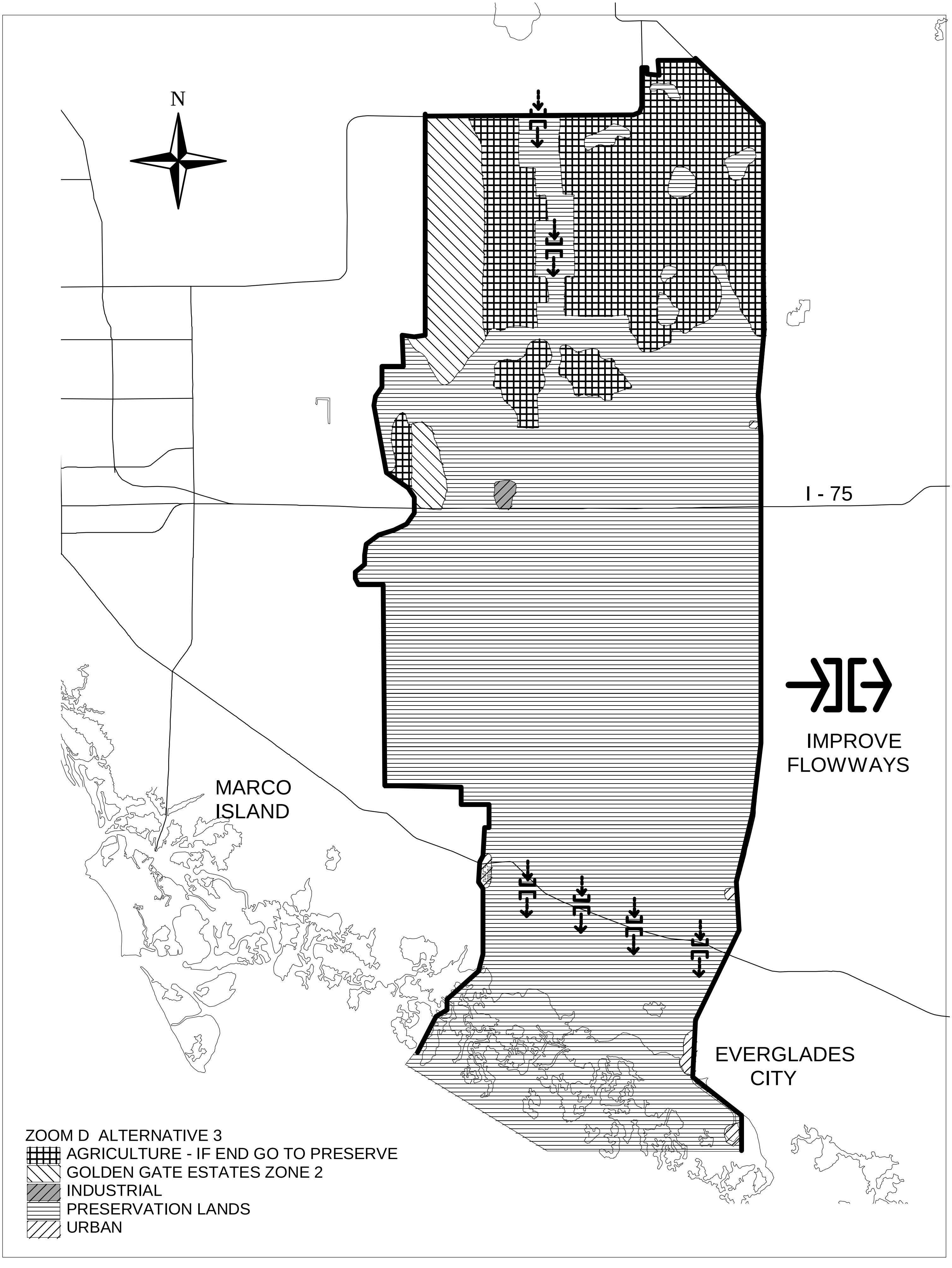
BONITA SPRINGS
NAPLES
MARCO ISLAND
I-75
IMPROVE FLOWWAYS
N
ZOOM C ALTERNATIVE 4
AGRICULTURAL
MINING
PRESERVATION / CONSERVATION
RURAL RESIDENTIAL
TRANSITION
URBAN

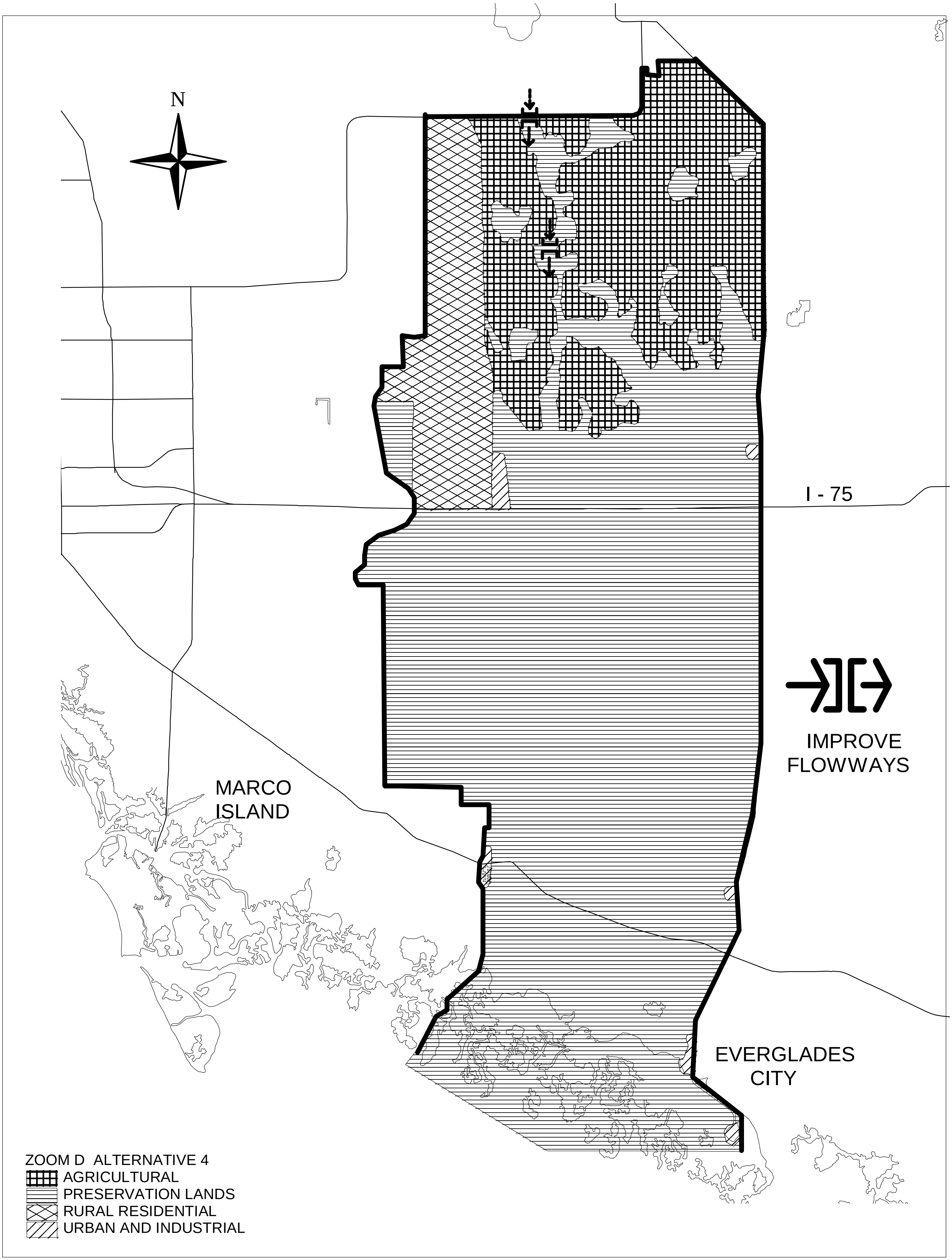

N
I - 75
MARCO ISLAND
EVERGLADES CITY
ZOOM D - ALTERNATIVE CP
AGRICULTURAL
INDUSTRIAL
PRESERVE
RURAL
URBAN


N
I - 75
MARCO
ISLAND
EVERGLADES
CITY
ZOOM D ALTERNATIVE 1A
AGRICULTURAL PRESERVE (NON-INTENSIFICATION)
GOLDEN GATES ESTATES CRITERIA
PRESERVATION LANDS
URBAN AND INDUSTRIAL


N
I - 75
MARCO
ISLAND
EVERGLADES
CITY
ZOOM D ALTERNATIVE 2A
AGRICULTURAL - LIMITED INTENSIFICATION
GOLDEN GATES ESTATES ZONE 2
PRESERVATION LAND CRITERIA
RURAL
URBAN AND INDUSTRIAL


N
I - 75
MARCO
ISLAND
EVERGLADES
CITY
ZOOM D ALTERNATIVE 2B
AGRICULTURAL - LIMITED INTENSIFICATION
AGRICULTURAL - NOT EXEMPT FROM BIG CYPRESS CRITERIA
GOLDEN GATES ESTATES ZONE 2
PRESERVATION LAND CRITERIA
RURAL
URBAN AND INDUSTRIAL


N
I - 75
IMPROVE
FLOWWAYS
MARCO
ISLAND
EVERGLADES
CITY
ZOOM D ALTERNATIVE 3
AGRICULTURE - IF END GO TO PRESERVE
GOLDEN GATE ESTATES ZONE 2
INDUSTRIAL
PRESERVATION LANDS
URBAN

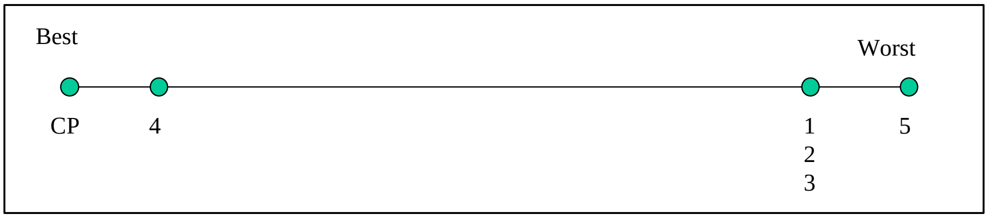

N
I - 75
IMPROVE
FLOWWAYS
MARCO
ISLAND
EVERGLADES
CITY
ZOOM D ALTERNATIVE 4
AGRICULTURAL
PRESERVATION LANDS
RURAL RESIDENTIAL
URBAN AND INDUSTRIAL

APPENDIX D

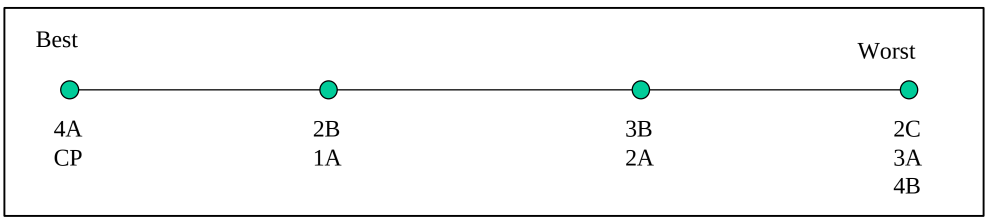
CONTINUUM OF ALTERNATIVES BY ISSUE CATEGORY

PROPERTY RIGHTS

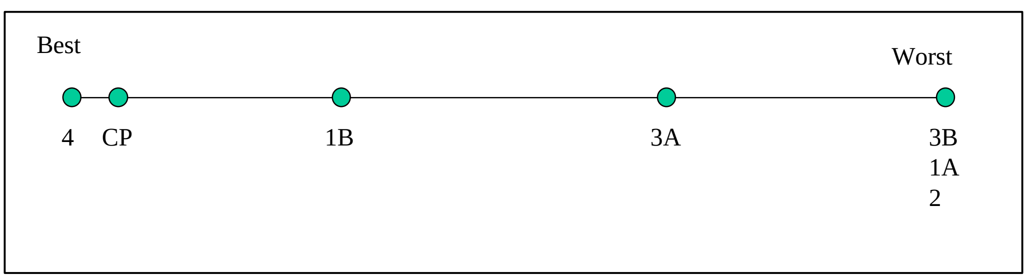
ZOOM A



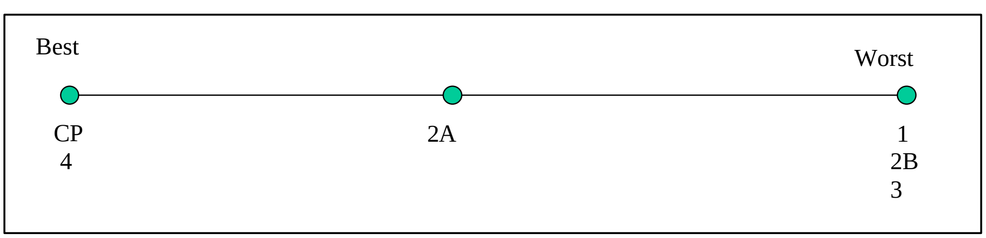
ZOOM B



ZOOM C

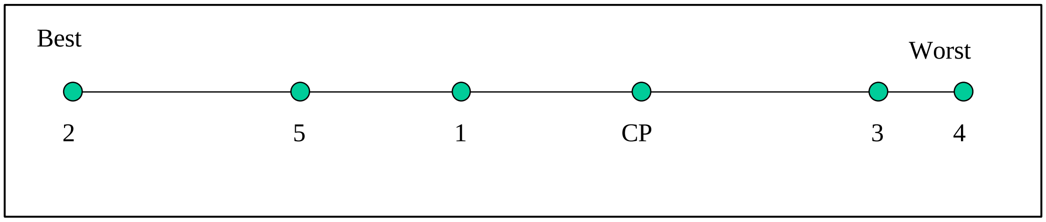


ZOOM D

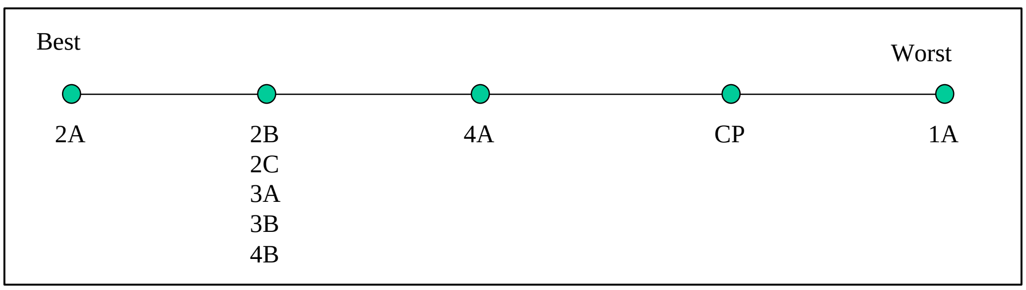


WATER MANAGEMENT

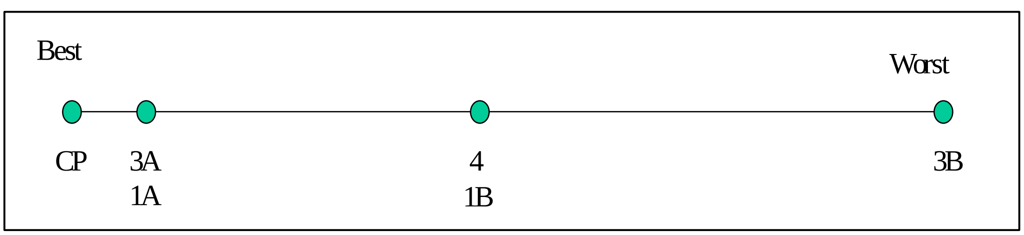
ZOOM A



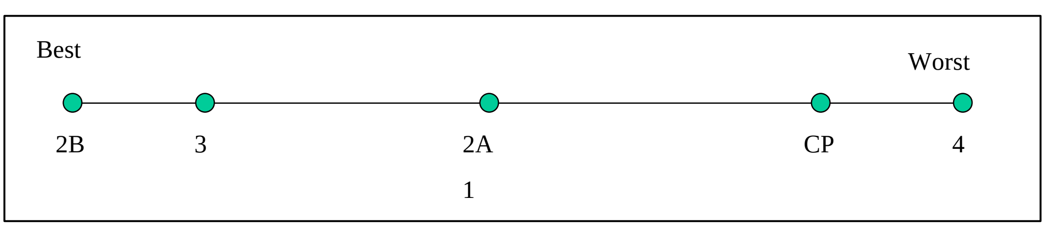
ZOOM B



ZOOM C



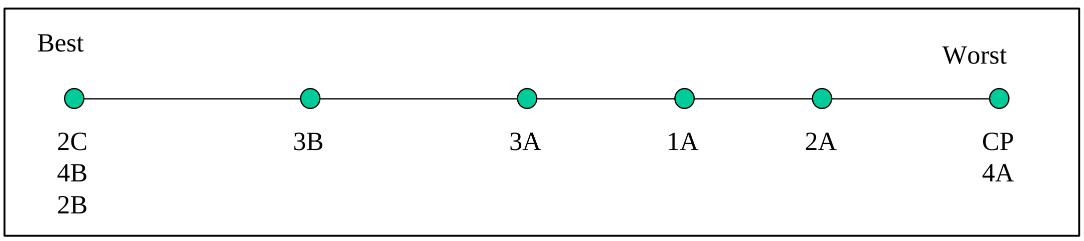
ZOOM D



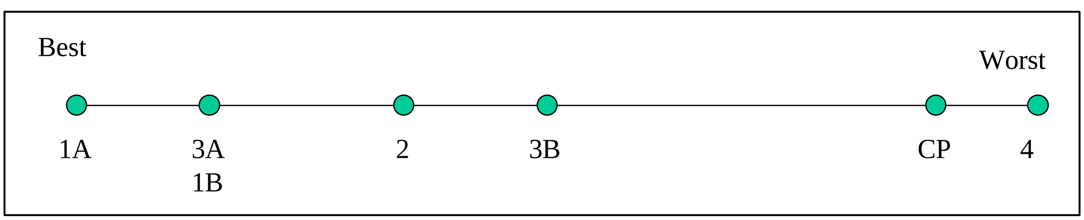
WATER QUALITY

ZOOM A

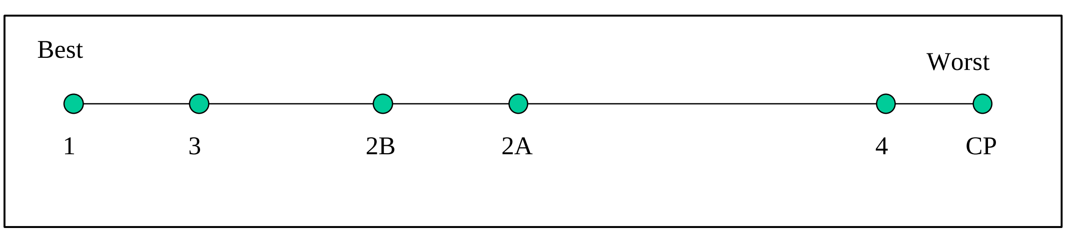
ZOOM B



ZOOM C

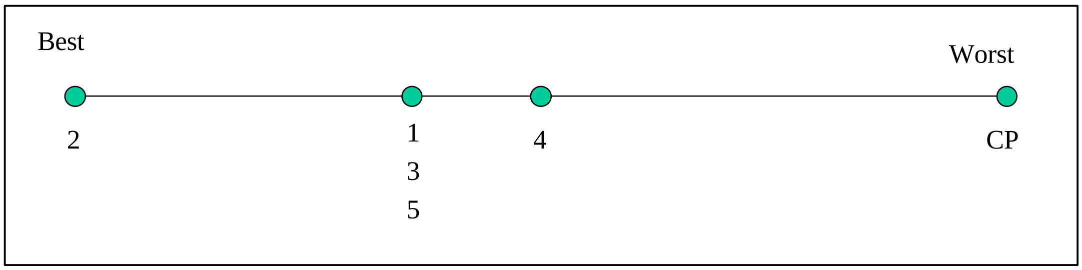


ZOOM D

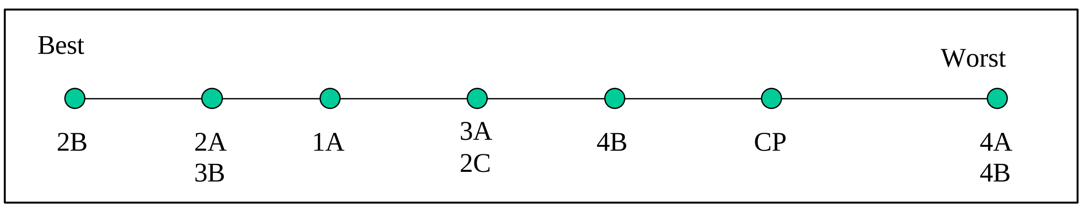


ECOSYSTEM FUNCTION, WILDLIFE HABITAT, AND LISTED SPECIES

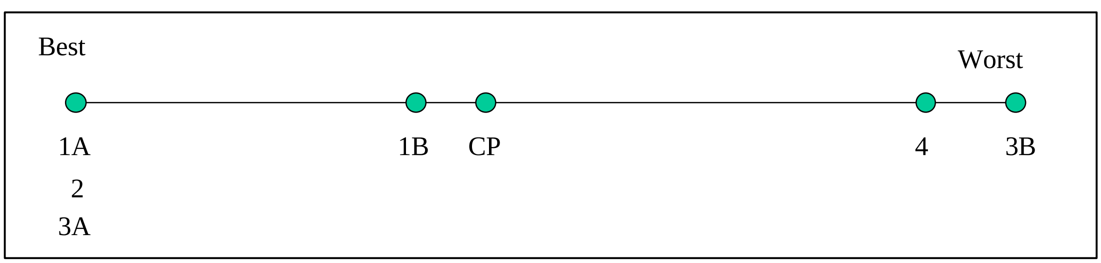
ZOOM A



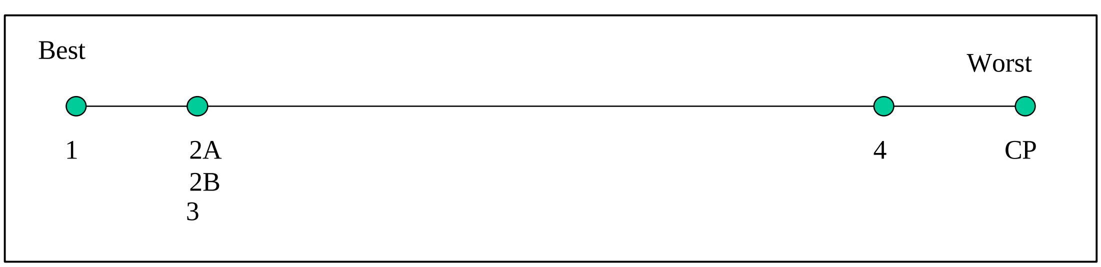
ZOOM B



ZOOM C



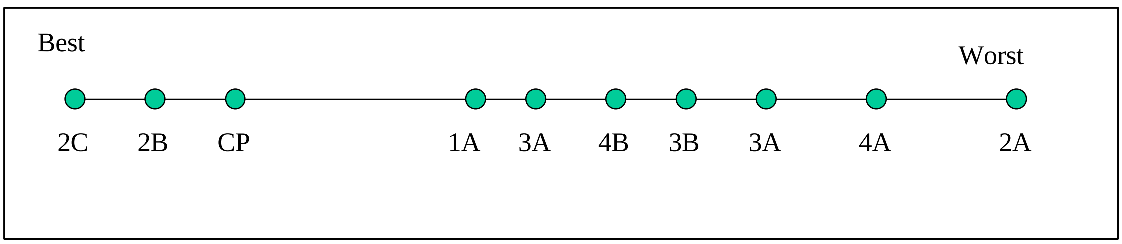
ZOOM D



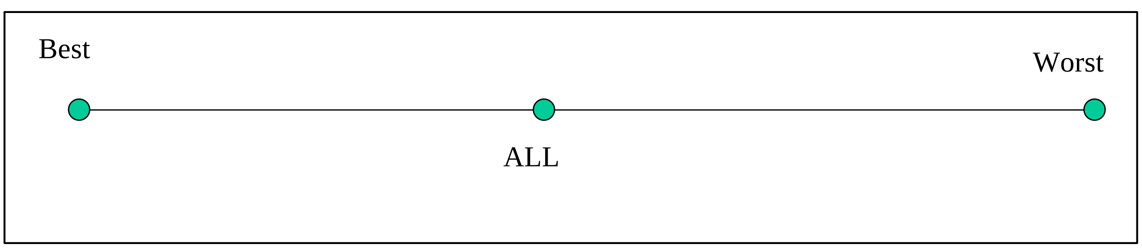
REGULATORY EFFICIENCY AND EFFECTIVENESS

ZOOM A

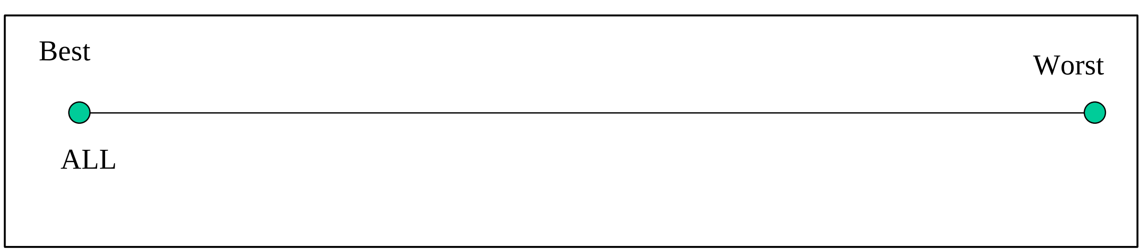
ZOOM B



ZOOM C

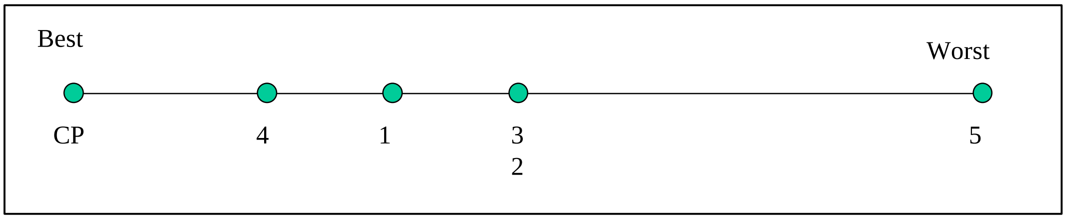


ZOOM D

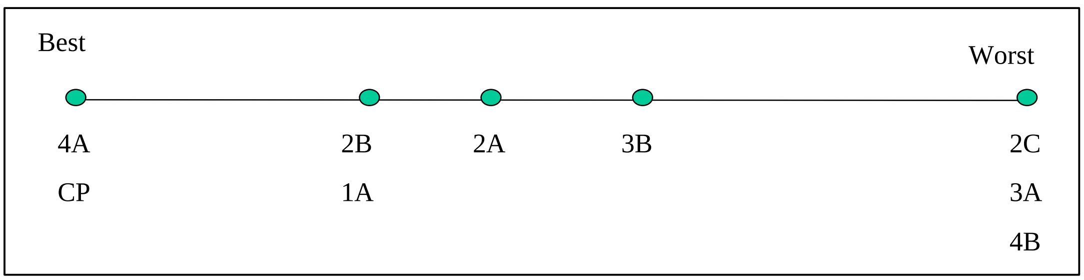


ECONOMIC SUSTAINABILITY

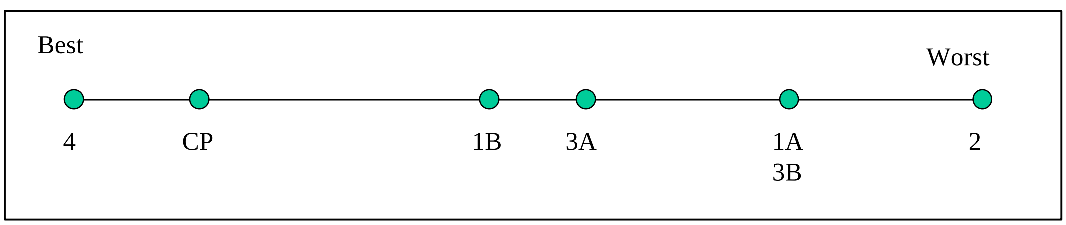
ZOOM A



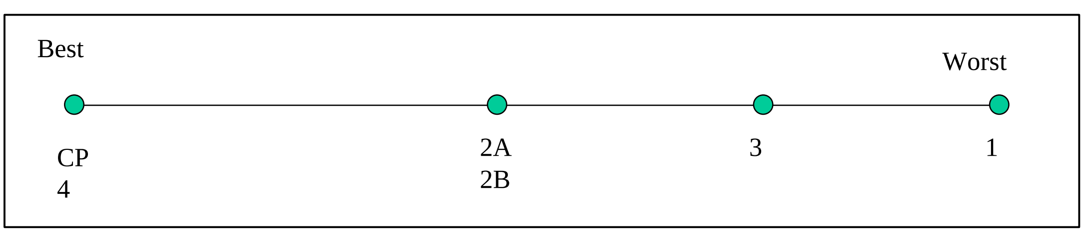
ZOOM B



ZOOM C

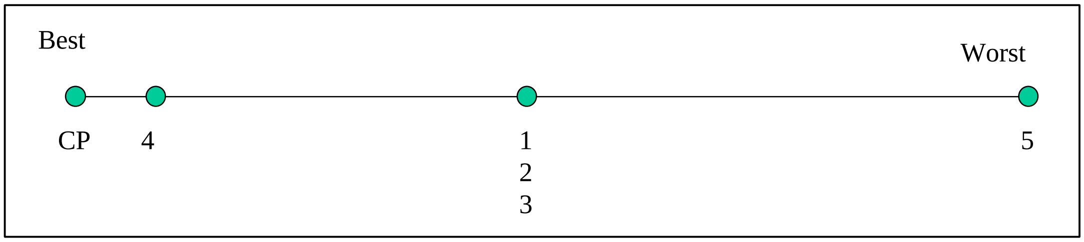


ZOOM D

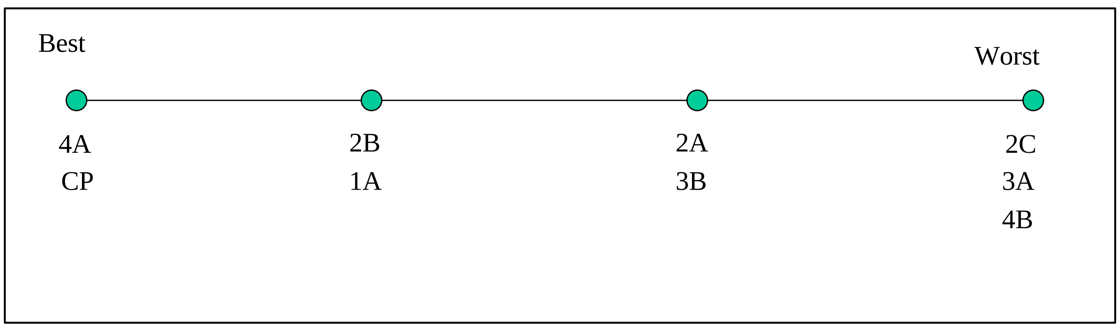


LOCAL LAND USE POLICY

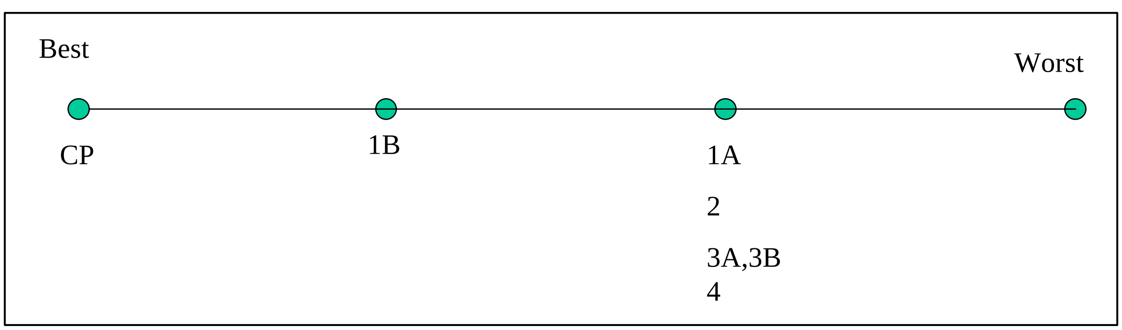
ZOOM A



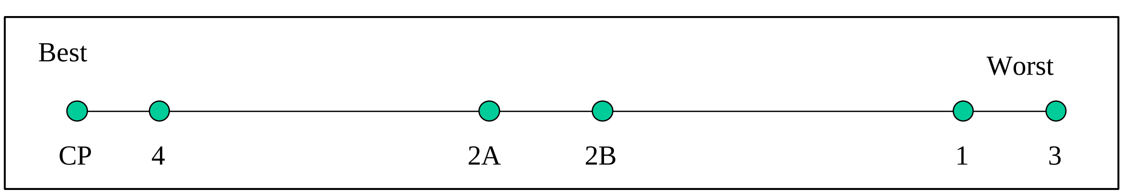
ZOOM B



ZOOM C

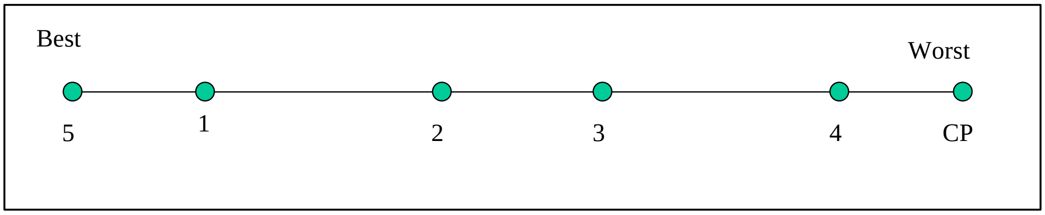


ZOOM D

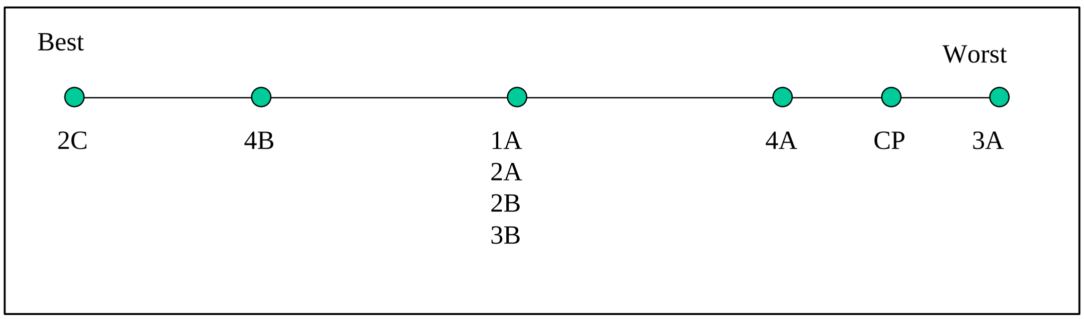


AVOIDANCE OF WETLAND IMPACTS

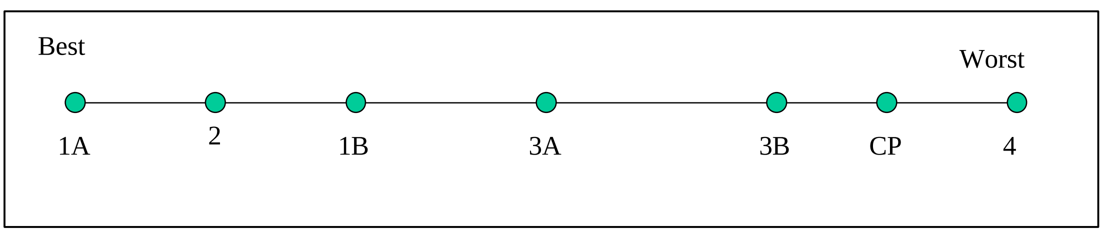
ZOOM A



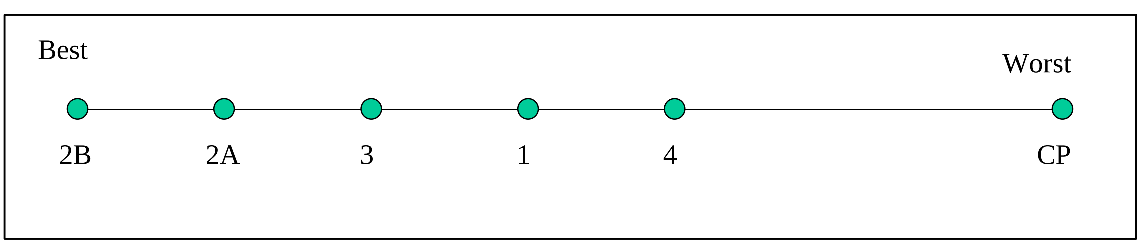
ZOOM B



ZOOM C

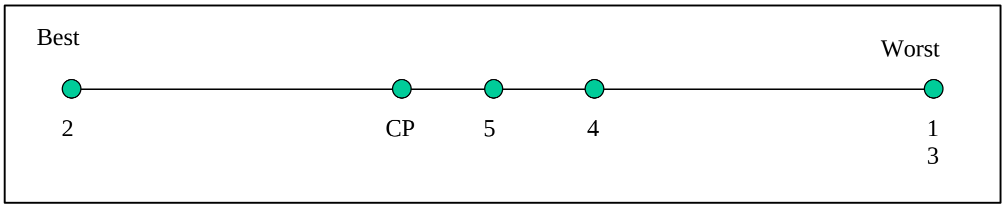


ZOOM D

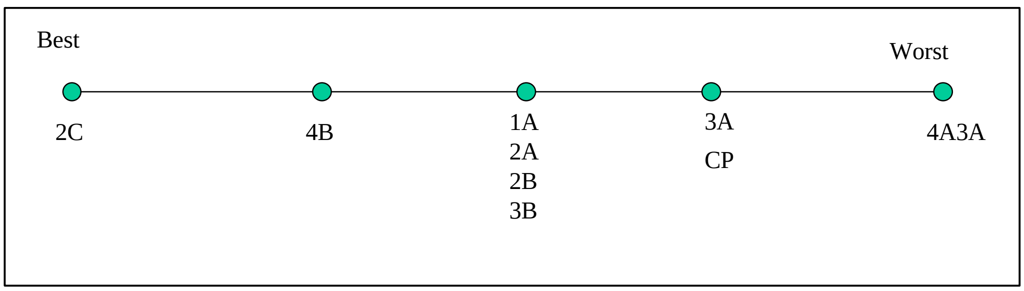


MITIGATION

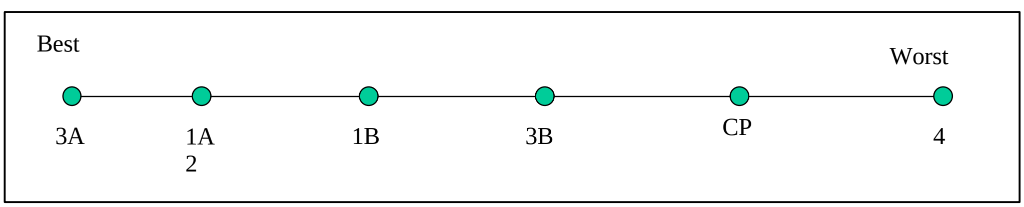
ZOOM A



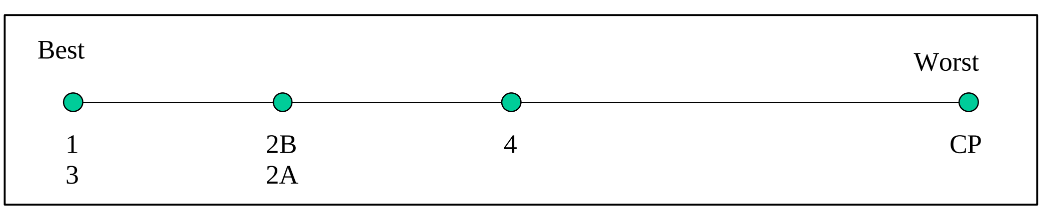
ZOOM B



ZOOM C

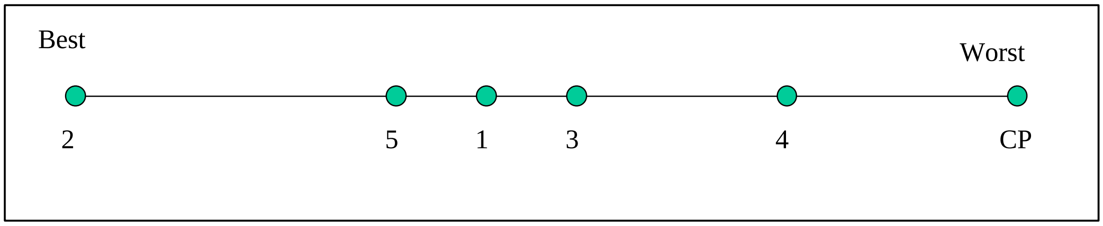


ZOOM D



CUMULATIVE/SECONDARY IMPACTS

ZOOM A



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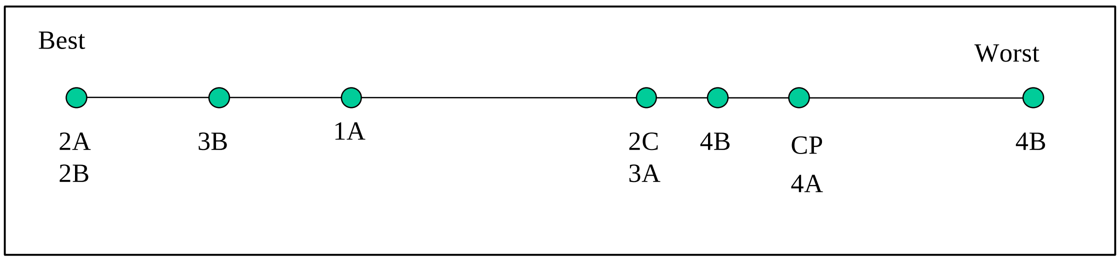
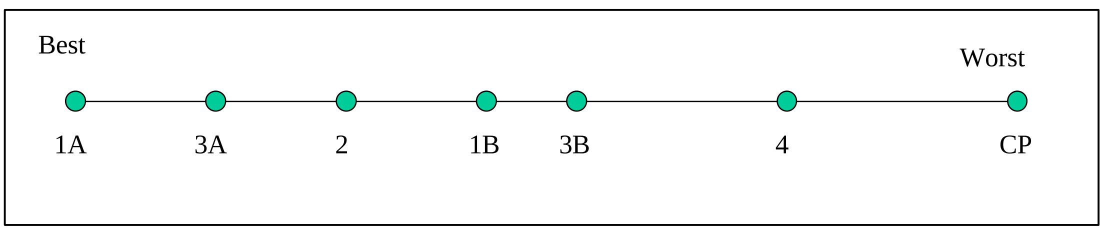
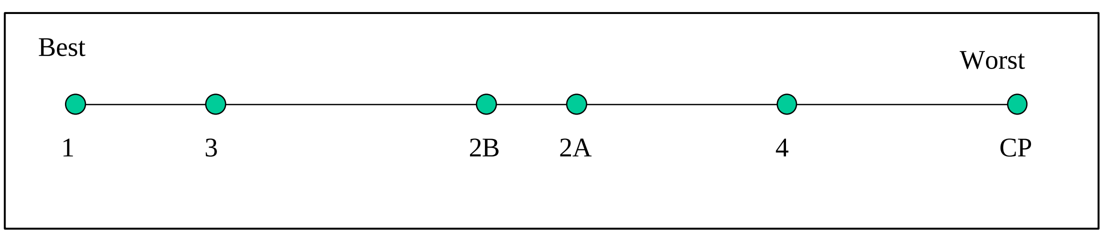


ZOOM C

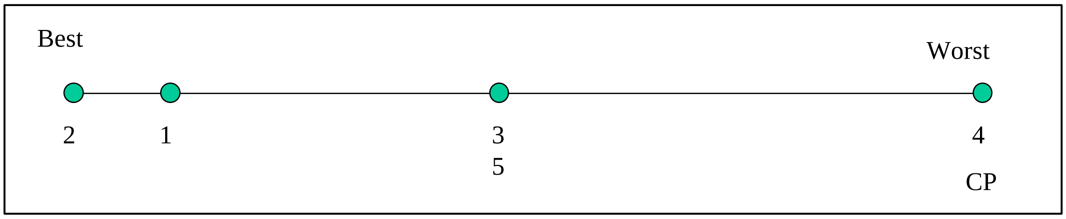


ZOOM D



RESTORATION/RETROFIT

ZOOM A



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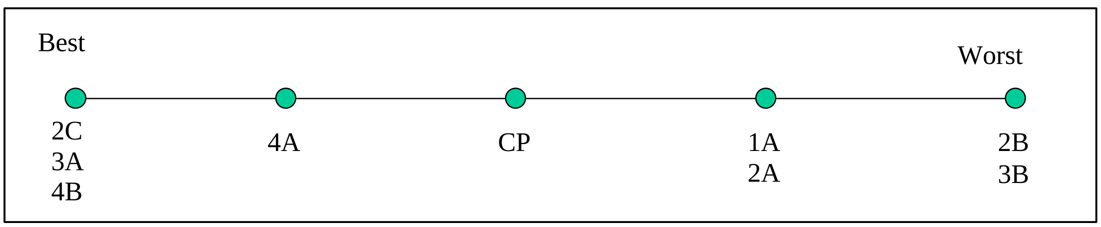

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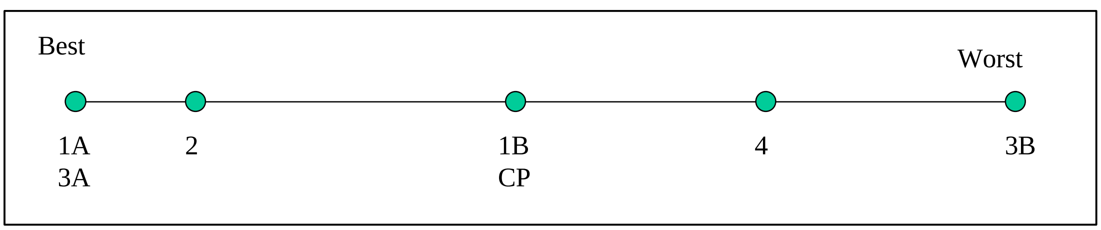

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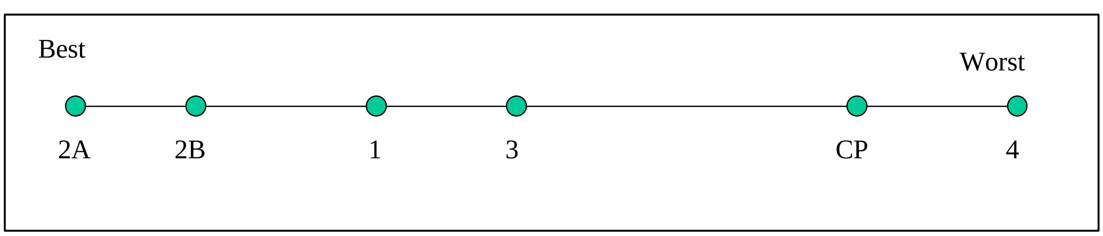
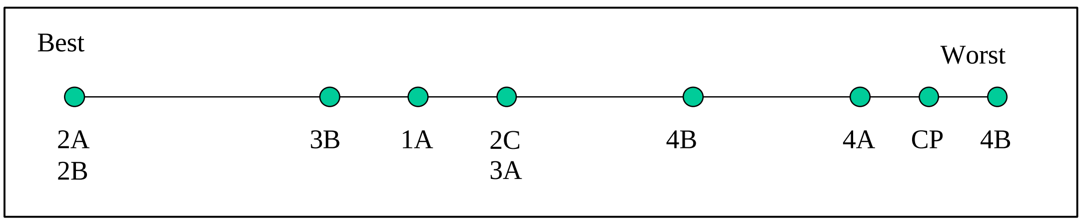


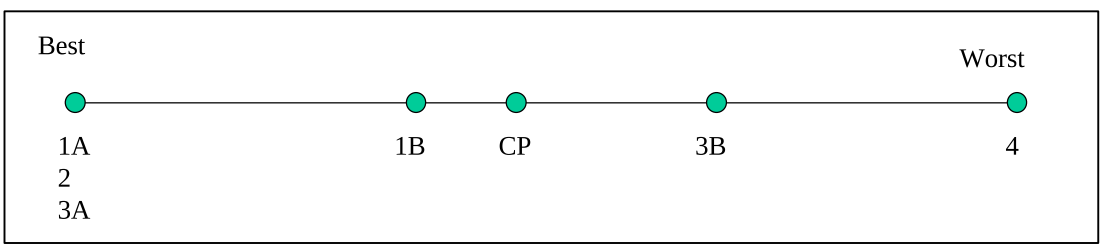
PUBLIC LANDS MANAGEMENT/USE

ZOOM A

ZOOM B



ZOOM C



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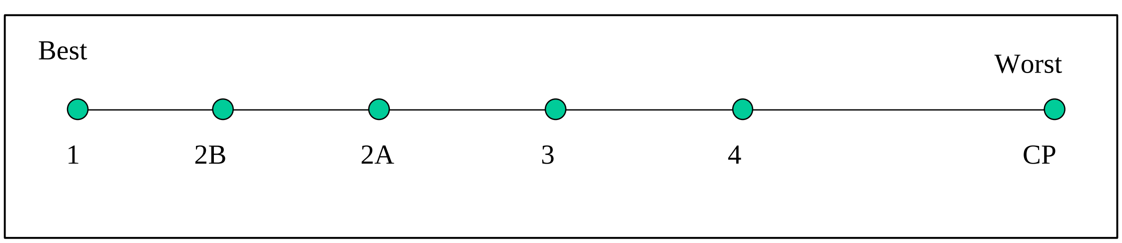


APPENDIX E

FAMILY AND SUBFAMILY DESIGNATION

Hierarchy from Family to SubFamily to Legend						
Fam	**Family Name**	**SUBFAM**	**SubFamily Name**	**Zoom**	**ALT**	**Legend**
100	Development	110		A	CP	Industrial
100	Development	110		A	CP	Urban
100	Development	110		A	1A	Airport
100	Development	110		A	2	Airport
100	Development	110		A	2	Urban & Industrial
100	Development	110		A	3A	Airport
100	Development	110		A	3A	Urban & Industrial
100	Development	110		A	4	Airport
100	Development	110		A	4	Urban & Industrial
100	Development	110		A	5	Airport
100	Development	110		C	CP	Industrial
100	Development	110		C	CP	Urban Landuses
100	Development	110		C	1A	Urban & Industrial
100	Development	110		C	4	Transition
100	Development	110		D	CP	Industrial
100	Development	110		D	CP	Urban Landuses
100	Development	110		D	1A	Urban & Industrial
100	Development	110		D	2A	Urban & Industrial
100	Development	110		D	2B	Urban & Industrial
100	Development	110		D	3	Urban
100	Development	110		D	3	Industrial
100	Development	110		D	4	Urban & Industrial
100	Development	110		Hub	CP	Urban Landuses
100	Development	110		Hub	CP	Industrial
100	Development	110		Hub	CP	Rural Residential
100	Development	110		Hub	2B	Urban & Industrial
100	Development	110		Hub	3B	Development
100	Development	110		Hub	4A	Development
100	Development	120	Flowway Improvements	C	3A	Urban & Industrial
100	Development	120	Flowway Improvements	C	3B	Urban & Industrial
100	Development	120	Flowway Improvements	C	4	Urban
100	Development	120	Flowway Improvements	Hub	1A	Urban & Industrial
100	Development	120	Flowway Improvements	Hub	2A	Development (w/ Flowways &tc)
100	Development	130	Compensate off-site for wide ranging species	Hub	2A	Off-site Compensation

Hierarchy from Family to SubFamily to Legend

Fam	Family Name	SUBFAM	SubFamily Name	Zoom	ALT	Legend
100	Development	140	Regional/Comprehensive Stormwater Mgmt	A	1A	Urban & Industrial
100	Development	150	Replumb Henderson/Culverts Tamiami	C	1B	Urban & Industrial
100	Development	160	S Criteria for Urban	C	2	Urban & Industrial
200	Lehigh	210		A	CP	Urban (Lehigh)
200	Lehigh	210		A	1A	Urban (Lehigh)
200	Lehigh	210		A	3A	Urban (Lehigh)
200	Lehigh	220	Urban Zone Updated	A	5	Urban Zone (Lehigh)
200	Lehigh	230	Lehigh - Restore, Retrofit, Redevel (3R)	A	1A	Restoration, Retrofit, Redevelopmt
200	Lehigh	230	Lehigh - Acquire, Restore, Fix (ARF)	A	3A	Acquire, Restore, Fix
200	Lehigh	230	Lehigh - Redevelopment	A	4	Redevelopment
200	Lehigh	240	Lehigh - Lehigh Acres Zone	A	2	Lehigh Acres
200	Lehigh	250	Lehigh - Lehigh Greenway	A	2	Greenway
200	Lehigh	260	Lehigh - Water Storage	A	4	Water Storage
200	Lehigh	270	ARF Zone	A	5	Acquire, Restore, Fix
300	GoldenGate	310		C	CP	Rural Residential
300	GoldenGate	310		C	1A	Golden Gates Estates
300	GoldenGate	310		C	1B	Golden Gates Estates
300	GoldenGate	310		C	4	Rural Residential
300	GoldenGate	310		D	CP	Rural Residential
300	GoldenGate	310		D	4	Rural Residential
300	GoldenGate	330	S Criteria for Golden Gate Estates ZONE 1	C	2	Golden Gates Estates Zone 1
300	GoldenGate	340	S Criteria for Golden Gate Estates ZONE 2	C	2	Golden Gates Estates Zone 2
300	GoldenGate	340	S Criteria for Golden Gate Estates Zone 2	D	1A	Golden Gates Estates
300	GoldenGate	340	S Criteria for Golden Gate Estates ZONE 2	D	2A	Golden Gates Estates
300	GoldenGate	340	S Criteria for Golden Gate Estates ZONE 2	D	2B	Golden Gates Estates
300	GoldenGate	340	S Criteria for Golden Gate Estates ZONE 2	D	3	Golden Gates Estates
300	GoldenGate	350	Estates (Rural) Standards	C	3B	Estates (Rural Residential)
300	GoldenGate	360	GGE: limit clear+protect isolated wet+connect	C	3A	Golden Gate Estates
400	Agriculture	410		A	CP	Agricultural
400	Agriculture	410		C	CP	Agricultural
400	Agriculture	410		C	1A	Agricultural

Hierarchy from Family to SubFamily to Legend

Fam	Family Name	SUBFAM	SubFamily Name	Zoom	ALT	Legend
400	Agriculture	410		C	1B	Agricultural
400	Agriculture	410		C	3A	Agricultural
400	Agriculture	410		C	4	Agricultural
400	Agriculture	410		D	CP	Agricultural
400	Agriculture	410		D	4	Agricultural
400	Agriculture	410		Hub	CP	Agricultural
400	Agriculture	410		Hub	1A	Agricultural
400	Agriculture	410		Hub	2B	Agricultural
400	Agriculture	410		Hub	3B	Agriculture
400	Agriculture	410		Hub	4A	Agricultural
400	Agriculture	420	Mining Lands	C	4	Mining
400	Agriculture	420	Mining Lands	Hub	3B	Mining Lands
400	Agriculture	420	Mining Lands	Hub	4A	Mining Lands
400	Agriculture	430	Non-intensification	D	1A	Agricultural Preserve
400	Agriculture	430	Maintain Intensity	Hub	2B	Agricultural - Maintain Intensity
400	Agriculture	440	Limited Intensification	D	2A	Agricultural
400	Agriculture	440	Limited Intensification	D	2B	Agricultural
400	Agriculture	440	Limited Intensification	Hub	2A	Agriculture (Limited Intensification)
400	Agriculture	450	Big Cypress ACSC: Agriculture non-exempt	D	2B	Agriculture (BCACSC)
400	Agriculture	460	If Agriculture ends then goes to preserve	D	3	Agricultural - Go To Preserve
400	Agriculture	470	S Criteria for Agriculture	C	2	Agricultural
500	Rural	510		A	CP	Rural Residential
500	Rural	510		A	3A	Rural Residential
500	Rural	510		A	4	Rural Development
500	Rural	520	Rural Low Density Mix	D	2A	Rural
500	Rural	520	Rural Low Density Mix	D	2B	Rural
500	Rural	530	Rural Criteria (Mtg 7 Append E)	A	1A	Rural Residential
500	Rural	530	Rural Criteria (Mtg 7 Append E)	A	2	Rural
500	Rural	530	Lower Density Rural uses+Hammond Flowway	Hub	2A	Rural
500	Rural	540	Rural Development Criteria ("Twin Eagle")	C	1A	Rural Development
500	Rural	550	Rural Development Criteria	C	1B	Rural Development
500	Rural	560	Rural Clustering Standards	C	3B	Rural Cluster (Agriculture)
500	Rural	570	Rural Low Density Mix	C	2	Rural

Hierarchy from Family to SubFamily to Legend						
Fam	**Family Name**	**SUBFAM**	**SubFamily Name**	**Zoom**	**ALT**	**Legend**
600	Preserve	610		A	CP	Preservation
600	Preserve	610		A	1A	Conservation Lands
600	Preserve	610		A	2	Preservation Lands
600	Preserve	610		A	3A	Preservation Lands
600	Preserve	610		A	4	Preservation Lands
600	Preserve	610		C	CP	Preservation/Conservation
600	Preserve	610		C	1A	Preservation Lands
600	Preserve	610		C	1B	Preservation Lands
600	Preserve	610		C	3B	Conservation
600	Preserve	610		D	CP	Preservation/Conservation
600	Preserve	610		D	1A	Preservation Lands
600	Preserve	610		Hub	CP	Preservation
600	Preserve	610		Hub	1A	Preservation Lands
600	Preserve	610		Hub	2B	Preservation Lands
600	Preserve	620	Flowway Improvements	C	3A	Preservation Lands
600	Preserve	620	Culverts	D	3	Preservation Lands
600	Preserve	620	Flowway Improvements	D	4	Preservation Lands
600	Preserve	620	Flowway Improvements	Hub	4A	Preservation Lands
600	Preserve	630	ABM Conservation/Preservation Strategy Map	Hub	2A	Preserve (Exist&Prop)
600	Preserve	630	ABM Conservation/Preservation Strategy Map	Hub	3B	Preserve (Exist&Future)
600	Preserve	640	S Criteria for Preserve	C	2	Preservation Lands
600	Preserve	640	S Criteria for Preserve	D	2A	Preservation Lands
600	Preserve	640	S Criteria for Preserve	D	2B	Preservation Lands
600	Preserve	650	Culverts under Tamiami and I-75	C	4	Preservation/Conservation
700	PermitStds	720	Critical Resource Protection Area	Hub	2C	Critical Resource Protection Area
700	PermitStds	720	Critical Resource Protection Area	Hub	3A	Critical Resource Protection Area
700	PermitStds	720	Critical Resource Protection Area	Hub	4B	Critical Resource Protection Area
700	PermitStds	730	Buffer Transitional Zone	Hub	2C	Buffer Transitional Zone
700	PermitStds	730	Buffer Transitional Zone	Hub	3A	Buffer Transitional Zone
700	PermitStds	730	Buffer Transitional Zone	Hub	4B	Buffer Transitional Zone
700	PermitStds	740	Urban Zone	Hub	2C	Urban Zone
700	PermitStds	740	Urban Zone	Hub	3A	Urban Zone
700	PermitStds	740	Urban Zone	Hub	4B	Urban Zone

Hierarchy from Family to SubFamily to Legend

Fam	Family Name	SUBFAM	SubFamily Name	Zoom	ALT	Legend
700	PermitStds	750	Preservation Zone (Updated from CRPA)	A	5	Preservation Zone
700	PermitStds	760	Agricultural Zone (Updated from CRPA)	A	5	Rural Residential
700	PermitStds	770	Urban Zone Updated	A	5	Urban Zone
800	NonAgree	820	Berm	Hub	4B	Berm
800	NonAgree	830	Pending Review (Develop or Preserve)	C	3A	Pending Review
800	NonAgree	830	Pending Review (Develop or Preserve)	Hub	4A	Pending Review

APPENDIX E - U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) WATER QUALITY STUDY

WATER QUALITY

1.0 INTRODUCTION

This section provides descriptions of the methodology, terminology, and rationale used to characterize the affected environment of surface and ground water quality within the study area. The status of historical and current water-quality conditions for the study area are described by means of water-quality parameters, Florida state water classifications, water-quality indices, and exceedences of Florida state water-quality criteria. Data for many parameters are sparse or missing entirely for certain years and in some cases decades. In short, they are inconclusive with respect to water quality trends for many watersheds discussed in the following sections. A discussion of parameters used to describe the watersheds within the study area follows. It is generally useful to have an understanding of each of these items prior to assessing water quality.

1.1 Water Quality Parameters

Water-quality parameters may be physical, chemical, or biological in nature, or a combination of the three. Understanding water quality through the use of measurable water-quality parameters provides a means of recording how a particular water body (lake, stream, canal, bay, nearshore water or estuary) responds to environmental and anthropogenic changes, as well as an indicator to specific water-quality problems. A brief description of some of the key water-quality parameters and their utility are discussed in the following sections:

Biochemical Oxygen Demand (BOD)
BOD is the amount of oxygen that is consumed by bacteria “feeding” on decomposable organic matter under aerobic conditions. Measures of BOD in rivers, lakes, and estuaries are used to predict potential negative impacts that stormwater runoff and other wastewater sources may have on natural waters (Sawyer and McCarty, 1978).

Chemical Oxygen Demand (COD)
COD is the amount of oxygen used by a strong oxidizing chemical during the decomposition of organic and inorganic matter (Water Quality Association, 1997). COD testing is often used as a substitute for BOD measurements, and is useful for determining the oxygen demand of polluted waters.

Chlorophyll a
Chlorophyll a is a plant pigment most responsible for the green color in plants including phytoplankton. The amount of chlorophyll a in the water column is an indicator of the abundance of free-floating. An increase in algae of this type can cause a reduction in light penetration through the water column, and a decline in BOD. In some estuaries, declines in seagrass acreage have been attributed to reduced light penetration attributed to increased algae concentrations in the water column. Nutrients, such as nitrogen, can trigger rapid algal growth known as blooms. Depending on the species,

large blooms of algae may release toxins into the water such as those that cause the red tide phenomenon (Boyer and Jones, 1996; Rice University, 1998).

Color

"True" color in water results from the contact of water with decomposing organic matter (leaves, pine needles, wood, etc.), and is mainly caused by the tannins, humic and fulvic materials, and humates which leach from these materials. Suspended sediments, such as red clay alter water color, but this type of color is termed "apparent" color. As color may normally increase with pH, it is important to record pH when measuring color. Wastewaters, particularly those from textile industries and pulping operations can increase water color as well. Aside from appearance, natural water coloring materials are generally not considered harmful. However, chlorination of naturally colored waters can result in the formation of harmful constituents such as chloroform (Sawyer and McCarty, 1978).

Conductivity

Conductivity is a measure of the ability of water to conduct an electrical current and is used to approximate salinity and total dissolved solids (Lee, 1992).

Dissolved Oxygen (DO)

It is commonly understood that most organisms depend on oxygen in some form. The solubility of oxygen or the amount of this gas that can be dissolved in water depends directly on the temperature and salinity of the water. Oxygen is less soluble in seawater than in freshwater, and is less soluble in warm than in cold water. Unpolluted water normally contains more oxygen than polluted water (Sawyer and McCarty, 1978). Municipal and industrial discharges, sewage leaks and overflows, and agricultural and urban stormwater runoff can deplete oxygen in surface waters. Aquatic plants produce oxygen through photosynthesis, and waters are aerated through movement such as wave action and surface ripples (Smith et al., 1994).

Fecal Coliform Bacteria

Fecal coliform bacteria are an important indicator of water quality because their presence indicates fecal contamination from warm-blooded animals. Such contamination in waters where people swim or harvest shellfish introduces serious potential risks of infection from disease causing organisms associated with fecal contamination (Smith et al., 1994). The acceptable limit for fecal coliform density in fresh and marine recreational waters is an average of 200 bacterial colonies/100 ml of water per month or that no more than 10% of samples exceed 400 colonies per 100 mls or no more than 800 colonies on any given day (FDEP, 1996b).

Nutrients (Total Nitrogen, Total Phosphorus)

Nitrogen is an important element in all living things, and is one of the nutrients essential to algal growth. Excess amounts of nitrogen in aquatic systems can lead to algal blooms. Phosphorus is another important nutrient in aquatic systems. It is usually the least available of all nutrients in freshwater systems, and because of this, it is termed a "limiting" nutrient with respect to algal growth. In marine environments, nitrogen is usually limiting. When phosphorus is available in larger quantities, algae increase such that light is blocked out and dissolved oxygen levels decrease, a detriment to animal life. This condition is known as eutrophication. Phosphorus sources include decomposing organic matter and phosphates from fertilizers and detergents. Sewage treatment discharges, industrial discharges, and agricultural and urban runoff are some point and non-point sources of these nutrients (Smith et al., 1994).

pH

The term for expressing the intensity, strength, or activity of hydrogen ions in an aqueous solution is pH. The pH measurement scale is expressed as a negative logarithm, where the lower the pH value, the more acidic a substance. The scale ranges from 0 to 14, with 0 the most acidic, 14 the most alkaline, and 7 being neutral (Sawyer and McCarty, 1978). Increased acidity in freshwater systems can upset the balance between plant and animal life, and many fish species cannot tolerate a pH below 5.0 (Lehninger, 1982). Estuarine and marine systems tend to contain higher amounts of pH stabilizing compounds, such as carbonates, than freshwater, and are not as subject to changes in pH as are freshwater systems (Lerman, 1986).

Salinity

Salinity is defined as the total amount of dissolved inorganic ionic material in water and is used primarily to reflect the salt content of water (Lerman, 1986). In estuaries, salinity can be an indicator of circulation, as well as certain aspects of the ecology. In fresh surface and ground waters, high salinity can be an indicator of saltwater intrusion into the aquifer. Salinity can be determined by measuring the electrical conductivity or by determining the degree of light refraction of water with a refractometer. Salinity is generally expressed in parts per thousand (ppt) (Rice University).

Total Suspended Solids (TSS)

Suspended solids are small particles floating in the water column usually consisting of sediments, organic matter, or plankton. The dry weight of these particles after filtration represents the total amount of suspended solids. Materials small enough to pass through the filter are the total dissolved solids and often include constituents such as ions of iron, chloride, sodium, sulfate, and others. There is a direct relationship between suspended solids and turbidity (Rice University, 1998).

Turbidity

Turbidity is the amount of suspended matter in water that interferes with the passage of light and visibility. Origins are organic and inorganic materials from soil, domestic and industrial wastewater, and runoff. Bacteria in the water feed on organic material, multiply, in turn supporting the growth of other microorganisms, thus further increasing turbidity. Nutrients such as phosphorus and nitrogen stimulate the growth of algae, another contributing factor to turbidity. Turbidity in domestic water drinking water supplies, e.g. East Caloosahatchee, can be difficult and costly to filter. High turbidity is often associated with wastewater pollution. Further, disease organisms can be shielded within suspended particles and be protected from disinfectant (Sawyer and McCarty, 1978).

1.2. Classification of Surface Waters and Designated Use

According to Florida Surface Water-quality Standards (F.A.C. 62-302), all surface waters in Florida are classified by a usage designation. These designations categorize the intended use of surface waters for specific water bodies within the state of Florida and are identified as follows:

Class I:
Potable water supplies

Class II:
Shellfish propagation or harvesting

Class III:
Recreation, propagation, and maintenance of a healthy, well-balanced, population of fish and wildlife

Class IV:
Agricultural water supplies

Class V:
Navigation, utility, and industrial use

Class I has the most stringent water-quality requirements, and Class V has the least. Classification by use does not preclude other types of use of a certain water body. Most state waters are classified as Class III unless otherwise stated in F.A.C. 62-302. Additional classification titles may be assigned to Class I, II, and III waters such as Outstanding Florida Waters (OFW), or Outstanding National Resource Water (ONRW). Outstanding Florida Waters are “deemed worthy” of special protection because of their natural attributes. Some examples of Outstanding Florida Waters may be waters in national parks, preserves, memorials, wildlife refuges, and wilderness areas. Other examples include waters in the state park system, waters on conservation lands obtained by donation through various state programs such as the Conservation and Recreation Lands (CARL) program or the Florida Scenic and Wild Rivers program, and waters in aquatic preserves. Outstanding National Resource Waters are of “such recreational or ecological significance that water quality should be protected under all circumstances” (FDEP, 1996b). No Outstanding National Waters occur within the study area, but the Everglades National Park, part of which lies in Collier County, is one of two such waters in the state. **Table 1** lists the classification of waters within Collier and Lee County. Water-quality criteria for selected parameters for Class I, II, and III waters are presented in **Table 2**.

TABLE 1. CLASS I AND CLASS II WATERS OF COLLIER AND LEE COUNTY. ALL OTHER WATER BODIES WITHIN COLLIER AND LEE COUNTY ARE DESIGNATED CLASS III

Collier County			Lee County		
Class I	**Class II**	**OFW**	**Class I**	**Class II**	**OFW**
None	Cocohatchee River	Waters within Florida Panther Wildlife Refuge	Caloosahatchee River from east Lee County line to Structure 79	Charlotte Harbor	Waters within Caloosahatchee Wildlife Refuge
	Connecting waterways from Wiggins Pass south to Outer Doctors Bay	Waters within Collier-Seminole State Park		Matanzas Pass, Hurricane Bay, and Peckney Bay	Waters within J.N. “Ding” Darling Wildlife Refuge
	Dollar Bay	Delnor-Wiggins Pass State Recreation Area		Matlacha Pass: Charlotte Harbor to San Carlos Bay	Waters within Matlacha Pass Wildlife Refuge
	Inner and Outer Clam Bay	Waters within Fahkahatchee Strand State Preserve		Pine Island Sound: Charlotte Harbor to San Carlos Bay	Waters within Pine Island Wildlife Refuge
	Little Hickory Bay	Barefoot Beach		San Carlos Bay from Point Ybel to Bodwitch Point to Punta Blanca Creek to Big Shell Island to Pine Island Sound	Waters within Cayo Costa State Park
	Tidal Bays and Passes: Naples Bay south and east through Rookery Bay and Ten Thousand Islands to Monroe County Line	Rookery Bay: Aquatic Preserve, Conservation Program, and National Estuarine Research Reserve			Waters within Gasparilla State Recreation Area
	Wiggins Pass	Waters within the Save Our Everglades Program			Waters within Lovers Key State Recreation Area

(Continued)

TABLE 1 (continued).

Collier County			Lee County		
Class I	**Class II**	**OFW**	**Class I**	**Class II**	**OFW**
		Cape Romano-Ten Thousand Islands Aquatic Preserve			Waters within Koreshan State Historic Site
		Waters within Big Cypress National Preserve			Estero Bay: Conservation Program Area, Aquatic Preserve
					Josslyn Island
					Cape Romano-Ten Thousand Islands Aquatic Preserve
					Gasparilla Sound-Charlotte Harbor Aquatic Preserve
					Matlacha Pass Aquatic Preserve
					Pine Island Sound Aquatic Preserve
					Estero Bay tributaries: Hendry Creek, Estero River, Spring Creek, and Imperial River
					Wiggins Pass Estuarine Area and Cocohatchee River System

Source: FDEP, 1996b

TABLE 2. WATER-QUALITY CRITERIA FOR CLASS I, II, AND III WATERS

Parameter	**Units**	**Class I**	**Class II**	**Class III**	
				Fresh	**Marine**
Turbidity	NTU	≤29 above background	≤29 above background	≤29 above background	≤29 above background
Dissolved Solids	mg/L	≤500 monthly average, ≤1000 maximum	None	None	None
PH	pH units	No change more than one unit above or below background	No more than one unit change for coastal waters or 0.2 unit change for open waters	No more than one unit change above or below background	No more than one unit change for coastal waters or 0.2 unit change for open waters
Chlorides	mg/L	≤250	No increase >10% above background	None	No increase >10% above background
Fluorides	mg/L	≤1.5	≤1.5	≤10.0	≤5.0
Conductivity	Micromho	No increase above 50% of background or 1275	None	No increase above 50% of background or 1275	None
Dissolved Oxygen	mg/L	Not less than 5.0	No average less than 5.0 and never less than 4.0	Not less than 5.0	No average less than 5.0 and never less than 4.0
BOD	mg/L	No increase such that DO drops below limit for any class			
Nutrients: Total Phosphorus, Total Nitrogen		No alteration in nutrients such that an imbalance in natural populations of aquatic flora or fauna results			
Total Coliform	#/100 ml	≤2,400 in any one sample	No more than 10% of samples exceed 230	≤2,400 in any one sample	≤2,400 in any one sample
Fecal Coliform	#/100 ml	≤800 in any one sample	≤800 in any one sample	≤800 in any one sample	≤800 in any one sample
Copper	µg/L	≤(.8545[ln hardness] – 1.465)	≤2.9	≤(.8545[ln hardness] – 1.465)	≤2.9
Iron	mg/L	≤0.3	≤0.3	≤1.0	≤0.3
Lead	µg/L	(1.273[ln hardness] – 4.705)	≤5.6	(1.273[ln hardness] – 4.705)	≤5.6
Zinc	µg/L	(0.8473[ln hardness] + 0.7614)	≤86	(0.8473[ln hardness] + 0.7614)	≤86
Mercury	µg/L	≤0.012	≤0.025	≤0.012	≤0.025

Source: FDEP, 1996b

1.3. Assessing Water Quality Through Indices

Streams, lakes and estuaries are evaluated by the Florida Department of Environmental Protection (FDEP) using two indices that combine data from selected water-quality parameters into single numeric values. Two indices are used because streams typically are flowing, and lakes and estuaries are more static. Normal conditions for one system may not be so for the other. The two indices are the United States Environmental Protection Agency (USEPA)-developed Water-Quality Index (WQI) for streams modified by the FDEP to fit Florida streams and the FDEP Trophic State Index (TSI). For this study, the FDEP WQI was further modified using data solely from south Florida waters.

FDEP: WQI

To assess water quality in streams, a Florida WQI was developed based on measurements of six categories: clarity, dissolved oxygen, oxygen-demanding substances, bacteria, nutrients, and biological diversity. Some categories have sub-categories. The yearly average data collected for streams is converted into percentile values ranging from 0 to 99 (**Table 3**). WQI values for a particular stream correspond to the percentile distribution of all Florida surface water-quality data. The 70th percentile level is used by FDEP to identify particular problem parameters and is termed the "screening level". Data from STORET surface water locations from 1980 to 1995 were used to determine percentile distributions for various water-quality parameters. The overall WQI is an average of the six main categories. As an additional qualitative assessment measure, Good, Fair, and Poor water-quality data ratings were developed and assigned to water bodies that conformed to USEPA's WQI for Florida data. Good water quality ranged 0 to less than 45; fair water quality ranged from 45 to less than 60; and poor water quality ranged from 60 to 99 (FDEP, 1996a). Over time, changes in water quality become evident through comparisons of yearly average WQIs. Much of the discussion within this report reflect data extracted from the FDEP's 305b report (WQIs: Good, Fair, Poor) as well as valuable studies conducted by the water management district, universities, counties, and private organizations.

Study Area: Water-Quality Index

To evaluate more recent and geographically specific water-quality data available within the study area, supplemental data were gathered (including STORET) through June 1998 from various sources and water-quality indices were revisited. In a nearly identical manner, water-quality indices were again based on measurements of six water-quality categories: clarity, dissolved oxygen, oxygen-demanding substances, bacteria, nutrients, and biological diversity. To assess historical and current water-quality trends for the study area surface waters, WQIs were recalculated for the following time periods: 1970-1980, 1980-1990, and 1990-1998. Similarly, annual average data collected for surface waters were converted into values ranging from 0 to 99 (**Table 4**). Recognizing the potential geographic water-quality differences of south Florida, WQI values correspond to the percentile distribution of only south Florida water-quality data. The qualitative assessments of Good, Fair, and Poor water quality were not assigned to these WQI's, as these values were developed solely as a measure to compare potential changes in water quality with future land use alternatives.

TABLE 3. FDEP'S FLORIDA WATER-QUALITY INDEX CRITERIA (percentile distribution of STORET data)

Parameter		**Best Quality**				**Median Value**			**Worst Quality**	
	Unit	10%	20%	30%	40%	50%	60%	**70%***	80%	90%
Category: Water Clarity										
Turbidity	NTU	1.50	3.00	4.00	4.50	5.20	8.80	12.20	16.50	21.00
Total Suspended Solids	mg/L	2.00	3.00	4.00	5.50	6.50	9.50	12.50	18.00	26.50
Category: Dissolved Oxygen										
Dissolved Oxygen	mg/L	8.00	7.30	6.70	6.30	5.80	5.30	4.80	4.00	3.10
Category: Oxygen Demand										
Biochemical Oxygen Demand	mg/L	0.80	1.00	1.10	1.30	1.50	1.90	2.30	3.30	5.10
Chemical Oxygen Demand	mg/L	16.00	24.00	32.00	38.00	46.00	58.00	72.00	102.00	146.00
Total Organic Carbon	mg/L	5.00	7.00	9.50	12.00	14.00	17.50	21.00	27.50	37.00
Category: Nutrients										
Total Nitrogen	mg/L as N	0.55	0.75	0.90	1.00	1.20	1.40	1.60	2.00	2.70
Nitrate plus nitrite	mg/L as N	0.01	0.03	0.05	0.07	0.10	0.14	0.20	0.32	0.64
Total Phosphorus	mg/L as P	0.02	0.03	0.05	0.07	0.09	0.16	0.24	0.46	0.89
Category: Bacteria										
Total Coliform	#/100/Ml	100.0	250.0	250.0	425.0	600.0	1100.0	1600.0	3700.0	7600.0
Fecal Coliform	#/100/mL 2	10.0	20.0	35.0	55.0	75.0	135.0	190.0	470.0	960.0
Category: Biological Diversity										
Diversity Index—Natural Substrate	Index	3.50	3.10	2.80	2.60	2.40	2.15	1.95	1.50	1.20
Diversity Index—Artificial Substrate	Index	3.55	3.35	3.20	3.05	2.90	2.65	2.40	1.95	1.35
Beck's Biotic Index	Index	32.00	28.00	23.00	18.50	14.00	11.00	8.00	5.50	3.50

*Screening level

TABLE 4. SOUTH FLORIDA WATER-QUALITY INDEX CRITERIA (percentile distribution of data)

Parameter	**Best Quality**				**Median Value**			**Worst Quality**	
	Unit	10%	20%	30%	40%	50%	60%	70%	80%	90%
Category: Water Clarity										
Turbidity	NTU	1.0	1.60	2.00	2.60	3.00	4.00	5.00	6.80	10.30
Total Suspended Solids	Mg/L	na	Na	na	na	na	na	na	na	na
Category: Dissolved Oxygen										
Dissolved Oxygen	Mg/L	8.70	7.90	7.20	6.70	6.10	5.50	4.80	3.90	2.50
Category: Oxygen Demand										
Biochemical Oxygen Demand	Mg/L	0.80	1.00	1.20	1.50	1.80	2.00	2.50	3.00	4.40
Chemical Oxygen Demand	Mg/L	25.85	36.70	42.60	46.30	51.05	55.75	61.00	68.45	81.25
Total Organic Carbon	Mg/L	na	Na	na	na	na	na	na	na	na
Category: Nutrients										
Total Nitrogen	Mg/L as N	0.59	0.82	1.02	1.20	1.39	1.59	1.84	2.22	3.12
Nitrate plus nitrite	Mg/L as N	na	Na	na	na	na	na	na	na	na
Total Phosphorus	Mg/L as P	0.01	0.03	0.04	0.06	0.09	0.14	0.22	0.38	0.74
Category: Bacteria										
Total Coliform	#/100/mL	4.00	18.00	79.00	100.00	200.00	400.00	900.00	1700.00	3100.00
Fecal Coliform	#/100/mL	2.00	5.00	10.00	30.00	69.00	100.00	120.00	300.00	920.00
Category: Biological Diversity										
Chlorophyll a	μg/L	1.74	3.10	4.77	6.84	9.60	13.20	18.74	27.20	43.30
Diversity Index—Natural Substrate	Index	na	Na	na	na	na	na	na	na	na
Diversity Index—Artificial Substrate	Index	na	Na	na	na	na	na	na	na	na
Beck's Biotic Index	Index	na	Na	na	na	na	na	na	na	na

na - not available

Trophic State Index

The Florida TSI is nutrient based in its approach. Lakes and estuaries are classified according to analysis of chlorophyll levels and nitrogen, and phosphorus concentrations. A ten unit change in the index represents a doubling or halving of algal biomass. Data from 313 Florida lakes were used to develop the lake criteria (FDEP, 1996a).

1.4. The Watershed Unit

The watershed is the hydrologic unit which was selected for this study to analyze water-quality impacts that may potentially result from changes in land use; primarily since water quality is influenced by many factors occurring throughout the surrounding watershed. By one definition, a watershed is “the land area that drains to a waterbody and affects its flow, water level, and loadings of pollutants” (USEPA, 1996). Within the study area, the very boundaries of the watersheds can be affected by the activities occurring within. This is largely due to the flat topography and the tendency for water to flow in sheets rather than through channels. Subtle changes in topography can cause directional changes in the sheet flow. Such changes have historically occurred within the study area as a result of development and wetland draining projects. In addition, man-made alterations such as drainage canals, dams, and other structures have impacted natural flow characteristics.

Multiple watershed boundaries have been developed by numerous agencies (USGS, SFWMD, and FDEP) in south Florida. To further complicate this issue, these watershed delineations have been dynamically changing through time, primarily a result of improved understanding of the watershed hydrology. Watershed boundaries within the study area include portions of the larger national watershed system (Caloosahatchee [HUC: 03090205] and Big Cypress Basin [HUC: 03090204]) as defined by the USGS, as well as the smaller hydrologic watersheds and basins as defined by the South Florida Water Management District (SFWMD) (**Figure 1**).

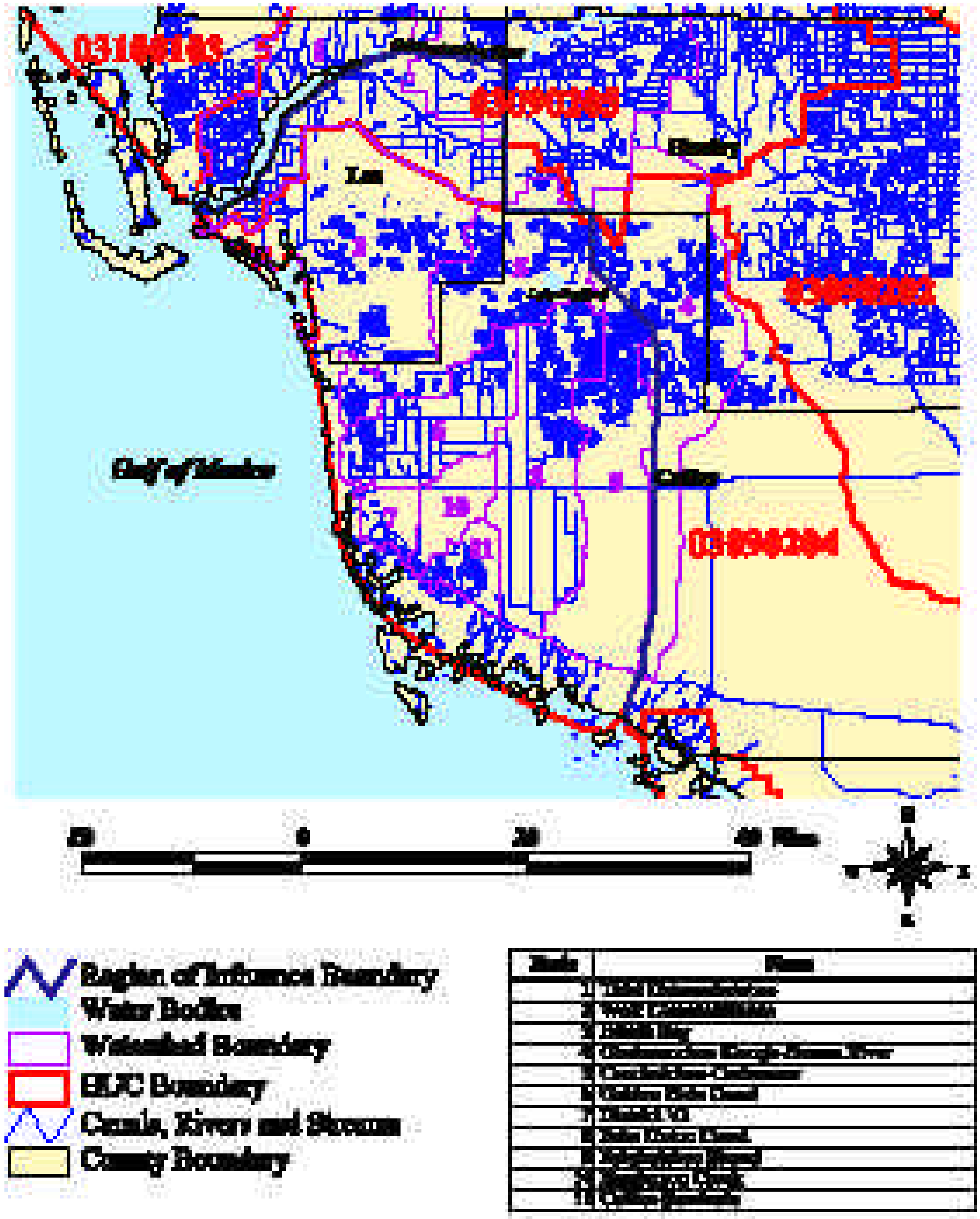


Figure 1. USGS and SFWMD Watersheds and Basins within the Study Area.

2.0 SURFACE WATERS

This section describes surface water quality as defined by physical and biological parameters, flow characteristics, pollutants, nutrients, and if known, biological indicators. The descriptions of water quality are largely based on STORET data summaries for individual watersheds within the larger study area watersheds. STORET is an Environmental Protection Agency (EPA) database of water-quality information collected by numerous agencies. Other water-quality studies were consulted as well (CDM, Inc., 1995; Gibson, 1997). Geography, topography, rainfall, evaporation, man-made alterations within the watershed such as hydrographic modifications (drainage canals, dams), development, and agriculture affect the quality of water. EPA and FDEP use STORET data to assess water-quality trends in watersheds by condensing certain parameters into one of two indices thereby facilitating year to year comparisons. Non-point source pollution, contaminant information, and exceedences of water-quality standards are also evaluated for trend determination. In the following sections, water quality of rivers, creeks, bays, canals, and swamps will be discussed for the three watersheds of interest to this study (**Table 5**).

TABLE 5. WATERSHEDS AND RECEIVING WATERS OF THE STUDY AREA

WATERSHED	DRAINAGE BASIN	RECEIVING WATER BODY	ULTIMATE ENDPOINT
Caloosahatchee Watershed	Tidal Caloosahatchee Basin	Tidal Caloosahatchee River	San Carlos Bay
	West Caloosahatchee Basin	West Caloosahatchee River	West Caloosahatchee River
Estero-Imperial Watershed	Estero Bay Basin	Estero River, Spring Creek	Estero Bay
	Imperial River Basin	Imperial River	Estero Bay
Big Cypress/West Collier Watershed	Corkscrew-Cocohatchee River Basin	Cocohatchee River, Corkscrew Swamp	Wiggins Pass/Gulf of Mexico
	Golden Gate Canal Basin	Golden Gate Canal	Naples Bay
	District VI Basin	Lely Canal	Gulf of Mexico
	Fahka-Union Canal Basin	Fahka-Union Canal	Fahka-Union Bay
	Henderson Creek Basin	Henderson Creek	Rookery Bay
	Collier-Seminole Basin	CR92 Canal	Gullivan Bay
	Fahkahatchee Strand Basin	Fahkahatchee Strand	Ten-Thousand Islands

For purposes of description and analyses, the study area watersheds have been identified as the Caloosahatchee, the Estero-Imperial Integrated, and the Big Cypress/West Collier, with various associated watershed basins as indicated in **Table 5**. Introductory information on the physical setting, surrounding land use, natural habitats, and physical characteristics of the various watershed systems have been provided to better assess historic and current water quality within the study area.

2.1 Caloosahatchee Watershed

The study area (**Figure 2**) incorporates portions of the Tidal Caloosahatchee and West Caloosahatchee watershed basins and sections of the Caloosahatchee River. The East Caloosahatchee River is also discussed since it drains into the study area impacting the water quality of the western and tidal sections of the Caloosahatchee.

The East and West portions of the freshwater segment of Caloosahatchee River have been restructured into a canal known as C-43. Drinking and irrigation water is obtained from the eastern portion of the canal, while the western portion is designated for wildlife and recreational use. There are about 60 tributaries of varying water quality with respect to FDEP indices within the Caloosahatchee River watershed.

Physical Description

To accommodate navigation, flood control, and land reclamation needs, the Caloosahatchee River has been radically altered from its natural state. One of the most dramatic changes was the dredging that connected the Caloosahatchee to Lake Okeechobee in 1881, in order to lower the water level of Lake Okeechobee. In 1882, the channelization of the lower reaches of the river began. Due to intensive canal construction by 1910, shallow draft navigation from the Gulf of Mexico to the Atlantic Ocean was possible. Canal locks at Moore Haven were completed in 1918, and the locks at Ortoona were completed in 1937. The W. P. Franklin Lock was completed in 1969, preventing saline water from flowing upstream of Olga (Kimes and Crocker, 1998).

The discharge from Lake Okeechobee can vary greatly depending upon water needs of the Everglades Agricultural Area and precipitation levels. The 2-in-10 dry year discharge to the river is 106 million cubic feet (cu.ft.) while the 2-in-10 wet year discharge to the river is 29.3 billion cu.ft. All of this water is in addition to that naturally occurring in the river.

In addition to the alteration of the main channel, many canals have been constructed along the banks of the river. These canals were constructed for both water supply and land reclamation in order to support the many agricultural communities along the river.

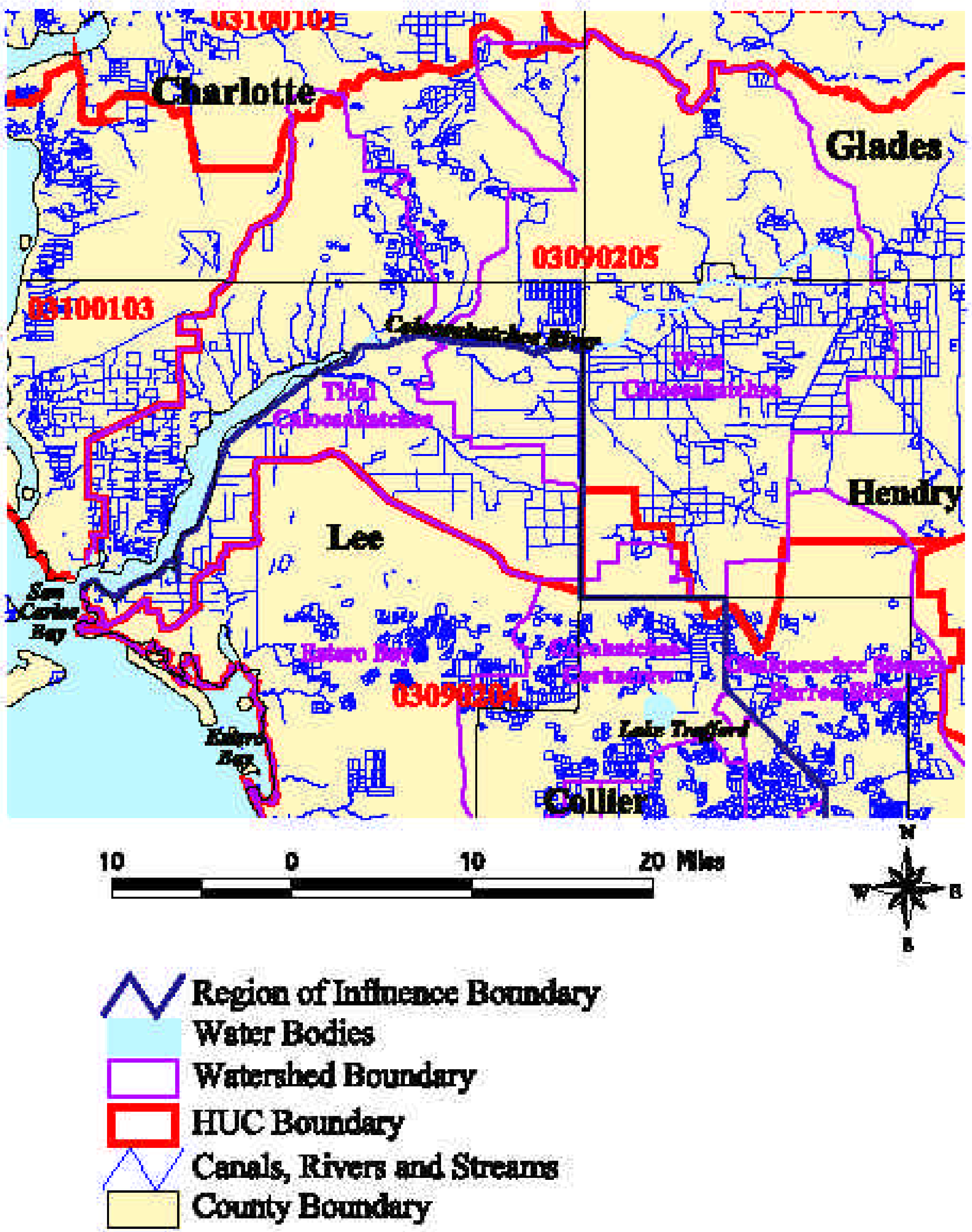


Figure 2. The Caloosahatchee watersheds and basins within the study area.

Land use within the Caloosahatchee watershed is dominated by rangeland and agriculture, particularly in the upper part of the basin (FDEP, 1996a). The major urban areas that occur along the tidal Caloosahatchee watershed basin are Ft. Myers, and across the river the large residential areas of Cape Coral and North Ft. Myers.

The primary habitat types of the Caloosahatchee watershed are pine flatwoods, dominated by slash pine (*Pinus ellioti* var. *densa*), cabbage palm (*Sabal palmetto*), and saw palmetto (*Serenoa repens*) (Drew and Schomer, 1984). Soils are predominantly Pamlico Formation, which consists of marine quartz sands and some hardened sandstone, and an estimated 25% Penholoway Formation, also consisting of marine quartz sands, but occurring at higher elevations than does the Pamlico (42 to 70 feet as opposed MSL to 25 feet) (Drew and Schomer, 1984).

Flow and stage height in the Caloosahatchee River is controlled by a series of locks. Agricultural practices and navigation channels have for many years dictated the patterns of surface water drainage. Canal, lock, and spillway construction and dredging have been occurring since the late 1800s, altering the natural watercourse of the Caloosahatchee River. Today, three primary locks function to regulate water level, usage, and saltwater intrusion. One, at Moore Haven, regulates Lake Okeechobee waters. The Ortoona Lock delineates the east river basin from the west and controls water on the adjoining land areas. The Franklin Lock at Ft. Myers prevents saltwater intrusion from the tidal Caloosahatchee River segment from proceeding eastward. The pattern and period of flow of the Caloosahatchee River is highly variable, based on demand. River flows are negative (from west to east) for a majority of the year, possibly resulting from heavy irrigation usage or losses to groundwater and/or evapotranspiration (Drew and Schomer, 1984).

Historical Description

Camp, Dresser and McKee (CDM), Inc. (1995) compared monitoring results of a 1993-94 study on the freshwater Caloosahatchee River with data from 1973-1980. Their conclusions are the basis for this historical description of water quality in the East and West Caloosahatchee River. CDM concluded that historical water quality differed from current water quality only with respect to small differences in nutrient concentrations. The report stated dissolved oxygen was historically low, as were suspended solids. Total phosphorus was comparable to other Florida water bodies, but nitrogen and chlorophyll a were generally high. Decreasing trends in total nitrogen were observed westward from Lake Okeechobee. Measurements of DO, pH, conductivity, and total phosphorus generally increased westward from Lake Okeechobee. FDEP nutrient indices indicated “poor” water quality but the WQI values are very close to “fair”. Algal blooms and high chlorophyll a measurements during the 1970s and 1980s were generally thought to result from agricultural runoff.

Historical information on the tidal Caloosahatchee from 1975-76 was available from Drew and Schomer (1984). Previous surveys indicated some aspects of water quality improved as one moved downstream away from the urbanized areas, such as DO. Seasonal water quality fluctuations have also been observed, with DO decreases in October and December. Chlorophyll a increased during the wet summer season as nutrient inputs increased from surface runoff and regulatory releases from Lake Okeechobee. Salinity measurements decreased with increases in freshwater flow. During winter, salinity increased, temperatures declined, and chlorophyll a decreased. DO stabilized in February, possibly allowing for an increase in oxygen demanding particulates to settle to the bottom, thus increasing the BOD values. During the 1970s, pollution was attributed to the following major sources: downstream flow from the Franklin Lock; Orange River inflow; the wastewater treatment plant (WWTP) effluent from the cities of Cape Coral and Fort Myers; and the residential development, Water Way Estates (Drew and Schomer, 1984).

Freshwater Systems

The freshwater systems of the Caloosahatchee River are discussed as the Eastern and Western Caloosahatchee (**Figure 2**). The Western Caloosahatchee begins at the point where Franklin Lock separates the tidally influenced waters from the upland waters. The Eastern Caloosahatchee begins at Ortoona Lock and extends to Lake Okeechobee. Before reaching Lake Okeechobee, the Eastern Caloosahatchee encounters Lake Hicpochee which is a small waterbody and historically (within the last twenty years) poor in water quality (FDEP, 1996a).

Water-quality parameters are expressed as annual averages and include physical and biological parameters, nutrients, and contaminants. Sediment quality data, if available, are also briefly discussed. Biological indicators such as important habitats, protected species, and pollution indicators may also be included under water quality. Known impaired usage of the basins is presented last. The majority of the current data discussion represent data collected from 1990 to 1995.

Eastern Caloosahatchee Basin

Eastern Caloosahatchee waters are usually above neutral in pH (>7), but tend towards low DO (<4.8 mg/L). CDM (1995) recorded seasonal lows from May through October. Water clarity is characterized by low turbidity and mostly low TSS, although color is higher than average (>71 PCUs) for Florida waters. Conductivity is above average for Florida waters (>335 micromhos), usually measuring above 500 for most stations in the Eastern Caloosahatchee (FDEP, 1996a). Ninemile Canal, which feeds into Lake Hicpochee, is of historically poor water quality having high color (120 PCUs), high conductivity (1195), and exceeding FDEP standards for DO (0.6 mg/L) (FDEP, 1996a).

The chlorophyll a content was high (32 μg/L), which is above 90% for other typical Florida waters. Average BOD levels (2.8 mg/L) also exceeded Florida standards. Low diversity, pollution-tolerant species, and algal blooms have been reported from Ninemile Creek (FDEP, 1996a). Coliform bacteria levels are low in the Eastern Caloosahatchee.

However, Goodno Canal, a tributary with otherwise excellent water quality exceeds FDEP standards for fecal coliform.

The average total nitrogen was high (>1.89 mg/L) in the river and in the tributaries while phosphorus measured 0.08 mg/L (FDEP, 1996a). In 1993-94, total nitrogen values ranged from 1.1 to 2.2 mg/L and were highest from August through December. Total phosphorus was also highest during the summer with a range of 0.05 to 0.25 mg/L (CDM, 1995). Lake Hicpochee exhibits "poor" water quality due to excessive nutrient concentrations. The lake rated a TSI value of 74 due to high nitrogen (2.6 mg/L) and low DO. Ninemile Canal near Lake Hicpochee also exceeds state standards for total nitrogen. Total nitrogen standards are set at >1.6 mg/L as an exceedence.

Biological indicators are habitats, plants or animals that noticeably respond to environmental stresses such as changes in water quality. Loss of habitat acreage, changes in species diversity, and appearance of pollution tolerant species are examples of indicators. Habitat types within the East Caloosahatchee basin are dry prairie, pineland, freshwater marsh, and hammock (SFWMD, 1995). Impaired use of the basin has been linked to agricultural runoff (CDM, 1995).

West Caloosahatchee Basin

The western basin of the Caloosahatchee appears overall to have good water quality, but has been in a "degrading" trend for areas north of Townsend Canal (FDEP, 1996a). Reductions in pH and increased suspended solids are partially responsible for this observed trend. Chlorophyll a levels are improving and most other parameters are holding steady. Other areas of the basin rate "good" on the WQI scale.

Physical water-quality parameters throughout most of the basin are characterized by relatively neutral pH, DO readings mostly above 7.0 mg/L, good water clarity (i.e. low turbidity, low color, low TSS), and specific conductance between 500 and 700. No state standards for physical water quality are exceeded.

Biological oxygen demand is low (<2.3 mg/L) in the West Caloosahatchee and chlorophyll a ranges from 2-8 μg/L, an improvement over previous years.

Nutrients generally do not exceed state standards, but at most basins are slightly higher than average for state waters. All waters in the West Caloosahatchee are rated "good" on the WQI scale.

Fecal and total coliform bacteria counts are low and do not exceed state standards. However, conventional pollutants (mercury) are present (FDEP, 1996a).

Approximately 41% of the West Caloosahatchee Basin are agricultural lands. Wetlands and pine forests make up 12% and 16%, respectively. Impaired usage in this basin primarily results from agricultural runoff**.**

Table 6 provides a summary of the water quality in the West Caloosahatchee Basin by decade for several water-quality parameters. The data from which Table 6 was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a)

TABLE 6. SUMMARY OF WATER-QUALITY DATA FOR THE WEST CALOOSAHATCHEE BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	**Units**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**
Turbidity	NTU	115	2.331	0.4	17	0.87	36	55	1.294	0	3.4	0	14.9	7	1.379	0.5	2.2	0	15.8
PH	pH	149	7.628	6.55	8.6	0		40	7.737	6.4	9.65	0		7	7.19	6.6	7.5	0	
Salinity	ppt	N/A						N/A						4	0	0	0	0	
Temperature	deg. C	189	25.05	12	33	0		46	25.6	17.6	3.4	0		7	25.51	15	29.5	0	
Chlorides	mg/L	184	85.12	35	990	1.6		45	121.1	26.1	360	15.6		5	28.94	22	40	0	
Fluorides	mg/L	35	0.224	0	0.31	0		31	0.247	0.17	0.43	0		N/A					
Conductivity	micromho	206	712.6	456	3850	1.5		51	798.1	390	1840	13.7		7	524.3	436	745	0	
DO	mg/L	142	6.419	2	11.4	12.7	46	33	6.325	2.2	11.9	18.2	47	7	5.514	4.6	8	42.9	61
BOD	mg/L	16	1.294	0.5	4.1	12.5	30.9	6	1.083	0.4	1.6	0	22.8	N/A					
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	153	1.426	0.21	6.49	56.9	52	27	1.602	0.71	3.15	66.7	60.5	2	0.59	0.54	0.64	0	10
Tot-P	mg/L	164	0.069	0	0.36	52.4	42	37	0.112	0	10	37.8	54	7	0.037	0.01	0.15	14.3	25.7
Tot-C	mg/L	17	9.271	2.4	15	0		2	6.5	3	10	0		N/A					
Tot-coli	/ 100 ml	2	120	108	132	100	46.5	N/A						N/A					
Fecal-coli	/ 100 ml	1	54	54	54	0	48	4	144.5	30	292	25	72.5	2	545	390	700	100	86.1
Cu	ug/l	2	2	2	2	0		3	10	2	20	66.7		N/A					
Fe	ug/l	65	8.246	0.07	490	1.5		27	23.89	0.05	350	3.4		N/A					
Pb	ug/l	2	3	3	3	0		3	3.667	0	9	33.3		N/A					
Zn	ug/l	2	10	0	20	0		3	93.33	10	240	33.3		N/A					
Chlor a	ug/l	N/A						6	0.833	0	1	0		N/A					
WQI	%						41.4						42.9						45.2

Estuarine Systems

Tidal Caloosahatchee Basin

The tidal Caloosahatchee extends 28 miles from Franklin Lock to San Carlos Bay, and is so named because its waters are subject to tidal forces (Drew and Schomer, 1984). Tributaries of the tidal Caloosahatchee include Billy Creek, Whiskey Creek, Orange River, Hickey Creek, Roberts Canal, and Daughtrey Creek (**Figure 2**).

Physical water quality of the tidal Caloosahatchee is represented by pH, DO, conductivity, and water clarity. pH ranges slightly above neutral at 7.3 – 7.8. Except for Deep Lagoon and Manuel Branch, the average DO of the tidal Caloosahatchee and its tributaries ranges from 6.5 to 7.4. The overall DO trend is stable. Conductivity is usually above 10,000 micromhos, which is typical for estuarine waters. The freshwater tributaries are lower in conductivity. Orange River is the lowest at 508 micromhos. Water clarity varies along the river and tributaries. Deep Lagoon color was highest at 130 PCUs. A low of 33 PCUs occurs in the lower tidal basin. TSS are generally low at 1-10 mg/L. The highest TSS occurs in Manuel Branch. Turbidity is generally low ranging between 1.3-6.3. The most turbid waters occur in Manuel Branch. Overall physical chemistry is stable (FDEP, 1996a).

Measured values of key biological parameters indicate degraded water quality in parts of the tidal Caloosahatchee and tributaries. Biochemical oxygen demand (BOD), fecal coliform bacteria, and chlorophyll a levels exceeded state standards at several locations. Fecal coliform bacteria were high in 1992 at Manuel Branch (2195 MPN/100 ml) and Billy Creek (1839 MPN/100 ml). The state screening level for fecal coliform bacteria is >190 MPN/100 ml (FDEP, 1996a). Chlorophyll a was high (27 µg/L) in Deep Lagoon and Billy Creek (57 µg/L). Due to the poor biological parameters, the tidal Caloosahatchee only partially meets its designated use as a Class 2 water, suitable for recreation and wildlife (FDEP, 1996a).

Nutrient measurements for total nitrogen and total phosphorus in the tidal Caloosahatchee were highest at or east of Ft. Myers. Total nitrogen levels were exceeded in the Caloosahatchee at a station adjacent to Ft. Myers with an average measurement of 1.64 mg/L in 1991. Total nitrogen exceedences (>1.22 mg/L) were also observed east of Ft. Myers in the Caloosahatchee, and at Billy Creek and Deep Lagoon. Averages for total phosphorus exceeded state standards (i.e. were >0.07) in most cases, with the exception of Orange River. The nutrient status as indicated by the TSI is “poor” for Deep Lagoon, “poor” for Billy Creek, and “fair” but close to “poor” for the tidal Caloosahatchee. The WQI for freshwater streams and rivers rated Orange River water quality “good” (FDEP, 1996a). **Table 7** provides a summary of the water quality in the tidal Caloosahatchee Basin by decade for several water-quality parameters. The data from which **Table 7** was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a). **Table 8** additionally provides a summary of the water quality by decade for various water-quality parameters of the Tidal Caloosahatchee Coastal Area (San Carlos Bay) region.

Important natural habitats remaining within the tidal Caloosahatchee drainage basin include mangrove, saltmarsh, tidal ponds, and according to one 1988 assessment, a small percentage of rare/unique slash pine/midstory oak (Godschalk and Associates, 1988). The West Indian manatee (*Trichechus manatus*) is a federally endangered species that frequents the tidal Caloosahatchee River and winters in the Orange River (FDEP, 1996a).

Impaired usage occurs from wastewater inputs from Ft. Myers WWTPs, high nutrient waters from upriver, inputs from tributaries, and stormwater runoff from cities. Algal blooms occur frequently because of excess nutrients (FDEP, 1996a).

TABLE 7. SUMMARY OF WATER-QUALITY DATA FOR TIDAL CALOOSAHATCHEE BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	**Units**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**
Turbidity	NTU	93	3.14	0.1	22	2.2	50.5	33	1.78	13	31.8	0	22.8	23	3.09	1	8.7	0	50.5
PH	pH	121	7.61	6.4	8.5	0		32	1.6	0.8	2.2	0		22	7.15	6	8.3	0	
Salinity	ppt	20	0.9	0	4	0		N/A				0		6	0	0	0	0	
Temperature	deg. C	460	26.96	2	38	0		12	25.98	13	31.8	0		24	24.13	14.5	30.5	0	
Chlorides	mg/L	60	785.5	38	6000	50		27	1234	36.5	8200	59.3		11	55.13	29	141	0	
Fluorides	mg/L	N/A						6	0.21	0.17	0.31	0		2	0.16	0.15	0.16	0	
Conductivity	micromho	82	4226	0.1	38500	42.7		43	3502	420	21500	53.5		24	5179	378	21800	37.5	
DO	mg/L	108	5.46	0.6	9.9	41.7	61.5	34	5.61	1.5	9.1	32.4	59	24	4.37	0.6	11	62.5	75
BOD	mg/L	80	1.65	0.3	5.7	17.5	45.5	7	1.6	0.8	2.2	0	42	14	1.84	0.6	5.4	14.3	49
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	25	1.46	0.38	5	52	54	24	1.83	0.42	3.56	62.5	51.3	3	1.09	0.59	1.59	33.3	33.5
Tot-P	mg/L	90	0.21	0	2.37	78.9	69	32	0.11	0.01	0.8	46.9	54	24	0.15	0.01	0.52	62.5	62
Tot-C	mg/L	26	12.35	8	19.7	0		22	12.57	9.3	18.5	0		N/A					
Tot-coli	/ 100 ml	28	21663	10	99990	64.3	97.7	N/A						2	270	270	270	100	54.3
Fecal-coli	/ 100 ml	32	15676	2	99990	21.9	100	5	88.6	28	195	20	53.4	18	703.8	10	3505	55.6	88.1
Cu	ug/l	N/A						N/A						N/A					
Fe	ug/l	4	0.4	0.22	0.64	0		5	85.27	0.12	425	20		N/A					
Pb	ug/l	N/A						N/A						N/A					
Zn	ug/l	N/A						1	17	17	17	0		N/A					
Chlor a	ug/l	N/A						8	4.5	0	12	0	29	7	15.27	1	57.2	28.6	98.8
WQI	%						63.5						46						58.7

TABLE 8. SUMMARY OF WATER-QUALITY DATA FOR THE TIDAL CALOOAHATCHEE COSTAL AREA (SAN CARLOS BAY)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	**Units**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**
Turbidity	NTU	N/A						5	5.64	3.6	8	0		15	3.07	1.7	4.4	0	
PH	pH	7	7.82	7.41	8.1			5	8.1	7.9	8.2			68	8.13	7.15	9.18		
Salinity	ppt	N/A						N/A						16	30.44	15	36.3		
Temperature	deg. C	7	26.5	23	29.8			22	26.7	19.1	30.4			74	25.52	15.3	32.3		
Chlorides	mg/L	2	4525	1350	7700			22	16220.9	10000	20000			N/A					
Fluorides	mg/L	N/A						N/A						N/A					
Conductivity	micromho	7	36857.14	5000	50500			22	43480	29900	51900			15	47097.6	37434	54544		
DO	mg/L	5	6.33	5.3	8.8	0		18	6.62	5.6	8	0		65	6.71	1.5	8.6	4.6	
BOD	mg/L	2	1	0.1	1.9	0		N/A						N/A					
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	N/A						1	0.44	0.44	0.44		38.9	N/A					
Tot-P	mg/L	2	0.05	0.04	0.06	0		22	0.08	0.04	0.16	54.5	62	15	0.04	0.02	0.07	0	
Tot-C	mg/L	N/A						22	5.4	2.5	11			5	5.82	3.5	8.6	0	
Tot-coli	/ 100 ml	2	10	10	10	0		N/A											
Fecal-coli	/ 100 ml	2	10	10	10	0		N/A											
Cu	ug/l	N/A						3	1	1	1	0		N/A					
Fe	ug/l	N/A						2	210	210	210	0		N/A					
Pb	ug/l	N/A						N/A						N/A					
Zn	ug/l	N/A						2	25	20	30	0		N/A					
Chlor a	ug/l	N/A						N/A						15	3.36	1	15.3	0	
TSI		TSI NOT CALCULATED											42	TSI NOT CALCULATED					

2.2. Estero-Imperial Integrated Watershed

Introduction

The Estero-Imperial Integrated Watershed is comprised of the Estero Bay Watershed and northern portions of the Big Cypress Watershed. The Caloosahatchee River Watershed to the north, the Golden Gate Canal Watershed to the south, and the Gulf of Mexico to the west border the area. Interstate 75 runs north to south through the westernmost portion of the Estero-Imperial Integrated Watershed and divides the more developed coastal areas from the less developed interior. Most of the watershed lies in Lee County with a small percentage located in Hendry County (**Figure 3**). The Estero and Imperial Rivers, and Spring Creek, though small, are the major tributaries within the Estero-Imperial Integrated watershed that drain into Estero Bay. According to several reports, surface runoff and altered freshwater flows impact water quality greatest within this watershed. Warm, slow moving, estuarine water bodies such as the Estero and Imperial Rivers have some naturally low water-quality characteristics such as low DO. Therefore, these may be more susceptible to water-quality impacts resulting from changes in land use.

Physical Description

Population centers include the towns of Bonita Springs and Immokalee with 13,600 and 14,120 persons, respectively (U.S. Department of Commerce, 1992). Bonita Springs is south of the Imperial River and above the Lee-Collier County border, and Immokalee is located along the eastern edge of the Estero-Imperial Integrated Watershed. Rapid growth is occurring in Bonita Springs where the population more than doubled from 1980 to 1990. Residential areas, cattle, and vegetable farms occupy the landscape, and except for the coastal areas, the population is low (FDEP, 1996a).

Native Estero River coastal habitats include abundant tidal wetlands consisting primarily of mangrove and some saltmarsh (Godschalk and Associates, 1988). Freshwater wetlands are dominated by sawgrass with patches of cypress or hardwoods (FDEP, 1996a). Palmetto prairie and pine flatwoods exist further upland. Rare and unique upland habitats include sand scrub and slash pine/midstory oak (Godschalk and Associates, 1988). Soils are mostly of the Pamlico formation, which are comprised of marine quartz sands and hardened sandstone (Drew and Schomer, 1984).

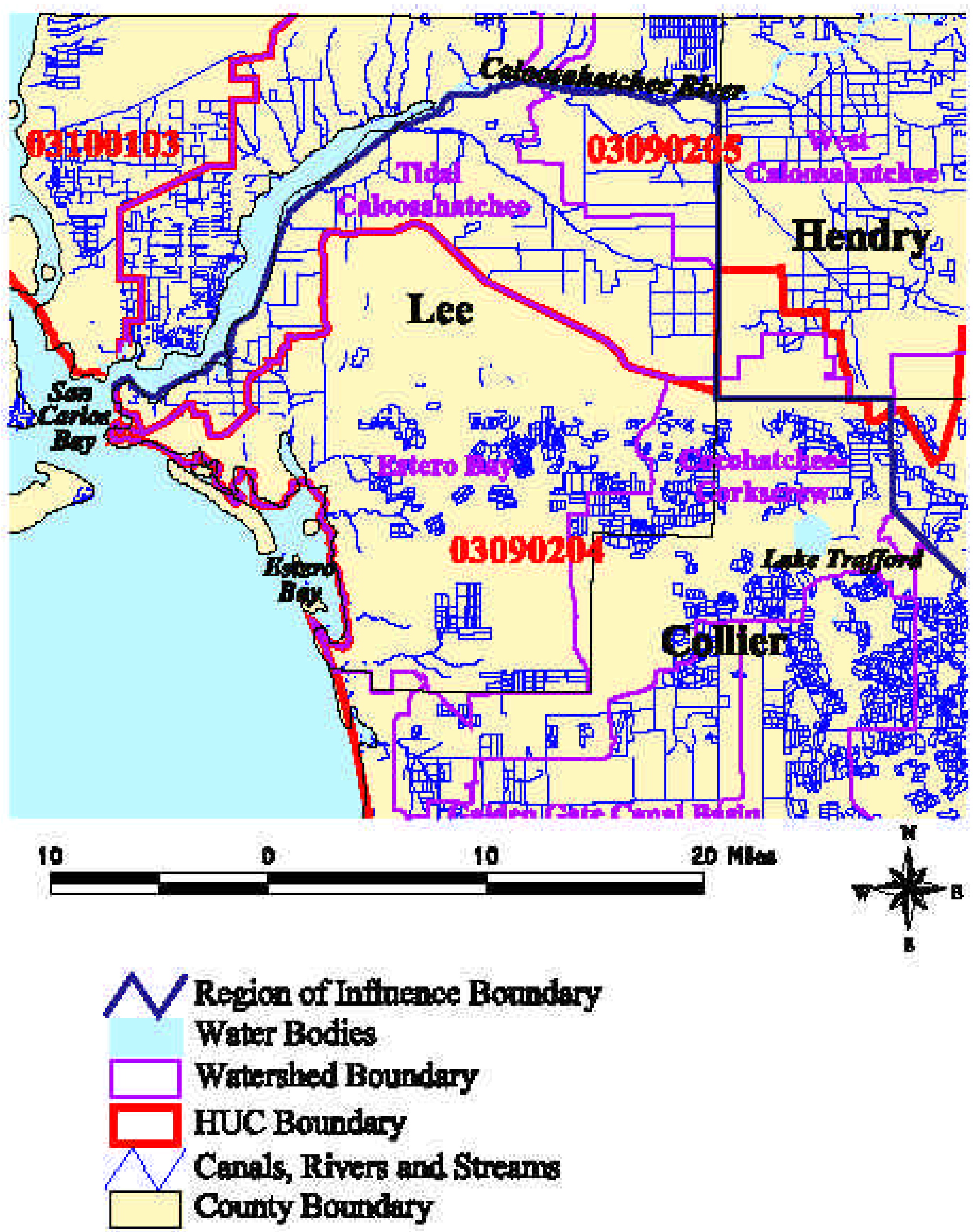


Figure 3. Estero-Imperial Watershed within the Study Area.

The Estero and Imperial Rivers, and Spring Creek provide minor freshwater flow into Estero Bay. The naturally low flow characteristics of these tributaries make Estero Bay notably susceptible to altered upland drainage water quality, volume, and seasonal inputs (Gissendanner, 1983). The topography of the watershed is relatively level thus accounting for the "sluggish" water movement in this part of the basin (FDEP, 1996a).

The highest freshwater inflows into Estero Bay occur in September with great variation in volume observed over the course of the year (Kenner and Brown, 1956; Drew and Schomer, 1984). At one time, tidally induced flows in Estero Bay exceeded the amount of freshwater inflow (Jones, 1980). Estero Bay tides are mixed and average about 0.54 m (1.75 ft) (Estevez et al., 1981), with velocities in the three major Bay-Gulf passes ranging from 0.64 m/s (ebb tide) to 1.52 m/s (flood tide). Flood tides can reach 1.07 m (3.5 ft) in height with volumes of 819 million cubic feet (measured for one pass in 1976) (Drew and Schomer, 1984). The low freshwater inflow into Estero Bay allows for generally high saline conditions year-round (around 34 ppt in the dry season), yet is high enough to prevent hypersaline conditions. Salinity seldom falls below 10 ppt even in the wet season (Tabb et al., 1974). Saltwater intrusion into local aquifers has resulted from inadequate recharge of groundwater. This occurrence has been attributed to surface hydrology modifications such as drainage canal construction. The construction of canals has increased surface water flow such that aquifers are not recharging, thereby allowing saltwater to infiltrate (Daltry and Burr, 1998). The Ten Mile Canal was constructed about 1920 to drain a 70 square mile area for agricultural uses. The canal directs this water into Mullock Creek a tributary of Estero Bay. Generally, this watershed does not have the extensive drainage network of the surrounding areas, but the construction of roads and other berms has still significantly altered the hydrology of the area. These changes have resulted in extensive flooding along the Imperial River. In addition, where flows from the Imperial and Estero Rivers into Estero Bay were once approximately equal, the proportional flow from the Estero River is now much less than that of the Imperial River (Johnson Engineering, Inc. et al., 1998). Surface water from the more interior areas of Flint Pen Strand and Bird Rookery Swamp are drained into Estero Bay and the Wiggins Pass/Cocohatchee River Estuarine System through the Imperial River, Spring Creek, and the Cocohatchee Canal (SFWMD, 1998a).

Historical Description

The Estero-Imperial Integrated Watershed was and in many areas still is typical of low, flat south Florida lands dominated by wetlands and characterized by slow, sheet-flow drainage patterns. In the past, the naturally dispersed water patterns served to distribute nutrients over broad areas of wetland vegetation. Thus, nutrient levels remained low in undrained areas of this watershed (Haag et al., 1996a). Seasonal fluctuations in flow due to rainfall created the necessary salinity regime in Estero Bay for good estuarine productivity. Estero Bay was recognized many years ago for it's natural qualities and became the state's first aquatic preserve in 1966 (Alleman in CHNEP, 1997). In 1983, the Estero Bay Aquatic Preserve Management Plan was implemented with emphasis placed on "enhancing the existing wilderness condition" (Gissendanner, 1983). Increasing development in the 1960s led to changes in the natural river systems around Estero Bay (Alleman in CHNEP, 1997). Changes in water quality and quantity have been observed. For example, the Imperial and Estero Rivers historically delivered less fresh water to Estero Bay. From 1940 to 1951, the maximum discharge from the Imperial River was 2,890 cu ft. Low flows were common and no flows occurred on occasion. Periodically, the rivers would flood (Kenner and Brown, 1956).

Freshwater Systems

Currently, physical water quality in the coastal areas of the Estero and Imperial Basins is characterized by clear water with neutral pH (7.1 to 7.3) but relatively high conductivity values (>16,000 micromhos). DO is slightly lower in the Imperial Basin (4.9 mg/L compared to 5.7 mg/L) than in the Estero Basin. Estero and Imperial Basin water clarity is attributed to low turbidity at <5.0 NTU/NTUs, generally low suspended solids at <10 mg/L, above average Secchi disc depths of 0.9 m to 1.5 m, and low color at 43 to 55 PCUs. Chloride measurements are not available, but conductivity indicates high dissolved mineral content in the Estero and Imperial Rivers. Biological parameters of chlorophyll a and 5-day biochemical oxygen demand (BOD-5) are of slightly lower quality in the Imperial River than in the Estero River. To clarify, BOD in the Imperial River is higher (2.4 mg/L over 1.4 mg/L) than in the Estero River; chlorophyll a is higher in the Imperial (12 μg/L over 2 μg/L), but generally, the two systems are comparable with respect to water quality. Water from the Estero and Imperial Rivers has a "residency time in the Bay of at least several days during the wet season" (Clark, 1987).

The TSI for the Estero and Imperial Rivers was evaluated as "fair" water quality by FDEP based on their nutrient status as determined by chlorophyll a, total nitrogen, and total phosphorus measurements. The TSIs for the Estero and Imperial Rivers were 52 and 53 respectively where scores below 50 rated "good" and scores above 59 rated poor. Spring Creek was also rated as 52 (FDEP, 1996a).

Metals have been detected from limited sampling of the waters of the Estero-Imperial Integrated Watershed (Table 9). In addition, elevated levels of cadmium, chromium, lead, mercury, and zinc have been found in the sediments of Estero Bay and River, Imperial River, and Spring Creek as recently as 1986 (Clark, 1987). In general, analysis of metals, pesticides and PCBs is lacking for the Estero-Imperial Watershed, with metals having only been sampled six times (with the exception of iron) within the last 30 years.

The Imperial River is classified in terms of usage as a Class 3 water body, suitable for wildlife and recreation. Due to low DO, nonpoint pollution, and conventional pollutants, water quality only partially supports the Imperial River for this type of use (FDEP, 1996a). Likewise, Estero River and Spring Creek are only in partial support of use: Spring Creek because of conventional pollutants and low DO, and Estero River for low DO and fecal coliform.

Important biological data useful in understanding and interpreting water quality are indicator species, species diversity information, and concentrations of chlorophyll a and fecal coliform bacteria. Indicator species may be sensitive to degraded water quality or they may be tolerant of degraded water quality. Certain species of polychaete and oligochaete worms become dominant under degraded water quality conditions. In south Florida wetlands, decreasing wading bird populations such as the endangered wood stork often reflect changes in hydrology. Species diversity will decline with declines in habitat quality and thus can be a potential water quality indicator. Increased chlorophyll a concentrations can indicate algal blooms and high nutrient levels, a condition which can eventually lead to eutrophication.

Table 9 provides a summary of the water quality in the Estero-Imperial Basin by decade for several water quality parameters. The data from which Table 9 was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a).

Estuarine Systems

Estero Bay

Recent STORET data were not available, but Estero Bay waters are described as shallow, turbid, and of “fair” quality. Nutrients at levels that exceed state standards tend to drive water-quality ratings down. Consequently, this water body only partially meets its Class 3 use designation (FDEP, 1996a). Measurements were available for one station at Big Carlos Pass in the Bay and therefore may not be indicative of other areas of the Bay.

Water clarity, as indicated by turbidity, TSS, and color (8.5 NTU/NTUs, 28 mg/L, 25 PCUs, respectively) is low. Waters were well oxygenated with mean DO levels at 6.5 mg/L. Conductivity was 37800 micromhos (FDEP, 1996a).

Low chlorophyll a and low BOD were observed in the past. The mean for chlorophyll a was 8 mg/L, and the mean BOD was 1.6 mg/L.

Historically, Estero Bay rated a TSI of 50, even with phosphorus levels that exceeded FDEP screening criteria, which is still “fair” but approaching “good”. Estero Bay phosphorus levels were above FDEP screening concentrations. Phosphorus screening levels are >0.07 mg/L and Estero Bay concentrations were 0.10 mg/L. Total nitrogen measured 0.81 mg/L, which is considered low for estuaries.

Estero Bay has not had a problem with high bacterial counts as indicated by the low total and fecal coliform analyses.

Some contamination by cadmium, chromium, lead, mercury, and zinc in Estero Bay sediments has been observed. Concentrations of pesticides and PCBs were below minimum detection limits (Clark, 1987).

Table 10 provides a summary of the water quality in the Estero/Imperial Basin Coastal Area (Estero Bay) by decade for several water-quality parameters. The data from which

Table 10 was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a).

TABLE 9. SUMMARY OF WATER-QUALITY DATA FOR THE ESTERO/IMPERIAL BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	87	2.69	0	10	0	41	245	2.9	0.2	62	2.0	44	19.73	2.23	.1	88	1.2	35.3
PH	pH	90	7.33	5.95	8.3	0		237	7.52	6.0	10.73	0		1960	7.39	5.2	9.2	0	
Salinity	Ppt	10	1.8	0	8	0		N/A						8	0.48	0	3.8	0	
Temperature	Deg. C	53	25.7	20.5	31	0		90	25.80	15.0	35	0		1962	24.93	10.9	44	0	
Chlorides	Mg/L	32	1819	7.7	22300	56.3		305	403.64	5.8	17251.7	17.7		1898	1064.94	1.5	7550	21.6	
Fluorides	Mg/L	N/A						3	0.12	0.1	0.17	0.0		N/A					
Conductivity	Micromho	79	6133	200	51000	36.7		339	1589	56	46700	16.2		1972	3989.57	64	54800	24.6	
DO	Mg/L	84	4.68	0.8	11.2	53.6	72	242	6.06	0	20	37.6	51.4	1962	3.87	.3	18.1	73.5	80.3
BOD	Mg/L	44	1.86	0.1	4	25	51.8	33	2.05	0	6	21.2	61.5	1691	2.22	0	8.5	31.1	66.2
COD	Mg/L	N/A						N/A						N/A					
Tot-N	Mg/L	42	1.42	0.5	4.33	56.2	51.5	236	1.16	0.24	5.11	33.5	37.5	1818	1.08	.01	192	22.6	33
Tot-P	mg/L	78	0.03	0	0.17	5.1	20	249	0.04	0	0.5	8.8	30	1377	.17	.01	3.73	56.1	65
Tot-C	mg/L	44	12.82	3.4	27.9	4.5	N/A	71	14.58	8.2	25.2	2.8		N/A					
Tot-coli	/ 100 ml	13	295.1	6	1120	61.5	54.9	N/A						6	111	10	420	33.3	45.1
Fecal-coli	/ 100 ml	21	154.3	1	720	28.6	72.6	4	114.3	68	205	25	69.4	691	155.30	2	2600	21.4	72.8
Cu	ug/l	N/A						15	9.31	0.47	10.0	93.3		1987	6.21	.5	399	53.1	
Fe	ug/l	6	0.58	0.19	1.04	0		181	0.36	0.02	1.32	0		4	213.5	136	304	7.9	
Pb	ug/l	N/A						20	9.04	0.4	10	90.0		1901	2.54	0	250	25.0	
Zn	ug/l	N/A						15	13.86	10	37.9	0.0		1898	10.86	5	260	0.9	
Chlor a	ug/l	N/A						2	1	1	1	0.0		98	8.80	.70	95.10	10.2	53.1
WQI	%						52.9						52.0						58.0

TABLE 10. SUMMARY OF WATER-QUALITY DATA FOR THE ESTERO / IMPERIAL COASTAL AREA (ESTERO BAY)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI
Turbidity	NTU/NTU	93	8.06	1	45	13.5		38	12.98	2.6	65	26.3		2	5.9	2.6	9.2	0	
PH	pH	96	8.05	7.1	8.7			36	7.95	7	8.3			1	7.8	7.6	7.9		
Salinity	ppt	36	30.9	20	40			2	25.5	20	31			N/A					
Temperature	deg. C	95	24.98	13.25	32			38	24.7	11	31			2	.5	24	25		
Chlorides	mg/L	21	19245.62	18	23700	95.2		1	20.8	20.8	20.8			N/A					
Fluorides	mg/L	14	0.9	0.78	1.12	0.0		10	0.74	0.17	0.91			N/A					
Conductivity	micromho	68	41491.3	28	57000	95.6		32	40621.9	23000	50000	100		1	49000	49000	49000	1.8	
DO	mg/L	98	6.64	0.2	10.6	8.2		38	6.6	3.9	8.6	10.5		2	6.7	6.1	7.3	0	
BOD	mg/L	16	3.40	2.4	4.4	100		1	1.6	1.6	1.6	0		1	1.5	1.4	1.6	0	
COD	mg/L	1	0.29	0.29	0.29	0.0		N/A						N/A					
Tot-N	mg/L	1	0.06	0.06	0.06	0.0	0	N/A						62	.38	0.86	1.95	39.5	62.5
Tot-P	mg/L	55	0.06	0	0.23	25.5	12.5	16	0.12	0.05	0.29	68.8		65	0.03	0	.1	.09	45
Tot-C	mg/L	57	5.65	0	16	0.0		10	5.4	3	11	0		N/A					
Tot-coli	/ 100 ml	55	7.3	0	68	0.0		10	13	2	40	0		N/A					
Fecal-coli	/ 100 ml	70	8.65	0	210	1.4		17	16.2	2	120	0		2	3	2	4	0	
Cu	ug/l	10	10.9	5	17	100		4	33.8	10	50	100		N/A					
Fe	ug/l	40	2757.3	50	100000	32.5		4	282.8	84	724	25		N/A					
Pb	ug/l	27	1309.8	0	35000	88.9		4	33.8	10	50	100		N/A					
Zn	ug/l	29	3588.9	30	100000	86.2		4	25.8	25	28	0		N/A					
Chlor a	ug/l	38	9.05	0	67	5.3	48	12	7.64	0.0	19.0	0		64	46.5	2.18	78	57.8	72
TSI							27	TSI NOT CALCULATED											62.4

Decreases in important estuarine habitats such as marine grassbeds, saltmarsh, and oyster bars may indicate declining water-quality trends (Clark, 1987; Gissendanner, 1983). Species with protected status may also provide an indication of improved or degraded water quality. Some of these include the Atlantic green turtle, Atlantic hawksbill, Atlantic Ridley, leatherback, Atlantic loggerhead, wood stork, West Indian manatee, southeastern snowy plover, eastern brown pelican, bald eagle, southeastern kestrel, least tern, and mangrove fox squirrel (Gissendanner, 1983; Wood, 1994).

Nutrient inputs from agricultural runoff (fertilizers) are cited as the source of high phosphorus. Habitat alteration through possible destruction of forests and wetlands, water flow changes, and pollution are listed as other impairments to use (Alleman in CHNEP, 1997).

2.3. Big Cypress/West Collier Watershed

Physical Description

The physical description of the Big Cypress/West Collier watershed includes brief descriptions of land use, habitat, soils, and water flow characteristics.

The Big Cypress/West Collier Watershed portion of the study area is situated in Big Cypress preserve, an area of low flat lands of cypress trees, pine forests, and wet and dry prairies. Agriculture and urban are the main types of human land use. However, it should be noted that lands that are zoned as agricultural may in actuality be swamp. Major urban areas situated along the coastal area of the watershed are Naples, East Naples, North Naples, Naples Park, Marco Island, and Golden Gate. The single most conspicuous feature of the area is the expansive system of roads and canals constructed during the 1960s for the Golden Gate Estates (GGE) land development project. The Golden Gate Estate canals channel drainage from approximately 200,000 acres into the Gordon River, Naples Bay, and the Fahka Union Bay (U.S. COE, 1980). Impacts from the Golden Gate Canal include overdrainage of surface waters, lowering of groundwater levels, altered traditional drainage patterns, reduction of habitats, and declines in agriculture potential (U.S. COE, 1980). Thus, the existing condition of water quality in the rivers and bays is undoubtedly linked to the major hydrological changes that have occurred in the past. Historically, the Big Cypress Basin was dominated by sheet flow but several land reclamation projects starting at the beginning of the century have dramatically changed the hydrology. The majority of Collier County inside of the study area has been drained through the construction of canal networks. The first of such projects was the creation of the Tamiami Trail during the earlier part of the century. The GGE project had the largest impact on the hydrology of the area. This area consists of hundreds of miles of large canals that drain approximately 300 square miles. The construction of GGE has dramatically lowered the groundwater table and changed salinity regimes of coastal areas of the Big Cypress/West Collier watershed.

Soil types are Pamlico formation sands and marl deposits with peat. Marls are silty calcium carbonate deposits, often with shell fragments, formed from eroded limestone (Drew and Schomer, 1984).

Cocohatchee River, Naples Bay, Gordon River, Blackwater River, Fahka Union Bay, Fahkahatchee Bay, Marco Bay, and Rookery Bay are the major natural water bodies within the study area. Barron Canal, Golden Gate Canal, Cocohatchee River Canal, Fahka Union Canal, Gordon River Canal, and Henderson Creek Canal are the major artificial drainage systems within this watershed. Flow direction and areas drained by canals are dependent upon rainfall amount. For example, the Cocohatchee River Canal drains an area southwest of Lake Trafford during dry periods and may have no flow during very dry years. During the rainy season, the Cocohatchee River Canal along with Henderson Creek Canal serves to collect excess drainage from the Golden Gate area (**Figure 4**).

Fahka Union Canal collects drainage from a series of smaller canals and discharges into the Ten Thousands Islands area. The Golden Gate Canal and Gordon River drain into Naples Bay, the periphery of which is lined with an extensive network of finger canals and residential developments. The Barron River Canal, built as a source of fill to make roads, drain strands and sloughs of the Big Cypress National Preserve (Drew and Schomer, 1984).

Historical Description

Without pre-canal water-quality data, little can be said about the original water quality within the Big Cypress/West Collier Watershed. In addition, it is recognized that good water quality can exist within areas of severely altered hydrology. However, there are some basic factors to consider related to the channelization of wetlands. Canal construction, which began in the 1920s, undoubtedly led to increased drainage of freshwater from wetlands into the estuaries and a subsequent increase in dissolved minerals. Possible changes in salinity, sedimentation, turbidity, and nutrients likely resulted. In lieu of more detailed pre-canal water quality descriptions, STORET data from the 1980s provides a historical description of post-canal water quality of the Golden Gate Watershed for comparison with the present day. Physical water quality was characterized by neutral pHs, DO levels that were on the average low (>5.0) at stations sampled in Naples Bay, Barron River Canal, Blackwater River, Gordon River, and Gordon River Canal, and conductivity above >1275 in some of the freshwater bodies (Cocohatchee River, Blackwater River). BOD and chlorophyll a were high in the Gordon River Canal and in the Blackwater River. Fecal coliform counts were high (>190 MPN/100 ml) in the Gordon River. Water quality in the Fahka Union canal was excellent, rating a very low 16 on the WQI scale. Naples Bay rated “fair” in terms of nutrient conditions according to the FDEP TSI with a 53. In general, the areas along the Blackwater River have the worst water quality.

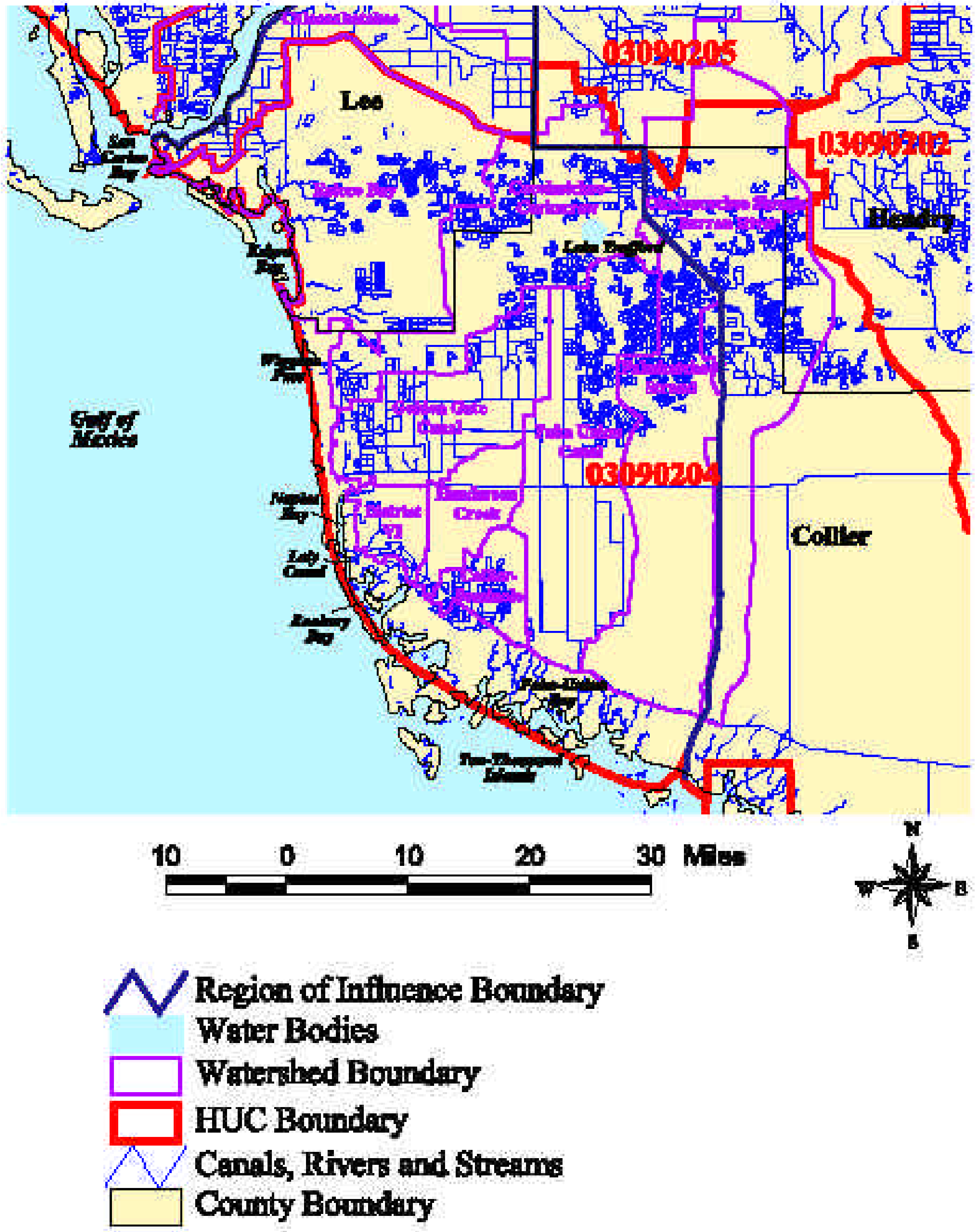


Figure 4. Big Cypress Basin Watershed within the Study Area.

Freshwater Systems

Corkscrew Swamp

Portions of Corkscrew Swamp are described as pristine due to its status as a National Audubon Society sanctuary. The Corkscrew Swamp Regional Ecosystem Watershed is a Southwest Florida Water Management District (SWFWMD) project that encompasses the sanctuary with goals to restore hydrologic conditions in impacted areas (Bird Rookery Swamp) and maintain flows and water quality in undisturbed areas of Corkscrew Swamp (SFWMD, 1998a). Lake Trafford, north of Corkscrew Swamp is of historically good to fair water quality that fully supports use designation as a Class 3 water.

Cocohatchee River

Current physical water quality of the Cocohatchee River is characterized relative to typical state waters by low turbidity (2.9-3.5 NTU/NTUs), low TSS (2 –10 mg/L), higher than average color (85 –100 PCUs), neutral pH, variable DO (3.2 to 7.0 mg/L), and variable conductivity (675 – 2650 micromhos (FDEP, 1996a). The low DO results from excessive aquatic vegetation in the canals using up more oxygen than what is produced through photosynthesis (Kirby et al., 1988).

Chlorophyll a levels were well below state standards with a mean concentration of 5 µg/L. BOD was, at one location, higher than average for typical Florida waters but just shy of exceeding state criteria. BOD averaged between 1.6 and 2.0 for two stations in the Cocohatchee River. Total coliform bacteria levels were higher than average for state waters, and fecal coliform counts exceeded state standards with 2650 MPN/100 ml.

Nutrient levels are lower than average, with phosphorus and nitrogen levels below state screening levels. The WQI modified by FDEP from a similar EPA index, currently rates the river as “fair” with a rating of 48, and historically rates the Cocohatchee River canal as “good” with a rating of 33. Scores between 45 and 59 are classified as “fair”. Values below 45 are “good” and values above 59 are “poor”. Low DO (5.1 mg/L) and high fecal coliform counts (381 MPN/100 ml), averaged from two locations, drive the WQI rating for the Cocohatchee River down. The TSI for the Cocohatchee River also classified the river as “fair” with ratings of 50 and 58 for two sections. The Cocohatchee River is a Class 2 water, suitable for shellfish harvesting, which partially meets its designated use.

Cocohatchee River Canal

According to STORET data, the Cocohatchee River Canal has not been sampled since 1988. Therefore, a current account of water quality is not possible. Historical data collected from 1980 to 1988 provide the basis of the following description. The Cocohatchee River Canal is about 13 miles long and less than 5 feet deep with better water quality than its natural counterpart. Compared to other state waters, physical water quality is better than average for most state waters.

Biological data for the Cocohatchee River Canal are absent from STORET for 1980-1988. Therefore, no BOD, coliform, or chlorophyll a information is presented.

Nutrients are present in amounts higher than average for most estuaries, but do not exceed state standards. Total nitrogen measured between 0.99 and 1.08 for two stations, and total phosphorus measured 0.03 for both stations.

No contaminants have been recently detected according to STORET data. However, the database compiled for this study indicate copper and zinc exceeded state standards in 23% and 14% of samples respectively from 1990-1998 (**Table 11**). Water quality is exhibiting a stable trend, and fully supports designated use for a Class 3 water body (FDEP, 1996a). Sediment quality information is not available for the Cocohatchee River Canal.

Table 11 provides a summary of the water quality in the Corkscrew/Cocohatchee Basin by decade for several water-quality parameters. The data from which **Table 11** was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a "good", "fair" or "poor" basis; as typically included in the Florida's 305b water quality report (FDEP, 1996a).

Golden Gate Canal:
Current water-quality data were not available for the Golden Gate Canal from the STORET database. However, historical STORET water-quality data from 1980-1989 are available. Physical water quality in the 1980s was characterized by relatively low turbidity (3.5-4.3 NTU/NTUs), low TSS (2-3 mg/L), higher color content than average (50-99 PCUs), neutral pH, and low to moderate levels of DO (4.8-6.0 mg/L). Conductivity was higher than average for typical state waters (572-650 micromhos).

BOD exceeded state standards with an average of 2.4 mg/L at one canal sample location. The state standard is 2.3 mg/L. One location was sampled for chlorophyll a and was higher than average for typical state waters with 19 µg/L. Fecal coliform bacteria were lower than average (55 MPN/100 ml).

Total nitrogen and total phosphorus met state standards and overall were lower than average for other state waters. Total nitrogen ranged from 0.81-1.07 and total phosphorus ranged from 0.02-0.03 for three locations along the Golden Gate Canal. The WQI for the Golden Gate Canal ranged from 36 to 40, an indication of "good" water quality (FDEP, 1996a). Sediment quality information was not available.

Table 12 provides a summary of the water quality in the Golden Gate Canal Basin by decade for several water-quality parameters. The data from which Table 12 was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a "good", "fair" or "poor" basis; as typically included in the Florida's 305b water quality report (FDEP, 1996a). **Table 13** provides a summary of the water quality in the Golden Gate Canal Coastal Area by decade for several water-quality parameters.

TABLE 11. SUMMARY OF WATER-QUALITY DATA FOR THE CORKSCREW/COCOHATCHEE BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	81	6.37	1	75	8.6	79	271	4.7	0.3	127	3	66.5	38	12.81	0.6	70	31.6	92.5
PH	pH	109	7.61	4.6	10.25	0		199	7.37	2.5	9.1	0		37	7.09	6.4	8.5	0	
Salinity	ppt	3	1.17	0	2.5	0		N/A						N/A					
Temperature	deg. C	161	26.95	14	240	0		28	25.49	0.24	34	0		16	26.03	18.5	31.6	0	
Chlorides	mg/L	70	154.38	5.8	3400	4.3		264	240.97	9.2	2950	15.2		28	47.01	18	114.6	0	
Fluorides	mg/L	N/A						9	0.24	0.17	0.44	0		N/A					
Conductivity	micromho	150	1943.43	70	51000	8.7		282	1767.62	80	46000	17.4		38	3173.92	179	36400	13.2	
DO	mg/L	95	6.59	1.3	14.4	28.4	42	197	4.99	0.1	12.8	50.3	68	38	5.12	0.2	11.3	52.6	67
BOD	mg/L	63	2.19	0.2	8.6	38.1	64	15	1.89	0.8	4.1	26.7	52	12	3.39	0.5	9.4	41.7	84
COD	mg/L	5	7.6	0	20	0	2.8	N/A						N/A					
Tot-N	mg/L	45	0.96	0.01	5.52	33.3	27	258	1.15	0.1	3.95	33.3	37	24	0.87	0.51	1.25	8.3	22.5
Tot-P	mg/L	79	0.13	0	2.3	38	58	274	0.11	0	2.92	26.3	54	38	0.13	0.01	0.69	42.1	58
Tot-C	mg/L	35	16.34	7.1	70	17.1	N/A	53	15.63	9.8	23.5	3.4	N/A	5	24	18	30	60	N/A
Tot-coli	/ 100 ml	31	88.9	1	1056	25.8	30.9	4	34.5	0	136	25	25.1	4	107.5	20	230	75	44.8
Fecal-coli	/ 100 ml	42	30.7	0	600	2.4	40	14	64.21	0	360	7.1	49.5	13	308.77	10	2224	30.8	81
Cu	ug/l	2	1	0	2	0		5	5.73	0.05	25	20		22	6.06	0.5	90.75	22.7	
Fe	ug/l	9	276.92	0.24	1700	11		233	1.21	0.04	157	0		22	1.52	0.25	5.35	0	
Pb	ug/l	7	7.71	0	19	57.1		5	0.64	0	2	0		22	0.6	0.5	1.43	0	
Zn	ug/l	N/A						4	31.03	23.1	43.8	0		22	44.14	20	421	13.6	
Chlor a	ug/l	N/A						11	14.75	5	33	27.3	63.1	6	47.4	2	147.7	50	91.5
WQI	%						46.5						53.9						69.3

TABLE 12. SUMMARY OF WATER-QUALITY DATA FOR THE GOLDEN GATES CANAL BASIN

WQ Parameters	Units	1970-1980 Obs	Mean	Min.	Max.	% Exc	WQI	1980-1990 Obs	Mean	Min.	Max.	% Exc	WQI	1990-1998 Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	227	8.47	0	140	10.6	86.2	372	4.41	0.3	101	2.7	65	2	2.35	2.2	2.5	0	36.5
pH	pH	248	7.67	6	79.5	0		278	7.44	2.3	8.93	0		2	7.55	7.1	8	0	
Salinity	ppt	5	3.8	0	11	0		N/A						57	26.15	14	39	0	
Temperature	deg. C	276	24.14	13.8	32.5	0		15	24.1	7.5	31	0		59	25.98	15	35	0	
Chlorides	mg/L	188	639.05	16	17000	11.7		344	185.67	4	8171.9	7.3		N/A					
Fluorides	mg/L	N/A						3	0.17	0.17	0.17	0		N/A					
Conductivity	micromho	301	2003.58	61	41500	10.6		370	1181.06	170	29900	9.5		59	38488.39	700	64465	96.6	
DO	mg/L	237	4.65	0.2	14.4	55.7	72	284	4.49	0.4	9.9	61.6	74	59	4.59	0	12.4	44.1	73
BOD	mg/L	113	1.72	0	7.3	16.8	48.2	7	1.74	0.7	3.8	14.3	48.4	1	1.5	1.5	1.5	0	39
COD	mg/L	N/A						0	N/A	N/A	N/A	N/A		N/A					
Tot-N	mg/L	135	1.09	0.37	7.88	22.2	33.5	362	1.22	0.37	7.18	36.5	41	N/A					
Tot-P	mg/L	188	0.04	0	0.75	8	26	368	0.04	0	0.34	9	26	2	0.07	0.04	0.1	50	42
Tot-C	mg/L	160	322.15	0	17000	19.4		79	17.8	10.4	33.2	20.3		N/A	N/A				
Tot-coli	/ 100 ml	125	5251.12	4	65000	84	28.1	N/A						N/A					
Fecal-coli	/ 100 ml	117	98.35	0	800	16.2	54.5	6	202	8	480	50	76.1	3	297.33	12	824	33.3	79.9
Cu	ug/l	84	5.91	0	20	64.3		7	1.91	0.06	6	28.6		1	5	5	5	100	
Fe	ug/l	129	855.13	0.23	4800	61.2		339	2.4	0.02	320	0.3		1	717	717	717	100	
Pb	ug/l	79	12.02	0	85	64.6		7	3.05	0.4	11	28.6		1	3	3	3	0	
Zn	ug/l	86	71.63	0	1700	16.3		5	33.28	21	55.7	0		1	6	6	6	0	
Chlor a	ug/l	N/A						7	9.173	3	34	14.3		2	7.2	2.4	12	0	41.5
WQI	%						55.5						59.4						54.08

TABLE 13. SUMMARY OF WATER-QUALITY DATA FOR GOLDEN GATES CANAL COASTAL AREA

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	N/A												N/A					
pH	pH	1	7.1	7.1	7.1			NO DATA						N/A					
Salinity	ppt	2	32.3	32.2	32.4									345	24.69	0.0	38.2		
Temperature	deg. C	3	24.87	23.9	26.0									345	26.03	13.5	35.05		
Chlorides	mg/L	N/A												N/A					
Fluorides	mg/L	N/A												N/A					
Conductivity	micromho	N/A												345	38710	0.0	66072	96.5	
DO	mg/L	3	5.5	1.4	8.1	33.3	60							345	5.12	0.0	12.8	34.8	66
BOD	mg/L	N/A												N/A					
COD	mg/L	N/A												N/A					
Tot-N	mg/L	N/A												N/A					
Tot-P	mg/L	N/A												N/A					
Tot-C	mg/L	N/A												N/A					
Tot-coli	/ 100 ml	N/A												N/A					
Fecal-coli	/ 100 ml	N/A												N/A					
Cu	ug/l	N/A												N/A					
Fe	ug/l	N/A												N/A					
Pb	ug/l	N/A												N/A					
Zn	ug/l	N/A												N/A					
Chlor a	ug/l	N/A												N/A					
WQI	%																		

Henderson Creek/Blackwater River

Henderson Creek appears to be of good water quality until it intersects Blackwater River, of historically fair to poor water quality, depending on which index is applied. The TSI rated Blackwater River a 61, which is “poor”, while the WQI rated the river a 46, which is “fair”, and close to “good”. Low DO (3.5 mg/L) and high BOD (2.8) drive the index down. Because of these factors, FDEP states that Blackwater River only partially meets its use designation. However, the overall status (derived from a combination of indices, contaminant information, nonpoint source assessments, and expert opinion) of the Blackwater River is represented as “poor” in the 1996 305b report (FDEP, 1996a).

Fecal coliform bacteria counts from STORET data were 3 MPN/100 ml, averaged over five observations. The study area database compiled for this report indicates average fecal coliform levels from 1980 to 1990 was closer to 111 MPN/100 ml. No total coliform counts were available from STORET records for this period, but data summarized for Table 13 indicate high total coliform levels in Henderson Creek, averaging 1830 MPN/100 mls. Chlorophyll a levels measured 40 μg/L, which is higher than 90% of similar state waters. However, total nitrogen and total phosphorus levels remained low at 0.98 mg/L and 0.03 mg/L, respectively.

Sediment quality data was not available.

Table 14 provides a summary of the water quality in the Henderson Creek Basin by decade for several water-quality parameters. The data from which **Table 14** was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a).

The literature provided very little historical or current water-quality data for the District VI Basin. **Table 15,** however, provides a summary of the water quality from the STORET database by decade for various water-quality parameters of the District VI Basin.

TABLE 14. SUMMARY OF WATER-QUALITY DATA FOR THE HENDERSON CREEK BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	9	8.33	1	25	22.2	85.4	59	3.25	0	29	3.4	52.3	36	2.22	.3	10.2	0	35.2
pH	pH	13	7.95	7.2	9.2	0		93	7.22	5.1	9	0		89	7.3	6.76	8.04	0	
Salinity	ppt	N/A						23	8.25	0	35.8	N/A		91	10.52	0.0	35.9	N/A	
Temperature	deg. C	51	25.1	14	31	0		96	26.58	17.5	33	0		94	26.47	19.11	32.11	0	
Chlorides	mg/L	20	94	11	250	0		17	97.01	27	334.7	5.9		N/A					
Fluorides	mg/L	N/A						2	0.17	0.17	0.17	0		N/A					
Conductivity	micromho	47	1012.98	230	1750	12.8		96	308.87	.3	9500	3.1		94	31.36	.24	1350	1.1	
DO	mg/L	2	11.5	9.9	12.4	0	8.5	80	4.09	.7	9.85	70.0	78.1	92	4.68	.53	8.59	51.1	72.2
BOD	mg/L	15	4.56	1.6	10.4	73.3	90.8	14	3.65	0.3	8.8	64.3	88.9	1	0.3	0.3	0.3	0	2
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	11	2.3	1.16	3.62	90.9	81.5	10	4.1	1.33	9.51	100	94.1	N/A					
Tot-P	mg/L	7	0.06	0.02	0.14	28.6	37	14	0.05	0.02	0.13	35.7	32	1	0.12	0.12	0.12	100	56
Tot-C	mg/L	4	26.0	17.0	30.0	75		N/A						N/A					
Tot-coli	/ 100 ml	8	5650.24	2	22999.95	75	93.6	8	1830	100	6000	100	97.4	N/A					
Fecal-coli	/ 100 ml	8	1350.25	2	9399.98	37.5	91.7	13	111.54	0	300	38.5	69.1	1	135	135	135	0	71.5
Cu	ug/l	5	4.0	0	8	40		1	1.0	1.0	1.0	0		1	5.0	5.0	5.0	100	
Fe	ug/l	3	286.67	40	500	66.7		N/A						1	237	237	237	0	
Pb	ug/l	5	10.8	5	17	60		1	1.0	1.0	1.0	0		1	1.0	1.0	1.0	0	
Zn	ug/l	3	23.33	0	50	0		N/A						1	5.0	5.0	5.0	0	
Chlor a	ug/l	N/A						3	62.33	6	107	66.7	94.9	1	6.23	6.23	6.23	0	37.3
WQI	%						67.3						73.1						47.4

TABLE 15. SUMMARY OF WATER-QUALITY DATA FOR THE DISTRICT VI BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	**Units**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**WQI**
Turbidity	NTU	5	3.2	1	6	0	51	4	3.05	1.6	5.2	0	50.2	3	2.73	1	5.9	0	41
pH	pH	6	7.49	7	7.8	0		4	7.54	7.3	7.8	0		3	7.6	7	8.1	0	
Salinity	ppt	3	10.33	0	25	0		N/A						N/A					
Temperature	deg. C	8	25.73	21.1	29	0		4	24.88	20	28.5	0		3	23.93	22	26.3	0	
Chlorides	mg/L	6	3229.67	75	12800	66.7		N/A						N/A					
Fluorides	mg/L	N/A						N/A						N/A					
Conductivity	micromho	2	960	880	1040	0		4	23275	1600	39000	100		3	8481.33	444	13000	66.7	
DO	mg/L	6	5.08	1.9	7.1	33.3	67	4	3.93	1	7	50	80	3	4.47	2	9	66.7	74
BOD	mg/L	6	1.13	0.3	2.2	0	23	4	2.03	1.4	3.2	25	55	1	1.8	1.8	1.8	0	49
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	N/A						N/A						N/A					
Tot-P	mg/L	4	0.03	0.02	0.05	0	20	4	0.14	0.09	0.22	100	60	3	0.07	0.01	0.11	66.7	42
Tot-C	mg/L	N/A						N/A						N/A					
Tot-coli	/ 100 ml	6	1250.83	90	3700	100	18.3	N/A						1	16	16	16	0	20.5
Fecal-coli	/ 100 ml	2	70	20	120	0	50.9	4	637	220	1420	66.7	20.5	3	784	12	1910	66.7	21.5
Cu	ug/l	N/A						N/A						1	23.0	23.0	23.0	100	
Fe	ug/l	N/A						N/A						1	319	319	319	100	
Pb	ug/l	N/A						N/A						1	3.0	3.0	3.0	0	
Zn	ug/l	N/A						N/A						1	6.0	6.0	6.0	0	
Chlor a	ug/l	N/A						3	34.43	6.3	84	33.3	85.5	2	6.85	3.7	10	0	40.5
WQI	%						39.1						53.1						45.4

Fahka Union Canal
No current data was available for Fahka Union Canal. Historical water-quality data from two stations from 1980 to 1989 indicate exceptional physical water quality. Turbidity measured less than 1 NTU/NTU, better than 90% of state waters, and color was low, between 10 and 30 PCUs. The DO was high (6.4 mg/L) and at one station it was above saturation (9.9). Conductivity was between 600 and 700, which is above average, but far from exceeding state standards.

Nutrient levels, bacterial contaminants, and BOD were all well within state standards. Total nitrogen ranged from 0.51-0.73 mg/L and total phosphorus measured 0.01 mg/L. The WQI rated Fahka Union Canal a 17, an indication of "good" water quality. **Table 16** provides a summary of the water quality in the Fahka Union Canal Basin by decade for several water-quality parameters. The data from which **Table 16** was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a "good", "fair" or "poor" basis; as typically included in the Florida's 305b water quality report (FDEP, 1996a)..

The literature provided very little historical or current water-quality data for the Collier-Seminole Basin. **Table 17**, however, provides a summary of the water quality from the STORET database by decade for various water-quality parameters of the Collier-Seminole Basin. Sediment quality information was not available.

Estuarine Systems

Naples Bay
Current water-quality information is not available for Naples Bay. STORET data from 1989 are used to describe water quality. Water clarity is characterized by near average turbidity (3.6-4.5 NTU/NTUs), and slightly better than average color (40-80). No information on TSS was available from STORET for Naples Bay. Low DO was observed at two sample locations in the Bay. Average DO ranged from 4.5 to 6.0 mg/L.

Chlorophyll a was low, measuring 6-7 µg/L, while total nitrogen levels exceeded state standards (1.31 mg/L), as did total phosphorus (0.10 mg/L).

Sediment quality information was not available.

Listed or otherwise protected species include the West Indian manatee (*Trichechus manatus*), protected under the Endangered Species Act; the Atlantic bottlenose dolphin (*Tursiops truncatus*), protected under the Marine Mammal Protection Act; and several species of wading birds.

Historically, the major sources of freshwater to Naples Bay were the Gordon River, Haldeman Creek, Rock Creek and direct run-off from the city of Naples providing a combined discharge of approximately 100 cubic feet per second (cfs). The construction of Golden Gate Canal has considerably increased the flow of freshwater into the Bay in the wet season to as much as 1,500 cfs. In contrast, during the dry season in April discharge to the Bay drops to near zero (Simpson et al., 1979). **Tables 18 and 19**, provide summaries of the water-quality data by decade for various water-quality parameters of the Corkscrew/Cocohatchee Coastal Area (Wiggins Pass) and the District VI Coastal Area (Naples Bay and Rookery Bay) estuaries, respectively. The data from which these tables were developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a "good", "fair" or "poor" basis; as typically included in the Florida's 305b water quality report (FDEP, 1996a).

Rookery Bay:

Current water-quality data is not available through STORET. Under the National Oceanic Atmospheric Association (NOAA) National Estuarine Reserve Research (NERR) National Monitoring Program, automated data collectors deployed throughout Rookery Bay will soon make continuously collected water-quality data available on the Internet. In addition to being part of the NERR program, Rookery Bay is designated by the state of Florida as an aquatic preserve, and as a National Audubon Society Wildlife Sanctuary.

Rookery Bay has been described as a "transitional" estuary in terms of its location between the high-energy (erosional forces) coastline to the north and the lower energy. Physical water quality is characterized by large fluctuations in salinity and low flushing due to the small size of the adjacent upstream watershed. Freshwater arrives into Rookery Bay via Henderson Creek to the west and Stopper Creek to the northwest. Tidal exchange is low due to the presence of oyster bars and low flushing of the shallow creeks that feed into the Bay. Hypersaline conditions can result during periods of drought (Drew and Schomer, 1984).

TABLE 16. SUMMARY OF WATER-QUALITY DATA FOR THE FAHKA UNION CANAL BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	83	9.51	0.3	68	15.7	88.3	102	1.3	0.1	10.2	0	15	3	0.767	0.4	1	0	4.7
pH	pH	95	7.2	4.1	8.45	0		75	7.7	6.8	9.8	0		3	7.7	7.6	8	0	
Salinity	ppt	1	6	6	6	0		N/A						0	N/A	N/A	N/A	0	
Temperature	deg. C	104	23.83	15.1	50.5	0		3	28	24	30	0		3	25.5	23.5	29	0	
Chlorides	mg/L	77	364.83	4	19999.96	5.2		94	52.3	18.7	199	0		N/A					
Fluorides	mg/L	N/A						3	0.17	0.17	0.17	0		N/A					
Conductivity	micromho	114	1933.99	70	52499	7.9		101	594.9	235	1490	0.99		3	770	700	810	0	
DO	mg/L	91	5.68	0.24	15.1	53.8	58.2	78	6.9	1.4	18.8	26.9	36	3	7.3	6.3	8.2	0	29
BOD	mg/L	3	1.63	1.5	1.7	0	45.3	3	1.3	0.9	2	0	31	3	1.1	0.4	1.5	0	23
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	61	1.41	0.1	11.02	34.4	51	100	0.796	0.1	2.99	12	19.1	N/A					
Tot-P	mg/L	92	0.05	0	0.48	20.7	32	102	0.02	0	0.6	2	12	3	0.167	0.1	0.3	100	64.7
Tot-C	mg/L	53	177.25	1	9000	3.8		27	10.367	5.4	23.1	3.7	N/A	N/A					
Tot-coli	/ 100 ml	39	18497.18	40	91000	97.4	97.3	N/A						N/A					
Fecal-coli	/ 100 ml	39	36.72	2	180	0	42.5	1	4	4	4	0	12	3	28	4	68	0	39.5
Cu	ug/l	3	2.93	1	5.8	33.3		2	0.815	0.63	1	0		2	5	5	5	100	
Fe	ug/l	48	1243.78	0.03	7200	75		90	0.127	0.02	0.5	0		2	38	11	65	0	
Pb	ug/l	3	3.43	1	7.3	33.3		2	1.7	0.4	3	0		2	3.05	2	4.1	0	
Zn	ug/l	3	211.3	40	297	66.7		2	27.55	21	34.1	0		2	11	5	17	0	
Chlor a	ug/l	N/A						3	2	1	3	0	12	3	1.49	1.03	2.14	0	8.5
WQI	%						60.6						21.9						32.2

TABLE 17. SUMMARY OF WATER-QUALITY DATA FOR THE COLLIER/SEMINOLE BASIN

WQ Parameters	Units	1970-1980 Obs	Mean	Min.	Max.	% Exc	WQI	1980-1990 Obs	Mean	Min.	Max.	% Exc	WQI	1990-1998 Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	NO DATA							NO DATA					3	1.63	0.8	28	0	21.3
pH	pH													3	7.37	6.8	8		
Salinity	ppt													N/A					
Temperature	deg. C													3	24.9	22.5	28		
Chlorides	mg/L													N/A					
Fluorides	mg/L													N/A					
Conductivity	micromho													3	21666.7	2000	48000	100	
DO	mg/L													3	3.77	2.4	4.5	100	81
BOD	mg/L													3	1.77	0.8	2.3	0	48.7
COD	mg/L													N/A					
Tot-N	mg/L													N/A					
Tot-P	mg/L													3	0.44	0.1	1.1	100	82.3
Tot-C	mg/L													N/A					
Tot-coli	/ 100 ml													N/A					
Fecal-coli	/ 100 ml													3	94.67	28	136	0	53.8
Cu	ug/l													2	25.5	25	26	100	
Fe	ug/l													2	160.5	117	204	0	
Pb	ug/l													2	6.5	3	10	50	
Zn	ug/l													2	15.5	6	25	0	
Chlor a	ug/l													3	7.6	3.74	14.7	0	43
WQI	%																		57.4

TABLE 18. SUMMARY OF WATER-QUALITY DATA FOR THE CORKSCREW/COCOCHATCHEE COASTAL AREA (WIGGINS PASS)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	**Units**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**
Turbidity	NTU	33	7.67	2	55	12.1		1	1.10	1.10	1.10	0.0		38	4.2	1.8	12.7	2.6	
pH	pH	43	8.21	7.8	8.7			1	7.25	7.25	7.25			38	7.53	6.4	7.91		
Salinity	ppt	11	68	26	35.5									N/A					
Temperature	deg. C	57	27.54	20	31.5			1	29.0	29.0	29.0			38	30.06	24.6	32.2		
Chlorides	mg/L	26	20907	12800	24500	100								N/A					
Fluorides	mg/L	N/A																	
Conductivity	micromho	16	46287	5100	53000	100								38	32215	11721	48700	100	
DO	mg/L	43	6.3	5.1	7.9	0.0		1	2.40	2.40	2.40	100		38	3.85	0.1	6.3	86.8	
BOD	mg/L	43	2.9	0.4	8.0	62.8								5	1.8	1.5	2.6	20.0	
COD	mg/L	N/A												N/A					
Tot-N	mg/L	N/A												20	.66	0.41	.89	0.0	47.5
Tot-P	mg/L	9	.06	.08	22.2	0								38	0.04	0.03	0.08	2.6	50
Tot-C	mg/L	N/A												N/A					
Tot-coli	/ 100 ml	37	25.68	2	180	10.8								N/A					
Fecal-coli	/ 100 ml	39	8.54	0	40.0	1.0								38	57.08	4	610	2.6	
Cu	ug/l	N/A												N/A					
Fe	ug/l	N/A												N/A					
Pb	ug/l	N/A												N/A					
Zn	ug/l	N/A												N/A					
Chlor a	ug/l	N/A												22	4.78	1.6	11.8	0.0`	38.3
TSI		TSI NOT CALCULATED																	43.5

TABLE 19. SUMMARY OF WATER-QUALITY DATA FOR THE DISTRICT IV COASTAL AREA (NAPLES BAY & ROOKERY BAY)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI
Turbidity	NTU	48	7.18	1.0	40.0	14.6		475	7.70	1.0	44.0	8.0		332	4.47	0.5	21.0	2.4	
pH	pH	58	7.54	6.3	8.5			754	7.57	6.6	8.2			813	7.75	5.43	8.41		
Salinity	ppt	22	14.05	1.0	36.00			287	33.34	13.5	43.8			835	29.83	0.00	41.80		
Temperature	deg. C	72	27.44	21	31.0			754	25.61	15.6	32.81			864	26.24	15.8	33.9		
Chlorides	mg/L	45	9530.4	36.7	22500	88.9		N/A						N/A					
Fluorides	mg/L	0	N/A					N/A						N/A					
Conductivity	micromho	27	32807	1070	53100	96.3		754	1105.7	4.98	53700	2.9		864	167.1	0.32	41000	0.6	
DO	mg/L	55	4.77	1.5	8	50.9		741	5.81	2.04	9.7	30.2		855	5.74	1.45	14.13	28.4	
BOD	mg/L	52	1.78	0.0	5.8	21.2		20	1.79	0.2	4.4	25.0		4	1.93	0.9	2.5	50.0	
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	N/A						N/A						N/A					
Tot-P	mg/L	26	0.11	0.02	0.78	46.1		23	0.08	0.04	0.28	39.1		5	.202	0.07	.64	60.0	
Tot-C	mg/L	4	8.50	1.00	16.00	0.0		N/A						N/A					
Tot-coli	/ 100 ml	55	524.4	2.0	5000	76.4		N/A						N/A					
Fecal-coli	/ 100 ml	18	169.9	2.0	1980	11.1		19	89.84	2	515	15.8		6	528.2	4.0	1220.0	66.7	
Cu	ug/l	N/A						N/A						2	16.5	8.0	25.0	100	
Fe	ug/l	N/A						N/A						2	291.5	99.0	484	50.0	
Pb	ug/l	N/A						N/A						2	11.0	10.0	12.0	100	
Zn	ug/l	N/A						N/A						2	15.5	6.0	25.0	0	
Chlor a	ug/l	N/A						22	12.59	3	40.5	18.2		4	15.4	2.4	31.4	25.0	
TSI		TSI NOT CALCULATED						TSI NOT CALCULATED						TSI NOT CALCULATED					

Table 20 provides a summary of the water quality for the Rookery Bay Estuary by decade for several water-quality parameters. The data from which **Table 20** was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a).

Mangrove and seagrass are important habitats within and around Rookery Bay that are subject to changes in water quality, particularly altered freshwater flow. Based on recent nonpoint source assessments Rookery Bay fully meets its designated use as a Class 2 water body for support of recreation and wildlife (FDEP, 1996a).

Important habitat types listed in the Rookery Bay and Cape Romano-Ten Thousand Islands Aquatic Preserve Management Plan (Gardner, 1988) include seagrasses, saltmarsh, mangrove forests, and coastal strand. Seaturtles, manatees, several species of wading birds, the Florida panther, and the Florida black bear are some of the protected species that occur in or near Rookery Bay.

Marco Bay

Neither current nor historic water-quality data was available through STORET. However, Drew and Schomer (1984) presented some general information on the freshwater and tidal exchange, nutrients, and habitats of the estuary.

Freshwater flow into Marco Bay is through coastal wetlands, and from groundwater, between the freshwater aquifer and the saline coastal aquifer. Inputs from the wetlands are approximately 100 to 200 times that of the groundwater input, with some of this large surface volume attributed to man-made drainage operations (Drew and Schomer, 1984).

DO levels were frequently found to be lower in natural areas than in disturbed areas (i.e. canals). Accumulations of mangrove detritus and restricted backwater circulation were cited as the cause for the low DOs (Drew and Schomer, 1984).

Nutrients are low in natural and artificial waterways of the Marco Bay/Estuary system. Locally, high nutrient conditions are theorized to result from certain wind conditions mixing the water column and causing releases from sediments (Drew and Schomer, 1984). Chlorophyll a was highest in the canals. No data accompanied the descriptions.

TABLE 20. SUMMARY OF WATER-QUALITY DATA FOR THE HENDERSON CREEK COASTAL AREA (ROOKERY BAY)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI
Turbidity	NTU	4	11.25	3.0	19.0	50.0		186	155	0.60	28.5	14.5		141	4.19	0.50	13.0	0.7	
pH	pH	4	8.13	7.80	8.5			284	7.47	6.1	8.5			351	7.59	6.4	8.5		
Salinity	ppt	2	10.5	7.0	14.0			100	26.09	0.0	43.4			366	21.46	0.0	40.5		
Temperature	deg. C	4	38	3	30.5			284	25.85	15.6	32.4			373	26.60	16.98	34.17		
Chlorides	mg/L	2	1120	4500	18000	100													
Fluorides	mg/L	N/A																	
Conductivity	micromho	2	42000	33000	51000	100		284	4601	0.40	64.4	0.0		373	33.62	0.28	60.30	0.0	
DO	mg/L	2	5.9	4.9	6.4	25.0		278	5.88	2.04	16.3	31.3		369	5.68	1.78	13.12	37.14	
BOD	mg/L	4	1.93	1.10	2.60	25.0													
COD	mg/L	N/A																	
Tot-N	mg/L	N/A																	
Tot-P	mg/L	2	0.04	0.04	0.04	0.0													
Tot-C	mg/L	N/A																	
Tot-coli	/ 100 ml	2	19	6	32	0.0													
Fecal-coli	/ 100 ml	2	5.0	2.0	8.0	0.0													
Cu	ug/l	N/A																	
Fe	ug/l	N/A																	
Pb	ug/l	N/A																	
Zn	ug/l	N/A																	
Chlor a	ug/l	N/A																	
TSI		TSI NOT CALCULATED																	

Fahkahatchee Bay

Current water-quality information on Fahkahatchee Bay was not available from the STORET database. Relative comparisons between Fahkahatchee Bay and adjacent Fahka Union Bay were given in Drew and Schomer (1984) for freshwater input, salinity regimes, and nutrient loading. Salinity ranges from 0 to 40 ppt throughout the wet and dry seasons. Specific data on other water-quality parameters are lacking. Heavy metal analysis from data collected in the 1970s did not indicate contamination of the waters, but some sediments did contain detectable amounts of lead particularly those near areas receiving roadway runoff (Drew and Schomer, 1984). Pesticides were also detected in some of the sediment samples; waters were described as uncontaminated. No specific concentrations were given.

Habitat types include various benthic communities, seagrass meadows, mangrove forests, and saltmarsh.

Abbott and Nath (1996) cited increased freshwater from Fahka Canal and abnormal salinity levels to blame for disappearance of seagrass meadows, displaced benthic habitats and fish communities, and declines in shellfish harvests.

2.4. Southern Big Cypress Swamp: West Collier County

The Southern Big Cypress Swamp is located in the southern half of the Big Cypress National Preserve and is part of the Big Cypress Swamp Watershed, USGS unit 03090204. The study area is situated in the western part of the Southern Big Cypress Swamp. Interest will focus on the Collier-Seminole Basin, the Fahkahatchee Strand, Okaloacoochee Slough, and the Barron and Turner Rivers, two canals which hydrologically affect the western portion of the preserve. The Turner and Barron River canals were not originally designed for the specific purpose of draining land, but as a supply source for road construction materials (Drew and Schomer, 1984).

Physical Description

Perhaps the most important drainage feature of the Big Cypress Swamp is the Fahkahatchee Strand. A strand is an elongate area of large trees growing within drainage depression with no well-defined channel. The Fahkahatchee Strand is a natural community of mixed hardwood swamp about five miles wide and twenty miles long. Along with Okaloacoochee Slough, it is a principal drainage slough of the western Big Cypress Swamp (McElroy and Alvarez, 1975). It is notable for being the world's only royal palm-bald cypress forest, having the largest stand of native Florida royal palms and the largest concentration of native orchids in North America. Numerous threatened and endangered plant and animal species are found within the Fahkahatchee Strand (McElroy and Alvarez, 1975).

Land use within the Southern Big Cypress Swamp is primarily wetlands, with an estimated less than 5% of land under agricultural use and less than 5% in small towns. Census data record that in 1990, Everglades City, at which Barron Canal discharges, had a population of 317, and Chokoloskee, a small fishing town at which Turner River discharges, had a population of 240 (U.S. Department of Commerce, 1992).

It is estimated that greater than 80% of the area consists of wetland habitat types. Mangrove swamp and saltmarsh are found along the coast, while freshwater swamp and freshwater marsh begin about 5 miles inland from Chokoloskee. Some dry prairie exists along the Barron River canal (SFWMD, 1995).

General soil types within the Southern Big Cypress Swamp are mangrove peat in coastal areas, and marl interspersed with peat in inland areas. Mangrove peat is found in "very low, wet areas of organic, marly to mucky soils thinly overlying bedrock" (Drew and Schomer, 1984).

The Turner and Barron River canals drain freshwater from the strands and sloughs of the Big Cypress Swamp, and also receive additional freshwater input from the shallow water aquifer. Okaloacoochee Slough and Deep Lake Strand are two such features that contribute freshwater to the canals. The Barron River canal flow rate varies from 0 to 8.27 m^3/s (0 to 292 cfs) over the course of a year. During dry season, flows are low, from 1.42 to 2.84 m^3/s (50 to 100 cfs) but increase during the wet season to between 2.84 and 4.96 m^3/s (100 to 175 cfs). Over the long term (decades), flows average 2.89 m^3/s (102 cfs). Given the age of the canals, constructed over 50 years ago, water levels in the Barron and Turner River canal watersheds are assumed to have stabilized. A series of removable stop-log gates control flow along the Barron River canal, inserted during the dry season to conserve the aquifer, and removed during the wet season to accommodate increased drainage (Drew and Schomer, 1984).

The Collier-Seminole Basin drains primarily cypress wetlands ultimately into Gullivan Bay. The basin exists within the boundaries of the Collier-Seminole State Park. No water-quality data was available.

Historical Description

Historical data from STORET indicate that water quality within much of the Big Cypress has been "fair" to "good" with respect to physical and biological parameters, and nutrient condition. However, metals were detected in previous sample data from Chokoloskee Bay at levels higher than in other local estuaries. Monitoring data from 1980-89 indicate that Barron River canal had good water conditions with a pH of 7.6, good water clarity as indicated by low turbidity (2.0 NTUs), low TSS (1 mg/L), and low color (55 PCUs). However, DO levels failed to meet state criteria with an average of 4.2 mg/L. Conductivity was normal at 536 micromhos. The Turner River canal exhibits freshwater conditions inland and estuarine conditions nearer the coast. Samples of the Turner River collected near the Tamiami indicate that physical water quality is good with an average DO of 7.3, low turbidity of 1.0 NTUs, and pH of 8.4. Conductivity, however exceeded state standards with an average measurement of 1300 micromhos. Where Turner River flows into Oyster Bay, turbidity was higher at 4 NTUs, color was higher at 40, and conductivity was higher at 41250 micromhos due to higher salt content. DO was high at 8.5.

Biological parameters, BOD, chlorophyll a, and fecal coliform bacteria, were 1.3 mg/L, 7 µg/L, and 14 MPN/100 ml, respectively. None of these values exceeded (i.e. failed to meet) state standards. Nitrogen and phosphorus levels of Barron River canal runoff into the Gulf has been historically low. The annual average for total nitrogen was 0.98 mg/L, and for total phosphorus, concentrations were low at 0.02 mg/L. The TSI for Barron River canal runoff into the Gulf was 46 and for Turner Canal, 47.

Freshwater Systems

Turner and Barron Canals

Current water-quality information for the Barron and Turner River canals is available from the Estuarine Receiving Water Quality Monitoring Program Data Summary (**Table 21**), Collier County for FY90-95 (Gibson, 1997). The STORET database does not contain data from this particular sampling phase of this program.

TABLE 21. WATER QUALITY MONITORING DATA OF BARRON AND TURNER CANALS (1990-95)

Location	PH	DO	Sal	Turb	TSS	TP	Chl A	Cond
April 1991								
Turner	7.9	6.6	33	.65	136	.15	BDL	N/A
Barron	7.8	5.4	31	.4	130	.12	BDL	50,000
August 1991								
Turner	7.7	3.7	15	2.3	25.5	.2	2.5	20,750
Barron	7.9	4.8	14	2	31	.13	11.5	25,000
April 1994								
Barron	7.8-8.1	4.9-6.0	27-28	4.3-14.4	22.0-40.0	N/A	N/A	43.6K-46K
Barron	7.3	3.6	1.2	1.0-2.0	1.0-1.5	N/A	N/A	2840-2850

No color, no Total nitrogen, no Fecal or Total coliform

The literature provided very little historical or current water-quality data for the Fahkahatchee Strand Basin. **Table 22**, however, provides a summary of the water quality in the Fahkahatchee Strand Basin by decade for several water-quality parameters. The data from which **Table 22** was developed are specific to the South Florida study area. The WQIs reflect changing water quality conditions over time only and are not intended to evaluate water quality on a “good”, “fair” or “poor” basis; as typically included in the Florida’s 305b water quality report (FDEP, 1996a).

TABLE 22. SUMMARY OF WATER-QUALITY DATA FOR THE FAHKAHATCHEE STRAND BASIN

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI	Obs	Mean	Min.	Max.	% Exc	WQI
Turbidity	NTU	73	4.41	0.35	63	5.5	52.1	NO DATA						3	2.5	1.8	3.5	0	38
pH	pH	73	7.41	6.7	8.2	0								3	7.23	7	7.7	0	
Salinity	ppt	1	0.0	0.0	0.0	0								N/A					
Temperature	deg. C	77	20.8	15	29	0								3	25.87	23	30	N/A	
Chlorides	mg/L	29	58.1	10	916	3.4								N/A					
Fluorides	mg/L	N/A												N/A					
Conductivity	micromho	73	367.92	190	670	0								3	21333.33	9000	42000	100	
DO	mg/L	68	4.16	0.73	13	73.5	77							3	4.2	3.9	4.6	100	77
BOD	mg/L	3	2.83	2	4.2	33.3	76.3							3	2.2	1	4.5	33.3	64
COD	mg/L	N/A												N/A					
Tot-N	mg/L	N/A												N/A					
Tot-P	mg/L	3	0.03	0.01	0.04	0	20							2	0.14	0.1	0.17	100	60
Tot-C	mg/L	72	11.9	1	45	13.9	N/A							N/A					
Tot-coli	/ 100 ml	60	17777.58	50	59000	98.3	97.1							N/A					
Fecal-coli	/ 100 ml	61	146.13	2	1320	24.6	72.3							2	22	4	40	0	38
Cu	ug/l	N/A												2	17.5	10	25	100	
Fe	ug/l	60	201.67	100	1400	10								2	101.5	96	107	0	
Pb	ug/l	N/A												2	7.5	5	10	50	
Zn	ug/l	N/A												2	15.5	6	25	0	
Chlor a	ug/l	N/A												3	7.18	2.6	14.1	0	41.6
WQI	%						62.0												55.4

Estuarine Systems

Chokoloskee Bay

Recent water-quality information was obtained from Gibson (1997) for 1990-1995. Historical data were obtained from the STORET database and from Drew and Schomer (1984).

The hydrology or rates of flushing and mixing of Chokoloskee Bay are not well known (Drew and Schomer, 1984). Historically salinity has varied from 2.5 ppt to 20.2 ppt at the mouth of the bay. The water has been relatively clear as indicated by the average turbidity (3 NTUs), and color (30 PCUs). DO was high at 8.5 and the pH was normal for saline waters at 8.5. High conductivity (41250 micromhos) is normal for waters with high salt content. No historical bacterial analyses or chlorophyll a measurements were available.

Historically nutrients increase with the rainy season from apparent increased flow from the Barron River Canal. Other sources of nutrients are possibly the oxidation of drained soils and runoff from agricultural and roadways (Drew and Schomer, 1984). Total nitrogen has historically been lower than average at 0.64 mg/L compared to other Florida streams. Total phosphorus likewise has been lower than average at 0.03 mg/L. The TSI indicated that the overall nutrient status of Chokoloskee Bay was good, with a 46. Contaminants have been sampled in the Bay, but seasonal increases were theorized to result from “desorption by dissolved ions in seawater” as salinity varied (Drew and Schomer, 1984). Manganese, copper, lead, and zinc were metals that increased with an increase in salinity. Concentrations of these metals were reported to be 1.5 to 3 times higher than metal concentrations from estuaries that received natural drainage (Drew and Schomer, 1984).

Current water quality from Gibson (1997) are available for Chokoloskee Bay and presented in **Table 23**. Average salinity is higher, while average DO is lower than historical data measurements. Nutrient data were not available.

TABLE 23. AVERAGE WATER-QUALITY DATA FROM CHOKOLOSKEE BAY (1990-95)

pH	DO	Sal	Turb	TSS	TP	Chl A	Cond
8.0	5.2-5.3	29.9	10.3-13.0	33.0-34.0	N/A	N/A	48050 avg

The literature provided very little historical or current water-quality data for many of the bays and estuaries of southwest Florida. Limited data are available for the Ten Thousand Isles region, and the associated bays of Chokoloskee and Fahka Union. **Tables 24, 25, and 26** provide limited summaries of the water-quality data by decade for various water-quality parameters of the Seminole/Collier Coastal Area(10,000 Isles), Fahka Union Canal Coastal Area (Fahka Union Bay), and Fahkahatchee Strand Coastal Area (Chocoluskee Bay) regions.

TABLE 24. SUMMARY OF WATER-QUALITY DATA FOR THE COLLIER/SEMINOLE COASTAL AREA (TEN THOUSAND ISLES)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI
Turbidity	NTU	71	4.61	0.42	46.0	9.9		18	8.74	2.40	30.0	22.2		87	7.04	0.60	40.50	9.2	
pH	pH	70	7.5	6.1	8.6			62	7.67	6.99	8.00			645	8.06	7.10	8.80		
Salinity	ppt	108	35.3	32.0	37.1			30	34.20	16.80	43.40			288	31.02	8.00	41.00		
Temperature	deg. C	205	28.75	10.0	35			62	26.09	17.76	32.76			829	25.74	.36	.56		
Chlorides	mg/L	66	18.4	3.0	153.0	0.0		62	50.82	6.34	64.30	0.0		N/A					
Fluorides	mg/L	N/A												N/A					
Conductivity	micromho	60	294.95	160	1190	0.0								157	48.44	23.50	60.60	0.0	
DO	mg/L	204	4.66	0.0	9.6	44.1		61	5.62	2.49	8.08	32.8		714	6.20	2.37	11.92	16.8	
BOD	mg/L	N/A						N/A						4	2.1	1.5	3.4		
COD	mg/L	N/A												N/A					
Tot-N	mg/L	N/A						N/A						N/A					
Tot-P	mg/L	193	0.112	0.00	2.90	62.2		N/A						40	0.05	0.02	0.09	10.0	
Tot-C	mg/L	193	10.64	2.40	120.0	5.7		N/A						42	7.95	4.80	13.60	0.0	
Tot-coli	/ 100 ml	N/A						N/A						N/A					
Fecal-coli	/ 100 ml	N/A						NA						N/A					
Cu	ug/l	N/A						N/A						N/A					
Fe	ug/l	N/A	64	202.5	10.0	2680.	10.9	N/A						N/A					
Pb	ug/l	N/A						N/A						N/A					
Zn	ug/l	N/A						N/A						N/A					
Chlor a	ug/l	N/A												42	4.49	0.20	11.20	0.0	
TSI		TSI NOT CALCULATED						TSI NOT CALCULATED						TSI NOT CALCULATED					

TABLE 25. SUMMARY OF WATER-QUALITY DATA FOR THE FAHKA UNION CANAL COASTAL AREA (FAHKA UNION BAY)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI	Obs	Mean	Min.	Max.	% Exc	TSI
Turbidity	NTU	14	15.79	1.2	42.0	50.0		8	4.65	3.30	7.00	0.0		120	6.84	1.5	26.6	7.5	
PH	pH	12	7.34	6.8	8.1			8	7.75	7.63	7.81			691	8.14	7.0	8.8		
Salinity	ppt	N/A						8	32.45	27.50	34.30			312	27.09	0.5	40.20		
Temperature	deg. C	14	22.64	19.0	28.0			8	25.40	25.01	26.01			1057	225.42	14.76	34.2		
Chlorides	mg/L	6	855	42	3300	50.0								N/A					
Fluorides	mg/L	N/A												N/A					
Conductivity	micromho	12	1887.9	580	10400	25.0		8	49.59	42.7	52.2	0.0		N/A					
DO	mg/L	12	4.64	2.88	8.0	58.3		8	6.87	6.50	7.58	0.0		901	6329	0.6	12.2	15.9	
BOD	mg/L	N/A												N/A					
COD	mg/L	N/A												N/A					
Tot-N	mg/L	N/A												N/A					
Tot-P	mg/L	N/A												124	0.04	0.01	0.08	0.8	
Tot-C	mg/L	11	5.00	1.00	14.0	0.0								126	7.34	4.4	12.8	0.0	
Tot-coli	/ 100 ml	9	16456.7	2800	51000	100.0								N/A					
Fecal-coli	/ 100 ml	9	269.7	10	1600	33.0								N/A					
Cu	ug/l	N/A												N/A					
Fe	ug/l	9	466.7	200.0	600.0	77.8								N/A					
Pb	ug/l	N/A												N/A					
Zn	ug/l	N/A												N/A					
Chlor a	ug/l	N/A												126	3.23	0.10	9.30	0.0	
TSI		TSI NOT CALCULATED												TSI NOT CALCULATED					

TABLE 26. SUMMARY OF WATER-QUALITY DATA FOR THE FAHKAHATCHEE STRAND COASTAL AREA (CHOKOLOSKEE BAY)

		1970-1980						1980-1990						1990-1998					
WQ Parameters	**Units**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**	**Obs**	**Mean**	**Min.**	**Max.**	**% Exc**	**TSI**
Turbidity	NTU	5	16.1	2.2	48	40		5	3.20	2.40	4.00	0.0		60	6.70	1.70	25.00	10.0	
pH	pH	3	7.53	6.8	8			7	7.75	7.70	7.90			191	8.15	7.70	8.70		
Salinity	ppt	N/A						1	31.8	31.8	31.8			83	25.49	3.00	38.40		
Temperature	deg. C	6	26.0	23.0	28.0			10	25.2	15.0	30.0			292	25.37	15.52	34.5		
Chlorides	mg/L	11	3158.2	1160	15000	100.0		20	5110.5	600	20000	100.0		N/A					
Fluorides	mg/L	N/A						N/A						N/A					
Conductivity	micromho	11	9709	3500	41000	100.0		2	41250	34000	48500	100		N/A					
DO	mg/L	3	4.4	1.8	6.1	33.3		8	6.42	3.10	9.90	37.5		250	6.4	2.5	11.67	16.4	
BOD	mg/L	N/A						N/A						N/A					
COD	mg/L	N/A						N/A						N/A					
Tot-N	mg/L	N/A						8	0.84	0.45	1.1	0.0	52	N/A					
Tot-P	mg/L	N/A						8	0.04	0.02	0.06	0.0	50	62	0.04	0.01	0.07	0.0	
Tot-C	mg/L	1	19	19	19	0		8	24	8.20	17.0	0.0		63	8.45	4.9	16.00	0.0	
Tot-coli	/ 100 ml	N/A						N/A						N/A					
Fecal-coli	/ 100 ml	N/A						N/A						N/A					
Cu	ug/l	N/A						N/A						N/A					
Fe	ug/l	N/A						N/A						N/A					
Pb	ug/l	N/A						N/A						N/A					
Zn	ug/l	N/A						N/A						N/A					
Chlor a	ug/l	N/A						N/A						63	3.17	.020	7.70	0.0	
TSI		TSI NOT CALCULATED											51	TSI NOT CALCULATED					

3.0 GROUNDWATER (AQUIFERS)

The Surficial, Intermediate, and Floridan Aquifer systems are the principal aquifers within the study area (**Figure 5**). The Floridan Aquifer system is widely used for ground water supply in other areas of the state, but within the study area, it is of naturally poor quality, having a high degree of mineralization. Thus, only the Surficial and Intermediate Aquifer Systems are used for ground water supply (SFWMD, 1995). The Floridan Aquifer is separated from the Surficial and Intermediate Aquifers by several layers of confining beds. Recharge areas for the Floridan Aquifer are outside the study area.

Within the study area, the Surficial Aquifer system contains the undifferentiated water table aquifer and the confined lower Tamiami Aquifer. The Biscayne Aquifer is another principal aquifer system within the Surficial Aquifer that occurs outside the study area (SFWMD, 1995).

Florida Geological Survey: Water quality
The primary data and discussion material for aquifer water quality was provided from Florida's Ground Water Quality Monitoring Program. This program derives aquifer water-quality data from three sources; Background Network wells, Very Intensive Study Area (VISA) Network wells, and Private Well Surveys. Only preliminary data from the Background Network were available from 1984 through 1988. A summary of these water-quality data for the Surficial, Intermediate, and Floridan Aquifers is presented in **Table 27**.

Study Area: Water quality
To evaluate more recent and geographically specific water-quality data available within the study area, supplemental data (USGS) were gathered (including STORET) through June 1998 and water-quality trends were revisited. To assess historical and current water-quality trends for the study area aquifers, summary data statistics for various water-quality parameters were recalculated for the following time periods: 1970-1980, 1980-1990, and 1990-1998.

3.1. Surficial Aquifer System

The Surficial Aquifer System is located beneath and adjacent to the land surface and is composed of Pliocene to Holocene quartz sands, shell beds, and carbonates. It consists of porous unconsolidated quartz sand deposits mixed with hardened carbonated rocks belonging to the Upper Miocene to Holocene Series (Florida Department of Natural Resources). The carbonate rocks are the water-producing zones (SFWMD, 1995).

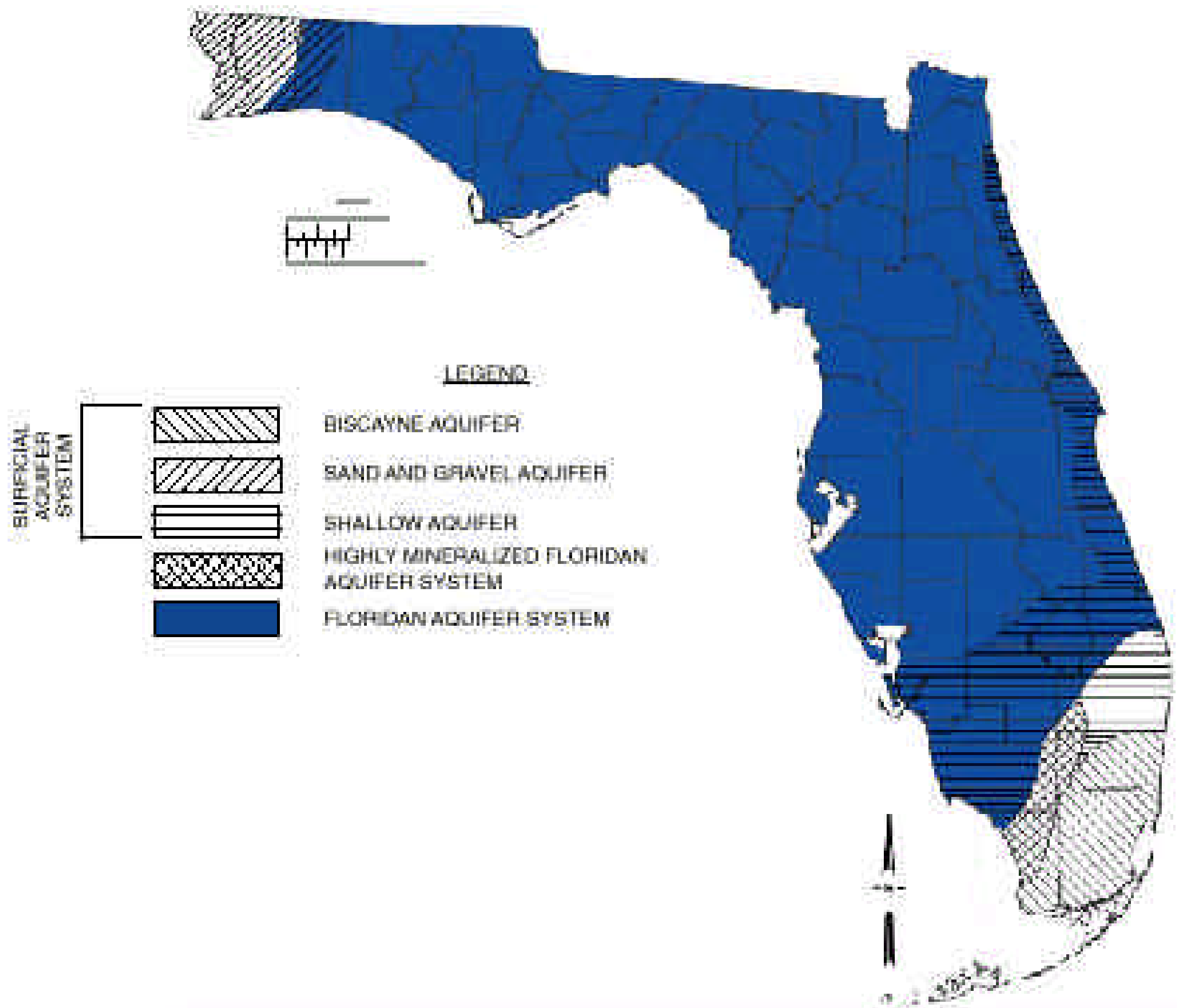


Figure 5. Surficial, Intermediate, and Floridan Aquifers (Source: Florida Department of Natural Resources, 1992).

TABLE 27. SUMMARY OF AQUIFER WATER-QUALITY DATA FOR THE SFWMD

Parameter	Surficial			Intermediate			Floridan		
	Median	Min	Max	Median	Min	Max	Median	Min	Max
Temperature	24.8	18.5	30.0	25.1	22.3	27.5	26.3	22.2	30.5
PH	6.9	**3.9**	**13.2**	7.3	**6.1**	8.5	7.4	**5.6**	8.9
Calcium	98.0	<0.1	756.0	70.5	2.5	478	67.2	5.9	227.0
Magnesium	3.9	<0.1	51.9	26.6	2.2	465.6	46.4	<0.1	264.2
Sodium	21.1	1.6	620.0	108.6	11.4	1264.0	220.5	2.7	2500.0
Potassium	1.3	<0.1	159.2	9.6	0.4	46.9	9.5	0.5	99.0
Iron	**0.88**	<0.01	**41.50**	<0.05	0.03	**26.6**	<0.05	<0.02	0.29
Mercury	<0.2	<0.1	**0.6**	<0.1	<0.1	<0.3	<0.1	<0.1	**0.2**
Lead	<2	<1	**173**	**1**	<1	**71**	<1	<1	**9**
Alkalinity	251	3	2260	234	111	445	130	10	287
Sulfate	11.8	<1.0	431	52.3	2.0	1754.0	176.4	3.3	713.1
Chloride	48.3	<0.4	**1100.0**	172.0	15.2	**2092.5**	**419.6**	3.5	**3785.0**
Phosphate	0.01	<0.01	4.0	<0.01	<0.01	2.28	<0.01	<0.01	0.15
Fluoride	0.20	0.02	3.73	0.82	<0.10	4.78	0.81	<0.10	3.70
Nitrate	<0.01	<0.01	**44.8**0	<0.01	<0.01	0.19	<0.01	<0.01	1.97
Total Dissolved Solids	388	26	**2537**	**508**	47	**4188**	**1138**	58	**7425**
Conductivity	619	41	8281	947	245	6920	1787	120	12204
Total Organic Carbon	17.0	<0.1	380.0	6.3	<0.1	71.0	1.9	<0.1	80.6
Total Synthetic Organics	0.00	0.00	995.00	<1.00	0.00	2.10	0.00	0.00	3.9
Total Pesticides	0.00	0.00	1100.00	<1.20	<0.01	<30.00	<1.30	<0.70	4.20

* - Bold values indicate an exceedence of maximum contaminant levels (MCL)

Within the Surficial Aquifer system, the water table is mostly unconfined, but in deeper regions some partially confined or locally confined conditions may predominate from beds of low permeability. Underneath the Surficial Aquifer are broad thick beds that are more confining. In south Florida, sediment beds of the Surficial Aquifer are the Tamiami, Caloosahatchee, Fort Thompson, and Anastasia Formation, the Key Largo, and Miami Limestones, and the undifferentiated sediments (Florida Department of Natural Resources, 1992). In general, Surficial Aquifer water levels slope downwards in a southwesterly direction towards the coast. Little seasonal fluctuation of the Surficial Aquifer water levels occurs (Dames and Moore).

Median values for water-quality measurements for the Surficial Aquifer are within state drinking water standards, with the exception of iron and lead. The MCL secondary standard for iron is 0.3 mg/L and the average for the Surficial Aquifer within the SFWMD was 0.88 mg/L. The high maximum values (>5mg/L) are likely the result of using unfiltered samples during analysis (Florida Department of Natural Resources, 1992). Iron is high in the Surficial Aquifer system due to its proximity to iron minerals, organic rich soil horizons, and dissolved humic substances (Florida Department of Natural Resources, 1992). Lead occurs in the surficial at “high” levels (Florida Department of Natural Resources, 1992). Given the lack of natural sources of lead in Florida, the presence of lead is attributed to human sources, most often lead weights used in water level recorders (Florida Department of Natural Resources, 1992).

Saltwater intrusion, incomplete flushing of seawater from the Everglades, and leftover irrigation water from the Floridan Aquifer system have created areas of increasing mineralization and high dissolved solids along the coast (SFWMD, 1995). The Surficial Aquifer System is susceptible to anthropogenic contamination due to its closeness to the land surface. Lack of confinement, high recharge, and relatively high permeability and high water table all increase contamination potential. The increasing demands heighten the constant threat of saltwater intrusion, often resulting in water usage restrictions to users of the Surficial Aquifer (SFWMD, 1995).

Physical and Geological Description

Water-quality data in this section is derived from the FY95/96 Trend Ground Water Quality Monitoring Program for Collier County (Gibson, 1997). Ground water samples from sixteen monitoring wells sampled quarterly were analyzed for “specific chemical analytes that are indicative of natural ground water geochemistry and potability” and compared to public water supply standards. In 1995-96, total dissolved solids, iron, chloride, and sulfate levels in the monitoring wells exceeded MCL standards (**Table 9**) established in F.A.C. 17-550 for treated community water supplies, but still compared favorably with historical data. The report concluded that these conditions “appear to represent the norm” for Surficial Aquifer waters in Collier County (Gibson, 1997). The lower Tamiami Aquifer supplies Collier County with most of its potable water supplies (Dames and Moore, 1997). **Table 28** provides a summary of the water-quality data by decade for various water-quality parameters of the Surficial Aquifer. The data from which **Table 28** was developed are specific to the South Florida study and reflect changing water quality conditions over time.

Recharge of the Collier County area of the Surficial Aquifer occurs primarily by rainfall over virtually the entire land surface. Less than 20% results from lateral and upward vertical recharge from other aquifers and surface waters (Gibson and Preston, 1993). North of Immokalee is an area of high recharge known as Immokalee Rise (Dames and Moore, 1997). Discharges primarily occur at surface water bodies and along the coast (Dames and Moore, 1997). The degree of movement of water through an aquifer is defined in terms of conductivity and transmissivity values. Figure 6 shows these values for the aquifers within the Collier County portion of the study area (Gibson and Preston, 1993). In the Tamiami Aquifer, the hydraulic conductivity can vary from 0.124 ft/day to 0.008860 ft/day with steep hydraulic gradients occurring near the local wellfields. An unconfined area of the Tamiami Aquifer occurs near Immokalee (Dames and Moore, 1997).

TABLE 28. SUMMARY OF WATER-QUALITY DATA FOR THE SURFICIAL AQUIFER

		1970-1980					1980-1990					1990-1998				
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	Obs	Mean	Min.	Max.	% Exc	Obs	Mean	Min.	Max.	% Exc
Temperature	deg. C	NO DATA					134	24.6	20.5	28.2		546	25.3	17	31	
PH	std pH						133	6.9	5.4	7.6		4	7.05	6.8	7.3	
Calcium	mg/L						120	100.4	10	171		19	94.8	54.3	126.5	
Magnesium	mg/L						NA									
Sodium	mg/L						121	49.6	3.9	498.8	0	19	92.2	5	504.5	0
Potassium	mg/L						120	2.43	0.06	20.6	0	19	4.3	0.2	259.5	0
Iron	mg/L						120	2117.08	20	25520	70	74	2747	15	18600	85.1
Mercury	mg/L						3	0.1	0.1	0.1	100	55	0.12	0.1	0.4	100
Lead	mg/L						83	12.76	0.1	99.1	37.3	55	16.3	0.2	140	36.4
Alkalinity	mg/L						121	258.5	66.2	358.4	0	19	248.1	143.7	298.2	0
Sulfate	mg/L						114	30.5	2	261	0	19	47.4	2	259.5	0
Chloride	mg/L						121	74.13	4.4	875.2	7.4	19	110.1	6.1	774.8	10.5
Phosphate	mg/L						21	0.04	0.004	0.21	14.3	19	0.05	0.005	0.2	21.1
Fluoride	mg/L						121	0.29	0.027	2.8	0.83	19	0.87	0.048	3.05	21.1
Nitrate	mg/L						108	0.02	0.004	0.41	1.9	18	0.01	0.004	0.04	0
TDS	ug/l						122	424.2	66.9	2032.9		66	510.9	56.4	1967	
Conductivity	Micromho						133	748.6	259	3320	12	545	991.1	62	3560	21.7
Total Carbon	mg/L						80	38.1	2.5	678	43.8	28	16.6	2	55	28.6
Synthetic Organics	g/l						900	65	65	65	0.11	500	6.49	5	37.3	0.2
Arsenic	ug/l						76	1.59	0.1	13.5	0	55	12.5	1	540	1.8
Pesticides	g/l						60	1.63	1.63	1.63	41.7	162	33.71	0.292	65.5	40.1

Withdrawals/Public Use

The principal source of urban water in Lee County is the Shallow Water Table Aquifer. The Shallow Water Table Aquifer is also used for agricultural irrigation. Transmissivities for the water table within Lee County range from 10,000 to 1,000,000 gpd/ft. Typical yields from public water supply wells are around 300 gpm (SFWMD, 1995) (**Table 29**).

TABLE 29. PERCENT EXCEEDENCES OF MCL STANDARDS FOR COLLIER CO.

Analyte	**MCL Value in mg/L**	**Percent Exceedences in FY 95/96**
	Physical	
Ph	6.5 – 8.5 pH units	0
	Metals	
Cadmium	0.005	0
Chromium	0.01	0
Copper	1.0	0
Iron	0.3	53
Lead	0.015	0
Manganese	0.05	0
Mercury	0.002	Detection limits not low enough
Sodium	160.0	0
Strontium	4.2	0
Zinc	5.0	0
	Inorganic	
Chloride	250	12.5
Fluoride	4.0*, 2.0**	0
Nitrate	10.0	0
Nitrite	1.0	Not analyzed
Sulfate	250	12.5
	Other	
Total Dissolved Solids	500	38

*Primary **Secondary N/A – Not applicable

The Tamiami is a major potable resource for Collier County serving as the primary source of municipal, industrial, and agricultural water supply (SFWMD, 1995). The water quality is similar to that of the water table aquifer, but often with lower iron concentrations, making it more suitable for potable supplies. Chloride concentrations may still be high in some coastal areas, with levels up to 10,000 mg/L. Aquifer thickness ranges from 150 ft to over 250 ft. Transmissivities range from 100,000 to 500,000 gpd/ft (Dames and Moore, 1997). Water use of the Surficial and Intermediate Aquifers by Collier and Lee Counties in 1995 is presented in **Table 30**. More water is used in agricultural irrigation than any other category for both counties. In Collier County, agricultural irrigation accounted for approximately 68% of all water use in 1995.

TABLE 30. 1995 WATER USE FOR COLLIER AND LEE COUNTY*

County	Public Supply	Domestic Self-Supply (private well)	Industry/ Commercial Self-Supply	Agricultural Irrigation Self-Supply	Recreation Self-Supply	TOTAL
Collier	14,250	1,785	2,181	51,985	16,641	**86,842**
Lee	14,673	2,081	1,974	22,063	12,011	**52,802**
TOTAL	**28,923**	**3,866**	**4,155**	**74,048**	**28,652**	**139,644**
% of Total	***20.7%***	***2.8%***	***3.0%***	***53.0%***	***20.5%***	***100%***

Source: SFWMD, 1998b * Note: Millions of Gallons per Year

3.2. Intermediate

The Intermediate Aquifer System is located in the Hawthorn group sediments and is comprised of two confined or in place semi-confined aquifers (Figure 6). The Sandstone Aquifer present in Lee County and Collier County north of Alligator Alley and the mid-Hawthorn aquifer underlie Collier County (Dames and Moore, 1997).

Physical and Geological Description

The Sandstone Aquifer is composed of sandy limestone, dolomites, and sandstone up to 100 feet thick and is possibly part of the Peace River Formation. The aquifer slopes southeastward, gradually thinning out. The transmissivity is generally below 100,000 gpd/ft with hydraulic gradients ranging from 0.5 feet per mile to 5 feet per mile. A recharge zone exists northeast of Immokalee. The iron content is relatively low and the chloride concentrations are usually less than 600 mg/L. Increases in hardness and alkalinity occur as one moves toward the coast. Water quality is described overall as good. Within Collier County, the direction of water flow in most confined layers is southwestward (Dames and Moore, 1997).

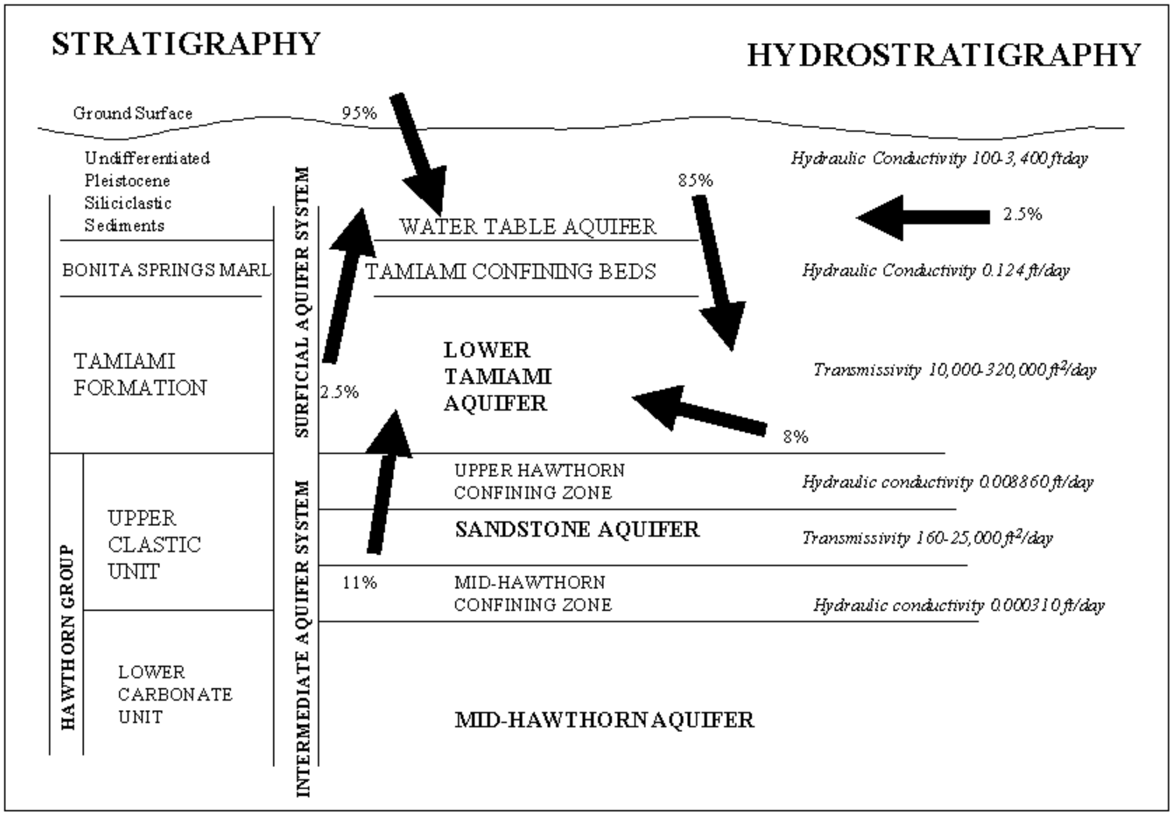
Limestone and dolomites from the Acadian Formation comprise the mid-Hawthorn Aquifer. Transmissivities are less than 50,000 gpd/ft. The mid-Hawthorn averages 100 feet in thickness with highly mineralized water. High levels of chlorides, calcium, magnesium, and sulfate are present within this aquifer. The mid-Hawthorn slopes toward the east-southeast and is under sufficient hydrostatic pressure to produce artesian conditions for wells drilling into this aquifer (Dames and Moore, 1997).

Mean water-quality parameters meet state drinking water standards with the exception of lead and total dissolved solids. Total dissolved solids in the Intermediate Aquifer range from 47 mg/L to 4188 mg/L within the SFWMD. Contact of water with carbonates and chemically unstable silicates (e.g. clays, opal), as well as saline intrusion are probable sources of high total dissolved solids (Florida Department of Natural Resources, 1992). **Table 31** provides a summary of the water-quality data by decade for various water-quality parameters of the Intermediate Aquifer. The data from which **Table 31** was developed are specific to the South Florida study area and reflect changing water quality conditions over time. **Figure 6** illustrates the Surficial and Intermediate Aquifer formations and confining layers.

3.3. Floridan Aquifer

The Floridan Aquifer within the study area is characterized by low hydraulic potential, low flushing, and saline intrusion from long contact/high dissolution of base strata of aquifer and coast (Florida Geological Survey, 1992). It is composed of Tampa Formation sediments and is connected to the underlying Suwannee and Ocala Limestone, and Avon Park, Oldsmar, and Cedar Keys Formations. It is separated from the Intermediate Aquifer through confining sediments of the Hawthorn Group. The transmissivity ranges from 75,000 to 450,000 gpd/ft in the upper areas of the Floridan. Water quality has been described as brackish, degrading with depth and towards the coast (Dames and Moore, 1997).

Mean chloride levels for Floridan Aquifer wells within the SFWMD exceed the states MCLs for drinking water. Median levels are 419.6 mg/L and the state standard is 250 mg/L. Median levels of total dissolved solids also exceed state standards (Florida Department of Natural Resources, 1992). **Table 32** provides a summary of the water-quality data by decade for various water-quality parameters of the Floridian Aquifer. The data from which **Table 32** was developed are specific to the South Florida study area and reflect changing water quality conditions over time. **Figure 7** illustrates the potential recharge areas of the Floridian Aquifer (Florida Geological Survey, 1992).



Source: Gibson et al., 1993

Figure 6. Surficial and Intermediate Aquifer Formations and Confining Layers.

TABLE 31. SUMMARY OF WATER-QUALITY DATA FOR THE INTERMEDIATE AQUIFER

		1970-1980					1980-1990					1990-1998				
WQ Parameters	Units	Obs	Mean	Min.	Max.	% Exc	Obs	Mean	Min.	Max.	% Exc	Obs	Mean	Min.	Max.	% Exc
Temperature	deg. C	No Data					91	25.4	23.2	27.6		227	25.43	19.5	29.3	
PH	std pH						91	7.3	6.6	8.3		2	7.2	7.1	7.3	
Calcium	mg/L						83	68.8	15	478	0	10	53	44.3	62.5	0
Magnesium	mg/L						N/A									
Sodium	mg/L						83	179.6	31.4	538	0	10	101.9	69.5	344	0
Potassium	mg/L						83	13.3	2.4	46.9	0	10	8.71	7	15.7	0
Iron	mg/L						81	453.2	30	9720	33.3	47	555.5	3	7600	19.1
Mercury	mg/L						5	0.1	0.1		100	37	0.1	0.1	79	100
Lead	mg/L						55	8.8	0.3	152	25.5	37	8.65	0.1	79	29.7
Alkalinity	mg/L						83	246.2	134	445	0	10	254.1	237	277	0
Sulfate	mg/L						78	106.8	4.7	1754	0	10	38.53	14	113	0
Chloride	mg/L						83	245.8	24.8	846	31.3	10	115.4	46.2	535	10
Phosphate	mg/L						11	0.06	0	0.25	18.2	10	0.05	0	0.18	30
Fluoride	mg/L						83	0.86	0.1	3.6	9.6	10	1.08	0.24	4.95	10
Nitrate	mg/L						77	0.01	0	0.07	0	9	0.01	0	0.03	0
TDS	ug/l						81	805.3	46.6	3329		36	715.6	258	2520	0
Conductivity	micromho						90	1315	431	3801	35.6	228	1191	257	3345	25.4
Total Carbon	mg/L						58	20	0.1	71	31	15	6.95	1.8	19	0
Synthetic Organics	g/l						650	65	65	65	0.15	260	5.74	5	19	0.4
Arsenic	ug/l						50	1.15	0.1	4.6	0	37	1.41	1	4	0
Pesticides	g/l						44	1.63	1.63	1.63	45.5	12	60.23	60.2	60.2	41.7

TABLE 32. SUMMARY OF WATER-QUALITY DATA FOR THE FLORIDIAN AQUIFER

WQ Parameters	Units	1970-1980 Obs	Mean	Min.	Max.	% Exc	1980-1990 Obs	Mean	Min.	Max.	% Exc	1990-1998 Obs	Mean	Min.	Max.	% Exc
Temperature	deg. C	No Data					41	27.1	24.9	28.8		79	26.79	21	31	
pH	std pH						40	7.25	6.6	7.8	0	2	7.45	7.4	7.5	0
Calcium	mg/L						36	92.66	28	170	0	9	98.9	47.7	164	0
Magnesium	mg/L						N/A					N/A				
Sodium	mg/L						36	534.9	60.3	931	0	9	576.6	347	716	0
Potassium	mg/L						36	25.84	4.53	33.9	0	9	27.96	23.3	34.7	0
Iron	mg/L						35	81.14	20	350	2.9	14	83.71	10	310	7.1
Mercury	mg/L						3	0.1	0.1	0.1	100	5	0.1	0.1	0.11	100
Lead	mg/L						21	1.02	0.3	3.1	0	5	1.4	1	3	0
Alkalinity	mg/L						36	170.7	116	287	0	9	173.4	114	213	0
Sulfate	mg/L						34	389.4	5.2	611	0	9	391.6	272	583	0
Chloride	mg/L						36	878.5	380	1335	100	9	818.1	167	1318	77.8
Phosphate	mg/L						9	0.01	0	0.01	0	9	0.01	0	0.02	0
Fluoride	mg/L						36	1.98	1.12	4.03	58.3	9	3.13	0.6	6.18	44.4
Nitrate	mg/L						32	0.01	0	0.06	0	9	0.06	0	0.46	11.1
TDS	ug/l						36	2190	1	3039	0	13	2036	197	2988	0
Conductivity	micromho						41	3071	1769	4920	100	79	4006	460	5100	98.7
Total Carbon	mg/L						23	6.93	0.9	48	8.7	3	1.53	1	1.9	0
Synthetic Organics	g/l						219	65	65	65	0.46	30	6.32	5	7	0
Arsenic							19	0.94	0.1	1.7	0	5	3.4	1	10	0
Pesticides	g/l						11	1.7	1.7	1.7	45	N/A				

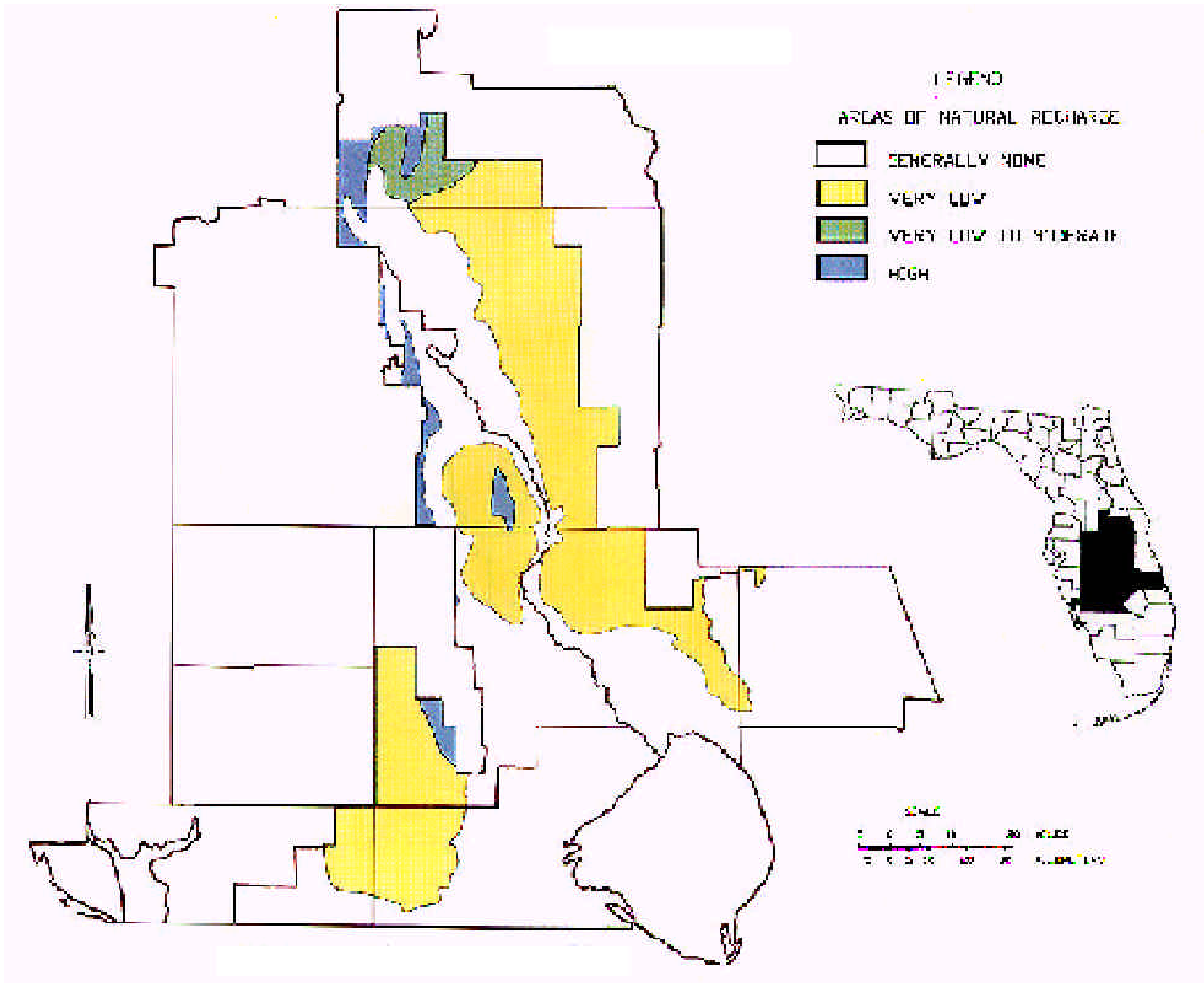


Figure 7. Recharge Potential of the Floridan Aquifer (Source: Florida Department of Natural Resources, 1992).

References:

Abbot, G.C. and A.K. Nath. 1996. Hydrologic Restoration of Southern Golden Gate Estates Conceptual Plan. Final Report. Big Cypress Basin Board, South Florida Water Management District. Naples.

Boyer, J.N. and R.D. Jones. 1996. The Florida Bay Water quality Monitoring Program: Assessing Status and Trends (1989-1995). Florida International University, Southeast Environmental Research Program, Miami. Abstracts Sheraton Key Largo € Key Largo, Florida. December 10-12.

Camp, Dresser and McKee, Inc. 1995. Caloosahatchee River Basin Assessment Water-quality Data Analysis Report (Phase II). Prepared for Upper District Planning, South Florida Water Management District. West Palm Beach.

CHNEP. 1997. Charlotte Harbor National Estuary Program. Harbor Happenings. Ed. M. Upton. Vol. 1, No. 2. Summer, 1997. Fort Myers.

Clark, R. 1987. Water-quality, Circulation and Patterns and Sediment Analysis of the Estero Bay Estuarine System, 1986. Department of Community Development, Lee County, Florida. Prepared under Coastal Zone Management Grant CM-123 from the Florida Department of Environmental Regulation.

Daltry, W.E. and D.Y. Burr. 1998. Base Programs Analysis. Volume 1: Description of the Existing Laws, Policy, and Resource Management Structure in the Greater Charlotte Harbor Watershed. Technical Report 98-01. Prepared for the Charlotte Harbor National Estuary Program. Fort Myers.

Dames and Moore. 1997. Big Cypress Basin Watershed Plan. Task A&B – Project Orientation and Data Collection. Prepared for South Florida Water Management District Big Cypress Basin Board. Contract No. C-7703.

Drew, R.D. and N.S. Schomer. 1984. An ecological characterization of the Caloosahatchee River/Big Cypress watershed. U.S. Fish Wild. Serv. FWS/OBS-82/58.2. 225 pp.

FDEP. 1996a. 1996 Water-quality Assessment for the State of Florida. Technical Appendix, South and Southeast Florida. Bureau of Surface Water Management, Division of Water Facilities. Tallahassee.

FDEP. 1996b. Surface Water-quality Standards. Florida Administrative Code 62-302. Tallahassee.

Florida Department of Natural Resources. 1992. Florida’s Ground Water Monitoring Program, Hydrogeologic Framework. Florida Geological Survey Special Publication No. 32. Tallahassee.

Gardner, T. 1988. Rookery Bay and Cape Romano-Ten Thousand Islands Aquatic Preserves Management Plan. Florida Department of Natural Resources. Tallahassee.

Gibson, G. 1997. FY 95/96 Collier County Trend Ground Water-quality Monitoring Data Report. Water Resources Management Section, Collier County Pollution Control Department. Naples.

Gibson, G. and S.V. Preston. 1993. Delineation and Management Plan of High Natural Aquifer Recharge Areas, Collier County, Florida. Pollution Control Department. Publication Series PC-OFR-93-01. Naples.

Gissendanner, E.J. 1983. Estero Bay Aquatic Preserve Management Plan. Florida Department of Natural Resources. Division of Recreation and Parks, Bureau of Environmental Land Management. Tallahassee.

Godschalk and Associates. 1988. Lee County Coastal Study. A Report to the Lee County, Florida Department of Community Development. Vol. 1. Findings and Recommendations.

Haag, K.H., R.L. Miller, L.A. Bradner, and D.S. McCulloch. 1996. Water-Quality Assessment of Southern Florida: An Overview of Available Information on Surface- and Ground-Water-quality and Ecology. U.S. Geological Survey. Water-Resources Investigations Report 96-4177. Tallahassee.

Hatcher, and W. D. Lorenz, Jr. 1988. Big Cypress Basin Water-quality Monitoring Network Annual Report for 1987. Collier County Environmental Science and Pollution Control Department. Naples.

Johnson Engineering, Inc., Agnoli, Barber, and Brundage, Inc., and Boylan Environmental Consultants, Inc. 1998. South Lee County Watershed Plan (Interim). Volume I. Prepared for the South Florida Water Management District.

Kimes, C.A., and L. C. Crocker. 1998. The Caloosahatchee River and its Watershed (Draft). Prepared for Florida Gulf Coast University Library Services. Ft. Meyers.

Kirby, M. N., J. M. Hatcher, and W. D. Lorenz, Jr. 1998. Big Cypress Basin Water Quality Monitoring Network Annual Report for 1987. Collier Co. Environmental Science and Pollution Control Department, Naples.
Kenner, W.E. and E. Brown. 1956. Interim Report on Surface Water Resources and Quality of Waters in Lee County, Florida. U.S. Geological Survey Kirby, M. N., J. M.

Lee, C.C. 1992. Environmental Engineering Dictionary. Second Edition. Government Institutes, Inc. Rockville.

Lehninger, A.L. 1982. Principles of Biochemistry. Worth Publishers, Inc. New York.

Lerman, M. 1986. Marine Biology, Environment, Diversity, and Ecology. The Benjamin/Cummings Publishing Company, Inc. Menlo Park.

McElroy, W.J. and K.C. Alvarez. 1975. Final Report on the Augmentation of Surficial Flow through the Fahkahatchee Strand Collier County, Florida. Water Resource Report No. 2. Department of Environmental Regulation and Department of Natural Resources. Tallahassee.

Rice University. 1998. Key Water-quality Indicators. http://riceinfo.rice.edu/armadillo /Galveston/Chap6/water.quality.indicator.html.

Sawyer, C.N. and P.L. McCarty. Chemistry for Environmental Engineering. Third Edition. McGraw-Hill Publishing Company. New York.

SFWMD. 1995. District Water Management Plan. Volume 1. West Palm Beach.

SFWMD. 1998a. Save Our Rivers 1998 Land Acquisition and Management Plan. West Palm Beach.

SFWMD. 1998b. Districtwide Water Supply Assessment. South Florida Water Management District. West Palm Beach, Florida.

Simpson, B. L., R. Aaron, J. Betz, D. Hicks, C. Van der Kreeke, and B. Yokel. 1979. The Naples Bay Study. The Collier County Conservancy. Naples.

Smith, R.A, R.B. Alexander, and K.J. Lanfear. 1994. Stream Water-quality in the Coterminous United States—Status and Trends of Selected Indicators During the 1980's. USGS National Water Summary home page. http://h20.usgs.gov/public /nwsum/sal/trends.html.

U.S. Army Corps of Engineers. 1980. Reconnaissance Report. Golden Gate Estates. Department of the Army, Jacksonville District, Corps of Engineers. Jacksonville.

U.S. Department of Commerce. 1992. 1990 Census of Population and Housing Summary Tape File 3A. Florida, Alachua-Lee Counties. Bureau of the Census, Data User Services Division. Washington, D.C.

U.S. Environmental Protection. 1996. Why Watersheds? OWOW Homepage http://www.epa.gov/OWOW /watershed/why.html.

Water Quality Association. 1997. Chemical Oxygen Demand (COD). Water Quality Association Glossary of Terms, 3rd Edition. http://www.wqa.org/ WQIS/Glossary/Cod.html.

Wood, D. A. 1994. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Florida Game and Freshwater Fish Commission, Tallahassee, Florida.

APPENDIX F - CRITERIA ASSOCIATED WITH EACH ENSEMBLE LEGEND AS DEVELOPED DURING THE ADG PROCESS

Appendix F

This Appendix includes several documents that are referenced by the narrative in Section 2.3 describing the Ensembles and other locations.

1. 404(b)(1) Guidelines. Excerpt from 40 CFR 230, U.S. Environmental Protection Agency, Guidelines for Specification of Disposal Sites for Dredged or Fill Material.

2. Criteria associated with Ensemble U. Alternative Plan Standards and Criteria. Submitted by Kris Thoempke, National Wildlife Federation, during the meeting of the Alternatives Development Group, August 27, 1998.

3. Principles of the Estero Bay Agency on Bay Management. Adopted December 8, 1997.

4. Estero Bay Watershed Land Conservation/Preservation Strategy Map. Adopted July 13, 1998 by the Estero Agency on Bay Managemeent.

5. Regional or Comprehensive Stormwater Management. Proposal submitted to the Alternatives Development Group.

6. Southwest Florida Region Regionally Significant Natural Resources. Map.

Environmental Protection Agency

40 CFR Part 230

Guidelines for Specification of Disposal Sites for Dredged or Fill Material

Authority: This regulation is issued under authority of Sections 404(b) and 501(a) of the Clean Water Act of 1977, 33 U.S.C. § 1344(b) and § 1361(a).

§ 230.10 Restrictions on discharge.

Note.—Because other laws may apply to particular discharges and because the Corps of Engineers or State 404 agency may have additional procedural and substantive requirements, a discharge complying with the requirement of these Guidelines will not automatically receive a permit.

Although all requirements in § 230.10 must be met, the compliance evaluation procedures will vary to reflect the seriousness of the potential for adverse impacts on the aquatic ecosystems posed by specific dredged or fill material discharge activities.

(a) Except as provided under § 404(b)(2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

(1) For the purpose of this requirement, practicable alternatives include, but are not limited to:

(i) Activities which do not involve a discharge of dredged or fill material into the waters of the United States or ocean waters;

(ii) Discharges of dredged or fill material at other locations in waters of the United States or ocean waters;

(2) An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant which could reasonably be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity may be considered.

(3) Where the activity associated with a discharge which is proposed for a special aquatic site (as defined in Subpart E) does not require access or proximity to or siting within the special aquatic site in question to fulfill its basic purpose (i.e., is not "water dependent"), practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. In addition, where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demostrated otherwise.

(4) For actions subject to NEPA, where the Corps of Engineers is the permitting agency, the analysis of alternatives required for NEPA environmental documents, including supplemental Corps NEPA documents, will in most cases provide the information for the evaluation of alternatives under these Guidelines. On occasion, these NEPA documents may address a broader range of alternatives than required to be considered under this paragraph or may not have considered the alternatives in sufficient detail to respond to the requirements of these Guidelines. In the latter case, it may be necessary to supplement these NEPA documents with this additional information.

(5) To the extent that practicable alternatives have been identified and evaluated under a Coastal Zone Management program, a § 208 program, or other planning process, such evaluation shall be considered by the permitting authority as part of the consideration of alternatives under the Guidelines. Where such evaluation is less complete than that contemplated under this subsection, it must be supplemented accordingly.

(b) No discharge of dredged or fill material shall be permitted if it:

(1) Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable State water quality standard;

(2) Violates any applicable toxic effluent standard or prohibition under section 307 of the Act;

(3) Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat which is determined by the Secretary of Interior or Commerce, as appropriate, to be a critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply in lieu of this subparagraph;

(4) Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.

(c) Except as provided under § 404(b)(2), no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of the waters of the United States. Findings of significant degradation related to the proposed discharge shall be based upon appropriate factual determinations, evaluations, and tests required by Subparts B and G, after consideration of Subparts C–F, with special emphasis on the persistence and permanence of the effects outlined in those subparts. Under these Guidelines, effects contributing to significant degradation considered individually or collectively, include:

(1) Significantly adverse effects of the discharge of pollutants on human health or welfare, including but not limited to effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites.

(2) Significantly adverse effects of the discharge of pollutants on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, and spread of pollutants or their byproducts outside of the disposal site through biological, physical, and chemical processes;

(3) Significantly adverse effects of the discharge of pollutants on aquatic ecosystem diversity, productivity, and stability. Such effects may include, but are not limited to, loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients, purify water, or reduce wave energy; or

(4) Significantly adverse effects of discharge of pollutants on recreational, aesthetic, and economic values.

(d) Except as provided under § 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. Subpart H identifies such possible steps.

§ 230.75 Actions affecting plant and animal populations.

Minimization of adverse effects on populations of plants and animals can be achieved by:

(a) Avoiding changes in water current and circulation patterns which would interfere with the movement of animals;

(b) Selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species which have a competitive edge ecologically over indigenous plants or animals;

(c) Avoiding sites having unique habitat or other value, including habitat of threatened or endangered species;

(d) Using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics. Habitat development and restoration techniques can be used to minimize adverse impacts and to compensate for destroyed habitat. Use techniques that have been demonstrated to be effective in circumstances similar to those under consideration wherever possible. Where proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiate their use on a small scale to allow corrective action if unanticipated adverse impacts occur.

(e) Timing discharge to avoid spawning or migration seasons and other biologically critical time periods;

(f) Avoiding the destruction of remnant natural sites within areas already affected by development.

As submitted to the ADG at meeting 10 8/27/98

Alternative Plan Standards and Criteria
(Submitted by Kris Thoemke/NWF)

The permitting standards and criteria below focus on the Corps' §404 permitting program in SW. Florida, in recognition that the alternatives have been developed for the Corps' EIS on its 404 Program in SW. Florida. It is understood, however, that achieving the vision outlined in the alternatives will require consistent and complementary efforts by EPA, FWS, NMFS, USDA, the SFWMD, DEP, FWGFC, other state agencies, regional and local governments, and the private sector. These efforts will include regulatory decisions, land use planning, water resource planning, and land acquisition (including conservation easement acquisition). These critical complementary efforts are also reflected in these standards and criteria.

****

PRESERVATION ZONE

Area Includes: SEE ALTERNATIVE MAPS. The basic intent is to include, at a minimum, all areas within the Study Area that are presently owned or under easement for conservation/preservation purposes (by government or private owners/easement holders). The Preservation Zone may also include areas within the Study Area that are targeted for such ownership or easement acquisition in the immediate future, including, but not limited to, such areas that are Florida Panther Habitat Areas 1&2, Strategic Habitat Critical Areas, and areas included on the Agency for Bay Management Land Conservation/Preservation Map.

Standards and Criteria

The Preservation Zone consists of lands that are, or soon will be, set aside strictly for conservation purposes. Many of these lands have been, or soon will be, purchased outright, in fee title, by government or private entities to protect critical wildlife and water resources. In other cases, such entities have purchased conservation easements on preservation zone lands, ensuring that such lands will not be used in ways that defeat their conservation purposes. Because of the protected status of its lands, the Preservation Zone is off limits to future development activity.**

This vision requires that owners of conservation lands and easements protect and manage Preservation Zone lands to protect the critical resources located on these lands, and that all governmental actions within the Preservation Zone are consistent with and complement these conservation goals.

**** The terms "development" and "development activity" refer to all human activities that physically alter lands and waters for human use, including agricultural and mining activities as well as urban, suburban, and industrial development activities.**

220, 270, 750, 760, 770 pg 2

Corps §404 permitting decisions must be made consistent with this vision as follows:

A. <u>Denial of dredge and fill permits in the Preservation Zone because:</u>

(1) dredge and fill activities in the Preservation Zone are contrary to the conservation purposes of these lands and waters;

(2) dredge and fill activities in the Preservation Zone are against the public interest;

(3) dredge and fill activities in the Preservation Zone will cause unacceptable adverse effects on critical wildlife and water resources, and significant degradation to Preservation Zone and "downstream" wetlands and waterways;

(4) dredge and fill activities in the Preservation Zone are adversely affecting, and likely jeopardizing the continued existence of, federally-listed threatened and endangered species;

(5) practicable alternatives exist elsewhere to dredge and fill activities within the Preservation Zone.

B. EPA should consider a §404(c) veto action prohibiting discharges of dredged and fill material in the Preservation Zone.

AGRICULTURAL ZONE

<u>Area Includes</u>: SEE ALTERNATIVE MAPS. The basic intent is to include all agricultural areas within the Study Area that are not included in the Preservation Zone, including agricultural areas identified as: Florida Panther Habitat Areas 1&2, Strategic Habitat Critical Areas, and/or areas included on the Agency for Bay Management Land Conservation/Preservation Map.

<u>Standards and Criteria</u>

The Agricultural Zone includes lands and waters that support critically important wildlife and water resources, and that warrant protection for conservation purposes, but have not yet been put in preservation status. These lands and waters are unsuitable for future non-agricultural development activity, and must be protected for conservation purposes. On-going agricultural use of these lands and waters can, under certain circumstances, be compatible with conservation of the critical wildlife and water resources in this zone. Agricultural areas within the zone should remain in agricultural use, compatible with conservation purposes, or be placed in preservation status, subject to the standards and criteria for the Preservation Zone.

220, 270, 750, 760, 770 pg 3

This vision requires that agricultural lands not be converted to non-agricultural development uses. This vision also requires that government and private entities move aggressively to acquire and manage lands and easements within the Agricultural Zone, where necessary to protect critical resources while avoiding unfair regulatory takings of private property. All governmental actions within the Agricultural Zone must be consistent with and complement conservation goals within this zone.

Most on-going agricultural activities are exempt from Corps §404 permitting requirements under §404(f). Some drained wetlands no longer meet the Corps' definition of wetlands and are exempt from permitting requirements as "prior converted cropland." However, to the extent that these agricultural exemptions have not been CLEARLY DEMONSTRATED TO APPLY, Corps §404 permitting decisions must be made consistent with the vision described above as follows:

A. Corps strictly applies the §404(b)(1) guidelines, including:

(1) a strong presumption that practicable alternatives exist outside the Agricultural Zone to dredge and fill activities in jurisdictional waters within the zone;

(2) a strong presumption that significant degradation to wetlands and waterways results within the Agricultural Zone and "downstream" from dredge and fill activities within the Agricultural Zone;

(3) significantly heightened levels of compensatory mitigation for any unavoidable impacts that are permitted within the Agricultural Zone. Such mitigation must fully replace wetland losses on an acreage and function basis.

B. Within the Agricultural Zone, Corps regulatory actions shall also:

(1) consider only "single and complete" projects, including all phases of residential, commercial, recreational, and mixed use development projects;

(2) reflect a strong presumption that dredge and fill activities will adversely affect, and likely jeopardize the continued existence of, federally-listed threatened and endangered species;

(3) fully consider and explicitly address all U.S. Fish and Wildlife Service, National Marine Fisheries Service, and state resource agency recommendations;

(4) eliminate the use of nationwide and other general permits that could authorize more than minimal cumulative adverse impacts (e.g., dock gp, NWPs 12, 14, 18, 26 and 26 replacements, and 29);

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(5) increase scrutiny of drainage, excavation, and fill activities on agricultural lands (e.g., careful review of prior converted cropland and 404(f)(1) exemptions);

(6) strictly enforce these standards and criteria for the Agricultural Zone in jurisdictional waters on agricultural lands, within the limits of §404(f), to prevent additional degradation of wetlands and waterways;

(7) reduce the potential for additional, secondary development surrounding any permitted activities;

(8) reflect a strong presumption against new road construction;

(9) implement the principles adopted by the Estero Bay Agency on Bay Management throughout the Agricultural Zone, as appropriate;

(10) ensure maintenance of water tables and recharge areas;

(11) promote restoration of flow ways;

(12) for any permitted activity, require establishment of buffer zones around wetlands and along flow ways, streams, and rivers;

(13) for any permitted activity, require buffer zones around eagles' nests and colonial bird rookeries;

(14) ensure no adverse impacts on water quality;

(15) ensure that any permitted activities do not contribute to hurricane shelter deficit or increase evacuation times.

C. In those instances where the Corps issues a permit within the Agricultural Zone, including a permit for agricultural activity on agricultural lands, the Corps shall require, in addition to full compliance with the 404(b)(1) guidelines and the standards and criteria above, compliance with the development criteria and standards set forth in the Big Cypress Area of Critical State Concern regulations (28-25.006 et seq.) throughout the Agricultural Zone.

D. The Corps shall work with other federal, state, local, and private entities to target aggressive acquisition/compensation and restoration initiatives in the Agricultural Zone (including Corps restoration and federal, state, local, and private acquisition initiatives).

E. The Corps shall work with other federal, state, local, and private entities to encourage agricultural preservation and best management practices that reduce impacts to water quality, listed species, and reduce conversion to residential, commercial, and industrial

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uses.

BUFFER ZONE

Area Includes: SEE ALTERNATIVES MAPS. The basic intent is to include in this zone areas that are adjacent to the Urban Zone, or already include some limited residential use. The buffer zone may include areas identified as: Florida Panther Habitat Areas 1&2, Strategic Habitat Critical Areas, and/or areas included on the Agency for Bay Management Land Conservation/Preservation Map. Some alternatives may not include a buffer zone.

Standards and Criteria:

The Buffer Zone is recognized to be a critical resource protection area to be conserved and protected, yet bordering urban areas. The vision is to protect the critical resources of this area, and to discourage urban expansion in and through this area, while recognizing that some development activity has already been approved here.

This vision requires that government and private entities move aggressively to acquire and manage top priority lands and easements within the Buffer Zone, where necessary to protect critical resources while avoiding unfair regulatory takings of private property. Government agencies must commit to actions that are consistent with and complement conservation goals within the Buffer Zone. New roads, utilities, and other infrastructure in the Buffer Zone must be strongly discouraged and, where essential to existing uses, must be designed to discourage growth in Preservation and Agricultural Zones.

Corps §404 permitting decisions must be made consistent with this vision as follows:

A. Corps strictly applies the §404(b)(1) guidelines, including:

(1) a strong presumption that practicable alternatives exist outside the Buffer Zone to dredge and fill activities in jurisdictional waters within the zone;

(2) a strong presumption that significant degradation to wetlands and waterways results within the Buffer Zone and "downstream" from dredge and fill activities within the Buffer Zone;

(3) significantly heightened levels of compensatory mitigation for any unavoidable impacts that are permitted within the Buffer Zone. Such mitigation must fully replace wetland losses on an acreage and function basis.

B. Corps regulatory actions shall also:

(1) consider only "single and complete" projects, including all phases of residential, commercial, recreational, and mixed use development projects;

220, 270, 750, 760, 770 PB

(2) reflect a strong presumption that dredge and fill activities will adversely affect, and likely jeopardize the continued existence of, federally-listed threatened and endangered species;

(3) fully consider and explicitly address all U.S. Fish and Wildlife Service, National Marine Fisheries Service, and state resource agency recommendations;

(4) eliminate the use of existing nationwide and other general permits that could authorize more than minimal cumulative adverse impacts within the Buffer Zone (e.g., dock gp, NWPs 12, 14, 18, 26 and 26 replacements, and 29);

(5) increase scrutiny of drainage, excavation, and fill activities on any areas within the Buffer Zone claimed to be exempt as prior converted cropland;

(6) reduce the potential for additional, secondary development surrounding any activities that are permitted within the Buffer Zone;

(7) reflect a strong presumption against new road and utilities construction in the Buffer Zone.

C. In those instances where the Corps issues a permit within the Buffer Zone, the Corps shall require, in addition to full compliance with the 404(b)(1) guidelines and the standards and criteria above, compliance with the development criteria and standards in the Big Cypress Area of Critical State Concern regulations (28-25.006 et seq.) throughout the Buffer Zone, as appropriate.

D. The Corps shall work with other federal, state, local, and private entities to target aggressive acquisition/compensation and restoration initiatives in the Buffer Zone (including Corps restoration and federal, state, local, and private acquisition initiatives).

E. The Corps shall work with other federal, state, local, and private entities to encourage best management practices within the Buffer Zone that reduce impacts to water quality, listed species, and reduce conversion to residential, commercial, and industrial uses.

F. <u>In implementing these standards and criteria within the Buffer Zone, the Corps shall</u>:

(1) implement the adopted principles of the Estero Bay Agency on Bay Management throughout the Buffer Zone, as appropriate;

(2) ensure maintenance (no net reduction) in water tables and recharge areas within the Buffer Zone;

(3) ensure, at a minimum, actual no net loss in area and function of wetlands beyond existing (1998) conditions;

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(4) promote restoration of flow ways;

(5) promote establishment of buffer zones around wetlands and along flow ways, streams, and rivers;

(6) promote buffer zones around eagles' nests and colonial bird rookeries;

(7) ensure no adverse impacts on water quality;

(8) ensure that regulatory actions do not contribute to hurricane shelter deficit or increase evacuation times.

ACQUIRE/RESTORE/FIX ZONE

Area Included: SEE ALTERNATIVES MAPS. The basic intent is to include in this zone specific areas where residential development has been attempted, but is unsuccessful and not considered suitable, and where there si potential to restore and preserve critical wildlife and water resources. This zone includes at least parts of Lehigh Acres and Golden Gates Estates. The acquire/restore/fix zone may include areas identified as: Florida Panther Habitat Areas 1&2, Strategic Habitat Critical Areas, and/or areas included on the Agency for Bay Management Land Conservation/Preservation Map. Some alternatives may not include an acquire/restore/fix zone.

Standards and Criteria:

The Acquire/Restore/Fix (ARF) Zone includes areas recognized to be in need of restoration and retrofit to protect and restore the critical wildlife and water resources of the area. Such restoration and retrofitting must also recognize that much land has been purchased for residential development in this area, and some residential development has been attempted in and around these areas.

This vision requires that government and private entities move aggressively to acquire top priority lands and easements within the ARF Zone, where necessary to protect and restore critical resources while avoiding unfair regulatory takings of private property. Government agencies must commit to actions that are consistent with and complement the conservation goals within the ARF Zone. Where lands are acquired and restored, they should generally be placed in preservation status, subject to the standards and criteria for the Preservation Zone. In very limited cases, some ARF Zone lands might be returned to a development use if: (1) located adjacent to existing successful development; (2) retrofitted and regulated to allow only development compatible with conservation purposes; and (3) the public is fully reimbursed for retrofitting and infrastructure costs. New roads, utilities, and other infrastructure in the ARF Zone must be strongly discouraged and, where essential, must be designed to discourage growth in Preservation and Agricultural Zones.

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Unless and until ARF Zone areas are placed in preservation status, Corps §404 permitting decisions must be made consistent with this vision as follows:

A. Corps strictly applies the §404(b)(1) guidelines, including:

(1) a strong presumption that practicable alternatives exist outside the ARF Zone to dredge and fill activities (except restoration/retrofit activities) in jurisdictional waters within the zone;

(2) a strong presumption that significant degradation to wetlands and waterways results within the ARF Zone and "downstream" from dredge and fill activities (except restoration/retrofit activities) within the ARF Zone;

(3) significantly heightened levels of compensatory mitigation for any unavoidable adverse impacts that are permitted within the ARF Zone. Such mitigation must fully replace wetland losses on an acreage and function basis.

B. Corps regulatory actions shall also:

(1) consider only "single and complete" projects, including all phases of residential, commercial, recreational, and mixed use development projects;

(2) reflect a strong presumption that dredge and fill activities (except restoration/retrofit activities) in the ARF Zone will adversely affect, and likely jeopardize the continued existence of, federally-listed threatened and endangered species;

(3) fully consider, and explicitly address, all U.S. Fish and Wildlife Service, National Marine Fisheries Service, and state resource agency recommendations;

(4) eliminate the use of existing nationwide and other general permits that could authorize more than minimal cumulative adverse impacts within the ARF Zone (e.g., dock gp, NWPs 12, 14, 18, 26 and 26 replacements, and 29);

(5) increase scrutiny of drainage, excavation, and fill activities on any areas within the ARF Zone claimed to be exempt as prior converted cropland;

(6) reduce the potential for additional, secondary development surrounding any activities that are permitted within the ARF Zone;

(7) reflect a strong presumption against new road and utilities construction in the ARF Zone.

C. In those instances where the Corps issues a permit within the ARF Zone, the Corps shall require, in addition to full compliance with the 404(b)(1) guidelines and the standards and criteria above, compliance with the development criteria and standards in the Big Cypress

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Area of Critical State Concern regulations (28-25.006 et seq.) throughout the ARF Zone, as appropriate.

D. The Corps shall work with other federal, state, local, and private entities to target aggressive acquisition/compensation and restoration initiatives in the ARF Zone (including Corps restoration and federal, state, local, and private acquisition initiatives).

E. The Corps shall work with other federal, state, local, and private entities to encourage best management practices within the ARF Zone that reduce impacts to water quality, listed species, and reduce conversion to residential, commercial, and industrial uses.

F. <u>In implementing these standards and criteria within the ARF Zone, the Corps shall</u>:

(1) implement the adopted principles of the Estero Bay Agency on Bay Management throughout the ARF Zone, as appropriate;

(2) ensure, at a minimum, maintenance (no net reduction) in water tables and recharge areas within the ARF Zone;

(3) ensure, at a minimum, actual no net loss in area and function of wetlands beyond existing (1998) conditions;

(4) promote restoration of flow ways;

(5) promote establishment of buffer zones around wetlands and along flow ways, streams, and rivers;

(6) promote buffer zones around eagles' nests and colonial bird rookeries;

(7) ensure no adverse impacts on water quality;

(8) ensure that regulatory actions do not contribute to hurricane shelter deficit or increase evacuation times.

URBAN ZONE

Area Includes: SEE ALTERNATIVES MAPS. The basic intent is to include areas within the Study Area that are: (1) presently in urban and suburban use, and (2) adjacent areas that are considered most suitable for urban and suburban development in the future.

<u>Standards and Criteria</u>:

The Urban Zone is recognized to be the focal point for present and future urban development. The vision is to direct development into this zone, in lieu of urban expansion

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east, west, north, or south of the zone, while maintaining watershed integrity within the zone.

This vision requires that government and private entities plan carefully for future growth in the Urban Zone, while protecting watershed integrity (and overall quality of life). Land and water use decisions must support the goals of protecting watershed integrity and focusing growth in the Urban Zone. New roads, utilities, and other infrastructure in the Urban Zone must be designed to support these goals as well.

Corps §404 permitting decisions must be made consistent with this vision as follows:

A. Corps applies the §404(b)(1) guidelines within the Urban Zone, including:

(1) a presumption that practicable alternatives exist to locating dredge and fill activities in creeks, rivers, other historic flow ways and adjacent wetlands; and to locating dredge and fill activities in isolated wetlands identified as important to wading birds, other species of concern, water quality, groundwater recharge, or flood control. In other words, a presumption that dredge and fill activities in these wetlands and waterways can be avoided. Otherwise, a recognition that practicable, off-site alternative locations for proposed dredge and fill activities are less likely to be available within the Urban Zone, and may be considered unavoidable.

(2) a presumption that significant degradation to wetlands and waterways results from dredge and fill activities in Urban Zone creeks, rivers, other historic flow ways and adjacent wetlands; and in Urban Zone isolated wetlands identified as important to wading birds, other species of concern, water quality, groundwater recharge, or flood control.

(3) mitigation for unavoidable wetland/water way losses within the Urban Zone that focuses on maintaining and improving watershed integrity (i.e., groundwater and surface water supply, surface water levels, flood retention, water quality, fresh/salt water balance, wading bird and fisheries production).

B. Corps regulatory actions shall also:

(1) consider only "single and complete" projects, including all phases of residential, commercial, recreational, and mixed use development projects;

(2) fully consider, and explicitly address, all U.S. Fish and Wildlife Service, National Marine Fisheries Service, and state resource agency recommendations;

(3) limit the use of nationwide and other general permits that could authorize more than minimal cumulative adverse impacts to the watershed or encourage secondary development beyond the Urban Zone (e.g., dock gp, NWPs 12, 14, 18, 26 and 26 replacements, 29, programmatic gp).

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(4) reduce the potential for additional, secondary development beyond the Urban Zone.

(5) require compliance with the Endangered Species Act, water quality standards, and promote compliance with the state Growth Management Act, other WMD and DEP environmental requirements, and local comprehensive plans (to the extent as strict or stricter than the above) to protect watershed integrity in the Urban Zone.

C. In implementing these standards and criteria within the urban zone, the Corps shall:

(1) implement the adopted principles of the Estero Bay Agency on Bay Management throughout the Urban Zone, as appropriate;

(2) promote restoration of flow ways;

(3) promote restoration or retrofitting of buffer zones around wetlands and along flow ways, streams, and rivers;

(4) work with other agencies to promote retrofitting of septic systems and package treatment plants as appropriate;

(5) work with other agencies to set and meet water pollution reduction goals through Urban Zone permit conditions and limitations and other appropriate regulatory actions;

(6) ensure that regulatory actions do not contribute to hurricane shelter deficit or increase evacuation times.

(7) encourage "smart growth" land use practices (e.g., clustering, TDRs, residential/commercial mixing, mass transit) to accommodate growth and watershed integrity within the Urban Zone.

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Principles of the Estero Bay Agency on Bay Management

The Estero Bay Agency on Bay Management (ABM) is a non-regulatory body whose directive is to make comments and recommendations for the management of Estero Bay and its watershed. The waters of Estero Bay provide a tremendous resource for local residents and tourists who enjoy fishing and appreciate the local vegetation and wildlife. It is also important to note that Estero Bay is Florida's first aquatic preserve. Due to the forthcoming increase in population density on and near the shores of Estero Bay and its watershed and the attendant increase in boat traffic, the Estero Bay Agency on Bay Management has adopted the following guiding principles. These principles are an attempt by the ABM to make strong and clear recommendations for the preservation and restoration of this rare and unique ecosystem. The ABM realizes that some situations within the Estero Bay Watershed may not allow the strict adherence to these principles, however, the ABM recommends that they be utilized wherever and whenever possible.

Water Courses

General

- Non-structural approaches versus structural approaches will be used for water resource management solutions.
- No further channelization of remaining natural watercourses will occur.
- A better balance of ecological needs versus water flow will be used for water resource management decisions.
- Establish and restore the historic basin flood plains to the maximum extent possible.
- Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.

Vegetation

- Natural, native vegetation versus non-native invasive vegetation within flowways and natural systems will be retained to the greatest extent possible.
- Physical removal of invasive vegetation versus widespread chemical treatment will be utilized for control.
- Limited application of herbicides that rapidly degrade may be used on a case-by-case basis, under the supervision of certified personnel, for control of nuisance and invasive non-native vegetation and to maintain native plant communities.
- Promote, whenever possible, the active and aggressive removal of invasive non-native plants from all common areas, conservation easements, preserves and natural areas within the Estero Bay watershed.

Physiographic

The ancient relief of the upper tributary reaches will be maintained by:

- Preserving vegetation that provide the characteristic riparian habitat and canopy.
- Retaining the relic natural features of the tributary bank contours.
- Reconnecting historic natural flowways that have been diverted or severed.
- No further channelization.
- No further dredging.

New Construction

- New setback criteria will be developed and implemented along watercourses to provide construction setbacks to the maximum extent possible. These setback criteria will be based on the best available scientific data.
- Construction within tributary flood plains shall be avoided wherever possible.
- For construction that must occur within flood plains, utilize techniques that do not adversely impact the capacity of the floodplain (e.g. pilings to raise living floor elevations versus fill).
- Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood) within flood plains.

Hazardous Materials

- Specifically placed larvicides and biological controls are the preferred methods for mosquito control. Adulticides should only be used in compliance with Section 388.011(1) Florida Statutes.

Agriculture and Urban

- Old surface water management (SWM) systems built before current regulations will be retrofitted, using best available management practices, to meet current SWM standards.
- Permitting must address cumulative impacts to the water storage capacity of the watershed.
- Grants or incentives should be provided for retrofitting old surface water management systems that are not effectively managing water volume or flow, or removing nutrients and other pollutants.

Roadways

- All future roadways to be located in the floodplain within the Estero Bay watershed will be designed and constructed to not impede flows from a 25-year, 3 day, storm event.

Boating

- No special accommodations will be made for boats (e.g. no cutting of overstory vegetation, no removal of oxbows, no dredging or filling except for permitted maintenance of navigation channels).

Public Notice

- Activities in the watershed by any regulatory agency shall provide the opportunity for public participation.

Uplands, Headwaters and Isolated Wetlands

General

- Lands identified as critical for listed species shall be targeted for public purchase and managed to maintain their environmental value.
- The Lee County Conservation Land Acquisition and Stewardship Advisory Committee will

consider priorities for land purchases adopted by the "Arnold Committee" and the ABM.

- The Lee County Conservation Land Acquisition and Stewardship Advisory Committee will use proactive approaches to investigate the willingness of landowners to be voluntary sellers, as specified in the requirements of the ordinance that established the land acquisition program.
- Tax incentives should be created so that landowners may continue land use practices that maintain ecologically important habitat.
- Adequate staff at Property Appraisers' Offices within the watershed will be provided to review the high number of applications and strictly enforce the rules for bona fide agricultural tax exemptions.
- The minimum time period for re-zoning of agricultural land should be increased from three years to ten years to reduce the speculative clearing of agricultural land for "higher use" which results in the loss of natural habitat and the loss of tax revenue.
- Regulations within the existing "Notice of Clearing" process by Lee County will be developed that require wildlife surveys, habitat assessments, and a development plan for the agricultural operations so that critical habitats for state and federal listed species can be preserved.
- Conservation easements will be used as an option to protect critical habitats.
- Legislation should be implemented that provides inheritance tax, real estate tax and estate tax relief for agriculture landowners and their heirs, who will maintain their land in agriculture.
- Legislation should be implemented that provides inheritance tax, real estate tax and estate tax relief for landowners and their heirs, who provide permanent conservation easements on their property.
- All re-zoning requests within the Estero Bay watershed will be critically evaluated to ensure protection of water quality, rare and unique habitats, listed wildlife, and ecosystem functions.
- Variances from environmental regulations and deviations from development standards will be the exception, not the rule.
- Environmental protection and long-term quality of life will not suffer based on short-term economic impacts or political pressures.
- Zoning resolutions that are required as a part of the approval for re-zoning must be tracked for future compliance and enforcement.
- Additional staff will be hired to assist in the compliance and enforcement of zoning resolutions related to environmental issues.
- The ABM will be cognizant of the "big picture" and to the concept of "ecosystem management" and sustainable development.
- Agency staffing will keep pace with increased demand on services, especially environmental protection issues. Trained and experienced wildlife biologists and environmental scientists will be hired to ensure adequate development review.
- Programs such as the "Keep It Clean" and "Florida Yards and Neighborhoods" programs should be promoted, to minimize inputs of stormwater pollutants into the bay.
- Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.
- The Inheritance Tax will be repealed, so as to encourage the retention of agricultural lands.

Vegetation

- Natural, native vegetation within natural systems will be retained to the greatest extent possible.
- Physical removal of invasive vegetation will be utilized for control rather than widespread chemical treatment.
- Limited application of herbicides that rapidly degrade may be used, according to the product label, on a case by case basis for the control of nuisance and invasive non-native vegetation

and to maintain native plant communities.

- Promote, whenever possible, the active and aggressive removal of invasive non-native plants from all common areas, conservation easements, preserves and natural areas within the Estero Bay watershed.

Physiographic

Consideration will be given to the ancient relief of the watershed by:

- Preserving vegetation that provide the characteristic habitat and canopy.
- Retaining the relic natural features.
- Reconnecting historic natural flowways that have been diverted or severed.

New Construction

- Construction within flood plains shall be avoided wherever possible.
- For construction that must occur within flood plains, utilize techniques that do not adversely impact the capacity of the floodplain (e.g. use of pilings to raise living floor elevations versus use of fill).
- Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood) within flood plains.

Hazardous Materials

- Specifically placed larvicides and biological controls are the preferred methods for mosquito control. Adulticides should only be used in compliance with Section 388.011(1) Florida Statutes.

Agriculture and Urban

- Old surface water management (SWM) systems built before current regulations will be retrofitted, using best available management practices, to meet current SWM standards.
- Permitting must address cumulative impacts to the water storage capacity of the watershed.
- Grants or incentives should be provided for retrofitting old surface water management systems that are not effectively managing water volume or flow, or removing nutrients and other pollutants.

Roadways

- All future roadways to be located in the floodplain within the Estero Bay watershed will be designed and constructed to not impede flows from a 25-year, 3 day, storm event.

Public Notice

- Activities in the watershed by any regulatory agency shall provide the opportunity for public participation.

Bay Waters

Water Quality

- Regulatory agencies will continue to support "Best Management Practices."
- Operation of overloaded and outdated package wastewater treatment plants will be discontinued.
- All urbanization will be served by centralized sewage systems.
- There should be uniform application of water quality protection measures by regulatory agencies. A holistic management scheme should be implemented that takes into consideration ecological impacts of regulated activities.
- Compliance and enforcement of existing regulations are needed to protect water quality and biological integrity.
- There shall be no discharge of hazardous materials into Estero Bay.
- Surface water management systems in new developments will be required to utilize state-of-the-art best management practices.
- Grants or incentives should be provided for retrofitting old systems that are not effectively removing nutrients and other pollutants from urban and agricultural stormwater systems.
- The State of Florida will actively investigate and prosecute water quality violators.
- Retrofitting existing shorelines hardened with vertical seawalls to sloping limerock revetments or native, salt tolerant vegetation, should be encouraged wherever possible.
- Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.

Habitat Alteration

- Construction within Estero Bay waters shall be avoided wherever possible.
- For construction that must occur within Estero Bay waters as proven necessary for the health, safety and welfare of the natural resources of Estero Bay and of the people in the watershed, utilize techniques that do not adversely impact Estero Bay waters

New Construction

- New construction projects should utilize best management practices to minimize negative impacts to the bay to the greatest extent possible; and in addition, the project as a whole, including mitigation, should be necessary to protect the public health, safety, or welfare, or the property of others, and should improve the current condition and relative value of functions being performed by the areas affected by the project.
- Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood).

Wildlife

- A manatee protection plan will be adopted to reduce the number of boat-related manatee mortalities and that respects the rights of other users of the bay; to achieve a sustainable manatee population (the goal of the Marine Mammal Protection Act, the Endangered Species Act and other pertinent legislation); to protect manatee habitat; to promote boating safety; and to increase public awareness of the need to protect manatees and their environment.
- Efforts by wildlife protection agencies will be accelerated to reduce other non-boat related manatee mortalities.
- Maintain and improve the overall ecology of the bay and its watershed.

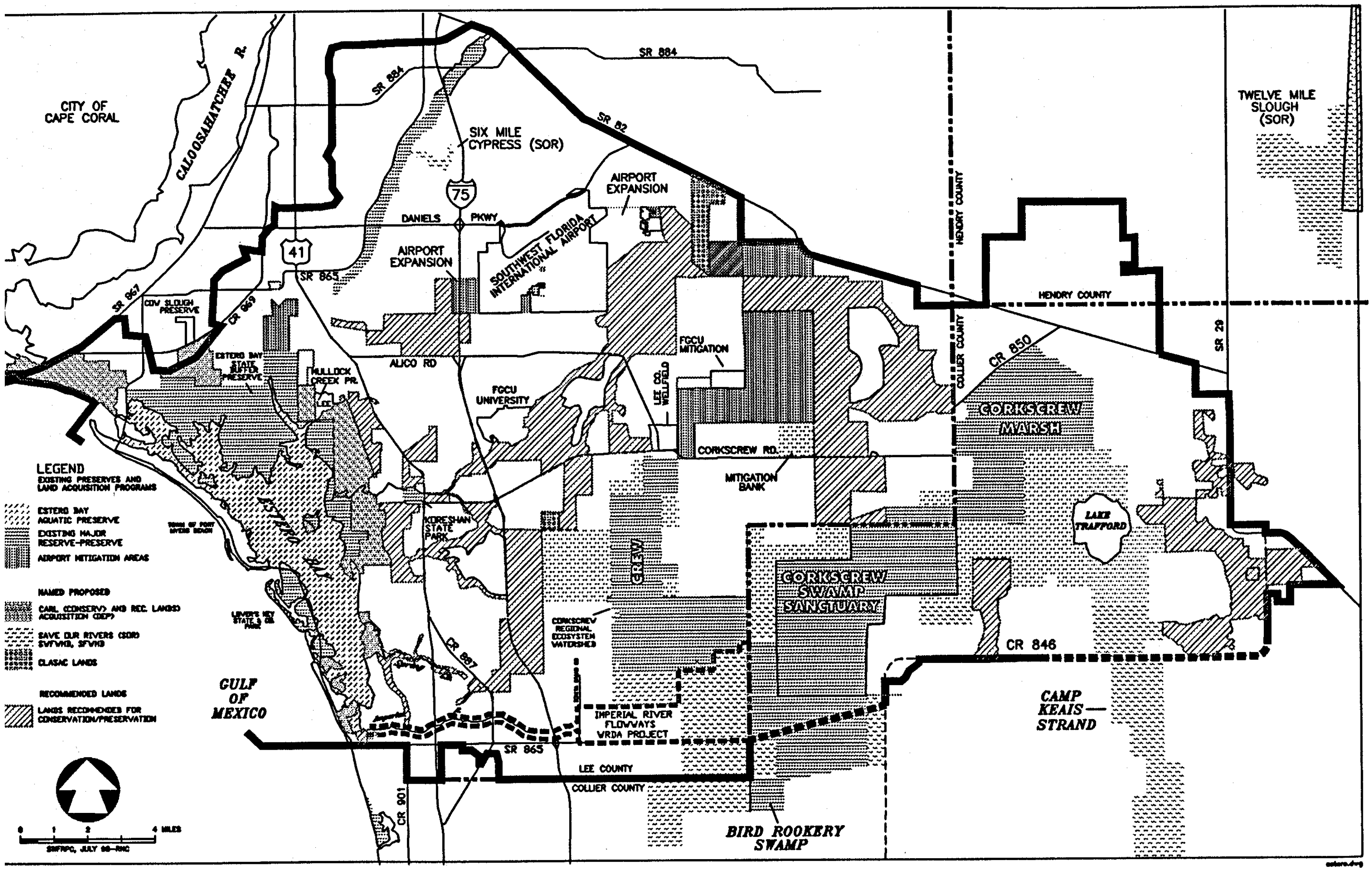
- Wildlife resources such as rookeries, sea grass beds and fisheries are under increasing threat from human activity. Greater efforts are required by regulatory and other agencies and groups to insure the sustained productivity of these resources.

Recreation

- Regulatory agencies will make special effort to maintain the bay as a major natural resource for fishing and appreciation of vegetation and wildlife.

Public Notice

- Activities in Estero Bay by any regulatory agency shall provide the opportunity for public participation.



ADOPTED JULY 13, 1998 BY THE ESTERO BAY AGENCY ON BAY MANAGEMENT

ESTERO BAY WATERSHED

LAND CONSERVATION/PRESERVATION STRATEGY MAP

PROPOSAL FOR AN ADG ALTERNATIVE

Criteria Identifier: REGIONAL OR COMPREHENSIVE STORMWATER MANAGEMENT

Potential Application: As an alternative for future urban areas (e.g. as a requirement of a general permit). Emphasis areas are those with receiving water bodies that are subject to the most significant impact. Examples might include the OFW tributaries of Estero Bay in the "Hub". In some cases, retrofitting existing systems may be possible.

Problem Description: In Florida, stormwater is the largest source of pollutants to lakes, rivers, and estuaries. In many lakes, it is the only major source of pollutants. On a statewide basis, stormwater as compared to regulated discharges (sewage and industrial treatment facilities) is the source of: 1) 80 to 95 percent of heavy metals; 2) 99 percent of all sediment; 3) 90 percent of oxygen demanding substances; and 4) 50 percent of nutrients. Thus severe environmental and economic impacts result when stormwaters are not managed. The usual approach to watershed management delegates stormwater management responsibilities to local land developers and each would be responsible for constructing stormwater management facilities on the development site to maintain post-development peak runoff and pollution loads from the site at predevelopment levels. With the usual approach there is little or no consideration of the cumulative effects of the developments with their individual stormwater systems on either the local government stormwater infrastructure or downstream lands and waters.

Proposed Criteria: Develop a comprehensive watershed plan for specific watersheds to identify the most appropriate control measures and the optimum locations to control watershed wide activities. A regional stormwater management approach would involve combinations of the following:

1) Overall review of the watershed and its characteristics to assess problems and potential solutions.

2) Strategically locating a single stormwater detention facility (a regional system) to control post-development runoff from several land development projects.

3) Provide stream channel improvements (e.g. removal of obstructions to flow, properly vegetating) where necessary upstream from the stormwater detention facility.

4) The use of nonstructural measures throughout the watershed, such as acquisition of parkland and floodproofing to supplement structural control measures.

5) Coordinate infrastructure improvements with point and nonpoint source management programs to provide a vital link between land use and water resources management.

Advantages of a regional stormwater management plan

— reduces capital and operation/maintenance costs
— reduces the risk of downstream flooding and erosion particularly in multi-jurisdictional waters
— Offers better opportunities to comprehensively manage stormwater problems
— Increases land development opportunities
— Increased opportunities for recreational uses

Advantages cont.

— Potential contributions to local land use planning
— Enhanced reuse of stormwater
— Popularity among land developers
— Better compliance with EPA stormwater discharge regulations

Possible disadvantages of regional stormwater management

— Local governments must conduct, in advance, studies to locate, and develop preliminary designs for regional stormwater management facilities.

— Local governments must finance, design, and construct the regional stormwater management facilities before most development occurs and provide for reimburesement by developers over a build-out period that can be many years long. However, there are a number of state and federal funding sources for this type of management.

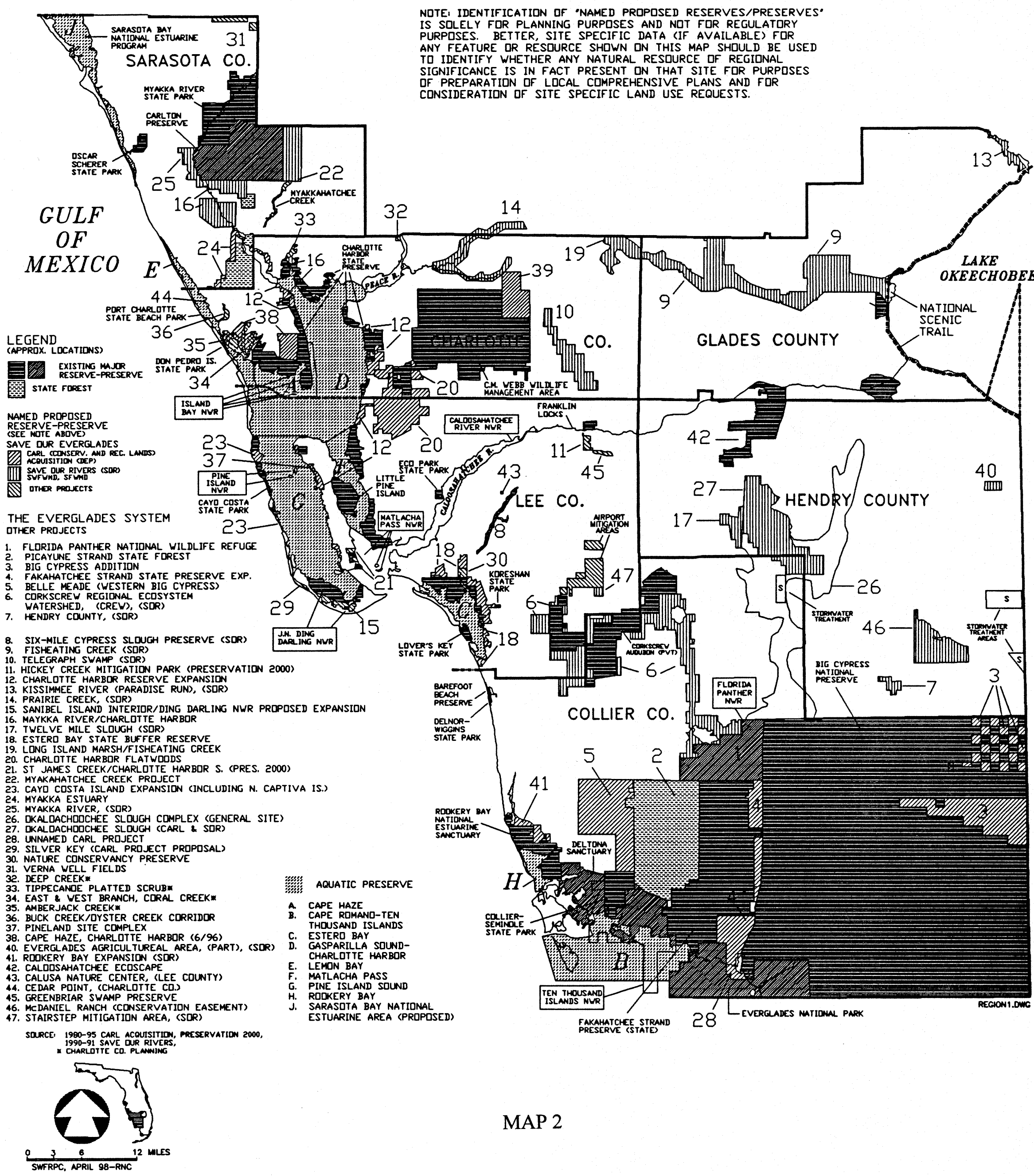
— In some cases, local governments may have to conduct extraordinary maintenance activities for regional stormwater management facilities the public feels are primarily recreational facilities that merit protection for water quality. An example might be canal dredging in Cape Coral canals. Howver the public accepts this and in some cases demands it.

Possible Funding Sources

— Florida Stormwater State Revolving Fund Loan Program (SWSRF). The SWSRF Program provides subsidized financing for stormwater management projects sponsored by local governmental agencies. The SWSRF is capitalized by federal appropriations, matching state funds and repayments form ongoing loans. The major program requirements are linked to federal appropriations and the federal Clean Water Act.

— EPA Clean Water State Revolving Fund (SRF) and the Clean Water Action Plan (CWAP). The SRF provides a powerful funding resource for implementing the CWAP. Since the end of FY 97, the SRF had funded a total of more than $650 million in nonpoint source and estuary projects around the country.

— Lee County Stormwater Utility if passed in November 1998.



MAP 2

SOUTHWEST FLORIDA REGION
REGIONALLY SIGNIFICANT NATURAL RESOURCES

APPENDIX G - EXTRACTS FROM MULTI SPECIES RECOVERY PLAN (DRAFT)

APPENDIX H - PROJECT REVIEW CRITERIA (DRAFT)

Permit Review Criteria DRAFT

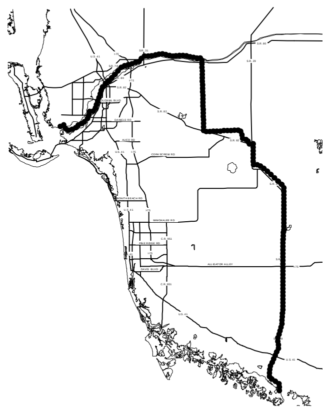
Suggestions for changes to this draft and the use of these evaluation factors are welcomed.

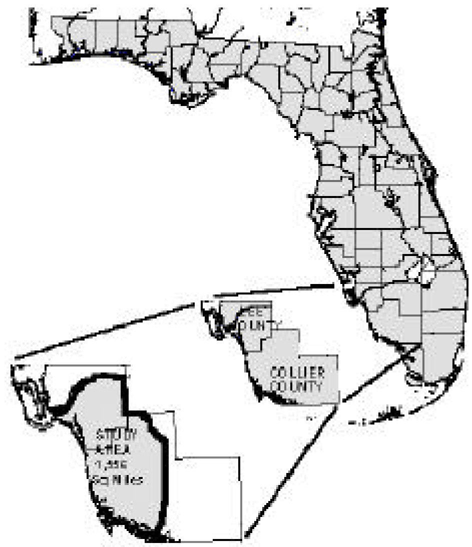
Table of Contents

Figures.

Preamble.

This document will be used by Corps Project Managers to evaluate the direct and indirect (cumulative and secondary) effects related applications for Department of the Army Permits under Section 404 of the Clean Water Act. This document applies to the study area of the Environmental Impact Statement for Improving the Regulatory Process in Southwest Florida (EIS). The study area measures 1,556 square miles.





The Corps' decision whether to issue or deny a Permit is based on an evaluation and weighing of the effects (both impacts and benefits) of the proposed project on many factors, including wildlife, endangered species, and water quality. The decision will consider both the direct and immediate effects and the indirect (cumulative and secondary) effects of the proposal. The decision will consider all the circumstances and design of each individual project. The Corp's Project Manger will use this document to prepare the Environmental Assessment/Statement of Findings (EA/SOF) memorandum that supports each Corps decision to issue or deny a permit.

This document provides several lists of questions. Each list is keyed to the land cover types of the Permit Review Map (Map), figure 2. If the proposed project is located within a "preservation" location on the Map, the applicant will be asked the "preservation" list of questions; if the proposed project is in "development" the applicant will be asked a different set of questions; and so forth.

The Map is based on the alternatives developed during the preparation of the EIS. Each alternative presented a map and associated criteria that represents a prediction of the what the study area will look like in approximately 20 years. The alternatives were then overlaid to find which geographic locations were mapped with similar land cover types, figure 3. For example, the alternatives variously use legends such as "urban" or "industrial" to indicate which areas of the study area will be occupied by commercial, retail, residential and other types of urban or suburban development and, for 14% of the study area, the alternatives all mapped some form of "development". For 25% of the study area, one or more of the alternatives map a location as "preservation" and the remainder at "development", "agriculture", etc., shown grey in Figure 3. For the remaining 8% of the study area, each Ensemble maps different land cover types, left as white areas in Figure 3. The Map (Figure 2) "fills in" the grey and white areas.

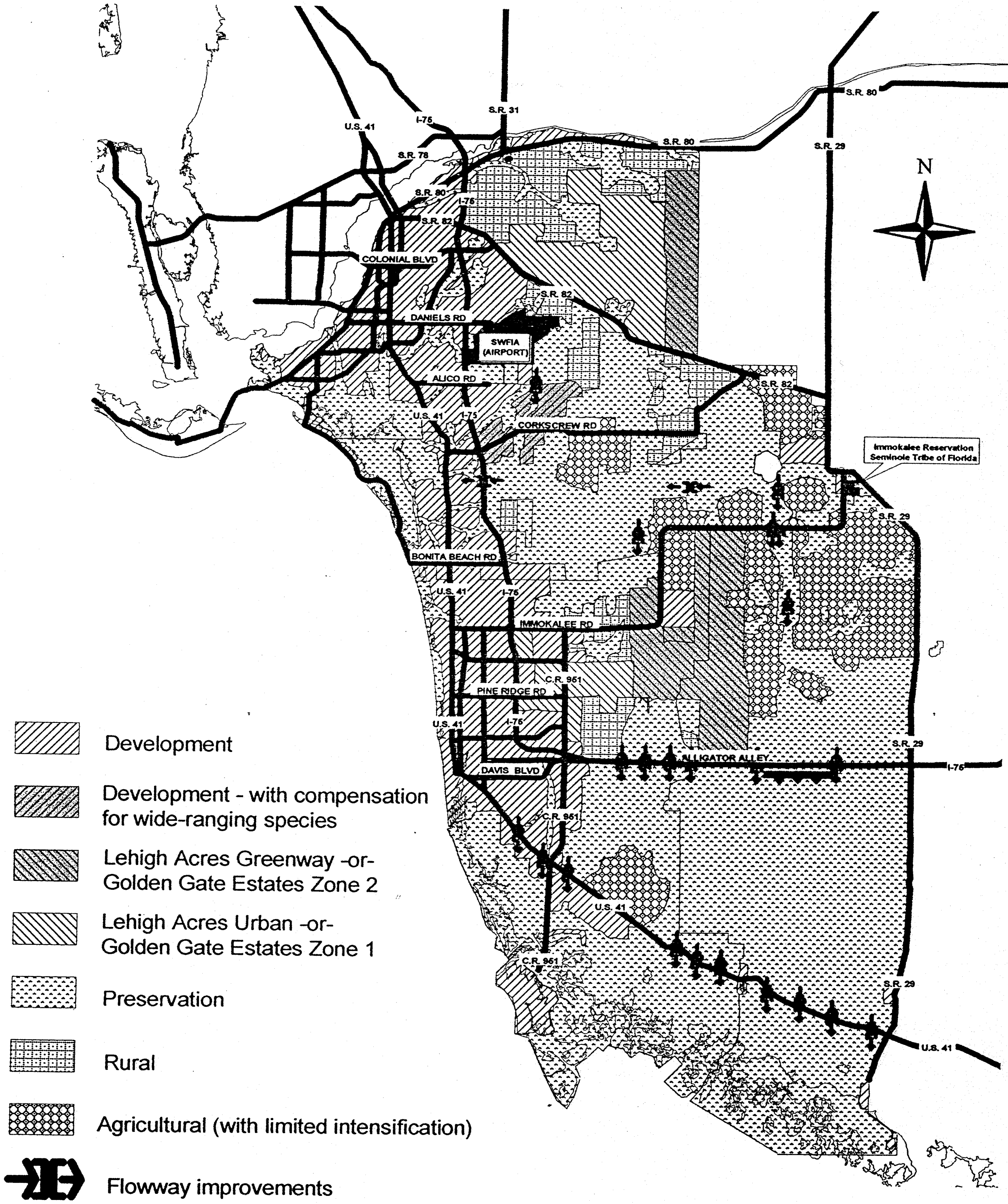


Figure 2. PROJECT REVIEW MAP

The Map does not predetermine the Corps permit decision. For example, if an application proposes construction of a residential development and if the project site is shown as "preservation" on the Map, the Corps will still consider all the circumstances and design of the individual project prior to deciding whether to issue or deny a permit. However, the nature of the questions demonstrates that the Corps intends to devote more attention to applications within the "preservation" area than to elsewhere.

Neither this document nor the Map applies to projects holding unexpired Department of the Army permits. This document only applies to applicants seeking authorization for placement of fill in Waters of the United States under Section 404 of the Clean Water Act.

The Map shows generalized land cover types. The information used to generate the Map reflects a synopsis of best available information. Boundaries between land cover types are not precise and no attempt was made to match parcel boundaries.

The document is subdivided by the land cover types (legends) on the Map. First, a general goal is stated for each legend. Then, questions are presented under four headings: I. Wetlands; II. Water quality and quantity; III. Habitat and listed species; and, IV. Other public interest factors. For most questions, suggestions are made for the statement(s) that would be placed in the EA/SOF. Parenthetical comments are provided that synopsize information found in the EIS.

The Map provides one prediction (of many possible predictions) of the total effect of twenty years of activities. Some of the activities, but not all, require Corps permits. The questions and suggested statements are designed to: (1) compare the effect of the individual application to the total predicted cumulative effect; and (2) provide notice if the individual project will change the prediction.

The evaluation factors used to analyze the effects are not elaborate. Their purpose is to present the relationship of an individual permit to the whole. As these are used, the Corps will periodically evaluate, in cooperation with other agencies, the accumulation of permit decisions to evaluate trends. The Corps recognizes that the evaluation factors presented herein are just one step in the development of a more elaborate analysis to describe the many interrelationships of wildlife and other issues across the landscape. The Corps is committed to working with the U.S. Fish and Wildlife Agency and others to develop more detailed analysis tools to be ultimately incorporated into the Corps' decision processes.

Immokalee Reservation, Seminole Tribe of Florida.

The Immokalee Reservation is not assigned a legend. Therefore, there is no prepared list of questions or evaluation factors for reviewing the cumulative effects of projects proposed within the Immokalee Reservation. Corps Project Managers 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.

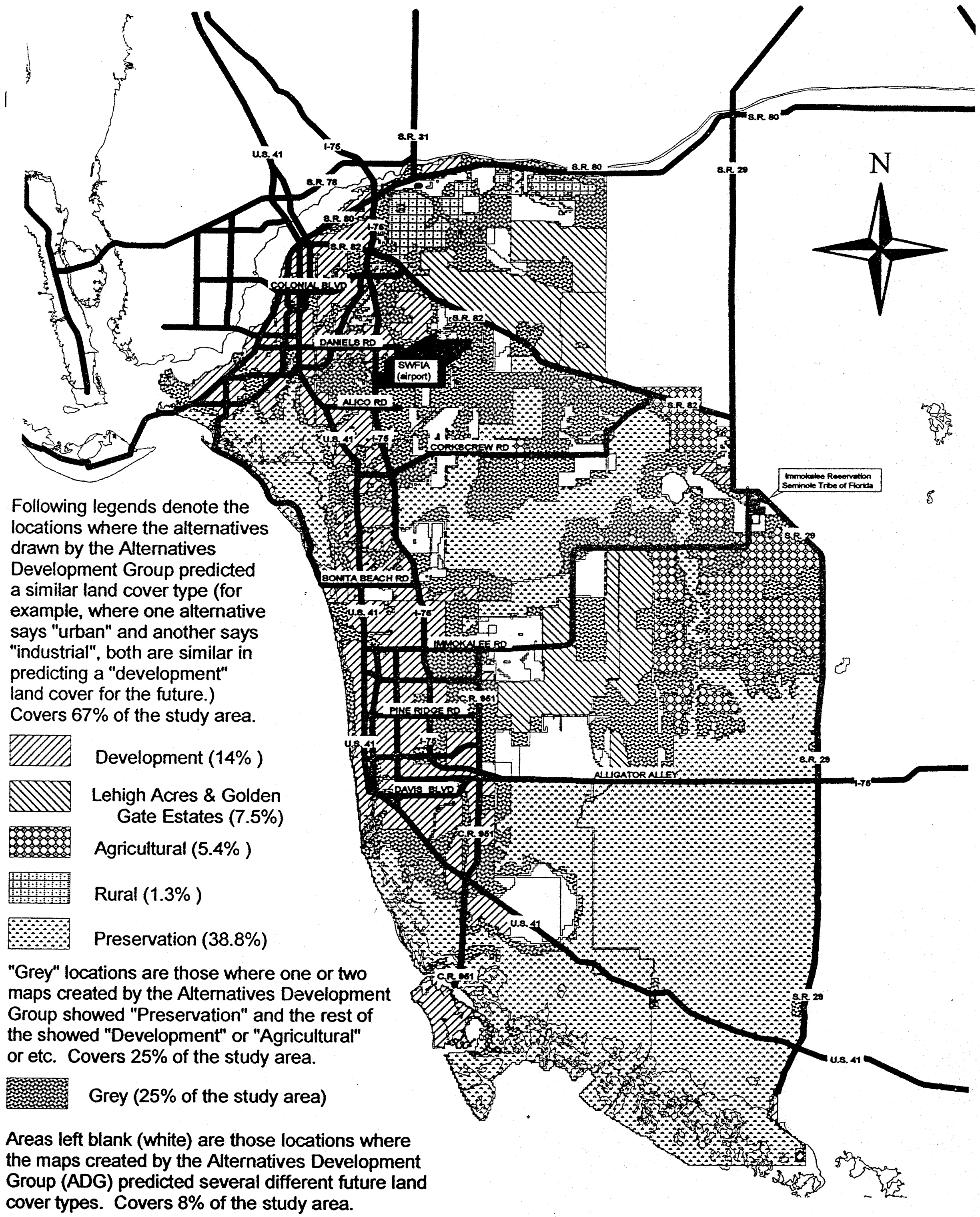


Figure 3. OVERLAY OF ALTERNATIVES

Legend: Preservation.

Goal. The Preservation land cover legend shows lands that are set aside strictly for conservation purposes. These areas are primarily existing and proposed public lands to be managed for wetlands and wildlife protection, but include private lands that have been identified as having significant resource value. Many of these lands have been, or are desirable for, fee title purchase by government or private entities (such as mitigation banks) to protect critical wildlife and aquatic/wetland resources. In other cases, such entities have or may purchase conservation easements ensuring that such lands will be managed consistent with conservation goals.

Criteria.

I. Wetlands.

A. **If the proposed project is for a non-preservation purpose, can the proposed project be located within the areas mapped as development?** The answer must be supported by an extensive geographic and site alternatives analysis.

(Corps regulations, including the Section 404(b)(1) Guidelines, require an analysis that shows the proposed project is the least damaging practicable alternative. The analysis is performed in sequence: (1) demonstration that no other sites are available to avoid the wetland impact, or if available, have greater impact; (2) demonstration that the selected site and selected site plan has the minimum impact compared to other alternatives; and (3) compensation for the resulting unavoidable impacts is provided. Presumptions are: (1) water dependency; (2) upland impact is less damaging to the aquatic environment. The U.S. EPA may formally raise concerns with the alternative analysis by writing comment letters as provided by the 404q MOU. The Map shows a large area of vacant/natural land for non-preserve land cover types. The Corps will presume, unless rebutted/justified as impracticable, that sites for non-preserve activities are available outside of the areas mapped as preserve.)

Evaluation factors to be used.

Avoidance of Wetland Impact. **State whether the acres of proposed fill would contribute to a cumulative fill greater than 5.6% of the wetlands in the study area.**

(Section 4.2 estimates that, for the five Ensembles, from 5.5% to 7.0% of the wetlands in the study area will be filled. The lower percentage better satisfies the requirement for avoidance. The estimate for the Map is 5.6%. However, in the calculation of this estimate, a small amount of wetland fill (1%) was estimated to occur within areas shown as preservation. If a project proposes any fill, and certainly any fill greater than 1% of the wetlands on the site, consideration must be given that this may result in cumulative impact greater than 5.6%.)

Loss of buffers adjacent to wetlands. **State whether the area of the project footprint will reduce the quantity of native vegetation in contiguous preserves to some number less than 42% of the study area.**

(Section 4.2 estimates that existing preserves total 27% of the study area. Native vegetation occupies 58%. For the five Ensembles, areas mapped as preserve range from 38% to 43% of the study area. The estimate for the Map is 42%. Natural resource benefits result from a matrix of upland and wetland. This matrix is ideally provided in contiguous preserves. Buffers outside of contiguous preserves have a higher probability to be impacted. Preservation of of a wetland and buffer provide greater benefits to the aquatic ecosystem than preservation of wetlands alone.)

B. **For an application that proposes effects that are a large percentage of the cumulative numbers for any of the evaluation factors, should a project specific EIS be prepared to support the permit decision?**

C. **Does the proposed project preclude use, for compensatory mitigation, of a portion of the area mapped as preserve?**

(All Ensembles predict expansion of existing public contiguous preserves. In part, this provides an opportunity for restoration or creation activities that would compensate for unavoidable impacts from projects located outside of the preserve mapping. Impacts are expressed in terms of acres and also in terms of the functions lost. Compensation is provided by creating new acres or restoring the functions of degraded areas and is often provided within the boundaries of the project. However, creation or restoration within contiguous large preserves sometimes provides greater natural resource benefits than performing the same work on a "postage stamp" wetland surrounded by urban development. The Map shows these contiguous areas as preservation. Therefore, within areas mapped as preservation, projects that create/restore natural benefits are preferred compared to non-preserve projects. A second preference is that compensation include the acquisition and preservation of "new preserves" so that the area of actual preserves is expanded, rather than simply performing restoration on existing public preserves.)

Evaluation factors to be used.

Availability of compensatory mitigation. **State that the wetlands within the project footprint are part of a set of wetlands particularly preferred for restoration and therefore the project may preclude the wetlands' availability as compensatory mitigation for projects elsewhere in the study area.**

(Section 4.2 estimates, for each Ensemble, the percent of the total wetlands within the study area that are located in areas of "new preserves". "New preserves" are areas mapped as preserves but are not currently in public or other management for the purposes of natural resource benefits. For the five Ensembles, the percentage ranges from 17% to 24%. The percentage for the Map is 22%. These are the wetlands that would be targeted for acquisition and restoration to provide compensatory mitigation based on the preferences stated in the background paragraph above. Adjacent uplands would be available for creation of wetlands, if appropriate. Not all of these wetlands need restoration. Not all of these wetlands would be available for restoration. However, a larger percentage provides a greater selection of compensatory mitigation sites for projects in "development" areas.)

Reduction in available acreage ratio. **State whether filling wetlands within the project footprint reduces the choice of mitigation sites for other projects in "development" areas.**

(Section 4.2 calculates, for each Ensemble, a ratio of the acres of wetlands in "new preserves" (factor #3) divided by the acres of wetlands that will be filled (factor #1). For the five Ensembles, the ratio ranges from 2.6:1 to 4.4:1. The Map has a ratio of 4.0:1. Acreage ratios are a convenient surrogate for the detailed analysis of wetland functions and values in calculating mitigation. The ratio calculated here would occur if (1) all of the estimated wetland impacts were compensated within "new preserves" (unlikely that "all" since some compensation will be performed at the project site) and (2) all of the "new preserves" were used for compensation (unlikely that "all" since some of the mapped "new preserves" will not be suitable for this). However, a higher the ratio indicates greater choice in location of compensatory mitigation.)

Availability of replacement wetland function. **State whether filling the wetlands within the project footprint reduces the assurance that ecosystem functions lost from other projects in "development" areas can be replaced.**

(Section 4.2 describes that, for each Ensemble, the presence of function was scored either high, medium, or low for wetlands that will be filled and those that are in the "new preserves". An acre of wetland filled that has a high score would represent a large number of lost "units" of function. An acre of wetland within "new preserves" that scored low would, through restoration, provide a large number of replacement "units". The ratio of units of restoration divided by units of impact vary, for the five Ensembles, from 1.8:1 to 3.3:1. The Map has a ratio of 2.8:1. A higher ratio indicates greater assurance that the ecosystem functions can be replaced.)

D. **Has the alternative analysis demonstrated that the applicant has satisfied avoidance?**

(The MOA between the Corps and EPA Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines requires the review to progress through a sequence demonstrating first, avoidance of impacts, second, minimization of impacts, and third, compensation for functions and values lost.)

E. **Has appropriate compensation been provided for functional replacement?**

(The analysis will use available numeric or other assessment tools, such as, the one published in the Joint State/Federal Mitigation Bank Review Team Process, Operational Draft, October 1998. Exceptional consideration will be given to the wetlands' location on a landscape scale, for example, cumulative losses of seasonal wetlands.)

F. **Are buffer zones (e.g., uplands, open space) provided around wetlands and other waters, particularly stream and river corridors and flowways?**

(There is very little topographic relief within the study area, therefore the surface area of marshes, streams, and other waters greatly expands into adjacent lands during the wet season. Native vegetation surrounding the wet-season expanse provides habitat for wetland dependent wildlife and visual, noise, and other buffering between the wetland and adjacent human activities. The purpose of Question #A above is to evaluate how the project footprint disrupts the ideal situation: a large contiguous matrix of wetland and upland. If the proposed project addresses that, then the current question is an additional evaluation whether impacts are minimized within the project footprint.)

Evaluation Factors to be used.

Connectivity between major habitat areas. **State whether the buffer width and arrangement maintains connectivity across the project footprint to surrounding contiguous areas of native vegetation.**

(Section 4.4 reports the evaluation of the connections proposed within areas mapped as development. That evaluation did not include connections within areas mapped as preserves since the presumption was that contiguous areas of native vegetation would remain. The evaluations concluded that wider and more numerous connections are more immune to disturbance from adjoining land uses.)

Fringe. **State whether the buffer width and arrangement affects the estuarine fringe.**

(Section 4.4 reports the evaluation of different configurations of the development mapping along the estuarine fringe. None of the Ensembles directly affected mangrove or salt marsh, but those Ensembles that proposed, as preservation, the pineland and hardwood hammock plant communities behind the fringe were considered to protect the fringe's ability to provide aquatic nursery and foraging habitat. The Map shows these areas as preservation.)

II. Water quality and quantity.

A. **Is the increase in pollutant loading minimized?**

(Corps must evaluate compliance with water quality standards but considers Florida's certification of compliance as conclusive unless EPA advises the Corps to consider other aspects. However, changes to the proposed project must be evaluated to confirm that the proposal is the least damaging practicable alternative.)

Evaluation factor to be used.

Pollution loading. **State whether impervious surfaces have been minimized and if all practicable opportunities have been included to provide BMPs.**

(All the Ensembles predict conversion of native vegetation to development. Section 4.10 notes that development had higher pollutant runoff compared to natural vegetation but that can be minimized by treating the runoff through detention ponds, vegetated swales, and similar "Best Management Practices" (BMPs). Ensembles that mapped less area of development and/or suggested installing/retrofitting regional BMPs were considered to be less likely to adversely affect water quality. The Map shows, as preservation, some of the areas where BMPs are not practicable or are not currently required under Florida's rules that grandfather older subdivisions.)

B. **Have wetlands been preserved in locations and quantities to minimize freshwater pulses and assimilate pollutants?**

(Pulses of freshwater have detrimental effect on estuaries by rapidly changing the salinity.)

Evaluation factors to be used.

Freshwater pulses. **State whether the project, by reducing wetlands and buffers, will increase the likelihood of freshwater pulses.**

(All the Ensembles predict conversion of native vegetation to development. Section 4.10 notes that the impervious surfaces within development would have a more rapid runoff of rainfall compared to natural vegetation. Ensembles that mapped less area of development and preserved greater area of wetland were considered less likely to affect water quality. The Map shows, as preservation, wetlands along flowways and in contiguous preserves to maintain storage of peak flows.)

Contaminant Reduction. **State whether the project, by reducing the contiguous areas of wetland and buffer, will increase the likelihood of degradation of water quality downstream.**

(All the Ensembles predict conversion of native vegetation to development. Section 4.10 reports Ensembles that mapped less area of development and preserved greater area of wetland were considered less likely to affect water quality. The Map shows, as preservation, wetlands along flowways and in contiguous preserves that, among other things, provides capability to assimilate pollutants.)

C. **Are historic water flows maintained or restored?**

(The study area has many man-made changes to the historic flow patterns, including drainage canals, roads that block historic sheet-flow, and berms. Many ideas have been developed in the past to retrofit structures or to restore areas. Some of those presented during the preparation of this document include: (1) restore southern Golden Gate Estates; (2) improve and add culverts under US 41; (3) fix canal plugs on canal south of I-75; (4) change existing drainage works in Water Management District VI and Belle Meade that place pulse discharges to Rookery Bay; (5) add weirs in Cocohatchee Canal; (6) restore Clam Bay and Vanderbilt Lagoon; (6) detain additional water in northern Golden Gate Estates to reduce fresh water pulses to Naples Bay; and (7) restore flows from the Estero Bay Watershed to Halfway Creek and the Estero River. Due to the complexity of the issue, comprehensive watershed modeling is usually needed, such as the South Lee Study and the Lower West Coast Water Supply Plan by the South Florida Water Management District and the District VI improvements by Collier County.)

Evaluation factors to be used.

Water Management. **State whether the fill, by reducing the area of contiguous wetland, will degrade historic flow patterns.**

(Section 4.15 reports the assessment whether the five Ensembles addressed seven factors. existence of infrastructure; potential for home damage; requirements for home construction meeting the one-hundred-year storm event; change in flood depth; maintenance or improvement toward historic flow patterns; water storage; and aquifer zoning. Existing local rules provide criteria either preventing or providing restrictions on design of homes within floodplains to prevent damage. Existing rules provide for the maintenance and upgrades of infrastructure from new development. Section 4.15 reports Ensembles that suggested wider flowways or preservation of wetlands reduced the potential for changes in flood depth and maintained historic flow patterns. The Map proposes preservation of large areas of wetlands and wide flowways to reduce the reliance on structural water management solutions.)

Groundwater impact. **State whether the project, by reducing the contiguous area of wetlands, directly or indirectly degrades wetlands surrounding wellfields.**

(Section 4.10 reports that much of the drinking water comes from the Surficial Aquifer System, closely linked to conditions in the wetlands on the surface. Existing local rules protect the wetlands in the vicinity of the wellfields. Ensembles that placed additional wetlands in preservation were considered to further reduce the likelihood of impact. The Map maps a large area as preservation based on recognition that the aquifer is influenced by activities over a large portion of the study area and that indirect effects (such as change in hydropattern) of wetlands in the vicinity of wellfields are less likely to occur if surrounded by contiguous preserves.)

III. Habitat and listed species.

Note. The Corps reviews applications requesting authorization to work in wetlands and other Waters of the United States. However, the Corps evaluation can include evaluating the effects that related upland work may have on the aquatic environment or other Federal interests as appropriate and as provided by law, for example, the Endangered Species Act and National Historic Preservation Act.

A. **Does the proposed project fragment habitat?**

(The study area still has a wide variety and large population of wildlife. The "fronts" of suburban development have been expanding inland from the urban centers of Fort Myers, Bonita Springs, and Naples. As these fronts meet with each other and with the suburban development in Lehigh Acres and Golden Gate Estates, the once large expanses of habitat are becoming more fragmented. Many species forage over large areas and require a mixture of vegetative communities for their life histories. Many efforts have been taken to identify the large "islands" shared by many species and their links so a fabric of habitat is maintained to retain a sustainable sample of what was once present.)

Evaluation factors to be used.

Strategic Habitat Conservation Area (SHCA). **State whether the project will preclude the opportunity to place, within contiguous preserves, areas identified as SHCA to some number less than 5.4% of the total SHCA in the State.**

(The Florida Game and Freshwater Fish Commission report Closing the Gaps in Florida's Wildlife Habitat Conservation System identified the minimum quantity of land that would maintain Florida's animal and plant populations at levels sustainable into the future. The report maps 33% of the area of the State. The SHCAs are the mapped areas not currently under public ownership. Section 4.4 reports that 8.2% of the SHCAs are found in the study area. The areas mapped as preservation in the five Ensembles encompass from 4.6% to 5.7%. The Map encompasses 5.4%.)

Connectivity between major habitat areas. **State whether the footprint of the project either blocks or narrows a connection between two major habitat areas.**

(Section 4.4 reports the evaluation of the connections proposed within areas mapped as development. That evaluation did not include connections within areas mapped as preserves since the presumption was that contiguous areas of native vegetation would remain. The evaluations concluded that wider and more numerous connections are more immune to disturbance from adjoining land uses.)

Regionally significant natural resources. **State whether the project preserves regionally significant natural resources.**

(The Southwest Florida Regional Planning Council has inventoried regionally significant natural resources and has drafted a Strategic Land Acquisition/Conservation/Preservation Plan for Southwest Florida. The Estero Agency on Bay Management (ABM) has prepared an Estero Bay Watershed Land Conservation/Preservation Strategy Map" and has adopted guiding principals. For the latter, Section 4.4 reports the assessment of how the five Ensembles enhanced implementation of the ABM's work.)

Multi-Species Recovery Plan (MSRP). **State whether the project footprint precludes the opportunity to place 52% of the study area into contiguous areas managed for natural resource purposes.**

(Section 4.3 reports the assessment of how the alternative enhances implementation of the U.S. Fish and Wildlife Service's MSRP. The Map, and the criteria proper, explicitly support MSRP recommendations. For all species, the MSRP recommends preservation of contiguous areas of native vegetation. The area mapped as preservation by the five Ensembles range from 45% to 53% of the total study area. The Map provides 52%.)

B. **Is Xeric oak scrub, rosemary scrub, and scrubby pine flatwoods, and other rare resources associated with ancient dune systems preserved?**

(Not many examples of these plant communities remain in the study area.)

Evaluation factor to be used.

Fringe. **State whether the buffer width and arrangement affects the estuarine fringe.**

(Section 4.4 reports the evaluation of different configurations of the development mapping along the estuarine fringe. None of the Ensembles directly affected mangrove or salt marsh, but those Ensembles that proposed, as preservation, the pineland and hardwood hammock plant communities behind the fringe were considered to protect the fringe's ability to provide aquatic nursery and foraging habitat. The Map shows these areas as preservation.)

C. **Are coastal forests (especially mangroves), coastal hammocks, sub-tropical hammocks, coastal pine flatwoods, and riparian forests (associated with streams or creeks) preserved?**

Factor to be used.

Flowways. **State whether the project will increased the vulnerability of these forests to impacts by removing the surrounding areas of vegetation.**

(Section 4.4 notes that most of the major habitat connections follow natural watercourses. Ensembles that mapped flowways through large contiguous areas better provided for a mix of upland and wetland habitat and for attenuation of peak flows. The Map shows large areas of contiguous preservation. A coastal and riparian forest that is part of a narrow flowway through a development is more vulnerable to impact from the development than if that forest was part of a contiguous preserve.)

D. **Are isolated and seasonal wetlands, including small wetlands, preserved or restored with functional buffers and water budgets that support natural hydroperiods? Where isolated wetlands are associated with larger sheetflow systems, is the system preserved?**

(Seasonal wetlands are found in shallow depressions that rely heavily on direct rainfall and runoff from adjacent uplands, with sheetflow between depressions during the wet season. The depressions are not evenly distributed across the landscape.)

Evaluation factor to be used.

Seasonal wetlands. **State whether the project will reduce the area of seasonal wetlands in contiguous preserves to some number less than 76% of the total area of seasonal wetlands in the study area.**

(Section 4.4 estimates that, for the five Ensembles, from 70% to 86% of the total area of seasonal wetlands are located within areas mapped as preservation. The higher the percentage, the more likely that natural hydropatterns will be maintained. The Map provides 76%.)

E. **Are high marsh systems and sea grasses preserved?**

F. **Is Florida panther habitat preserved?**

(This wide ranging species requires a mixture of upland and wetland habitat. The Florida Panther Habitat Preservation Plan (HPP) identified as either Priority 1 or Priority 2 those lands not in public ownership but essential for maintaining the population.)

Evaluation factors to be used.

Florida panther priority lands. **State whether the project will reduce the quantity of Priority 1 and 2 habitat within contiguous preserves to some number less than 70% of the total priority habitat in the study area.**

(Section 4.3 estimates that, for the five Ensembles, from 56% to 72% of the total Priority 1 and 2 lands within the study area will be encompassed by the lands mapped as preservation. The Map provides 70%. The higher percentage within contiguous preserves provides greater assurance of preserving the population.)

Florida panther on agricultural lands. **State whether the project blocks connection to or affects the agricultural lands that have suitable habitat.**

(Section 4.3 estimates that, for the five Ensembles, from 18% to 26% of the total Priority 1 and 2 lands within the study area will be encompassed by the lands mapped as agriculture. These areas are typically adjacent to public or proposed contiguous preserves and are important components of the total habitat available to the panther. In addition, those Ensembles that proposed criteria to restrict the intensification of agriculture were considered to increase the assurance of the preservation of the species. The agricultural area shown on the Map encompasses 18% of the Priority 1 and Priority 2 lands in the study area.)

G. **Are Bald eagle nests protected**?

(The Habitat Management Guidelines for the Bald Eagle in the Southern Region provides for minimum buffer distances for construction and permanent activity near a nest site. It does not protect foraging area.)

Evaluation factor to be used.

Bald eagle. **State whether the project, by removing native vegetation outside of the nest buffer zones, will reduce the number of nests within contiguous preserves below 20.**

(Section 4.3 estimates that, for the five Ensembles, from 18 to 20 of the total 27 known nests within the study area will be located within areas mapped as preservation. The Map maps 20 nests. Location within contiguous preserves provides higher assurance of preservation of the species since these sites also include adjacent lands used for foraging.)

H. **Is nesting and foraging habitat of the American crocodile protected and buffered from adverse impacts?**

(The American alligator is not endangered but is listed under the Endangered Species Act due to its similarity of appearance to the crocodile.)

Evaluation factors to be used.

American crocodile. **State whether all practicable opportunities have been included to preserve wetlands to provide attenuation of flows.**

(Section 4.3 notes that changes in the timing and quantity of freshwater flows affect plant and animal communities in estuaries, where the crocodile is found. As measured under Question #B in part II above, maintenance of wide flowways reduce the potential changes in hydropatterns, increasing the potential for preservation of this species.)

American alligator. **State whether the project will reduce the areas of seasonal wetlands available for this species.**

(Section 4.3 notes that this species is found throughout the area in large wetland areas, including the seasonal ones measured in Question #D above.)

I. **Is shorebird nesting, foraging and resting areas protected and buffered from adverse impacts?**

(This question applies to shorebirds in general, although one in particular is listed under the Endangered Species Act.)

Evaluation factor to be used.

Piping plover. **Note that potential changes in water quality, as measured by the questions in part II above, may affect the beaches.**

(Section 4.3 notes that none of the Ensembles propose direct impact (fill) on the barrier beaches used as wintering sites.)

J. **Are wading bird rookeries protected?**

(Set Back Distances to Protect Nesting Bird Colonies from Human Disturbances in Florida (Rodgers and Smith, 1995) provides for minimum buffer distances for construction and permanent activity near a rookery.

It does not protect foraging area. Foraging range for wading birds is up to 15 kilometers, 30 kilometers for Wood storks.)

Evaluation factors to be used.

Wading bird rookeries. **State whether the project, by removing native vegetation outside of the rookery buffer distances but within foraging range, will reduce the number of rookeries within contiguous preserves below 17.**

(Section 4.4 estimates that, for the five Ensembles, from 13 to 18 of the total 27 known rookeries within the study area will be located within areas mapped as preservation. The Map shows 17 rookeries. Location within contiguous preserves provides higher assurance of preservation of the species since these sites also include adjacent lands used for foraging.)

Woodstork rookeries. **State whether the project, by removing native vegetation outside of the rookery buffer distances but within foraging range, will reduce the number of rookeries within contiguous preserves below 12.**

(Section 4.4 estimates that, for the five Ensembles, from 9 to 14 of the total 14 known rookeries within the study area will be located within areas mapped as preservation. The Map maps 12 rookeries. Location within contiguous preserves provides higher assurance of preservation of the species since these sites also include adjacent lands used for foraging.)

K. **Are sea turtle nesting areas protected from adverse impacts and construction impacts proposed during the nesting season?**

(This question applies to the Loggerhead, Green, Hawksbill, and Kemp's Ridley sea turtles.)

Evaluation factor to be used.

Sea turtles. **Note that potential changes in water quality, as measured by the questions in part II above, may affect the beaches.**

(Section 4.3 notes that none of the Ensembles propose direct impact (fill, artificial lighting, human presence, and exotic vegetation) on the nesting beaches. However, there could be an effect if there is a change in water quality.)

L. **Are red-cockaded woodpecker cluster sites and associated foraging habitat protected on-site (or mitigated off-site when consistent with regional recovery plans and developed in conjunction with fish and wildlife agency recommendations)?**

(Since the habitat of this species is in old growth pine, it is very difficult to identify new sites beyond those presently occupied.)

Evaluation factor to be used.

Red cockaded woodpecker. **State whether the project, by removing native vegetation outside of the cluster site buffers and within foraging range, will reduce the number of cluster sites within contiguous preserves below 13.**

(Section 4.4 estimates that, for the five Ensembles, from 2 to 18 of the total 40 known cluster sites within the study area will be located within areas mapped as preservation. The Map shows 13 cluster sites. Location within contiguous preserves provides higher assurance of preservation of the species since these sites also include adjacent lands used for foraging.)

M. **Are Audubon caracara nesting territories protected from adverse impacts consistent with regional recovery plans or fish and wildlife agency recommendations?**

(The study area is on the fringe of the ten county area where the population is found.)

Evaluation factor to be used.

Audubon's crested caracara. **State whether the project footprint affects adjacent agricultural or prairie areas, directly or indirectly, thereby reducing the availability of habitat on agriculture lands below 10% of the study area.**

(Section 4.3 estimates that, for the five Ensembles, from 10% to 18% of the study area is mapped as agriculture. This species prefers native range and unimproved pasture for foraging. Those agricultural areas remaining in low intensity use provide more assurance that appropriate habitat, with interspersed seasonal wetlands, will be maintained. The Map provide 10% of the study area but also provides for non-intensification of agricultural use.)

N. **Is Florida scrub jay habitat protected from adverse impacts consistent with regional recovery plans developed in conjunction with fish and wildlife agency recommendations?**

(Since the habitat of this species is in scrub, it is very difficult to identify new sites beyond those presently occupied.)

Evaluation factor to be used.

Scrub jay. **State whether the project, by removing native vegetation outside of the colony site and within potential areas for expansion, will reduce the number of colony sites within contiguous preserves below 11.**

(Section 4.4 estimates that, for the five Ensembles, from 6 to 11 of the total 26 known colonies within the study area will be located within areas mapped as preservation. The Map maps 11 colony sites. Location within contiguous preserves provides higher assurance of preservation of the species since these sites also include adjacent lands for foraging and expansion of the families.)

O. **Is snail kite foraging and nesting habitat protected or compensated consistent with regional recovery plans or fish and wildlife agency recommendations?**

(Feeds only on apple snails that are in turn found only in seasonal wetlands.)

Evaluation factor to be used.

Seasonal wetlands. **State whether the project will reduce the area of seasonal wetlands in contiguous preserves to some number less than 76% of the total area of seasonal wetlands in the study area.**

(Same as Question #D above.) (Section 4.4 estimates that, for the five Ensembles, from 70% to 86% of the total area of seasonal wetlands are located within areas mapped as preservation. The higher the percentage, the more likely that natural hydropatterns will be maintained. The Map provides 76%.)

P. **Are projects with adverse impacts to eastern indigo snake habitat developed consistent with the provisions of the Eastern Indigo Snake Protection Guidelines (FWS, 1998)?**

Q. **Are federally listed plant species protected and buffered from adverse impacts?**

R. **Is construction within designated critical habitat of the West Indian manatee conducted consistent with the Standard Manatee Protection Construction Guidelines to minimize impacts associated with water craft-related mortality?**

IV. Other public interest factors.

Suggestions for changes to this draft and the use of these evaluation factors are welcomed.

A. **Is the project of a nature that would support additional development pressure within the preservation area?** For example: new public/private utilities; new or expanded roads; new well fields or well field expansions.

B. **Does the project affect hurricane preparedness?**

(The South Florida Regional Planning Council's Hurricane Storm Tide Atlas and Hurricane Evacuation Study estimate the population to be evacuated, the shelters available, and evacuation times based on road capacities. The Corps does not have direct authority over preparedness. The Corps can consider hurricane preparedness concerns as part of its public interest reviews, for example, safety and flooding.)

Evaluation factor to be used.

Hurricane preparedness. **State whether the site itself or the evacuation route is particularly subject to flooding or wind damage and identify the actions by the applicant or local government that are mitigating the concern (for example, improvement of roads or identification of shelters).**

(Section 4.15 reports that none of the Ensembles were considered to have changed preparedness. However, most of the areas mapped preservation on the Map have a high percentage of wetlands or are along the coastal or riverine fringe. These areas are natural locations for flooding. Some of these areas are also typically distant from major road networks or existing shelters, increasing the vulnerability during evacuation within or outside of the region.)

C. **Are reasonable expectations of the landowner affected?**

(A wide variety of actions by the Federal, State, and local governments over time provide the background for the landowner's understanding of the extent of any limitations to the exercise of rights from property ownership.)

Evaluation factor to be used.

Property rights. **State the influences on the rights associated with ownership of the project site. These would include: (1) designations in the Comprehensive Plans, (2) history of the landowner's preparation of the project proposal prior to submission of the application, (3) development orders or other actions issued by local, State, or Federal governments, and (4) surrounding land use and activities that have affected or are expected to affect the value of the property.**

(Section 4.6 reports the assessment whether the five Ensembles addressed three factors: fair market value of property; reasonable expectations for use of land and return on investment; and, vested rights. Ensembles with additional restrictions beyond those in the Comprehensive Plans or that designated areas as preservation beyond those in the Future Land Use Maps would not meet the expectations of the landowners affected. These permit review criteria and the accompanying map do not establish a particular restriction or land use, but identify evaluation questions to assess compliance with existing limitations established by Federal law.)

Difference from Comprehensive Plans. **State the degree of difference from the local Comprehensive Plan (and accompanying goals and policies).**

(Section 4.6 reports the assessment that decisions that departed from the current Comprehensive Plans would be detrimental not only to landowners' rights but also to other socio-economic concerns of the community. All five Ensembles represent potential futures. The Comprehensive Plans have been modified in the past and may be modified in the future. The Ensemble that represents the Comprehensive Plan is not exactly representative of the current Plan, for example, in southern Golden Gate Estates.)

D. **Does the project affect sustainability of local economy?**

(This issue is very complex. For a project submitted by a private enterprise, the Corps generally assumes that appropriate economic evaluations have been completed, the proposal is economically viable, and is needed in the market place.)

Evaluation factors to be used.

Economic Sustainability. **State whether the project will make a substantial difference to whether the local economy continues to be "sustainable".** This will (1) note the project located within the preservation mapping will be an incremental increase over the 38% of the study area already mapped for development, (2) recognize that there is a contribution to the local economy, but (3) consider that the increase is a very small portion of the total economy.

(Section 4.6 reports the assessment of how the five Ensembles affected six factors describing economic impact: job creation; home affordability; cost of living; property tax base; cost to implement; and increased taxes. Increasing or decreasing the area of development mapped in the Ensembles increased or decreased the creation of jobs and the size of the local government's property tax base. Increasing or decreasing the restrictions on use increased or decreased the costs of producing the product, which affects home affordability and cost of living. Increasing the area of preservation or the area of restoration efforts implies an increased cost to local government to implement, which when combined with a smaller tax base results in higher taxes. All the Ensembles predict that suburban development will continue, but they differ in how much more. Approximately 20% of the study area is currently urban or suburban development (included in this 20% are "vacant" lots and lands with roads, comprising greater than 3% of the study area). The five Ensembles range (in their predictions of the future extent of development) from 31% to 41%. The Map shows 38%. Once the 38% of the area is developed with the resulting economic activity, each incremental increase in area of development will be a smaller proportion of the total economy.)

E. **Is management of public lands affected?**

(Public lands provide the opportunity for the general public to access the unique natural characteristics of the region.)

Evaluation factor to be used.

Management of public lands. **State whether the project affects management of public lands in the vicinity.**

(Section 4.8 notes that public lands are affected by the compatibility of adjacent lands and by actions that directly degrade or improve the public lands proper. Ensembles that had the least effect on public lands provided non-intensive agriculture or expanded contiguous preserves to separate public lands from suburban development.)

Legend: Development.

Goal. The areas mapped Development include areas within the study area that are: (1) presently in urban and suburban use, and (2) adjacent areas that are considered most suitable for urban and suburban development in the future. The areas mapped Development are recognized to be the focal point for present and future urban development. Land and water use decisions should direct development into this area in lieu of promoting urban expansion elsewhere, while maintaining watershed integrity and coastal resources within the urban boundary. Permit decisions for new roads, utilities, and other infrastructure should also support these goals.

Criteria.

I. Wetlands.

A. **Have impacts been minimized?** The answer must be supported by an analysis of alternative site plans.

(Corps regulations, including the Section 404(b)(1) Guidelines, require an analysis that shows the proposed project is the least damaging practicable alternative. The analysis is performed in sequence: (1) demonstration that no other sites are available to avoid the wetland impact, or if available, have greater impact; (2) demonstration that the selected site and selected site plan has the minimum impact compared to other alternatives; and (3) compensation for the resulting unavoidable impacts is provided. Presumptions are: (1) water dependency; (2) upland impact is less damaging to the aquatic environment.

The U.S. EPA may formally raise concerns with the alternative analysis by writing comment letters as provided by the 404q MOU. The Map shows a large area of vacant/natural land for development. The Corps will presume that proposed development within the area mapped as development is appropriate.)

Evaluation factors to be used.

Avoidance of wetland impact. **State whether the acres of proposed fill would contribute to a cumulative fill greater than 5.6% of the wetlands in the study area.**

(Section 4.2 estimates that, for the five Ensembles, from 5.5% to 7.0% of the wetlands in the study area will be filled. The lower percentage better satisfies the requirement for avoidance. The estimate for the Map is 5.6%. The bulk of the estimated impact was from projects within areas mapped as development. However, in the calculation of this estimate, only a portion of wetlands on the site would be filled. Some projects will impact more than others by the nature of the projects and the configuration of the wetlands: the amount proposed must be justified by an analysis comparing alternative site plans.)

Loss of buffers adjacent to wetlands. **State whether the site plan preserves contiguous areas of wetlands and buffers vegetation, even if not adjoining public preserves, so that greater than 42% of the study area is preserved.**

(Section 4.2 estimates that existing preserves total 27% of the study area. Native vegetation (upland and wetland, including exotics) occupies 58%. For the five Ensembles, areas mapped as preserve range from 38% to 43% of the study area. The estimate for the Map is 42%. Natural resource benefits result from a matrix of upland and wetland. This matrix is ideally provided in contiguous preserves. Buffers outside of contiguous preserves have a higher probability to be impacted. Preservation of a wetland and buffer provides greater benefits than preserving wetlands alone.)

B. **For applications for projects that propose, individually, impacts that are a large percentage of the cumulative numbers for any of the evaluation factors, should a project specific EIS be prepared to support the permit decision?**

C. **Has the alternative analysis demonstrated that the applicant has satisfied avoidance?**

(The MOA between the Corps and EPA Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines requires the review to progress through a sequence demonstrating first, avoidance of impacts, second, minimization of impacts, and third, compensation for functions and values lost.)

D. **Has appropriate compensation been provided for functional replacement?**

(The analysis will use available numeric or other assessment tools, such as, the one published in the Joint State/Federal Mitigation Bank Review Team Process, Operational Draft, October 1998. Exceptional consideration will be given to the wetlands' location on a landscape scale, for example, cumulative losses of seasonal wetlands.)

E. **Has the project design optimized for habitat the design of retention lake shorelines?**

(Retention lake shorelines are often narrow strips of vegetation subject to disturbance from adjacent activities. Designs that create wider "shelves" and planted buffers reduce disturbance. Designs that include shallow depression "potholes" to concentrate fish and amphibians are concentrated during low water levels ehance their value to wading birds and other species.)

F. **Are buffer zones (e.g., uplands, open space) provided around wetlands and other waters, particularly stream and river corridors and flowways?**

(There is very little topographic relief within the study area, therefore the surface area of marshes, streams, and other waters greatly expands into adjacent lands during the wet season. Native vegetation surrounding the wet-season expanse provides habitat for wetland dependent wildlife and visual, noise, and other buffering between the wetland and adjacent human activities.)

Factors to be used.

Connectivity between major habitat areas. **State whether the buffer width and arrangement maintains connectivity across the project footprint to major habitat preserves.**

(Though not formally listed, inspection of the Ensembles show connections proposed between major habitat preserves such as Corkscrew Marsh, Estero Bay, Six Mile Cypress Strand, Belle Meade, Rookery Bay, and Fakahatchee Strand. The evaluations concluded that wider and more numerous connections are more immune to disturbance from adjoining land uses.)

Fringe. **State whether the buffer width and arrangement affects the estuarine fringe.**

(Section 4.4 reports the evaluation of different configurations of the development mapping along the estuarine fringe. None of the Ensembles directly affected mangrove or salt marsh, but those Ensembles that proposed, as preservation, the pineland and hardwood hammock plant communities behind the fringe were considered to protect the fringe's ability to provide aquatic nursery and foraging habitat. The Map shows these areas as preservation.)

II. Water quality and quantity.

A. **Is the increase in pollutant loading minimized?**

(Corps must evaluate compliance with water quality standards but considers Florida's certification of compliance as conclusive unless EPA advises the Corps to consider other aspects. However, changes to the proposed project must be evaluated to confirm that the proposal is the least damaging practicable alternative.)

Evaluation factor to be used.

Pollution loading. **State whether impervious surfaces have been minimized and if all practicable opportunities have been included to provide BMPs.**

(Section 4.10 notes that development had higher pollutant runoff compared to natural vegetation but that can be minimized by treating the runoff through detention ponds, vegetated swales, and similar "Best Management Practices" (BMPs). Ensembles that mapped less area of development and/or suggested installing/retrofitting regional BMPs were considered to be less likely to adversely affect water quality.)

B. **Have wetlands been preserved in locations and quantities to minimize freshwater pulses and assimilate pollutants?**

(Pulses of freshwater have detrimental effect on estuaries by rapidly changing the salinity.)

Evaluation factors to be used.

Freshwater pulses. **State whether all practicable opportunities have been included to preserve wetlands along flowways to provide attenuation of flows.**

(All the Ensembles predict conversion of native vegetation to development. Section 4.10 notes that the impervious surfaces within development would have a more rapid runoff of rainfall compared to natural vegetation. Ensembles that mapped less area of development and preserved greater area of wetland were considered less likely to adversely affect water quality. The Map shows, as preservation, wetlands along flowways and in contiguous preserves to maintain storage of peak flows.)

Contaminant Reduction. **State whether all practicable opportunities have been included to preserve wetlands within flowways to provide treatment downstream of the project.**

(All the Ensembles predict conversion of native vegetation to development. Section 4.10 reports Ensembles that mapped less area of development and preserved greater area of wetland were considered less likely to affect water quality. The Map shows, as preservation, wetlands along flowways and in contiguous preserves that, among other things, provides capability to assimilate pollutants.)

C. **Are historic water flows maintained or restored?**

(The study area has many man-made changes to the historic flow patterns, including drainage canals, roads that block historic sheet-flow, and berms. Due to the complexity of the issue, comprehensive watershed modeling is usually needed, such as the South Lee Study and the Lower West Coast Water Supply Plan by the South Florida Water Management District and the District VI improvements by Collier County.)

Evaluation factor to be used.

Water Management. **State whether all practicable opportunities have been included for non-structural maintenance of historic flow patterns.**

(Section 4.15 reports the assessment whether the five Ensembles addressed seven factors. existence of infrastructure; potential for home damage; requirements for home construction meeting the one-hundred-year storm event; change in flood depth; maintenance or improvement toward historic flow patterns; water storage; and aquifer zoning. Existing local rules provide criteria either preventing or providing restrictions on design of homes within floodplains to prevent damage. Existing rules provide for the maintenance and upgrades of infrastructure from new development. Section 4.15 reports Ensembles that suggested wider flowways or preservation of wetlands reduced the potential for changes in flood depth and maintained historic flow patterns. The Map proposes wide flowways to provide storage of surface waters and to reduce the reliance on structural water management solutions.)

D. **Have alternatives to installation of individual septic systems been considered?**

(One of the sources of existing and increased load in pollutants is from septic systems. Older systems may be located too close to the water table or to open water. Newer systems add more load than would be seen if waste was treated in package plants or regional systems. The evaluation of the cumulative effect of the project will identify if all practicable opportunities have been taken to avoid use of on-site-disposal-systems (OSDSs) or to retrofit package or regional treatment to existing OSDSs.)

III. Habitat and listed species.

Note. The Corps reviews applications requesting authorization to work in wetlands and other Waters of the United States. However, the Corps evaluation can include evaluating the effects that related upland work may have on the aquatic environment or other Federal interests as appropriate and as provided by law, for example, the Endangered Species Act and National Historic Preservation Act.

A. **Does the proposed project provide compensation for wide ranging species?**

(Wide-ranging species that may require off-site compensation for habitat impacts under a landscape-scale analysis include the Florida panther, Florida black bear, wood stork, snail kite, eastern indigo snake, red-cockaded woodpecker, big cypress fox squirrel, state-listed wading birds, and migratory birds. For some species, some geographic locations, or source project types, avoidance of the impact will be preferred. Off-site compensation for impacts to individuals for habitat may not be adequate. In determining off-site habitat compensation requirements, the impacts to individuals of a species or species habitat will be assessed, including the potential for incidental take, the habitat quality, and the function of the habitat on a landscape scale. The Map labels certain areas as "Compensate for Wide-Ranging Species" for locations expected to be developed but that provides particularly important habitat.)

Evaluation factors to be used.

Strategic Habitat Conservation Area (SHCA). **State whether any of the 2.8% of the total area of SHCA in the State is preserved as habitat within the proposed footprint of the project.**

(The Florida Game and Freshwater Fish Commission report Closing the Gaps in Florida's Wildlife Habitat Conservation System identified the minimum quantity of land that would maintain Florida's animal and plant populations at levels sustainable into the future. The report maps 33% of the area of the State. The SHCAs are the mapped areas not currently under public ownership. Section 4.4 reports that 8.2% of the SHCAs are found in the study area. For the Map, 2.8% is located outside of the preservation areas.)

Connectivity between major habitat areas. **State whether the footprint of the project either blocks or narrows a connection between two major habitat areas.**

(Section 4.4 reports the evaluation of the connections proposed within areas mapped as development. The evaluations concluded that wider and more numerous connections are more immune to disturbance from adjoining land uses.)

Regionally significant natural resources. **State whether the project maintains or connects regionally significant natural resources, or, through compensatory mitigation, acquires and restores areas mapped as preservation.**

(The Southwest Florida Regional Planning Council has inventoried regionally significant natural resources and has drafted a Strategic Land Acquisition/Conservation/Preservation Plan for Southwest Florida. The Estero Agency on Bay Management (ABM) has prepared an Estero Bay Watershed Land Conservation/Preservation Strategy Map" and has adopted guiding principals. For the latter, Section 4.4 reports the assessment of how the five Ensembles enhanced implementation of the ABM's work.)

Multi-Species Recovery Plan (MSRP). **State whether all practical measures have been taken to maintain habitat for listed species on site or, as compensatory mitigation, acquires and restores areas mapped as preservation.**

(Section 4.3 reports the assessment of how the alternative enhances implementation of the U.S. Fish and Wildlife Service's MSRP. The Map, and the criteria proper, explicitly support MSRP recommendations. For all species, the MSRP recommends encouraging management of privately owned lands.)

B. **Is Xeric oak scrub, rosemary scrub, and scrubby pine flatwoods, and other rare resources associated with ancient dune systems preserved?**

(Not many examples of these plant communities remain in the study area.)

Evaluation factor to be used.

Fringe. **State whether the buffer width and arrangement affects the estuarine fringe.**

(Section 4.4 reports the evaluation of different configurations of the development mapping along the estuarine fringe. None of the Ensembles directly affected mangrove or salt marsh, but the pineland and hardwood hammock plant communities behind the fringe were considered to protect the fringe's ability to provide aquatic nursery and foraging habitat.)

C. **Are coastal forests (especially mangroves), coastal hammocks, sub-tropical hammocks, coastal pine flatwoods, and riparian forests (associated with streams or creeks) preserved?**

Factor to be used.

Flowways. **State whether all practical measures have been taken to provide a wide flowway.**

(Section 4.4 notes that most of the major habitat connections follow natural watercourses. Ensembles that mapped flowways through large contiguous areas better provided for a mix of wetland and buffer habitat and for attenuation of peak flows. A coastal and riparian forest within a development is less vulnerable to impact from adjacent activities if buffered by vegetation.)

D. **Are isolated and seasonal wetlands, including small wetlands, preserved or restored with functional buffers and water budgets that support natural hydroperiods? Where isolated wetlands are associated with larger sheetflow systems, is the system preserved?**

(Seasonal wetlands are found in shallow depressions that rely heavily on direct rainfall and runoff from adjacent uplands, with sheetflow between depressions during the wet season.)

Evaluation factor to be used.

Seasonal wetlands. **State whether appropriate buffers and water management will maintain the natural hydropatterns.**

(For the Map, 24% of the total area of seasonal wetlands are located outside of areas mapped as preservation.)

E. **Are high marsh systems and sea grasses preserved?**

F. **Is Florida panther habitat preserved?**

(This wide ranging species requires a mixture of upland and wetland habitat. The Florida Panther Habitat Preservation Plan (HPP) identified las Priority 1 or Priority 2 lands not in public ownership but essential for maintaining the population.)

Evaluation factors to be used.

Florida panther priority lands. **State whether the project design will maintain habitat within its footprint, and thereby reduce the quantity of "developed" Priority 1 and 2 to some number less than 30% of the total priority land in the study area.**

(Section 4.3 estimates that, for the five Ensembles, from 56% to 72% of the total Priority 1 and 2 lands within the study area will be encompassed by the lands mapped as preservation. For the Map, 30% of the total Priority 1 and 2 lands within the study area will be within lands mapped as development or agricultural. The 30% number is <u>after</u> existing public preserves are expanded to the extents shown on the accompanying map as preservation.)

G. **Are Bald eagle nests protected and buffered consistent with the recommendations of the <u>Habitat Management Guidelines for the Bald Eagle in the Southern Region</u>?**

(The referenced document provides for minimum buffer distances for construction and permanent activity near a nest site. It does not protect foraging area.)

Evaluation factor to be used.

Bald eagle. **State whether minimum buffer distances are provided and if, in addition, adjacent land for foraging is preserved.**

(For the Map, the 7 of the total 27 known nests within the study area will be surrounded by development or agriculture.)

H. **Is nesting and foraging habitat of the American crocodile protected and buffered from adverse impacts?**

(The American alligator is not endangered but is listed under the Endangered Species Act due to its similarity of appearance to the crocodile.)

Evaluation factors to be used.

American crocodile. **State whether all practicable opportunities have been included to preserve wetlands to provide attenuation of flows.**

(Section 4.3 notes that changes in the timing and quantity of freshwater flows affect plant and animal communities in estuaries, where the crocodile is found. As measured under Question #B in part II above, maintenance of wide flowways reduce the potential changes in hydropatterns, increasing the potential for preservation of this species.)

American alligator. **State whether the project will reduce the area of seasonal wetlands available for this species.**

(Section 4.3 notes that this species is found throughout the area in large wetland areas, including the seasonal ones measured in Question #C above.)

I. **Is shorebird nesting, foraging and resting areas protected and buffered from adverse impacts?**

(This question applies to shorebirds in general, although one in particular is listed under the Endangered Species Act.)

Evaluation factor to be used.

Piping plover. **Note that potential changes in water quality, as measured by the questions in part II above, may affect the beaches.**

(Section 4.3 notes that none of the Ensembles propose direct impact (fill) on the barrier beaches used as wintering sites.)

J. **Are wading bird rookeries preserved and buffered consistent with the "Set Back Distances to Protect Nesting Bird Colonies from Human Disturbances in Florida" (Rodgers and Smith, 1995)?**

(The referenced document provides for minimum buffer distances for construction and permanent activity near a rookery. It does not protect foraging area. Foraging range for wading birds is up to 15 kilometers, 30 kilometers for Wood storks.)

Evaluation factors to be used.

Wading bird rookeries. **State whether the project protects the rookery, if present.**

(For the Map, 8 of the total 25 known rookeries within the study area will be surrounded by development or agriculture.)

Woodstork rookeries. **State whether the project protects the rookery, if present.**

(For the Map, 2 of the total 14 known rookeries within the study area will be located within areas mapped as development or agriculture.)

K. **Are sea turtle nesting areas protected from adverse impacts and construction impacts proposed during the nesting season?**

(This question applies to the Loggerhead, Green, Hawksbill, and Kemp's Ridley sea turtles.)

Evaluation factor to be used.

Sea turtles. **Note that potential changes in water quality, as measured by the questions in part II above, may affect the beaches.**

(Section 4.3 notes that none of the Ensembles propose direct impact (fill, artificial lighting, human presence, and exotic vegetation) on the nesting beaches. However, there could be an effect if there is a change in water quality.)

L. **Are red-cockaded woodpecker cluster sites and associated foraging habitat protected on-site (or mitigated off-site when consistent with regional recovery plans and developed in conjunction with fish and wildlife agency recommendations)?**

(Since the habitat of this species is in old growth pine, it is very difficult to identify new sites beyond those presently occupied.)

Evaluation factor to be used.

Red cockaded woodpecker. **State whether the foraging area is maintained.**

(For the Map, 27 of the total 40 known cluster sites within the study area will be located within areas mapped as development or agriculture. Protection of the cluster itself and a large area surrounding it for foraging provides higher assurance of preservation of the species.)

M. **Are Audubon caracara nesting territories protected from adverse impacts consistent with regional recovery plans or fish and wildlife agency recommendations?**

(The study area is on the fringe of the ten county area where the population is found.)

Evaluation factor to be used.

Audubon's crested caracara. **State whether the project footprint affects adjacent agricultural or prairie areas, directly or indirectly, thereby reducing the availability of habitat on agriculture lands below 10% of the study area.**

(Section 4.3 estimates that, for the five Ensembles, from 10% to 18% of this study area is mapped as agriculture. This species prefers native range and unimproved pasture for foraging. Those agricultural areas remaining in low intensity use provide more assurance that appropriate habitat, with interspersed seasonal wetlands, will be maintained. The Map provides 10% of the study area but also provides for non-intensification of agricultural use.)

N. **Is Florida scrub jay habitat protected from adverse impacts consistent with regional recovery plans developed in conjunction with fish and wildlife agency recommendations?**

(Since the habitat of this species is in scrub, it is very difficult to identify new sites beyond those presently occupied.)

Evaluation factor to be used.

Scrub jay. **State whether the project protects the colonies, if present.**

(For the Map, 15 of the total 26 known colonies within the study area will be located within areas mapped as development or agriculture.)

O. **Is snail kite foraging and nesting habitat protected or compensated consistent with regional recovery plans or fish and wildlife agency recommendations?**
(Feeds only on apple snails that are in turn found only in seasonal wetlands.)

Evaluation factor to be used.

Seasonal wetlands. **State whether the project provides appropriate buffers and water management to maintain the natural hydropatterns.**

(Same as Question #D above.) (For the Map, 24% of the total area of seasonal wetlands are located outside of areas mapped as preservation.)

P. **Are projects with adverse impacts to eastern indigo snake habitat developed consistent with the provisions of the <u>Eastern</u> <u>Indigo</u> <u>Snake</u> <u>Protection</u> <u>Guidelines</u> (FWS, 1998)?**

Q. **Are federally listed plant species protected and buffered from adverse impacts?**

R. **Is construction within designated critical habitat of the West Indian manatee conducted consistent with the Standard Manatee Protection Construction Guidelines to minimize impacts associated with water craft-related mortality?**

IV. Other public interest factors.

A. **Does the project affect hurricane preparedness?**

(The South Florida Regional Planning Council's Hurricane Storm Tide Atlas and Hurricane Evacuation Study estimates the population to be evacuated, the shelters available, and evacuation time based on road capacities. The Corps does not have direct authority over preparedness. The Corps can consider hurricane preparedness concerns as part of its public interest reviews, for example, safety and flooding.)

Evaluation factor to be used.

Hurricane preparedness. **If the project site itself or evacuation route is particularly subject to flooding or wind damage, identify the actions by the applicant or local government that mitigate the concern, for example, improvement of roads or identification of shelters.**

(Section 4.15 reports that none of the Ensembles were considered to have changed preparedness. The areas mapped as development have ongoing local preparedness planning.)

B. **Are reasonable expectations of the landowner affected?**

(A wide variety of actions by the Federal, State, and local governments over time provide the background for the landowner's understanding of the extent of any limitations to the exercise of rights from property ownership.)

Evaluation factor to be used.

Property rights. **State the influences on the rights associated with ownership of the project site.** These would include: (1) designations in the Comprehensive Plans, (2) history of the landowner's preparation of the project proposal prior to submission of the application, (3) development orders or other actions issued by local, State, or Federal governments, and (4) surrounding land use and activities that have affected or are expected to affect the value of the property.

(The areas of development and agriculture shown by the Map are also mapped as development and agriculture by the Comprehensive Plans. Section 4.6 reports the assessment whether the five Ensembles addressed three factors: fair market value of property; reasonable expectations for use of land and return on investment; and, vested rights. Ensembles with additional restrictions beyond those in the Comprehensive Plans would not meet the expectations of the landowners affected. These permit review criteria do not establish a particular restriction or land use, but identify evaluation questions to assess compliance with existing limitations established by Federal law.)

Difference from Comprehensive Plans. **State the degree of difference from the local Comprehensive Plan (and accompanying goals and policies).**

(Section 4.6 reports the assessment that decisions that departed from the current Comprehensive Plans would be detrimental not only to landowners' rights but also to other socio-economic concerns of the community. All five Ensembles represent potential futures. The Comprehensive Plans have been modified in the past and may be modified in the future. The Ensemble that represents the Comprehensive Plan is not exactly representative of the current Plan, for example, in southern Golden Gate Estates.)

D. **Affects sustainability of local economy?**

(This issue is very complex. For a project submitted by a private enterprise, the Corps generally assumes that appropriate economic evaluations have been completed, the proposal is economically viable, and is needed in the market place.)

Evaluation factors to be used.

Economic Sustainability. **State whether restrictions applied to the development affect the sustainability of the local economy. This will note that the increased costs from the restrictions may be a small portion of the total economy.**

(Section 4.6 reports the assessment of how the five Ensembles affected six factors describing economic impact: job creation; home affordability; cost of living; property tax base; cost to implement; and increased taxes. Increasing or decreasing the area of development mapped in the Ensembles increased or decreased the creation of jobs and the size of the local government's property tax base. Increasing or decreasing the restrictions on use increased or decreased the costs of producing the product, which affects home affordability and cost of living. Increasing the area of preservation or the area of restoration efforts implies an increased cost to local government to implement, which when combined with a smaller tax base results in higher taxes. The Map predicts future extent of development to occupy 38% of the study area. Approximately 20% of the study area is currently urban or suburban development (included in this 20% are "vacant" lots and lands with roads, comprising greater than 3% of the study area). Projects proposing development within the areas mapped as development (or agriculture within agriculture mapping, etc.) will be presumed to be supportive of enhancing the sustainability of the local economy.)

Legend: Agricultural.

Goal: The Agricultural mapping consists of lands that are primarily used for large scale agricultural activities. These areas contain a mosaic of land and water types that support critically important wildlife and water resources and, therefore, warrant protection for conservation purposes. Lands that contain very high quality resources or rare natural resources should be considered for acquisition or conservation easements to preserve their condition. Proposed nonagricultural development activities should be discouraged to the maximum extent possible, for example, golf courses or ranchettes.

Criteria.

The Criteria are the same as for the Development legend with the following additions.

III. Habitat and listed species.

S. **Does the proposed project intensify the agricultural activity?**

(In developing the Map, a rebuttable assumption was made that, within agricultural areas, that limited intensification of use will occur and that there will be no changes that require additional loss of native habitat or that would alter hydrology (such as new large scale citrus operations): range and improved range land will stay the same; vegetable crops may change or the fields will be allowed to go to fallow and back again.)

Evaluation factors to be used.

Strategic Habitat Conservation Area (SHCA). **State whether any of the 1.3% of the total area of SHCA in the State is preserved as habitat within the proposed footprint of the project.**

(The Florida Game and Freshwater Fish Commission report Closing the Gaps in Florida's Wildlife Habitat Conservation System identified the minimum quantity of land that would maintain Florida's animal and plant populations at levels sustainable into the future. This document notes, for the panther, that "…habitat quality on private lands is higher than habitat quality on public lands due to sol productivity and drainage characteristics." The SHCAs included areas of low-intensity agriculture. For the Map, 1.3% of the total area of SHCA in the state is encompassed by the area mapped agricultural.)

Connectivity between major habitat areas. **State whether the change from low to high intensity activity either blocks or narrows a connection between two major habitat areas.**

(Section 4.4 reports the evaluation of the connections proposed within areas mapped as development. The evaluations concluded that wider and more numerous connections are more immune to disturbance from adjoining land uses. Low-intensity agricultural activities are considered to be low disturbance and can be utilized by wildlife as connections.)

Multi-Species Recovery Plan (MSRP). **State whether all practical measures have been taken to maintain habitat for listed species on site or, as compensatory mitigation, acquires and restores areas mapped as preservation.**

(Section 4.3 reports the assessment of how the alternative enhances implementation of the U.S. Fish and Wildlife Service's MSRP. The Map, and the criteria proper, explicitly support MSRP recommendations. For many species, the MSRP recommends encouraging management of privately owned lands.)

Florida panther on agricultural lands. **If the project proposes an intensification of agriculture or intensification to other development, state whether subsequent management will maintain habitat within its footprint, and, if habitat is not maintained, reduce the quantity of "agricultural" Priority 1 and 2 to some number less than 18% of the total priority land in the study area.**

(For the Map, 18% of the Priority 1 and Priority 2 lands are encompassed by agriculture. These areas typically adjacent to public or proposed contiguous preserves and are important components of the total habitat available to the panther. In addition, those Ensembles that proposed criteria to restrict the intensification of agriculture were considered to increase the assurance of the preservation of the species.)

Legend: Rural.

Goal. The Rural land cover legend includes lands that are used for low density residential development (e.g., ranchettes and nurseries). The area contains a mosaic of land and water types that support critically important wildlife and water resources and , therefore, warrant protection for conservation purposes, or if very high quality, for preservation status. Lands that contain very high quality resources or rare natural resources should be considered acquisition or conservation easement to preserve their condition. This area needs a mapping effort that identifies existing flow ways and forested habitats, as well as seasonal wetlands that are large or contiguous to each other, so that a strategy can be devised to protect these resources as a connected system at the landscape scale as the greater area develops.

Criteria.

The Criteria are the same as for the Development legend except, as stated in the goal statement, is lower density and preserves resources in a connected system.

Legend: Golden Gate Estates Zones 1 and 2.

Goal. Golden Gate Estates is a forested subdivision that has been drained and disturbed by canals and a road network for low density residential development (1 to 5 acre lots). Residential development is ongoing. Although the area retains wetland and wildlife resource value, Zone 1 (to the west) is more developed and drained than Zone 2. Zone 2 to the east is still relatively intact and has greater potential for restoration.

Criteria.

The Criteria are the same as for the Development legend except with the following additions recognizing that the typical application is for fill to build single family residences on single lots.

I. Wetlands.

F. **For project within Golden Gate Zone 1, does the project propose greater than 50% fill in wetlands?**

(This supplements Question #A (regarding avoidance of wetland impacts.)

Evaluation factors to be used.

Avoidance of Wetlands Impact. **State whether the acres of proposed fill is greater than 50% of the wetlands on site and, if so, state if this would contribute to a cumulative fill greater than 5.6% of the wetlands in the study area.**

(Section 4.2 estimates that, for the five Ensembles, from 5.5% to 7.0% of the wetlands in the study area will be filled. The lower percentage better satisfies the requirement for avoidance. The estimate for the Map is 5.6%. For the residential lots in Zone 1, preference is that each individual application not exceed 50% of the wetlands within the parcel. Some projects will impact more than others because of the configuration of the wetlands. It is expected that most will impact less than 50%. If a project proposes any fill, and certainly any fill greater than 50% of the wetlands on the site, consideration must be given that this may result in cumulative impact greater than 5.6%.)

G. **For project within Golden Gate Zone 2, does the project propose greater than 10% fill in wetlands?**

(This supplements Question #A regarding avoidance of wetlands impacts.)

Evaluation factors to be used.

Avoidance of Wetland Impact. **State whether the acres of proposed fill is greater than 10% of the wetlands on site and, if so, state if this would will cause a particular remnant that crosses multiple parcels to be lost and contribute to a cumulative fill greater than 5.6% of the wetlands in the study area.**

(Section 4.2 estimates that, for the five Ensembles, from 5.5% to 7.0% of the wetlands in the study area will be filled. The lower percentage better satisfies the requirement for avoidance. The estimate for the Map is 5.6%. For the residential lots in Zone 2, preference is that each individual application not exceed 10% of the wetlands within the parcel. Some projects will impact more than others because of the configuration of the wetlands. It is expected that most will impact less than 10%. If a project proposes any fill, and certainly any fill greater than 10% of the wetlands on the site, consideration must be given that this may result in cumulative impact greater than 5.6%. It is expected that this limit, when applied to adjoining parcels, will provide the preservation of the remnant wetland systems.)

H. **Has compensatory mitigation been located in Golden Gate Zone 2?**

(Preservation and restoration of wetlands in Picayune Strand is the preferred mitigation receiving area. Compensatory mitigation shall be directed to this area or areas of Golden Gate Estates adjacent to Corkscrew Marsh if mitigation bank or in-lieu fee arrangement is established.)

II. Water quality and quantity.

E. **Are entrance roads culverted?**

F. **Is fill placed to not impede sheet flow across the site?**

Legend: Lehigh Acres Urban or Lehigh Acres Greenway.

Goal: Lehigh Acres is a planned community with small lots and road and canal networks. Drainage has reduced but not eliminated the wetlands. Being elevated “tableland”, the zone contains primarily isolated seasonal wetlands.

Criteria.

The Criteria are the same as for the Development legend except with the following additions.

II. Water quality and quantity.

G. **Does the project propose regional stormwater management for Lehigh Acres?**

(Since implementation of BMPs is difficult on the size of the lots typical in Lehigh Acres, treatment of subdivision total flow is considered one method to address concerns of added pollution load. If an application is received, favorable consideration will be given to regional storm water management facilities to Caloosahatchee/Orange Rivers, water quality restoration and protect Hickey and Bedman Creek watersheds. This question recognizes that the infrastructure and lot ownership patterns have already been established.)

H. **Does the project propose regional water storage in Lehigh Acres?**

(If an application is received, favorable consideration will be given to, if appropriate, locating a regional water storage facility adjacent to the existing Harnes Marsh. This question recognizes that current drainage infrastructure results in freshwater pulse flows into the downstream waterbodies.)

IV. Other public interest factors.

E. **Does the proposed project restore wetlands within the area mapped as Lehigh Acres Greenway?**

(If an application is received, favorable consideration will be given to projects that remove roads and restore hydropatterns and connecting sheetflow to seasonal wetlands. This question recognizes that much of the original wetland and upland vegetation remain in areas of Lehigh Acres that is crisscrossed with roads and canals.)